File No. 10318

SPECIFICATIONS FOR THE CITY OF CAMBRIDGE, MASSACHUSETTS

RIVER STREET INFRASTRUCTURE AND STREETSCAPE IMPROVEMENTS PROJECT

Conformed Set

CITY OF CAMBRIDGE
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
August 2022

McMAHON TRANSPORTATION ENGINEERS & PLANNERS

GEI Consultants

HALVORSON Tighe&Bond STUDIO

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FOR CONSTRUCTION, RECONSTRUCTION, ALTERATION,
REMODELING, OR REPAIR OF ANY
CITY OF CAMBRIDGE PUBLIC WORK

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ARTICLE 1 - PROTECTION OF LIVES, HEALTH AND PROPERTY

1.1 The Contractor will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. The Contractor shall take all necessary precautions for the safety of and will provide the necessary protection to prevent damage, injury, or loss to:

1.2 All employees on the work and other persons who may be affected thereby;

1.3 All the work and all materials or equipment to be incorporated therein, whether in storage on or off the site; and

1.4 Other existing property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

1.5 Notwithstanding any other provisions of this contract, the Contractor shall at Contractor's expense promptly restore to its prior condition all property (regardless of by whom owned or where located) damaged as a result of Contractor's operations.

1.6 The Contractor shall comply with all applicable laws, ordinances, rules, regulations, and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss. The Contractor shall erect and maintain as required by the conditions and progress of the work, all necessary safeguards for safety and protection, and in addition the Contractor shall comply with all applicable recommendations of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. The Contractor shall notify owners of adjacent utilities when prosecution of the work may affect them. All damage, injury, or loss to any property referred to in section 1.4 or 1.5 above, caused directly or indirectly, in whole or in part by the Contractor and subcontractor, or anyone directly or indirectly employed by any of them; or anyone for whose acts any of them may be liable will be remedied by the Contractor; except damage or loss attributable to the fault of drawings or specifications, or to the acts or omissions of the Engineer, the Owner, or the Engineer, or anyone employed by either of them; or anyone for whose acts either of them may be liable and not attributable directly or indirectly in whole or in part to the fault or negligence of the Contractor.

1.7 The Contractor shall designate a responsible member of its organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent, unless otherwise designated in writing by the Contractor to the Owner.

1.8 The Contractor and all subcontractors shall immediately report all accidents, injuries, or health hazards to the Owner or its designated representatives in writing for information purposes only. This shall not relieve the Contractor or all subcontractors from mandatory reporting requirements, or any other requirements under the Occupational Safety and Health Act of 1970.

1.9 This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Massachusetts Department of Labor and Workforce Development, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations (Industrial Bulletin No. 12)." Contractors shall be familiar with the requirements of these regulations, and MUCTD and ADA safety requirements.

ARTICLE 2 - ACCESS TO THE WORK

2.1 The Owner and agents and employees of the Owner may at all times enter upon the work and areas occupied by the Contractor, and the Contractor shall provide safe and proper facilities for such entrance and for the inspection of the work.

2.2 The Contractor shall at all times provide proper facilities for access and inspection by representatives of the Commonwealth of Massachusetts to all work under this project wherever it is in preparation or progress.

ARTICLE 3 - CONTRACTOR TO LAY OUT CONTRACTOR'S OWN WORK

3.1 The Owner will establish such general reference points for all detailed layout, staking, and grade control as in its judgment will enable the Contractor to proceed with the work. The Contractor at its own expense shall provide all materials and equipment and such qualified helpers, including a registered engineer and/or land surveyor, as the Owner may require for utilizing the general reference points, and also, protect and preserve all stakes, benches, and other markers used to identify the reference points and be responsible for the accuracy of all lines, grades, and measurements. See also, DWPC Construction Grants Policy Memorandum No. CG-3.

ARTICLE 4 - PROJECT MEETINGS

4.1 First Progress Meeting: Prior to the commencement of Work at the site, the first progress meeting will be held at a mutually agreed time at the Owner's office which shall be attended by the Contractor's Project Manager, its superintendent and CQC Manager, and its Subcontractors as the Contractor deems appropriate. Other attendees will be:

Resident Project Representative.
Representatives of Owner.
Governmental representatives as appropriate.
Others as requested by Contractor or Owner.

4.2 The Contractor shall bring to the meeting the submittals specified in the GENERAL CONDITIONS, SUPPLEMENTAL GENERAL CONDITIONS AND THE SPECIAL CONDITIONS and Section 01300.

4.4 The purpose of the meeting is to designate responsible personnel and establish a Working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date. However, the Contractor should be prepared to discuss all of the items listed below.

Contractor's tentative schedules.
Transmittal, review, and distribution of Contractor's submittals.
Processing applications for payment.
Maintaining record documents.
Critical Work sequencing.
Field decisions and Change Orders.
Use of project site, office and storage areas, security, housekeeping, and Owner's needs.
Major equipment deliveries and priorities.
Contractor's assignments for safety and first aid.

4.5 The Owner will preside at the meeting and will arrange for keeping and distributing the minutes to all persons in attendance.

4.6 The Contractor and its Subcontractors should plan on the meeting taking no less than one full Working day.

4.7 Weekly Progress Meetings: See Article 5.6.6 of the GENERAL CONDITIONS.

ARTICLE 5 - PROJECT SIGN DETAILS

5.1 The Contractor shall furnish and erect two (2) signs at the project site at the location directed. The Contractor shall maintain the signs, including repainting, in a satisfactory condition for the life of this Contract. Upon completion of the project and when directed, the sign shall become the property of the Contractor and shall be satisfactorily removed and disposed of by the Contractor off the site. The costs of furnishing, erecting, and maintaining the project signs shall be considered to be included in the prices stipulated for the various items of work as listed in the Bid; no direct payment will be made for this work. The signs shall meet the following criteria:

¾" thick exterior high density overlay plywood
Signs shall be 5 feet wide by 3 feet high, mounted at least 4 feet above the ground
Signs shall be multi-colored and with font style and font size as directed by the Owner
Signs shall include graphic logo for the City of Cambridge, DPW's "The Works" logo, the Engineers, and the Contractor.
The lettering on the signs shall be provided as indicated and to additional requirements as directed.

ARTICLE 6 - SUBSURFACE DATA

6.1 Subsurface soil and rock information and investigations have been obtained, made, and plotted for use by the Owner for the purpose of design of the project. The subsurface soils and rock data shown on the Drawings and in the Specifications are based on the geotechnical and environmental reports prepared for the work proposed. These reports, which are included in the appendices, are for the general information of bidders and the Contractor and the attention of Bidders and Contractors is directed to the fact that by reason of methods commonly used for obtaining and expressing such boring data, these information and data may be limited and subject to error or misunderstanding. The terms used to describe soils, rock, groundwater, and such other conditions are subject to local usage, and to the interpretation of the person obtaining and making the records. The borings have been made with reasonable care, substantially at the locations indicated and to the depths shown. Groundwater levels shown in the reports in Appendix B are those reported by the driller to be existing at the particular boring location at the time subsurface investigations were made, and do not necessarily represent permanent groundwater levels; it shall be the responsibility of the Contractor to determine for itself annual and seasonal variations in groundwater levels which may affect the Contractor's work. Each bidder is expected to examine the site and the compiled record of investigations and information and then, based upon those inspections, interpretations, and such other investigations as the bidder may desire, decide the character of material to be encountered and excavated, the suitability of the materials that are to be used for backfilling and such other purposes, groundwater conditions, difficulties, or obstacles likely to be encountered, and other conditions affecting the work. No warranty, either expressed or implied by the Owner, Engineer, or their agents, is made as to the accuracy of the subsurface information and data shown on the Drawings, and the Engineer, the Owner, together with their agents, will not assume responsibility for any consequences delays, expense, or losses which may occur or have occurred in the event that such indications shall be found to be incomplete, incorrect, or misleading; nor shall such variations or inaccuracies in the indications of subsurface information and data constitute grounds for revision in contract price or the time of completion.

ARTICLE 7 - ADDITIONAL DEFINITIONS

7.1 Earth – Earth, whenever used as a name of material excavated or to be excavated, shall mean all kinds of material except rock.

7.2 Loam – "Loam", "Soil", or "Top Soil" shall mean the material composing the surface layer of ground containing varying amounts of organic matter.

7.3 Rock – Rock, whenever used as a name of material excavated or to be excavated, shall mean the sound bedrock properly removed by blasting, wedging or barring, also such boulders as exceed one cubic yard in volume removed or to be removed from the excavation.

7.4 Ton – Ton shall mean 2,000 pounds.

ARTICLE 9 – INSURANCE REQUIREMENTS

9.1 Insurance requirements provided in Article 8 of Section 00800 "General Terms and Conditions" shall include the City of Cambridge, HDR Engineering, Inc., McMahon Associates, Inc., Tighe & Bond Studio, and Irrigation Consulting, Inc.

9.2 Engineers providing professional design services to the Contractor are required to carry Professional Liability Insurance in the amount of at least $1,000,000, unless otherwise specified, and meeting all requirements laid out in this Section and Section 00800 "General Terms and Conditions".

ARTICLE 11 – QUANTITIES AND UNIT PRICES

The unit prices for each of the several items in the proposal of each Bidder shall include its prorated share of overhead, so that the sum of the products obtained by multiplying the quantity shown for each item by the unit price bid represents the total bid. Any Bid not conforming to this requirement may be rejected as informal. The special attention of all Bidders is called to this provision, should conditions make it necessary to revise the quantities, no limit will be fixed for such increased or decreased quantities nor extra compensation allowed, provided the net monetary value of such additive or subtractive changes in quantities of such items of work (i.e., difference in cost) shall not increase or decrease the original contract price by more than twenty-five percent (25%) except for work not covered in the Contract Documents as provided for in Section 00800, Article 11 CHANGES IN THE WORK."

END OF SECTION 00825

SECTION 00825A

SPECIAL CONDITIONS

FOR CONSTRUCTION, RECONSTRUCTION, INSTALLATION, DEMOLITION, MAINTENACE OR REPAIR OF ANY CITY OF CAMBRIDGE PUBLIC WORK

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SPECIAL CONDITIONS

ARTICLE 1 - SCOPE OF THE WORK: The Contractor shall furnish all plant, labor, materials, supplies, equipment and other facilities and things necessary or proper for, or incidental to, the work contemplated by this Contract as required by and in strict accordance with the Drawings, Specifications and Addendum (or Addenda), and/or required by, and in strict accordance with, such changes as are ordered and approved pursuant to this Contract, and the Contractor shall perform all other obligations imposed on the Contractor by this Contract. The Contractor shall be responsible for all materials delivered and work performed until completion and final acceptance. Upon completion of this Contract, the work shall be delivered complete and undamaged.

ARTICLE 2 - SPECIAL CONSIDERATIONS AND NOTICES:

a. The Contractor shall be responsible for the control of flows in the existing sewers and drains affected by the work under this Contract. The use of stop logs, bagging, sand bags, or any other suitable method approved by the Owner may be used to interrupt flows within the work areas, provided pumping is used to maintain sewerage and drainage flows and water levels in the incoming sewer and drainage systems during construction operations. Pumped sewage and drainage shall be discharged into other sewers and drains, respectively, as approved by the Owner. The Contractor shall submit for review his proposed methods of flow controls.

b. The Contractor shall supply the Owner, prior to the start of construction operations, with a telephone number and location of a place where he may be contacted at any time during the performance of this contract.

c. All flows within the existing sewers shall be maintained. Existing combined sewers may flow at full capacity during storms. All plugs or similar devices used to block sewers or storm drains shall be removed at the end of each work day unless otherwise directed by the Owner due to special conditions. All plugs or similar devices to block sewers and storm drains shall be recorded as to location and time installed, and shall be recorded as to location and time removed. This accounting shall be enforced in order to avoid the potential for sewage or stormwater back-ups due to blocked pipelines. Copies of the recorded information shall be provided to the Engineer on a daily basis.

d. All damaged areas outside the Contract work limits shall be restored to its original condition at the expense of the Contractor.

e. Removal of portions of the existing manholes and existing storm catch basins may be required to permit construction operations. Portions of manholes and catch basins removed shall be replaced in conformance with the catch basin or manhole details contained in the Contract Drawings or shall consist of the same design as the structure removed unless otherwise specified by the Contract Documents or by the Engineer.

f. The Contractor shall take all necessary precautions during the performance of the work to prevent causing a surcharge in the existing sewers and drains.

g. The Contractor's attention is directed to Articles 9, 10 and 40 of these Special Conditions and Specification Section 01570, Maintenance of Traffic of the Technical Specifications.

h. The Contractor shall contact Mr. David Lefcourt, City Arborist, at the City of Cambridge Urban Forestry Division at telephone number 617-349-6433 immediately upon notification to proceed by the City. All construction operations shall be coordinated with the Urban Forestry Division to avoid damage to existing trees. Any permitted pruning of the trees shall be accomplished with a representative of the Urban Forestry Division present at the construction site. The Contractor will need to comply with the City of Cambridge Department of Public Works Division of Urban Forestry, Tree Protection During Construction policy attached at the end of these Special Conditions.

i. The Contractor shall be made aware of the following Cambridge events scheduled for the 2022, 2023, and 2024, and 2025 calendar years and beyond which may affect the Contractor's work. This partial list is provided for information purposes only and is subject to change:

Head of the Charles Regatta –October 2022, 2023, 2024, 2025
MIT Spring Term Final Examination Period – May 2022, 2023, 2024, 2025
MIT graduation – June 2022, 2023, 2024, 2025
Harvard Spring Term Final Examination Period – May 2022, 2023, 2024, 2025
Harvard graduation – June 2022, 2023, 2024, 2025
Cambridge River Festival – June 2022, 2023, 2024, 2025
DCR Memorial Drive Closures – Weekends, April-November
Cambridge Dance Party – June 2022, 2023, 2024,2025

Contractor shall be prepared to stop work due to weather conditions, parades, and other City and local school functions at the request of either City. The stoppage will result in no payment to the Contractor until the work is resumed when notified by the City.

ARTICLE 3 - WORK TO BE ACCOMPLISHED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS: The work during its progress and at its completion, shall conform to the lines and grades shown on the drawings and to the directions given by the Owner from time to time, subject to such modifications or additions as the Owner shall determine to be necessary during the execution of the work; and in no case will any work be paid for in excess of such requirements. The work shall also be accomplished in accordance with the data in these Specifications.

ARTICLE 4 - CONTRACTOR TO CHECK DIMENSIONS AND SCHEDULES: The Contractor shall be responsible for checking all dimensions and quantities shown on the drawings or schedules given to him by the Owner, and shall notify the Owner of all errors therein which he may discover by examining and checking the same. The Contractor shall not take advantage of any error or omission in these Specifications, Drawings or schedules. The Owner will furnish all instructions should such error or omission be discovered, and the Contractor shall carry out such instructions as if originally specified.

ARTICLE 5 - FIRST AID TO INJURED: The Contractor shall keep in its field office ready for immediate use, all articles necessary for giving first aid to injured employees. The Contractor shall also provide arrangements for the immediate removal and hospital treatment of any employee injured on the work who may require the same.

ARTICLE 6 - PROTECTION AGAINST HIGH WATER AND STORM:

a. The Contractor shall take all precautions to prevent damage to the work or equipment by flooding, high winds, high waters or by storms, including hurricanes. The Owner may prohibit the carrying out of any work at any time when in its judgement, high winds, high waters or storm conditions are unfavorable or not suitable, or at any time, regardless of the weather, when proper precautions are not being taken to safeguard previously constructed work or work in progress.

b. In case of damage caused by the failure of the Contractor to take adequate precautions, the Contractor shall repair or replace equipment damaged and shall make such repairs or rebuild such parts of the damaged work, as the Owner may require, at no additional expense to the Owner.

ARTICLE 7 - SEQUENCE OF WORK: The Contractor shall be required to prosecute the work in accordance with a schedule prepared by the Contractor and approved by the Owner and Engineer prior to commencement of the work and in accordance with the additional requirements specified herein, and approved by the Owner. The Contractor shall include cost loading, monthly payment requisitions and project status reporting requirements within the Schedule. This schedule shall state the methods and shall forecast the times for doing each portion of the work. Before beginning any portion of the work, the Contractor shall give the Owner advance notice and ample time for making the necessary preparations.

Construction sequencing information provided in the Contract Documents are for information purposes in order to aid the Contractor in the sequencing of the work.

ARTICLE 8 - COMPETENT HELP TO BE EMPLOYED: The Contractor shall employ only experienced forepersons, craftspersons and other workers competent in the work in which they are to be engaged.

ARTICLE 9 - STREETS AND SIDEWALKS TO BE KEPT OPEN:
(See also SC Article 40 and Section 01570 of the Technical Specifications)

a. The Contractor shall at all times keep the streets and sidewalks in which the Contractor may be at work open for pedestrian and vehicular traffic and for vehicles maintaining public services. The Contractor shall bridge or construct plank crossings over the trenches at street crossings, roads or private ways. No sidewalk shall be obstructed where it is possible to avoid it. See Article 17b for restrictions on plank or steel plate crossings in the event of snow.

b. Having obtained approval from the Owner to close a street to traffic, the Contractor shall notify the Fire Chief and the Chief of Police of Somerville and Cambridge; then provide a system of detour signs, approved by the Owner.

ARTICLE 10 - LIGHTS, BARRIERS, WATCHMEN, AND INDEMNITY:
a. The Contractor shall put up and maintain such barriers, barricades, fencing, lighting and warning lights, danger warning signals and signs that will prevent accidents during the construction work and protect the work and insure the safety of personnel and the public at all times and places; the Contractor shall indemnify and protect the Owner and the Engineer in every respect from any injury or damage whatsoever caused by any act or neglect of the Contractor or its subcontractors or their servants or agents.

b. All construction warning and traffic control signs, barricades, lights, and pedestrian safety controls shall be in compliance with the Massachusetts Department of Transportation, Highway Division (MassDOT), Standard Specifications for Highways and Bridges, Section 850 (Traffic Controls for Construction and Maintenance Operations), latest edition; the Massachusetts Manual on Uniform Traffic Control Devices (MUTCD), Part IV, latest edition; American Disabilities Act (ADA); regulations set forth by the City of Cambridge Department of Public Works, and Section 01570 of the Technical Specifications.

Reflective sheeting for barricades and signs shall conform to Subsection M9.30.2 (Encapsulated Lens Reflective Sheeting) of the Standard Specifications for Highways and Bridges.

c. In addition to the above, when and as necessary or when required by the Owner, the Contractor shall post signs and employ watchmen at the site for excluding unauthorized persons from the work at all times, for which the Contractor will not be paid additional compensation.

d. All detours required for pedestrian and vehicular traffic shall be in conformance with regulations set forth by the City of Cambridge Department of Public Works (DPW) and MUTCD requirements (see also Article 40). It shall be the Contractor's responsibility to contact and make all necessary arrangements for detours with the Department of Public Works prior to the beginning of construction operations.

e. The Contractor shall be responsible for excluding at all times from lands within easement areas, or other state or municipally owned areas, all persons not directly connected with the work or authorized by the Owner to be in the work areas.

ARTICLE 11 - WORK OUTSIDE REGULAR HOURS: Night work or work on Saturdays, Sundays, or legal holidays, requiring the presence of an engineer or inspector, will not be permissible except in case of emergency, and only upon the approval of the Owner. Should it be desired or required by the Owner to

operate an organization for continuous night work or for emergency night work, the lighting, safety and other facilities which are deemed necessary by the Owner for performing such night work shall be provided by the Contractor. For night work, work on Saturdays, Sundays or legal holidays, if any be performed, the Contractor will receive no extra payment, but compensation shall be considered as having been included in the prices stipulated for the appropriate items of work as listed in the Bid. See Section 01010 of the Technical Specifications for work hour restrictions. See notes on plans for additional restrictions.

ARTICLE 12 - PUBLIC TRANSPORTATION INTERFERENCE: Whenever it may be necessary to interfere with any public transportation systems notice shall be given to the corporation owning the same, and reasonable time shall be given to said corporation to arrange the schedule for operation of same, as may be necessary.

ARTICLE 13 - WORK IN COLD WEATHER:

a. The Owner will determine when conditions are unfavorable for work and may order the work or any portion of it suspended whenever, in his opinion, if the conditions are not such as to insure first class work. In general, work shall be prosecuted throughout the year and the Contractor will be expected to keep work going, and employment of labor as continuous as possible.

b. All methods and materials used in the performance, and for the protection of, the work in cold weather shall be subject to the approval of the Owner. The Contractor shall take necessary precautions to protect the work from damage and for removing ice and frost from materials, including heating the water, sand and coarse aggregate, and for protecting the newly laid masonry. The Contractor will be responsible for snow removal and sidewalk maintenance and de-icing at the time of a snow event within the areas of work and as required for the work to proceed. The Contractor will receive no extra payment for any labor, apparatus, tools or materials necessary to comply with the above requirements, but compensation shall be considered to be included in the prices stipulated for the appropriate items of work as listed in the Bid. Contractor will provide contact phone number to Owner and Engineer for party responsible for snow removal.

c. See Article 17b for restrictions on plank or steel plate crossings in the event of snow.

ARTICLE 14 - TUNNELING : Tunneling will not be permitted without the consent of the Owner.

ARTICLE 15 - RESERVED MATERIALS: Materials found on the work suitable for any special use in the project shall be reserved for that purpose. When approved by the Owner, the Contractor may use in the various parts of the work, without charge therefore, any suitable materials taken from the excavations.

ARTICLE 16 - DISPOSAL OF MATERIALS, ACCESS TO HYDRANTS AND GATES, AND MATERIALS TRIMMED-UP FOR CONVENIENCE OF PUBLIC TRAVEL OR ADJOINING TENANTS: The materials from trenches and other excavations and those used in the construction of the work shall be deposited in such a manner that they will not endanger the work and that free access may be had at any time to all hydrants and gates in the vicinity of the work. The materials shall be kept trimmed-up in such a manner as to be of as little inconvenience as possible to the public travel or the adjoining tenants. All suitable excavated materials not utilized as refill or backfill at the site of excavation or other locations on the project shall be removed and legally disposed of by the Contractor at no additional expense to the Owner. All unsuitable excavated material including rock shall be removed and legally disposed of by the Contractor at no additional expense to the Owner.

ARTICLE 17 - LENGTH OF TRENCH TO BE OPENED AND MAINTAINING PREMISES FREE FROM OBSTRUCTIONS:

a. The length of trench opened at any time, from point where ground is being broken to completed backfill and also the amount of space in streets or public and private lands occupied by equipment, trench and supplies, shall not exceed the length or space considered reasonably necessary

and expedient by the Owner. In determining the length of open trench or spaces for equipment, materials, supplies and other necessities, the Owner will consider the nature of the lands or streets where work is being done, types and methods of construction and equipment being used, inconvenience to the public or to private parties, possible dangers and other proper matters. All work must be constructed with a minimum of inconvenience and danger to the public and all other parties concerned.

b. Whenever any trench obstructs pedestrian and vehicular traffic in or to any public way, private driveway or property entrance, or on private property, the Contractor shall take such means as may be necessary to maintain pedestrian and vehicular traffic and access in accordance with Article 10. Until such time as the work may have attained sufficient strength to support backfill, or if for any other reason it is not expedient to backfill the trench immediately, the Contractor shall construct and maintain suitable plank or steel plate crossings and bridges, as approved by the Owner, to carry essential traffic in or to the street, driveway or property in question as specified or directed. Plank or steel plate crossings will not be allowed to be used to cover open trenches or excavations in the event of snow. In this event, the trench or excavation must be backfilled immediately and temporary pavement installed.

c. Suitable signs, lights, and such items required to direct traffic shall be furnished and maintained by the Contractor in accordance with Article 10.

d. The Contractor must keep streets and premises free from unnecessary obstructions, debris, dust and all other materials. The Owner may, at any time, order all equipment, materials, surplus from excavations, debris and all other materials lying outside that length of working space promptly removed, and should the Contractor fail to remove such material within 24 hours after notice to remove the same, the Owner may cause any part or all of such materials to be removed by such persons as it may employ, at the Contractor's expense, and may deduct the costs thereof from payments which may be or may become due to the Contractor under the Contract. In special cases, where public safety urgently demands it, the Owner may cause such materials to be removed without prior notice.

e. Storage of materials on the public way is not allowed except where placed temporarily to be used immediately in the work.

f. The Contractor shall provide storage areas off the site of the work, as required, and shall include the cost of same in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 18 - INTERFERENCE WITH EXISTING STRUCTURES:

a. Whenever it may be necessary to cross or interfere with existing culverts, drains, sewers, cable television, water pipes or fixtures, guardrails, fences, gas pipes, electrical, or telephone cables or conduits, or fixtures or other structures needing special care, public or private, due notice shall be given to the owner of the aforementioned utility, and the work shall be done according to the Owner's directions. Whenever required, all objects shall be strengthened to meet any additional stress that the work herein specified may impose upon it, and any damage caused shall be thoroughly repaired. If so directed by the Owner, the locations of any existing work shall be changed to meet the requirements of the sewerage system or appurtenances or the sewerage system may be relocated, if necessary, to leave all in good working order. The entire work shall be the responsibility of the Contractor and the work shall be performed at no additional expense to the Owner.

b. The Contractor shall be responsible for any damage to all known mains or utilities encountered during the progress of the work and shall repair and be responsible for correcting all damages to such ex- isting utilities and structures at no additional expense to the Owner. The Contractor shall contact the proper utility or authority to correct or make any changes due to utility or other obstructions during the work of construction of the sewerage and drainage systems, but the entire responsibility and expense shall be with the Contractor.

c. All items required to be removed and replaced due to construction and all existing items damaged by the Contractor shall be replaced or repaired by the Contractor to the complete satisfaction of the property owners and/or the Owner at no additional expense to the Owner, unless otherwise specified.

ARTICLE 19 - FENCING, TURF, TOPSOIL, AND OTHER REPLACED ITEMS: Where construction is through cultivated or sodded lands, the Contractor shall save the turf and topsoil separately and replace the same after the trench is filled, leaving the land as nearly as possible in its original condition. Trees, fences, walls, grassed and landscaped areas, walks, and play and recreational areas, and such other items must be restored or repaired to the satisfaction of the Owner, if damaged by work under this Contract, at no additional expense to the Owner.

ARTICLE 20 - MATERIALS: All materials furnished and used in the completed work shall be new, of best quality workmanship and design, and recognized as standard in good sewer construction practices. Whenever a Specification number or reference is given, the subsequent amendments shall be included. The standards set forth in the selection of materials and supplies are intended to conform with those standards adopted by the Owner. Preference in manufacturer shall be given to adopted standards and the Contractor shall further familiarize himself with the requirements of the Owner when the occasion or choice of materials or supplies so demand.

ARTICLE 21 - DEFECTIVE MATERIALS, INSPECTION AND TESTING OF MATERIALS FURNISHED, SAMPLES AND ORDERING LISTS:

a. No materials shall be laid or used which are known, or may be found, to be in any way defective. Notice shall be given to the Owner of any defective or imperfect material. Defective or unfit material found to have been laid shall be removed and replaced by the Contractor with sound and unobjectionable material without additional expense to the Owner.

b. All materials furnished by the Contractor are subject to thorough inspections and tests by the Owner.

c. The Contractor shall submit samples as required by the Owner of the various materials used in the Contract for testing purposes.

d. All ordering lists shall be submitted by the Contractor to the Owner for approval and shall be approved before the ordering of the materials.

ARTICLE 22 - CONTRACTOR'S OFFICE: The Contractor shall maintain during the performance of this Contract, an office at the site of the work at which the Contractor or its authorized agent shall be present at all times while the work is in progress. The Contractor shall be responsible for equipping its office at the work with all office facilities which may be required. Instructions from the Owner left at this office shall be considered as delivered to the Contractor. Copies of the Contract, Drawings, and Specifications shall be kept at said office ready for use at any time. The obtaining of a suitable site for the location of the office shall be the responsibility of the Contractor; however, the location and site shall be subject to approval of the Owner; all costs in connection with the obtaining and use of a suitable office site shall be the responsibility of the Contractor.

ARTICLE 23 - SANITARY REGULATIONS:

a. Adequate sanitary conveniences for use of workers on the premises, properly secluded from public observation, shall be provided and maintained by the Contractor in accordance with requirements of local and State health authorities and in such manner and at such points as shall be approved, and their use shall be strictly enforced. Sanitary waste shall be treated and disposed of in a manner satisfactory to and as directed by the Owner and the local and State health authorities; under no circumstances shall sanitary wastes be allowed to flow on the surface of the ground.

b. The Contractor shall rigorously prohibit the committing of nuisances by persons connected with the work upon the lanes or right- of-way of the Owner, about the work, or upon adjacent public or private property.

c. The cost of the sanitary conveniences and maintenance of same will not be paid for separately, but compensation will be considered to be included in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 24 - SPIRITUOUS LIQUORS: The Contractor shall neither permit nor suffer the introduction or use of spirituous liquors upon the work embraced in this Contract.

ARTICLE 25 - FINISHING AND CLEANING UP: In completing the backfilling of the trenches, the Contractor shall replace all surface material to the satisfaction of the Owner, and shall then immediately remove all surplus material, and all tools and other property belonging to him, leaving the entire street or surroundings free and clean and in good order at no additional expense to the Owner. The backfilling and removing of surplus materials shall follow closely upon the completion of the work. The Contractor shall exercise special care in keeping right-of-way and private and public lands, upon which work is to be performed, clean and free of debris at all times and to remove tools and other property belonging to the Contractor when they are not being used.

ARTICLE 26 - CLEAN-UP AT CONTRACTOR'S EXPENSE: In case the Contractor shall fail or neglect, after backfilling, to promptly remove all surplus materials, tools and other incidentals, or promptly do the required repaving when ordered, the Owner may after 24 hours notice, cause the work to be done, and the cost thereof shall be deducted from any monies then or thereafter due the Contractor.

ARTICLE 27 - RIGHTS OF ACCESS: Nothing herein contained or shown on the Drawings shall be construed as giving the Contractor exclusive occupancy of the work areas involved. The Owner or any other contractor employed by the Contractor, the various utilities companies, contractor or subcontractor employed by the Federal, State or local governmental agencies or other utility firms or agencies involved in the general project or upon public rights-of-way, may enter upon or cross the areas of work or occupy portions of it as directed or permitted. When the territory of one contract is the convenient means of access to the other, each contractor shall arrange its work in such manner as to permit such access to the other and prevent unnecessary delay to the work as a whole.

ARTICLE 28 - EXISTING UTILITIES OR CONNECTIONS:

a. The location of existing underground pipes, cables, conduits and structures as shown has been collected from the best available sources and the Owner together with its agents does not imply or guaran - tee the data and information in connection with underground pipes, cables, conduits, structures and such other parts as to their completeness nor their locations as indicated. The Contractor shall contact utility owners and request marking location of all their lines in the work areas. The Contractor shall assume that there are existing water, gas, and other utility connections to each and every building enroute, whether they appear on the Drawings or not. Any expense and/or delay occasioned by these utilities and structures or damage thereto, including those not shown, shall be the responsibility of the Contractor at no additional expense to the Owner. See General Notes on Contract Drawings.

b. Before proceeding with construction operations at any location, the Contractor shall make such supplemental investigations, including test pits, as it deems necessary and approved by the Owner to uncover and determine the exact location of utilities, structures, or other conditions, and the Contractor shall have no claims for damages due to encountering subsurface structures, utilities, or other conditions. The Contractor shall also have no claims for damages due to encountering subsurface structures, utilities or other conditions which are made known to the Contractor prior to construction operations.

ARTICLE 29 - COMPLETENESS OF WORK: In addition to the specified or described portions of work,

all other work and all other materials, equipment and labor of whatever description which are necessary or required to complete the work, or for carrying out the full intent of the Drawings and Specifications, as interpreted by the Owner, shall be provided by the Contractor, and payment therefore shall be considered as having been included in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 30 - PLANK CROSSINGS: As required or directed by the Owner, the Contractor shall install in selected locations suitable plank, steel plate or timber crossings substantially built and reinforced to sustain vehicular traffic across trench or other excavations. Crossings shall be constructed with wide and usable approaches for use by the traveling public, private property owners, or emergency equipment. No separate payment will be made for this work but the cost shall be included in the price the Bid. (See Article 17).

ARTICLE 31 - CLEANING FINISHED WORK: After the work is completed, the sewers, drains, manholes, catchbasins, and other structures shall be carefully cleaned free of dirt, broken masonry, mortar, construction and other debris and left in first class condition ready for use. All temporary or excess material shall be legally disposed of and the work left broom-clean to the satisfaction of the Owner.

ARTICLE 32 - DUST CONTROL: The Contractor shall exercise every precaution and means to prevent and control dust arising out of all construction operations from becoming a nuisance to abutting property owners or surrounding neighborhoods. Pavements adjoining the excavation or pipe trenches shall be kept broomed off and washed clean. The Contractor will be responsible for street sweeping within the areas of work delineated by the Contract Documents. Earth stockpiles along trenches when permitted, stockpiles, and surfaces of refilled trenches shall be kept moist at all times, as directed. No extra payment will be made for providing the dust control conforming to the requirements specified above, but compensation therefore shall be considered to be included in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 33 - CARE OF THE WORK: The Contractor shall be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence in connection with the prosecution of the work and shall be responsible for the proper care and protection of all material delivered and work performed until completion and final acceptance, whether or not the same has been covered by partial payments made by the Owner.

ARTICLE 34 - INDEMNIFICATION:

a. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, the Engineer and their agents and employees from and against all claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this Article 34.

b. In any and all claims against the Owner, the Engineer or any of their agents or employees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Article 34 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 35 - CONSTRUCTION SCHEDULE: In addition to other requirements specified, the

Contractor shall confer with the Owner for the purpose of drafting a construction schedule satisfactory to the Owner which is to include all the work of this Contract. The Contractor shall perform the work of this Contract to conform to the construction schedule as approved by the Owner, except that the Owner reserves the right to amend and alter the construction schedule as approved at any time in a manner which it deems to be in the best interest of the Owner so to do. The Contractor shall arrange its work under this Contract to conform with the construction schedule as it may be revised from time to time by the Owner at no additional expense to the Owner. The Contractor shall notify the Owner immediately of any circumstances which affect the performance of the work in accordance with the current construction schedule.

ARTICLE 36 - WORK BY OTHERS: The Owner reserves the right to do any other work which may connect with or become a part of, or be adjacent to the work embraced by this Contract at any time by contract work or otherwise. The Contractor shall not interfere with or obstruct in any way the work of such other persons as the Owner may employ, and shall execute its own work in such manner as to aid the executing of work by others as may be required. No backfilling of trenches or excavations will be permitted until such work by the Owner is completed.

ARTICLE 37 - FIRE PREVENTION AND PROTECTION:

a. All State and municipal rules and regulations with respect to fire prevention, fire-resistant construction, and fire protection shall be strictly adhered to, and all work and facilities necessary therefore shall be provided and maintained by the Contractor in an approved manner at no expense to the Owner.

b. All fire protection equipment such as water tanks, hoses, pumps, extinguishers, and other materials and apparatus, shall be provided for the protection of the contract work, temporary work and adjacent property. Trained personnel experienced in the operation of all fire protection equipment and apparatus shall be available on the sites whenever work is in progress and at such other times as may be necessary for the safety of the public and the work at no expense to the Owner.

ARTICLE 38 - RECORD DRAWINGS:

a. The Contractor shall maintain to the satisfaction of the Engineer at the site a set of Drawings on which shall be recorded accurately as the work progresses, the actual "as built" locations and dimensions of all his work, indicating thereon all variations from the Contract Drawings. This record of "as built" conditions shall include the work of all subcontractors, and any discrepancies found in the course of the work between actual locations of existing utility lines and structures and the locations shown on the Drawings, details at test pits and all excavations that reveal existing detail, connections to existing structures and lines and their construction and conditions, buildings, services, vacant lots, etc., and shall be available at all times for inspection by the Engineer. Progress sets of “as built” drawings shall be reviewed at construction progress meetings.

b. The Contractor shall submit monthly progress red line Record Drawing updates with each Pay Application. Progress Record Drawing red lines shall show daily progress of all construction and the information required as indicated above. Pay Applications which do not have a set of Progress Record Drawing red lines attached will not be processed until which time as the Progress Record Drawing red lines have been received by the Owner and Engineer and have been approved for completeness.

c. Prior to final acceptance of the work, all recorded data as gathered above shall be submitted to the Owner by the Contractor. The final record drawings will be prepared by the Owner with the information provided by the Contractor as specified above.

d. The survey data shall be obtained by Global Positioning Survey (GPS) and certified by a Professional Land Surveyor registered in the Commonwealth of Massachusetts.

e. No separate payment will be made for this work, but compensation Therefore, it shall be considered as having been included in the prices stipulated for the appropriate items of work as listed in

the Bid.

ARTICLE 39 - CONSTRUCTION STAGING: Construction staging areas will be limited to only those areas approved by the Owner.

ARTICLE 40 - STREETS TO BE KEPT OPEN-ADDITIONAL REQUIREMENTS:
Minimum requirements for keeping streets within the project areas open shall be as follows:
The Contractor shall submit for approval by the Owner, proposed traffic management and pedestrian safety plans in conformance with the requirements set forth in Section 01570 of the technical specifications. Construction will not be allowed to proceed until approval of the Contractor's proposed traffic control and pedestrian safety plans unless otherwise directed by the Owner. The Contractor shall secure and pay for all permits, fees, and bonds in connection with his operations. It is envisioned that All streets shall be open to traffic and abutters at all times during construction of this contract. However, requests by the Contractor to close or to provide one-way traffic flow in a street shall be submitted by the Contractor to the Owner a minimum of five (5) working days in advance of the Contractor's proposed construction operations affecting the street. Any intended detour of traffic is to be temporary in nature and should be designed in accordance with the MUTCD and coordinated with City of Cambridge Traffic Parking and Transportation Department. The detour should not impart any degradation of safety to traffic, pedestrians and adjacent properties. The request for approval shall include the contractors proposed traffic control plan and schedule. Submission of incomplete or deficient planning and schedules shall result in denial of the request Delays or costs incurred by Contractor for failure to comply with the requirements set forth herein will be borne by the Contractor at no cost to the City. The Contractor shall furnish, provide, erect, and maintain all signs, necessary barricades, suitable and sufficient red lights, lights, reflectorized signs or signals and danger signals in accordance with Article 10 of the Special Conditions, and Section 01570 of the Technical Specifications. The Contractor shall arrange for sufficient police details and
watchpersons and take all necessary precautions for the protection of the work, control of traffic and safety of the public.

ARTICLE 41 - WORK WITHIN THE LIMITS OF PRIVATE PROPERTY:
a. Particular attention is hereby directed to the fact that some of the work included under this Contract may be done within the limits of properties that are state-owned and/or privately-owned. The Owner has, or will, secure the necessary limited temporary or permanent easements for construction purposes. The Contractor will be permitted to use the areas of the Owner's easements subject to all conditions and requirements applicable to the use of said easements, including restoration of grassed and landscaped areas, fences, etc., which are disturbed. The Contractor shall be responsible for always determining all conditions and requirements as they may affect the Contractor's operations and the work of this Contract and shall conduct its operations and activities in the performance of the work under this Contract in accordance with all such conditions and requirements and such additional requirements as may be required by the Owner. All other means and rights of ingress and egress to the work areas and all other areas required for workspace, in addition to the said Owner's easements, shall be the entire responsibility of the Contractor. All costs in connection therewith shall be considered to be included in the prices stipulated for the appropriate items of work as listed in the bid. The Contractor shall neither use nor occupy public or private lands outside the limits of the Owner's easements and rights-of-way unless permits in writing have first been obtained by the Contractor from the owners of the public and/or private land and copies of such permits filed with the Owner. The Contractor shall be responsible for cooperating with state and private property owners and for the coordination and prosecution of the work of this Contract. Any abuse to lands of state or private owners shall be immediately corrected by the Contractor at its expense to the complete satisfaction of the owners, and such precautionary or preventive measures as required by the Owner shall be taken or made to prevent further additional nuisances, interference, or inconvenience to the abutting owners.

b. It shall be the Contractor's full responsibility to familiarize itself with the limitations imposed on the work of construction within the various properties of state or private ownership and rights- of-way by

the existing occupancy or use. To this end, the Contractor shall be required to make every effort to fully and satisfactorily protect trees, shrubs, lawns, gardens, fences, walks, driveways, yards or structures; protect all work by the erection or placing of safety guards or barriers, lights and such other incidentals; and where required, the Contractor shall construct temporary plank crossings, steel plates or timbers to permit full use of private facilities at all times at no additional expense to the Owner. All other applicable provisions for control of work within the areas of public travel set forth elsewhere herein shall also apply to work within the limits of private ownership.

c. The Contractor shall cooperate with state and private property owners and shall also contact the Owner for additional information regarding the requested (or required) length of time needed as a notice to be given to the state and private property owners before the Contractor enters the state or privately- owned property in order to start the construction work. In some cases, a certain time to start the work and a certain limited length of time may be permitted by the state and private property owners for any required shutdowns or construction operations so the work of the Contractor will not interfere with the private operations of the state or private property owners.

d. Before proceeding with construction operations, the Contractor shall provide suitable and substantial gates or other approved forms of wire gap in every existing fence within the limits of the Owner's easements and through which the The contractor intends to move or pass equipment and materials. It shall be the responsibility of the Contractor to determine with the owner of each fence all requirements, in addition to those specified above, relating to the construction of gates or other forms of wire gap; conditions to be observed in their use and for the rebuilding of fences. It shall be the responsibility of the Contractor to comply with all requirements as specified herein and as determined with the owners of the fences. Any damage to fences because of the Contractor's operations shall be made good by the Contractor in a manner satisfactory to the Owner.

e. No separate payment will be made for the requirements specified under "WORK WITHIN THE LIMITS OF PRIVATE PROPERTY," and all costs in connection therewith shall be included in the price of the Bid.

ARTICLE 42 - DISTURBANCE OF BOUNDS: The Contractor shall replace all bounds disturbed by his operation at his own expense. The bounds shall be reset by a land surveyor registered in the Commonwealth of Massachusetts.

ARTICLE 43 - ARCHAEOLOGICAL FINDS DURING CONSTRUCTION AND RELATED ACTIVITIES: During the life of this Contract the Contractor is herewith required to immediately notify the following organizations in the event that any articles such as "fire cracked stones," "stone flaking material," or any other such related items of historical significance are discovered.

a. City Engineer

b. State Archaeologist of Massachusetts

c. Resident Engineer or Inspector

ARTICLE 44 - NOT USED

ARTICLE 45 - PROSECUTION OF THE WORK-SUPPLEMENTAL REQUIREMENTS: The Contractor shall establish liaison with other contractors working in adjacent areas under other construction programs to assure that their work is closely coordinated with his work to prevent any delay in the overall program.

ARTICLE 46 - EQUIPMENT RESTRICTIONS: The sizes of equipment to be used for the construction will be restricted in certain areas, where larger equipment could cause damage to sidewalks and curbs on

narrow streets, or to trees adjacent to the work and tree limbs overhanging the work. The Contractor shall submit the sizes of equipment he proposes to use on each street to the Owner for approval.

ARTICLE 47 - CONTRACTOR RECORDS: The Contractor shall comply with all applicable provisions of M.G.L., Chapter 30, Section 39R relative to Contractor's Records. The Contractor shall make, and keep for at least six years after final payment, books, records, and accounts which in reasonable detail accurately and fairly reflect the transactions and dispositions of the Contract. A complete copy of Section 39R shall be available for review at Engineer's office.

ARTICLE 48 - CONTRACT DRAWINGS: The work shall conform to the Contract Drawings, titled River Street Infrastructure and Streetscape Improvement Project, all of which form a part of these specifications.

ARTICLE 49 - PIPE TESTING: All sewer pipe shall be tested in accordance with the Contract documents and sound engineering practice. If, after 60 days following submission of a monthly payment estimate for pipe items, the pipe for which payment is requested has not been successfully tested, the owner may withhold up to 10% of the amount requested for such pipe items until the pipe has been so tested. However, in the case of a major (pipe diameter 24 inches or greater) interceptor pipe installation, sums retained by the owner pursuant to this policy memorandum shall not exceed two per centum (2%) of the costs of such pipe items.

ARTICLE 50 - EXCAVATIONS IN PUBLIC WAYS: See Notice Requirements relative to excavations in public ways (Chapter 353 of the Acts of 1983) inserted at the end of these Special Conditions.

ARTICLE 51 - LEAKAGE TESTS:

a. The sewers and appurtenant structures connected thereto shall be made as nearly watertight as practicable. Where practical, as determined by the Owner, leakage tests will be performed for the new sewers and sewer manholes. Leakage into or from the sewers and structures will be determined by infiltration tests, exfiltration tests, or Low Pressure Air Acceptance tests as specified herein and as directed. The maximum allowable amount of infiltration into the sewers or exfiltration from the sewers, as determined respectively by the infiltration or exfiltration tests, including manholes, shall be at a rate of not greater than 125 gallons per inch of pipe diameter per mile of pipes per 24 hours, and there shall be no gushing or spurting streams of water into or from the sewers or manholes. The phrase "per mile of pipes" shall refer to the total length of sewers measured through manholes. Where the groundwater level can be maintained at a height of not less than one foot above the top of the pipe for the full length of the section of sewer pipe being tested for leakage, the leakage into the sewers and manholes shall be determined as specified under "Infiltration Tests." When the ground water cannot be maintained at a level of not less than one foot above the top of the pipe for the full length of the section of sewer being tested, the leakage from the sewers and manholes shall be determined as specified under "Exfiltration Tests."

b. Infiltration Tests. The tests shall be conducted at such times as the groundwater level is at a height of not less than one foot above the top of the pipe for the full length of the section of sewer being tested. The groundwater leakage into the pipes will be measured by the Owner at such point or points as he may direct. The Contractor shall construct such weirs or other means of measurement as shall be required and shall do such pumping as shall be necessary to enable the tests to be satisfactorily made.

c. Exfiltration Tests. Where exfiltration tests are required, the section of the sewer to be tested shall be subjected to an internal pressure. The lower end of the section of sewer to be tested shall be closed and the entire section of the sewer, including manholes, shall be filled with clean water so as to obtain a minimum head of 2 feet above the top of the pipes; the length of the section of sewer pipeline being tested shall be such that with the head of water 2 feet above the top of pipe at the upper end of the section of pipeline being tested, the pipeline being tested will not exceed 8 feet. The rate of leakage from each section of the sewers being tested will be determined by the Owner by measuring the amount of water

required to maintain the minimum head of 2 feet above the top of the pipes for the full length of each section of the sewers being tested.

d. Low Pressure Air Acceptance Test. The Contract may perform the leakage tests using the low pressure air test where approved by the Owner. This test shall conform to Uni-Bell Plastic Pipe Association recommended practice, UNI-6, latest revision, for all PVC pipes and to the additional requirements listed herein.

1. The pipeline shall be considered acceptable if the time interval for the 1.0 psi pressure drop is not less than the holding time as calculated in accordance with UNI-6, latest revision.

e. Testing as described above cannot readily be performed on many sewers due to the presence of existing building service connections which could offset test results or surcharge during testing, resulting in basement flooding. Testing of such sewers will be limited, as determined by the Owner, to physical inspection of the pipe sections from adjacent manholes or closed circuit television inspection. Any defective pipe, joints, or other construction shall be replaced or repaired by the Contractor at no additional expense to the Owner.

f. The Contractor shall do all the work, provide all necessary weirs, gauges, or such other measuring devices as required, do all pumping and furnish all labor, equipment and materials necessary for the proper performance of leakage tests at no additional expense to the Owner. Leakage tests shall not be performed in Owner's absence.

g. Should the leakage test on any section of the sewers, including manholes, show a rate of leakage into or from the sewers exceeding the maximum allowable rate specified herein, the Contractor shall locate and repair or replace defective joints or pipe and work in a manner satisfactory to the Owner, and retest at no additional expense to the Owner until the rate of leakage from each section or joint of the sewers being tested does not exceed the rate specified herein.

h. When hydrants are used with the consent of the City, the Cambridge Water System shall be protected with backflow prevention devices per Massachusetts Department of Environmental Protection (DEP) Regulation 310 CMR 22.22 and the Cambridge Water Department Cross Connection Control Program. This includes, but is not limited to, street sweepers, sewer flushing and paving equipment, and hookups for any purpose.

ARTICLE 52 - TEST REPORTS, CERTIFICATES OF COMPLIANCE AND SHIPPING LISTS:
In addition to other requirements specified herein, the Contractor shall furnish to the Owner the materials, manufacturers notarized test reports and methods of tests to show compliance of materials furnished with all specification requirements, and manufacturer's notarized certificates of compliance stating that all materials to be furnished under these Specifications conform with all specification requirements; each shipment of materials shall be accompanied with the manufacturer's notarized certificate of conformance and a shipping list itemizing the amounts of each item shipped. All testing of all materials furnished under these Specifications shall be provided by the Contractor at no additional expense to the Owner.

ARTICLE 53 -SERVICES OF MANUFACTURER'S REPRESENTATIVES: The Contractor shall furnish, at no additional expense to the Owner, the services of materials and manufacturer's representatives for such lengths of time as may be necessary to properly instruct the Contractor's personnel and the Owner in the proper handling and installation of the material in accordance with the manufacturer's printed recommendation.

ARTICLE 54 - NOT USED

ARTICLE 55 - SAFETY AND HEALTH REGULATIONS: This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the

Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations (Chapter 454 C.M.R. 10.00 et seq.)". Contractors shall be familiar with the requirements of these regulations and the safety requirements of the MUTCD and ADA.

ARTICLE 56 - SPECIAL PROVISIONS - The Owner reserves the right to assess special penalties if the Contractor's actions during construction result in the following situations:

a. Closing of a traffic lane or lanes not previously permitted nor approved by the Owner or Engineer in writing prior to the commencement of work

b. Working during hours not stipulated by permit nor approved by the Owner or Engineer in writing prior to the commencement of work.

c. Damage to Public Shade Trees: See "City of Cambridge Department of Public Works, Division of Urban Forestry Tree Protection During Construction" which is included in ATTACHMENT-I of Section-00825A Special Conditions.

Penalties shall be assessed on a per occurrence basis at up to $500 per occurrence and shall be deducted from the progress payments due to the Contractor.

ARTICLE 57 - STATE GOVERNMENT PROVISIONS:

a. State Government Provisions included herein, have been selected from those to which specific references have been made elsewhere in the Contract Documents. Each and every other provisions of law of clause required by law to be inserted in this Contract shall be deemed to be also inserted herein in accordance with paragraph GC-2.3.2 of the General Conditions.

b. The OWNER and CONTRACTOR also agree that the provisions of Mass General Law Chapter 82 Section 40, which are included in ATTACHMENT II of SECTION 00825A apply to the work to be performed under this Contract and that these provisions supersede any conflicting provisions of this Contract.

c. The OWNER and CONTRACTOR also agree that the provisions of Mass General Law Chapter 149 Sections 27 and 27B relating to Minimum Wage Rates apply to the work to be performed under this Contract and that these provisions supersede any conflicting provisions of this Contract. Copies of minimum wage rates established for labor categories employed on this Contract are included in SECTION 00670. A copy of the required payroll reports to be submitted to the OWNER on a weekly basis is included in SECTION 00680.

ARTICLE 58 – COMMUNITY AND STAKEHOLDER MEETINGS: The CONTRACTOR is required to attend at least six (6) community and/or stakeholder meetings held during working hours, or at night, for the purpose of informing the residents, businesses and other interested parties about the schedule and project and answering questions. The on-site superintendent and project manager must both attend these meetings.

ARTICLE 59 – PERMITS: The CONTRACTOR shall refer to the Technical Specifications Section 01060 for a list of all permits and regulatory requirements.

ARTICLE 60 – MASSACHUSETTS GENERAL LAWS: The following Massachusetts General Laws apply to the contract. The list is not meant to be all inclusive:

- M.G.L. c.30 s39F Payment to Subcontractor (See General Conditions 13.8.2)
- M.G.L. c.30 s39I Deviation from Plans and Specifications (See General Conditions 11.2.1)
- M.G.L. c.30 s39J No Arbitrary Decisions are Final (See General Conditions 16.6.3)
- M.G.L. c.30 s39L Construction of Work by Foreign Corporations
- M.G.L. c.30 s39M(b) Substitution of Equal Products (See General Conditions 5.13.1)

- M.G.L. c.30 s39N Differing Site Conditions (See General Conditions 16.4.1)
- M.G.L. c.30 s39O Equitable Adjustment for Delays (See General Conditions 12.3.6)
- M.G.L. c.30 s39P Decision on Interpretation of Specifications (See General Conditions 16.6.1)
- M.G.L. c.30 s39R Contractor's Records (See Special Conditions Article 47)
- M.G.L. c.149 s34 Limitations on Hours of Work (See General Conditions 5.5.4)
- M.G.L. c.149 s44J Advertising Invitations to Bid
- M.G.L. c.82 s40 Excavations; Notices; Penalties

END OF SECTION 00825A - SPECIAL CONDITIONS (ATTACHMENTS I, II, III, IV, V TO SECTION 00825A FOLLOWS)

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. The Work to be done under this contract consists of the rehabilitation of existing sewer pipe; the installation of new storm drain pipe and structures including pile supported pipe; the installation of new sanitary sewer pipe and structures; the relocation and reconstruction of existing water mains; over excavation and replacement of organic soils; full depth roadway construction; asphalt excavation by cold planer; pavement overlay; granite curbing; concrete and brick sidewalk and driveway reconstruction; pervious asphalt separated bike lane construction; street trees and landscaping including structural soil and passive irrigation system; roadway lighting, traffic signal construction; pavement markings and traffic signage; rehabilitation of retaining wall ; coordination with public art installation; streetscape furnishings; the reconstruction of public plazas, including pervious pavers with underdrains, new benches and granite seating, planter elements, planting areas and trees; construction of custom transit shelters with transit amenities and seating, and a MBTA bus operator booth; fabrication and erection of a customized architectural element; specialty paving, and a foundation and conduits to support the installation by others of a future kiosk; automatic irrigation system; and miscellaneous furnishings and appurtenances.

B. A general description of the Work to be performed under this Contract shall include, but will not be limited to the following construction operations:

1. Coordination with Public and private utilities for the relocation of their facilities as may be required.

2. Relocation and replacement of existing water mains.

3. Installation of (Reinforced Concrete Pipe) RCP, (Polyvinyl Chloride) PVC, and (Ductile Iron) DI storm drains with related manholes; installation of PVC sewer with related manholes; and the replacement of the existing water mains with DI water mains with related hydrants and valves.

4. Installation of full length cured-in-place pipelining.

5. Installation of manhole lining.

6. Removal and relocation of existing sewer, drain and water services which are in direct elevation or alignment conflict with the Work of this Contract or which may interfere with the installation of that work as approved by the City and Engineer.

7. Demolition and abandonment of existing structures and pipes.

8. Removal of concrete slab, rail, and rail ties.

9. Installation of a roadway lighting system and traffic signals.

10. Overexcavation of organic soils within a section of the River Street and Blackstone Street corridors.

11. Disposal of excess geotechnically; analytically; and logistically unsuitable excavated material.

12. Reuse geotechnically and analytically suitable excavated material on site as backfill and dispose of excess material from excavation not required for fill or backfill as specified, and to the satisfaction of the City.

13. Remove and Reset or furnish and install new granite curb; cold planing and overlay paving; trench pavement restoration; and installation of new cement concrete and brick sidewalks and cement concrete pedestrian ramps conforming to the latest MA AAB rules and regulations and to the latest ADA standards for accessible design.

14. Rehabilitation of Riverside Press Park concrete retaining wall

15. Installation of pervious pavement with an underdrain system.

16. Reconstruction of Tubman Square and pervious pavers with an underdrain system

17. Reconstruction of Carl Barron Plaza

18. Fabrication of the architectural “the ribbon” element

19. Artist coordination and installation of “the ribbon” element within Carl Barron Plaza including foundation system

20. Fabrication of custom transit shelters and MBTA operator’s booth

21. Installation of custom transit shelters and foundations

22. Installation of public art along River Street

23. Installation of structural soil, planting soil, street trees, planters and plantings

24. Full-depth roadway reconstruction and cold plane and overlay.

25. Installation of pavement markings.

The work shall conform to such additional drawings, specifications and addenda to these Specifications and Drawings as may be published or exhibited prior to the opening of Bid Proposals or as may be furnished by the Engineer from time to time during the construction.

C. Work and materials which are necessary in the construction but which are not specifically referred to in the Specification, or shown on the Drawings, but implied by the Contract shall be furnished by the Contractor and included in the Contractor's Unit and Lump Sum Prices Bid. The work and materials shall be such as will correspond with the general character of the work as may be determined by the Engineer, whose decisions as to the necessity for and character of such work and materials shall be final and conclusive. It is the intent of these specifications to produce a complete, finished job whether shown in every detail or not.

D. For the purposes of this Contract, anywhere the term "Temporary" is used in the Specifications, in the Plans, in Contract Addenda, in any revisions made to the Contract Documents at any time prior to or during construction, verbally, in writing, in change orders or work change directives or at any other time whether listed here or not, it shall be taken to mean "Temporary" only as it relates to the duration of the Contract. All repairs, restoration, and construction shall be considered permanent.

1.2 CONSTRUCTION SEQUENCE

Inclusion of the following sequencing restrictions does not relieve the Contractor from its responsibility to complete the Work with the specified contract duration, nor does it relieve the Contractor from its responsibility to sequence and carry out the work so as not to cause harm to the existing systems, environment, or community.

A. Establish baseline Rodent Control

B. Pre-construction Survey

C. Establish baseline Sedimentation and Erosion Control

D. Establish baseline Geotechnical Instrumentation and Monitoring

E. Mobilization

F. Establish advance warning Traffic Management

G. Layout of site work and survey control

H. Establish the construction dewatering treatment system

I. Perform Test Pits: All Test Pits identified in the Contract Drawings as well as those by the City and Engineer shall be performed and completed prior to any other work commencing on the site.

J. Prior to installation of the Work the Contractor shall verify the relocation of any existing utilities that are scheduled for relocation, coordinate with the responsible utility, and relocate those utilities which are the Contractor's responsibility as per these Contract Documents.

K. Prior to any work adjacent to the existing 48-inch MWRA MET sewer on River Street and Blackstone Street or the 8'x6' NCRS sewer on River Street Drive, the contractor shall conduct CCTV inspection.

1.3 UNDERGROUND UTILITIES

A. The underground utilities shown on the plans have been located primarily from information furnished by others and are considered approximate both as to size and location. There are additional utilities to be encountered that are not shown on the plans, and it shall be the Contractor's responsibility to locate all existing utilities and to protect same from damage or harm. All utilities interfered with or damaged shall be properly restored, at the expense of the Contractor, as required by City. Unapproved service interruptions will not be allowed.

1.4 SURFACE RESTORATION

A. Any damage to the pavement, curbing, or sidewalks outside of the limits of excavation and excavation support as defined in the Contract Documents shall be the responsibility of the Contractor and all costs associated with the repair of the excavation, sub-base, pavement, curbing, and sidewalks shall be fully borne by the Contractor. Repairs shall be immediately made by the Contractor as per the Contract Documents and as required by the Engineer.

1.5 HOURS OF WORK

A. The hours of work shall be Monday through Friday, 7:00 a.m. – 4:00 p.m excluding the City of Cambridge Holidays, except for the work within Memorial Drive and the intersection of Memorial Drive and River Street, which must be performed during the restricted hours detailed below:

1. Work occurring within the traveled way of the Memorial Drive and the intersection of Memorial Drive and River Street shall be detailed on the DCR Permit.

performed overnight from 8:00 p.m. to 5:00 a.m. Sunday through Thursday unless otherwise required by the City and/or the Department of Conservation and Recreation (DCR).

2. Work occurring on Memorial Drive and in the intersection of River Street and Memorial Drive shall not begin earlier than November 15, 2022 and must be completed prior to November 15, 2023.

3. For additional requirements and restrictions for work on Memorial Drive, refer to DCR Construction Access Permit that has been appended to these specifications.

B. During non-work hours (typically 4:00 p.m. – 7:00 a.m. weekdays; weekends and holidays) the Contractor shall make the following provisions:

1. Access to all properties shall be maintained. Work zones shall be cleaned, protected and made safe. The Contractor shall minimize the amount of parking restrictions.

2. At the end of each work day, the Contractor shall backfill and pave and/or place steel road plates over all excavations so as to maintain automobile/truck traffic, bicycle traffic, and pedestrian traffic access and flow. Under no circumstances will obstructions or open excavations be allowed during non-work hours. All parking will be given back to the community and businesses during non-work hours. Work zones shall be cleaned, protected and made safe.

1.6 CONTRACTOR USE OF PROJECT SITE

A. The Contractor's use of the project site shall be limited to its construction operations, including on-site storage of materials, on-site fabrication facilities and field offices.

B. The Contractor shall determine the location(s) of the staging area(s) to be used for this project and shall obtain approval of the location(s) from the City of Cambridge prior to any mobilization activities. Contractor equipment and materials shall not block hydrants or emergency vehicle access. Equipment stored after hours shall be at least 25 feet away from intersections so that large emergency response vehicles may access all properties within the Contract area.

C. The Contractor shall maintain access to street parking and driveway parking and access to all properties and businesses outside the work zone during off work hours.

D. The Contractor shall remove all equipment and materials, provide full sidewalk and street access, and sweep clean the project area along River Street, up to two (2) times per calendar year to accommodate special events.

E. The City of Cambridge does not provide general parking for private vehicles that belong to contractors. As a condition of construction permits, the Contractor will be required to manage employee parking ensuring personal vehicles are parked off-site. Note that overtime parking at City meters, and/or parking in Residential Permit parking spaces without a permit, will not be tolerated. Repeated violations may result in loss of project permits.

1.7 LIST OF DRAWINGS

A. The location, general characteristics, and principal details of the work are indicated on a set of drawings entitled “River Street Infrastructure and Streetscape Improvement Project”.

B. The drawings stated above are the Contract Drawings, sometimes referred to herein as the "Drawings." Additional drawings showing details in accordance with which the work is to be done may be furnished from time to time by the Engineer, if found necessary, and shall then become a part of the Drawings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01010

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 — GENERAL

1.1 SUMMARY

A. Payment for the items specified in the Bid Schedule shall include compensation for furnishing all labor, tools, equipment, supplies, manufactured articles, and for all operations, and incidentals appurtenant to the items of work described, to complete the various items of the Work, all in accordance with the requirements of the Contract Documents, Drawings, Specifications, Addendum, and other modifications issued and approved by the City and Engineer.

B. Payment for the items specified in the Bid Schedule shall include all costs for permits and compliance with the regulations of public agencies having jurisdiction including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA).

C. The bid prices listed in the Bid Schedule shall include all Work items described or implied in the Contract Documents, Drawings, Specifications, Addendum, and other modifications issued and approved by the City and Engineer, and all other Work items necessary to manufacture, furnish, install and test a complete working project.

D. The following items are considered "Incidental" to the completion of the Work included in this Contract. These incidental work items shall be included in the Bid Schedule prices and are not included for separate payment. The incidental work items include, but are not limited to:

a. Abandonment, removal and disposal of existing, abandoned or relocated private utilities and water main not specified for payment elsewhere.

b. Establishing and maintaining Construction Baselines and Profile Grade Lines.

c. Horizontal and vertical layout and staking.

d. Dust control.

e. Construction photographs.

f. Attending City meetings, neighborhood meetings, and all other Construction meetings.

g. Submitting work plans, shop drawings, and materials samples.

h. Construction of mock-ups and sample panels.

i. Protection of installed materials from damage, and replacement of damaged materials as directed by the Engineer.

j. Warrantees and Guarantees as indicated in the Contract Documents.

k. Maintenance of plant materials as indicated in the Contract Documents.

l. Concrete encasement of impacted utilities.

m. Street sweeping and removing snow from streets and sidewalks where work is ongoing.

n. Transporting trash and recyclables out of the work area where municipal pickup is hindered.

o. Providing certificates of design where required.

p. Submitting weekly and bi-weekly construction schedule projections and updates.

q. Fulfilling all reporting requirements.

r. Clean-up and restoration of all surface features not included for payment elsewhere.

u. Obtain all permits including payment of fees.

v. Cast-in-Place Concrete Collars for Pipe-to-Pipe Connections for Pipe Smaller than 15-in Diameter.

w. Demolition and Removal of Pipe Smaller than 15-in Diameter.

x. Permanent Masonry Plugs and Bulkheads for Pipe Abandonment smaller than 15-in Diameter.

y. CDF for pipe abandonment for Pipe Smaller than 15-in Diameter.

z. Furnishing and Placing Backfill by one of the approved methods listed below:

    1. Reuse excavated material immediately on site at the general area of excavation.

    2. Furnish and install imported suitable backfill.

3. Transport the material to a staging area, stage and protect the material, load the material, transport the material to be used as backfill at the general area of excavation or to another backfill area of equal or greater contamination, where geotechnically suitable.

aa. Furnishing, installing, compacting and testing gravel sub-base by one of the approved methods listed below:

1. Reuse excavated sub-base material immediately on site at the general area of excavation, as sub-base material.

2. Transport the material to a staging area, stage and protect the material, load the material, transport the material to be used as backfill at the general area of excavation or to another sub-base area of equal or greater contamination, where geotechnically suitable.

bb. Remove and reset all signs and sign posts, trash receptacles, meters, or any other site feature or furnishing not specifically listed for separate payment elsewhere.

cc. Rodent Control.

dd. Pre- and Post- Construction Video.

ee. Protection of private property including walls at the back of sidewalk.

ff. Modification, removal, and disposal of existing tree pits

E. No separate payment shall be made for any item that is not specifically specified in the Bid Schedule, and all costs therefore shall be included in the prices named in the Bid Schedule for the various appurtenant items of work.

F. The Contractor and Subcontractors shall not take advantage of any apparent error or omission on the Drawings or in the Specifications. The Contractor and Subcontractors shall make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents at no additional cost to the City.

G. Anywhere in these Contract Documents, the term furnish shall mean manufacture; supply; delivery to the Project site including the actual unloading and unpacking; assembly; erection; placing; installation; anchoring; applying; working to dimension; finishing; curing; protecting; cleaning; testing; start-up; and similar operations unless stated otherwise.

1.2 LUMP SUM ITEMS

A. Payment for the lump sums shall be full compensation for all labor, materials and equipment required to furnish, install, construct, startup and test the work covered under that lump sum item, whether listed in the related Compensation subsection for each item or not. All supervision: overhead items including but not limited to bonds, insurance, and labor burden; and profit are also included.

B. Payment shall fully compensate the Contractor for any other work which is not specified or shown, but which is necessary to complete the Work.

1.3 UNIT PRICE ITEMS

A. Unit prices shall be full compensation for all labor, materials and equipment required to furnish, install, construct, startup and test the work covered under that unit price item, whether listed in the related Compensation subsection for each item or not. All supervision: overhead items including but not limited to bonds, insurance, and labor burden; and profit are also included.

B. Payment shall fully compensate the Contractor for any other work which is not specified or shown, but which is necessary to complete the Work.

1.4 MEASUREMENT FOR PAYMENT

A. Work completed to date shall be submitted by the Contractor and substantiated as required by the Engineer.

B. The City and Engineer will review the submittal for completeness and verification. Failure to submit any of the below requirements will be grounds for a rejection of the submitted pay request until such time as the submittals are complete, accurate, up to date, and have been approved by the City and Engineer.

1. Include a checklist of completed items. Only items signed-off by the Engineer will be considered for payment.

2. Include red-lined “As-built” drawings indicating degree of completion, as described in Section 01400 – QUALITY CONTROL.

3. Include a revised CPM schedule and narrative as required in the Specifications and showing actual record information.

4. Include a copy of all required test results including, but not limited to geotechnical and settlement monitoring results, compaction test results, concrete strength test results, grain size analysis and analytical test results.

5. Certified payrolls for general and all sub-contractors.

6. MBE and WBE reporting and certifications.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01025

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SECTION 01040

PROJECT COORDINATION AND MEETINGS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes general coordination requirements including preconstruction conference, site mobilization conference, and progress meetings.

1.2 CONTRACTOR COORDINATION

A. Coordinate scheduling, submittals, and the Work to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Coordinate completion of the Work and clean up for Substantial Completion and for portions of Work designated for City's partial utilization.

C. Coordinate access to site for correction of nonconforming Work to minimize disruption of City's activities where City is in partial utilization.

D. Contractor to provide a full onsite project manager for the duration of the project. Refer to Specifications – Statement of Bidder's Qualifications for project manager experience requirements.

E. Coordination is considered incidental to the project, no additional payment will be authorized.

F. Construction shall be coordinated with adjacent projects within the City of Cambridge.

G. Contractor shall attend all City of Cambridge Utility Coordination meetings. Meetings typically occur on Mondays at 9:00 a.m. at the City of Cambridge Public Library at 449 Broadway, between April and November.

1.3 PRECONSTRUCTION CONFERENCE

A. The City will schedule a preconstruction conference.

B. Attendance Required: City's representatives, Engineer, Contractor, Contractor's Project Manager and Superintendent and major Subcontractors.

C. Sample Agenda:

1. Designation of personnel representing the parties in Contract and the Architect/Engineer.

2. Description of the Project background, purpose, basis of design and major elements of the Work.

3. Community Relations requirements

4. Soil and Waste Management requirements

5. Major Geotechnical requirements such as temporary support of excavation; backfill and compaction; geotechnical instrumentation and monitoring, and dewatering.

6. Requirements and procedures for the submission of change orders and pay requisitions.

7. Requirements, procedures and processing of shop drawings and other submittals; Schedules and schedule updates; substitutions; and Requests for Information.

8. Scheduling of the Work and coordination with other contractors.

9. Review of Subcontractors

10. Continuation of City services (trash and rubbish removal, recycling, street sweeping, and snow removal).

11. Meeting requirements (Progress, Work Shops, etc.)

12. Utility coordination

13. Traffic and pedestrian management requirements

14. Other

1.4 PROGRESS MEETINGS

A. Project meetings shall be held at a location designated by the City and Engineers. Meetings shall be held at weekly intervals, or more frequent intervals if required by the City or Engineer.

B. Attendance Required: Job superintendent, Contractor's Project Manager, major Subcontractors and suppliers, City representatives, and Architect/Engineer as appropriate to agenda topics for each meeting.

C. The City or Engineer or their representative will make arrangements for meetings, and record minutes.

D. The City or Engineer or their representative will prepare the agenda and preside at meetings.

E. Contractor shall provide required information and be prepared to discuss each agenda item.

F. Sample Agenda:

1. Review minutes of previous meetings

2. Community Relations

3. Review of work progress. Review of work completed, work on going and work scheduled within the coming month.

4. Field observations, problems, and decisions

5. Identification of problems which impede planned progress

6. Review of submittals schedule and status of submittals

7. Review of RFI and RFP status

8. Proposed Change Orders (PCO), claims, credits, Work Change Directive, and change order status

9. Review of off-site fabrication and delivery schedules

10. Maintenance of progress schedule

11. Corrective measures to regain projected schedules

12. Maintenance of quality and work standards

13. Effect of proposed changes on progress schedule and coordination

14. Other item relating to Work

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01040

SECTION 01045

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1. Requirements of this Section do not apply to mechanical installations.

1.2 SUBMITTALS

A. Submit proposed procedures for cutting and patching at a minimum of four (4) weeks in advance of the time cutting and patching will be performed. The submittal shall contain, but not be limited to the following information:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.

2. Describe anticipated results in terms of changes to existing or proposed construction; include changes to structural elements and operating components.

3. List firms or entities that will perform Work.

4. Indicate dates when cutting and patching is to be performed.

5. List utilities, service, or performance that will be disturbed or affected and indicate how long service will be disrupted.

6. Where cutting and patching involves addition of reinforcement to structural elements, submit details stamped by a Massachusetts Professional Engineer to show how reinforcement is integrated with the original structure.

B. Review by the Engineer prior to proceeding with cutting and patching does not waive the Engineer's right to later require complete removal and replacement of a part of the Work found to not meet the requirements of the Contract.

1.3 QUALITY ASSURANCE

A. Requirements for Structural and Utility Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

1. Submit the cutting and patching proposal, including a structural analysis and design of additional reinforcement, stamped by a Massachusetts Professional Engineer, before cutting and patching.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

1. Submit the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:

a. Shoring, bracing, and sheeting.

b. Primary operational systems and equipment.

c. Control systems.

d. Electrical wiring systems.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior, in a manner that would, in the Engineer's opinion, reduce aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work that has been cut and patched that does not meet requirements of the Contract as determined by the Engineer.

1. Retain the original installer or fabricator to cut and patch or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm acceptable to the Engineer:

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials whose installed performance will equal or surpass that of existing materials.

B. Where cutting and patching occurs on exposed exterior structures or work, use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting, and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

1. Before proceeding, meet at the site with parties involved in cutting and patching, including but not limited to mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Take all precautions to avoid cutting existing pipe, conduit or duct banks that are scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 CUTTING

A. General: Employ skilled workmen to perform cutting and patching. Complete cutting and patching without delay.

B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

C. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible, review the proposed procedures with the original installer or manufacturer or with an installer or manufacturer with similar experience. Comply with the installer's and / or manufacturer's recommendations.

D. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

E. Cut through concrete and masonry using a cutting machine such as a carborundum saw or a diamond core drill.

F. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

3.4 PATCHING

A. Inspect and test patched areas to demonstrate integrity of the installation.

3.5 CLEANING

A. Thoroughly clean areas where cutting and patching is performed or used as access. Remove completely mortar, oils, reinforcing, concrete, masonry and items of similar nature. Thoroughly clean piping, conduit and similar features before finishing is applied. Restore damaged pipe to its original condition.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01045

SECTION 01060

PERMITS AND REGULATORY REQUIREMENTS

1060.1	**MWRA DEWATERING DISCHARGE PERMIT FEE**	**ALLOWANCE**
1060.2	**ERUV MAINTENANCE OF NORTH CHARLES ERUV SYSTEM**	**LUMP SUM**
1060.3	**MBTA FORCE ACCOUNT**	**ALLOWANCE**

PART 1 - GENERAL

1.1 REGULATORY AGENCIES

A. The Contractor shall comply with all laws, rules, and regulations and ordinances promulgated by any authority having jurisdiction over the Work.

B. The Contractor shall be fully responsible for obtaining and complying with all required permit(s). The Contractor shall be responsible for including all costs and fees required to obtain and comply with the permits, in the Bid. The Contractor shall ensure that all necessary permits from the Department of Public Safety, Cambridge Fire Department, Cambridge Police Department, Cambridge Electrical Department, Cambridge Water Department, Cambridge Department of Public Works, Massachusetts Water Resource Authority, Massachusetts Department of Environmental Protection, Department of Conservation and Recreation, Massachusetts Bay Transit Authority, U.S. Environmental Protection Agency (EPA) and all other regulatory agencies and/or inspectional authorities having jurisdiction are obtained and paid for by the Contractor or its subcontractor (s) as appropriate.

C. Permit fees will be waived for permits administered by the Cambridge Department of Public Works and Cambridge Traffic, Parking and Transportation Department.

D. The Contractor shall be fully responsible for maintaining and preserving the portion of the North Charles Eruv (NC Eruv) and coordinating with the North Charles Community Eruv through construction.

1.2 PERMITS OBTAINED BY THE CONTRACTOR

A. The Contractor or its subcontractor shall be responsible for obtaining; paying for; and complying with, as part of its base Bid, all permits; licenses; certifications; and approvals required for the work of this contract. The Contractor's responsibility includes but is not limited to, all permits required for his equipment, work force, and particular operations such as transportation and storage of fuel, chemicals or other materials and air emission.

B. At a minimum, the Cambridge Department of Public Works and Cambridge Traffic and Parking Department permits that the Contractor shall be responsible for obtaining, paying for, and complying with include, but are not limited to, the following:

1. Excavation Permit

2. Street Obstruction Permit

3. Sidewalk Obstruction Permit

4. Street Closing Permit

5. Curb Cut Permit

6. Traffic Management Plans including Detours and Bus Routing

7. Pedestrian Management Plans

8. Water Construction Permit

   a. The Cambridge Water Department (CWD) will not issue new water construction permits until all requirements for previous (i.e., initial CWD permit) CWD permits are met. These requirements include accurate and legible swing tie dimensions to all new water main gate valves, Tee's and elbows, required CWD "sign off's" on the contractor's copy of the CWD executed permit (when permitted work is complete), test documentation that includes Massachusetts State certified initial chlorination and bacteria testing of new water main work, and pressure test results of new water main work. The contractor is hereby advised that the CWD will not be responsible for the contractor's slip in project schedule if these requirements for permits are not followed.

9. Noise Variance for work outside regular hours of construction. Regular hours of construction are Monday through Friday (excluding City Holidays) from 7:00 am to 6:00 pm and Saturdays (excluding City Holidays) from 9:00 am to 6:00 pm.

E. At a minimum, the other Permits the Contractor shall be responsible for obtaining, paying for, and complying with should they be required include, but are not limited to, the following:

- (NPDES) Construction General Permit (CGP) for Stormwater Discharges from Construction Activities
- NPDES Remediation General Permit (RGP)
- NPDES Dewatering and Remediation General Permit (DRGP)

- MWRA Construction Site Dewatering Permit
- MWRA wastewater discharge permits for CIPP Lining operations

F. The Contractor shall be responsible for scheduling and coordinating inspections and receipt of local, state, or federal permits/approvals/certifications for all Work as part of this Contract.

G. The Contractor shall be responsible for obtaining, paying for and complying with MassDEP and City of Cambridge Backflow Prevention Permits.

H. The Contractor is solely responsible for the implementation of the permit requirements and shall include as such in the Bid.

I. The Contractor is solely responsible for any punitive action resulting from any violation of the permit.

J. Actual permits, issued by the respective agencies will be considered part of this Contract.

K. The Contractor shall, at a minimum, include compliance with the provisions and requirements of a typical NPDES Construction Dewatering Discharge General Permit and the MWRA dewatering permit and typical Cambridge permits listed above. The Contractor will receive no additional compensation for compliance with any permit requirements.

1.3 PERMITS OBTAINED BY THE CITY

A. The City has obtained or initiated the following permits, which are included in the appendices to these Specifications. All other permits, including construction dewatering discharge permits, are the responsibility of the Contractor.
   a. DCR Construction Access Permit
   b. MWRA Waterworks 8(m) Permits
   c. MWRA Wastewater 8(m) Permits
   d. MBTA License for Entry
      i. This License pertains to work above the MBTA tunnel in the Central Square area. The Contractor shall execute this License before commencing work, and abide by all of its terms and conditions.

1.4 MAINTENANCE OF NORTH CHARLES ERUV

A. The work shall include the maintenance and preservation of the portion of the North Charles Eruv System located within the limits of this contract for the total duration of the construction work. The Eruv is a boundary of religious significance to the Jewish community that is generally comprised of linear elements of a minimum height of 48-inches but generally 15-18 feet high; commonly chain-link

fences, walls of buildings, and utility poles and wires. The Eruv is a continuous boundary with no gaps or openings, except for certain openings that are allowed if the opening is framed in a type of a doorway scheme (two doorposts and a lintel). The purpose of an Eruv is to integrate a number of private and public properties into one larger private domain that then permits the carrying of objects from home to public areas, and within public areas, by members of the Jewish community on the Sabbath and Holidays, that would be restricted by Jewish Law without the presence of the Eruv.

The Eruv boundary map can be found at the following website: nceruv.org/eruvBoundary.html

Along Memorial Drive at River Street, the existing Eruv is comprised of a polypropylene twine attached to two 20' high, light poles, one wood and the other metal. The first pole is on the southeast corner of River Street, the pole Eruv continues to the west 120' to the next wood pole along Memorial Drive.

The Eruv **must always be maintained intact**, except for temporary dismantling for construction purposes, or if relocated. In either case, approval by the North Charles Community Eruv, Inc. (NCCE) is required prior to work. Construction activities may proceed so long as the work does not disturb the integrity of the Eruv. The Contractor is not responsible for damage to the Eruv outside of the work limits of the Contract, unless that damage is perpetrated by the Contractor during work on this Contract.

B. Before any work is performed to maintain or relocate the Eruv, the Contractor shall attend a meeting with the NCCE to coordinate the required relocation/modification of the Eruv. The Contractor shall submit to Engineer, City of Cambridge and NCCE for approval a plan and schedule for any work associated with the Eruv. The Contractor may adjust the alignment of the Eruv within the limits of the contract area, and shall submit for approval each alternate alignment for the Eruv. Submittals shall be sent to info_eruv@nceruv.org for review and approval. Additionally, the Contractor shall contact the NCCE a minimum of ten (10) business days prior to any work associated with the Eruv and coordinate all schedules for maintenance, relocation, dismantlement, and reconstruction

C. RELIGIOUS HOLIDAY RESTRICTIONS

If the Eruv is temporarily dismantled for construction purposes, the Eruv shall be reconstructed and kept intact for the duration of the Sabbath and Holidays. Construction activities may proceed during the Sabbath and Holidays so long as the work does not disturb the integrity of the Eruv. For the purposes of this Contract, the Sabbath shall be defined as a 36-hour period beginning at 12:00 PM (noon) on every Friday, and ending at 11:59 PM (midnight) on the succeeding Saturday. This period roughly approximates the hours of the Jewish Sabbath. For the purposes of this Contract, Holidays in calendar years 2022, 2023, 2024, and

2025 shall consist of the holidays specified below. It is the responsibility of the Contractor to confirm each holiday period specified for each year of the contract. Holidays last for a period of 36 hours up to 9 days, and shall always begin at 12:00 PM (noon) and end at 11:59 PM (midnight). Should this Contract extend past December 31, 2025, the Contractor shall obtain an updated list of Holidays from the NCCE

Eruv Holidays and Durations

Passover (9 days)

Shavuot (2 days)

Rosh Hashana (2 days)

Yom Kippur (1 day)

Sukkot/Simchat Tora (9 days)

PART 2 – PRODUCTS

1.1 ERUV MATERIALS

A. All materials used for maintaining the Eruv shall be of solid durable materials as approved or directed by the NCCE.

PART 3 – EXECUTION (Not Used)

1.1 ERUV DISMANTLEMENT AND RECONSTRUCTION

A. The Eruv may only be dismantled by the Contractor within the work zone of this Contract. Any portion of the Eruv, including utility poles and overhead wires, that is dismantled as part of the work will constitute a disruption to the Eruv and must be supplemented by temporary work during the hours listed above. Any components of the Eruv that are owned by the NCCE that are removed by the Contractor shall be delivered to the NCCE. No existing Eruv components shall be modified, adjusted, or removed until approved by the NCCE. The Contractor shall provide access to the work site for representatives of the NCCE to perform the installation work. Any portion of the Eruv System that is impacted as part of work by the Contractor will constitute a disruption to the Eruv and must be maintained by approved temporary means.

B. All work done to reconstitute (reconstruct) the Eruv shall be of durable construction as approved or required by the NCCE. All lines of the Eruv shall be continuous following neat lines and grades.

PART 4 – COMPENSATION

Item 1060.1 – MWRA Dewatering Discharge Permit Fee

METHOD OF MEASUREMENT:
Payment will be made against the allowance based on invoices submitted by the General Contractor on a monthly basis. Incomplete or incorrect invoices will not be approved.

BASIS OF PAYMENT:
The allowance for this item shall be reimbursement to the General Contractor to pay MWRA Dewatering Discharge Permit Fee.

Item 1060.2 – Eruv Maintenance of North Charles Eruv System

METHOD OF MEASUREMENT:
Measurement for Payment for Eruv Maintenance of North Charles Eruv System will be paid .

BASIS OF PAYMENT:
The Contractor shall be paid the lump sum contract price for all work associated with maintaining the North Charles Eruv System, including coordinating with the North Charles Community Eruv, Inc. to maintain, temporarily modify, and permanently modify the North Charles Community Eruv system as directed by the Engineer. This payment shall be full compensation for furnishing all equipment, labor, and materials necessary to complete the work.

Item 1060.3 – MBTA Force Account

METHOD OF MEASUREMENT:
Payment will be made against the allowance based on invoices submitted by the General Contractor on a monthly basis. Incomplete or incorrect invoices will not be approved.

BASIS OF PAYMENT:
The allowance for this item shall be reimbursement to the General Contractor to pay MBTA License Agreement and Force Account fees.

END OF SECTION 01060

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SECTION 01061

National Pollutant Discharge Elimination System (NPDES)
Construction General Permit (CGP) for Stormwater Discharges from
Construction Activities

1061.1 NPDES CONSTRUCTION GENERAL PERMIT LUMP SUM

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Procedures to submit, secure, maintain, and conduct any and all construction activities in accordance with a NPDES Construction General Permit (CGP) for Stormwater Discharges from Construction Activities. Work to be done as part of this specification includes, but is not limited to:

a. Obtain an EPA NPDES Construction General Permit (CGP) for Stormwater Discharges from Construction Activities.
b. Develop and maintain a Storm Water Pollution Prevention Plan required by the National Pollutant Discharge Elimination System (NPDES) and applicable Construction General Permit (CGP).
c. Perform site inspections and submit inspection reports.
d. File a Notice of Termination.

1.2 RELATED SECTIONS

A. Section 01060 – PERMITS AND REGULATORY REQUIREMENTS

B. Section 01300 – SUBMITTALS

C. Section 02010 – SUBSURFACE INVESTIGATION

D. Section 02080 – SOIL AND WASTE MANAGEMENT

E. Section 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

F. Section 02140 – DEWATERING

G. Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

H. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS or as otherwise directed below:

1. The Contractor must prepare and file a Notice of Intent (NOI) for a CGP to be secured in advance of construction using submittal methods [ex. NPDES eReporting Tool (NeT)] current and applicable at the time of filing. The Contractor is responsible to ensure that all required Permittees, including but not limited to, the City of Cambridge and the Contractor, are properly covered under said NOI and resultant CGP, and shall provide proof of same to the City of Cambridge prior to the start of any work.

2. The NPDES Construction General Permit requires the preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the associated statutes and regulations. The SWPPP shall include the NPDES Construction General Permit conditions and required information, City of Cambridge Performance Standards, and detailed descriptions of erosion and sedimentation controls 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 NPDES Construction General Permit and, if applicable, the DEP requirements. The Contractor shall submit an electronic copy, and by hard copy if requested, three (3) copies of the draft SWPPP to the City of Cambridge for review and approval at least four weeks prior to any regulated site activities. The Contractor is responsible for keeping the SWPPP current and for any necessary amendments that need to be made for throughout construction. Any need for amendment must be communicated to the City of Cambridge and said amendment must be provided to the City of Cambridge for review and approval in advance of implementation. It is the responsibility of the Contractor to be familiar with the NPDES Construction General Permit conditions and all other environmental permits and regulations applicable to this Project. The Contractor shall include in the SWPPP the methods and means necessary to comply with applicable conditions of said permits and regulations.

3. Included in the NPDES Construction General Permit conditions is the requirement for inspection of all erosion and sediment controls and site conditions. The Contractor must conduct inspections in accordance with the frequencies identified in the CGP. Written Weekly Inspection forms, Storm Event Inspection forms, and Monthly Summary Reports shall be completed and provided to the City of Cambridge within two (2) business days of completion. 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.

4. The Contractor must prepare and file a Notice of Termination (NOT) of coverage under the CGP using submittal methods [ex. NPDES eReporting Tool (NeT)] current and applicable at the time of filing. The Contractor is responsible to ensure that all required Permittees, including but not limited to, the City of Cambridge and the Contractor, are properly covered under said NOT, and shall provide proof of same to the City of Cambridge prior to filing.

PART 3 – EXECUTION

3.1 GENERAL

A. The Project is subject to the EPA Construction General Permit (CGP). Pursuant to the Federal Clean Water Act, construction activities which disturb one acre or more of land are required to apply to the U.S. EPA for coverage under the NPDES General Permit for Storm Water Discharges from Construction Activities. The Contractor must secure the applicable CGP which is in effect (currently 2022) at the time of application, and any subsequently issued CGP, if not grandfathered by EPA, during the applicable construction period until the Termination of Coverage.

3.2 COMPLIANCE WITH CONSTRUCTION GENERAL PERMIT

A. The contractor is required to comply with all requirements and procedures outlined in the Construction General Permit and said requirements and procedures take priority over the procedures outlined in these specifications.

B. Included in the NPDES Construction General Permit conditions is the requirement for inspection of all erosion and sediment controls and site conditions. The Contractor must conduct inspections in accordance with the frequencies identified in the CGP which has been applied for and in effect which may include: Once every seven (7) calendar days or once every fourteen (14) calendar days and within twenty-four (24) hours of the occurrence of a storm event of 0.25 inches or greater, or the occurrence of runoff from snowmelt sufficient to cause a discharge. For any location where stormwater may discharge to sensitive waters, as defined by the issued CGP, inspection frequency may need to be increased to facilitate compliance with said CGP. The Contractor shall choose a Qualified Person (herein after referred to as the "Inspector"), as defined by the issued CGP, who will be on-site during construction to perform the abovementioned

inspections. The City of Cambridge must approve the Contractor's Inspector. In addition, if the City of Cambridge determines at any time that the Inspector's performance is inadequate, the Contractor shall provide an alternate Inspector.

C. The Standard Specifications require adequate erosion control for the duration of the Contract. Inspection of these controls is considered incidental to the applicable items. 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.

PART 4 – COMPENSATION

METHOD OF MEASUREMENT:
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, weekly inspections, weekly/monthly reports and filing fees, and termination of coverage.

BASIS OF PAYMENT / INCLUSIONS:
Payment of fifty (50) % of the contract price shall be made upon acceptance of the Notice of Intent and 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.

END OF SECTION 01061

SECTION 01063

SEQUENCING OF WORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies construction sequencing requirements for the following work:
   1. General sequencing requirements
   2. Porous Pavement Installation
   3. Sidewalk and Driveway Installation
   4. Traffic Signals
   5. Roadway Lighting
   6. Final Paving
   7. Pavement Marking Installation
   8. Coordination with abutting businesses and residences

1.2 SUBMITTALS

A. The Contractor or its subcontractor shall be responsible for submitting sequencing plans for the construction activities described in Section 1.1 of this section and outlined in Part 3 below. Each plan shall describe sequence of activities required to complete work, indicate duration and schedule of work; indicate work zones and equipment used to complete work; provide traffic and pedestrian management description and plans, including abutter and pedestrian access, for each activity.

1.3 RELATED SECTIONS

A. Specification Section 00020 – INVITATION TO BID

B. Specification Section 01010 – SUMMARY OF WORK

C. Specification Section 01568 – EROSION AND SEDIMENTATION CONTROL

D. Specification Section 01570 – MAINTENANCE AND PROTECTION OF TRAFFIC

E. Specification Section 02100 – PREEMPTIVE TREE CARE

F. Specification Section 02500 – PAVING AND SURFACING

G. Specification Section 02510 – HOT MIX ASPHALT POROUS PAVING

H. Specification Section 02524 – CURBS, WALKS AND DRIVEWAYS

I. Specification Section 02890 – TRAFFIC SIGNALS
J. Specification Section 16135 – ROADWAY LIGHTING

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 GENERAL SEQUENCING REQUIREMENTS

A. The Contractor shall sequence the work with the following general requirements;

1. Tree pruning and installation of tree protection.

2. Test pits indicated in the Contract Drawings or as otherwise required by the Engineer shall be performed prior to starting subsurface work on a street.

3. Contractor shall coordinate with utility companies for required relocations and structure adjustments. Refer to U-sheets for required relocations and/or test pits required to confirm relocations.

4. Contractor to complete roadway and sidewalk construction following the submission of phasing plans for review and approval by the Engineer and City.

i. Provide for one travel lane on River Street (minimum of 15 foot width to accommodate both vehicles and bicycles unless alternative dedicated bicycle facilities of equal or greater comfort are provided) throughout the project area at all times, except for times when alternate travel setups have been approved per the TMP.

1. The only exception to the above is during the installation of the storm drainage line where a minimum 10 foot wide travel lane shall be provided. The minimum 15 foot width travel lane indicated above shall be restored as soon as feasible upon completion of drainage line installation or at the end of any work day involving installation of the storm drainage line.

ii. Maintain or install working vehicle, bicycle and pedestrian signals at all times. Temporary signals, if approved by the Engineer and City, may be utilized at no additional cost to the City. Coordinate with the City regarding energizing of new signals and transference of signal operations prior to decommissioning of existing signal equipment. Work is to be performed during off-peak times to minimize disruption to traffic flow.

5. Full depth roadway construction and installation of base pavement shall be performed prior to installation of adjacent curb and sidewalk.

B. It is a goal of this project to minimize both the number and duration of disruptions to sidewalks in the project area. This will apply specifically as well to Carl Barron Plaza. To that end, the Contractor's proposed sequence and schedule shall demonstrate that to the maximum extent practicable, all work in a given sidewalk work zone is complete before fully reopening that segment for public use. The work that the City expects to be completed during a single sidewalk closure shall include, but not be limited to: removal and resetting of curb; placement of lighting conduit; removal of old light poles and placement of new bases and poles; demolition of existing sidewalk and construction of new sidewalks; and other items requiring excavation or substantial disruption to pedestrian activity.

C. It is understood that final placement of streetscape furnishings, lighting and plantings, and other similar above-grade finish work may occur subsequent to the initial sidewalk zone work described above.

3.6 GENERAL SEQUENCING REQUIREMENTS FOR POROUS PAVEMENT INSTALLATION

A. This Section specifies construction sequencing requirements for the following work:

1. Refer to Specification Section 02510 – HOT MIX ASPHALT POROUS PAVING.

2. Refer to Specification Section 02500 – PAVING AND SURFACING.

3. Hot Mix Asphalt Porous Pavement shall not be placed between October 31st and May 1st.

4. Porous pavement shall be placed in 2 – 2inch layers.

5. No traffic loading is allowed on choker course, reservoir course and filter medium layers in the porous pavement trench.

6. Contractor to control surface run-off water from entering the porous pavement trench.

3.7 GENERAL SEQUENCING REQUIREMENTS FOR COORDINATION WITH ABUTTING RESIDENCES AND BUSINESSES

A. This Section specifies construction sequencing requirements for the following work:

1. Contractor to coordinate with abutters to minimize shut-down durations for installation of water services.

2. Contractor to maintain access to abutters at all times. Sidewalks adjacent to an abutter entrance shall be installed within two (2) weeks from the beginning of removal of existing sidewalk and/or curb adjacent to the abutter entrance.

3. For water service and sewer connections or any other work affecting the water service provided to commercial properties, the Contractor shall be prepared to complete work during off-peak hours, including night work, at no additional cost to the City.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01063

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SECTION 01070

ABBREVIATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAB	Architectural Access Board
AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	American Disabilities Act
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association or American Parquet Association, Inc.
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association

BBC Basic Building Code, Building Officials and Code Administrators

	International
BHMA	Builders Hardware Manufacturer's Association
CABO	Council of American Building Officials
CDA	Copper Development Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
DCR	Department of Conservation and Recreation
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute
HPMA	Hardwood Plywood Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISDSI	Insulated Steel Door Systems Institute
ISA	Instrument Society of America
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MADEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MBTA	Massachusetts Bay Transit Association
MHD	Massachusetts Highway Department
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
MUTCD	Manual of Uniform Traffic Control Devices
MWRA	Massachusetts Water Resource Authority
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NAGDM	National Association of Garage Door Manufacturers
NB	National Board of Boiler and Pressure Vessel Inspectors (alternate NBBPVI)

NBS	National Bureau of Standards (Now NIST)
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association or National Fluid Power Association or National Forest Products Association
NISO	National Information Standards Organization
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association
NPDES	National Pollution Discharge Elimination
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SDI	Steel Door Institute
SMA	Screen Manufacturers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPIB	Southern Pine Inspection Bureau
SPR	Simplified Practice Recommendation
SSA	Swedish Standards Association
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WEF	Water Environment Federation
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01070

SECTION 01090

REFERENCE STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Specialists, Assignments: In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the Contractor.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents.

B. References herein to "Building Code" or "Uniform Building Code" shall mean Uniform Building Code of the International Conference of Building Officials (ICBO). Similarly, references to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean Uniform Mechanical Code, Uniform Plumbing Code and Uniform Fire Code of the International Conference of the Building Officials (ICBO).

"Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the Work is advertised for bids, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

C. In case of conflict between codes, reference standards, drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or furnishing labor. The Contractor shall bid for the most stringent requirements.

D. The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein.

E. Applicable Standard Specifications: References in the Contract Documents to "Standard Specifications" or SSPWC shall mean the Standard Specifications for Public Works Construction, 1991 Edition unless otherwise stated in the specification section.

F. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

G. References herein to "OSHA Standards" shall mean, Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

H. References herein to "MUTCD Standards" shall mean, the latest edition of the Manual for Uniform Traffic Control Devices (MUTCD) published by the US DOT, including all changes and amendments thereto.

I. References herein to "MHD Standards" and/or “MASSDOT Standards” shall mean, the Massachusetts Department of Transportation – Highway Division Standard Specifications for Highways and Bridges, latest edition, including all changes and amendments thereto.

J. References herein to "ADA Standards" shall mean, the Americans with Disabilities Act of 1990 including all changes and amendments thereto.

K. ASTM: American Society for Testing Materials

L. AASHTO: American Association of State Highway and Transportation Officials

M ACI: American Concrete Institute

N. Final Rule for the Accessibility Guidelines for Recreational Facilities and Outdoor Developed Areas by the Recreational Access Advisory Committee, US Architectural and Transportation Barriers Compliance Board, most recent edition, including all changes and amendments thereto.

O. MAAB: Massachusetts Architectural Access Board, most current edition.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. The Contractor is responsible for ensuring that all work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01090

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SECTION 01105

RODENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies rodent control and general pest control requirements within project areas, and bordering areas as designated by the City and Engineer. This work is to be performed prior to demolition, excavation, and site preparation and throughout the Contract, so that rodents and other pests do not disperse from or infest the project area.

B. The Contractor shall develop and implement an Integrated Pest Management (IPM) approach. As part of that approach, the Contractor shall maintain a cooperative dialogue with appropriate agencies and management/representatives of neighboring properties.

C. The Contractor shall perform the rodent control tasks described in this Scope of Work and also respond to other pest control needs when required by the City.

1.2 SUBMITTALS

A. Submit to the Engineer copies of pesticide applicator certifications and licenses within ten (10) days of the start of Rodent Control activities and ten (10) days prior to their issuance or renewal for the duration of this Contract.

B. After performing the survey described in Paragraph 3.2 below and before initiating baiting, submit to the Engineer a written description of proposed pest control procedures, indicating materials, quantities, methods, and time schedule. For all pesticides to be used, submit a copy of the pesticide manufacturer's EPA-approved pesticide label with application directions.

C. Submit to the Engineer documentation of pest control activities and results and follows:

1. Weekly - Submit data sheets with locations of sites treated, amounts and types of pesticide used, number and types of traps set, survey and inspection results, sanitation conditions, complaint calls investigated, and any problem that occurred.

2. Monthly - Submit a written summary that includes determinable results of the IPM program and recommendations.

3. Quarterly - Submit a map that shows bait stations, manholes, and catch basins where rodent baits are being maintained.

1.3 QUALIFICATIONS

A. The Contractor shall perform this work at all times in accordance with the following minimum standards and as acceptable to the City and Engineer.

1. The Contractor and key personnel shall have experience with commercial and residential accounts and construction projects; have experience and technical training in vertebrate pest management and integrated pest management; have experience with various rodent control techniques, equipment, and strategies; have training and experience with insect control; and have knowledge of and experience with techniques to reduce non-target hazards.

2. The supervisor shall be licensed and certified by the Massachusetts Pesticide Bureau and certified in General Pest Control (category 41) and Vertebrate Pest Control (category 44). The supervisor shall have specific training and experience in vertebrate pest management, commercial rodent control, general pest control, and integrated pest management.

3. Applicators shall be licensed by the Massachusetts Pesticide Bureau and certified in General Pest Control (category 41). Applicators shall have specific training and experience in commercial rodent control and integrated pest management.

1.4 COORDINATION

A. Perform this Work in cooperation with the other Work performed under the Contract.

B. Initiate the work on or before field mobilization begins for the Contract and with adequate timing to achieve control before environmental disruptions. Provide a maintenance program until Contract is completed and all equipment and materials are removed.

C. Perform the Work according to the preliminary schedule described in this section and as accepted or revised by the City and Engineer. Estimated durations and start dates may be changed by the City or Engineer to suit changes in construction schedules and field conditions. The Work could potentially require performance any day of the week and any hour of the day or night, regardless of weather.

D. Perform this work in such a manner that toxicant or other control tools do no pose a hazard to persons, domestic animals, or non-target wildlife.

1.5 PERMITS

A. Obtain and maintain in coordination with the Subcontractor appropriate permit(s) from city or state agencies for pest control activities associated with this Work.

B. Obtain and maintain in coordination with the Subcontractor all right of entry permits required for the performance of this Work. This includes all utilities and private properties to which entrance is required.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Furnish and use only pesticide formulations registered by the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Food and Agriculture, where appropriate according to label directions and as acceptable to the Engineer.

B. Furnish and use devices and supplies (e.g., traps and bait stations) to facilitate the management and effectiveness of the pest control program, where appropriate and as acceptable to the Engineer.

PART 3 - EXECUTION

3.1 MEETINGS

A. Before proceeding with the Work, all pest control personnel shall attend a Work Shop held by the Contractor and Engineer to discuss planned pest control methods and coordination.

B. The supervisor shall meet with the Contractor and Engineer weekly to discuss pest control activities.

3.2 SURVEY

A. Prior to baiting, survey the proposed construction area and accessible or observable bordering areas and record signs of rodent activity and sanitation conditions. Closely inspect all embankments, edge areas, and properties within and abutting the construction area. Maintain survey records in the manner described in Paragraph 3.7 below.

B. Thoroughly inspect construction area and accessible or observable bordering areas and any nearby areas designated by the City or Engineer, for rodent activity and sanitation deficiencies weekly throughout the duration of this Contract and in accordance with the work schedule. Maintain inspection records in the manner described in Paragraph 3.7 below.

C. Plan the control program and allocate resources based on survey and inspection data and as acceptable to the City.

3.3 APPLICATION FOR RODENT CONTROL

A. Apply rodenticide in strict accordance with EPA-approved label directions and the Rules and Regulations of the Massachusetts Department of Food and Agriculture. Maintain records of all bait placements in the manner described in Paragraph 3.7 below.

B. Where appropriate, especially for surface placements of rodent baits, use properly secured and tamper-resistant bait stations consistent with EPA regulation. Individually number and properly identify all bait stations.

C. Surface Applications

1. Initial Surface Baiting

Rid the construction area of all detectable rodents before construction begins, or as acceptable to the City. Bait all observable rodent burrows. Install and secure bait stations at regular and appropriate intervals and locations, and document rodent activity (burrows, droppings, bait consumed, dead rodents). Replenish bait and shift bait stations as necessary to ensure complete control of rodent populations. Bait edge and accessible bordering areas as necessary to ensure that rodents will not be dispersed by construction activities and that rodents will not infest work areas.

2. Maintenance Surface Baiting

Establish a maintenance baiting program prior to mobilization by the Contractor, including construction areas and accessible bordering areas, as acceptable to the City. Check bait placements weekly. Use survey and baiting data to determine the most effective distribution of baiting locations and bait quantities. Shift and distribute bait and bait stations as appropriate to ensure continued control.

D. Subsurface Applications

1. General

For situations involving underground construction/demolition, utility relocation, or utility construction, and for other situations when determined necessary by the City or Engineer, initiate subsurface baiting and rid underground environments of all detectable rodents before construction begins. Assign an identifying number to each manhole and catch basin where bait is placed so that locations of bait placements can be identified and rodent activity (droppings, bait consumed, dead rats) can be documented. Conduct bait applications during off-peak traffic hours unless otherwise required by the Engineer. Access manholes according to the requirements of appropriate agencies and utility companies. Coordinate the Work with appropriate municipal agencies and utility companies.

2. Initial Subsurface Baiting

Apply appropriate baits to control rodent populations in manholes and catch basins. This will involve suspending and securing bait using noncorrosive wire (e.g., 24 gauge plastic coated). Place bait in all accessible manholes and catch basins within the construction work area. In addition, bait an appropriate set of manholes and catch basins in the blocks bordering the work area and as acceptable to the City. Identify all baited manholes and catch basins with a standardized paint mark on the street and a numbered tag to be attached to the suspending wire. Approximately seven (7) days after completion of the first baiting, check all manhole and catch basin baits and record estimates on the amount of bait consumed. Replenish or increase the amount of bait applied according to the amount consumed or as acceptable to the City and Engineer. Repeat this process again approximately fourteen days later and until there is little or no bait consumed. Check manholes and catch basins weekly when they repeatedly have 100 percent of the bait consumed.

3. Maintenance Subsurface Baiting

Prior to mobilization by the Contractor, establish a maintenance baiting program appropriate for the rodent infestation patterns identified during initial subsurface baiting. This program shall ensure continued control and shall be performed in a manner acceptable to the City and Engineer. Maintain bait in manholes and catch basins that have rodent activity and those that had activity during initial baitings. Check each bait according to rodent activity levels. This could range from weekly to approximately every three (3) months, depending upon the recent history of bait consumption. Use utility maps and baiting data to determine the most effective distribution of baiting locations and bait quantities. Shift and distribute baiting locations as

necessary to ensure adequate interception points for controlling immigrating rodents.

E. Cleanup

1. Remove visible rodent carcasses and dispose of them daily consistent with the pesticide label directions and applicable codes, laws, and regulations.

2. Upon completion of any pest control operations at the site, remove remaining bait and dispose of it according to the pesticide label and applicable codes, laws, and regulations. Also remove all wires used for subsurface baiting and any bait stations or traps.

3.4 SANITATION

A. Prior to construction and throughout the duration of this Contract, identify and document harborage and food sources available to rodents on the construction site and in observable bordering areas. This includes any littering or improper or insufficient use of trash receptacles in construction areas. It also includes any bordering areas with sanitation conditions or structural deficiencies that violate City or State sanitation codes.

B. Maintain records of sanitation conditions in the manner described in Paragraph 3.7 below.

3.5 COMPLAINT CALLS

A. During construction, respond to pest-related complaints from the "adjacent" neighborhood (i.e. within 200 feet of the project limits) within twelve (12) hours when required by the City or Engineer. Inspect the particular premises and adjacent areas for sanitation and structural deficiencies and also signs of historic and recent pest activity. Provide sanitation and structural maintenance information to the property City or manager. Use pesticides or traps as necessary and appropriate to resolve the complaint when there is a relationship between the pest infestation and construction activities, or when required by the City or Engineer.

B. Maintain records of all complaints investigated, including location, contact person, inspection results, and actions taken. Document the relatedness of the pest infestation to construction activities.

3.6 GENERAL PEST CONTROL

A. When required by the City or Engineer, the Contractor shall determine appropriate methods for any pest control task not specifically identified above and shall submit them in writing to the City and Engineer for approval in advance. Such pest control tasks would relate to unanticipated pest control needs within construction areas or adjacent areas. This could include control of insects or vertebrates other than rats and mice.

B. Maintain records of general pest control activities and results in the manner described in Paragraph 3.7 below.

3.7 RECORD KEEPING

A. Use standardized data sheets acceptable to the City and Engineer to maintain accurate records of date, placement, type, and amount of pesticides or other control tools (e.g., traps) applied. Similarly, maintain records of surveys, inspections, changes in pest activity, sanitation conditions, and complaint calls. Submit data in a format acceptable to the City and Engineer and as required under Paragraph 1.3 (3) above.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01105

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SECTION 01108

HEALTH AND SAFETY PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Prepare a Health and Safety Plan (HASP) that meets all applicable state and federal health and safety regulations, including, but not limited to, those listed below. The Contractor shall be solely responsible for developing a HASP suitable for the Contractor's use and all work done by their subcontractors. The City, Engineer and/or their representative is not responsible for establishing or enforcing the health and safety requirements of the Contractor, and that nothing herein shall relieve the Contractor from its exclusive responsibility for the health and safety of its employees, and/or its representatives, and/or subcontractors.

B. The Contractor shall be responsible for being aware of all potential hazards at the site and reviewing existing information which provides evidence of contamination within the limit of the work.

C. Copies of the **Report -- Environmental and Geotechnical File Review, River Street Infrastructure and Streetscape Improvements, River Street, Cambridge, Massachusetts, dated February 25, 2022.** are attached as an Appendix to these Specifications.

D. The Contractor shall also be required to defend, indemnify, and hold the City of Cambridge, MA, and the Engineer harmless against any and all claims, liabilities, fines, or penalties arising out of actual or alleged failure of the Contractor and/or its agents, employees, or subcontractors to comply with any health or safety regulation, rule, ordinance, legislation, and/or health and safety plan.

E. All work required in the Specifications regarding development and implementation of a HASP shall be in accordance with State hazardous waste site regulations (310 CMR 40.0018) and OSHA requirements (29 CFR 1910 and 1926). The HASP shall be submitted to the Engineer prior to site mobilization. Work shall not proceed at the site until the Engineer and the City of Cambridge has received a copy of the Contractor’s Health and Safety Plan meeting all the requirements specified herein.

F. The Contractor shall be responsible for the construction, maintenance, and dismantling of the decontamination areas specified within the HASP. This includes providing all labor, materials, and equipment to prepare, maintain in working order, and remove the decontamination area, including collection and disposal of decontamination water and solids, and subsequent dismantling and disposal of materials.

G. The Contractor is responsible for establishing, implementing and maintaining of ambient air and dust monitoring programs and all other environmental monitoring programs. All such programs shall be operated by the Contractor whenever there are soils handling construction activities occurring at the site.

H. The Contractor shall be responsible for providing all materials, equipment, and labor associated with applying dust control suppressants, including equipment that shall be required during all soil handling activities, in the event that fugitive dust or excessive odors are encountered.

1.2 DUST CONTROL

A. During excavation of soil and fill material, dust shall be controlled to limit potential spread of contaminants and potential exposure of contaminants to workers and the public. The dust control measures implemented at the site shall be performed in accordance with this Section.

B. During the progress of the work, the Contractor will conduct his operations and maintain the area of his activities, including sweeping and sprinkling of water if acceptable to the Engineer, so as to minimize the generation and dispersion of dust.

1.3 AIR MONITORING

A. Air monitoring shall involve direct reading instruments capable of providing real-time indications of air contaminants to protect on-site personnel and the local population. The Contractor's Site Health and Safety Officer and Superintendent shall be responsible for assuring that monitoring is conducted in an approved manner, that air monitoring/sampling are conducted at a frequency sufficient to ensure accurate assessments of site conditions, and that work practices, engineering controls, and/or personal protective equipment are proper for the conditions.

B. At a minimum, detectors for organic contaminants shall be utilized to monitor on-site and off-site breathing zones and possible sources of potentially hazardous material (e.g., excavations, regrading, etc.). All personnel shall be made aware of the potential hazards and be informed of air monitoring information. Particular attention to air quality shall be made in the work area during earthwork activities to ensure that contaminants do not escape to the atmosphere and affect off-site population, on-site control, working conditions, and personnel protection measures.

C. The Contractor shall keep accurate documentation of all air monitoring, which shall be made available to the City and Engineer for review at all times.

PART 2 - PRODUCTS

2.1 HEALTH AND SAFETY PLAN AND CERTIFICATIONS

A. The Contractor shall, prior to the start of work on the site, submit six (6) copies of its site-specific Health and Safety Plan to the Engineer. Submit with the site-specific Health and Safety Plan, a certification that states the following:

1. The Contractor hereby certifies that the Contractor and any workers engaged in work on the project meet the requirements of 29 CFR 1910.120 and the provisions of the American National Standards Institute, Standard Z88.2, for training, medical surveillance, and respirator protection unless the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards. These requirements include, but are not limited to, the following items:

a. The Contractor's employees have been examined by a licensed physician within the last twelve (12) months, and have been determined to be physically able to perform the work and use the respirator and other protective or safety equipment required for this assignment.

b. The employees have received health and safety training for working in environments with known and unknown hazards within the past twelve months.

c. The Contractor has established and is maintaining a respiratory protection program that complies with the provision of 29 CFR 1910.134.

d. The Contractor maintains appropriate surveillance of the work area conditions and degree of employee exposure or stress.

2. The Contractor shall further certify that only respirators approved or accepted by NIOSH/MSHA shall be provided and used by the Contractor's employees; that each of the Contractor's employees has been properly fitted to the respirators provided by the Contractor, including a test of the face-to-face piece seal; that the Contractor has provided its employees with written procedures covering the use of respirators in dangerous atmospheres; and that the Contractor has established a program for inspection, maintenance, and care of the respirators.

The certification shall be signed and dated by the Contractor.

3. Work shall not proceed at the project site until the Engineer has received all certification(s) and the Contractor's Health and Safety Plan. Any delays incurred by the Contractor relating to the Health and Safety Plan shall be the responsibility of the Contractor, and constitute no additional costs or claims to the City of Cambridge.

PART 3 - EXECUTION

3.1 HEALTH AND SAFETY PLAN CONTENTS, MAINTENANCE, AND IMPLEMENTATION

A. The Contractor's Plan shall address the specific work activities to be conducted by the Contractor. The HASP shall include, but not be limited to, the following:

1. All anticipated hazards based on site conditions, construction activities and the levels of contamination and information presented in previous studies.

2. Provisions for continually updating the Plan in accordance with any new applicable state and federal regulations or any additional information regarding conditions at the site.

3. The following information, shall be included in the HASP in accordance with the minimum standards set forth in 29 CFR 1910.120, 29 CFR 1910.1000, and 29 CFR 1926, and 310 CMR 40.0018:

a. Contractor's Standard Operating Procedures, including Personnel Training and Field Orientation; Personal Hygiene Requirements and Guidelines; Field Monitoring of Site Contaminants; Respiratory Protection Training and Requirements; Levels of Protection and Selection of Equipment Procedures; Zone Delineation of the Project Site; Site Security and Entry Control Procedures; Contingency and Emergency Procedures; and Listing of Emergency Contacts.

b. Identification of Contractor's Site Safety Officer.

c. Identification of Contractor's Designated Field Personnel.

d. Identification of hazard and risks associated with the Contractor's work.

e. Type of Medical Surveillance Program.

f. List of all hazardous materials that the Contractor shall have on site; the location of the latest Material Safety Data Sheets (MSDS) for each material listed; and the plan for notifying all on-site personnel, including, but not limited to, the Engineer and/or their representatives, of the presence of hazardous materials on site. If there are no hazardous materials to be brought on site, the Contractor shall provide a written statement to the Engineer and/or their representative, prior to initiating work activities, certifying that the Contractor shall not transport, store, or use hazardous materials on site.

B. The Contractor shall keep a copy of the HASP on site during all operations and shall conduct daily health and safety meetings. Failure to keep a copy of the HASP on site, or any other breach of the Contractor's Plan, shall be cause for stopping work at the cost of the Contractor. Delays caused by the Contractor's failure to comply with the health and safety regulations, or any health and safety plan, shall not entitle the Contractor to recover any additional costs or time lost. The Contractor shall not be allowed to resume activities until corrective measures are implemented.

C. Medical surveillance records, OSHA 40-hour training forms, accident forms, and all other documentation requirements of the Contractor's health and safety plan for personnel working on the site shall be up-to-date and kept on file at the site. The Contractor shall provide documentation of employee status upon request of the Engineer.

D. The Contractor shall make available Level C personal protective equipment and clothing, not including respirators, to the Engineer and/or their representative for use during site inspections by the Engineer and/or their representative, up to a maximum of three (3) complete sets per day. These shall be supplied and maintained at no cost to the City and shall be returned to the Contractor upon completion of the work (except for expendable disposal protective clothing). The Contractor shall provide a repository for collection of disposed health and safety materials. Collection and disposal of contaminated expendable supplies shall be the Contractor's responsibility.

E. The level of dermal and respiratory protection shall be determined based upon continuous air monitoring to be performed by the Contractor. The Engineer may conduct duplicate air monitoring for quality control purposes. As air monitoring indicates the levels of contaminants in the air, the personal protective equipment shall be determined based upon established standards and the standards set forth in the Contractor's Health and Safety Plan. Regardless, modified Level D protection for all on-site personnel is the minimum project requirement.

F. The Contractor shall be aware of site-specific requirements, such as site security during non-working hours, limited work space, and minimizing the effects of soil excavation, in preparing its health and safety program.

3.2 ROUTINE SAFETY MEETINGS

A. The Contractor shall keep a copy of the HASP on site during all operations, and shall conduct routine health and safety meetings to ensure that all work is being performed in accordance with OSHA regulations, the Contractor's HASP, and prior to initiating a new task, following an incident or following any changes to the HASP necessitated by site conditions. Failure to conduct routine safety meetings may be cause for stopping work at the cost of the Contractor.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01108

SECTION 01200

GENERAL REQUIREMENTS FOR UTILITY WORK

1200.1 TEMPORARY UTILITY SUPPORT AND COORDINATION **LUMP SUM**

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies general requirements for construction, protection, support, maintenance, and restoration for underground and overhead utilities affected by construction of the Project. This section includes coordination with private utility companies. The Work includes new construction, reconstruction, relocation, and abandonment.

B. The utility works and services that may be affected include, but are not limited to:

1. Storm drain, sanitary sewer, and combined sewer
2. Water distribution and transmission mains
3. Gas distribution
4. Electric power, utility poles, and street lighting (underground and overhead)
5. Telephone
6. Traffic signals
7. Fiber optic communications
8. Cable Television
9. Signal communication
10. City fire signal lines and pull boxes
11. Steam
12. MBTA overhead and underground electric

C. This Section shall be used in conjunction with the specific underground utility work sections that apply to the Contract.

1.2 WORK BY UTILITY COMPANIES

A. Certain parts of the utility work shall be performed, where shown or specified, by the utility company.

B. Disconnecting and connecting of storm drains; sanitary sewers; and combined sewers services shall be the Contractor's responsibility as required in the Specifications or after having notified the Cambridge Department of Public Works. Disconnecting and connecting of water services shall be the Contractor's responsibility as required in the Specifications or after having notified the Cambridge Water Department.

C. Contact the utility companies in advance of construction to allow sufficient time for the utility companies to accomplish the work they are required to perform. Provide the utility company at least thirty (30) days advance notice prior to the scheduled date for commencement of work under this Contract.

D. Work performed by utility companies to facilitate the Work under this Contract, and other work performed by utility companies solely for the convenience of the Contractor, shall be at no additional cost to the City.

1.3 DEFINITIONS

A. Abandoned means that use of a utility asset has been discontinued by the utility company.

B. To be abandoned means that use will be discontinued as part of the Work under this Contract.

C. Maintenance means providing continuous service that meets project requirements during construction.

D. Maintain complete-in-place means to protect, support, and otherwise maintain the existing condition and function of a facility during construction.

E. Restoration means replacement of a facility or portions of a facility that have been removed or made inoperative by the Contractor in the performance of the Work.

F. Utility Company means the company, agency, owner, or operator of the facility concerned.

G. Temporary Facility means a facility provided, in lieu of an existing or new facility, to ensure continuity of service. When a temporary facility is not shown on the Contract Drawings, but is provided for the convenience of the Contractor, it shall be constructed at no additional cost to the City.

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTALS

1. Submit working drawings and, if applicable, shop drawings showing the details, procedures, and scheduling for performance of each utility work. Show actual verified field locations of existing utility facilities that are affected by the Work under this Contract; interferences which these facilities present to the new work; location of settlement markers; method proposed to proceed with the construction; and, if applicable, procedures for restoration and method of testing to demonstrate restoration was performed satisfactorily.

2. Submit to the Engineer specifications and drawings describing the method to be used to temporarily support existing subsurface, surface and overhead utilities during construction. Include working drawings that indicate proposed materials and details.

3. Submit to the Engineer for review a detailed excavation procedure for subsurface utilities. At a minimum, the procedure shall include:

    a. Equipment to be used for anticipated subsurface utility investigation and excavation.

    b. Personnel to be used and designated utility coordinator.

    c. Duration and schedule of investigation and excavation.

    d. Techniques proposed to isolate and protect existing utilities.

    e. Method for the Contractor to provide utility information derived from subsurface investigation to field personnel doing excavation.

    f. A disciplinary plan that delineates all steps to be taken as a result of a utility disruption or tree damage caused by negligence or failure to follow proper procedures or the Contract requirements, including possible removal of Contractor personnel from the site.

    g. Techniques proposed to identify and protect existing tree roots from damage, including notification of the City's arborist, exploration procedure with air spade, and protection of exposed roots as outlined in section 02100.

4. Submit an emergency action plan outlining procedures to be followed by the Contractor in case of unplanned utility interruptions or unplanned damage to utilities in service. Obtain concurrence from each affected utility company.

a. List Contractor's personnel assigned responsible charge for emergency action on site for each shift, and those on call.

b. List phone notification numbers for each utility company, fire, and police departments, and other relevant agencies.

c. Include copies of utility plans showing the valve or switch locations to isolate each line.

B. Transmit to the Engineer the as-built utility location survey data as specified in Article 3.11 of this Section.

1.5 APPROVAL BY UTILITY COMPANIES

A. All personnel performing work on to expose and support existing utility facilities shall be fully qualified and able to meet the standards of the affected utility company. If the Contractor does not have the required utility experience, Contractor shall retain a specialist firm acceptable to the affected utility company to perform the Work.

B. Prior acceptance of temporary support methods for each affected utility facility shall be obtained by the Contractor from each utility company concerned.

C. Prior permission for disrupting a utility shall be obtained by the Contractor from each utility company concerned.

D. Prior approval for disrupting fire signal lines, high pressure fire water mains and hydrants, and fire service lines shall be obtained from the Cambridge Fire Department.

1.6 NOTIFICATION

A. In addition to the initial thirty (30) day utility company notification, the Contractor shall notify the appropriate utility companies and the Engineer at least seven (7) days prior to starting any work involving or adjacent to surface, subsurface, or overhead utility facilities.

B. Eversource Gas Requirements:

1. If cut-off or connection is expected, notify the Eversource Gas Company Engineering Department four (4) weeks prior to cut-off or connection to gas main.

2. Immediately notify the Gas Company Engineering Department if surface or subsurface settlement or movement in excess of the design amount is observed, regardless of the proximity to an existing gas facility.

3. Gas valves to remain exposed at all times during work. Contractor to coordinate with Eversource Gas at least two (2) weeks prior to any required gas valve adjustments (raising or lowering).

4. At locations where the sand bedding material of gas mains are excavated and removed by the Contractor, the Contractor shall put back or replace the bedding material, in kind. Crushed stone shall not be used as backfill for bedding material beneath gas mains.

C. MWRA Water and Sewer Operations Requirements:

1. Contractor or its designee to provide at least **72-hour** prior notice to the MWRA's **Inspection Department**, by calling **Warren Murphy** (**617) 305-5833,** located at 2 Griffin Way, Chelsea, MA 02150.
2. All work, including but not limited to excavation, vibration requirements, equipment, must be done in accordance with the MWRA Permit Conditions.

D. Eversource Electric Transmission Requirements

1. All work near Eversource Electric Transmission's 115kV PTC 2 line must be done in accordance with the Eversource's requirements.

E. National Grid Gas Requirements:

1. All work near National Grid Gas' 30'x36" line must be done in accordance with the National Grid's requirements.

1.7 STANDARD SPECIFICATIONS OF UTILITY OWNERS

A. Specifications and construction methods from each utility owner apply to individual utility specification sections.

B. It is the Contractor's responsibility to ensure that, unless otherwise specified, the standards for materials and construction methods required by the utility owner are met.

C. For installation of foundations for transit shelters, trees within the MWRA easement, and for sewer, storm drain, water main crossing the MWRA 48-inch water main on Magazine Street, Contractor to obtain an MWRA Waterworks 8(m) permit.

D. For installation of proposed stormwater pipes and manholes, sewer pipes and manholes, trees within the MWRA easement, and for sewer, storm drain, water main crossing both the MWRA MET Sewer and North Charles Relief Sewer near Blackstone Street and Riverside Press Park, Contractor to obtain an MWRA Wastewater 8(m) permit.

Permit requirements include:

3. A minimum **vertical clearance of 18 inches** shall be maintained between the Authority's water mains and other utility crossings unless otherwise noted. However, water/gas and other utility service crossings with a pipe size diameter of 2-inches or less may be permitted to cross the Authority's pipe line at a reduced clearance subject to MWRA review. (Except for special provisions, i.e. capped or plugged pipes, thrust blocks and or bends which would require a greater clearance separation)

4. A minimum of three-(3) feet to five-(5) feet horizontal clearance is required between adjacent utilities and the side (spring line) of any MWRA main. (Except for special provisions, i.e. capped or plugged pipes, thrust blocks and or pipe bends which would require a greater clearance separation)

5. Crossings of MWRA water mains shall be located a minimum horizontal distance of at least four (4) feet from any joints of the Authority's mains.

6. Proposed pipe/utility crossings of the Authority's water mains shall cross at a 90-degree angle to minimize interference.

7. For distances over four (4) feet of the Authority's mains which are to be undermined the method and type of support shall be submitted and stamped by a Professional Engineer (P.E.) licensed in Massachusetts for prior approval by the Authority.

8. For distances under four (4) feet of the Authority's mains which are to be undermined, the on-site MWRA inspector shall review and approve the proposed support of the main. Under no circumstances shall the Authority's main be left in an unsupported, undermined position overnight.

9. During construction, appropriate sheeting measures must be taken to protect the integrity of the Authority's water mains. The sheeting design must be reviewed by the Authority prior to the start of the construction. The design shall be stamped by a Professional Engineer, licensed in Massachusetts. The use of a Trench Box is not permitted in this application.

10. Suitable compaction methods shall be employed in restoring the beds of the MWRA's mains backfilling around the MWRA's main shall be placed in maximum 6-inch lifts and compacted by hand vibratory compactors.

11. The MWRA pipeline must be protected at all times during construction. The Authority may require a professional engineer licensed in the State of Massachusetts to submit a construction plan and or **pipeline analysis**.

12. Screened gravel shall be uniformly graded with maximum size of a particle between 3/8 inch and ¾ inch. Screened gravel shall consist of clean, hard and durable particles free from an excess of soft, elongated and disintegrated pieces or other objectionable material. Crushed rock of suitable size and grading maybe used in place of screened gravel at the option of the MWRA Inspector.

13. For test pit excavations or unearthing of the Authority's water main the Permittee must excavate the last **2-feet, before the top of pipe, by hand** or use a vacuum boring method and backfill with approved material within an easement or roadway area.

14. The Permittee is responsible to adjust any or all MWRA frames and covers to grade within their limits of work in accordance with the Plans. The Authority will provide the contractor with new replacement MWRA frames and covers (at no expense to the Contractor) for any existing frames and covers that have been deemed unusable by Authority personnel.

15. All MWRA manhole openings that were covered during the binder course installation shall be made accessible within 48-hours. MWRA manhole frame and covers shall not be removed for grinding and or pulverizing. Pulverizing is not allowed over MWRA manhole structures.

16. The contractor will provide a logistics construction schedule in writing, along with emergency contact information whenever MWRA valves (manhole covers) or facilities are covered or obstructed.

17. MWRA Inspection personnel must be on site whenever excavation, construction and hoisting or rigging occurs around an MWRA water main pipeline.

18. No construction equipment including cranes, backhoes or material may be parked, stationed, set up or stored on top of the MWRA's water mains or infrastructure.

19. Replacement (shutdown) of the MWRA's mains shall be coordinated with the Authority. Four-(4) weeks-advanced notice in writing is required for shutdowns.

20. The Permittee or its designee shall contact the Authority three (3) weeks in advance when an MWRA water main valve must be operated. **Only MWRA Personnel Will Operate MWRA Valves.** The Permittee or its designee shall not operate any MWRA valves. MWRA Valve Operations are limited during peak demand periods and may not be available between the dates of **May 15th** and **September 15th** of each calendar year.

21. **The Permittee will be responsible to protect and correct any damage(s) to the Authority's property or pipeline at no cost to the MWRA**.

22. As-built drawings shall be furnished to the Authority upon the completion of the Work. A Professional Massachusetts Registered Land Surveyor or Engineer shall stamp as-built drawings.

23. MWRA Detail Records "field sketches" shall be updated (with accurate field ties) by the Contractor and shall be furnished to the Authority upon the completion of the Work.

24. The Contractor shall indemnify and hold harmless the Authority and its successors and assigns from any and all damages and/or claims for damage to the Contractor's conduits, facilities and/or property as a result of the Authority's operation, maintenance, repair, and/or replacement of Authority property, or as a result of the failure of an Authority water pipe.

25. The Work and location of installed facilities and appurtenances shall not deviate from the construction plan that is referenced in the Plans. No field changes are allowed without prior review and written approval by the MWRA 8m Permit Project manager. An MWRA on site inspector shall review all field changes and coordinate with the Contractor regarding submitting a change of work plan to the Authority for review and comment. If MWRA field inspection indicates changes undertaken without approval, the Contractor may be issued a cease and desist order and be required to correct/reconstruct any completed work.

26. The Authority may require a construction plan along with an analysis of the MWRA's pipeline (prepared by a professional engineer licensed in the State of Massachusetts). The pipeline analysis shall take into consideration the contractor's equipment which would be used over the Authority's pipeline in instances where the existing roadway surface will be completely excavated away removing the protection of the HS-20 surface loading barrier. This Plan and supporting calculations will need to be submitted to the MWRA for review.

27. The Authority requires the submittal of "Cut Sheets and or Shop Drawings" for review of all newly proposed materials that will come under the ownership of the MWRA.

D) Eversource Electric Transmission Requirements
    1. All work near Eversource Electric Transmission's 115kV PTC 2 line must be done in accordance with the Eversource's requirements.
E) National Grid Gas Requirements:
    1. All work near National Grid Gas' 30'x36" line must be done in accordance with the National Grid's requirements.

PART 2 - MATERIALS

2.1 GENERAL

A. Materials for temporary and permanent work shall be of the type, grade, and class specified by reference to utility company standards.

PART 3 - EXECUTION

3.1 GENERAL CONSTRUCTION REQUIREMENTS

A. Unless otherwise noted, conform to the construction standards, specifications, and standard practices of the affected utility companies. Coordinate with each utility company the work to be done by the Contractor and the work to be done by utility company. Ensure continuity of all existing utility services to all users, except when the utility company determines that temporary interruption is acceptable.

B. Unless otherwise indicated, maintain all utility facilities complete in place. Provide temporary support of utilities during construction only by methods acceptable to the utility company concerned.

C. Provide and maintain all temporary facilities required to provide interim utility service when a utility facility is to be relocated and when a utility facility to be replaced is abandoned prior to replacement.

D. Where an existing utility facility is encountered that is not indicated or that is determined to be a different utility facility than that indicated, promptly notify the Engineer. The Contractor is responsible for determining the owner of the facility and the disposition of the facility.

E. All water, sanitary, and storm services must be maintained throughout the project through the use of temporary pumps and piping. Unless otherwise noted, no service interruptions will be permitted.

F. The Contractor shall dewater existing utility manholes and structures prior to beginning construction. Any dewatered material shall be properly treated and disposed.

G. In addition to notices previously specified, the Contractor shall notify the Cambridge Water Department, City, and Engineer forty-eight (48) hours prior to excavating or working near the existing large diameter (>18-inch) water transmission main.

H. Contractor shall carefully excavate soils and materials adjacent to the existing water transmission main. Excavation shall be performed slowly and carefully to minimize the possibility of failure of the existing water transmission main due to sudden relief of soil pressure on the pipe exterior. Exposure of the existing water main shall be minimized so as to limit exposure of the line to damage.

I. Permits to excavate the public way cannot be issued until the applicant has notified the appropriate utility companies, as required by Massachusetts General Laws, Chapter 370 of the Acts of 1963. The applicant must either: 1) obtain written receipts from the affected utilities, and provide copies of same to the owner; or 2) utilize the Dig-Safe System for the required notifications, and also submit written notifications for those utilities not participating in the Dig-Safe System. Written notifications must state that utility companies have been notified and the contractor cleared to begin work.

The following utility companies must be notified in writing:

M.B.T.A. (617) 222-3200
10 Park Plaza, Suite 3910
Boston, MA 02116

M.W.R.A. (617) 242-6000
100 First Avenue
Charlestown Navy Yard
Boston, MA 02129

The following utility companies must be notified in writing or through Dig-Safe.

Enbridge (781) 329-3750 x7710
Attention: Peter Kerrigan
pfkerrigan@spectraenergy.com
Westwood Area Office 1-800-726-8383
8 Wilson Way
Westwood, MA 02090

Verizon (781) 376-8172
Attention: Matt King
matthew.i.king@one.verizon.com
275 Wildwood St.
Woburn, MA 01801

KeySpan Gas Attention: Mr. Dennis Peri 201 Rivermoor Street West Roxbury, MA 02132	(617) 323-9210
Eversource Electric Attention: William Zamparelli william.zamparelli@eversource.com 1165 Massachusetts Avenue Dorchester MA 02125	(617) 541-7072 x4195
Veolia Steam Attention: John Moloney john.moloney@veolia.com 53 State Street, Suite 14 Boston, MA	(857) 401-9812
Eversource Gas Attention: Michael Needham michael.needham@eversource.com 101 Linwood Drive Somerville, MA 02143	(339) 987-7979
COMCAST Attention: Anthony Vataloro Anthony_Vatalaro@cable.comcast.com 55 Concord St. North Reading, MA 01864	(617) 279-7037
Cambridge Water Department Attention: Steve Lush slush@cambridgema.gov 250 Fresh Pond Parkway Cambridge, MA 02138	(617) 349 4770
Cambridge Electrical Department Attention: Steve Lenkauskas slenkauskas@CambridgeMA.GOV 489 Broadway Cambridge, MA 02138	(617) 349-4900
Bay State Network Services Ben Whitaker bwhitaker@baystatens.com 4 Meredith Way, Suite # 4 Rockland, MA 02370	(617) 429-3847
Dig-Safe	811

At least a 72 business hour notice is required for DIG SAFE in Massachusetts.

The Contractor shall have all utilities marked out along the course of this work by such means as the Owner shall approve, and shall preserve such marked locations until the work has progressed to the point where the encountered utility is fully exposed and protected as required. It shall be the Contractor's responsibility to notify utilities at least 48 hours prior to the start of any excavation.

The Contractor is responsible for contacting any other utilities that are not listed herein.

3.2 SUBSURFACE UTILITY INVESTIGATION

A. The Contractor shall excavate test pits where indicated on the Contract Drawings and as specified.

3.3 UNSAFE AND UNSUITABLE UTILITY STRUCTURES

A. If, upon exposure, the condition of a facility to be maintained complete-in-place is found to be unsafe, the Contractor shall notify the utility company, for support or for maintenance of service, the Contractor shall replace or reconstruct or coordinate the replacement or reconstruction of the facility with the utility Owner and shall promptly notify the Engineer of additional costs anticipated prior to beginning the work.

3.4 ABANDONED FACILITIES

A. Demolish and remove abandoned utility facilities that interfere with the Work of this Contract. Abandoned facilities that do not interfere with the Work of this Contract may remain.

B. Do not undertake demolition or removal until permission for such Work has been obtained from the utility company.

C. When abandoned facilities are to be left in place, plug or cap the ends of conduits and pipes, and fill with controlled density fill (CDF) unless otherwise indicated. Remove abandoned utility manholes, junction boxes, and similar structures to a minimum depth of four (4) feet below finished grade, and puncture or break the bottom slabs of manholes and similar structure to allow drainage. Backfill and compact excavations resulting from removal of utility facilities as required to restore original grade.

3.5 SETTLEMENT OR MOVEMENT

A. In case of settlement or other movement that causes or could cause damage, take immediate remedial measures to correct the conditions and repair the damage.

3.6 ACCESS

A. At all times permit free and clear access to the affected facilities by personnel of the utility companies.

B. Throughout the construction period, maintain access to all utility vaults and structures.

3.7 SERVICE CONNECTIONS

A. Work required for maintaining, supporting, relocating, restoring, and constructing all service connections is included as part of the Work of this Contract, even though some existing service connections, for which record information is not available, may not be shown on the Contract Drawings.

3.8 REPAIR AND RESTORATION

A. Repair all damage to utilities caused by Work under this Contract. Clean all utility structures of dirt caused by Work under this Contract. Immediately notify the Engineer and the utility company of damage to utilities.

3.9 EXCAVATION AND BACKFILL

A. Perform excavation and backfill in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Excavation and handling of contaminated soil is specified in Sections 02080 - SOIL AND WASTE MANAGEMENT, and 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL.

3.10 CLEANING UP

A. In accordance with Section 01630 – RESTORATION OF GROUNDS AND CLEANING UP, the Contractor shall, upon completion of the Work, remove all temporary construction facilities, equipment, debris, and unused materials, and shall restore the project area and adjacent affected areas to a neat and clean condition.

3.11 AS-BUILT LOCATION SURVEY

A. For each new or relocated utility installed, including those installed or relocated by others in the Project Area, perform an as-built location survey by coordinates prior to backfilling the excavation.

B. For each new hardscape feature installed perform an as-built location survey by coordinates. Hardscape features to be surveyed for location and elevation include but are not limited to; top and bottom of curb lines, limits of sidewalks and wheelchair ramps, roadway crown, manhole covers, gate box covers, pavers and limits of loam and seed. Hardscape features to be surveyed for location include but are not limited to; street lighting, pedestrian lighting, pedestrian signals, traffic signals, crosswalks, control panels, benches, trash receptacles, parking and traffic striping, landscaping features, fences and irrigation heads.

C. The survey work, including verification of the existing survey data, shall be performed by a licensed Professional Land Surveyor registered in Massachusetts to accurately record progress of the work throughout the duration of the Contract

1. The Surveyor is subject to the approval of the City. The Contractor shall submit the qualifications of the Surveyor documenting performance of similar scopes of work utilizing software specified below.

2. All coordinates shall be geographically registered in the project datum coordinate system using the control points for horizontal and vertical controls.

3. Horizontal accuracy shall be 0.01 feet.

4. Elevation accuracy shall be 0.1 feet except benchmarks, topography, and structure foundations (including manholes pipe inverts) shall be accurate to 0.01 feet.

5. Digital As-built drawings, including surface data shall be provided in AutoCAD Civil 3D format to match the text styles and line types of the design drawings provided by the Engineer.

6. It is recommended that the Surveyor attend the Preconstruction meeting.

7. Prior to submitting a monthly payment application, the Contractor's progressive electronic as-built drawings shall be acceptable to the Engineer.

D. The Contractor shall also maintain red line record documents at the site to accurately record progress of the work throughout the duration of the Contract.

1. Contractor shall delegate the responsibility for maintenance of the record documents to one person on the Contractor's staff as approved by the City.

2. Changes to the record documents shall be coordinated with adequate and proper entries on each page of the specifications and each sheet of drawings and other documents where such entry is required to show progress and changes properly, including change orders, approved shop drawings, RFIs, and other modifications.

3. Record information shall be updated within 24 hours of installation or survey.

4. All locations of utilities exposed by the work shall be checked with the plans. Utilities not shown as indicated on the plans shall be recorded and show in its accurate location with notes about where the utility is located at versus what is shown on the plans and submitted with the record drawings.

5. All utilities shall be recorded whether shown on the plans or not and shall be submitted with the record drawings.

PART 4 - COMPENSATION

Item 1200.1 – Temporary Utility Support and Coordination

METHOD OF MEASUREMENT:
Measurement for payment for Temporary Utility Support and Coordination will be on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Payment for Temporary Utility Support and Coordination will be based on the bid for this item in the proposal. Under the Lump Sum Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment and incidentals required to maintain continuity of gas, telephone, electric, telecommunications, cable TV, steam, MBTA, and privately owned utilities. The work includes all trunk, supply, transmission, service and main lines impacted by the Work. Under the Lump Sum Price bid for this item, the Contractor shall also furnish all labor, materials, tools, equipment and incidentals to coordinate and/or temporarily support all utilities exposed during the excavation for the installation of the Work; submission of all utility coordination and support work plans and shop drawings, including plan stamped by a Professional Engineer in the State of Massachusetts; coordinate the protection of and protect all overhead utilities; and perform all coordination with the utility companies for the relocation, abandonment, protection, support, and other work required to facilitate the completion of the project. This Item further includes utility location (Dig Safe); provide, install, maintain, and disconnect portable generators to maintain electrical service to dwellings; coordination of construction with existing utility owners and operators; providing access for utility owners and operators to their respective utilities; and communicating with affected homeowners and residents.

EXCLUSIONS:
The following items are not included for payment under this item and are included for payment elsewhere; labor, materials, tools, equipment and incidentals required to maintain continuity of water mains; restoration of curbing, sidewalks, and bituminous concrete pavement; providing by-pass pumping of sanitary sewers and storm drains; and temporarily and permanently relocating sanitary sewers, storm drains, water and services for sanitary sewers, storm drains and water mains.

END OF SECTION 01200

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes general requirements for project submittals by the Contractor.

1.2 PROGRESS REPORTS, RECORDS AND DATA

A. The Contractor shall submit to the City such schedules of quantities and costs, progress schedules, payrolls, reports, estimates, records, and other data as outlined in Section 01311 – SCHEDULING AND REPORTING and as the City may request concerning work performed or to be performed under this Contract.

1.3 OPERATION MANUALS

A. Unless the specified operations manuals for equipment are submitted along with shop drawings at the time of submission no action will be taken on reviewing the shop drawings. The manuals shall include, at a minimum, operating instructions and recommended maintenance schedules for all the equipment to be furnished.

1.4 SHOP DRAWINGS, SAMPLES, PROJECT DATA

A. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

1. Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

2. All submittals, regardless of origin, shall be clearly identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each submittal

shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified, and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data. Engineer will not accept submittals from anyone but the Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

3. All deviations from the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by the Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

4. Contractor shall submit shop drawings electronically. For electronic submittals, drawings and the necessary data shall be submitted electronically to the Engineer as specified below. Submittal documents shall be in black and white unless color is required for the review of the submittal. All electronic files shall be in Portable Document Format (PDF) as generated by Adobe Acrobat Professional Version 7.0 or higher. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file. The PDF documents shall have a bookmark created in the navigation frame for each major entry ("Section" or "Chapter") in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.

   The opening view for each PDF document shall be as follows:
   - Initial View: Bookmarks and Page
   - Magnification: Fit In Window
   - The file shall open to the Contractor's transmittal letter, with bookmarks to the left. The first bookmark shall be linked to the Table of Contents.

   PDF document properties shall include the submittal number for the document title and the Contractor's name for the author. Electronic submittal file sizes shall be limited to 10 MB. When multiple files are required for a submittal the least number of files possible shall be created. The contractor shall post submittals and retrieve the Engineer's submittal review comments through the Engineer's project website accessible through the Internet. Instruction on procedures for posting and retrieving submittals will be provided after award of the Contract. Facsimiles (fax) will not be acceptable. Engineer will not accept submittals from anyone but the Contractor. Submittals shall be consecutively numbered in direct

sequence of submittal and without division by subcontracts or trades.

5. In addition, two hard copies of each *full size* drawing shall be submitted to the Engineer and will return two marked copies (or one marked reproducible copy) to Contractor.

6. Engineer's submittal review period shall be twenty-one (21) consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal on the project website. The time required to mail any hard copies of the submittal or resubmittal back to the Contractor shall not be considered a part of the submittal review period.

7. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by the Engineer are provided on the resubmittal. When corrected copies are resubmitted, the Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by the Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal. If more than one resubmittal is required because of failure of the Contractor to provide all previously requested corrected data or additional information, the Contractor shall reimburse the City for the charges of the Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal. Resubmittals shall be made within 60 days of the date of the letter returning the material to be modified or corrected, unless within 30 days the Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time. The need for more than one resubmittal, or any other delay in obtaining the Engineer's review of submittals, will not entitle the Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of the Engineer to review and return any submittal to Contractor within the specified review period.

B. When submitted for the Engineers' review, all shop drawings shall bear the Contractor's certification that he has reviewed, checked and approved the shop drawings, that they are in harmony with the requirements of the Project and with the provisions of the Contract Documents, and that he has verified all field measurements and construction criteria, materials, catalog numbers and similar data. The Contractor shall also certify that the work represented by the shop drawings is recommended by the Contractor and the Contractor's Guaranty will fully apply.

C. All samples called for in the Specifications or required by the Engineer shall be furnished by the Contractor and shall be submitted to the Engineer for his review. Samples shall be furnished so as not to delay fabrication, and to allow the Engineer reasonable time for the consideration of the samples submitted.

D. Checking of submittals is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

E. The Contractor may only proceed with fabrication and construction of items with returned submittals marked "No Exception Taken", "Make Corrections as Noted" or “Noted: No Action Required”. Resubmit submittals if marked "Rejected", "Revise and Resubmit" or "Submit Specified Item."

F. The Contractor shall furnish such samples of material as may be required for examination and test. All samples of materials for tests shall be taken according to ASTM Specifications or as provided in the Contract Documents.

G. All samples shall be submitted by the Contractor with a covering letter indicating that such samples are recommended by the Contractor for the service intended and that the Contractor's Guaranty will fully apply.

H. All materials, equipment and workmanship shall be in accordance with samples guaranteed by the Contractor and reviewed by the Engineer.

I. Submittals requiring a Certificate of Design will be considered incomplete and not acceptable unless a complete Certificate of Design is submitted.

J. The Certificate of Design requires that the engineer providing the submittal carries Professional Liability insurance meeting the requirements laid out in Section 00800 “General Terms and Conditions” and additionally meeting the requirements of Section 00825 “Supplemental General Conditions”.

1.5 CONTRACTOR'S ORDER OF CONSTRUCTION

A. The Contractor shall submit schedules and reporting information in accordance with the requirements of Section 01311 – SCHEDULING AND REPORTING.

1.6 CONTRACTOR'S COST BREAKDOWN

A. The Contractor shall submit a schedule of values in accordance with the requirements of Section 01301 – SCHEDULE OF VALUES.

1.6 CERTIFICATE OF DESIGN

CERTIFICATE OF DESIGN

The undersigned hereby certifies that he/she is a Professional Engineer registered in the state of _____ and that he/she has been employed by (Name of Contractor) _____ to design _____ in accordance with Specifications Section _____ for the (Name Project) _____. The undersigned further certifies that he/she has performed similar designs previously and has performed the design of the _____; and regulations and professional practice standards; that his/her signature and Professional Engineer (P.E.) Stamp have been affixed to all calculations and drawings used in, and resulting from, the design; and that the use of that stamp signifies the responsibility of the undersigned for that design.

The undersigned hereby certifies that he/she has Professional Liability Insurance and a Certificate of Insurance is attached.

The undersigned hereby agrees to make all original design drawings and calculations available to the City of Cambridge or City's representative with seven (7) days following written request therefore by the City.

_____ _____

P.E. Name Contractor's Name

_____

P.E. Registration Number, State of Registration and Discipline

_____ _____

Signature Signature

_____ _____

Title Title

_____ _____

Address Address

_____ _____

Telephone Telephone

_____ _____

Email Address Email Address

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01300

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SECTION 01301

SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section defines the process whereby the Schedule of Values shall be developed and incorporated into the cost loading function of the CPM Schedule as specified in Section 01311 – SCHEDULING AND REPORTING. Monthly progress payment amounts shall be determined from the monthly progress updates of the CPM Schedule activities.

B. The Schedule of Values shall be developed independently but simultaneous with the development of the CPM Schedule activities and logic as follows:

1.2 PRELIMINARY SCHEDULE OF VALUES

A. The Contractor shall submit a preliminary Schedule of Values for the major components of the work at the Preconstruction Conference. The listing shall include, at a minimum, the proposed value for the following major work components:

1. Mobilization.

2. The total value of civil piping work inclusive of excavation, support of excavation, pipe installation, testing and backfill of pipe or other structures, and all incidental work associated with underground pipe installations. Additionally, this total value shall be broken down into separate values for water lines, drain lines, sanitary sewer lines, and appurtenant work such as manholes and service connections constructed or modified as a part of the work.

3. The total value of site civil work inclusive of full depth roadway reconstruction, cold planing, regrading, paving, grading, curbs and sidewalks, and landscaping.

4. The total value of all other work not specifically included in the above items.

B. After the Pre-construction Conference, the Contractor and Engineer shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the Engineer, these are necessary to establish fair and reasonable allocation of values for the major work components. Front end loading will not be permitted. The Engineer may require reallocation of major work components from items in the above listing if in the opinion of the Engineer such reallocation is necessary. This review and any necessary revisions shall be completed within fourteen (14) calendar

days from the date of Notice to Proceed.

1.3 DETAILED SCHEDULE OF VALUES

A. The Contractor shall prepare and submit a detailed Schedule of Values to the Engineer within twenty-eight (28) calendar days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major work components. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the CPM Schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The Engineer shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the Engineer, a greater number of Schedule of Values items than proposed by the Contractor is necessary, the Contractor shall add the additional items so identified by the Engineer.

B. All lump sum, allowance and unit price items included for payment in the Contract shall be included in the schedule of values. Greater detail shall be provided for the following items and as further required by the Engineer.

1. Mobilization by activity.

2. Scheduling and Reporting broken down by submittal.

3. Geotechnical Instrumentation Monitoring

4. Soil and Waste Management

5. Pre / Post Construction Survey

6. Tree Protection

7. Utility Coordination

8. Traffic and Pedestrian Management

9. Traffic/Pedestrian Signals

10. Landscape

11. All other work not specifically included in the above items shall be broken down as necessary for establishment of pay and Schedule activity items.

C. The Contractor and Engineer shall meet and jointly review the detailed Schedule of Values within thirty-five (35) calendar days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if

sufficient detail has been proposed to provide cost loading of the CPM Schedule activities. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the Contractor and a revised detailed Schedule of Values shall be submitted within thirty-eight (38) calendar days from the date of Notice to Proceed.

D. Following acceptance of the detailed Schedule of Values, the Contractor shall incorporate the values into the cost loading portion of the CPM Schedule. The CPM activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the CPM Schedule activities, where interfacing these two (2) documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the CPM Schedule activities. Where such instances arise, the Contractor shall propose changes to the Schedule of Values and to the CPM Schedule activities to satisfy the CPM Schedule cost loading requirements.

1.4 CROSS REFERENCE LISTING

A. To assist in the correlation of the Schedule of Values and the CPM Schedule, the Contractor shall provide a Cross Reference Listing which shall be furnished in two parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled item should be indicated.

B. These listings shall be updated and submitted in conjunction with the CPM monthly submittals as stated in Specification Section 01311 – SCHEDULING AND REPORTING.

C. Approved change orders reflected in the CPM Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

1.5 CHANGES TO SCHEDULE OF VALUES

A. Changes to the CPM Schedule which add activities not included in the original schedule but included in the original work (schedule omissions) shall have values assigned as approved by the Engineer. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the Engineer.

B. In the event that the Contractor and Engineer agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

1.6 LIQUIDATED DAMAGES

A. The Schedule of Values information is an integral part of the scheduling and reporting under Section 01311 – SCHEDULING AND REPORTING and the progress payment information. As such, it is critical information to evaluating the project's progress and the proper planning of the City's and Engineer's work effort as well as their financial obligations associated with this Project. Accordingly, if any submittal required by this Section is found to be incomplete or is submitted later than required, the City will suffer financial loss and, accordingly, liquidated damages will be assessed against the Contractor in accordance with the Agreement.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01301

SECTION 01311

SCHEDULING AND REPORTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes scheduling and reporting requirements of the Contractor.

1.2 GENERAL

A. The scheduling of the Work under the Contract shall be performed by the Contractor in accordance with the requirements of this Section. The development of the schedule, the cost loading of the schedule, monthly payment requisitions and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) scheduling. The CPM Schedule shall be cost loaded based on the schedule of values as approved by the City in accordance with the requirements of Section 01301 – SCHEDULE OF VALUES. Where submittals are required hereunder, the Contractor shall submit an electronic copy and four hard copies of each submittal item.

1.3 INITIAL QUALIFICATIONS

A. The Contractor shall submit a statement of computerized CPM capability at the First Progress Meeting verifying that either the Contractor has in-house capability qualified to use CPM techniques or that the Contractor will employ a CPM consultant so qualified. In either event the statement shall identify the individual who will perform the CPM scheduling. Capability shall be verified by description of construction projects on which the individual has successfully applied computerized CPM and shall include at least two projects of similar nature, scope and value not less than one-half the Total Bid Price of this project. The statement shall also provide the contact persons for the referenced projects with current telephone and address information.

1.4 INITIAL SCHEDULE SUBMITTALS

A. The Contractor shall submit two (2) short term schedule documents at the First Progress Meeting which shall serve as the Contractor’s Plan of Operation for the initial sixty (60) day period of the Contract Time and to identify the manner in which the Contractor intends to complete all work within the Contract Time. The Contractor shall submit: (1) a 60 day Plan of Operation bar chart, and (2) a project overview bar chart type plan for all work as indicated below.

1. 60-Day Plan of Operation: During the initial 60 days of the Contract Time, the Contractor shall conduct Contract operations in accordance with the 60-day bar chart Plan of Operation. The bar chart so prepared and submitted shall show the accomplishment of the Contractor's early activities (mobilization, permits, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, CPM submittals, initial site work and other submittals and activities required in the first 60 days).

2. Project Overview Bar Chart: The overview bar chart shall indicate the major components of the project work and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the Work will be made substantially complete and placed into service. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 36-inch by 60-inch in size. Not more than three (3) sheets shall be employed to represent this overview information.

B. The City and the Contractor shall meet to review and discuss the 60-day plan of operations and project overview bar chart within one week after they have been submitted to the City. The Contractor shall make corrections to the schedules necessary to comply with the Contract requirements and shall adjust the schedules to incorporate any missing information requested by the City.

1.5 CPM SCHEDULE SUBMITTALS

A. Original CPM Schedule Submittal: Within thirty (30) calendar days after the commencement date stated in the Notice to Proceed, the Contractor shall submit for review by the City an electronic and a hard copy of the CPM Network Schedule. This submittal shall have already been reviewed and approved by the Contractor's Project Manager, Project Superintendent, and the Project Estimator prior to submission. The CPM Schedule shall show a complete interdependence and sequence of construction and project related activities reasonably required to complete the Work. The CPM Schedule shall also describe the activities to be accomplished and their logical relationships and show a discernable Critical Path.

B. As stated in Paragraph 1.7.F herein, all float indicated in the schedule shall belong to the project. The Computerized Schedule Report tabulations shall include the following:

1. Report of activities sorted by Early Start date.

2. Report of activities sorted by Total Float.

3. Report of activities sorted by Responsibility Code. Responsibility Codes shall be established for the Contractor, City, subcontractors, suppliers, etc. These codes shall be identified in the CPM Schedule.

4. A successor-predecessor report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.

5. A report explaining changed logic.

6. Report explaining adjusted or modified sequences of work.

7. Schedule of Values report showing budgeted, cost this period, total cost billed to date, remaining cost and approved change order values. Organization shall be based upon the City's accepted SOV line items.

C. Original CPM Schedule Review Meeting: The Contractor shall, within 40 calendar days from the commencement date stated in the Notice to Proceed, meet with the City and Engineer to review the original CPM schedule submittal. The Contractor shall have the Project Manager, Project Superintendents, and the Project Scheduler in attendance. The City's review will be limited to the submittal's conformance to the Contract requirements. However, the review may also include:

1. Clarifications of the design intent, process, and startup requirements.

2. Directions to include activities and information missing from the submittal.

3. Requests to the Contractor to clarify the schedule.

D. Revisions to the Original CPM Schedule: Within fifty (50) calendar days after the commencement date stated in the Notice to Proceed, the Contractor shall have revised the original CPM schedule submittal to address all review comments from the original CPM schedule review meeting and resubmit the CPM Schedules and reports for the City's review. The City, within fourteen (14) calendar days from the date that the Contractor submitted his revised schedule will either (1) accept the schedule and cost loaded activities as submitted, or (2) advise the Contractor in writing to review any part or parts of the schedule which either do not meet the Contract requirements or are unsatisfactory for the City to monitor the project's progress and status or evaluate monthly payment requests by the Contractor. The City may accept the schedule with conditions that the first monthly CPM schedule update be revised to correct deficiencies identified. When the schedule is accepted, it shall be considered as the "Original CPM Construction Schedule" until an updated schedule has been submitted. The City reserves the right to require that the Contractor adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of the Work or approval of

partial payment requests. No additional compensation will be provided for such adjustments, additions or clarifications.

E. Acceptance: The acceptance of the Contractor's schedule by the City will be based solely upon the schedule's compliance with the Contract requirements. By way of the Contractor assigning activity duration and proposing the sequence of the Work, the Contractor agrees to utilize sufficient and necessary management and other resources to perform the work in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.

F. Submission of the Contractor's progress schedule to the City shall not relieve the Contractor of total responsibility for scheduling, sequencing, and pursuing the Work to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed work.

G. Monthly Updates and Periodic CPM Schedule Submittals: Following the acceptance of the Contractor's Original Construction Schedule, the Contractor shall monitor the progress of the Work and adjust the schedule each month to reflect actual progress and any changes in planned future activities. Each schedule update submitted must be complete including all information requested in the original schedule submittal and that shown in Paragraph 1.7. Each update shall continue to show all work activities including those already completed. These completed activities shall accurately reflect the "as built" information by indicating when the work was actually started and completed.

H. Neither the submission nor the updating of the Contractor's original schedule submittal nor the submission, updating, change or revision of any other report, curve, schedule or narrative submitted to the City by the Contractor under this Contract, nor the City's review or acceptance of any such report, curve, schedule or narrative shall have the effect of amending or modifying, in any way, the Contract completion date or milestone dates or of modifying or limiting, in any way, the Contractor's obligations under this Contract. Only a signed, fully executed change order can modify these contractual obligations.

I. Weekly schedule updates shall be submitted by the Contractor and will be reviewed with the Contractor during the weekly construction progress meetings. The goal of these meetings is to enable the Contractor and the City to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the Work and to determine the amount of Work completed since the last month's schedule update. The status of the Work will be determined by the percent complete of each activity shown in the CPM Schedule. These meetings are considered a critical component of the overall monthly schedule update submittal and the Contractor shall have appropriate personnel attend. As a minimum, these meetings shall be attended by the Contractor's Project Manager and General Superintendent.

J. The Contractor shall submit the revised CPM Schedule, the revised successor/predecessor report, the Project Status Reports as defined by Paragraph 1.8 of this Section with the Contractor's Application for Payment. Applications for Payment which are submitted without the proper CPM Updates shall be held until the Contractor has satisfied the Contract requirement. Within five (5) working days of receipt of the above noted revised submittals, the City will either accept or reject the monthly schedule update submittal. If accepted, the percent complete shown in the monthly update will be the basis for the Application for Payment to be submitted by the Contractor. If rejected, the update shall be corrected and resubmitted by the Contractor before the Application for Payment for the update period can be processed.

K. Schedule Revisions: The Contractor shall highlight or otherwise identify all changes to the CPM Schedule Logic or activity durations made from the previous schedule. The Contractor shall modify any portions of the CPM schedule which become infeasible because of activities behind schedule or for any other valid reason.

1.6 CHANGE ORDERS

A. Upon written approval of a change order, or upon written receipt by the Contractor of authorization to proceed with additional work, the change shall be reflected in the next submittal of the CPM schedule by the Contractor. The Contractor shall utilize a sub-network in the schedule depicting the changed work and its effect on other activities. This sub-network shall be tied to the main network with the appropriate logic so that a true analysis of the Critical Path can be made.

1.7 CPM STANDARDS

A. Definitions: CPM, as required by this Section, shall be interpreted to be generally as outlined in the Association of General Contractors (AGC) publication, "The Use of CPM in Construction." except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this specification and the AGC Document, this specification shall govern.

B. Construction Schedules: Construction schedules shall include a graphic CPM Schedule and computerized construction schedule reports as described in Paragraph 1.8.

C. Networks: The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets. Individual sheets shall not exceed 36-inch by 60-inch.

D. All construction activities and procurement shall be indicated in a time-scaled format and a calendar time line shall be shown along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar time line. All activities shall be shown using the symbols that clearly distinguish between critical path activities, non-critical activities and free float for each non-critical activity. All activity items shall be identified by their respective Activity Number, Responsibility Code, Work Duration, and their Dollar Value. All non-critical path activities shall show their total float time in scale form by utilizing a dotted line or some other graphical means.

E. Duration Estimates: The duration estimate indicated for each activity shall be computed in working days and shall represent the single best estimate considering the scope of the activity work and resources planned for the activity. Except for certain non-labor activities, such as curing of concrete or delivery of materials, activity duration shall not exceed ten (10) working days nor be less than one working day unless otherwise accepted by the City.

F. Float Time: Float time shall be as follows:

1. Definition: Unless otherwise provided herein, float as referenced in these documents, is total float. Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, that activity then becomes part of the critical path and controls the end date of the project. Thus, the delay of the non-critical path activity beyond its float period will cause delay to the project itself.

2. Float is not for the exclusive benefit of the Contractor, but is an expiring resource available to the City, or the Contractor, to accommodate changes in the Work, however originated, or to mitigate the effect of events which may delay performance or completion of all or part of the Work within the Late Dates, the Contractor's anticipated completion, or Contract Time. Contract time extensions for the Contract performance will be granted only to the extent that delays or disruptions to affected work paths exceed total float along those paths of the current Working Schedule (updated schedule) in effect at the time of delay or disruption. Delays and disruptions which cause the end date of the Work to exceed current contract completion date must be beyond control and without fault or negligence of the Contractor or any Subcontractor at any tier. In the event that the delays or disruptions impact an already negative float path, the Contractor will not receive a time extension unless and until the activity with the highest negative float is driven even further negative. Delays or disruptions are not considered a basis for time extension to this contract unless and until such delays or disruptions are resolved as set forth in the General Conditions.

3. Pursuant to the float sharing requirements of this Section, the use of float suppression techniques such as preferential or logic sequencing (crew movement, equipment use, etc.), special lag/lead restraints, and extended activity times or duration, imposed dates, scheduling of work not required for a Contract Time as required work, and others, are expressly prohibited. Use of float time disclosed or implied by use of alternate float suppression techniques shall be shared to the benefit of both the City and the Contractor. Justify use of preferential sequencing, special lag/lead relationships and other network techniques that may be construed as float suppression techniques as being necessary for efficient utilization of resources in execution of the Contract. Use of any network techniques solely for the purpose of suppressing float will be cause for rejection of schedule submittal. The Contractor shall adjust or remove any float suppression techniques as a prerequisite to a request for an increase in Contract Price or Contract Time.

1.8 SCHEDULE REPORTS (FORMAT)

A. Schedule Reports: Schedule Reports shall be prepared based on the Construction Schedule, and shall include the following minimum data for each activity:

1. Activity Numbers and Responsibility Codes.

2. Work Order No.

3. CIP No.

4. Estimated Activity Duration.

5. Activity Description.

6. Activity's Percent Completion.

7. Early Start Date (Calendar Dated).

8. Early Finish Date (Calendar Dated).

9. Late Start Date (Calendar Dated).

10. Late Finish Date (Calendar Dated).

11. Status (Whether Critical).

12. Total Float for Each Activity.

13. Free Float for Each Activity.

14. Cost Value for Each Activity.

B. Project Information: Each Schedule Report shall be prefaced with the following summary data:

1. Project Name.

2. Contractor.

3. Type of Tabulation.

4. Project Duration.

5. Contract Completion Date (revised to reflect time extensions).

6. The Commencement Date Stated in the Notice to Proceed.

7. The Data Date and Plot Date of the CPM Schedule.

8. If an update, cite the new schedule completion date.

1.9 PROJECT STATUS REPORTING

A. In addition to the submittal requirements for the CPM scheduling identified in this Section, the Contractor shall provide monthly project status reports (Overview Bar Chart and a written narrative report) to be submitted in conjunction with the revised CPM Schedules as specified in Paragraph 1.4. Status reporting shall be in the form specified below.

B. The Contractor shall prepare and submit monthly an Overview Bar Chart schedule of the major project components. The overview bar chart schedule shall be a summary of the current CPM schedule (original and as updated and adjusted throughout the entire construction period). It shall be limited to not more than four sheets which shall not exceed 8-1/2-inch by 11-inch. The major project components shall be represented as time bars which shall be subdivided into various types of work.

C. Each major component and subdivision shall be accurately time scale plotted consistent with the project overview bar chart specified above. It shall represent the same status indicated by early start and finish activity information contained in the latest update of the CPM schedule. In addition, a percent completion shall be indicated for each major component and subdivision. The initial submittal of the overview bar chart schedule shall be made at the time that the revised original CPM schedule is submitted to the City. The Contractor shall amend the overview schedule to include any additional detail required by the City. The Contractor shall include any additional information requested by the City at any time during the construction of the Work.

D. The Contractor shall prepare monthly written narrative reports of the status of the project for submission to the City. Written status reports shall include:

1. The status of major project components (Percent Complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.

2. The progress made on critical activities indicated on the CPM schedule.

3. Explanations for any lack of work on critical path activities planned to be performed during the last month.

4. Explanations for any schedule changes, including changes to the logic or to activity duration.

5. A list of the critical activities scheduled to be performed in the next two (2) month period.

6. The status of major material and equipment procurement.

7. The value of materials and equipment properly stored at the site, but not yet incorporated into the work-in-place.

8. Any delays encountered during the reporting period.

9. An assessment of inclement weather delays and impacts to the progress of the Work.

10. A statement as to the adequacy of remaining contract time to complete Work.

E. The Contractor shall include copies of the last month’s daily logs, field reports, and As-Built redlines with the written monthly narrative report.

F. The Contractor may include any other information pertinent to the status of the project. The Contractor shall include additional status information requested by the City.

1.10 INCLEMENT WEATHER PROVISIONS OF THE SCHEDULE

A. The Contractor’s construction schedule shall include lost days on the CPM schedule's critical path due to inclement weather during an active period of Work. The Contractors schedule shall also include lost days due to an inclement weather-related shutdown at the requirement of the City, see Article 2 of the Special Conditions.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01311

SECTION 01390

PRE-CONSTRUCTION SURVEY

1390.1	**EXTERNAL BUILDING INSPECTION - SINGLE FAMILY, DUPLEX**	**EACH**
1390.2	**INTERNAL AND EXTERNAL BUILDING INSPECTION - NON-RESIDENTIAL**	**EACH**
1390.3	**INTERNAL BUILDING INSPECTION**	**ALLOWANCE**

PART 1 - GENERAL

1.1 SUMMARY:

A. Provide construction videos and photographs pertinent to the work during the Contract period specified.

B. Perform pre-construction conditions surveys on all exterior surface features, building exterior surfaces, and interiors of the buildings indicated on the plans or as otherwise required by the Geotechnical Engineer.

C. Perform additional pre-construction conditions surveys

D. Perform post-construction survey at properties where a damage claim has been reported.

1.2 SYSTEM DESCRIPTION:

A. Work under this section includes photography and video recording of surface conditions of interior and exterior of building and exterior areas and structures as indicated on the drawings.

B. Perform photography and video recording:

1. Before commencement of work.

2. After completion of construction activities at areas where damage claims have been reported.

1.3 QUALITY ASSURANCE

A. Qualifications

1. The company engaged for professional photography shall, during the past five (5) years, have successfully completed photographing and video recording three construction projects of similar scope and dollar value as the construction project which is the subject of this Contract.

2. Qualifications of the firm performing the pre- and post-construction building surveys:

   a. Inspections shall be performed by or under the direct supervision of a Registered Professional Engineer, licensed in the state of Massachusetts. This individual shall have at least three (3) years' experience in the inspection or design of residential and commercial structures.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01300 Submittals.

B. Within thirty (30) days of Notice to Proceed and prior to performing any photography and video work, submit the qualifications of Professional Engineer(s) that will perform the pre- and post-condition survey of building as specified in paragraph 3.1 of this section, and qualification of the firm performing the photography and video recording work. Include a list of projects to demonstrate compliance with paragraph 1.3.A.1 of this section. For each project, include project name, location, owner, year(s), name of general contractor, and current address and phone number of the owner or owner's representative.

C. Submit written release(s) from the photographer and photographic studio covering all videos, photographs (prints), and photo CDs of images taken as specified. Submit each release at the time of development of the subject video and/or photograph.

D. Within thirty (60) days of Notice to Proceed, submit four (4) copies of pre-construction "Pre-Construction Building Condition Survey" reports and videos (on DVD) of buildings as indicated in paragraph 3.1 to ENGINEER.

   1. Separate reports shall be provided for each address.

   2. Each copy of the report shall include a copy of the video in DVD format

   3. Each copy of the report shall include a photographic compact disc (photo CDs) with all of the photos taken of the property.

1.5 SEQUENCING AND SCHEDULING:

A. Pre-construction photography and video, including pre-construction building surveys and exterior areas shall be completed prior to beginning of construction.

B. Post-construction building condition survey work: only of areas where a damage claim has been reported.

C. Dates for other photography and video recording at the site shall be coordinated with the ENGINEER.

1.6 WORKSITE CONDITIONS

A. Right of entry for building conditions survey: Contractor shall obtain the right of entry for all structures to be surveyed.

1. Prior to contacting the individual building owners, the ENGINEER will provide a general notice describing the project and the need to obtain access to each building. The Contractor shall not contact individual building owners until at least two (2) weeks after the ENGINEER has provided notice to the building owners.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Video:

1. Format: Digital recorded and submitted on DVD.

2. Video Identification:

a. Video Number:AAA-##Str
Where: AAA = Contract Number
= street number
Str = Street Name

Riv = for properties with a River Street address
Bla = for properties with a Blackstone Street address
Gre = for properties with a Green Street address
Faa = for properties with a Fairmount Avenue address
Fas = for properties with a Fairmount Street address
Roc = for properties with a Rockwell Street address
Lau = for properties with a Laurel Street address
Kel = for properties with a Kelly Road address
Ple = for properties with a Pleasant Street address
Wes = for properties with a Western Avenue address

b. Project name and Contract No.
c. Property Address
d. Date of video

3. Log of Videos: Provide a binder with the log of all videos taken for this Contract. Format of the log shall be tabular and shall include the following:
    a. Project name and Contract No.
    b. Video Number
    c. Property Address
    d. Date of video & weather conditions

B. Photographs:

1. Format: photographic compact disc (photo CDs)

2. Photo CD identification:

a. Photo CD Name: AAA-##STR
Where: AAA = Contract Number
= street number
STN = Street Name

RIV = for properties with a River Street address
BLA = for properties with a Blackstone Street address
GRE = for properties with a Green Street address
FAA = for properties w/ a Fairmount Avenue address
FAS = for properties with a Fairmount Street address
ROC = for properties with a Rockwell Street address
LAU = for properties with a Laurel Street address
KEL = for properties with a Kelly Road address
PLE = for properties with a Pleasant Street address
WES = for properties with a Western Avenue address

b. Project name and Contract No.
c. Property Address
d. Date of video

3. Photograph identification: AAA-##STR-XX
Where: AAA = Contract Number
= street number
STR = Street Name

RIV = for properties with a River Street address
BLA = for properties with a Blackstone Street address
GRE = for properties with a Green Street address
FAA = for properties w/ a Fairmount Avenue address
FAS = for properties with a Fairmount Street address
ROC = for properties with a Rockwell Street address
LAU = for properties with a Laurel Street address
KEL = for properties with a Kelly Road address
PLE = for properties with a Pleasant Street address
WES = for properties with a Western Avenue address

XX = sequential number for given property

4. Log of photos: Provide a binder with a separate log for each address of all photos taken for this Contract. Format of the log shall be tabular and shall include the following:
   a. Project name and Contract No.
   b. Photo CD identification
   c. Property Address
   d. Date of Photos & weather conditions
   e. Photograph identification
      i. The view/orientation of the photograph (compass direction and vertical declination of view (e.g., horizontal, looking up, looking down, etc.)
      ii. Identification of main features in view.
      iii. Any other data and information pertinent to the purpose and identification of the exposure.

PART 3 - EXECUTION

3.1 GENERAL PHOTOGRAPH AND VIDEO RECORDING:

A. General:

1. All views shall contain a relative dimension reference that is easily recognizable. In views where dimensions are critical use a recognizable measuring device such as folding ruler or measuring tape in a manner that the markings are clean and sharp in the photograph and the device located in close relationship to the subject of the photograph.

B. Detailed examination of the above grade structures, buildings and outside areas shall include documentation of exterior visual survey of the property, on-site improvements and plantings; detailed video inspections of the exteriors of buildings; color photographs of the exteriors showing visually evident structural faults, including but not limited to:

1. exterior façade and interior for structures indicated in the Contract Drawings.

2. location and size of cracks in exterior/interior walls, especially instances of cracked or missing plaster within defined survey areas;

3. damaged masonry or roofing with the defined survey areas;

4. damaged windows or doorway within the defined survey areas;

5. walls which are not vertical within the survey area;

6. damage to foundation, including exterior/interior basement walls; and tightness of fit of doors and windows with respective jambs.;

7. sidewalks, paved areas, utility poles, stairways, patios, retaining walls, and landscaped areas.

PART 4 – COMPENSATION

Item 1390.1 – External Building Inspections – Single Family, Duplex

METHOD OF MEASUREMENT:
Measurement for payment for Internal and External Building Inspections will be based on the per Each bid as approved by the Engineer.

BASIS OF PAYMENT/ INCLUSIONS:
Under the Unit Price for External Building Inspections, the Contractor shall furnish all labor, materials, instrumentation, tools, equipment, and incidentals required to complete an external building inspection for each building. Payment under this Item includes, but is not limited to, obtaining Right of Entry(ies), up to 3 documented attempts to notify the property owner(s) via certified mail; video inspection and documentation of external conditions; delivering report of inspection.

Contractor to provide schedule of values for the completion of external inspection, and documented attempt for each unit. In the event property owner is unable to be contracted, the contractor will receive partial payment for external inspection and documented attempts.

Item 1390.2 – Internal and External Building Inspections – Non-Residential

METHOD OF MEASUREMENT:
Measurement for payment for Internal and External Building Inspections will be based on the per Each bid as approved by the Engineer.

BASIS OF PAYMENT/ INCLUSIONS:
Under the Unit Price for Internal and External Building Inspections – non-residential, the Contractor shall furnish all labor, materials, instrumentation, tools, equipment, and incidentals required to complete an internal and external building inspection for each building. Payment under this Item includes, but is not limited to, obtaining Right of Entry(ies), up to 3 documented attempts to notify the property owner(s) via certified mail; video inspection and documentation of internal and external conditions; delivering DVD and report of internal and external inspection; and re-inspection of internal and external building.

Contractor to provide schedule of values for the completion of internal inspection, external inspection, and documented attempt for each unit. In the event property owner is unable to be contracted, the contractor will receive partial payment for external inspection and documented attempts.

Item 1390.3 – Internal Building Inspections

METHOD OF MEASUREMENT:
Payment will be made against the allowance based on invoices submitted by the General Contractor on a monthly basis. Labor, professional services, technician, and other invoices shall include a breakdown of hours, labor rates, direct expenses of all sub-consultant and contractor mark-ups, material costs, shipping, taxes and all other costs included in the request. Incomplete or incorrect invoices will not be approved.

The General Contractor is allowed up to a 5% mark-up on labor, professional service, technician, and other costs related to internal building inspections as approved by the resident engineer.

BASIS OF PAYMENT/ INCLUSIONS:
The allowance for this item shall be reimbursement to the General Contractor to furnish all labor, professional services, technician, equipment, and incidentals for the Contractor to complete Internal Building Inspections as required by the Engineer and not included in other pay items.

EXCLUSIONS AND SPECIAL NOTES:
Payment for External Building Inspections and Internal and External Building Inspections shown on the Contract Drawings shall be paid for elsewhere.

END OF SECTION 01390

SECTION 01400

QUALITY CONTROL

1400.1 QUALITY CONTROL AND TESTING ALLOWANCE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes quality assurance and control of installation and manufacturer's field services and reports.

1.2 WATERTIGHTNESS

A. All structures, pipes, and equipment which are to contain water shall be watertight under all operating conditions for which they are intended. The Contractor shall furnish all labor, materials and equipment and do all work required by the Engineer to make all such parts of the work watertight, or to replace them if in the opinion of the Engineer any leakage is excessive. All such parts of the work filled with water for testing watertightness shall be left filled as required by the Engineer.

1.3 LAYOUT OF WORK

A. The Contractor shall employ a Massachusetts Registered Land Surveyor, acceptable to the Engineer and direct him to establish an initial "Construction Base Line" as indicated on the Drawings. Said base line shall be staked at 25-foot stations. The Engineer shall also provide benchmark information on the Drawings or separately in writing. The Contractor shall do all layout of the work from said base line and benchmarks.

B. The Contractor shall employ a Massachusetts Registered Land Surveyor, approved by the Engineer and cause him to establish permanent benchmarks during the entire progress of the work, to which easy access may be made to determine and assure all lines and grades and to verify same from time to time. The Contractor shall keep on the job a level and transit and allow the City's Representative and the Engineer unrestricted use of same at the work site. Such check shall not be considered as approval of the Contractor's work.

C. The Contractor shall maintain the construction base line stakes at all times. Should stakes or marks be destroyed during the course of the work, by the Contractor or by others, the Contractor shall, at his own expense, provide the services of a Massachusetts Registered Land Surveyor, acceptable to the Engineer, to reestablish such stakes and marks.

1.4 CARE OF WATERCOURSES

A. The Contractor shall maintain the flow in all watercourses, whether open channels or in pipes, in all sewers and other pipes interfered with in the line of work and convey the flow to a suitable point of discharge so as not to flow upon the work or create a nuisance. In the discharge of water removed from the excavations by pumping or by gravity similar precautions shall be observed as well as those outlined in specifications relating to contaminated and hazardous materials.

1.5 HYDRANTS

A. Fire hydrants on or adjacent to the work shall be kept accessible to fire-fighting equipment at all times.

1.6 MANUFACTURER'S FIELD SERVICES AND REPORTS

A. When specified in individual specification sections, provide material or product supplier's or manufacturer's technical representative to observe site conditions; conditions of surfaces and installation; quality of workmanship; start-up of equipment; operator training, testing, adjustment, and balance of equipment as applicable; and to initiate operation, as required. Conform to minimum time requirements for start-up operations and operator training if defined in specification sections.

B. At the City's or Engineer's request, submit qualifications of the manufacturer's representative fifteen (15) days in advance of required representative's service. The representative shall be subject to approval of the City and Engineer.

C. Manufacturer's representative shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions. Submit reports within fourteen (14) days of observation to Engineer for review.

1.7 THIRD-PARTY MATERIALS TESTING

A. The Contractor shall employ a qualified third-party quality control testing company certified in the applicable materials testing procedure required by the Specifications and shall have adequate staffing available and laboratory capacity to provide testing results in a reasonable timeframe. The quality control testing company hired by the Contractor shall be subject to approval by the City and Engineer.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION

Item 1400.1 – Quality Control and Testing

METHOD OF MEASUREMENT:
Payment will be made against the allowance based on invoices submitted by the General Contractor on a monthly basis. Labor, professional services, technician, and other invoices shall include a breakdown of hours, labor rates, direct expenses all sub-consultant and contractor mark-ups, material costs, shipping, taxes and all other costs included in the request. Incomplete or incorrect invoices will not be approved.

The General Contractor is allowed up to a 5% Mark-up on labor, professional service, technician, and other costs related to testing.

BASIS OF PAYMENT:
The allowance for this item shall be reimbursement to the General Contractor to furnish all labor, professional services, technician, equipment, and incidentals for testing required in this contract and not included in other pay items. The work includes, but is not limited to, testing for: backfill compaction, concrete, Hot Mix Asphalt Porous Paving and Hot Mix Asphalt standard paving compaction testing items.

SPECIAL NOTES/EXCLUSIONS:
Contamination, In-situ Soil density, pipe and manhole testing, water main testing, test pits and all other testing not explicitly called out in this Section will not be paid for under this item and are covered under separate pay items.

END OF SECTION 01400

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SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUBMITTALS

A. The Contractor shall submit a complete work plan including: proposed hours of operation, sequencing of work, number of shifts, number of work crews, and anticipated conflicts with existing utilities and facilities throughout the project. The work plan shall also include dates for temporary facility service interruption and required utility relocation. The plan shall also include a detailed schedule of all cooperation requirements with owners/operators of existing utilities and facilities.

1.2 PRIVATE LAND

A. The Contractor shall not enter or occupy private land outside of easements, except by permission of the City.

1.3 PIPE LOCATIONS

A. Pipelines shall be located substantially as indicated on the Drawings, but the Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing utilities, structures, or for other reasons.

B. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve the Contractor for laying and jointing different or additional items where required.

1.4 HAULING, HANDLING AND STORAGE OF MATERIALS

A. The Contractor shall, at his own expense, handle and haul all materials furnished by him and shall remove any of his surplus materials at the completion of the work. The Contractor shall provide suitable and adequate storage for equipment and materials furnished by him and shall be responsible for any loss or damage to any equipment or materials by theft, breakage, or otherwise. The Contractor shall be responsible for all damages to the work under construction during its progress and until final completion and acceptance even though partial payments have been made under the Contract.

1.5 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, steel plates, construction and caution signs, concrete barriers, protective 7' tall fencing, lights and other means to prevent accidents to persons, vehicles, and damage to property. The Contractor shall, at his own expense, provide suitable and safe means for completely covering all open excavations and for accommodating pedestrian and/or vehicular travel when work is not in progress. Bridges provided for access to private property during construction shall be removed when no longer required. The length of open trench will be controlled by the particular surrounding conditions but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, then special construction procedures shall be taken, such as limiting the length of open trench.

B. All trenching operations and end of day conditions shall be in accordance with Jackie's Law, (520 CMR 14.00).

1.6 TEST PITS

A. Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the Contractor in accordance with the requirements of the Engineer, as shown on the Drawings, or described in the Specifications, or as directed by the City or Engineer. Test pits shall be backfilled and compacted immediately after their purpose has been completed, after information is recorded, written, photos or videos taken, and the surface restored and maintained as required by the Engineer.

1.7 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. The Contractor shall assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, fiber optic lines, fire signals, cable television cables, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. The Contractor shall notify the owner/operator of the proposed work and proposed protection plan so the owner/operator can review and approve protection measures. The Contractor is required to comply with all provisions of Massachusetts General Laws Chapter 353 entitled "Excavations-Public Ways-Notice Requirements" otherwise known as Dig Safe. Any damage resulting from the Contractor's operations shall be repaired by the Contractor at the Contractor's expense.

B. The Contractor shall bear full responsibility for obtaining all locations of underground structures, utilities, and services. Services to buildings shall be maintained and all costs or charges resulting from damage thereto shall be paid by the Contractor.

C. Protection and temporary removal and replacement of existing utilities and structures as described in this section shall be a part of the work under the Contract. The Contractor will be responsible for the removal and replacement of existing utilities or coordination with the owners/operators of the existing utilities and assisting the existing utilities where required.

D. If, in the opinion of the Engineer, permanent relocation of a utility owned by the City of Cambridge is required, that is not shown on the plans or the specifications; he may require the Contractor, in writing, to perform the work. Work so ordered will be paid for as extra work under provisions of the General Conditions. If relocation of a privately owned utility is required, the Contractor will notify the utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the City and utility and shall have no claim for delay due to such relocation. The Contractor shall notify public utility companies in writing at least seven days (excluding Saturdays, Sundays and legal holidays) before excavating or working in any public way. The Contractor shall notify public utilities 30 days prior to any service call wherever possible.

1.8 WATER FOR CONSTRUCTION PURPOSES

A. The Contractor will be allowed to purchase water from the City of Cambridge, MA for construction testing and start-up purposes.

B. The express approval of the Cambridge Water Department shall be obtained before water is used. Water shall be metered as specified by the Cambridge Water Department. Hydrants shall only be operated under the supervision of Cambridge Water Department personnel.

C. No direct cross connections will be permitted between the public water supply and the new water mains, or any other point where the possibility of backflow of contaminated water exists. All connections to points where there is the possibility of backflow shall be arranged to prevent backflow and shall be approved by the City's Plumbing Inspector before they are put into operation.

1.9 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. All newly constructed Work shall be carefully protected. No driving or wheeling, walking or placing of heavy loads on newly constructed Work shall be allowed. All portions damaged shall be reconstructed, repaired, or replaced

by the Contractor at his own expense.

B. All elements of the Work shall be protected in a manner approved by the Engineer. Should any part of the Work become heaved, cracked, or otherwise damaged, all such damaged portions of the Work shall be completely repaired and made good by the Contractor at his own expense as required by of the Engineer.

C. If, in the final, or any daily inspection of the Work, any defects, faults or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein for at least the guarantee period described in the Contract Documents.

D. The Contractor shall take all necessary precautions to prevent damage to all elements of the Work due to water pressure during and after construction and until such Work is accepted and taken over by the City.

1.10 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the Contractor, such property shall be restored by the Contractor at his expense to a condition similar or equal to that existing before the damage was done or he shall make good the damage in another manner acceptable to the City and Engineer.

B. Along the location of this Work, all fences, walks, bushes, trees, shrubbery, and other physical features shall be protected and restored in a thoroughly workmanlike manner. Fences and other features removed by the Contractor shall be replaced in their original location or at a location indicated on the Drawings as soon as conditions permit. All grass areas beyond the limits of construction which have been damaged by the Contractor shall be graded and seeded.

C. Trees close to the work shall be boxed or otherwise protected against injury as described in Section 02100 PREEMTIVE TREE CARE. No trees shall be cut, braced, or damaged without prior notification of the City Arborist.

D. The protection, removal, and replacement of existing physical features along the line of work shall be a part of the work under the Contract, and all costs in connection therewith shall be included in the Bid Proposal unless a Bid Item has been established elsewhere in these Construction Documents for the express payment of that specific item of Work.

1.11 INSTALLATION OF EQUIPMENT

A. All wedges, shims, filling pieces, keys, packing, red or white lead grout, or other materials necessary to properly align, level and secure apparatus in place shall be furnished by the Contractor. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper bearing after erection shall be done at the expense of the Contractor.

1.12 SLEEVES AND OPENINGS

A. The Contractor shall provide all openings, channels, etc., and install anchor bolts and other items to be imbedded in concrete, as required to complete the work under this Contract, together with those required by subcontractors, and shall do all cutting and patching excepting cutting and patching of materials of a specific trade and as stated otherwise in the following paragraph.

1.13 REJECTED MATERIALS AND DEFECTIVE WORK

A. Materials furnished by the Contractor and condemned by the Engineer as unsuitable or not in conformity with the specifications shall forthwith be removed from the work by the Contractor and shall not be made use of elsewhere in the work. Any errors, defects or omissions in the execution of the work or in the materials furnished by the Contractor, even though they may have been passed or overlooked or have appeared after the completion of the work, discovered at any time before the final payment is made hereunder, shall be forthwith rectified and made good by and at the expense of the Contractor as required by the City and Engineer. The Contractor shall reimburse the City for any expenses, losses or damages incurred in consequence of any defect, error, omission or act of the Contractor or his employees, as required by the City and Engineer, occurring previous to the final payment.

1.14 TEMPORARY UTILITIES

A. Temporary Light and Power: The Contractor shall at his own expense, provide his own temporary light and power as required for the prosecution and completion of work, including light and power for the construction and engineering trailers as well as light and power for dewatering pumps, and trench and staging area lighting.

B. Temporary Heat: The Contractor shall, at his own expense, provide sufficient temporary heat to maintain minimum temperatures specified elsewhere, in all areas designated elsewhere in these documents.

C. Temporary Water: Water for drinking purposes and other usage will be provided by the Contractor at his own expense.

D. Sanitary Provisions: The Contractor shall provide and maintain sanitary accommodations for the use of his employees and the Engineer, as may be necessary to comply with the requirements and regulations of the local and state departments of health.

E. Maintaining Operation of the Existing Facilities:

1. The Contractor shall provide temporary utilities and/or cooperate with utilities to maintain full service to the residences and buildings in the project area. The Contractor shall be responsible for careful consideration of the construction scheduling and anticipation of potential interferences with existing utilities, operations and structures. The Contractor shall maintain close communications with the Engineer and provide the Engineer with a detailed description of each proposed activity sufficiently in advance of its commencement for review and comments to be made.

2. Temporary facilities which may be required include, but are not limited to, electrical power; lighting; heating; cooling; ventilating; telephone; cable television; potable water; fire protection; drainage; sanitary facilities; trench covers; protection of existing utilities; structures; streams; trees and shrubs; access roads; sewage conveyance; piping; and pumping. The Contractor will be responsible for providing, connecting, and maintaining emergency generators to serve homes in the event temporary electrical services cannot be established by the power company. The Contractor will be responsible to furnish a licensed electrician to connect the houses to the emergency generators, maintain the generators twenty-four (24) hours a day, and disconnect the houses when service can be reestablished to the power lines. The generators will be provided and maintained at no additional cost to the City.

3. The Contractor shall coordinate efforts with the owners and/or operators of the existing facilities to avoid any service interruption. The Contractor shall keep utilities informed of proposed work activity and notify utilities of required work four weeks in advance. The Contractor must schedule work to avoid repeated, unnecessary, or last minute service calls by the owners/operators of existing facilities.

1.15 ACCESS TO THE WORK

A. The Contractor shall provide sufficient and proper facilities at all times for inspection of all work under this project in preparation or in progress, by the City, the agents and employees of the City, by authorized representatives of the Commonwealth of Massachusetts and the Federal Government and by the Engineers.

B. The Contractor shall furnish the Engineer or his authorized representative and other personnel mentioned above with such facilities and assistance as are necessary to ascertain performance of the work in accordance with the plans and specifications.

C. The Contractor must provide sufficient and safe access to existing facilities for the owners/operators of existing facilities to maintain service.

1.16 POLLUTION CONTROL

A. The Contractor shall conduct clean-up and disposal operations, as necessary, to comply with state and local ordinances and anti-pollution laws.

B. Outdoor burning of rubbish and waste material on the site will not be permitted.

C. Disposal of volatile fluid wastes (such as mineral spirits, oil, gasoline, or paint thinner) in storm or sanitary sewer systems or into streams or waterways is not permitted.

D. Refer also to Section 01560 TEMPORARY ENVIRONMENTAL CONTROLS.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01500

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SECTION 01505

MOBILIZATION

1505.1 MOBILIZATION LUMP SUM

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes mobilization consisting of moving all plants and equipment onto the site required for the contractor's operations; furnishing and erecting plants, temporary buildings, and project and other construction facilities; erecting project signs and traffic management signs; implementing security features and requirements; all as required for the proper performance and completion of the Work. Mobilization shall further include the following principal items:

1. Installing temporary construction power, wiring, and lighting facilities.

2. Developing construction water supply.

3. Providing on-site sanitary facilities and potable water facilities.

4. Arranging for and erection of Contractor's work and storage/staging yard(s).

6. Having all OSHA required notices and establishment of safety programs.

6. Having the Contractor's superintendent and project manager at the job site full time. The project manager shall not have superintendent duties.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION

Item 1505.1 - Mobilization

METHOD OF MEASUREMENT:
Payment for Mobilization will be at lump sum price bid for this item in the proposal and shall be payable by percentage complete per the previous listed items when the Contractor is operational on the site. Operational is defined as the substantial commencement of work on site as described in the following paragraph. The Lump Sum price bid for mobilization shall not exceed 3 percent of the Total Amount of Bid.

BASIS OF PAYMENT:
Under the Lump Sum price bid for Mobilization, the Contractor shall move his equipment to the site and prepare to begin construction. Mobilization shall include all costs of initiating the Contract, exclusive of the cost of materials. Mobilization includes securing and constructing a staging area(s) for materials and office trailers and erecting all temporary fencing (0.4%); furnishing and paying for all utilities (0.2%), broadband (0.2%), furnishing and installing pre-construction traffic management signage (0.2%); distributing contact numbers for Contractor's staff to City and Engineer; submission and approval of initial shop drawings (0.2%); submission and approval of Traffic Management Plans (0.3%); submission and approval of initial work plans and sequencing plans (0.3%); installing temporary power, lighting and water for construction purposes (0.4%); implementing security features (0.2%); furnishing and installing temporary sanitary facilities (0.2%); transporting all necessary trucks and construction equipment to the site necessary to begin construction (0.4%); and all other work necessary to start Construction.

END OF SECTION 01505

SECTION 01560

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes temporary environmental controls necessary for the project including dust abatement, rubbish control, sanitation, chemicals, and cultural resources. Snow removal and sweeping of streets and sidewalks are discussed in Section 01570 - MAINTENANCE AND PROTECTION OF TRAFFIC.

1.2 DUST ABATEMENT AND CONTROL

A. The Contractor shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for any damage resulting from dust originating from its operations. The dust abatement measures shall be continued until the Contractor is relieved of further responsibility for the Work. Dust abatement measures shall include but not be limited to spraying water, applying calcium chloride, or placing temporary pavement on and around trenches and at work sites.

B. During excavation of soil/fill material dust shall be controlled to limit potential spread of contaminants and potential exposure of contaminants to workers and the public.

C. Ambient dust levels at the site shall be monitored by the Contractor prior to construction. During construction, real-time dust monitoring shall be conducted during any soil/fill handling activities. The monitoring shall consist of total dust testing using MIE, Inc. Miniram PDM-3 Dust Monitors, or like instruments. The total dust criteria at the site shall conform to the requirements of the HASP. Should fugitive dust quantities exceed twenty percent (20%) of the ambient level, the Contractor shall perform additional measures to reduce the total dust concentrations.

D. Nuisance dust levels may be encountered during regrading activities and excavation. Dust levels shall be reduced by pre-wetting the surface soils and by establishing and maintaining clean access roads. The Contractor's Dust, Vapor, and Odor Control Plan shall describe the procedures and materials to minimize dust. The Contractor shall refer to Section 02080 - SOIL AND WASTE MANAGEMENT for the Dust, Vapor and Odor Control Plan submittal requirements. At a minimum, the Contractor shall provide clean water, free from salt, oil, and other deleterious materials.

E. Failure to maintain positive and effective dust control may result in a suspension of the work, at no additional cost to the City, until dust control is addressed to the City's satisfaction.

F. Areas of exposed earth to be excavated shall be lightly sprayed with water before excavation. Additional water spray may be utilized only when any indication of excessive dust is observed. The Contractor shall minimize the use of water within the limits of excavation.

G. Access roads shall be sprayed with water on a regular basis to minimize the generation of dust.

1.3 RUBBISH CONTROL

A. During the progress of the Work, the Contractor shall keep the Site and other areas used by it in a neat and clean condition and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Site and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

B. In the event that the Contractors work zone restricts municipal trash or recycling collection or makes it difficult for residents to bring trash or recycling to the street, the Contractor shall collect all trash and recycling within the work zone and transport it outside the work zone for municipal collection. Return trash and recycling receptacles back to respective properties.

1.4 SANITATION

A. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.

B. Sanitary and Other Organic Wastes: The Contractor shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of away from the Site in a manner satisfactory to the Work and in accordance with all laws and regulations pertaining thereto.

1.5 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.6 CULTURAL RESOURCES

A. The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").

B. The Contractor shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.

C. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The Engineer will issue a Field Order requiring the Contractor to cease all construction operations at the location of such potential cultural resources find.

2. Such Field Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the State Historic Preservation Office.

D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the State Historic Preservation Office, the Contractor shall suspend work at the location of the find under the provisions for changes contained in the General Conditions.

1.7 NOISE CONTROL

A. The Contractor shall comply with the City of Cambridge Noise Ordinance.

B. The Contractor shall make every effort to minimize noises caused by his/her operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with State and Federal (OSHA) regulations.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01560

SECTION 01568

EROSION CONTROL, SEDIMENTATION AND
CONTAINMENT OF CONSTRUCTION MATERIALS

1568.1 SEDIMENTATION AND EROSION CONTROL LUMP SUM

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide all work and take all measures to control soil erosion resulting from construction operations, prevent flow of sediment from construction site.

1.2 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTAL PROCEDURES:

1. Two weeks prior to the start of the work, the Contractor shall submit for review, a plan with detailed sketches showing the proposed methods to be used for controlling erosion during construction.
2. Contractor shall submit manufacturer's literature describing products, installation procedures, and routine maintenance of the sediment filter device and composting sock.
3. Contractor shall submit one sample of a sediment filter fabric device as produced by the manufacturer for the City's Approval.

1.3 QUALITY ASSURANCE

A. Use acceptable procedures, including water diversion structures, diversion ditches, composting socks, settling basins, and sediment filter devices.

B. Operations restricted to areas of work indicated on Contract Drawings.

C. If construction materials are washed away during construction, contractor shall remove materials from fouled areas.

PART 2 – PRODUCTS

2.1 COMPOSTING SOCKS

A. Composting socks shall consist of a three-dimensional tubular sediment control and storm water runoff filtration device.

B. The compost material for the composting socks shall consist of unvegetated composting material and be made with sanitized, mature compost that has no identifiable feedstock constituents or offensive odors. The compost used in the composting sock shall meet all local, state, and Federal quality requirements.

C. The mesh material for the composting socks shall be biodegradable.

2.2 SEDIMENT FILTER DEVICE

A. Sediment filter device shall be manufactured to fit the opening of the catch basin or drop inlet. The sediment filter device shall have the following features:

1. Two dump straps attached at the bottom to facilitate the emptying of the device and shall have lifting loops as an integral part of the system.

2. Yellow restraint cord approximately halfway up the sack to keep the sides away from the catch basin walls. Yellow restraint cord is also a visual means of indicating when the sack should be emptied.

3. Fabric shall consist of a woven polypropylene geotextile and be sewn by a double needle machine, using a high strength nylon thread.

4. Sediment filter device shall have a certified average wide width per ASTM Standard D-4884 standard of 165 lbs/in.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall not discharge chemicals, fuels, lubricants, bitumen, raw sewage, and other harmful waste into or alongside any body of water or into natural or manmade channel.

B. It is the intent of these Specifications to prevent the unnecessary occurrence of sedimentation or siltation of waterways and private properties. In the event the sedimentation or siltation prevention measures used by the Contractor prove to be inadequate as determined by the City and Engineer, the Contractor shall be required to adjust his operations to the extent necessary to prevent any such

sedimentation or siltation from occurring, at no additional cost to the City.

3.2 INSTALLATION

A. Composting Socks shall be placed to form temporary water stops, dams, diversions, dikes, berms and for other uses connected with water pollution control and; composting socks shall be disposed of by the Contractor upon completion. Composting socks shall be installed per manufacturer's written installation procedures.

B. The Contractor shall protect catch basins by installing sediment filter devices as specified in this Specification in every catch basin within and downstream of the project limits.

C. The Contractor shall install the sediment filter device before any work begins and shall place the device so that it is flush with the material around the frame of the grate of the catch basin structure. The Contractor shall be responsible for maintenance and placement of the strap lift holes to ensure that they do not become a hazard for pedestrians.

D. The Contractor shall maintain the sediment filter device and remove the collected debris as required by the Engineer. If any material is lost in the removal of the sediment filter device, then the Contractor shall be responsible for cleaning of the catch basin. The Contractor shall inspect the position of the device to ensure that the sediment filter device will work properly during any heavy rain or any storm greater than a 10-year flood.

E. Existing natural drainage patterns and vegetative cover shall be preserved to the maximum possible extent.

F. The Contractor shall use temporary vegetation, mulching, and paving to protect areas exposed during construction. He shall minimize the amount of bare earth exposed at any one-time during construction, and he shall also minimize the length of time bare earth is exposed.

G. On sloping terrain, composting socks may be used to trap sediment until vegetation has become established. The details of their placement shall be as approved by the Engineer.

H. Water that is being pumped from the trenches or excavations shall not be pumped directly into water courses or pipe conveyance systems. At a minimum, sedimentation control measures shall include portable sedimentation tanks, pumps, and piping, or other means acceptable to the City and Engineer to meet the water quality parameters specified in both the NPDES Dewatering Permits and these Specifications, whichever is more stringent.

I. Spoil resulting from the trench excavation shall be leveled or removed to permit free entry of water from adjacent land surfaces without excessive erosion or harmful ponding.

PART 4 – COMPENSATION

Item 1568.1 – Sedimentation and Erosion Control

METHOD OF MEASUREMENT:
Measurement for payment for Sedimentation and Erosion Control will be on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS
Payment for Sedimentation and Erosion Control will be based on the bid for this item in the proposal. Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment and incidentals required to furnish, install, maintain, relocate, and remove all sedimentation and erosion control measures. Under the Unit Price bid for this item, the Contractor shall also furnish all labor, materials, tools, equipment and incidentals to prepare and submit all work plans and submittals; line all existing and new catch basins with sediment filter devices and remove prior to inclement weather; install, maintain, and remove composting socks; install, maintain and remove temporary vegetation for erosion control; removal and disposal of all silt and sediment collected from sedimentation and erosion control measures; and all other items of work not specifically included herein or elsewhere required to furnish, install, maintain, relocate, and remove sedimentation and erosion control devices as specified and required.

END OF SECTION 01568

SECTION 01571

MAINTENANCE AND PROTECTION OF TRAFFIC

1570.1	**TRAFFIC AND PEDESTRIAN MANAGEMENT**	**LUMP SUM**
1570.2	**REMOTE CONTROLLED CHANGEABLE MESSAGE SIGN**	**UNIT WEEK**

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, equipment, and materials and perform all operations in connection with the maintenance and protection of vehicular, transit, bicycle, and pedestrian traffic on all roads, state and local, directly or indirectly affected by the construction. The work of this section also includes maintaining access to all properties adjacent to the work.

B. The Contractor is responsible for preparing and submitting plans for traffic management to the City and Engineer, including updates as conditions warrant and as appropriate to the various phases of construction. The Contractor is responsible for design and implementation of revisions to the traffic management procedures during the course of the project at the requirements of the Engineer and at no additional cost to the City.

C. The Contractor shall develop and implement a detailed Traffic Management and Control Plan, Engineer to review plan and Contractor to obtain approval from the City of Cambridge Traffic, Parking and Transportation Department and Department of Public Works four (4) weeks prior to proceeding with the work.

D. Coordination with MBTA is required for temporary relocation of bus stops. Bus stop access shall be maintained at all times during construction unless otherwise agreed to by MBTA and City. Coordination is also required for work in the vicinity of the MBTA Red Line escalators and stairways at the intersection of River Street and Massachusetts Avenue.

E. Furnish, erect, set, reset, relocate, move, remove, and maintain signs, temporary lighting, barrels, flashers, channelizing devices (concrete barriers), fencing, and other traffic control devices on a continuous basis as necessary to protect the work and the general public at all times during construction in accordance with Contractor's approved Traffic Management and Control Plans. The work of this Section shall also include temporary bridging or plating for traffic across excavations.

F. The design, application, and installation of all traffic control devices required by this section shall conform to the requirements of the Manual on Uniform

Traffic Control Devices (MUTCD) published by U.S. DOT, latest edition; Massachusetts Amendments to the 2009 MUTCD and the Standard Municipal Traffic Code; MassDOT Standard Details and Drawings for the Development of Temporary Traffic Control Plans; American Disabilities Act (ADA); Massachusetts Architectural Access Board; and the Massachusetts Department of Transportation – Highway Division (MassDOT), Standard Specifications for Highways and Bridges, latest edition. All traffic signs provided by the Contractor must be gender-neutral.

G. "Approved by the City" throughout this Section shall mean the review by the Engineer and approval of the Cambridge Department of Public Works and Traffic Parking and Transportation Department.

H. Traffic control during construction also includes street sweeping and snow removal from sidewalks and streets within the work zone as described in section 3.1 D. Maintaining rubbish and recyclable removal is also required and described in Section 01560 - TEMPORARY ENVIRONMENTAL CONTROLS.

I. Designated accessible parking spaces must be maintained at all times. If a designated accessible parking space must be impeded the contractor must make arangements to temporarily relocate the spot to the nearest reasonable space as possible. The contractor must coordinate relocating an accessible parking space ahead of time with the City and the Engineer. The Contractor must supply MUTCD and City approved signage to designate the relocated accessible spot. The accessible spot must be coordinated with the intended user and notification shall be provided in advance.

1.2 REFERENCES

A. Reference is made herein to the MassDOT, Standard Specifications for Highways and Bridges, latest edition. References made to particular sections or paragraphs in the Standard Specifications for Highways and Bridges shall include all related articles mentioned therein.

B. Manual of Uniform Traffic Control Devices Part VI Standard and Guides for Traffic Controls for Streets and Highway Construction, Maintenance, Utility and Incident Management Operations, latest edition.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Traffic Management and Control Plan: Before starting any work under this Contract, the Contractor shall prepare a plan that indicates construction equipment movement and the traffic routing proposed by the Contractor during the various stages and time periods of the work, and the location of temporary pedestrian, bicycle routes and construction facilities, temporary barricades, signs, drums, and other

traffic control devices to be employed during each stage and time period of the work, to maintain traffic and access to abutting properties. The plan must be in accordance with the latest edition of the MUTCD and certified by the Contractor's Engineer. The Plan must specifically identify any proposed temporary relocation of MBTA or private bus stops; and/or detours of MBTA or private bus routes from their pre-construction routings. Particular care shall be taken to establish and maintain methods and procedures that will not create unnecessary or unusual hazards to public safety. The Plan shall be submitted a minimum of four weeks prior to the start of construction for acceptance by the Engineer and approved by the City prior to start of Work. The Plan shall be reviewed on a daily basis with the Engineer during construction. The Plan shall include procedures for the Contractor to coordinate daily with City Departments (Department of Public Works, Traffic and Parking Department, Police, Fire, and Emergency Medical Services). Traffic Management Plans shall depict the actual site, traffic signals, pedestrian crosswalks, proposed MUTCD traffic control signs, proposed vehicular detours, bike lanes and their protection thereof, pedestrian travel, pedestrian detours, sidewalk closed and pedestrian detour routes and signage, maintenance of ADA access, temporary pedestrian ramps if the sidewalk closures are not at existing ADA ramps, accessible parking spaces, bus stops for public, school and private busses

2. *Temporary Pedestrian Access Ramp Work Plan, Temporary Pedestrian Protection Work Plan and Temporary Pedestrian Detour Plan*: Contractor shall provide a work plan detailing the location and layout of temporary ramps and their protection, type of ramps and protection to be used with manufacturer's information, and duration the ramps and protection will be utilized. These ramps and associated sidewalk access areas shall be a minimum of 10 feet in width to allow for sufficient capacity at peak times. If this constraint cannot be met, the Contractor is to evaluate the peak pedestrian times to determine the demand and submit findings to the Engineer for approval. All pedestrian detours required shall be submitted for approval with these plans.

B. Shop Drawings shall be submitted for review four (4) weeks prior to start of construction. Thereafter, the Contractor shall submit to the Engineer updated Traffic Management and Control Plans a minimum of 10 working days prior to the start of construction at any new location or updates required in the work zone resulting from progress of Work throughout the duration of construction.

1. Submit complete shop drawings and work plans for staged construction and traffic movement including temporary vehicle, pedestrian, and bicycle as needed.

2. Show on the shop drawings all materials, dimensions, sizes, and methods of installation.

3. Safety Signing for Construction Operations: The Contractor shall submit temporary pedestrian, bicycle, and traffic management sign placement and sign size sketches showing the proposed sign setups intended to be used to provide the necessary traffic control and protection during the progress of work, plus the sign and legend size and layout. These sketches shall be submitted to the Engineer and City for review and approval before work begins.

4. When a detour or by-passing of vehicular traffic is anticipated, the Contractor shall submit for approval by the Engineer and City, a detour plan showing the proposed alternative routes and location, size, and type of signs and traffic controls to be used. The traffic routing through or around the Work and provisions for control of same shall be approved by the Engineer and City.

5. The Contractor shall submit a Truck and Hauling Route Work Plan for all proposed truck routes prior to mobilizing. No trucking or hauling will be allowed without the approval of the City of Cambridge. No trucking or hauling will be allowed outside the proposed routes without the prior approval of the Engineer and City. The Contractor is responsible for obtaining all permits and permissions. The Contractor is further responsible for obtaining approval for and coordinating parking restrictions required to facilitate trucking and hauling.

6. Contractor is responsible for providing appropriate advance warning signs limiting and/or restricticting truck access and to update controls as needed if a problem for truck detours to local streets develops or implementation of time-of-day restrictions are necessary.

1.4 SPECIAL REQUIREMENTS

A. The Contractor shall provide access for fire apparatus and other emergency vehicles through the work zones to abutting properties at all times. Equipment and materials shall be stored at least fifty (50) feet away from an intersection so as to not obstruct turning radii for emergency vehicles or lines of sight and is subject to approval by the City and the Engineer.

B. At the end of each workday, where trenches in areas of public travel are covered with steel plates, each edge of the plates shall be either beveled or protected by a bituminous concrete ramp as accepted by the Engineer. Temporary bituminous patching material may be used to construct the ramps. The cost of patching materials, and their maintenance and removal, will be considered incidental to the Traffic Management item with no separate payment elsewhere. Plates shall be pinned or welded together to eliminate movement, noise or vibration. Use of steel plates are as approved by the City and the Engineer. Steel plates shall be removed from the right of way during

inclement weather. The subsurface shall be flat to minimize deflection of the plates. Steel plates shall be supported to allow for H-20 loading when traffic is resumed on top of the plates. All steel plates shall be signed with "STEEL PLATES AHEAD" to advise motorists of the steel plates.

C. Open excavations adjacent to the traveled way or shoulders shall not remain open through non-work hours unless steel plated for the passage of heavy vehicles or protected by concrete barricades or barriers and specifically authorized by the City and Engineer.

D. Do not block more than one-side of the roadway at a time when making open cut or other street crossings unless otherwise approved.

E. The Contractor shall be responsible for the costs in obtaining all permits to perform the Work.

F. At least one serviceable driveway access to all residences and businesses within the project shall be maintained at all times unless otherwise approved.

G. The Contractor shall provide temporary lighting to properly illuminate the work area and approaches in the event of nighttime work. Equipment must not exceed 65 decibles (dB) measured 10 feet away.

H. The Contractor shall not allow unnecessary idling of trucks and/or equipment throughout the entire project area. The City of Cambridge prohibits idling of trucks and equipment for periods of time exceeding five (5) minutes when not in use.

I. The Contractor shall notify the Cambridge Fire and Police Departments of any street closings.

1.5 SEQUENCING AND SCHEDULING

A. All streets within or adjacent to the contract limits shall have their full roadway widths available for traffic or permitted parking at all times except for such restrictions as may be approved by the City and Engineer.

B. Notify the City and Engineer at least 48 hours in advance (not including Saturday or Sunday or Holidays) prior to the access lane restriction of the roadway. Notification shall include the date of the restriction, the hours of the day the roadway access will be restricted, and the estimated completion date.

C. The City and Engineer shall be notified of any re-routing of traffic 48 hours in advance (not including Saturday or Sunday or Holidays). Approval shall be obtained from the City and Engineer prior to any re-routing of traffic (except emergencies).

D. The Contractor shall verify street sweeping schedules in the work zone. Delivery related parking restrictions will not be permitted on days where street sweeping is scheduled unless otherwise approved.

1.6 HAULING AND TRUCK ROUTES

A. The Contractor is advised that all roads and bridges within or adjacent to the project shall be subject to legal loads, heights of vehicles and vehicle type / use restrictions. The Contractor is responsible for understanding the restrictions and obtaining all necessary permits.

B. The Contractor is advised that no agreements have been made by the City of Cambridge, MassDOT, or with surrounding cities or towns to relieve the Contractor of liability for damage to local roads and bridges caused by the Contractor's operation. The Contractor shall contact appropriate officials of the surrounding cities, towns or agencies concerning hauling over city or town roads and bridges.

1.7 STORAGE OF MATERIALS, PARKING OF CONSTRUCTION EQUIPMENT AND WORKER PARKING

A. No material shall be stored within the work area or on adjacent roadways or residential streets except that which is needed to complete the work for that day and approved by the City and the Engineer. Any material approved to be stored in the roadway shall be at a minimum of fifty (50) feet away from an intersection to allow for all emergency response vehicles to navigate the corners and intersections and to minimize line of sight obstruction.

B. If permitted by the City and the Engineer; The Contractor shall park construction equipment within the work zone and protect equipment with barriers or barricades. Parking outside the work zone will be required if the equipment obstructs traffic flow. All equipment parking and storage must be approved by the City and Engineer. Any equipment approved to be stored in the roadway shall be at a minimum of fifty (50) feet away from an intersection to allow for all emergency response vehicles to navigate the corners and intersections and to minimize line of sight obstruction.

C. See Section 01010 SUMMARY OF WORK for provisions related to Contractor employee parking.

1.8 BARRICADES, WARNING SIGNS AND OTHER PROTECTIVE DEVICES

A. Install, inspect, remove, maintain, and reset all temporary construction controls as frequently as required and in accordance with an approved construction staging sequence and traffic management plan.

B. Regulatory and warning devices shall be subject to removal, replacement and repositioning as often as necessary, and as directed by the City and Engineer.

C. Temporary pavement markings and devices shall be used as shown on the approved plans and as required by MUTCD, MassDOT Amendments to the MUTCD, and ADA standards for traffic control and pedestrian safety.

D. Existing pavement marking shall be maintained at all times. When existing pavement marking are disrupted by the work they shall be replaced at no additional expense to the City.

1.9 POLICE DETAILS SERVICE

A. Uniformed City, Municipal, or State police officers shall be utilized to maintain safe traffic flow throughout the construction period. A Police Detail is to be present during all construction activity. Scheduling Police Details shall be the responsibility of the Contractor. To schedule a detail officer, call (617) 349-3350.

B. The Cambridge Police Department requires 24-hour advance notice to obtain a Police Detail, except in emergencies and 4-hour advance notice to cancel a detail. Contractor shall use as many police details as needed to ensure the safety of pedestrians and traffic at all times.

C. The Contractor shall coordinate all work with the police officers including but not limited to: locations of work, delivery of materials, equipment movement, required traffic management and schedules.

D. The Contractor must submit all signed detail forms to the project managers or engineer, so that Public Works can pay all submitted and approved Police Detail invoices. Any invoices that are not approved will be the responsibility of the Contractor to pay.

E. The City of Cambridge Police Department shall bill the City of Cambridge Department of Public Works or whatever department has oversight of the contract for the services of uniformed police officers provided by the Police Department.

F. The Contractor will be required to reimburse Public Works or whatever department has oversight of the contract for Police Details, if the Contractor fails to show for the job or if the Contractor fails to cancel the detail with adequate advance notice.

1.10 PEDESTRIAN TRAFFIC

A. Sidewalks and pedestrian ramps shall be maintained at all times through the construction period. Temporary sidewalks, pedestrian detours and pedestrian and construction facilities shall be constructed as needed to maintain pedestrian traffic and business access. The Contractor shall anticipate that temporary pavement markings (paint or tape) will be required in order to comply with this provision.

a. Constructed items such as approved temporary sidewalks and ramps will be paid for under the appropriate items of the Contract. Temporary signs, markings and other traffic control devices will be paid for under Item 1571.1 Traffic and Pedestrian Management.

B. Pedestrian access shall be provided to abutting land uses and businesses at all times, as approved by the City and Engineer and in accordance with MUTCD, Massachusetts Amendments to the MUTCD, MassDOT Standard Drawings and Details, and ADA requirements.

C. Unobstructed walkways of 4-feet minimum width, unless otherwise approved by the City and Engineer shall be provided at all times.

D. Temporary pedestrian walkways shall be separated from roadway and construction areas by barricades and fence as approved by the City and Engineer. Pedestrian walkway barricades shall be firm, cane-detectable at top and bottom and securely fixed in place. These provisions will be strictly enforced. The use of isolated, discontinuous, and non-detectble roadway channelizing devices such as traffic cones or barrels is not acceptable.

E. The Contractor shall be notified by telephone of any location not providing adequate pedestrian access. The Contractor shall acknowledge notification of the call within one (1) hour by contacting the Project Engineer or the Public Works Dispatcher at (617) 349-4800.

F. The Contractor shall respond to the work site within one and a half (1.5) hours of acknowledged notification with sufficient equipment and labor to perform the required work.

G. The Contractor's failure to respond within the specified response time twice within the Contract time will result in a permanent deduction of $250.00 from Contract payments due.

H. The Contractor's failure to respond within the specified response time three times within the Contract time will result in an additional permanent deduction of $400.00 from Contract payments due.

I. The Contractor's failure to respond within the specified response time four or more times within the Contract time will result in an additional permanent deduction of $500.00, per each additional occurrence, from Contract payments due.

J. Continued failure to provide adequate pedestrian access may result in the City terminating the contract in accordance with Paragraph 18.3 of Section 800 (General Terms and Conditions of the Contract).

1.11 VEHICULAR TRAFFIC

A. The Contractor shall meet the following conditions, unless otherwise specifically approved by the City and Engineer:

1. All work shall be prosecuted with proper regard for the convenience of the public and in a manner to permit unimpeded traffic flow whenever possible. The interruption of traffic will not be permitted unless specifically allowed by the City and Engineer and in accordance with the requirements of the City and in conformance with MUTCD and Massachusetts Amendments to the MUTCD.

2. The Contractor shall be responsible for necessary coordination with the City departments affected by the project.

    a. The Contractor shall be responsible for coordination with the Cambridge Fire Department, specifically as it relates to access for the River Street Fire House located at 176 River Street.

3. The Contractor shall provide for one travel lane on River Street (minimum 15 foot width to accommodate both vehicles and bicycles unless alternative dedicated bicycle facilities of equal or greater comfort are provided) throughout the project area at all times, except for times when alternate travel setups have been approved per the TMP.

4. The Contractor shall maintain travel lanes at intersection approaches. If lane width reductions are needed (minimum 11 foot width), the lane reductions shall be in accordance with MUTCD and Massachusetts Amendments to the MUTCD.

5. Traffic control devices and signs shall be removed, demounted or properly covered for those periods of the day not in use.

6. The Contractor shall coordinate the work with the schedules of City Rubbish and Recycling Collection trucks and delivery trucks to the adjacent stores and property owners so as not to impede their access, and cooperate with delivery personnel to facilitate deliveries to properties within the work zone.

7. No operations shall be conducted, including the loading or unloading of equipment or materials, on or near the traveled lanes or road shoulders without first erecting warning signs and channelizing devices. These precautions shall be maintained at all times while work, loading and unloading is in progress.

8. Construction signs and channelizing devices shall be used to separate traffic from the work areas and for traffic control. Placement, other than as shown in the plans or the MUTCD, will require prior approval. The Contractor shall locate temporary signs and channelizing devices so that they do not impede safe travel for pedestrians and bicycles.

9. Temporary signs and channelizing devices shall not be set up until there is adequate visibility or appropriate construction lighting. The Contractor shall schedule his work so that temporary signs and channelizing devices are removed and traffic is returned to its normal pattern before the end of the work period.

10. Work requiring overnight lane closures shall not begin until all materials required for the completion of each nights work are delivered or available to the project site, unless otherwise approved by the City and Engineer. Night work is to occur only with approval by City and with appropriate Noise Ordinance variances.

11. Accesses to residential and commercial buildings shall be maintained at all times for pedestrians.

12. Work operations shall not be performed on the roadway in such a manner that traffic is obstructed or endangered simultaneously from both sides of the roadway unless otherwise reviewed by Engineer and approved by City.

13. The Contractor shall keep all roadway areas open to traffic as clear as possible at all times. Materials shall not be stored on any roadway area or within four (4) feet of the traveled way. Material shall be delivered to the installation areas as they are needed to provide a continuous installation. Location of storage areas shall be subject to approval.

14. The Contractor may occupy a maximum of 100 linear feet of curb lane at any time for its operations, or for storage during non-working periods. The remainder of available curbside frontage shall be available for parking/loading or bus stops as appropriate.

15. The Contractor shall remove all equipment and construction vehicles from the traveled way and shoulders open to traffic during non-work hours. Vehicles shall be parked no closer than four (4) feet from the traveled way in pre-approved areas unless specifically permitted.

16. Each driver of any vehicle or piece of equipment used on this contract shall be furnished written instructions concerning the manner of operation for that vehicle or piece of equipment. Specifically, these instructions shall warn against stopping on the traveled portions of the roadway, against passing other vehicles, and against traveling in close proximity to other vehicles. A copy of these instructions shall be given to the Engineer.

17. Temporary signs and channelizing devices shall not be set up in inclement weather.

18. The Contractor shall furnish 60-inch x 30-inch approved signs reading "CONSTRUCTION VEHICLE - DO NOT FOLLOW" to be used on trucks hauling to the project, when such signs are deemed necessary by the City

and/or Engineer. The color, type of sheeting and size of lettering shall conform to that of the permanent construction signs.

19. The Contractor shall furnish, install, and maintain 36-inch x 36-inch approved signs reading “ROUGH ROAD” AND “MOTORCYCLES USE CAUTION” in advance of all roadway areas which have been cold-planed. If the road has exposed soils place “GRAVEL ROAD AHEAD” signs in advance of the exposed soil sections.

20. The Contractor shall furnish, install, and maintain additional temporary cones and barrels, as required by the Engineer, after Traffic Calming devices (horizontal and vertical deflections) have been constructed.

21. The Contractor will be responsible for snow removal within active work zones. Snow shall be removed from the entire right of way inclusive of the entire traveled way, bike lanes, parking lanes, bus stop areas and sidewalks within the areas the contractor is working.

22. Driveways cannot be blocked for weekends. During sidewalk pours the driveway apron must be available for the weekend. If the contractor elects to pour a driveway apron on a Friday they must commit to removing the forms on Saturday morning to allow for driveway access over the weekend. Driveway apron blocking must be coordinated with the propery owners ahead of time and in some cases a temporary driveway access must be provided by the contractor to the property at no additional cost to the City.

23. Traffic signals shall be maintained in normal operation at all times. Traffic loops shall be repaired immediately if the traffic signals are critical to maintaining traffic flows as in systematic programmed signals that include operation of more than one set of signals at no additional expense to the City. Where traffic signals are simple in their application and allowed by the City and Engineer, traffic loops shall be repaired within a week of their disruption at no additional expense to the City.

1.12 BICYCLE TRAFFIC

A. The Contractor shall meet the following conditions, unless otherwise specifically approved by the City and Engineer:

1. Bicycle traffic shall be accommodated on all public streets either within bicycle lanes where existing or in vehicular travel lanes.

2. Where bicycle lanes are not present, provide a shared vehicle lane as wide as physically feasible.

3. When travel lanes are restricted to less than fourteen (14) foot in

width, warning signage (W11-1/W16-1 combination - Bicycle warning symbol with SHARE THE ROAD plaque) shall be placed warning motor vehicle operators of the presence of bicycles in the roadway.

4. If the disruption occurs in a bicycle lane over a short distance (approximately 500 feet or less), bicyclists should be routed to share a motor vehicle lane. In locations where bicycles and vehicles share the same lane a "BICYCLES MAY USE FULL LANE" sign shall be placed with the construction signage.

5. When existing bicycle lanes are to be transitioned to shared lanes due to construction, the following shall also apply:

   a. "BICYCLE LANE ENDS" sign shall be placed as directed by the Engineer. This sign shall not be placed in the bicycle lane.
   b. To create the merge of the bicycle lane and the vehicular lane, orange traffic cones should delineate a taper. Cones must be spaced 6 feet apart and be connected with traffic cone bars. The taper length for bicycle traffic must be 18 feet long and the downstream end should be 6 feet upstream of the work zone.

6. Steel plates:

   When steel plates are used in the travel way warning signage (Warning Steel Plates 100 FT) shall be placed at least 100 feet in advance.

   Steel plates shall be set so there is no vertical lip over 1/4 inch between the plate and adjacent pavement. This shall be accomplished in one of the following ways:

   a. Recessing the plate so that the top of the plate matches adjacent pavement (with no lip over 1/4 inch).

   b. Providing bituminous concrete lip painted reflective pink to provide a smooth transition slope up from existing pavement to top of plate.

   Non-slip surface steel plates are preferred for use, and must be used where plates are in an intersection, on a hill, or within a crosswalk.

   Steel plates used to support traffic must be at least H-20 rated.

   Steel plates that deflect under the weight of vehicles must be removed and reset with additional support provided to minimize deflection.

7. Raised castings: Where raised castings are present after cold planing and/or in anticipation of final paving and/or anytime castings will be left raised for more than 12 hours, provide the following:

   a. Advance warning signs saying: “Caution – Raised Castings Ahead.”

   b. Spray paint reflective fluorescent pink the raised portions of the castings in their entirety. Spray paint shall be re-applied daily, or as needed, on all raised castings to maintain visibililiy.

8. Cold planing and pavement installation: Where cold planing or the installation of pavement in lifts results in vertical joints greater than 1/4 inch, provide temporary bituminous concrete lip painted reflective pink to provide a smooth transition slope between the pavement layers. Paint shall be reapplied daily, or as needed, to maintain a visible queue of joint.

9. When the roadway or travel lanes narrow due to construction, advance warning signs should be placed at least 20 feet in advance, and in accordance with the MUTCD and the Massachusetts Amendments to the MUTCD.

10. Narrow cuts that are parallel with the direction of travel create an extreme hazard for cyclists, whose tires could get caught. These should never be made and left in an area where bicyclists will be traveling. If necessary, they should be blocked off and cyclists routed around the hazard. When performing advance pavement cutting for trenching or other roadway excavation, use only saw cutting (approximately 1/4 inch or narrower).

11. Debris should be swept to maintain a reasonably clear riding surface in the bicycle lanes or, where there are no bicycle lanes, the outer 5 or 6 feet of roadway. Promptly remove gravel, debris, litter, sand, stone, and other obstructions from bicycle lanes and travel lanes.

12. Advance construction signs shall not be placed in bicycle lanes and shall not otherwise obstruct bicyclists’ path.

13. Temporary ramps for site access ramps. The creation of ramps in the roadway is not permitted unless being created in an area that is otherwise used by on-street parking.

14. Restore pavement markings for bike lanes within 2 weeks of paving.

PART 2 – PRODUCTS

2.1 MATERIAL

A. All barricades, drums, cones and other channelizing devices shall meet the requirements for MassDOT Standard Specifications for Highways and Bridges Section 850 Traffic Control for Construction and Maintenance Operation (Latest Revision) and the Manual of Uniform Traffic Control Devices (Latest Revision).

B. Traffic Control Materials

1. Materials required for the work of this Section need not be new, but must be in first-class condition and acceptable to the City and Engineer. Any materials that in the judgment of the City are unsatisfactory in appearance or performance shall be removed and immediately replaced by acceptable units.

2. Signs, portable barricades, and drums shall have "High Intensity Encapsulated Lens Reflective Sheeting" in accordance with Section M9.30.2 of the MassDOT Standard Specifications for Highways and Bridges and MUTCD requirements.

3. Signs shall be fabricated with "High Intensity Encapsulated Lens Reflective Sheeting". Transparent red, blue, yellow or black opaque paint (ink) may be used over "High Intensity Encapsulated Lens Reflective Sheeting" in accordance with the provisions of subsection M9.30.2, "D.2 Surface", of the MassDOT Standard Specifications for Highways and Bridges, where these colors are specified.

4. Safety signage for construction operations shall consist of furnishing, positioning, repositioning, inspecting, maintaining, and removing regulatory, warning, and guide signs and temporary bus stop signs and taxi stop signs and their supports as approved by the City and Engineer.

5. Replace all signs and posts, which are damaged or are missing from their location at no additional cost to the City.

6. Maintain all signs in a satisfactory manner including the removal of dirt or road film that cause a reduction in sign reflective efficiency.

C. Portable Barricades

1. Furnish, install, relocate, remove, re-install, and maintain portable barricades in accordance with MassDOT and MUTCD requirements or as directed by the City and Engineer.

2. Portable barricades shall conform with Standard Plate No. 40612 of the MassDOT (Metric Edition). Reflectorized sheeting shall conform

to Section M9.30.2, of the MassDOT Standard Specifications for Highways and Bridges.

3. Eight-foot-long units of portable barricades shall be constructed, as needed.

4. Alternating 6 inches (152.4 mil) wide diagonal stripes shall be orange and white and shall slope downward at 45 a degree toward the end by which traffic is to pass. Barricades that block the passage of traffic or designate the end of the traveled way shall have alternating vertical orange and white stripes on the rails.

5. Barricades shall be maintained in good and serviceable condition throughout the duration of the Contract.

6. Temporary pedestrian and construction facilities shall be kept clean and freshly painted as required.

D. Signs, Covered

1. Cover any existing regulatory and warning signs as required by the City and Engineer.

2. Use a cover approved by the City and Engineer which shall be securely fastened to the existing sign and shall completely cover the legend of the existing sign. The cover shall remain in place as long as necessary at which time it shall be promptly removed.

3. Signs shall be covered without causing any damage to the existing sign.

4. All construction signage that cannot be removed at the end of the day shall be covered at the end of the work day during non-work hours.

E. Traffic Signals

1. Traffic signals shall remain operable at all times throughout the duration of the contract unless approved otherwise by the City.

2. It shall be the Contractor's responsibility to maintain the traffic signal system in continuous and good working order. The Contractor at his expense, shall repair any damage to the traffic signal system resulting from the Contractor's work.

3. Traffic signals shall be maintained in normal operation at all times. Traffic loops shall be repaired immediately if the traffic signals are critical to maintaining traffic flows as in systematic programmed signals that include operation of more than one set of signals at no additional expense to the City. Where traffic signals are simple in

their application and allowed by the City and Engineer, traffic loops shall be repaired within a week of their disruption at no additional expense to the City.

4. The Contractor shall note that there are Fire Department pre-emption systems on the signals at River Street/Green Street/Massachusetts Avenue and at River Street/Kelly Road/Howard Street. These systems shall remain functional at all times, and the Contractor shall coordinate with the Cambridge Fire Department in advance of any required interruptions.

F. Temporary Precast Concrete Barriers and Work Zone Protection

1. Temporary precast concrete barriers shall be furnished and installed as shown on the approved traffic management plans and where required to protect work zones and excavations which cannot be completed and backfilled or plated within a daily work period. Fencing shall be affixed to the barriers to a height of six feet above the road surface and shall not have any holes in the perimeter barriers or fencing larger than the chain link fencing spacing (2 inches by 2 inches). Barriers shall be removed or relocated when no longer required and with the approval of the City and Engineer.

2. Precast concrete median barrier shall conform with Standard Plate No. 401.15.1 of the MassDOT, as well as be acceptable for temporary pedestrian and construction facilities and signage.

3. Temporary precast barrier for use for temporary pedestrian and construction facilities shall have three sleeves cast in the barrier to receive a post for panel and fence installations.

4. Temporary chain link fence, four (4) feet high, with a dust screen, shall be erected at work zones abutting pedestrian travel paths and around work zones hazardous to pedestrians in conjunction with precast barriers to form a “safety zone” seven (7) feet high, or as required by the City and Engineer. The barriers and fencing shall be overlapped at the corners of the excavated area to provide a continuous protective screen.

G. Remote Controlled Changeable Message Signs

1. The internally illuminated changeable message sign shall consist of a magnetically operated matrix, LED, fiber optic, or lamp matrix message board; a diesel engine driven generator power supply; hardware for connection to a 110 volt power source; and a computer operated interface, all mounted on a towable, heavy duty trailer.

2. In the raised position, the bottom of the sign shall be at least seven (7) feet above the pavement surface. The sign shall be clearly legible for a distance of 900 feet.

3. The sign shall be controlled by an on-board computer. The sign shall automatically change to a pre-selected default message upon failure. That default message shall remain on display until the problem is corrected.

4. The Remote-Controlled Changeable Message Sign unit shall be equipped with a security system to prevent unauthorized access. The security system shall allow access only through use of a code or password unique to that sign. If the proper code or password is not entered within 60 seconds of initial telephone contact, the call will be terminated. Remote control for the changeable message sign shall be by cellular telephone and touch tone modem decoder.

5. The lamp matrix, LED or fiber optic sign, shall be equipped with a top-mounted photocell for automatic sign dimming during nighttime use.

6. The remote controlled portable changeable message sign shall be capable of performing all functions at ambient temperatures ranging from -31° to 165°F (–35 to 74°C). There shall be no degradation of operation due to fog, rain or snow. Maintenance shall include periodic cleaning. When not being used the sign shall be stored in a secure area approved by the Engineer.

7. Message Sign

    a. Type – The technology can be LED or a combination of both Flip Disk and LED (Hybrid).

    b. Matrix Displays – Shall be character, line or full matrix.

    c. Size – The message sign shall have a minimum height of 6 feet, maximum height of 6.5 feet and a minimum width of 8 feet, maximum width of 12 feet. (Note: Narrower signs may be used in locations where required to avoid obstructing vehicular, bicycle, or pedestrian traffic).

    d. Colors – The display shall be either fluorescent yellow or ITE amber.

    e. Lines – The message sign shall have the capability of displaying at least three lines of 18-inch characters with a minimum of 8 characters per line.

8. The sign shall be capable of storing 100 pre-programmed messages and be able to display any one of those messages upon call via the trailer-mounted terminal or through the cellular telephone hookup.

9. The sign shall be capable of operation from a diesel-powered generator, a battery, or solar power. The power supply shall be protected from the weather and be locked for security.

10. The trailer shall include swivel jacks capable of leveling the trailer on a 1:6 (1 vertical to 6 horizontal) slope and capable of stabilizing the trailer in winds of up to 80 miles per hour. The sign shall be capable of being locked in a stowed position while being towed

PART 3- EXECUTION

3.1 GENERAL

A. Conduct the work in manner that interferes as little as possible with public travel, whether vehicular or pedestrian.

B. Provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel whenever it is necessary to cross, or obstruct roads, driveways, and walks, whether public or private.

1. Give a minimum of 48 hours (not including Saturday, Sunday or Holidays) written notice to owners of private driveways before interfering with them.

C. Provide temporary surfacing on shoulders when necessary.

D. Provide snow removal within the work limits to maintain safe and efficient vehicular, bicycle and pedestrian traffic flow, including accesses and sidewalks. Contractor shall plow snow out of the work zone in all areas where municipal snow removal is prevented by construction in the opinion of the City and Engineer. The Contractor shall also remove snow from all sidewalks in areas where construction related activities are occurring or have recently occurred.

E. Provide street sweeping within the work limits to maintain safe and efficient vehicular, bicycle and pedestrian traffic flow, including accesses and sidewalks. The Contractor shall sweep sidewalks, pedestrian walkways and detours, and streets within the work zone on a daily basis. In the event that the Contractors work zone restricts municipal street sweeping in the area, the Contractor shall sweep the restricted streets (including streets outside the work zone) to a point where municipal street sweeping can continue.

F. Street sweeping shall be done a minimum twice per week by mechanical sweepers capable of adding water to the sweeping operation as directed by

the City. Power brooms are prohibited. Small mechanical sweeps (not including power brooms) should be done in conjunction with watering operations unless otherwise approved by the City. Sweeping, watering, and/or the use of calcium chloride shall be used at a minimum at the end of each day and more frequently as directed by the City. Temporary paving as a means of dust control shall be completed, at a minimum each Friday, or more frequently, as directed by the City.

G. Sufficient and adequate signs, flashers, channelizing devices, lights, arrow boards and other precautions necessary to protect the work and the public, as determined by the Engineer shall be used at all times during construction.

H. Provide trench bituminous paving repairs on a daily basis, but at intervals no longer than weekly, unless required or allowed otherwise by the City and Engineer or applicable agency having jurisdiction.

I. Pedestrian access shall be maintained at all times. Access shall be a minimum of four (4) feet, clear of all obstructions and meet all American with Disability Act (ADA) requirements. If an existing pedestrian walkway is interrupted, temporary walkways with ramps shall be provided.

J. Carl Barron Plaza pedestrian access shall be a minimum of ten (10) feet, clear of all obstructions and meet all American with Disability Act (ADA) requirements. If an existing pedestrian walkway is interrupted, temporary walkways with ramps shall be provided with ramps widths as appropriate for the connecting pedestrian access.

K. Contractor shall post “No Parking” signs 48-hours in advance for residential permit parking locations and 24-hours in advance for metered, public, etc. If work does not take place that day, signs must be reposted. Standard Cambridge signs shall be used that provide information regarding proposed construction and parking restriction hours. Signs shall be placed at a minimum of 25-foot intervals. Signs shall be removed or updated immediately upon the completion of the range of dates depicted on the signs.

3.2 DETOURS

A. If approved by the City, and Engineer, construct and maintain detours around the work to maintain traffic over any construction work in a public street, road, or highway where traffic cannot be maintained on alignment of original roadbed or pavement.

B. When detours are allowed, the Contractor shall provide all detour signs approved by the City and/or Engineer with directional arrows. Signs shall be placed at all streets and intersections to provide required direction to allow motorists to return to the street location beyond the detour. The Contractor must submit a written detour plan for the City and/or Engineer's approval prior to implementation of the detour.

C. All detouring and signing shall meet the requirements of the applicable references specified in Parts 1 and 2 above.

D. The Contractor shall provide Police details in the work areas. Contractor shall coordinate vehicle towing with the police.

E. The Detour Plan shall be reviewed and approved by the City, and Engineer prior to establishing any detours.

F. The Contractor is responsible for the notification of any parties affected by the detour, including, but not limited to Cambridge Fire Alarm, Cambridge Police, State Police, MBTA, Cambridge Traffic Department, and abutting property owners.

G. Detour signs shall have a street name placard indicating the name of the road that is being detoured.

3.3 PROTECTION

A. Signs and Channelizing Devices:

1. Locate signs and channelizing devices with lights to protect public thoroughfares which are closed to traffic.

2. Ensure that all open trenches and other excavations have signs, channelizing devices and lights to provide protection to the public.

a. Provide similar warning signs and lights for obstruction such as material piles and equipment.

b. Ensure that the material storage and conduct of the work on or alongside streets causes minimum obstruction and inconvenience to the traveling public.

3. Install and maintain all signs, channelizing devices, lights, and other protective devices in conformity with applicable statutory requirements and as required by the municipalities or agencies having jurisdiction.

4. Illuminate all channelizing devices with flashing lights.

5. No traffic control devices shall be stored adjacent to the roadway.

6. During inclement weather (hurricanes, high winds, snow, etc.) as directed by the City or the Engineer and after the work has suspended for the day or the weekend; remove all signs, barrels, cones and other traffic management devices from the right of way to prevent traffic management devices from blowing over and creating a hazard in the right of way. Any traffic management devices to remain shall be

secured in a manner that prohibits winds from blowing them over or prohibits them from serving their intended function.

B. REMOTE CONTROLLED CHANGEABLE MESSAGE SIGN

1. The Contractor shall furnish, place, operate, maintain and relocate the sign as required. When the sign is no longer required, it shall be removed and become the property of the Contractor. The cellular telephone required for the Remote-Controlled Changeable Message Sign shall be provided to the Engineer for his use, and subsequently returned to the Contractor. When the sign is not in use, it shall either be turned off or turned from view.

2. Any signs that are missing, damaged, defaced or improperly functioning so that they are not effective, as determined by the Engineer and in accordance with the ATSSA guidelines contained in "Quality Standards for Work Zone Traffic Control Devices," shall be replaced by the Contractor at no cost to the State.

3. Signs shall be placed so that they do not obstruct bicycle or pedestrian traffic.

PART 4 – COMPENSATION

Item 1571.1 - Traffic and Pedestrian Management

METHOD OF MEASUREMENT:
Measurement for payment for Traffic and Pedestrian Management will be on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the original Contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Traffic and Pedestrian Management shall be based on the lump sum price bid for this item in the proposal. Under the lump sum price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to provide, maintain, relocate, and remove Traffic and Pedestrian Management in areas directly or indirectly influenced by construction within the limits of work or outside the limits of work; along truck routes inside or outside the limits of work; as delineated in the approved Traffic and Pedestrian Management Plan, by the MUTCD, Massachusetts Amendments to the MUTCD, ADA, MA AAB, and MassDOT standards; and as further required by the City and Engineer. The work includes but is not limited to fabrication of signage; furnishing and installing signage; mounting and securing signage; maintaining signage; protecting and storing signage not in use; relocating signage; removal of signage; The work further includes, but is not limited to obtaining permits; coordination with the City Department of Public Works and Traffic and Parking Department; coordination with private property owners within the limits of work; preparing,

submitting, reviewing, implementing, and revising traffic management and control plans; work zone layouts, installing, and maintaining traffic management devices based on approved traffic management and control plans including precast concrete and/or triplex barriers with fencing and plywood panels, reflectorized drums, lane delineators, portable barricades, temporary crosswalks, and cones; repaint faded pavement markings as needed and as directed by the engineer; removal of existing pavement markings; furnishing, installing, shimming, pinning, maintaining, and removing steel road plates; furnishing, installing, and removing cold patch pavement as necessary or as directed by the Engineer; ordering and coordinating police details; furnishing and installing temporary construction fencing; maintaining roadways and sidewalks inside or outside the limits of work; establishing and dismantling detours; covering existing traffic signs; obtaining, posting and maintaining "No Parking" signs; meeting with police details daily; coordinating police detail locations; and all incidental work, whether listed here or not, required to provide maintenance and protection of traffic and pedestrians.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item and are included for payment elsewhere; bituminous hot mix asphalt pavement; variable message boards; temporary pavement markings; and Police Details. Police Details will be paid directly by the City. Signage damaged as a result of misuse or improper handling shall be replaced by the Contractor at no additional cost to the City.

Item 1571.2 - Remote Controlled Changeable Message Sign

METHOD OF MEASUREMENT:
Measurement for Payment for Remote Controlled Changeable Message Sign (CMSs) shall be based on the number of weeks each changeable message sign is provided, moved, removed and maintained, complete, as required by the City or Engineer. CMSs which are on site but not requested or approved by the City or Engineer shall be at the Contractor's expense, i.e. CMSs which are brought on site earlier than directed, not removed in a timely manner when required, or which are not operational.

BASIS OF PAYMENT:
Payment for Remote Controlled Changeable Message Sign (CMSs) will be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to provide, program, move, remove and maintain changeable message signs in approved locations within or adjacent to the project area, complete, as required by the City or Engineer. The work further includes, but is not limited to the following; coordinating with the City and Engineer for changeable message sign locations; furnishing and setting-up changeable message signs, power supply, programming equipment and appurtenances; maintaining message signs throughout project; relocating message signs to new locations as required by the City and Engineer; transportation and handling; and all incidental work required to furnish, place, program, maintain, relocate, and remove the CMSs. Additionally, for the "Remote Controlled Changeable Message Sign," the cellular telephone service and telephone charges shall be included.

END OF SECTION 01570

SECTION 01600

PRODUCTS, MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install products, equipment and materials as specified and indicated in accordance with the Contract Documents.

B. Provide transportation, handling, storage, and protection of all products, materials and equipment in accordance with the Contract Documents.

1.2 DEFINITIONS

A. The word "Products," as used herein, is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for the project or taken from Contractor's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying and erection of the Work.

C. Spare Parts are defined as subassemblies or components of the Products installed in the Work.

1.3 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of work, the Contractor shall provide products, materials, and equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one (1) choice is available as options for Contractor's selection of a product, material, or equipment, the Contractor shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.4 PRODUCT DELIVERY AND STORAGE

A. The Contractor shall deliver and store products, materials, and equipment for the Work in accordance with manufacturer's written recommendations and by methods and means that will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of materials, products, and equipment at site and overcrowding of construction spaces. In particular, the Contractor shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive products, materials, and equipment to deterioration, theft, and other sources of loss.

1.5 TRANSPORTATION AND HANDLING

A. Products, materials and equipment shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.

B. The Contractor shall provide equipment and personnel to handle products, materials, and equipment by methods to prevent soiling and damage.

C. The Contractor shall provide additional protection during handling to prevent marring and otherwise damaging products, materials, equipment, packaging, and surrounding surfaces.

1.6 STORAGE AND PROTECTION

A. Products, materials and equipment shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products, materials and equipment shall be stored in weather-tight climate controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.

B. For exterior storage of fabricated products, materials and equipment, the products, materials and equipment shall be placed on sloped supports above ground. Products, materials and equipment subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.

C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

D. Storage shall be arranged to provide access for maintenance and inspection. The Contractor shall periodically inspect to assure products, materials and equipment are undamaged and are maintained under required conditions.

E. Storage of materials and equipment in resource areas shall not be permitted.

1.7 MAINTENANCE OF STORAGE

A. Stored products, materials and equipment shall be periodically inspected. The Contractor shall maintain a log of inspections and shall make the log available on request.

B. The Contractor shall comply with manufacturer's product, material and equipment storage requirements and recommendations.

C. The Contractor shall maintain manufacturer-required environmental conditions continually.

D. The Contractor shall ensure that surfaces of products, materials and equipment exposed to the elements are not adversely affected and that weathering of finishes and coatings does not occur.

E. Products, materials and equipment shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to acceptance by the City in accordance with the Contract Documents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Do not use materials and equipment removed from existing premises, except as specifically required by the Contract Documents.

B. Where similar Products (such as grease fittings, flexible couplings, etc.) are used on different pieces of equipment or in different areas within the Work, standardize the Products by providing all Products from the same Supplier.

2.2 SPARE PARTS

A. Provide spare parts for Products as indicated and specified.

B. The Contractor shall deliver to the City all spare parts except those requiring maintenance in storage, at least thirty (30) days prior to scheduled starting of system. Spare parts that require maintenance in storage shall be held and maintained by the Contractor until Substantial Completion and then a separate delivery of the remaining spare parts will occur. The spare parts that do not require maintenance in storage shall be packed so that they are protected from damage and the environment during storage.

C. Tag spare parts and containers to clearly identify them. Cross reference all parts to the Tag ID numbers as indicated and as specified.

D. All spare parts are to be identical and interchangeable with similar parts installed in the Work.

E. The Contractor is to submit to the City at least 120 days prior to startup, all initial submittals of spare parts for review and approval.

1. Early submittal is encouraged.

2. The Contractor will have all spare parts submittals finalized, submitted and approved, and all spare parts shall be delivered to the City at least thirty (30) days prior to scheduled starting of systems.

2.3 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS:

A. The following requirements shall constitute the acceptable minimum standards for the equipment specified herein. Should these requirements conflict with the Supplier's recommendations or in any way be less stringent than the Supplier's requirements, they shall be superseded by the Supplier's requirements.

B. Grease Fittings:

1. Provide extension fittings and tubing on all grease fittings that are installed so that equipment can be lubricated from the operating level without the use of ladders, staging, or shutting down the equipment. Tubing shall be of corrosion resistant materials compatible with the material to which it is attached.

C. Concrete Inserts:

1. Use concrete inserts for hangers to completely support the maximum load that can be imposed by the hangers used in the inserts.

2. Provide inserts for hangers of a type which will permit adjustment of the hangers both horizontally (in one plane), and vertically, and locking of the hanger head or nut. Galvanize all inserts by the hot-dip process in conformity with ASTM Standard Specification for Zinc (Hot -Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip, Designation A123-78, or ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153-80.

D. Sleeves:

1. Provided sleeves shall be of ample diameter to pass the pipe and its insulation, if any, and to permit expansion.

2. Provide sleeves that are flush at the walls and at the bottom of slabs. Sleeves must project one inch above the finished floor surface. Threaded nipples shall not be used as sleeves.

E. Protection against Electrolysis:

1. Where dissimilar metals are used in conjunction with each other, provide insulation between adjoining surfaces to eliminate direct contact and any resultant electrolysis. Provide bituminous insulation, heavy bituminous coatings, nonmetallic separators or washers, impregnated felt, or similar arrangement.

PART 3 - EXECUTION

3.1 GENERAL MATERIAL AND EQUIPMENT INSTALLATION REQUIREMENTS

A. The following requirements shall constitute the acceptable minimum standards for installing the equipment specified herein. Should these requirements conflict with the Supplier's recommendations or in any way be less stringent than the Supplier's requirements, they shall be superseded by the Supplier's requirements.

1. Bolts, Anchor Bolts, and Nuts

a. Set anchor bolts and expansion bolts as indicated and as specified.

b. If anchor bolts are set before the concrete has been placed, use templates.

c. Where indicated, or specified, provide anchor bolts with square plates at least 4 in. by 4 in. by 3/8 in., or with square heads and washers set in the concrete forms with pipe sleeves, or both.

d. If anchor or expansion bolts are set after the concrete has been placed, do all drilling and grouting or caulking without damaging the structure or finish by cracking, chipping, or spalling.

B. Equipment Foundations and Grouting

1. In setting pumps, motors, and other grouted equipment, make an allowance of at least one inch for grout under the equipment bases. Use steel shims to level and adjust the bases. Shims may be left embedded in the grout, in which case they shall be installed neatly and inconspicuous in the completed work. Use non-shrink grout.

2. Mix and place grout in accordance with the recommendations of the Supplier and as indicated and as specified. Place grout through the grout holes in the base, work outward and under the edges of the base, and across the rough top of the concrete foundation to a peripheral form to provide a chamfer around the top edge of the finished foundation.

3. After the grout has hardened, remove all forms, hoppers, and excess grout. Patch all exposed grout surfaces, give a burlap-rubbed finish, and coat with at least two coats as specified.

C. Sleeves and Openings

1. Provide all chases or openings for the installation of the Work or cut the same in existing Work.

2. Provide all sleeves or forms at the Work, and set them as indicated and as specified, and in ample time to prevent delays.

3. Locate all chases, openings, and sleeves as specified and indicated. If the location is not specified or indicated, locate all openings to avoid interference with equipment and piping.

4. If openings and/or sleeves were not provided prior to concrete placements, the Contractor shall provide and set them afterwards at no additional cost to the City. Confine the cutting to the smallest extent possible. In no case shall piers or structural members be cut without the written consent of the City.

5. Fit around, close up, repair, patch, and point around the work specified herein to the requirements of the City.

6. Perform all of this work by workmen using small hand tools. Do not use power tools except where, in the opinion of the City, the type of tool proposed can be used without damage to any work or structures and without interference with the operation of any facilities. The City's concurrence with the type of tools shall not in any way relieve or diminish the responsibility of the Contractor for such damage, or interference resulting from the use of such tools.

7. Do not cut or alter the work of any subcontractor or any other contractor, nor permit any subcontractor to cut or alter the work of any other contractor or subcontractor, except with the written consent of the contractor or subcontractor whose work is to be cut or altered, and with the written consent of the City. All cutting and patching or repairing made necessary by the Contractor or any subcontractors shall be done at no additional cost to the City.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01600

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SECTION 01630

RESTORATION OF GROUNDS AND CLEANING UP

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The Contractor on or before the completion of the work, except as otherwise expressly required or permitted in writing by the City, shall tear down and remove and legally dispose of all temporary structures built or used by the Contractor; shall remove all rubbish and debris of all kinds from all Contract structures and from any grounds which he shall have occupied within the limits of the project site; shall leave the site of the work in a satisfactorily neat and clean condition; shall remove from the land all abandoned materials and plant; and shall leave the spoil areas and the property which may have been affected by his operations in a neat and satisfactory condition and shall clean any affected by over spatter on fences, stairs, curbs, plaques, etc. Also included is the restoration of all private grounds, including lawns, landscaped areas, driveway aprons and walkways damaged or disturbed in connection with the new work not elsewhere specified. Unless otherwise specified, all materials salvaged and not required to be reused shall be the property of the Contractor and shall be legally disposed of off the site of the work.

B. Included in the work under this Section is the restoration, including replacement of damaged and disturbed shrubs and trees, retaining walls, fence and stairs of all grounds and grassed and landscaped areas removed or disturbed or damaged during the construction of the new work, and storage and field office areas.

C. Also included in the work under this Section is the furnishing of all labor, materials, and equipment required to remove, store, and reset or replace bumper posts, stone walls of all types, flagstone, brick, concrete, asphalt walks, fences of all types, railings, signs and sign posts, signal posts, mailboxes and such other miscellaneous objects damaged or disturbed during construction.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01630

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SECTION 01701

PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes the requirements for project closeout including final clean up, closeout timetable, Owner's manual submittal, final submittals, maintenance and guarantee, and bonds.

1.2 FINAL CLEANUP

A. The Contractor shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the City will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

B. The Contractor shall cleanup and restore all areas affected by the work on public and private property.

C. The Contractor shall cleanup and restore all areas affected by staging, trailer(s) placement and parking. Restoration includes regrading, re-establishing topsoil and reseeding.

D. Refer to Specification section 01630 RESTORATION OF GROUNDS AND CLEANING UP.

1.3 CLOSEOUT TIMETABLE

A. The Contractor shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established as specified elsewhere in the Contract Documents.

1.4 OPERATION AND MAINTENANCE

A. The Contractor's attention is directed to the condition that one percent (1%) of the applicable bid item price will be deducted from any monies due the Contractor as progress payments, if at the seventy-five percent (75%) construction completion point, the final O & M manuals complying with Section 01300 and the individual technical specification sections have not been submitted. The aforementioned amount will be retained by the City as the agreed, estimated value of the approved O & M manuals. Any such retention of money for failure to submit the approved O & M manuals on or before the seventy-five percent (75%) construction completion point shall be in addition to the

retention of any payments due to the Contractor.

1.5 FINAL SUBMITTALS

A. The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Engineer for transmittal to the City:

1. Written guarantees, where required.

2. Testing Results, where required.

3. Close-out of any Permits with local, state and federal agencies.

4. Provide Construction Photographs as described in the General Conditions.

5. New permanent cylinders and key blanks for all locks.

6. Maintenance stock items; spare parts; special tools.

7. Completed as-built / record drawings as described in Section 01200 GENERAL REQUIREMENTS FOR UTILITY WORK.

8. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

9. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.6 MAINTENANCE AND GUARANTEE

A. The Contractor shall comply with the guarantee and warranty requirements contained in the General Conditions.

B. The Contractor shall comply with the guarantee and warranty requirements contain on the Contract Documents.

C. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the City from further responsibility in connection with such repair or resurfacing.

D. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the City. If the Contractor fails to make such

repairs or replacements promptly, the City reserves the right to do the Work and the Contractor and his surety shall be liable to the City for the cost thereof.

1.7 BOND

A. The Contractor shall provide a bond to guarantee performance of the provisions contained in Paragraph "Maintenance and Guarantee" above, and of the General Conditions.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01701

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SECTION 01740

WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.2 RELATED WORK

A. Refer to General Conditions of the Contract for the general requirements relating to warranties and bonds.

B. General closeout requirements are included in Section 01701 - PROJECT CLOSEOUT.

C. Specific requirements for warranties for the Work and products and installations that are specified to be warranted are included in the individual Specification Sections.

D. Certifications and other commitments and agreements for continuing services to City are specified elsewhere in the Contract Documents.

1.3 SUBMITTALS

A. Submit written warranties to the City prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the City.

B. When a designated portion of the Work is completed and occupied or used by the City, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the City within fifteen days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Engineer for approval prior to final execution.

D. Refer to individual Specification Sections for specific content requirements, and particular requirements for submittal of special warranties.

E. At Final Completion, compile two copies of each required warranty and bond properly executed by the Contractor, or by a subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Contract Specifications.

G. Table of Contents: Neatly typed. Identified each item with the number and title of the Specification Section in which the Work and Warranty and Bond requirement was specified, and the name of the product or work item.

H. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer, supplier, and manufacturer.

I. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name, address, and telephone numbers of the Contractor and equipment supplier.

J. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.4 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the City has benefited from use of the Work through a portion of its anticipated useful service life.

D. City's Recourse: Written warranties made to the City are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the City can enforce such other duties, obligations, rights or remedies.

E. Rejection of Warranties: The City reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The City reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

G. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.5 DEFINITION

A. Standard Product Warranties are pre-printed written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the City.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the City.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01740

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SECTION 02010

SUBSURFACE INVESTIGATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes the basic requirements and expectations of the Contractor in all work pertaining to subsurface conditions.

1.2 GENERAL REQUIREMENTS

A. The Contractor acknowledges that he has satisfied himself as to the nature and location of the Work; the general and local conditions, particularly those bearing upon groundwater table or similar physical conditions at the site; the characterization and conformation of subsurface materials to be encountered; and all other matters that can in any way affect the work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with all available information concerning these conditions will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the Work.

1.3 SUBSURFACE DATA

A. The findings of recent subsurface investigations are provided in the boring log information in Appendix A. The analytical results of samples collected for waste characterization analyses are provided in Appendix A. The findings from the subsurface utility investigations are provided in Appendix B.

B. Such data is offered in good faith solely for the purpose of placing the Contractor in receipt of information available. The Contractor shall interpret such data according to their own judgment and acknowledges that they are not relying upon the same as accurately describing the actual subsurface conditions or quantities of materials that may be encountered. The Contractor further acknowledges that they assume all risk contingent upon the nature of the subsurface conditions to be actually encountered in performing the work covered by the Contract, even though such actual conditions may result in the Contractor performing more or less work than originally anticipated. In the event that quantities of waste soil/fill and related work as established in this Contract vary significantly from estimates provided, the unit bid prices will be the basis for compensation.

C. Re-use of excavated soils on- or off-site is subject to local, state and federal regulations and as specified in Section 02080 – SOIL AND WASTE MANAGEMENT and 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL.

D. Since individual disposal facilities will have different permit conditions and specific pre-characterization data requirements, the Contractor shall use the information provided for waste characterization; however the Contractor shall be responsible for final waste characterization prior to transport and disposal. The Contractor is hereby made aware that for the purposes of disposal, final waste characterization testing is the responsibility of the Contractor, and costs for any additional characterization shall be incorporated into the Contractor's lump sum bid price for Soil Management.

E. Additional subsurface investigation as may be warranted to satisfy a disposal facility's data requirements shall be the responsibility of the Contractor. Subsurface investigation activities shall not commence until a written work plan detailing the Contractor's approach for obtaining the data is approved by the City's Licensed Site Professional. The work plan must indicate the location and frequency of sampling; sampling parameters and sampling methodology. The Contractor shall allow a minimum of fourteen (14) days for review and comment.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

PART 4 – COMPENSATION (Not Used)

END OF SECTION 02010

SECTION 02011

PIPELINE CLEANING, INSPECTION AND REPORT

02011.1	**CLEANING, INSPECTION AND REPORT – PIPE SIZE 6" TO 12"**	**LINEAR FOOT**
02011.2	**CLEANING, INSPECTION AND**	**LINEAR FOOT**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing all plant, labor, equipment and materials, as well as performing all operations associated with pipeline cleaning within the pipelines indicated on the Drawings in accordance with these Specifications.

2. Furnishing all plant, labor, equipment and materials, as well as performing all operations associated with pre and post construction closed-circuit television inspection of the pipelines indicated on the Drawings in accordance with these Specifications.

3. Performing the work in a sequence that is the least disruptive to vehicular and pedestrian traffic and in a manner that shall protect the public from damage to persons and property.

B. Related Sections include the following:

1. Section 02761 – FLOW BYPASS

1.3 SUBMITTALS

A. General: Submit each item in this article according to the conditions of the Contract and Division 1, SECTION 01300 – SUBMITTALS:

1. Shop drawings and/or manufacturer's descriptive literature indicating materials, equipment and methods to complete pipeline cleaning operations.

2. Shop drawings and/or manufacturer's descriptive literature indicating materials, equipment and methods to complete internal inspection operations to complete internal inspection operations.

3. A representative sample DVD showing the quality of work obtained by the assembly prior to internal inspection andcleaning.

4. Two copies of inspection reports for both pre and post construction internal inspections.

5. Confined Space Entry certifications for all personnel entering pipeline or access structures.

B. Contractor shall submit complete documentation of qualifications as specified herein.

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified herein.

B. The Contractor cleaning and internally inspecting the pipeline shall have completed at least three projects of similar size and complexity as this project in the United States within the past three years. Contractor may employ the services of a subcontractor that specializes in this work to fulfill this requirement.

C. Rejection of any subcontractor and/or manufacturer by the Engineer due to insufficient qualifications shall not be grounds for modifications to the Contract Documents such as change in scope, time of completion or contract amount.

D. All Contractor's personnel entering pipeline or access structures shall be Confined Space Entry trained per OSHA, Title 29 CFR 1910.46 and shall have a copy of their certification available on site at all times.

1.5 PRODUCTS, MATERIALS AND EQUIPMENT

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 - PRODUCTS

2.1 CLEANING

A. Contractor shall use mechanical, hydraulically-propelled, and/or high-velocity cleaning equipment, which does not exert internal pressures great enough to damage the pipelines and associated structures. Selection of the cleaning equipment shall be based on the condition of the pipeline at the

time work is scheduled to commence.

B. Equipment shall include the following systems:

1. High pressure water of sufficient capacity and volume to remove debris from the pipe and structure walls as approved by the Engineer.

2. Motorized equipment complete with belt booster clutch, overload clutch or other means or devices that shall prevent damage to the pipeline and associated structures. Direct drive shall not be permitted.

3. Standard mechanical equipment including a combination of rodding machines, boring machines, bucket machines, hydraulic balls, B-liners, cones, ferrets or similar equipment. Direct drive shall not be permitted.

4. High pressure, hydraulically-propelled equipment and chemical compounds as approved by the Engineer.

5. Mechanical cutting devices suitable for the removal of roots, gaskets, protruding services, etc.

6. Footage metering devices for location of all equipment, devices and points of reference on measuring target that is known at all times at the ground level.

2.2 CLOSED CIRCUIT TELEVISION INSPECTION

A. Camera and vehicle assembly:

1. Industry standard for internally inspecting pipelines within the range of diameters applicable to this project.

2. Remote–controlled, robotic assembly capable of view 360^{o} of pipeline interiors. At areas of interest, camera shall be capable of rotating its lens to obtain a more direct viewing angle.

3. Capable of operation in 100 percent humidity conditions.

4. Capable of being moved through the pipeline in either direction at a slow rate by means of manual cable winches or motorized mechanical equipment of indirect drive type.

5. Capable of slowing down and stopping at areas of interest.

6. Provide high intensity light feature for recording purposes.

7. Capable of measuring the camera's position within the pipeline accurate 0.10 feet.

B. During the internal inspection of pipelines, the Owner and the Engineer shall have the ability to view the pipe interior as it is being inspected on a TV monitor set up in a command center.

C. DVD:

1. DVD recordings shall, by electronic means, display continuously and simultaneously generated transparent digital information to include the date, time, pipeline section number, corresponding station numbers and direction of camera relative to flow.

Example: Time: 4:14:08 PM
Date: 5/7/02

ELM ST.
MH #2 to MH #3 (Downstream)
STATION 2+50.7

2. Inspections shall be documented on DVD formatted discs. The DVD shall be in color and capable of being played on a DVD player.

PART 3 – EXECUTION

3.1 GENERAL

A. Contractor shall perform all work in accordance with municipal, state and federal requirements including OSHA.

B. Contractor shall obtain all permits required to perform work prior to the commencement of construction at no additional cost to the Owner.

C. Contractor shall locate and uncover all manholes and/or access structures required to complete the work in accordance with this Section.

D. Contractor shall maintain existing flows around the work during cleaning operations in accordance with Section 02761 – FLOW BYPASS.

3.2 PIPELINE CLEANING

A. Contractor shall clean the pipeline to facilitate inspection and construction.

B. Contractor shall protect the pipeline from damage that could be inflicted by use of cleaning equipment. Any damage inflicted, regardless of technique, shall be repaired by the Contractor to the requirements of the Owner, at no additional cost to the Owner.

C. All sludge, dirt, sand, rocks, grease, and other solid or semi-solid materials that may cause an obstruction or impede the inspection and/or construction shall be removed and disposed off site during cleaning operations in watertight containers in conformance with all applicable federal, state and municipal laws and regulations, at no additional cost to the Owner. All materials that will not cause an obstruction or impede the inspection and/or construction shall be flushed downstream.

D. Contractor shall manage, transport and dispose of waste materials collected and removed from the pipeline during cleaning operations in accordance with Section 02080 – SOIL AND WASTE MANAGEMENT and Section 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL MATERIAL.

E. If during cleaning operations an obstruction is encountered, the Contractor shall prosecute cleaning operations and supplement with either high pressure water or needle hammer to remove. Contractor shall limit the amount of water pressure used to prevent any structural damage to the existing pipelines and structures. Should the obstruction prevent the pipeline from being cleaned, the Engineer shall be notified immediately. If, in the opinion of the Engineer, a point repair is required to facilitate cleaning, Contractor shall perform the repair and clean through said repair upon its completion. No additional compensation shall be paid to the Contractor for any portion of the pipe which requires re-cleaning after successful completion of the repair.

F. Contractor shall limit the use of water from hydrants to operations pertaining only to pipeline cleaning or other operations allowed in these Specifications. If water from fire hydrants is deemed necessary by the Contractor to avoid delay in normal work procedures, the water shall be conserved.

G. No fire hydrants shall be obstructed at any time, nor shall a hydrant be used for the work described in these Contract Documents, unless a reduced pressure backflow preventor is furnished and installed by the Contractor and prior approvals have been obtained from the Owner and Municipal Fire Department. The Contractor shall be responsible for all related charges for the set-up, including the water usage bill.

H. Contractor shall re-clean the pipeline, if in the opinion of the Engineer, materials have washed into the pipeline after acceptance of the cleaning and prior to construction at no additional cost to the Owner.

3.3 CLOSED CIRCUIT TELEVISION INSPECTION

A. Contractor shall stop and focus the camera at locations where one or more of the following points of interest are observed:

1. Inflow/Infiltration sources.

2. Construction defects, discolorations, wrinkles, etc.

3. Structural defects including broken pipe, collapsed pipe, cracks or abnormalities.

4. Abnormal joint conditions such as root intrusion, protruding lateral connections, in-line pipe size changes and/or material changes.

5. Mineral deposits, grease, obstructions, etc.

6. Lateral connections; plugged or open.

7. Offset joints or misalignments:

8. Manholes, access structures, etc.

9. Any other locations where the conditions may affect construction operations.

10. Any other location as required by the Engineer.

B. If, in the opinion of the Engineer, certain conditions may impede construction, Contractor shall perform a point repair.

C. The Contractor shall provide and maintain access to the system, including inflow control and dewatering within pipelines and associated structures as well as all other work required to perform the internal inspections to the satisfaction of the Engineer.

3.4 INSPECTION REPORTS

A. At the conclusion of each internal inspection, the Contractor shall provide a summary report highlighting results of the investigations and summarizing conditions and points of interest as specified herein. All documentation shall be cross-referenced by stationing to enable the reviewer to identify a particular location.

B. The pre-construction inspection report shall detail and document areas requiring point repairs. Recommendations for repairs as described by the Contractor shall be submitted to the Engineer.

C. The post construction inspection report shall detail the condition of constructed items and describe recommendations for repairs of any defects.

1. All areas where the construction is defective due to workmanship, chemical deterioration, or other, shall be identified by the Contractor.

2. If repairs are required, the Contractor shall produce a second post construction inspection report.

3.5 ACCEPTANCE

A. Acceptance of the pipeline cleaning shall be made upon the successful completion of the television inspection. If, in the opinion of the Engineer, cleaning has not been completed in accordance with these Specifications, the Contractor shall be required to re-clean and re-inspect the pipe until the cleaning is shown to be satisfactory, at no additional cost to the Owner.

B. Internal inspection operations, both pre and post construction, shall be considered for acceptance upon receipt by the Engineer of the following:

1. Two copies of the internal inspection reports

2. Two copies of the DVD discs showing pipelines and associated structures inspections.

3.6 PROJECT CLOSEOUT

A. Provide in accordance with SECTION 01701.

PART 4 – COMPENSATION

Item 02011.1 --- Cleaning, Inspection and Report – Pipe Size 6” to 12”

METHOD OF MEASUREMENT*:*

Measurement for payment for Cleaning, Inspection and Report – Pipe Size 6” to 12” shall be based on the actual length of pipe cleaned and inspected from centerline of manhole to centerline of manhole. Verification of adequate cleaning shall be made by television inspection.

BASIS OF PAYMENT:

Payment for Cleaning, Inspection and Report – Pipe Size 6” to !2” will be based on the unit price bid for this item in the proposal. Under the linear foot price for Cleaning, Inspection and Report – Pipe Size 6” to 12”, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to clean and CCTV the existing 6” to 12” pipes at the locations specified. The work includes, but is not limited to; heavy and light cleaning sewer, use of mechanical cleaning equipment, by-pass pumping, plugging or blocking of sewer flow, water for cleaning of sewer, television inspection work; pre and post construction digital video recordings; pre and post construction CCTV inspection reports; grease removal, and the storage, transportation, and disposal of any material retrieved from sewer cleaning. All digital recordings and CCTV inspection reports shall be given to the Owner upon completion of the project.

Item 02011.2 --- Cleaning, Inspection and Report – Pipe Size 13” to 30”

METHOD OF MEASUREMENT*:*

Measurement for payment for Cleaning, Inspection and Report – Pipe Size 13” to 30” shall be based on the actual length of pipe cleaned and inspected from centerline of manhole to centerline of manhole. Verification of adequate cleaning shall be made by television inspection.

BASIS OF PAYMENT:

Payment for Cleaning, Inspection and Report – Pipe Size 13” to 30” will be based on the unit price bid for this item in the proposal. Under the linear foot price for Cleaning, Inspection and Report – Pipe Size 13” to 30”, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to clean and CCTV the existing 13” to 30” pipes at the locations specified. The work includes, but is not limited to; heavy and light cleaning sewer, use of mechanical cleaning equipment, by-pass pumping, plugging or blocking of sewer flow, water for cleaning of sewer, television inspection work; pre and post construction digital video recordings; pre and post construction CCTV inspection reports; grease removal, and the storage, transportation, and disposal of any material retrieved from sewer cleaning. All digital recordings and CCTV inspection reports shall be given to the Owner upon completion of the project.

END OF SECTION 02011

SECTION 02015

GEOTECHNICAL MONITORING AND INSTRUMENTATION

2015.1	**VIBRATION MONITORING**	**LUMP SUM**
2015.2	**BUILDING MONITORING POINTS**	**EACH**

PART 1 – GENERAL

1.1 SUMMARY

A. Work in this Section shall include, but not be limited to, all materials, equipment, labor, and services required to install, protect, replace, monitor and report on geotechnical instrumentation specified herein.

B. The work included in this section includes the following:

1. Vibration monitoring shall be performed continuously during all excavation, backfill, and compaction and installation of temporary earth support. Two (2) seismographs shall monitor vibrations at two separate locations per a crew; one (1) adjacent to the work and one adjacent to the nearest private property. Vibration levels shall not exceed the criteria indicated herein.

2. Furnish, install, protect, replace, monitor and report on wall monitoring points on the top of the temporary excavation support walls (not including trench boxes), a minimum of one every 20 feet, to measure horizontal displacements of these points during the Work. Locations of the monitoring points shall be distributed uniformly around the excavation support wall at locations proposed by the Contractor and accepted by the Engineer.

3. Furnish, install, protect, replace, monitor and report on building monitoring points (BMP). The Engineer will assist the Contractor in determining the final locations. Contractor shall conduct site visit with the Engineer at least two weeks prior to the start of construction to determine locations of building monitoring points.

4. Monitoring may be required of the 48-inch-diameter cast iron water main located in Magazine Street and Carl Barron Plaza as part of the MWRA Waterworks 8(m) permit.

5. The Contractor shall retain the services of Geotechnical Monitoring Consultant to install, monitor, maintain and report on geotechnical instrumentation that includes but is not limited to temporary excavation support wall monitoring points, building monitoring

points, crack gauges and vibrations. Monitoring frequency shall be daily during installation of the support of excavation, and two (2) times per week thereafter for all instruments located within 100 feet from the edge of the excavation, during all excavation, backfill and compaction, unless otherwise directed by the Engineer or specified

6. Replace instrumentation damaged or made inaccessible by the construction operations at no additional cost to the City.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS.

B. Qualifications of the Geotechnical Monitoring Consultant

C. Shop drawings that indicate the instrumentation locations, sizes, material types, manufacturers' data and specifications, installation procedures, and other data. Provide description of work and materials.

D. A mitigation plan shall be submitted to the Engineer by the Contractor prior to any excavation and prior to the installation of the excavation support system. The mitigation plan shall detail the Contractor's course of action in the event threshold or limiting response values are met or exceeded. Such mitigation plan shall be revised as appropriate for each instance threshold and/or limiting values are reached.

E. The Geotechnical Monitoring Consultant shall submit initial baseline data along with a plan indicating locations of all instrumentation monitoring points to the Engineer at least three (3) days prior to beginning of the installation of the excavation support and excavation operations.

F. The Geotechnical Monitoring Consultant shall submit subsequent survey data on all instrumentation monitoring points to the Engineer prior to the beginning of work the following day. A faster turnaround of data reporting may be required by the Engineer if threshold or limiting response values, as specified in this Section, are approached or exceeded. Data shall be tabulated and depicted graphically on plots and show incremental and cumulative movement since the start of excavation.

1.3 QUALITY CONTROL

A. The Contractor shall provide sufficient notice to the Engineer to allow the Engineer to be present to observe the Work. Cooperate with the Engineer in all respects to facilitate any testing or observations.

B. The Contractor may conduct additional testing or monitoring for its own information, at no additional cost to the City.

C. The presence of the Engineer (including observations and review of test results) shall not relieve the Contractor of its sole responsibility to perform the work in accordance with the Contract Documents, nor shall they be construed to relieve the Contractor from full responsibility for the means and methods of construction and for safety on the construction site.

D. Work not in conformance with the specified requirements shall be improved, or removed and replaced, at no additional cost to the City. All costs related to testing of nonconforming Work or materials shall be paid for by the Contractor, at no additional cost to the City.

E. Measure and report all data on movements of all instrumentation monitoring points to the nearest 0.01 ft.

F. Retain the services of Geotechnical Monitoring Consultant to monitor the geotechnical instrumentation, which includes and is not limited to excavation support system, and building monitoring points, and vibrations. The consultant shall be a Geotechnical Engineer registered in the Commonwealth of Massachusetts and shall have demonstrated at least five years' experience and at least three projects of similar type, size, and complexity including installation and monitoring of surface settlement and vibrations with seismographs. The Geotechnical Monitoring Consultant shall be approved by the Engineer and must be approved two weeks prior to mobilization for construction. The Geotechnical Monitoring Consultant shall adhere to all methods and standards described in this Specification.

G. Retain the services of a Surveyor to monitor the Building Monitoring Points.

1. The Contractor's Surveyor shall be registered in the Commonwealth of Massachusetts and shall have demonstrated at least five (5) years experience and at least three (3) projects of similar type, size, and complexity including installation and monitoring of surface vertical and horizontal displacement points.

2. The Contractor's Surveyor shall be approved by the City and must be approved two (2) weeks prior to construction.

PART 2 – PRODUCTS

2.1 VIBRATION MONITORING

A. Construction vibrations shall be monitored as described in the Contract Specifications in terms of peak particle velocity using a seismograph with continuous recording capability. Capability to record vibrations at two locations simultaneously is required. The vibration sensors shall be capable of recording three orthogonal components of vibration.

2.2 BUILDING DEFORMATION MONITORING POINTS

A. Deformation monitoring points shall consist of 3-inch long surveyors' "PK" nails, securely nailed in place, or ½-inch diameter carriage bolts drilled 2 inches into the building surface and extending approximately 3 inches from the building face. Surface monitoring points may also consist of an observable point punch marked on the top horizontal surface of a manhole or catch basin rim. The steel surface within 3 inches of the point shall be cleaned by wire brush to permit easy identification of the exact point. The point shall be clearly identified using fluorescent spray paint adjacent to the point.

2.3 TEMPORARY EXCAVATION SUPPORT WALL MONITORING POINTS

A. Temporary excavation support wall monitoring points shall consist of an observable point punch marked on the top horizontal surface of the piles or sheeting. The surface within three inches of the point shall be cleaned by wire brush to permit easy identification of the exact point. The point shall be clearly identified using fluorescent spray paint adjacent to the point.

2.4 CRACK GAUGES

A. Provide a calibrated direct read building crack monitor consisting of overlapping glass or acrylic plates. The crack monitor shall be waterproof and weather resistant and shall be capable of being read to a resolution of 0.02-inch with a maximum horizontal range of at least 0.75-inch and a vertical range of at least 0.375-inch using a device such as the Avongard Calibrated Crack Monitor (Avongard Products, Waukegan, IL or approved equal) shall be bolted or epoxied to the surface.

B. For uneven surfaces, such as stone, pairs of flat washers should be used, with the distance between the washers measured with a caliper.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. Do not install any instruments until the City and the Engineer have been notified.

B. Vibration inducing construction activities including, but not limited to, pavement breaking, excavation, installation of temporary excavation support systems, excavation, and backfilling shall not commence until instrumentation is installed within the vicinity of the work and first initial reading (FIR) data has been received.

3.2 INSTALLATION

A. Vibration Monitoring

1. Two (2) seismographs shall be installed each day for each crew performing vibration inducing construction activities. The seismographs shall be installed adjacent to existing above grade structures within 50 feet of the work. If there are no existing structures within 50 feet, the seismographs shall be installed on firm surfaces, at 25 and 50 feet from the work zone.

2. Vibration sensors shall be firmly mounted on the surface of concrete or asphalt, or firmly set in undisturbed soil.

3. The daily reports shall clearly describe the location of the seismograph relative to the work zone and the work performed on that date.

B. Building Monitoring Points (BMPs) and Temporary Excavation Support Wall Monitoring Points (SHMP)

1. BMPs shall be installed at the approximate locations indicated on the Drawings. The Engineer will assist the Contractor in determining the final locations during site walks prior to construction.

2. SHMPs shall be installed at the top of temporary excavation support walls at the locations proposed by the Contractor and accepted by the Engineer but not less than 20 feet on-center on all sides of the excavation.

3. All BMPs and SHMPs shall have the horizontal as-built location determined to an accuracy 0.05-feet and the elevation to an accuracy of 0.01-feet.

C. Crack Gauges

1. Locations of existing building cracks shall be identified during the Pre-Construction Condition Survey. The Contractor shall assume a minimum of 60 existing and new cracks will need to be monitored as part of the work of this Section.

D. Formal Initial Readings

1. Obtain formal initial readings (FIRs) on all installed instruments for use as the baseline reference for the instrument. Before establishing the FIR for each instrument, a minimum of three readings shall be performed that demonstrate that changes resulting from the installation process have ceased. The three readings demonstrating that the installation has stabilized shall be performed on different days and may be used to establish the FIR.

2. The FIR (background reading) for a seismograph shall be performed for a 24-hour period prior to any vibration-producing construction activities to document background vibrations, and also at the start of vibration-producing construction activities to establish the maximum energy which can be used without surpassing acceptable vibration and overpressure levels at nearby facilities. The Contractor shall notify the City at least 24 hours prior to starting a new vibration-producing construction task. Monitoring during pavement breaking, excavation, and other vibration-producing construction activity shall consist of recording single-component peak particle velocities, which shall be printed on a strip chart. Continuous monitoring and full wave form data shall be recorded and submitted. During all monitoring of vibration-producing construction activities the Contractor shall document all events that are responsible for the measured vibration levels, and submit the documentation to the City with the data.

3. The FIR for a BMP and SHMP shall consist of the average of two survey measurements of elevation or horizontal offset with two independent set-ups. Where applicable, the initial readings shall be taken after allowing sufficient time for the grout or epoxy to set. Each reading other than the FIR shall consist of a single set of survey measurements. Reference all elevation readings to a deep benchmark. Reading accuracy shall be +/-0.01-foot. Report elevations to the nearest 0.001-foot.

   The FIR for a crack monitor will be the reading of the cross hairs on the crack monitor when the tape connecting the two plates is cut after the monitor has been installed and/or the epoxy has set. Reading accuracy shall be +/-0.5 mm.

3.3 MONITORING

A. Monitoring frequency may be increased as required by the Engineer for some or all of the monitoring points if the threshold or limiting response values are approached or exceeded during the Work, at no additional cost to the City.

B. Vibration monitoring shall be performed continuously during all vibration inducing construction activities.

C. Building monitoring points shall be read at a minimum every 14 days when work is taking place within 50 feet of the building.

D. Temporary Excavation Support Wall Monitoring Points shall be monitored at least once a week during excavation, construction, and backfilling unless otherwise directed by the Engineer.

3.4 REPORTING DATA

A. A plan showing location and numbering system for BMPs, SHMPs, and crack gauges shall be submitted to the Engineer prior to start of earthwork activities along with results of first initial readings.

B. After each set of readings is obtained, the data shall be sent to the Engineer within 24 hours, where the data will be reviewed and interpreted. The Contractor shall make its own interpretations for the data. The Contractor shall monitor and interpret data from additional instrumentation that it deems necessary to ensure the safety of its work. The Engineer is not responsible for the safety of the work based on its review of the instrumentation data.

C. Tables of data shall be submitted prior to the beginning of work the following day. The table shall include the initial measurement, the current measurement, and the amount of movement since start of excavation.

D. Survey data shall be depicted graphically on plots and submitted with the tabular results to show incremental and cumulative movement since the start of excavation.

3.5 THRESHOLD AND LIMITING VALUE CRITERIA

A. Criteria for "threshold" and "limiting" response values have been established as provided in the following table.

Instrument	**Monitoring**	**"Threshold" Value**	**"Limiting" value**
BMP	Vertical or horizontal movement	0.25 inches	0.5 inches
	Angular distortion between adjacent points	1/1000	1/750
SHMP	Horizontal movement	0.25 inches	0.5 inches
Seismograph	Vibrations in peak particle velocity	0.3 inches per second	0.5 inches per second

B. Angular distortion is defined as the ratio of the differential elevation between any two points over the horizontal distance between those points.

C. These criteria are intended to establish a minimum basis for the Contractor's design and procedures and does not relieve the Contractor of its responsibility for preventing detrimental movements and damage to adjacent structures, utilities or other work.

D. In the event the Contractor does not comply with the approved mitigation plan, or continues to work in violation of threshold or limiting values being reached or exceeded, the Contractor shall not be allowed to continue work until proper mitigation procedures and corrections have been made as determined by the City and Engineer.

E. The Contractor shall be responsible for repairing all property damage caused by construction activities.

3.6 PROTECTION OF INSTRUMENTATION

A. Protect all instruments during the course of the Work. Any damage or loss of function caused by the Contractors operations, or by any other cause, to new or existing instrumentation devices, shall be immediately repaired or the equipment replaced at no additional cost to the City.

PART 4 – COMPENSATION

Item 2015.1 - Vibration Monitoring

METHOD OF MEASUREMENT:
Measurement for payment for Vibration Monitoring will be on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT/ INCLUSIONS:
Under the Unit Price for Vibration Monitoring, the Contractor shall furnish all labor, materials, instrumentation, tools, equipment, and incidentals required to perform all vibration monitoring as specified in the Contract Specifications and also as required by the Engineer. Payment under this Item includes, but is not limited to; furnishing, installation and maintenance of seismographs; monitoring seismograph data and submission of all data to the Engineer; submission of shop drawings and submittals as required.

Item 2015.2 – Building Monitoring Points

METHOD OF MEASUREMENT:
Measurement for payment for Building Monitoring Points will be based on the per Each bid as approved by the Engineer.

BASIS OF PAYMENT/ INCLUSIONS:
Under the Unit Price for Building Monitoring Points, the Contractor shall furnish all labor, materials, instrumentation, tools, equipment, and incidentals required to furnish, install, replace, monitor, and report on all building monitoring points as specified in the Contract Specifications and also as required by the Engineer. Payment under this Item includes, but is not limited to; acquisition of rights of entry, furnishing, installation, maintenance, and monitoring for structure monitoring points; furnishing, installation, and maintenance of up to XX crack gauges; monitoring of up to XX crack gauges and submission of all data to the Engineer; conduct site visits with the Geotechnical Engineer to locate building or structure monitoring points of shop drawings and submittals as required.

END OF SECTION 02015

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SECTION 02051

DEMOLITION, MODIFICATION, AND ABANDONMENT

2051.1	**DISPOSAL OF CONSTRUCTION DEBRIS AS SOLID WASTE**	**TON**
2051.2	**DISPOSAL OF BITUMINOUS CONCRETE**	**TON**
2051.3	**DEMOLITION OR REMOVAL OF LAMP HOLE, MANHOLE, CATCH BASIN OR OTHER STRUCTURE**	**EACH**
2051.4	**ABANDON IN PLACE MANHOLE, CATCH BASIN, OR OTHER STRUCTURE**	**EACH**
2051.5	**DEMOLITION OR REMOVAL OF PIPE 15-INCH THROUGH 24-INCH DIAMETER**	**LINEAR FOOT**
2051.6	**DISPOSAL OF TREATED WOOD PRODUCTS**	**TON**

PART 1 – GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all plant, labor, tools, equipment, materials, and supplies as required for utility and structure removal, demolition, modification, and/or abandonment as specified.

B. The Work of this Section shall include the following significant items; all other activity shown on the Drawings; and work necessary and defined herein pertaining to the project area: demolition of roadway and sidewalk; removal of existing catch basins and manholes; abandonment of existing catch basin laterals; removal of existing pipe; modification to existing piles; and selective demolition.

1.2 RELATED DOCUMENTS

A. Section 02080 – SOIL AND WASTE MANAGEMENT

B. Section 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

C. Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

D. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

E. Section 02590 – BRICK MASONRY

G. Section 03315 – GROUT

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Removal and abandonment procedures that shall provide for safe conduct of the Work, careful removal and disposition of materials and equipment, protection of utilities, structures, property, or other features which are to remain undisturbed and coordination with existing utilities or owners responsible for those nearby elements to remain in service.

2. A detailed work plan to include a list of items to be removed and/or abandoned, a sequence and schedule, and a list of salvageable materials and equipment.

3. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

B. Schedule of Selective Demolition, Modification and Abandonment Activities

1. The Schedule of Selective Demolition, Modification and Abandonment Activities shall be subject to approval by the City and Engineer.

Indicate the following:

a. Detailed sequence of selective demolition, modification and abandonment work, with starting and ending dates for each activity. Ensure the City's operations are uninterrupted.

b. Interruption of utility services.

c. Coordination for shutoff, capping, bulkheading and continuation of utility services.

d. Proposed materials, construction details, locations of temporary utilities, abandonment materials, and means of access.

e. Coordination of City's continuing use of portions of utilities, structures, property or other features and of City's partial occupancy of completed Work.

C. Additional Submittals for Selective Demolition, Modification, and Abandonment Activities

1. Inventory: After selective demolition or modifications are complete, submit a list of items that have been removed and salvaged.

2. Pre-demolition Photographs or Videotape: Show existing conditions of adjoining utility construction and site improvements that might be misconstrued as damage caused by selective demolition or modification operations. Submit before Work begins.

3. Landfill Records: Indicate receipt and acceptance of all wastes by disposal facility licensed to accept the wastes to be disposed.

4. Treated Wood Products: Submit disposal manifests for all treated wood product disposal.

D. Masonry Plugs and Bulkheads

1. For each permanent and temporary bulkhead and masonry plug, the Contractor, at a minimum, shall submit the following, prepared by a Massachusetts Registered Professional Civil or Structural Engineer:

a. Design Loads

b. Restraining Mechanisms

c. Method of Installation

d. Results of Field Inspection after Installation

e. Decommissioning Method

2. If temporary pneumatic or hydro plugs are proposed, in addition, the Contractor shall submit the method and procedure of maintaining bladder pressure.

1.4 REPAIR OF DAMAGE

A. Any damage to existing facilities to remain, as caused by the Contractor's operations shall be repaired at no additional cost to the City.

B. Damaged items shall be repaired or replaced, at no additional cost to the City, with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this Contract.

1.5 PROTECTION OF EXISTING WORK

A. Before beginning any cutting, trenching or demolition work, the Contractor shall carefully review the work sequence and examine the Drawings and Specifications to determine the extent of the Work. The Contractor shall take all necessary precautions to prevent damage to existing facilities, which are to remain in place, and be responsible for any damages to existing facilities, which are caused by the operations. Damages to such work shall be repaired or replaced to its existing condition at no additional cost to the City. The Contractor shall carefully coordinate the work of this Section with all other work and shall provide shoring, bracing, and supports, as required. The Contractor shall insure that structural elements are not overloaded or compromised and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract. The Contractor shall remove all temporary protection when the work is complete.

B. A jack hammer or sawcut shall be used at the beginning of each excavation and at all “back of sidewalk” limits in order to avoid damage to abutting properties and features which are to remain.

C. The Contractor shall carefully consider all bearing loads and capacities for placement of equipment and material on site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the Contractor shall consult with the City prior to the placement of such equipment or material.

1.6 JOB CONDITIONS

A. The City assumes no responsibility for actual condition of the facilities to be removed, abandoned or modified. The Contractor shall visit the site; inspect all facilities to get familiarized with all existing conditions and utilities.

B. The City may occupy portions of the utilities, structures, properties or other facilities immediately adjacent to selective demolition area. Conduct selective demolition, modification and abandonment so City's operations will

not be disrupted. Provide not less than 24 hours notice to City of activities that will affect City's operations.

D. City assumes no responsibility for condition of the utilities, structures, properties or other facilities to be selectively demolished.

E. If materials suspected of containing hazardous or asbestos materials are encountered, do not disturb; immediately notify Engineer.

F. Storage or sale of removed items or materials on-site will not be permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition, modification and abandonment operations.

G. Existing timber railroad ties and timber piles are suspected to be treated with creosote, pentachlorophenol and/or CCA. Appropriate testing, handling, transportation, and disposal are required.

1.7 QUALITY ASSURANCE

A. Comply with Section 01400 - QUALITY CONTROL

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Pre-Demolition, Modification, and Abandonment Conference: Conduct conference at Project site, which includes City and Engineer. Review methods and procedures related to selective demolition.

D. Review and finalize selective demolition, modification and abandonment schedule and verify availability of materials, labor, equipment, and facilities needed to make progress and avoid delays.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Comply with material and installation requirements specified in individual Specification Sections.

2.2 MATERIALS OWNERSHIP

A. Coordinate with Engineer and City, who will make final determination as to whether an item is to be salvaged or removed. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain City's property, demolished materials shall become Contractor's property and shall be removed from Project site.

2.3 REPAIR MATERIALS

A. Use repair materials identical to existing materials. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 – EXECUTION

3.1 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to City ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

3.2 PREPARATION FOR WORK

A. Verify that all active and inactive (temporarily not in use) sewer and drain services have been re-directed prior to abandonment. Perform CCTV inspection of gravity mains, building inspections and flow/dye testing to locate, observe and confirm that no known or unknown services remain connected. Any monetary losses or damage to facilities or property due to backups, flooding or loss of use because of the abandonment of an active line shall be the sole responsibility of the Contractor.

B. Verify that utilities have been disconnected and capped, shut-off, or bulk headed. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition, modification and abandonment

required. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

D. Engage a professional engineer to survey condition of structures to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

F. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition, modification, and abandonment operations.

3.3 SITE ACCESS, TEMPORARY FACILITIES AND PROTECTION

A. Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used utilities, structures, properties or facilities.

B. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from City. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

C. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

D. Protect existing site improvements, appurtenances, and landscaping to remain.

E. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

F. Temporary Facilities: Provide temporary barricades and other protection required for demolition security and to prevent injury to people and damage to adjacent utilities, structures, properties and facilities to remain.

G. Provide protection to ensure safe passage of people around the area.

H. Temporary Shoring: Provide and maintain in accordance with Section 02160 - TEMPORARY EXCAVATION SUPPORT SYSTEMS.

I. Strengthen or add new supports when required during progress of selective demolition.

J. Existing landscaping materials, structures, pipes and appurtenances, which are not to be removed/abandoned shall be protected and maintained as required by the Engineer and as specified.

3.4 POLLUTION CONTROL

A. Water sprinkling, temporary enclosures, and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. Comply with government regulations pertaining to environmental protection. Water shall not be used when it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

B. For the cutting and removing of existing timber pile or railroad ties, Contractor shall isolate, capture and dispose with the removed piles or ties any sawdust generated from cutting.

C. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3.5 CLEANING

A. During and upon completion of work, the Contractor shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by work in a clean, approved condition.

B. All areas shall be cleaned of dust, dirt, and debris caused by demolition, modification, or abandonment and adjacent areas returned to conditions existing prior to start of work.

3.6 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition, modification and abandonment operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by City and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to City and to authorities having jurisdiction.

C. Provide at least 72 hours notice to City if shutdown of service is required during changeover.

D. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished or abandoned.

E. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition, relocation or abandonment, and that maintain continuity of service to other parts of building.

3.7 DEMOLITION AND ABANDONMENT PROCEDURES

A. Disposal of all materials shall be performed in compliance with applicable local, state, and federal codes and requirements. Provide labor, equipment, and materials to perform work as specified and indicated.

B. The Contractor shall flush all pipe and structures to be removed or abandoned to remove solids and objectionable material prior to commencing demolition, modification, or abandonment.

C. When existing pipe is removed, the Contractor shall plug all resulting abandoned connections whether or not shown. Where removed piping is exposed, the remaining piping shall be fitted with a removable cap or plug, or bulk headed. Where existing piping, to include catch basin laterals, is to be abandoned, the Contractor shall cut back the abandoned pipe for a distance of 5 feet from any connecting structures to remain. Pipes to be abandoned in structures to be abandoned may be capped, plugged or bulk headed from inside the structure. All holes at the existing structures shall be repaired. Abandoned pipe smaller than 15 inches diameter shall be capped or plugged at both ends prior to backfill. Abandoned pipe 15 inches diameter and larger shall be filled with Controlled Density Fill (CDF) prior to being capped, plugged, or bulk headed and backfilling unless otherwise noted. Each pipe reach to be abandoned with CDF shall be filled with CDF from the up gradient end of the pipe reach wherever possible. The CDF shall completely fill each pipe reach and flow out the other end. The Contractor can aid the flow of the CDF in the pipe by providing a temporary structure at the access point to build up head or by pumping the CDF or by providing vibration in the pipe reach or access point. Requirements for Controlled Density Fill are described in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

D. Where existing drainage structures such as catch basins, drain manholes, sewer manholes, and combined sewer manholes are to be abandoned in place, the Contractor shall remove the frames, grates, and covers and cut the structures down a minimum of 2 feet below final grade. The Contractor shall put a minimum of four, 2-inch diameter drainage holes in the invert of each structure and then backfill the structure with control density fill or compacted sand as specified and as approved by the Engineer. Backfill around the structure shall be in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

E. Permanent plugs shall be constructed of Class B concrete, brick or other

material approved by the engineer.

G. Fill excavations with solid fill resulting from earth removal operations and/or with select borrow material in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING. Final grade to be restored in kind unless otherwise noted.

H. Exercise precautions for fire prevention. Make fire extinguishers approved for Class A, B and C fires available at all times in areas where performing demolition or abandonment work with burning torches. Do not burn demolition debris on site.

3.8 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings, joints and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

2. Maintain adequate ventilation when using cutting torches.

3. Existing Treated Wood Products including Railroad ties and timber piles shall be removed by neatly cutting to the dimensions required. Timber piles and railroad ties shall not be torn, shredded or otherwise damaged by removal methods.

4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

5. Dispose of demolished items and materials promptly.

6. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

7. Existing Facilities: Comply with City's requirements for using and protecting utilities, structures, properties and other facilities.

B. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to City.

4. Transport items to City's storage area designated by City.

5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition, cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.9 REHABILITATION/MODIFICATION PROCEDURES

A. Certain areas of existing piping, conduits, and the like will be affected by work necessary to complete modifications under this Contract. The Contractor shall be responsible to rehabilitate those areas affected by his construction activities.

B. When new piping is installed in existing manholes, catch basins or other structures, the Contractor shall accurately position core-drilled openings in the concrete as shown or otherwise required. Openings shall be of sufficient

size to permit a final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory installation of a flexible connector to ensure water tightness around openings so formed.

C. When new piping is to be connected to existing piping, the existing piping shall be cut square and ends properly prepared for the connection shown. Any damage to the lining and coating of the existing piping shall be repaired by the Contractor.

D. At locations where existing piles can be reused to replace the existing sewer or drain, the Contractor shall verify that the wood pile is not deteriorating. If wood piles are found to be in good condition, the piles shall be trimmed and capped with a concrete pile cap. If wood piles are found to be deteriorating, the Contractor shall notify the Engineer immediately.

3.10 DISPOSAL OF REMOVED/DEMOLISHED MATERIALS

A. The Contractor shall prepare and transport all demolition debris, materials, refuse, and abandoned equipment to an approved disposal site as part of the work under this section. All costs associated with the proper performance of this work shall be included in the appropriate Bid Items and at no additional cost to the City.

B. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. Demolition material shall be reused as fill to the extent possible. Removal of demolition debris, not utilized as fill, shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the City. Alternate routes shall be provided around closed or obstructed traffic ways.

C. Burning: Do not burn demolished materials.

D. Disposal: Transport demolished materials off City's property and legally dispose of them. See Sections 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL and 02080 – SOIL AND WASTE MANAGEMENT as they relate to the transportation and disposal of non-hazardous and hazardous solid waste.

E. Treated wood products: the Contract is responsible for sampling, laboratory testing, loading, transportation and disposal of treated wood. All aspects of this work are to be completed in accordance with state and federal regulations.

3.11 REPAIR OF DAMAGE

A. Any damage to existing facilities to remain, as caused by the Contractor's operations shall be repaired at no additional cost to the City. Damaged items

shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this Contract.

B. Promptly repair damage to adjacent construction caused by selective demolition operations.

C. Patching: Comply with Section 01045 - CUTTING AND PATCHING.

D. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

E. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

3.12 MASONRY PLUGS AND BULKHEADS

A. Shall be designed by a Massachusetts Registered Professional Civil or Structural Engineer and shall be installed by a qualified mason having experience in the construction of temporary and permanent masonry plugs and bulkheads of the same general nature of those Specified and proposed.

PART 4 – COMPENSATION

Item 2051.1 - Disposal of Construction Debris as Solid Waste

METHOD OF MEASUREMENT:
Measurement for payment for Disposal of Construction Debris as Solid Waste shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip. Solid Waste disposed of for which return manifests or certified weight slips have not been submitted will not be paid for.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Disposal of Construction Debris as Solid Waste shall be based on the per ton price bid for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to Dispose of Construction Debris as Solid Waste. The work includes, but is not limited to; handle, load, transport, stockpile, weigh and dispose at an appropriately permitted facility; all cobbles, rail, timber, brick, cement concrete, metals, granite curb, edging, inlets and corners, plastic, or other construction debris; and all fees, permits, taxes, sampling, testing and analysis required by the facility.

SPECIAL NOTES ON EXCLUSIONS:
The excavation and removal of the items listed above for disposal are not included herein but are included for payment elsewhere. This is a disposal item only. Soils are not included for payment herein but are included for payment in the appropriate soil disposal item. Soil weight excavated and disposed with Construction Debris due to poor segregation techniques

shall be estimated by the Engineer and deducted from the total weight disposed. Disposal of bituminous concrete is not paid for herein but is included for payment elsewhere. Bituminous Concrete weight excavated and disposed with Construction Debris due to poor segregation techniques shall be estimated by the Engineer and deducted from the total weight disposed. Payment for the disposal of abandoned or relocated existing gas, telephone, electric, cable TV, telecommunications, fire alarm and traffic signal utilities shall NOT be paid herein or separately elsewhere and are considered "incidental" to the Contract, with costs to be carried in the Contractor's base bid. Disposal of concrete and brick sidewalks, driveways, and handicap ramps removed and disposed of is not included herein but is carried under the unit price for the construction of the new sidewalks, driveways and handicap ramps.

Item 2051.2 - Disposal of Bituminous Concrete

METHOD OF MEASUREMENT:
Measurement for payment for Disposal of Bituminous Concrete shall be on the basis of Tons of bituminous concrete actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip. Bituminous Concrete disposed of for which return manifests or certified weight slips have not been submitted will not be paid for.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Disposal of Bituminous Concrete shall be based on the per ton price bid for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to Dispose of Bituminous Concrete. The work includes, but is not limited to; handle, load, transport, stockpile, weigh and dispose at an appropriately permitted facility all bituminous concrete; and all fees, permits, taxes, sampling, testing and analysis required by the facility.

SPECIAL NOTES ON EXCLUSIONS:
The excavation and removal of bituminous concrete is not included herein. The excavation of bituminous concrete is considered incidental to the contract and is not included for separate payment unless otherwise specified. This is a disposal item only. Soils are not included for payment herein but are included for payment in the appropriate soil disposal item. Soil weight excavated and disposed with Bituminous Concrete Pavement due to poor segregation techniques shall be estimated by the Engineer and deducted from the total weight disposed. Disposal of construction debris as solid waste is not included for payment herein but is included for payment elsewhere.

Item 2051.3 - Demolition or Removal of Lamp Hole, Manhole, Catch Basin or Other Structure

METHOD OF MEASUREMENT:
Measurement for payment for Demolition or Removal of Lamp Hole, Manhole, Catch Basin or Other Structure shall be on the basis of the number of individual lamp holes, manholes, catch basins or other structures demolished or removed complete as measured by the Engineer. Manholes, catch basins or other structures that are partially demolished or removed for the Contractor's convenience, or not fully removed or demolished where indicated in the Contract Documents, will be at the Contractor's expense and at no additional cost to the City.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Demolition and/or Removal of Lamp Hole, Manholes, Catch Basins or Other Structures shall be based on the number of individual lamp holes, manholes, catch basins or other structures demolished or removed complete for this item in the proposal. Under the per each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Demolition or Removal of Lamp Hole, Manhole, Catch Basin or Other Structure. The work includes, but is not limited to: saw cutting existing bituminous and cement concrete; excavation; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction and compaction testing; temporary excavation support furnished and installed complete; construction dewatering; disconnecting existing pipe, services and other connections; removal or demolition of the manhole, catch basin or other structure; masonry plugs in the disconnected pipe not specified for payment elsewhere; remove and stack or remove and dispose existing castings as required; salvage of materials specified; stockpile of salvaged materials and delivery of materials identified as to be salvaged to a location designated by the City.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item but are included for separate payment elsewhere; disposal of construction debris as solid waste; demolition and removal of pipes; abandonment of manholes, catch basins or other structures.

The demolition of existing, abandoned or relocated gas, electric, telephone, cable TV, fire alarm, traffic signal, or telecommunications structures and utilities are not included for payment herein or elsewhere but are considered incidental to the Contract and the Contractor shall carry costs in the base bid as necessary.

Item 2051.4 – Abandon in Place Manhole, Catch Basin, or Other Structure

METHOD OF MEASUREMENT:
Measurement for payment for Abandon in Place Manhole, Catch Basin or Other Structure shall be on the basis of the number of individual manholes, catch basins or other structures abandoned in place as specified herein and as measured by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Abandon in Place of Manholes, Catch Basins or Other Structures shall be based on the per number of individual manholes, catch basins or other structures abandoned in place complete for this item in the proposal. Under the per each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to Abandon in Place a Manhole, Catch Basin or Other Structure. The work includes, but is not limited to; saw cutting existing bituminous or cement concrete; excavation; furnishing and placing backfill per one of the approved methods; compaction and compaction testing; temporary excavation support furnished and installed complete; construction dewatering; disconnecting existing pipe, services and other connections; remove and stack or remove and dispose existing castings as directed; cutting and demolition of the manhole, catch basin or other structure sections a minimum of 2-ft below finished grade or to a greater extent to facilitate installation of adjacent work; masonry plugs in the disconnected pipe not specified for payment elsewhere; stockpile of salvaged materials and delivery of materials identified as to be salvaged to a location designated by the City; drill a minimum of four 2-in holes in invert of structure and furnish, install control density fill or compacted sand; and incidental work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item but are included for separate payment elsewhere; disposal of construction debris as solid waste; demolition and removal of pipes, lamp holes, manholes, catch basins or other structures.

The abandonment-in-place of existing, abandoned or relocated gas, electric, telephone, cable TV, fire alarm, traffic signal, or telecommunications structures and utilities are not included for payment herein or elsewhere but are considered incidental to the Contract and the Contractor shall carry costs in the base bid as necessary.

Item 2051.5 – Demolition or Removal of Pipe 15-inch Through 24-inch Diameter

METHOD OF MEASUREMENT:
Measurement for payment for Demolition or Removal of Pipe 15-Inch Through 24-Inch Diameter shall be based on per linear feet of individual pipes, 15-inch through 24-inch diameter, demolished or removed complete as measured by the Engineer as measured from inside wall of structure or beginning of demolition to inside wall of structure or end of demolition. Pipe demolished or removed for the Contractor's convenience, not indicated to be removed or demolished in the Contract, will be at the Contractor's expense and at no additional cost to the City.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Demolition or Removal of Pipe 15-Inch Through 24-Inch Diameter shall be based on the linear feet of existing pipe requiring removal as indicated in the Contract Documents or as required by the Engineer. Under the per unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to Demolish or Remove Pipe 15-Inch Through 24-Inch Diameter. The work includes, but is not limited to; saw cutting; excavation; furnish and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction and compaction testing; temporary excavation support furnished and installed complete; furnish and installation of masonry plugs or caps; construction dewatering; disconnecting existing pipe, services and other connections; identification and verification of all unknown active connections through surface inspection, CCTV inspection, dye testing, test pit, or other method approved by the Engineer for transfer to an active and functioning pipe; demolition and removal of the pipe; salvage of materials specified; stockpile of salvaged materials and delivery of materials identified as to be salvaged to a location designated by the City; and incidental work not indicated for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item but are included for separate payment elsewhere; disposal of construction debris as solid waste; and demolition and removal of lamp holes, manholes, catch basins or other structures.

The demolition of existing, abandoned or relocated gravity pipe less than 15-inches in diameter, gas, electric, telephone, cable TV, fire alarm, traffic signal, or telecommunications structures and utilities are not included for payment herein or elsewhere but are considered incidental to the Contract and the Contractor shall carry costs in the base bid as necessary.

Item 2051.6 - Disposal of Treated Wood Products

METHOD OF MEASUREMENT:
Measurement for payment for the Disposal of Treated Wood Products shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip. Material disposed of for which return manifests or certified weight slips have not been submitted will not be paid for.

BASIS OF PAYMENT / INCLUSIONS:
Payment for the Disposal of Treated Wood Products shall be based on the per ton price bid for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to dispose of existing treated wood products including railroad ties and timber piles from the project right of way. The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted facility; and all fees, permits, taxes, sampling, testing and analysis required by the facility and in accordance with state and federal regulations.

SPECIAL NOTES ON EXCLUSIONS:
The excavation and removal of the items listed above for disposal are not included herein but are included for payment elsewhere. This is a disposal item only. Soils are not included for payment herein but are included for payment in the appropriate soil disposal item. Soil excavated and disposed with existing treated wood products due to poor segregation techniques shall be estimated by the Engineer and deducted from the total weight disposed. Bituminous Concrete and Cement Concrete weight excavated and disposed with existing treated wood products due to poor segregation techniques shall be estimated by the Engineer and deducted from the total weight disposed.

END OF SECTION 02051

SECTION 02080

SOIL AND WASTE MANAGEMENT

2080.1 OHM - SOIL AND WASTE MANAGEMENT LUMP SUM

PART 1 – GENERAL

1.1 QUALIFICATIONS

A. The Contractor shall be experienced and knowledgeable and have the trained and qualified personnel needed to conduct the work as specified herein. Contractor shall have demonstrated experience in excavation, handling, and management of soils and waste, including characterization for off-site disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. The following documents are available for review at the office of the City (Cambridge DPW), 147 Hampshire St, Cambridge, MA 02139 and appended to the technical specifications in Appendices or the Attachment to the Special Conditions in Division 0.

1. Report – Soil Characterization Report, River Street Infrastructure and Streetscape Design Project, River Street, Cambridge, Massachusetts, dated February 25, 2022.

2. City of Cambridge Asbestos Ordinance.

1.3 OBJECTIVE and OVERVIEW

A. This Section includes furnishing all plant, labor, equipment, appliances, and materials, and performing all operations in connection with the handling, treating, stockpiling, transporting, and disposal and/or reuse of soil and associated fill and waste material resulting from the construction operations as specified.

B. This Section also includes requirements for handling spills of contaminated and/or hazardous materials.

C. The objective of soil management practices is to handle all soil and fill excavated during this contract in accordance with applicable state, federal and local regulations and bylaws and to implement off-site soil management in a cost-effective manner.

D. This Section includes protocol for handling and management of waste materials, including, but not limited to, construction debris, municipal waste, boulders, soil, fill, ash, rubble, and empty or crushed drums and/or drum parts. The Contractor shall provide the services of an Environmental Professional qualified to coordinate all soil/fill-handling activities with the City or Engineer and/or their representative.

E. In the course of the work, it may be necessary to excavate and handle potentially contaminated soil/fill. The soil/fill management practices specified herein apply to all soil/fill excavated during the course of this contract.

F. To the extent possible, the Contractor shall reuse geotechnically suitable excavated material prior to using imported backfill to reduce the volume of material to be disposed off-site. Imported backfill shall be used only as accepted by the Engineer.

G. Excavation and management of project soils and groundwater shall be conducted in accordance with:

1. If required based on additional testing, a Project-Specific Utility-related Release Abatement Measure (URAM) Plan to be prepared by the City's Licensed Site Professional (LSP) and submitted to MassDEP by the City of Cambridge; and

2. Report – Soil Characterization Report, River Street Infrastructure and Streetscape Design Project, River Street, Cambridge, Massachusetts, dated February 25, 2022.

H. All work shall be conducted in compliance with the following Contractor-prepared plans. These plans may be combined as appropriate so long as all requirements of each Plan are incorporated and distinct.

1. Site-Specific Health and Safety Plan;
2. Soil Management Plan;
3. Equipment and Personnel Decontamination Plan;
4. Dust, Vapor and Odor Control Plan;
5. Air Monitoring and Quality Control Plan; and
6. Spill and Discharge Control Plan.

I. For work conducted on private and public properties outside of the Rights of Way (ROW) of public roadways, additional requirements for soil testing, reuse, storage, and backfill apply, as described in this section. Excavated soil shall not be removed from the individual property until all excavation and backfill has been completed on that property. Soil shall be stored, if necessary, on the property from which it came until backfill is completed on that property. The Contractor shall reuse excavated soils as backfill within the same property from

which it originated. Under no circumstances shall surplus project soil be used as backfill on a property outside of the Right of Way unless the soil originated on that property. If surplus soil cannot be used on the same property and is consistent with soil in the adjacent Right of Way, it may be used as backfill in the Right of Way within the project limits, subject to Engineer's approval. If surplus soil cannot be used as backfill in the Right of Way, it shall, with the Engineer's approval, be combined with other surplus soils; in all instances it shall be reused or disposed of in accordance with the requirements of this section.

J. For work conducted on properties outside of the public Rights of Way, the Contractor shall notify the Engineer if visual or olfactory evidence of contamination is observed in the soil on any property. The Contractor shall not collect samples for chemical testing from individual properties outside of the Right(s) of Way except as allowed by the Engineer.

1.4 DEFINITIONS

A. Area of Contamination: For the purpose of managing soil classified as RCRA characteristic or listed hazardous waste, the area of contamination is the contiguous area within which the waste has been identified.

B. Area of Excavation: For the purposes of reusing soil/fill on-site, the *area of excavation* is considered to be the approximate area in which the soil/fill was removed provided that area is consistent in soil strata, color, texture, geotechnical properties and has substantially similar visual and olfactory characteristics as accepted by the Engineer. Soil/fill returned to the *area of excavation* shall be placed approximately in the same horizontal and vertical location from which it originated.

C. Excavation: The removal of materials encountered to the elevation and width limits indicated in the Contract Drawings, Specifications, or as directed by the Engineer.

D. Fill (Historic Fill): Fill, also known as historic fill or miscellaneous fill, is defined as a mixture of soil and other materials which have been located in the area through man-made processes primarily for the purpose of grading, backfilling or filling in low areas. Materials commonly associated with historic fill includes, but are not limited to; coal, glass, brick, ash, wood fragments and other similar granular materials. Historic fill shall not include boulders, ledge, consolidated rock, asphalt pieces, concrete, railroad timbers, rail, cobblestones or other abandoned building materials that would preclude the disposal of the urban fill as daily cover at a landfill.

E. Hazardous Waste:

1. Defined in 310 CMR 40.0006; or

2. Defined in 40 CFR 261.3.

3. A waste, or combination of wastes, that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may:

   a. Cause or significantly contribute to an increase in mortality or cause or significantly contribute to an increase in a serious irreversible or incapacitating reversible illness; or
   b. Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

F. Peat: A substance of vegetable origin, consisting of roots and fibers, moss, etc., in various stages of decomposition, and found as a kind of turf or bog. Peat shall be considered natural soil when it is encountered in small amounts (layers 1-foot (304.8 mm) or less in thickness) and when it is impractical to separate the peat from the natural soil or urban fill strata. Otherwise, peat shall be considered a distinctive stratum.

G. Sediment: All detrital and inorganic or organic matter situated on the bottom of lakes, ponds, streams, rivers, the ocean, or other surface water bodies.

H. Soil Classification Categories: Unless specifically stated otherwise terms used in this specification are as defined in the MCP, 310 CMR 40.0006. The following definitions and soil classifications apply to these specifications:

1. (Class A) Any soil or fill material which has concentrations of chemicals < RCS-1 Reportable Concentrations established by 310 CMR 40.0300 and 40.1600.

   Class A soils may be reused at the following types of facilities: Managed Fill Site (operating under an Administrative Consent Order (ACO) issued by MassDEP, unless otherwise approved by the owner); or a permitted landfill, provided that in all cases, the excavated soil analyte concentrations meet the acceptance criteria established by the facility and that disposal of soil at the receiving facility will not result in an exceedance of an RC applicable at the point of reuse/disposal and which would require notification of a release pursuant to 310 CMR 40.0300. Soils not exhibiting evidence of contamination or soils determined through laboratory chemical analysis to be Class A soils may also be reused in the area of excavation or elsewhere within Project limits as approved by the City's LSP.

   Soil/fill with OHM concentrations equal to or greater than (≥) RCS-1, but which have been confirmed by the City's LSP to contain asphalt as a result of historic road construction or filling operations, and therefore exempt from notification requirements, may be categorized as Class A at the discretion of the City's LSP.

Class A soil may be reused as common fill/ordinary borrow provided it also meets the physical requirements as specified herein and as specified in Section 02210 - Earth Excavation, Backfill, Fill and Grading. Class A soil may be used in gravel processing facilities provided the soil analytical data is comparable to materials being used by the facility and such use is approved by the Engineer.

Class A soil/fill which is reused or disposed of off-site shall be transported under a MassDEP Bureau of Waste Prevention Material Shipping Record & Log (MSR). Management of Class A soils shall be conducted in conformance with the MassDEP Similar Soils Provision Guidance – WSC#-13-500 (2014).

2. (Class B) Contaminated: Any soil or fill material which contains oil or hazardous materials (OHM) at concentrations ≥ a release notification threshold established by 310 CMR 40.0300 and 40.1600.

   Soils with OHM ≥ RCS-1 resulting from exempt activities or meeting the definition of "background" per 310 CMR 40006, may be managed as Class A at the direction of the City's LSP.

   Any soils exhibiting either petroleum or chemical odor or visual indications of oil or hazardous materials as accepted by the Engineer shall be handled as potentially contaminated soils. Potentially contaminated soils may be reused within the area of excavation without first performing laboratory analyses, with the approval of the City's LSP. Potentially contaminated soils shall not be mixed with soils not exhibiting either petroleum or chemical odor or visual indications of oil or hazardous materials. Any excavated soil/fill material which is not reused within the area of excavation, must be characterized prior to reuse.

   Following receipt of analytical results, Class B soil/fill shall be handled in accordance with the type and concentrations of OHM present in the soil/fill. Surplus soil/fill which may be contaminated shall be segregated by the Contractor. Soil/fill which has been staged and characterized can be reused within the area of excavation or elsewhere on site provided the material has been characterized by laboratory analysis and has equal or less contamination than the point where it is to be reused. Class B soil may not be reused beneath a permanent structure such as a building foundation without approval from the City's LSP.

3. Class B soil which cannot be reused on site shall be reused off-site, recycled, or disposed of at a permitted facility. Subcategories of Class B, which establish off-site management requirements, are defined as follows:

a. Class B-1: Soil and Fill that meet all applicable criteria (i.e., Massachusetts Department of Environmental Protection (MassDEP) Policy # COMM 97-001 - Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy, and/or facility-specific permit requirements) for reuse as daily cover, intermediate cover, or pre-cap contouring material at in-state unlined landfills. Note: per COMM 97-001, sediments may not be re-used as Class B-1.

b. Class B-2: Soil and Fill that meet all applicable criteria (i.e., COMM 97-001 and/or facility-specific permit requirements) for reuse as daily cover, intermediate cover, or pre-cap contouring material at in-state lined landfills.

c. Class B-3: Soil and Fill that meet all applicable criteria for recycling at an asphalt batching plant and/or the specific licensing requirements for the proposed recycling facility.

d. Class B-4: Soil and Fill that contain concentrations of contaminants that exceed in-state, lined, and unlined landfill reuse criteria as well as asphalt batching acceptance criteria, but meet the criteria for regional thermal treatment facilities, and are not classified as a RCRA Hazardous Waste.

e. Class B-5: Soil and Fill that contain concentrations of contaminants that exceed in-state, lined and unlined landfill reuse criteria or which require removal to regional disposal facilities and which is not classified as RCRA Hazardous Waste.

f. Class B-6: Soil and fill which does not meet one of the designations above due to excessive foreign materials and/or debris and which is not classified as a hazardous waste.

4. (Class C) Hazardous Waste: A waste, or combination of wastes, that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or cause or significantly contribute to an increase in a serious irreversible or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Also included within the definition of hazardous waste is hazardous waste as defined 310 CMR 40.0006 and 40.CFR 261.3. Hazardous waste, as defined in 40 CFR 261.3, is a solid waste that exhibits any of the characteristics of hazardous waste in excess of regulation levels presented in 40 CFR 261, subpart C and/or that is listed in 40 CFR 261, subpart D; that is a mixture of solid and hazardous waste; or that is derived from a listed waste.

   Soil having or suspected of having the characteristics of a hazardous waste or of containing a listed hazardous waste shall not be removed from the lateral limits of an excavation or staged at another location except at the direction of the Engineer. Subcategories of Class C shall be as follows:

a. Class C-1: Soils classified as hazardous waste that can be treated on-site to eliminate the toxicity characteristic (e.g., for lead).

b. Class C-2: Material determined to contain "listed" or "characteristic" hazardous waste constituents which cannot be treated on-site. Land disposal of hazardous soil is prohibited until the soil has been treated to meet Land Disposal Restrictions (LDR) standards pursuant to 40 CFR 268.48. This material must be transported to an out-of-state approved RCRA permitted disposal or treatment facility under a Uniform Hazardous Waste Manifest. Land disposal following achievement of the Uniform Treatment Standards (UTS) shall be at a RCRA landfill.

I. Special Waste: means any solid waste that is determined not to be a hazardous waste pursuant to 310 CMR 30.000 and that exists in such quantity or in such chemical or physical state, or any combination thereof, so that particular management controls are required to prevent an adverse impact from the collection, transport, transfer, storage, processing, treatment or disposal of the solid waste. Asbestos and PCB-contaminated soils/fill (at regulated concentrations) are examples of special waste categories.

J. Soil (Natural Soils): Soil, otherwise known as natural soil, is defined as unconsolidated sand, gravel, silt and clay, and the organic material which has become part of the unconsolidated soil matrix.

K. Over Excavation: Consists of removal of materials beyond elevations and width limits indicated in the Contract Documents without direction of the Engineer. Over-excavation material handling, transportation and disposal, backfilling and compaction shall be at the Contractor's expense. Over-excavations shall be backfilled and compacted as specified for excavations of the same class, unless otherwise directed by the Engineer.

L. Unknown Materials: Any material, that is not readily identifiable as non-hazardous waste, and which has not been previously characterized or encountered during site investigation activities. The Unknown Material classification is to be used in the event that an unexpected, unusual material is encountered for which special handling procedures shall be required in order to handle the material safely. Such wastes include but are not limited to:

1. Unlabeled drums or containers containing material which is not readily identifiable as a non-hazardous substance.

2. Any material which varies significantly from material previously observed on site and which cannot be readily identified as a non-hazardous.

3. Waste material of unusual color or odor or material with indications of hazardous levels (e.g. exceeding OSHA permissible exposure limits)

of contaminants as evidenced on an organic vapor monitor or other similar instrument.

The City reserves the right to apply generator knowledge to classify and profile the material as a previously encountered waste or as a known waste. In the event that a material is encountered which the Contractor is uncertain as to its nature, the City or their representative shall assess the material with the Contractor and direct the Contractor as to the nature of the material being known or unknown.

1.5 WORK INCLUDED

A. Managing excavated soil and fill material, including disposal and/or reuse of excavated soil and fill material.

B. The Contractor's Environmental Professional shall characterize all excavated soil and fill material prior to off-site reuse or disposal; pre-excavation characterization may be conducted by the Contractor. Characterization requirements may vary depending on the site selected to receive soil suitable for reuse or the disposal facility permits and policies. The Contractor is responsible for final waste characterization.

C. At a minimum, all surplus soils shall be analyzed for the following parameters:

1. MCP 14 total metals;
2. Volatile organic compounds (EPA Method 8260B);
3. Semi-volatile organic compounds (EPA Method 8270);
4. Total petroleum hydrocarbons (EPA Method 8100M or equivalent);
5. Polychlorinated biphenyls (PCBs) (EPA Method 8082); and
6. pH, Ignitability, Reactive Sulfide, Reactive Cyanide, Specific Conductance.

D. The City shall not be responsible for costs associated with additional soil characterization.

E. Characterization of soil, fill, and unknown material for disposal/reuse purposes, including; field screening and soil management/segregation; temporary storage/staging; and laboratory analysis (as may be necessary for unknown materials and/or for compliance with receiving facility requirements).

All laboratory chemical analyses conducted shall utilize currently accepted U.S. EPA and applicable state agency analytical protocols and procedures. Laboratory chemical analysis reports shall meet MassDEP Compendium of Analytical Methods (CAM) requirements for analysis which have published CAM requirements. The MassDEP MCP Analytical Method Protocol Certification Form shall be provided by the Laboratory with all sample results.

Metals analysis shall be for MCP 14 metals. TCLP analysis shall be conducted for any analyte for which the RCRA "rule of twenty" is exceeded.

F. Management of contaminated groundwater: If groundwater potentially impacted by OHM, based on visual or olfactory evidence, is encountered in the course of the work and dewatering is required, discharge permits, modification of discharge permits, and/or groundwater treatment may be necessary depending upon the discharge method(s) and/or location(s) utilized by the Contractor. The City and Engineer shall be notified by the Contactor if groundwater potentially impacted by OHM is identified.

G. All work at the site must be performed in accordance with all applicable federal, state, and local regulations, permits and licenses, including, but not limited to:

1. The applicable parts of the Code of Federal Regulation (CFR) Title 40: Protection of Environment, pertaining to the Comprehensive Environmental Response and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA), RCRA, Toxic Substances Control Act (TSCA), and the National Emission Standards for Hazardous Air Pollutants (NESHAPS) as regulated by the U.S. Environmental Protection Agency (U.S. EPA);

2. State regulations specified in the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000), and Massachusetts General Law 21E - Massachusetts Oil and Hazardous Materials Release Prevention and Response Act, and applicable Massachusetts Department of Environmental Protection (MassDEP) guidelines and policies;

3. MassDEP Technical Update. Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil (2002)

4. Department of Transportation (DOT) regulations 49 CFR, and state transportation licenses and permits;

5. OSHA regulations (including, but not limited to, 29 CFR 1910.1000, 29 CFR 1926, and CFR 1910.120), 40-hour Occupational Safety and Health Administration (OSHA) training (plus 8-hour refresher training) and all other applicable state and federal regulations regarding health and safety requirements;

6. NIOSH/OSHA/USCG/EPA: "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" October 1985, DHHS (NIOSH). Publ. No. 85-115;

7. Department of Transportation training;

8. U.S. Army Corps of Engineers Section 404 Programmatic General Permit, Commonwealth of Massachusetts;

9. General Contractor's license;

10. National Pollutant Discharge Elimination System (NPDES) Notice of Intent (NOI) to discharge and associated Construction General Permits, Remediation General Permits, and/or Dewatering General Permits;

11. Regional and local Publicly Owned Treatment Works (POTW) pre-treatment and construction dewatering requirements and permits;

12. Excavation and/or grading permits;

13. Special use permits;

14. Special waste haulers certificate;

15. Massachusetts Wetlands Protection Act and associated Order of Conditions; and

16. The Contractor's Soil Management Plan (SMP) and Health and Safety Plan to protect the workers and the public.

17. Massachusetts Division of Occupational Safety (DOS): The Removal, Containment or Encapsulation of Asbestos (453 CMR 6), including all clarifications, policy statements, etc.

18. Massachusetts Department of Environmental Protection: 310 CMR 7.00, 7.09, 7.15 and all related amendments and policy statements, and

19. MassDEP: Asbestos Cement Pipe Guidance Document (2011)

20. MassDEP Technical Update: Considerations for Managing Contaminated Soil: RCRA Land Disposal Restrictions and Contained-In Determinations, August 2010;

21. MassDEP Similar Soils Provision Guidance (2014); and

22. MassDEP Interim Policy on the Re-Use of Soil for Large Reclamation Projects (COMM-15-01).

E. Implementation of the submitted HASP and other applicable monitoring and control plans includes establishing work zones (e.g., support zone, contamination reduction zone, exclusion zone), preparing a decontamination pad(s) and staging area(s), performing the appropriate environmental monitoring, training and medical monitoring of personnel, coordinating waste disposal and waste characterization as needed.

F. The Contractor shall develop, implement, maintain, supervise, and be responsible for all soil management practices during the course of this contract. The Contractor's Environmental Professional shall be present during all field screening, segregating, handling, and characterization of all soils excavated in the course of completing this contract to ensure that soil is managed in accordance with applicable laws, regulations, and this Section.

Soil management activities shall include and be conducted as specified herein:

1. Providing and constructing a secure soil staging area sized to adequately segregate soils in accordance with the conditions specified without impeding construction-related activities. The Contractor is to use existing information and obtain additional information as may be needed at no additional cost to the City to minimize the need for a staging area. If a staging area is required to characterize unknown or excess material for any reason, the Contractor is responsible for locating, selecting, preparing and securing the area. Contractor shall provide means of separating potentially contaminated material from the staging area ground surface to prevent the potential of cross-contamination. Separation method to be provided in accordance with 3.4(C).

2. Excavated soil that cannot be re-used on site shall either be loaded directly into containers for off-site reuse or disposal (provided the material is consistent in visual, olfactory and chemical characteristics as observed in previous investigations and provided the material has been approved for acceptance at an off-site facility) or shall be staged at a location determined and secured by the Contractor pending sampling and analytical characterization by the Contractor's Environmental Professional prior to off-site reuse or disposal, with the exception that soil suspected of having the characteristics of a hazardous waste or of containing a listed hazardous waste. These soils shall not be removed from the Area of Contamination or staged at another location except at the direction of the Engineer. Since individual disposal facilities have different permit conditions and specific pre-characterization data requirements, the Contractor is responsible for final soil characterization prior to transport and disposal. The Contractor is hereby made aware that for the purposes of disposal, final soil characterization is the responsibility of the Contractor and costs for securing a staging area and conducting waste characterization shall be incorporated into the Contractor's bid price for construction.

3. Soil that has been characterized as a Remediation Waste must be either live loaded, stockpiled on-Site or stockpiled on a property owned and/or controlled by the City. Stockpiling of known Remediation Waste at an alternative location shall be conducted only with the approval from the City and the City's LSP.

4. The Contractor shall control and contain runoff of free liquids drained from stockpiled soil/fill. Free liquids shall be managed in accordance with applicable regulations.

5. Soil that has been chemically stabilized shall be confirmed through laboratory chemical analysis to be characteristically non-hazardous pursuant to RCRA prior to off-site shipment and disposal.

6. Soil/fill shall not be staged within 100 feet (30.5 meters) of a Reservoir or Area of Critical Environmental Concern. Soil/fill shall not be staged in the work area over night.

7. Excavating unknown, previously uncharacterized material which may be classified as RCRA hazardous waste and disposing of it at an approved facility and/or on-site treatment of these materials to render it non-hazardous prior to and disposing of it at an approved facility.

8. Removing characterized on-site materials for off-site re-use or disposal.

9. Demobilizing the site, including, but not limited to, removing and disposing of construction-related equipment and materials used for personnel and equipment decontamination and related waste such as personal protective equipment (PPE), decontamination water/solids, temporary covers, and washwater storage tanks; disconnection of temporary utilities; and final clean-up to pre-construction conditions.

10. The Contractor shall manage unknown material separately and temporarily stage the material pending characterization.

G. All incidental, Contractor-generated waste (such as Personal Protective Equipment, decontamination wash water, etc.) resulting from the services hereunder are the property and responsibility of the Contractor and are to be disposed of by the Contractor under a Uniform Hazardous Waste Manifest and/or by a Massachusetts Bureau of Waste Site Cleanup Bill of Lading, as appropriate.

H. The Contractor is responsible for identifying potential hazards at the site and reviewing existing information.

1.6 RELATED WORK

A. Section 01025 – MEASUREMENT AND PAYMENT

B. Section 01108 – HEALTH AND SAFETY PROCEDURES

C. Section 01500 - TEMPORARY FACILITIES AND CONTROLS

D. Section 02010 - SUBSURFACE INVESTIGATION

E. Section 02095 - TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

F. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

G. Section 02140 – DEWATERING

1.7 EXISTING CONDITIONS

A. Limited chemical characterization of soil has been conducted, the results of which are presented in the report referenced in Paragraph 1.2 of this section. The Contractor is obligated to review existing environmental assessment reports and manage the soil and groundwater in accordance with applicable state and federal regulations.

1. Fourteen (14) borings were advanced in or adjacent to the project area. Soil samples were collected from nine (9) borings: GEI-B2, GEI-B3, GEI-B5, GEI-B7, GEI-B9, GEI-MW101, GEI-MW102, GEI-MW103, and GEI-MW104 for laboratory chemical analysis.

2. Laboratory analysis identified 2-methylnaphthalene and total petroleum hydrocarbons (TPH) above the RCS-1 MCP Reportable Concentration in GEI-B7-S1 on River Street. These concentrations are exempt from reporting in accordance with 310 CMR 40.0317(12)(a). Arsenic was also detected above the RCS-1 MCP Reportable Concentration in GEI-MW101-S2. These concentrations are exempt from reporting in accordance with 310 CMR 40.0317(12)(b).

B. Asbestos-wrapped steam pipe is known to exist within the project alignment. Known locations of the steam pipe are shown on the Contract Drawings. This asbestos-wrapped steam pipe is considered Asbestos-Containing Material (ACM) as that term is defined and used in this section (refer, for example, to Paragraph 3.7). The Contractor is obligated to review existing information and manage the ACM in accordance with applicable state and federal regulations.

1.8 SUBMITTALS

A. The Contractor shall prepare a Work Plan that generally describes the work to be performed under Section 02080 Part 3 (Execution). The work plan shall include, but not be limited to detailing the submittal and implementation of the following:

1. Site-Specific Health and Safety;

2. Soil Management;

3. Dust, Vapor, and Odor Control;

4. Air Monitoring and Quality Control; and

5. Spill and Discharge Control.

The Work Plan shall be submitted to the City and Engineer for review and acceptance at least two weeks prior to beginning any intrusive work at the site.

B. The Contractor shall provide the qualifications of the Environmental Professional(s) to be assigned to this project. The Environmental Professional(s) shall be at a minimum certified, registered or licensed as an Environmental Professional or equivalent and hold a Bachelor of Science Degree in Environmental Science, Environmental Engineering, or Public Health or related degree and have sufficient experience in similar work to perform the responsibilities detailed herein. The Environmental Professional(s) shall have demonstrated experience in management of RCRA hazardous waste soils and groundwater.

C. Soil Management: The Contractor shall prepare a Soil Management plan that outlines measures for soil and fill sampling, field screening, laboratory chemical analysis, treatment, and disposal/reuse. At a minimum, this plan shall address the following:

1. Methods, procedures, and equipment used for treating, excavating, dewatering, characterizing, segregating, reusing/backfilling, loading, and transportation of contaminated soil/fill materials encountered during excavation operations;

2. A list of all transporters and waste facilities, complete with license numbers, permit numbers or ACO numbers (as applicable), contact person, and address and telephone number that the Contractor utilizes for waste disposal. The Contractor shall provide copies of the permits/ACOs held by each disposal facility which the Contractor plans to use to dispose of non-hazardous solid waste; and if necessary, to dispose of hazardous waste (due to lead toxicity), PCB-impacted waste and/or asbestos-containing waste;

3. 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. The City reserves the right to reject any facility on the basis of poor compliance history;

4. Procedures for securing the staging area, controlling dust and soil/fill migration, prevention of contamination of excavated soil by trucks used for asphalt transport, separation of stockpiled materials from the staging area ground surface, preventing damage to uncontaminated

areas via contaminant migration and for decontaminating vehicles and personnel exiting the staging area;

5. The means and methods for decontaminating all equipment and personnel, including provisions for installing an equipment decontamination pad if required or specified;

6. Methods and procedures for identifying stockpiled material (e.g., labeling, marking containers) and procedures for identification and tracking;

7. Methods, procedures, and equipment used for obtaining the necessary information needed to satisfy the off-site reuse/disposal facility requirements specified herein and/or by the facility;

8. Methods, procedures, and equipment proposed for assessing and handling Unknown Materials. The SMP shall indicate which laboratory(ies) the Contractor shall utilize for chemical analysis soil, groundwater and unknown materials:

   a. An Unknown Materials information sheet shall be developed as part of the Contractor's SMP, upon which the Contractor shall record information such as container type, size, and condition; and, any identifying characteristics of the unknown material. The format of the information sheet shall be as accepted by the City and/or its representatives.

   b. The Contractor’s plan for notifying the City and Engineer in the event that an unknown material as defined in this specification is encountered. The plan shall include the phone numbers and names of the City’s representative(s) that the Contractor will contact in such an event.

9. Provisions for separation of incompatible materials;

10. Protocol for over-packing drums (if encountered);

11. Procedures for consolidating (i.e., bulking) compatible materials for disposal; and

12. Procedures for dewatering; testing, handling, treatment, and disposal/discharge of groundwater.

D. Soil Management/Tracking Documentation:

Prior to off-site disposal or reuse, the Contractor shall provide to the Engineer a letter from the disposal facility indicating that the facility has reviewed the available data relative to the soil/fill to be delivered and agrees that the soil/fill

meets their acceptance criteria. The letter shall be signed by a duly authorized representative of the receiving facility.

Within the time constraints established in state and/or Federal laws and regulations, the Contractor shall submit to appropriate authority(ies), as applicable, Uniform Hazardous Waste Manifests and/or Bills of Lading for all soils and associated fill disposed or reused of off-site utilizing such documents. Copies of all manifests, Bills of Lading, and all other documents used to track and/or permit off-site transportation of soils shall be submitted to the Engineer and City within ten (10) days of shipment. The Contractor is responsible for preparation of all manifests, Bills of Lading, Material Shipping Records, and all other related documents completely, legibly, and accurately prior to submitting them to the City and/or its representative for generator and LSP signatures. (Bills of Lading shall be prepared electronically by the City's LSP; the Contractor shall be responsible for providing information necessary for completion of the BOL). The Contractor shall be responsible for paying for any and all fines associated with inaccurate, incorrect, or improperly completed manifests, Bills of Lading and all other related documents, including fines resulting from late or untimely submittals.

E. Spill and Discharge Control (SDC): The SDC program shall provide contingency measures and reporting responsibilities for potential uncontrolled spills and discharges of contaminated and/or hazardous materials, including, but not limited to, leachate, decontamination water, sewage, and other on-site waste materials. In addition to the above listed items, the SDC program shall specifically contain: procedures for containing dry and liquid spills; absorbent material available on site; storage of spilled materials; governmental reporting (i.e., notification) procedures; decontamination procedures; discharges of sanitary or combined sewers into storm drains either by flow handling/bypassing or accidental or unintentional discharge; and procedures for protecting wetlands and surrounding public and private property.

The Spill and Discharge Plan shall indicate the location and quantity of the materials to be staged on site and the basis for the quantities (i.e., indicate the vessel which will be on site containing the greatest volume of oil or hazardous materials). No fuel or oil tanks or drums may be temporarily staged on site unless they are stored within a secondary containment system. Fuel deliveries shall be performed in a designated area which has either secondary spill containment or an impervious surface with absorbent berms located around the point of fuel delivery. The Spill and Discharge Plan shall indicate the location of the fueling area and the nature of secondary containment which the Contractor intends on utilizing.

1. Notification Procedures: The Contractor shall prepare in advance of work activities a notification list, complete with phone numbers,

addresses, and contact names for all parties to be notified in the event of a spill. This list shall include:

a. City's designated representatives;
b. City;
c. Fire Department;
d. Engineer; and
e. Massachusetts Department of Environmental Protection (as required per 310 CMR 40.0000).

The City shall be notified immediately of an uncontrolled spill or discharge. If human health or the environment are potentially threatened, the Contractor shall take immediate action to abate the conditions and notify emergency personnel.

2. Spill Incident Report(s): In the event of an uncontrolled spill or discharge, a written report detailing each uncontrolled spill or discharge shall include, at a minimum, the cause and resolution of incident, outside agencies involved, and date of occurrence. The report shall be submitted to the City within 48 hours of the incident. The Contractor shall document all spills on the as-built Drawings and submit the Drawings to the City at project completion. The Contractor shall be responsible for remediating any spills or releases of oil or hazardous materials as a result of the Contractor's activities. The site shall be remediated to pre-release conditions at no additional cost to the City.

F. Dust, Vapor and Odor Control (DVOC): The DVOC program shall include measures to control objectionable dust, vapors, and chemical or natural odors originating from the work area or soil/fill staging area. The DVOC Plan shall describe procedures to minimize the creation of dust, and the control of objectionable vapors and odors originating from the site. At a minimum, the DVOC program shall include air monitoring as specified in paragraph 3.6. The Contractor shall have materials on hand to implement control measures.

PART 2 – PRODUCTS

2.1 DUST AND VAPOR CONTROL

A. Air monitoring shall include total dust testing using MIE, Inc. Miniram PDM-3 Dust Monitors, or like instruments. Air monitoring shall include monitoring for total volatile organic vapors using a MiniRAE Photoionization Detector, or like instrument.

2.2 SPILL CONTROL

A. At a minimum, the Contractor shall maintain on-site absorbent pads, booms and absorbent materials in sufficient quantity to address a release of fuel oil, hydraulic oil or other OHM that the Contractor intends to use or store on site, including fuel oil and hydraulic oil that is used within earth moving equipment. The quantity of spill containment materials maintained on site shall be sufficient to respond to a catastrophic release from the vessel containing the greatest quantity of oil or hazardous material on-site.

2.3 EQUIPMENT DECONTAMINATION PAD

A. The Contractor shall provide all materials and labor to complete an equipment decontamination pad. Liner materials and collection system shall be selected by the Contractor to perform as specified.

PART 3 – EXECUTION

3.1 GENERAL

A. All work in this section will be performed in accordance with the Contractor's Work Plan, SMP and Site-Specific HASP.

B. The primary concern of the Contractor in the excavating, handling, sampling, bulking, and on-site storage of soil/fill and/or drummed material (if encountered) will be to protect the health and safety of the site workers, the public, and the environment.

C. The Contractor shall keep a copy of the Health and Safety Plan (HASP) on site during all operations and shall conduct daily health and safety meetings. Failure to keep a copy of the HASP on-site, or any other breach of the Contractor's Plan, may be cause for stopping work at the cost of the Contractor. Delays caused by the Contractor's failure to comply with the health and safety regulations or any health and safety plan shall not entitle the Contractor to recover any additional costs or time lost. The Contractor shall not be allowed to resume activities until corrective measures are accepted by the Engineer and/or their representative and implemented.

D. Medical surveillance records, OSHA 40-hour training forms, accident forms, and all other documentation requirements of the Contractor's safety and health program for personnel working on the site (who are subject to exposure to potentially contaminated soil) shall be up-to-date and kept on file at the site. The Contractor shall provide documentation of employee status upon request of the Engineer and/or their representative.

3.2 SOIL/FILL MANAGEMENT

A. Soil and fill material that is managed under a Utility-related Abatement Measure (URAM) Plan pursuant to the MCP, which is staged off-site, and which is not characteristically hazardous, may be re-used within fourteen (14) calendar days of excavation. Any material which is suitable for re-use as ordinary borrow, based on analytical results and could have been placed on site, but was not, due to Contractor delay (i.e. analytical results were not available within ten (10) days following excavation) will be disposed in accordance with the applicable regulations by the Contractor at no cost to the City.

B. Soil and fill material that is managed under a Utility-related Abatement Measure (URAM) Plan pursuant to the MCP, which is staged off-site and which is determined at the staging area to be characteristically hazardous for lead may be treated (stabilized) within the “Area of Contamination” only and must be reused or disposed of within ninety (90) calendar days of excavation. No treatment may occur at the staging area if outside the “Area of Contamination”.

C. Class B and C excavated soils shall be completely covered with a minimum 10-mil thick layer of plastic tarp. Soils exhibiting evidence of potential contamination including but not limited to odors and/or staining shall be covered prior to characterization and off-site reuse or disposal. Stockpiled soils determined to be Class B or C, as described herein, shall be securely covered at the close of each day and continuously when not being added to or otherwise being handled by the Contractor. Stockpiles, including those of Class A soils, shall also be covered at times as directed by the Engineer.

D. Excavated soil shall not be removed from a private property until all excavation and backfilling has been completed on that property. Soil shall be stored, if necessary, on the property from which it was excavated until backfill is completed on that property. The Contractor shall reuse excavated soils as backfill within the same property from which it originated. Under no circumstances shall surplus project soil be used as backfill on a property outside of the Right of Way unless the soil originated on that property. If surplus soil is generated that cannot be used on the same property, and is consistent with soil in the adjacent Right of Way, it may be used as backfill in the Right of Way within the project limits, subject to the Engineer’s approval. If surplus soil cannot be used as backfill in the Right of Way, it shall, with the Engineer’s

approval, be combined with other surplus soils and reused or disposed of in accordance with the requirements of this section. The Contractor shall not collect samples for chemical testing from individual public or private properties outside of the Right of Way except as allowed by the Engineer.

E. Excavated soil shall be managed such that it is not exposed to contamination following excavation. Equipment and supplies in contact with excavated soil shall be free of asphalt, petroleum products or other hazardous materials that could be transferred to soil. Vehicles used to transport asphalt shall not be used to transport soil except by permission of and following inspection by of the truck, by the Engineer.

3.3 SOIL/FILL CHARACTERIZATION

A. Soil and fill material shall be classified based on the criteria established in the accepted SMP and these Specifications.

B. Initial Characterization of Soil/Fill Material: A summary of existing conditions and investigation findings performed by the Engineer during design, including a summary of analytical results, is appended to this section.

C. The Contractor may either perform independent sampling and pre-characterization of soil/fill strata to be encountered during construction in advance of excavation such that excavated soil can be directly transported to an appropriate facility; or the Contractor shall make the necessary arrangements to secure a staging area(s) suitable for storing soil stockpiles pending analyses.

D. Soil shall be preliminarily segregated based on the Soil Classification Categories detailed in Sub-section 1.4, except as indicated below.

1. Potential Asbestos Containing Material (PACM): If soil/fill suspected of including asbestos-containing debris is encountered during excavation, the Contractor or the Contractor-hired Environmental Professional shall immediately contact the Engineer to discuss the nature and extent of the PACM and to assess potential hazards and appropriate handling procedures. Prior to handling and removing the PACM, MassDEP shall be notified and approval for handling and disposal obtained. Discovery and management of PACM shall be documented as required in the SMP. Evidence of PACM includes but is not limited to the presence of suspect asbestos-containing building debris such as broken or crushed asbestos-cement (transite) piping, vinyl floor tiling, tar-based pipe wrap, roofing paper or paper-like insulation materials. Following MassDEP approval, such soil/fill shall be managed in accordance with applicable regulations. Soils shall be analyzed for OHM to determine appropriate disposal requirements, as required by the proposed disposal facility.

2. Unknown Material. If unknown material is encountered during excavation, the Contractor or the Contractor-hired Environmental Professional shall immediately contact the Engineer to discuss the nature and extent of the unknown material and to assess potential hazards and appropriate handling procedures. Prior to handling and removing the unknown material from the excavation area, the Contractor and City and/or its representatives, shall visually assess the material and its potential hazards. Drums shall be assessed to determine whether they are leaking, bulging (evidence of reactive waste), crushed, or empty. Crushed, empty, and/or skeletal parts of drums shall be handled as solid waste, as specified. The Contractor shall record any identification or markings on the drummed material(s). Discovery and management of unknown materials shall be documented as required in the SMP.

E. Disposal Characterization: Waste characterization shall be the responsibility of the Contractor. The Contractor shall be responsible for determining the characterization requirements of each disposal facility in advance to facilitate timely disposal and to adequately estimate the disposal costs. The Contractor shall perform additional segregation based on disposal requirements. Disposal or reuse of the material shall depend on sampling and characterization analytical results.

Stockpiles within the staging area shall be sampled and characterized within a timely manner so as not to impede construction activities or preclude the reuse of soil/fill on site. If soil/fill cannot be reused on site due to the Contractor's delay in sampling material, the Contractor shall dispose of the soil/fill at no additional cost to the City including the cost of imported fill material used in its place.

3.4 STAGING AREAS

A. Unless the staging area is comprised of an impervious surface material such as asphalt or concrete, the Contractor shall pre-characterize the surface soils (0-6") at the staging area(s) prior to staging any soils to document the existing conditions relative to contamination which may result from using the area to stage excess or unknown materials. A minimum of one composite surface soil sample, consisting of at least five grab samples, for every 2,500 square feet of staging area shall be collected by the Contractor prior to staging materials at the location. The samples will be submitted to a certified laboratory for analysis for:

1. MCP 14 total metals;
2. Volatile organic compounds (EPA Method 8260B);
3. Semi-volatile organic compounds (EPA Method 8270);
4. Total petroleum hydrocarbons (EPA Method 8100M or equivalent); and
5. Polychlorinated biphenyls (PCBs) (EPA Method 8082).

B. At the completion of the work, the Contractor shall replicate the pre-staging sampling and analysis protocol to assess impacts to the area from use as a staging area.

C. Stockpiles located within the soil staging areas shall be placed on asphalt or concrete, or on a 20-mil HDPE liner/filter fabric and bermed to minimize the effects of contamination release. Each soil category shall be staged in separate areas with berms constructed a minimum of 2 feet above the existing grade with common fill, hay bales, concrete barriers, or functionally equivalent berm material. All wastes must be disposed off-site within ninety (90) days of excavation.

D. As described above and herein, excavated materials shall be completely covered with a minimum 10-mil thickness polyethylene tarp and secured with tires, ropes, anchors or equivalent material. The covered system shall be capable of resisting actual wind gusts at the site, with a minimum wind capacity of 40 miles per hour. The stockpile covers shall be installed and secured at the end of each working day and at all times when earthwork is not taking place on site. Stockpile covers shall be immediately recovered should wind forces expose any of the excavated materials. Stockpiles shall also be covered at times as directed by the Engineer.

E. Stockpiles are to be segregated based on a review of pre-characterization data and visual and olfactory conditions and field screening results obtained during excavation. Similar material may be stockpiled together. Each stockpile must be clearly separated from adjacent stockpiles.

F. Stockpiles shall be clearly designated by a signpost or marker which can be cross-referenced with samples collected from the pile for characterization purposes. The signs/markers are not to be moved, except by authorized personnel and not until the soil is ready to be either reused on site or loaded for off-site disposal.

G. Stockpiles shall be limited in size to approximately 500 cubic yards, unless approved by the Engineer. If, as a result of combining soil piles into larger volumes than 500 cubic yards, soil must be disposed of as a higher cost bid item than would otherwise be required, the Contractor shall be responsible for the additional cost.

H. Excavated soil shall not be added to a stockpile after it has been sampled for characterization.

I. Unknown, potentially hazardous soils/debris and drummed materials encountered during the project shall be located in a separate bermed location. The Contractor's Soil Management Plan shall provide construction details of the dimensions and protective measures proposed for the staging area(s). The construction details and protective measures are subject to the acceptance of the City and/or its representatives. The Contractor shall select the area to facilitate handling of the material and to minimize interference with other ongoing construction activities. The City or Engineer must agree with the location prior to construction.

3.5 EQUIPMENT AND PERSONNEL DECONTAMINATION

A. Equipment and personnel decontamination area(s), conforming with the Contractor's HASP and these Specifications, shall be constructed in such a manner to protect existing site surfaces, materials, and structures from contamination. Equipment decontamination areas shall be sized adequately to provide for the decontamination of the largest piece of equipment to be decontaminated. Filter fabric shall be placed over an impermeable liner to protect the liner from rips, punctures, or tears from traffic and heavy equipment.

B. The Contractor shall establish a site-specific decontamination protocol and decontamination areas for personnel and equipment utilized at the subject site. Personnel and equipment decontamination shall be conducted in compliance with the HASP.

C. The decontamination protocol shall include (i) the means, methods, and materials for the proposed decontamination procedures; (ii) the procedures employed to contain and store the wash or rinse liquids/sludges; (iii) procedures used to sample, analyze, and characterize the contaminated wash or rinse liquids/sludges; (iv) procedures to contain or clean contaminated equipment and PPE; and (v) the procedures for handling and disposing of solid wastes generated from site decontamination activities. All sample analysis or sample compositing shall be completed by a certified laboratory. The Contractor shall be responsible for the cost of this analytical work. The Contractor shall submit a copy of the analytical results and laboratory certifications to the City for review prior to proceeding with disposal. The Contractor shall be responsible to properly manifest and dispose of all residual wastes generated from on-site activities in conformance with federal, state, and local environmental and transportation regulations. The Contractor shall be responsible for the manifests and procedures to be used to package and dispose of contaminated solid wastes, wash, or rinse liquids at an EPA or state-approved treatment or disposal facility. The Contractor shall be responsible for any releases from site or decontamination activities due to its work, and will

remediate any release for which the Contractor is responsible to pre-existing conditions at the Contractor's expense.

D. Provisions for collecting decontamination water will be incorporated into the maintenance of the decontamination pad and will include placing an impermeable liner over a sloped surface such that water is directed, if necessary, into an area for subsequent pumping to 55-gallon drums or other appropriate tankage. Following completion of the work, the wash water shall be characterized by the Contractor and disposed off-site, in accordance with federal, state, and local regulations.

3.6 ENVIRONMENTAL FIELD MONITORING/DUST CONTROL

A. The Contractor's Site Health and Safety Officer shall keep accurate documentation of all air monitoring in accordance with the Contractor's Health and Safety Plan. Air monitoring data shall be made available to the Engineer or City upon request. At the direction of the Engineer, air monitoring may be limited to visual assessment for dust and odor monitoring; instrument monitoring may be required at any time by the Engineer, based on the results of visual and odor monitoring.

B. During excavation and construction at depths of greater than 2 feet below ground surface, the Contractor shall monitor the air quality at and surrounding the areas where construction activities involve soil handling such as excavation, re-location, staging, loading or grading of soil/waste materials. Air monitoring shall involve appropriate techniques capable of providing real-time indications of air contaminants to protect on-site personnel and the local population. If there are indications of contamination, the frequency of air monitoring shall be determined by the Contractor's Industrial Hygienist or competent environmental health professional. The Contractor's Site Health and Safety Officer and Superintendent shall be responsible for assuring that monitoring is conducted in an appropriate manner by personnel trained to operate the air monitoring equipment, record measurements, and compare to actions limits established by the Contractor's Health and Safety Plan, and that work practices, engineering controls and/or Personal Protective Equipment are proper for the conditions.

C. The air monitoring program is to be designed to protect public health and the environment from the potential generation of dust and odors and contaminant release during work. At a minimum, the air monitoring shall include daily monitoring and documentation of one upwind, and two downwind conditions during periods of activity on the site and when there is a potential for dust being generated on the site. The air monitoring information including air monitoring in the vicinity of all site activities shall also be utilized for establishing levels of personal protection measures in the Contractor's Site Specific Health and Safety Plan. The Contractor shall submit his/her air quality monitoring program for review prior to commencement of site activities.

D. Air monitoring shall be performed by the Contractor during all soil handling operations. In contaminated areas, detectors for organic contaminants and dust should be utilized to monitor on-site and off-site breathing zones and possible sources of potentially hazardous material (e.g. excavations, regrading, etc.). All personnel shall be made aware of the potential hazards and be informed of air monitoring information by the Contractor. Particular attention to air quality shall be made in the work area during earthwork activities to ensure that contaminants do not escape to the atmosphere and affect off-site population, on-site control, working conditions and personnel protection measures.

E. Dust shall be controlled during excavation of soil/fill material to limit potential spread of contaminants and potential exposure of contaminants to workers and the public.

F. Ambient dust levels at the site shall be monitored by the Contractor prior to construction. During construction, real-time dust monitoring shall be conducted during any soil/fill handling activities. The monitoring shall consist of total dust testing using MIE, Inc. Miniram PDM-3 Dust Monitors, or like instruments. The total dust criteria at the site shall conform to the requirements of the HASP. Should fugitive dust quantities exceed 20 percent of the ambient level, the Contractor shall perform additional measures to reduce the total dust concentrations.

G. Nuisance dust levels shall be reduced by pre-wetting the surface soils and by establishing and maintaining clean access roads. The Contractor's Dust, Vapor, and Odor Control Plan shall describe the procedures and materials to minimize dust. At a minimum, the Contractor shall provide clean water, free from salt, oil, and other deleterious materials.

Areas of exposed earth to be excavated shall be lightly sprayed with water before excavation if there is potential for nuisance dust generation. Additional water spray may be utilized only when any indication of excessive dust is observed. To the extent feasible, the Contractor shall minimize the use of water within the limits of excavation.

Access roads shall be sprayed with water on a regular basis to minimize the generation of dust.

H. All containers temporarily storing waste material shall be covered at all times except as necessary to place waste material into the container. The Contractor shall monitor the covers daily to ensure the covers are in place and effectively eliminating the generation of dust and make appropriate notes in the site log.

I. In the event that asbestos containing materials are encountered, dust control measures, which may include negative air containment, shall be instituted in accordance with all applicable local, state and federal laws and regulations.

3.7 REMOVAL OF ASBESTOS-CONTAINING MATERIALS

A. Inspections: Prior to commencing with ACM removal or other ACM disturbance, each individual work area must pass an inspection by the Asbestos Project Monitor. If deficiencies are observed, immediate correct in a manner satisfactory to Asbestos Project Monitor.

B. Maintain all work area isolation and controls during work of this section. The Contractor shall conduct ongoing inspections of the work area, adjacent areas and surrounding areas beneath, as applicable, for containment breaches, leaks or other containment failures. In the event breeches or potential breeches are identified, immediately repair the containment barriers as needed and complete all clean up and decontamination work.

C. Secondary Barrier: Over any surfaces beneath or surrounding ACM to be removed in the work areas, install as a drop cloth a clear 6-mil sheet plastic in all areas where asbestos removal work is to be carried out. Completely cover surfaces with sheet plastic. Install Secondary Barrier at the beginning of each work shift. Install only sufficient plastic for work of that shift. Remove Secondary Barrier at end of each work shift or as work in an area is completed. Carefully pack in disposal bags

D. Wet Removal and Waste Packaging - General:

1. Thoroughly wet ACM to be removed or otherwise disturbed prior to disturbance, stripping and/or tooling to reduce fiber dispersal into the air. Maintain materials as adequately wetted during Work and as required by NESHAPS. Accomplish wetting by a fine spray (mist) of amended water. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow time for amended water to penetrate material and seams thoroughly. Spray material repeatedly during the work process to maintain a continuously wet condition.

2. Where necessary, carefully remove ACM while simultaneously spraying amended water to minimize dispersal of asbestos fibers into the air. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels. Do not allow ACM to dry out. As it is removed, simultaneously pack material into appropriate asbestos waste disposal bags/containers. For waste bags, twist neck of waste bags, bend over and seal with minimum three wraps of duct tape. Clean outside of packaging and move packaged waste to the equipment decontamination unit for further cleaning and waste re-packaging. Once in equipment

decontamination unit and cleaned, repackage waste in second waste bag and seal as indicated above.

3. Continuously clean excess water using wet wiping and HEPA vacuuming such that excess water build up on containment surfaces does not occur and so that water does not leak or migrate outside of the work area.

4. Use work procedures that result in 8-hour TWA and STEL airborne fiber counts less than the required limits established by OSHA and as described herein. If airborne fiber counts exceed this level immediately mist the area with amended water to lower fiber counts and revise work practices and engineering controls to maintain level within the required limits.

5. Where clearance air monitoring samples are collected and analyzed using phase contrast microscopy pursuant to this section, an Asbestos Response Action shall be considered complete when the concentration of asbestos in each of the air samples collected inside the contained work space is less than or equal to 0.010 fibers per cubic centimeter of air. All analyses of clearance air monitoring samples by phase contrast microscopy pursuant to 453 CMR 6.14(5)(b)2. shall be performed by an Asbestos Analytical Service certified and approved pursuant to 453 CMR 6.08(1)(c). Should the work area fail the clearance air testing requirements of this section it shall be repeatedly cleaned by the Asbestos Contractor or other entity performing the work as prescribed by 453 CMR 6.14(4)(f) until the requirements of 453 CMR 6.14(5)(b)2.d. are met.

E. Other Safety: As applicable, comply with all appropriate safety procedures during Work in accordance with industry standards and all applicable OSHA regulations including but not limited to: confined space work safety procedures in accordance with 29CFR Part 1910.146; proper personal protective equipment; worker safety training and written programs per current OSHA requirements; fall protection; lockout tag out; and take precautions to avoid burns and heat stress of hot equipment and excessive heat as applicable.

F. Glovebag Removal of Pipe and Pipe Fitting Insulation

1. Enclosure or Encapsulation of Exposed ACM. Any friable ACM that has been exposed as a result of an Asbestos Response Action shall be suitably enclosed or encapsulated in accordance with 453 CMR 6.14(4)(d)4. and/or 6.14(4)(d)5.

2. ACM Pipe and fitting insulation shall be removed using glovebag enclosure removal techniques as appropriate. Conduct glovebag removal within negative pressure enclosures or full containment barriers. Glovebags will be used in strict accordance with 29 CFR 1926.1101 (OSHA) and other applicable regulations. Install polyethylene sheeting drop cloths beneath pipe areas to be worked and along all foot traffic areas in the work area. After the negative pressure enclosure in constructed, install glovebags in accordance with manufacturer's instructions and regulatory requirements.

3. Glove bags shall be installed so as to form an airtight covering over the structure to which they are applied. Any friable ACM in the immediate area of glove bag attachment shall be wrapped and sealed in two layers of six mil plastic sheeting or otherwise rendered intact prior to glovebag installation. All openings in the glove bag shall be sealed against leakage with duct tape or equivalent material. Once completely sealed around the pipe to be worked, the glovebags will be inspected for adequate seals and tested using proper smoke testing. A dedicated water supply and HEPA equipped vacuum will be provided at each glovebag and the glovebag removal will be conducted using the two-man technique in accordance with manufacturer’s recommendations. Amended water will be applied to the ACM such that it saturates the material to the substrate.

4. The ACM shall be removed by cutting the outer jacket, bands or coverings and removing the ACM by hand. Remove job-molded fitting insulation in chunks and hand place to the bottom of the glovebag. The removed ACM will be placed into the disposal bag portion of the glovebag. Do not drop any material or allow material or water to fall out of the glovebag or to fall to the surface.

5. Any ACM debris or residue shall be removed from the substrate using wet wiping, scrubbing with stiff bristle brushes or abrasive pads. Once all cleaning is complete, evacuate the glovebag using a HEPA filtered vacuum to remove any contaminated air. Twist off the debris chamber just below the glove-sleeves and tightly wrap neck of chamber with duct tape. Cut through center of duct taped area to separate chamber from rest

of glovebag. The glovebag will then be cut from the substrate, and both pieces placed into an asbestos waste disposal bag.

6. Any ACM that has been exposed as result of the glovebag operation shall be suitably encapsulated or enclosed so as to prevent the leakage of asbestos fibers prior to the removal of the glovebag.

7. All surfaces from which ACM has been removed inside the glovebag and the upper portions of the glovebag itself shall be cleaned free of visible debris prior to removal of the glovebag.

8. Following removal from the structure the glovebag and its contents shall be containerized in accordance with 453 CMR 6.14(4)(d)2. and disposed of in accordance with 453 CMR 6.14(4)(h).

9. Clean-up. Following an Asbestos Response Action, the Asbestos Contractor or entity performing the work shall decontaminate all contaminated surfaces within the Work Area using HEPA vacuuming and/or wet cleaning techniques. All equipment and materials used and all surfaces from which ACM has been removed shall be decontaminated. All cleanup materials shall be disposed of as asbestos waste. Clean-up shall be to the level of no visible debris.

10. Clearance Monitoring. Following the cleanup required by 453 CMR 6.14(4)(f), the facility owner, Asbestos Contractor or entity conducting the Asbestos Response Action, and/or the Asbestos Project Monitor employed to oversee the work operation shall ensure that the clearance monitoring requirements of 453 CMR 6.14(5) are met. Until these conditions are achieved all Work Area barriers shall remain in place, Work Area ventilation systems (if required) will remain in operation, respirators and other personal protective equipment shall be worn and all other work practice controls, as required by 453 CMR 6.14(4) shall remain in effect.

3.8 VAPOR AND ODOR CONTROL

A. The Contractor shall provide the materials and labor to control objectionable vapors and odor in accordance with the Contractor's Vapor and Odor Control Plan. The Contractor shall limit the exposure area and shall cover the exposure area with synthetic reusable covers, lime, foam suppressants, or other methods

to reduce off-site odors to acceptable levels. The Contractor shall not use soil suitable for on-site reuse as cover to control vapor and odors.

3.9 BULKING

A. Following characterization and compatibility testing of waste material, the Contractor shall place compatible materials into common containers to reduce transport and disposal costs. In addition, materials that are improperly contained shall be transferred into the appropriate containers. Drums and containers used during this project shall meet the appropriate DOT, OSHA, and U.S. EPA regulations for the materials contained. The Contractor shall describe the bulking procedures in the Soil and Fill Management Plan.

3.10 BACKFILLING AND COMPACTION

A. Excavated areas shall be backfilled with appropriate backfill material (including excavated material suitable for reuse and, when necessary, imported off-site material). Imported backfill used in excavated areas shall have been analyzed and certified as free of contaminants and as specified in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING.

PART 4 – COMPENSATION

Item 2080.1 – OHM - Soil and Waste Management

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the following breakdown; a maximum of 3 percent of the lump sum will be paid upon the finished construction of the completed soil/fill staging area as specified and accepted by the Engineer. A maximum of 4 percent of the lump sum will be paid upon the submittal and acceptance of all related submittals, plans and shop drawings. A minimum of 3 percent of the lump sum will be paid at the complete removal and restoration of the staging area, as approved by the Engineer. The balance of the Lump Sum measurement for payment will be on a percent of the Lump Sum bid remaining, calculated by dividing the elapsed time to date by the contractual construction time limit as approved by the Engineer. Deducts for work not performed as specified shall be applied.

BASIS OF PAYMENT / INCLUSIONS:

Payment for Soil and Waste Management shall be based on the lump sum price complete for this item in the proposal. The Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Soil and Waste Management. The work includes, but is not limited to; Environmental Professional; dewatering Professional; soil/fill sampling; analytical services; development and implementation of all submittals and plans specified including, but not limited to: Health and Safety Plan; Equipment and Personnel Decontamination Plan; Soil and Waste Management Plan; Dust, Vapor, and Odor Plan; Air Quality Control Plan; and a Spill and Discharge Control Plan; submittal of all required certifications; coordination with all parties affected and maintaining proper documentation necessary; disposal of wastes, such as

construction-related waste and by-products, and Contractor-generated waste material, such as personal protective equipment, excess materials, debris, wash water, and any other waste materials not specifically addressed in other payment items; waste characterization sampling and analysis costs for the waste referenced above; construct and maintain a secure (enclosed with 8 foot high fencing and gate) soil/fill staging area for soil/fill stockpiling pending analytical testing, reuse, or disposal; all permits and administration fees; collecting and testing surface soil samples pre- and post- use of staging area; placement of polyethylene liner under piles; additional placement of bituminous or cement concrete as may be needed at the staging area; construction of segregated soil/fill bays; signage and lighting at the staging area; installation of sedimentation and erosion control at the staging area; construction of a truck wash down area; construction of a decontamination area with wheel wash; maintenance including placement of daily polyethylene covers over existing stockpiles; performing dust control; street sweeping; vehicle wheel-washing in the staging areas as needed to control airborne dust and sediment from spreading beyond the staging area or presenting a health risk to the workers or public; day to day security measures; maintenance of the soil/fill stockpiles to avoid migration; and maintenance of the sedimentation and erosion control measures; and removal, hauling, and disposal of all items of which the staging area was constructed as well as the restoration of the site to pre-construction conditions.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material; re-use of soil and fill material on site as backfill; handling unknown materials; sedimentation and erosion control for other uses besides soil management (at the staging area); and all work associated with a staging area for other uses beyond soil and waste management.

END OF SECTION 02080

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SECTION 02095

TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

2095.1	**OHM-DISPOSAL OF SOIL – LESS THAN RCS-1 (CLASS A)**	**TON**
2095.2	**OHM - DISPOSAL OF SOIL – DAILY COVER UNLINED LANDFILL (CLASS B-1)**	**TON**
2095.3	**OHM - DISPOSAL OF SOIL – DAILY COVER LINED LANDFILL (CLASS B-2)**	**TON**
2095.4	**OHM - DISPOSAL OF SOIL – NON-HAZARDOUS SOLID WASTE ASPHALT BATCHING (CLASS B-3)**	**TON**
2095.5	**OHM - DISPOSAL OF SOIL - NON-HAZARDOUS SOLID WASTE THERMAL TREATMENT (CLASS B-4)**	**TON**
2095.6	**OHM - DISPOSAL OF SOIL – NON-HAZARDOUS SOLID WASTE (CLASS B-5)**	**TON**
2095.7	**OHM - DISPOSAL OF SOIL WITH DEBRIS – NON-HAZARDOUS SOLID WASTE DISPOSAL (CLASS B-6)**	**TON**
2095.8	**OHM - DISPOSAL OF SOIL – TREATMENT OF RCRA CHARACTERISTICALLY HAZARDOUS SOIL TO DE-CHARACTERIZE & DISPOSAL OF SOIL AS NON-HAZARDOUS WASTE (CLASS C-1)**	**TON**
2095.9	**OHM - DISPOSAL OF SOIL – RCRA HAZARDOUS WASTE (CLASS C-2)**	**TON**
2095.10	**OHM - DISPOSAL OF SPECIAL WASTE**	**TON**

PART 1 – GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials, equipment, and incidentals required to transport waste material off site, and dispose, reuse or recycle excess soil or waste materials at a licensed facility approved by the City.

B. All personnel involved in the transportation of waste from the site shall have the required Department of Transportation (DOT) and Occupational Safety and Health Administration (OSHA) training.

1.2 RELATED WORK

A. Section 01108 – HEALTH AND SAFETY PROCEDURES

B. Section 01500 – TEMPORARY FACILITIES AND CONTROLS

C. Section 02010 – SUBSURFACE INVESTIGATION

D. Section 02051 – DEMOLITION, MODIFICATION, AND ABANDONMENT

E. Section 02080 – SOIL AND WASTE MANAGEMENT

F. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. A list of all transporters, destination/receiving sites and waste facilities, complete with license numbers and permit numbers (as appropriate), contact person, and address and telephone number that the Contractor utilizes for soil management and waste disposal.

2. Where appropriate the Contractor shall submit waste manifests for all waste disposed off-site to the appropriate authority, agency, facility, or person within the time constraints specified by state and federal regulations. Copies of all waste manifests and Bill of Lading documentation including weight slips and BOL summary sheets shall be provided to the Engineer and City within ten (10) days. It is the responsibility of the Contractor to complete all waste manifests and bills of lading completely and accurately prior to submitting them to the City. The Contractor shall be responsible for preparation of Material Shipping Records and Bills of Lading. (Bills of Lading shall be prepared electronically by the City's LSP; the Contractor shall be responsible for providing information necessary for completion of the BOL). The City's LSP and the City shall sign any MassDEP Bill of Lading forms where required only after the Contractor has provided the information required for preparation of electronic MassDEP forms. The Contractor shall reimburse the City for any and all fines associated with inaccurate, incorrect, or improperly completed waste manifests, including fines resulting from late or untimely submittals.

3. Disclose a summary of the history of compliance 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. The City reserves the right to reject any facility on the basis of poor compliance history.

4. Prior to transporting any soils or fill material to a disposal facility the Contractor shall submit a letter from the disposal facility indicating that the facility has reviewed the available data and the generator's profile of the material and the facility agrees that it meets the facility's acceptance criteria.

5. Within ten (10) business days following off-site disposal of soil or fill materials at a disposal facility the Contractor shall submit Material Shipping Record or MCP Bill of Lading load log sheets signed by the facility.

6. Following disposal of all the soil represented by a Material Shipping Record or Bill of Lading, the Contractor shall submit that Material Shipping Record "Acknowledgment of Receipt by Receiving Facility" or Contractor shall arrange for receiving facility to electronically sign that Bill of Lading "Attestation of Disposal", as applicable, within ten (10) days of final shipment.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide completed Bills of Lading, Material Shipping Records, manifests, certificates of disposal, weight slips and all other documentation relative to disposal, reuse or recycling of soil and waste material.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall reuse, recycle or dispose of all excess soil and wastes resulting from excavation activities in accordance with federal, state and local regulations and these specifications. Transport shall be by a permitted and licensed waste transporter. The Contractor shall be responsible for supplying the proper manifests to be approved and signed by a representative of the City.

B. Prior to disposal, it shall be the responsibility of the Contractor to maintain segregated waste stockpiles in conformance with all applicable federal, state, and local waste disposal regulations and as specified in Section 02080 - SOIL AND WASTE MANAGEMENT.

C. The Contractor shall be responsible for preparing and keeping in proper order all waste manifests, Bills of Lading and Material Shipping Records, and shall

designate one person who shall be made available to sign all transportation documentation. The Engineer shall be responsible for obtaining the City's signature and all other signatures required for the proper completion of the manifests. The Contractor shall allow a minimum of five working days from the date of the submittal for any documents requiring the signature of the City and/or the LSP. The manifests shall document the handling of the waste from the time it is generated until the time it is properly disposed.

D. The Contractor shall be responsible for obtaining all federal, state, and local permits and variances to allow transport of materials on public roadways.

E. The Contractor shall be responsible to inform the City if hazardous waste disposal will not be performed within 90 days of hazardous waste characterization. This notification shall take place a minimum of 30 days prior to the 90-day deadline. No hazardous waste stockpiled at the site shall remain on site more than 60 days after it is characterized.

F. The Contractor shall obtain certificates of disposal for all disposed waste.

G. Transportation of solid wastes shall be in compliance with any relevant federal, state and local special waste requirements, and such as to assure that waste material is not released during transit.

3.2 SOLID WASTES

A. Transporters of solid wastes that include, but are not limited to, contaminated soil/fill (including oil-contaminated soil/fill), construction and demolition debris, non-hazardous laboratory wastes, bottles, tires, metal parts, tree stumps, brush, and grass cuttings will utilize trucks or dumpsters specifically designed to ensure that material, dust, or liquid is not released in transit. No truck shall be allowed to exit the site until all free liquids are drained from soil/fill or other solid waste being transported off-site. Material shall be covered at all times. The vehicle in which the waste is transported shall be driven directly to the intended destination without any stops or detours in between, except those necessary in response to road conditions, vehicle service needs, or emergencies. Discharge or release of material during transport shall be immediately reported to the City. Transporters shall clean up any discharge that occurs in transit, at the Contractor's expense.

B. The disposal site shall be permitted by the state in which the facility is located to receive and dispose of solid waste and shall be approved for use by the City. The Contractor shall provide copies of the disposal facility's operating permit.

C. Manifesting of solid waste shall be required and shall include vehicle identification; date of loading and disposal; tonnage, as measured at the disposal site; and signature of the City and/or its representative, transporter, and disposal facility's representative. Transportation of the wastes shall be accompanied by the appropriate manifests, as required in the Code of

Massachusetts Regulations (CMR) 310 CMR 40.0030, such as a Material Shipping Record, MassDEP Bill of Lading, or by a Uniform Hazardous Waste Manifest. Where paper documents are utilized, the original shall be returned to the City, and/or their representative, within ten (10) working days of disposal.

D. All solid waste shall be disposed in accordance with all applicable federal, state and local laws and regulations, as well as all other state laws through which the waste material is being transported.

E. Transport of soils in which asbestos containing materials have come to be located shall be transported and disposed of in accordance with Section 02080 – SOIL AND WASTE MANAGEMENT and all applicable local, state and federal laws and regulations.

3.3 HAZARDOUS WASTES

A. Transporters of hazardous wastes shall be in conformance with Code of Federal Regulations (CFR) 40 CFR, Part 171, all other federal laws and regulations, 310 CMR 30.400, and all other state laws through whose boundaries the waste material is being transported. The transporter shall provide copies of its EPA identification number, Massachusetts transporter's license, and proof of driver training in transporting hazardous waste.

B. The disposal site shall be in conformance with 40 CFR, Part 264 and relevant laws of the state in which the facility is located. The Contractor shall provide copies of the disposal facility’s EPA and state treatment and disposal permit.

C. Manifesting of hazardous wastes shall be in conformance with 40 CFR, Part 264, Subpart E and 310 CMR 30.405.

3.4 DUST CONTROL

A. Dust control measures shall be implemented during loading and transport of waste material from the site in accordance with the contractor's Dust Control Plan, as specified in Section 02080 – SOIL AND WASTE MANAGEMENT.

PART 4 – COMPENSATION

4.1 GENERAL

A. Measurement and Payment for Transportation and Disposal of Soil and Fill items shall be as listed below. Payment for lump sum items and unit price items shall constitute full payment for all fees, labor, materials and equipment required to perform the work; all supervision; all overhead items including but not limited to bonds, insurance, labor burden, profit, protections and cautions are also included. Payment for unit price items shall be as detailed below and as measured by the Engineer. The Contractor shall be made aware that for

Transportation and Disposal of Soil and Fill unit price items, the actual quantities encountered may vary significantly from the estimated quantities presented in the Bid Schedule. The estimated quantities presented have been established for bid comparison purposes only and do not represent a warranty of work. In the event of quantity changes, the unit bid price shall be the basis for compensation or credit.

B. The following unit price payment items are for transporting and disposing excess soils and fill material encountered during the course of this contract. Management of soil/fill shall be in accordance with applicable regulations and technical specifications. The costs associated with disposing excess soil and fill other than allowed for in the following payment items shall be incorporated into the contractor's lump sum bid price for soil and fill management. A minimum unit bid cost has been established for each unit price bid item. The Contractor is required to review the minimum unit bid price and increase it within the bid table as the Contractor sees fit. The Contractor is not obligated to accept the minimum unit price indicated but shall not be able to reduce it. The minimum unit price established may be below actual market cost and is provided to avoid unbalanced bidding. The Contractor is required to review the minimum unit price presented and develop a competitive unit price for inclusion in the bid table. Any bids received which do not present a unit price entered by the Contractor within the bid table or present a unit price below the minimum unit price established, shall be rejected as non-responsive.

C. The quantity of any pay item expressed as tons shall be subject to verification by the Engineer by calculation of the in-place weight using the horizontal and vertical trench pay limits defined in the Contract Drawings, a bulking factor applicable to the soil type, and in place density tests supplied from a certified soil testing lab, hired by the Contractor. Should the quantity presented by the Contractor on the certified weight slips, be significantly more (i.e. greater than 10%) than that as determined through the Engineer's calculations, the Contractor shall be compensated for the lesser tonnage. The Contractor shall receive no additional compensation for material removed outside of the approved pay limits. The City, and/or their representative, shall have the right to perform independent weighing of trucks. No payments will be made in cases of incomplete documentation of disposal. Payment will be at the unit price established set in the FORMS FOR GENERAL BID.

D. The quantity of any pay item expressed as cubic yards shall be as measured by the Engineer, per the horizontal and vertical trench pay widths established in the Drawings, and confirmed through field engineering surveys performed by the Contractor. The Contractor shall receive no additional compensation for material removed outside of the approved pay limits. Payment will be at the unit price established set in the FORMS FOR GENERAL BID.

E. Preference is to be given to the most cost effective option of either reusing excavated material on-site as fill or disposal off-site.

2095.1 – OHM - Disposal of Soil – Less than RCS-1 (Class A)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil –Less than RCS-1 (Class A) shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a reuse location that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil –Less than RCS-1 (Class A) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Less than RCS-1 (Class A). The work includes, but is not limited to; handle, load, transport, and dispose at a facility in accordance with the facility's acceptance criteria, all soil/fill which is unsuitable for on-site reuse and is defined as less than RCS-1; placing, grading and compacting the material at the disposal site as specified; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.2 – OHM - Disposal of Soil – Daily Cover Unlined Landfill (Class B-1)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Daily Cover Unlined Landfill (Class B-1) shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal

of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Daily Cover Unlined Landfill (Class B-1) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Daily Cover Unlined Landfill (Class B-1). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, solid waste facility, all soil/fill which is unsuitable for on-site reuse and is defined as a non-hazardous solid waste suitable for reuse as daily cover at an unlined Massachusetts Landfill (as defined in MassDEP Policy #COMM-97-001); placing, grading and compacting the material at the disposal site as specified; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A level; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.3 – OHM - Disposal of Soil – Daily Cover Lined Landfill (Class B-2)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Daily Cover Lined Landfill (Class B-2) shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Daily Cover Lined Landfill (Class B-2) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Daily Cover Lined Landfill (Class B-2). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, solid waste facility, all soil/fill which is unsuitable for on-site reuse or disposal at one of the lesser unit

price options and is defined as a non-hazardous solid waste suitable for reuse as daily cover at a lined Massachusetts Landfill (as defined in MassDEP Policy #COMM-97-001); placing, grading and compacting the material at the disposal facility as specified; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A or B-1 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.4 – OHM - Disposal of Soil – Non-Hazardous Solid Waste Asphalt Batching (Class B-3)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste Asphalt Batching (Class B-3) shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste Asphalt Batching (Class B-3) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Non-Hazardous Solid Waste Asphalt Batching (Class B-3). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, asphalt batching plant, all soil/fill which is suitable for recycling at an asphalt batching plant (as defined in MassDEP Policy WSC-94-400) and which is unsuitable for on-site reuse or off-site reuse or as daily cover at a Massachusetts Landfill; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, or B-2 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.5 – OHM - Disposal of Soil – Non-Hazardous Solid Waste Thermal Treatment (Class B-4)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste Thermal Treatment (Class B-4) shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste Thermal Treatment (Class B-4) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Non-Hazardous Solid Waste Thermal Treatment (Class B-4). The work includes, but is not limited to; handle, load, transport, and dispose soil/fill which is unsuitable for in-state recycling, on-site reuse, off-site reuse or as daily cover at a Massachusetts Landfill, at an appropriately permitted out-of-state, recycling or thermal treatment facility; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, or B-3 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.6 – OHM - Disposal of Soil – Non-Hazardous Solid Waste (Class B-5)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste (Class B-5) shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as

required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste (Class B-5) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Non-Hazardous Solid Waste (Class B-5). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, solid waste facility, all soil/fill (including embedded debris or foreign objects), which is not hazardous waste but is unsuitable for other non-hazardous recycling and disposal options listed above; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, B-3, or B-4 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.7 – OHM - Disposal of Soil with Debris – Non-Hazardous Solid Waste (Class B-6)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil Debris – Non-Hazardous Solid Waste Disposal (Class B-6) shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

It is the intent, that if the analytical and physical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil with Debris– Non-Hazardous Solid Waste Disposal (Class B-6) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil with Debris– Non-Hazardous Solid Waste Disposal (Class B-6). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, solid waste facility, all soil/fill (including embedded debris or foreign objects), which is not hazardous waste but is unsuitable for other non-hazardous recycling and disposal options listed above; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, B-3, or B-4 or B-5 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.8 – OHM - Disposal of Soil – Treatment of RCRA Characteristically Hazardous Soil to De-Characterize and Disposal of Soil as Non-Hazardous Waste (Class C-1)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Treatment of RCRA Characteristically Hazardous Soil to De-Characterize and Dispose of as Non-Hazardous (Class C-1) shall be on the basis of tons of waste actually treated and disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP BWSC Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Treatment of RCRA Characteristically Hazardous Soil to De-Characterize and Dispose of as Non-Hazardous (Class C-1) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Treatment of RCRA Characteristically Hazardous Soil to De-Characterize and Dispose of as Non-Hazardous (Class C-1). The work includes, but is not limited to: treat on-site all soil/fill determined through testing to be characteristically hazardous waste to render the material characteristically non-hazardous; handle, load, transport, and dispose at an appropriately permitted facility, all soil/fill determined through testing to be hazardous waste which has been treated on-site and subsequently determined through laboratory testing to be characteristically non-hazardous; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, B-3, B-4, B-5, or B-6 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.9 – OHM - Disposal of RCRA Hazardous Waste (Class C-2)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of RCRA Hazardous Waste (Class C-2) shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate Uniform Hazardous Waste Manifest. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of RCRA Hazardous Waste (Class C-2) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of RCRA Hazardous Waste (Class C-2). The work includes, but is not limited to; handle, load, transport and dispose at an approved RCRA-permitted hazardous waste facility all soil and fill determined through testing to be hazardous waste; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, B-3, B-4, B-5, B-6 or C-1 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

2095.10 - OHM - Disposal of Special Waste

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Special Waste shall be on the basis of tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP BWSC Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the City.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Special Waste shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Special Waste. The work includes, but is not limited to; handle, load, haul, and dispose all soil and fill material defined as asbestos-containing waste; procuring all health and safety items; compliance with local ordinances and preparing appropriate waste manifests; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which does not meet the definition of soil of this classification; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; disposal of construction debris; segregate, handle, stage, test, and characterize all soil and fill material suspected of containing asbestos-containing materials; protecting the excavation from accidental entry; and controlling windblown litter and the spread of airborne contaminants.

END OF SECTION 02095

SECTION 02100

PREEMPTIVE TREE CARE

2100.1	**PREEMPTIVE TREE CARE**	**LUMP SUM**
2100.2	**TREE REMOVAL**	**EACH**
2100.3	**STUMP REMOVAL**	**EACH**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Tree Care and Selective Site Preparation including, but not limited to, the following:

1. Preemptive Tree Care

a. Instituting and maintaining positive measures to protect and maintain public and private shade trees within and adjacent to the limits of work as detailed on the Drawings and as directed by the Engineer

b. Proactive measures prior to, during and after construction to ensure the short and long–term health of existing trees to remain on site and to prevent damage due to construction operations.

c. Tree Protection for existing trees to remain within the project limit of work where proposed construction activity is to occur beneath the canopy and within the drip lines of existing trees to remain. Tree protection shall remain in-place throughout the duration of the construction project but may be temporarily relocated to allow for work to occur in select areas in-close proximity to existing trees to remain, as approved by the Engineer. Tree protection shall be promptly restored following work operations. The measures described herein are anticipated to be required and will be verified based on actual field conditions. Provisions under this item include: tree protection fencing measures to minimize disturbance to existing trees and their root systems; canopy and root system review and evaluation; canopy

and root pruning in areas of proposed disturbance; and post-pruning care including mulching and watering of root zones.

d. Preemptive Tree Care also includes the following:

1. Tree Protection
2. Temporary Tree Protection Fence
3. Preparation of a Tree Protection and Maintenance Plan and Work Schedule.
4. Hiring of a Massachusetts or International Certified Arborist for the Duration of the Construction Activity.
5. Development of a Plant Health Care Program.
6. Tree Pruning
7. Root Pruning / Air Spading
8. Watering During Construction
9. Deep Root Fertilization
10. Protection of Exposed Roots
11. Regular Tree Inspections
12. Protection of existing pavements, site elements and furnishings to remain in place as directed by the Engineer.

2. Tree Removal

3. Stump Removal

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02901 – Planting Soils
3. Section 02930 – Planting
4. Section 02970 – Landscape Maintenance

1.3 REFERENCES

A. Comply with applicable requirements of:

1. City of Cambridge Department of Public Works, Division of Urban Forestry regulation “Tree Protection During Construction”. This regulation contains specific measures and remedies should the Contractor fail to abide by the City’s requirements.

1.4 GENERAL REQUIREMENTS

A. Tree, stump and shrub removal: Remove City and private trees as specifically designated on the plans, as listed in this specification, and as directed by the Engineer. Trees to be removed shall be verified with the Engineer prior to undertaking any work under this Item. Trees shall be completely removed, including stumps, and legally disposed of offsite. Existing tree pits shall be restored to existing conditions or as per the Contract Documents.

B. Pruning: The Contractor shall prune City and private trees within the limit of work before and after construction under the direction of a Massachusetts or International Certified Arborist and only as directed by Engineer. Provide protection of existing trees and vegetation not designated for removal within the limits of work and along truck routes outside the limit of work. Temporarily stump or stockpile as applicable topsoil, shrubs, and vegetation within the limits of work that will interfere with construction and as required.

C. Conduct tree removal and pruning operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities only as directed by the Engineer. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Engineer.

D. Public trees are protected by Massachusetts State Law, Chapter 87. Section 12 states that a fine of up to five hundred dollars, ($500.00) per incident of damage to public shade trees can be levied. Each branch broken or improperly pruned, each improper wounding of the trunks of the trees, and each root improperly pruned shall constitute an infraction. Section 12 further provides that anyone who negligently or willfully damages a tree will be liable to the City for all damages.

E. The Contractor shall exercise special care when excavating near trees. When major roots are in the way (4" dia or as determined by Engineer), the Contractor shall go under or between them. In no case shall the Contractor disturb the root structure of the trees without direction from the City Arborist. Expose roots shall be covered promptly. Excavation of all tree wells shall be done entirely by hand.

F. The Contractor shall take the utmost care to avoid unauthorized, unnecessary or improper wounding of City or private shade trees. Prior to construction, the Contractor shall provide a Tree Protection and Maintenance Plan and Work Schedule. A Massachusetts or International Certified Arborist shall be sub- contracted by the Contractor to provide a protection and maintenance plan and perform specified work. All plans and schedules shall be subject to review and approval by the City Tree Warden. Infraction of Massachusetts State Law Chapter 87 or failure to provide a protection plan and work schedule will result in fines or the immediate cancellation of the contract.

G. The Contractor shall engage a board-certified arborist with a **minimum of five-years of experience** including experience with supersonic air tools such as the "airspade" for the project.

H. The work shall consist of the provision of all labor, materials, equipment, and transportation required to complete the pruning as required by the Engineer in strict accordance with the conditions and specifications of these Contract Documents. The work shall include, but is not necessarily limited to, the following:

1. Attending initial site visit and assessment with City representatives
2. Securing necessary permits and approvals before commencement of work
3. Posting work areas for parking restrictions
4. Securing police details, if necessary
5. Marking work zones for traffic and pedestrian control
6. Providing a schedule of work for City review and approval

7. Meeting with City staff on a periodic basis
8. Visual assessment of each tree to be pruned including the assessment of the need for airspading and/or tree root pruning
9. Determination of pruning objectives
10. Making pruning cuts and wound care
11. Wood waste and debris consolidation & disposal
12. Site cleanup

1.5 QUALITY ASSURANCE

A. Tree Protection measures to be performed by Massachusetts or International Certified Arborist with a minimum of five-years of experience and as reviewed and approved by the Engineer and City Tree Warden.

1.6 SUBMITTALS

A. Certification: Submit the Certification of the arborist to be performing the work.

B. Tree Protection and Maintenance Plan, Plant Health Care Program and Work Schedule: submit for review and approval by the Engineer and City Tree Warden at least two (2) weeks prior to beginning initial work on a project street. Refer to Section 3.20 below for requirements.

C. Product Data: Submit most recent printed information from manufacturers for:

1. Tree Watering Bags (if required)
2. Slow Release Fertilizer
3. Proposed nutrients and bio-stimulants for deep root fertilization

D. Samples: Submit samples of:

1. Tree Trunk Wrapping
2. Tree Protection Fencing
3. Wood Chips
4. Tree Watering Bags

E. Shop Drawing/ Field Mock-Up: Submit for review and approval by the Engineer and City Tree Warden:

1. Tree Box. Engineer to approve first tree box constructed prior to Contractor completing remaining boxes.

PART 2 – PRODUCTS

2.1 TREE BOX

A. Tree Box shall be constructed from 2 in. x 4 in. lumber creating a box around the border of the tree pit with 2 in. x 4 in. lumber standing straight up at the corners and wrapped with orange snow fence. Fasteners as per detail.

2.2 TREE TRUNK WRAPPING PROTECTION LUMBER

A. Tree Trunk Wrapping Protection Lumber shall consist of 2 in. x 4 in. and 8 ft.height lumber wired together in close spacing with 16 gauge galvanized steel wire to form a protective enclosure around tree trunks.

2.3 TREE PROTECTION FENCING

A. Tree Protection Fencing: new 4' height of high density polyethylene laminar netting.

1. Mesh dimensions: 3 ¾" x 2" with ½" strands.
2. Mesh color: black

B. Stakes: 2" diameter black painted galvanized steel pipe or 2in. x 4in. stained lumber stock as approved by the Engineer.

2.4 WOOD CHIPS

A. Wood Chips shall conform to provisions of Wood Chip Mulch under Materials Section M6.04.3 of the MassDOT Standard Specifications.

2.5 WATER

A. Water shall be furnished by Contractor, suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for work shall be furnished by Contractor.

2.6 TREE WATERING BAGS

A. Tree Watering Bags: Treegator Original, as supplied by Spectrum Products, Youngsville, NC, 27596. Phone: (866) 873-3428, or approved equal.

1. Color: green.

2.7 LIQUID FERTILIZER AND BIO-STIMULANT

A. Product(s) to improve vigor and soil moisture shall be reviewed and approved by the Engineer, prior to use. Bio-stimulant shall be Essential Plus 1-0-1, as supplied by Growth Products, www.growthproducts.com, 800-648-7626, or approved equal.

PART 3 – EXECUTION

3.1 GENERAL

A. Remove trees, shrubs, grass and other vegetation, improvements, or obstructions that interfere with installation of new construction and as required. Removal includes digging out stumps in their entirety and grubbing roots to at least 2.5 feet below existing grades shown on the Drawings.

B. Prior to start of subsurface work, Contractor shall conduct project-wide pruning of existing trees and shrubs within the right-of-way.

3.2 SPECIAL REQUIREMENTS

A. The Contractor is required to conform to the requirements of the City of Cambridge Department of Public Works, Division of Urban Forestry regulation “Tree Protection During Construction”. This regulation contains specific measures and remedies should the Contractor fail to abide by the City’s requirements.

B. For definitions and pruning standards, the Contractor is required to adhere to the requirements of ANSI A300, American National Standard for Tree Care Operations “Tree, Shrub and Other Woody Plant Maintenance Standard Practices”.

3.3 TREE, STUMP AND SHRUB REMOVAL

A. Work to be done under this item shall conform to the relevant provisions of Section 101 Clearing and Grubbing of the MassDOT Standard Specifications.

B. Trees to be removed shall be verified with the Engineer prior to undertaking any work under this Item. Trees shall be completely removed, including stumps, and legally disposed of offsite. Existing tree pits which are not going to be replanted under this contract shall be restored as sidewalk under the appropriate sidewalk item.

3.4 SITE REVIEW OF EVALUATION OF TREES AND POTENTIAL CONSTRUCTION RELATED IMPACTS TO ROOT SYSTEMS

A. Prior to mobilization and construction operations, Contractor, Contractor’s Certified Arborist, Engineer and City Tree Warden shall conduct a site review of the existing trees to remain in relation to proposed limits of construction operations, confirm the limits of tree protection fencing, and confirm which trees are to receive other types of Tree Protection including those designated as "Special Mature Trees". Contractor to document the trees and strategy to receive type of Tree Protection and submit for Engineer 's approval.

3.5 PROTECTION OF EXISTING TREES AND IMPROVEMENTS

A. Provide protection necessary to prevent damage to existing trees and improvements indicated to remain in place inside or outside of the limit of work. Existing trees and shrubbery to remain shall be protected from injury. Except as otherwise approved, cutting and trimming of existing tree limbs and roots will not be permitted. Existing trees to remain which can potentially be damaged by construction operations shall be protected. Trees having a caliper under 20" dbh shall be wrapped with tree protection lumber. "Special Mature Trees", those trees with a caliper over 20" dbh, shall be wrapped with tree protection lumber and protected with a tree box. Protection shall be maintained until completion of the work of the Contractor. Tree protection requirements are described in City of Cambridge Department of Public Works, Division of Urban Forestry regulation “Tree Protection During Construction”.

B. Protect trees and improvements on adjoining properties and within City right- of-way. Restore improvements damaged by Contractor’s clearing and construction activities to their original condition, at no additional expense to the City. Remove and replace trees damaged by Contractor’s clearing and construction activities at no additional expense to the City.

C. Protect existing trees and other vegetation indicated to remain in place or outside of the clearing/grading limit lines.

3.6 TREE PROTECTION FENCING

A. Contractor shall erect the tree protection fence before site preparation or other construction activity commences. For each tree to be protected, set posts and fencing at minimum to the limit of the existing non-paved area, i.e. existing tree pit opening, and to the drip line in cases where pedestrian and vehicular movements will not conflict with an expanded fence location. Individual tree protection fencing, trunk protection, branch protection, and wood chips shall be determined on a case by case basis at the start of the project and shall be maintained throughout the duration of the contract until removal is approved by the Engineer.

B. During the course of the project, adjustments or temporary relocations to the fence locations might be required to facilitate the work. Adjustments shall be made at no additional cost to the City.

C. Erect the protective fence so that it is securely in place and resistant to seasonal climatic forces, adjacent pedestrian movement, and work operations to ensure root and tree protection.

D. Periodically inspect, repair and maintain protective fences during the course of construction operations. During periods of construction stoppages, including but not limited to delays and over-wintering, periodically inspect, repair and maintain protective fences. Of particular concern is compaction by vehicles once the existing pavement has been removed, exposing roots to damage and by drying out.

E. Engineer reserves the right to require Contractor to provide additional or more secure tree protection devices if it is determined that the existing trees are not being properly

protected or if the vegetation is threatened with damage through the construction operations.

F. Protect existing trees and other vegetation to remain in place. Do not burn, cut, break, skin, or bruise trunk, roots, or branches. Do not fasten ropes, cables, or guys to any existing trees unless specifically authorized by the Engineer.

G. If the Engineer determines that trees are not being protected to the standards herein, Engineer may order construction activity to stop immediately and to remain stopped until the non-compliant condition or practice is corrected. The Contractor shall comply with this provision at no additional cost to the City. This provision in no way affects the Contractor's obligation to complete the work of this contract by the date specified.

H. The Engineer may require tree fencing to be temporarily removed, and later reinstalled, if there is no construction activity in the vicinity of a tree or trees for an extended period of time. This may be required in order to prevent unchecked weed growth or trash buildup within the fenced-in area. The Engineer may also require the Contractor to weed or clear trash from within fenced-in areas from time to time. Tree fence removal and reinstallation, and tree pit weeding and trash removal shall be considered incidental to the work of this Section.

3.7 TEMPORARY ACCESS

A. Temporary access within plant protection areas is permitted to perform construction operations as approved by the Engineer. Work within tree protection areas shall be performed by hand or with small equipment that will not damage or threaten damage to trees. Restore tree protection at the end of each day's operation.

3.8 TREE PROTECTION AND AIR SPADING OF ROOTS FOR SPECIAL MATURE TREES

A. The Contractor shall stake out the following in relation to "Existing mature trees" as identified as being greater than 20" dbh or as identified in the field by the City Arborist at the start of the project. This should be done prior to initiating excavation and should be reviewed together in the field by the City's representatives, the Contractor, Contractor's arborist, and Engineer. This includes:

1. limits of utility trenching
2. limits of sidewalks and proposed tree pit openings
3. limits of proposed construction fences,
4. alignment of proposed limits of excavation.

B. After areas of potential negative impact are reviewed and confirmed in the field, the Contractor's arborist shall perform subsurface root exploration and evaluate root distribution in the area of the final cut lines.

C. As a guideline, the minimum final cut line distance from trunk of tree shall be established by taking the tree's diameter at breast height in inches and converting it to feet, (For example, 12" caliper tree translates into a 12' offset from the edge of the trunk to the final cut line.) Site constraints may dictate that the final cut line is closer to the trunk than

guidelines will allow. Do not perform subsurface exploration near the trunk or within the drip line without authorization from the Engineer.

D. The Contractor's arborist shall perform subsurface exploration in areas of negative impact adjacent to the final cut line using an air spade to cut windows in the soil to a depth of 10" or greater to expose the root systems without damaging them.

E. Based on the proposed alignment of the new utilities, pavement, curbs, formwork, etc. in relation to "Existing mature trees" the Contractor's arborist with the Engineer's review and approval, will define the final cut lines depending on the density and distribution of the root systems. The final cut line will be created by the supersonic air tool such as "airspade". The Contractor's arborist shall redirect root systems within the final cut line area and shall prune roots that extend beyond the final cut line with pruning tools. The Contractor and arborist shall minimize exposure of tree root systems during the exploration and pruning/construction activities over exposed roots, support edge of excavation and mulch to a depth approved by the Engineer. The Contractor shall saturate burlap and mulch with water and maintain the burlap in a damp condition during daylight hours as to not allow roots to dry out. If tree roots will be exposed for a period of time longer than 1 week, the contractor shall install 2" depth of wood chip mulch.

F. Once final cuts are completed by the Contractor's arborist with airspade and pruning tools, no mechanical excavation shall be allowed beyond the final cut line around the existing tree to remain.

G. The Contractor shall install forms for sidewalks or install curbs, etc. in locations shown on the Drawings at the limits of excavation. If possible existing tree roots to remain can be extended below pavement areas or planting surfaces, or within pavement sand based structural soils or other similar landscape zones that are not in conflict with the final pavements. Planting soils shall be hand placed over these areas as shown on drawings and as described in specifications.

3.9 GENERAL HORTICULTURAL TREE AND ROOT RELATIONSHIPS

A. The majority of a tree's roots are located in the upper few inches of topsoil. For this reason, trees are vulnerable to immediate and long-term damage. Immediate damage to roots is caused by grading, use of vehicles and tools, and excess pedestrian traffic above the roots. Long-term damage is caused by the compaction of the soil above the roots by use of vehicles, storage of materials, and excess pedestrian traffic.

B. Protection of a tree therefore includes the protection of the roots of the tree as well as its trunk, branches, and leaves. Roots are best protected by fencing off as large an area as possible around each tree, so that no driving, parking, walking, or storage of materials takes place where it may cause damage.

C. The roots of a tree often extend far into the surrounding landscape, including areas well beyond the outer perimeter of the tree's canopy / drip line. For this reason, operations should be confined to the smallest possible area.

D. As a practical minimum, however, every effort shall be made to protect the area beneath the canopy of the tree, also known as the area inside the “drip line.” This area is sometimes referred to as the “root zone.”

E. Soil is most vulnerable to compaction, and roots to damage, when the soil is wet.

3.10 ROOT PROTECTION

A. Roots that cannot be avoided during construction for all other trees to remain shall be carefully and cleanly cut. Only hand methods for grubbing roots will be accepted inside drip lines of trees to be left standing. All pruning of any roots greater than 2" must be completed under the supervision of the City Arborist. Root pruning shall include application of root treatment or fertilizer as required. In order to minimize impacts to roots, Contractor shall uncover roots with air spade for all Special Mature Trees as identified under Section 3.8 of this specification. Additionally, the City Arborist may determine that certain significant roots of trees under 20" in diameter may also require the use of an air spade.

B. Trucks and heavy equipment shall not pass over or park on roots of public shade trees; nor shall construction materials, debris, or excavated material be stored within drip line of trees or within tree pits. For occasional or one time access over roots, ½-inch plywood overlapped may be used. Permeable materials such as gravel or wood chips shall be placed over root systems of trees which are not covered by hardscape and over which trucks and heavy equipment must travel during construction operations, when such travel is unavoidable, to prevent soil compaction and root damage. Material shall be replaced as needed.

C. During sidewalk construction adjacent to trees, suitable soil shall be maintained within tree wells. Moist soil or mulch shall also be maintained around surface roots outside of tree wells which may become exposed during construction. Such covering shall be placed as soon as possible after roots are exposed. If roots are going to be exposed for more than one hour, cover roots with damp burlap. Burlap shall be kept moist until most soil and mulch can be used for permanent cover.

D. Tunneling shall be the preferred method of excavation adjacent to tree roots to avoid root pruning. If root pruning is unavoidable, a certified arborist shall be onsite to execute or oversee the operation with sufficiently sharpened hand tools and in such a fashion as to have minimum negative impact on tree health and safety.

3.11 EXCAVATION WITHIN DRIP LINE

A. Where excavation for new construction is required within drip line of trees, tie branches out of the way, hand clear and excavate to minimize damage to root systems and place wood chips to a depth of six inches (6") on the ground to protect the root systems.

B. Use narrow-tine spading forks and comb soil to expose roots. Relocate roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits to bend and relocate them without breaking.

C. No roots greater than two (2) inches in diameter shall be cut from trees to remain without prior approval of the Engineer. Provide protection for roots over one inch (1") diameter cut during construction operations. Prune roots that are either cut or broken with a smooth, clean cut.

3.12 ROOT PRUNING

A. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of structures. Cut roots with sharp pruning instruments; do not break or chop; cutting of roots with machinery is expressly prohibited. When roots that must be cut are encountered, work shall cease until roots have been properly cut.

3.13 ROOT SYSTEM EXPOSURE AND SUPPORT

A. Provide saturated burlap or temporary earth to cover tree roots exposed by construction. Do not allow exposed roots to dry out before placing permanent backfill. Water and maintain roots in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.14 PRUNING SAFETY STANDARDS

A. Tree pruning and airspading shall be performed only by certified arborists or arborist trainees who, through related training or on-the-job experience, or both, are familiar with the practices and hazards of arboriculture and the equipment used in such operations.

B. The Contractor's certified arborist must be present at all times while tree pruning is performed.

C. Tree pruning operations shall comply with the American National Standard for Tree Care Operations—Safety Requirements (ANSI Z133.1), as approved by the American National Standards Institute, and published by the National Arborists Association. Operations shall also comply with applicable Occupational Health and Safety Administration (OSHA) standards.

3.15 PRUNING OBJECTIVES

A. The pruning operation shall focus on the following types of pruning:

1. Cleaning: selective pruning to remove one or more of the following parts—dead, diseased, and/or broken branches. All deadwood that is two (2) inches or greater in diameter shall be removed. Branches with splits, large cavities or any defect that may result in failure shall be reduced or removed to the trunk if reduction is not feasible.

2. Thinning: selective pruning to reduce density of live branches. Thinning shall result in an even distribution of branches on individual limbs and throughout the crown.

3. Raising: selective pruning to provide vertical clearance. The intent of crown raising for this project will be the removal of all branches extending lower than fourteen (14) feet above a public roadway and eight (8) feet above a public sidewalk. This includes trees endangered by traffic re- routing as the result of construction operations, as well as trees over existing roadways and sidewalks which do not presently meet these height requirements. However, the level of pruning of each tree will be determined at the site walk with the Contractor, Contractor's arborist, Engineer and City arborist. Additionally, any cuts to lateral branches over 4" as well as any questionable cuts will require the approval of the City arborist.

4. Reduction: selective pruning to decrease height and/or spread. Consideration shall be given to the ability of a tree species to tolerate this type of pruning. All branches obstructing park signs, street signs, traffic signs, traffic lights, and park or street lighting shall be removed. Branches shall be pruned away from all houses and buildings a minimum of five (5) feet, or more if appropriate to the tree shape and structure.

5. Specialty (Young) Trees. For young yet established trees, branches that are rubbing or poorly attached shall be removed. A central leader or leaders as appropriate to the species should be developed. A strong, properly spaced scaffold branch structure should be selected. For newly planted trees, pruning shall be limited to cleaning.

    a. During the First Three Years After Planting: A central leader or leaders (as most appropriate for the species and specimen) shall be developed by removing competing leaders and removing vigorously growing branches that compete with the selected leader(s). A strong scaffold branch structure shall be developed by selecting the primary scaffold branches. To improve the scaffold structure, branches that are crossing, have included bark or interfere with the scaffold branches shall be removed. Scaffold branches shall be properly spaced. For deciduous shade trees that will reach or exceed 40 ft (12.2 m) in height at maturity, the recommended spacing is approximately 18 in (457.2 mm). For smaller species, 6 to 8 in. (152.4 mm to 203.2 mm) would be adequate.

    b. Between Four and Six Years After Planting: The development of a good, structurally sound scaffold branch system should be continued by selective thinning of or on branches and removing dead, interfering, split and broken branches. Large-growing branches with narrow angles of attachment shall be removed from the trunk and canopy. The crown shall be raised for pedestrian clearance and vehicular clearance.

3.16 PRUNING PRACTICES

A. The Contractor's certified arborist shall visually inspect each tree before commencing work.

B. If a condition is observed requiring attention, the condition should be reported to the City within 24 hours. Such conditions may include structural weakness, rot or decay that cannot be corrected by cleaning, and dead trees.

C. Equipment and work practices that damage living tissue and bark beyond the scope of work shall be avoided. Climbing spurs shall not be used when climbing and pruning trees. Spurs may be used to reach an injured climber or when removing a tree.

D. Pruning tools (e.g. chain saws, pole saws, hand saws, pole pruners, etc.) shall be sharp and regularly sharpened and maintained throughout the Contract Term.

E. Not more than 25% of the foliage of an individual tree should be removed within an annual growing season. The percentage and distribution of foliage to be removed shall vary according to the tree species, age, health and site, in accordance with the types of pruning identified above.

F. Not more than 25% of the foliage of a branch or limb shall be removed when it is cut back to a lateral. The lateral shall be large enough to assume apical dominance.

G. Heading shall be permitted only by the expressed permission of the City, when needed to reach a defined objective.

H. Topping and lion tailing shall be considered unacceptable pruning practices.

I. All pruning cuts shall be made in accordance with the American National Standard for Tree Care Operations—Standard Practices (ANSI A300 Part 1), as approved by the American National Standards Institute, and published by the National Arborists Association (revised 2001). All terminology included in these Technical Specifications shall be defined by ANSI A300 Part 1.

J. When tracing wounds, only loose, damaged tissue should be removed. No other wound treatments shall be used.

K. On mature trees the maximum diameter of any undesirable branch (dead, broken, rubbing, structurally unsound) that may be left shall not exceed 2 in. (50.8 mm).

L. Pruning cuts shall be clean and smooth with the bark at the edge of the cut firmly attached to the wood.

M. Large or heavy branches that cannot be thrown clear shall be lowered on ropes to present injury to the tree and other property.

N. Rope injury to trees from leading out heavy wood shall be avoided by using a cambium guard or installing a false crotch.

3.17 UTILITY CONSTRUCTION NEAR TREES

A. Route utilities away from existing trees. Review re-routing with Engineer. Do not proceed without written direction. Minimize the cutting of tree roots, and when cutting is unavoidable, cut cleanly with a power saw and not an excavating machine.

3.18 ACTIVITIES PROHIBITED WITHIN DRIP LINE

A. Do not store and stockpile construction materials and/or excavated materials, park vehicles, drive vehicles, remove soils, and stockpile soils within the drip line of trees, including trees located on adjacent properties which overhang the site unless otherwise indicated in Contract Drawings. Excavation within these areas shall be subject to special care as described below in “Excavation within Drip line”.

3.19 EQUIPMENT

A. The following equipment and vehicles shall be available on-site for use. All gas- powered equipment and vehicles must be five years old or less and in good condition as determined by the Engineer.

1. Two (2) aerial lift trucks with an articulating boom that have a working height of not less than sixty (60) feet with Contractor’s name painted on each side.

2. Two (2) chipper dump trucks with a minimum capacity of nine (9) cubic yards, with Contractor’s name painted on each side.

3. Two (2) wood chippers with a capacity for 16” diameter limbs.

4. All relevant traffic control devices as prescribed by the Manual of Uniform Traffic Control Devices (MUTCD) of the U.S. Department of Transportation.

5. Supersonic air tools such as the “airspade” for use on designated trees with root conflicts as designated by Engineer.

3.20 PLANT HEALTH CARE PROGRAM

A. Prior to mobilization and construction operations, Contractor's arborist shall document and submit a strategy for maintaining the health of existing trees within the project limits including strategies for watering and fertilizing as outlined below.

B. Watering: Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.

C. Drainage: Do not permit water to stand around the base of plants within the drip line during construction operations except during that period of inundating flooding which would, in its natural course, cover the base of trees. Provide temporary drainage where required to avoid ponding during construction operations.

D. Deep Root Fertilizing: After pruning operations are completed, fertilize trees to increase vigor with a liquid fertilizer with biostimulant. Where liquid injected fertilizer is not

practical, and when approved by Engineer, drill holes 6" to 10" deep and place granular fertilizer (as approved by the engineer) at frequent spacing. Two (2) phases of deep root fertilization are required:

1. The first phase shall take place within 6 weeks of the Notice to Proceed.
2. The second phase shall take place at the end of construction when the final planting work is taking place.

E. Tree Pruning: proposed schedule for both phases of pruning, and name and contact information of Certified Arborist responsible for the work.

F. Airspade excavation: name and contact information of Certified Arborist responsible for the work.

G. Root pruning: name and contact information of Certified Arborist responsible for the work.

H. Arborist Inspection Reports: A certified arborist shall inspect all existing trees to remain within the limit of work once a month during construction. Each inspection shall include a brief report of any insect, disease, and/or stress problems observed. Reports shall include recommendations for remedial actions (watering, pest removal, etc.) as required.

3.21 DAMAGE DUE TO CONSTRUCTION OPERATIONS

A. Contractor shall be responsible for the health of the existing trees in the immediate vicinity of construction. Trees damaged by construction operations which, as determined by the Engineer, can be remedied by corrective pruning measures shall be addressed immediately.

B. The City shall engage an independent qualified Arborist to inspect the damaged trees and to make a determination on damage, sustainability, and remediation procedures.

C. The Contractor shall strictly adhere to the independent Arborist’s recommendations.

D. Broken limbs shall be pruned according to industry standards.

E. Wounds shall not be painted.

F. The total cost of tree repair, including the cost of the independent Arborist, shall be borne by the Contractor.

3.22 TREE REPLACEMENT DUE TO DAMAGE

A. If the independent Arborist determines that the damaged tree cannot be repaired and restored to full-growth status, the Contractor shall replace the damaged tree(s) and pay liquidated damages as noted below. The size of the replacement tree shall equal 1” caliper for every 1” caliper inch of the damaged tree (size of the damaged tree shall be measured, the new tree shall be based on nursery measurements). The species of the replacement tree shall be determined by the City Arborist.

B. In addition to providing a new tree replacement, Contractor shall pay City $850.00 for every caliper inch of the damaged tree (the size of the damaged tree shall be as shown on the Drawings).

C. An example of the conditions stated above: A 20” caliper tree was damaged and determined to need replacement. To remedy this situation, the Contractor would purchase and install a 20” caliper tree and pay the Owner $17,000.

D. The total cost of tree replacement, including the cost of the tree and stump removal and the independent Arborist, shall be borne by the Contractor.

3.23 TEMPORARY REMOVAL OF SHRUBS AND TOPSOIL

A. Topsoil, shrubs, and vegetation to be temporarily removed shall be carefully removed from overall areas to be excavated, and over all other areas to be disturbed as a result of the Contractor's operations in the performance of the Contract work. The topsoil shall be transported and deposited in storage piles convenient to the areas which are subsequently to receive the application of topsoil, separate from other excavated materials, and in approved locations. The topsoil shall be stockpiled free of roots, stones and other undesirable material. The Contractor shall take all necessary precautions to prevent other excavated material or other objectionable material from becoming intermixed with the topsoil, either before or after the stripping and stockpiling operations. Shrubs and other vegetation shall be balled and burlaped and then transported and stored until they can be replaced after construction has been completed in that area. The shrubs and vegetation must be watered and maintained to remain healthy while being temporarily stored. Any shrubs and vegetation that do not remain healthy during storage shall be replaced by the Contractor at no additional cost to the City.

3.24 DISPOSAL OF WASTE MATERIALS

A. Remove waste materials and unsuitable topsoil from project area and dispose of off-site in a legal manner. Waste materials shall include but not be limited to timber, brush, refuse, stumps, roots, vines, debris and other objectionable matter. Removal includes raking and sweeping after completion of clearing and pruning operations.

B. Tree branches shall be removed in such a manner so as not to cause damage to other parts of the tree, or to surrounding people and property. Where necessary, ropes or other equipment shall be used to lower large branches to the ground. All severed limbs shall be chipped, hauled away from the site, and disposed of in a legal manner. All wood waste, sawdust, leaves, and associated organic debris shall be collected from both public ways and adjacent private property, hauled away from the site, and disposed of in a legal manner.

C. Site cleanup shall follow as closely as possible to the pruning operation.

3.25 POST-CONSTRUCTION CLEANUP

A. After construction is complete, but prior to preparation and seeding of lawn area and planting, remove and properly dispose of the following off site: wood chips, temporary fencing, branch protection, tree boxes and trunk protection, and other materials.

PART 4 – COMPENSATION

2100.1 PREEMPTIVE TREE CARE LUMP SUM

METHOD OF MEASUREMENT:
Measurement for payment for Preemptive Tree Care will be measured by the unit Lump Sum. The unit bid price lump sum shall constitute full compensation for providing materials, equipment, labor and incidentals required to perform the work of this Item, including but not limited to coordinating the work with other relevant Items.

BASIS OF PAYMENT:
Payment for work under Preemptive Tree Care will be based on the unit Lump Sum and shall include full compensation for all labor, materials, disposal, equipment, tools, and any other incidentals necessary for the completion of this work as specified, including but not limited to tree protection, including tree box at Special Mature Trees, temporary tree protection fence, tree maintenance, preparation of a tree protection and maintenance plan and work schedule, development of a plant health care program, air-spading and root pruning before and after construction begins; branch pruning before and after construction; furnishing, installing, maintaining, and removing drip line or tree pit fencing and/or tree wrap; covering exposed roots with moist burlap, mulch, or soil, watering trees, injecting fertilizer into trees, storing, maintaining and re-planting of targeted shrubs and plantings and protection of existing pavements, site elements and furnishings to remain in place as specified or as otherwise required by the Engineer or City arborist.

2100.2 TREE REMOVAL EACH

METHOD OF MEASUREMENT:
Measurement for payment for Tree Removal will be based each tree removed as required by the City Arborist and as indicated on the contract documents.

BASIS OF PAYMENT:
Payment for work under Tree Removal will be based on the unit Each and shall include full compensation for all labor, materials, disposal, equipment, tools, and any other incidentals necessary for the completion of this work as specified, including but not limited to removal and disposal of trees and branches; coordination with overhead electric and other utilities for the removal of the tree; and any other work incidental to the removal of the tree.

2100.3 STUMP REMOVAL EACH

METHOD OF MEASUREMENT:
Measurement for payment for Stump Removal will be based each stump removed as required by the Engineer and as indicated on the contract documents.

BASIS OF PAYMENT:
Payment for work under Stump Removal will be based on the unit price Each and shall include full compensation for all labor, materials, disposal, equipment, tools, and any other incidentals necessary for the completion of this work as specified, including but not limited to removal and disposal of stump and roots; coordination with overhead electric and other utilities for the removal of the tree; and any other work incidental to the removal of the stump.

END OF SECTION 02100

SECTION 02140

DEWATERING

2140.1 TREATMENT OF CONSTRUCTION DEWATERING DAY

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Design, furnish, operate, maintain, and remove temporary dewatering systems to control groundwater and surface water to maintain stable, undisturbed subgrades, and allow work to be performed under dry and stable conditions and comply with discharge permit and other regulatory requirements. Work to be done as part of dewatering includes, but is not limited to:

a. Obtain necessary state, local and Federal discharge permits, including an EPA NPDES Remediation General Permit (RGP) Discharge Permit or MWRA Construction Site Dewatering Discharge Permit, as applicable. A Draft Dewatering and Remediation General Permit (DRGP) was issued in May 2022 but is not yet in effect. If the Final Permit is issued in advance of securing the current necessary RGP, then this will need to be obtained instead of the RGP which it will replace.

b. Lower the groundwater level within excavations to at least 2 feet below the bottom of the excavation.

c. Lower hydrostatic pressure.

d. Prevent surface and storm water from entering the excavation during construction.

e. Limit settlement of utilities and adjacent structures.

f. Implement erosion and sedimentation control measures for disposing of discharge water.

g. Provide treatment system to treat all water removed from excavations as required by discharge permits, except water that is re-infiltrated to the ground on site in a manner that does not result in negative on- or off-site impacts.

h. Provide an Environmental Site Professional/Dewatering Specialist/Field Representative (hereinafter referred to as the

Dewatering Professional) who will be responsible for dewatering, re-infiltration, treatment and discharge of dewatering flows as specified and in compliance with all applicable permits and regulations.

i. Common dewatering methods include, but are not limited to, sump pumping, deep wells, well points, vacuum well points or any combinations thereof.

j. Water removed from excavations shall be re-infiltrated to the ground if feasible. If re-infiltration is not feasible, treated water shall be discharged to the City of Cambridge sewer system under either an EPA NPDES RGP Discharge Permit, Dewatering and Remediation General Permit (DRGP), and/or MWRA Construction Site Dewatering Discharge Permit, as applicable, to be obtained by the Contractor and other appropriate permit(s) and regulations. In no case shall dewatering flows be directly or indirectly released to surface waters or storm drains prior to settling of suspended solids and appropriate additional treatment. The Contractor is responsible for obtaining and paying for necessary permits.

1.2 RELATED SECTIONS

A. Section 01060 – PERMITS AND REGULATORY REQUIREMENTS

B. Section 01300 – SUBMITTALS

C. Section 02010 – SUBSURFACE INVESTIGATION

D. Section 02080 – SOIL AND WASTE MANAGEMENT

E. Section 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

F. Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

G. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

1.3 SUBMITTALS

A. Shop Drawing: Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Submit the following qualifications at least three weeks prior to the construction:

a. Qualifications of specialist or firm's Registered Professional Engineer as specified below.

b. Qualifications of the Dewatering Professional who shall oversee the installation, operation and maintenance of the dewatering system.

2. Submit a dewatering plan including design calculations at least four (4) weeks prior to start of any dewatering operation. The review will be only for the information of the City and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

   a. Dewatering plan and details stamped and signed by a Massachusetts Registered Professional Engineer that conform to the requirements of the dewatering permit(s), and all other applicable regulations and permits including, but not limited to, requirements for equipment, monitoring, sampling and reporting.

   b. Submit a generalized plan of actions at least two (2) weeks before operation of the groundwater control system to be implemented in the event that the Threshold and Limiting values for groundwater lowering have been reached.

   c. Certificate of Design.

   d. A list of equipment including, but not limited to, pumps, prime movers, and standby equipment.

   e. A description of the proposed method of dewatering; water re-infiltration; containment; treatment and discharge; and installation, monitoring, maintenance, and system removal procedures.

   f. A groundwater monitoring plan shall be developed by the Professional Engineer retained by the Contractor that designs the dewatering system. The monitoring plan shall address groundwater control within the excavations and address settlements of utilities and adjacent structures.

   g. A description of erosion/sedimentation control measures, and methods of disposal of pumped water.

   h. List of all applicable laws, regulations, rules, and codes to which dewatering design conforms.

3. Data for the required discharge reports shall be collected by the Contractor's Dewatering Professional. It shall consist of periodic sampling and analysis of system influents, midfluents and/or effluents and discharge quantities and other requirements of the relevant permits. The Contractor's Dewatering Professional shall also coordinate analysis of samples at an appropriately certified analytical laboratory and shall comply with all permit reporting requirements.

4. A modified dewatering plan within 24 hours, if open pumping from sumps and ditches results in boils, loss of fines or softening of the ground.

1.4 AVAILABLE SUBSURACE INFORMATION

A. Subsurface exploration data are provided as referenced in Sections 02010 and 02080.

1.5 QUALITY ASSURANCE

A. Employ the services of a Dewatering Professional having the following qualifications: A Massachusetts Registered Professional Civil Engineer who has completed the design of at least five (5) successful dewatering projects of equal size and complexity and with equal systems within the last five (5) years consisting of deep wells, well points, vacuum well points, and sump pumping for heavy Civil projects of similar size, type, and complexity in urban areas with the appropriate temporary support of excavation systems proposed by the Contractor including, but not limited to, trench boxes, soldier pile and lagging, timber sheeting support and secant pile support of excavation systems.

B. The dewatering systems installer supervisor shall have a minimum of five (5) years' experience in installation of well points, deep wells, recharge systems, or equal systems.

C. The Dewatering Professional responsible for day to day operation of the system shall have the following minimum qualifications:

1. Completion of at least five (5) successful dewatering projects of equal size and complexity with equal systems within the last five (5) years consisting of system operation and troubleshooting, collection of readings, maintenance of logs and other required documents, collection of samples, coordination of analysis of samples, and compliance with reporting requirements during pumping for heavy civil projects of similar size, type, and complexity in urban areas.

2. Valid certification from the Massachusetts Department of Environmental Protection (DEP) to operate the proposed treatment system.

D. If subgrade soils are disturbed or become unstable due to dewatering operation or an inadequate dewatering system, notify the Engineer, stabilize the subgrade, and modify system to perform as specified at no additional cost to the City.

E. Notify the Engineer immediately if any settlement or movement is detected on any adjacent structures. If the settlement or movement is deemed by the Engineer to be related to the dewatering, take actions to protect the adjacent structures and submit a modified dewatering plan to the Engineer within 24-hours. Implement the modified plan and repair any damage incurred to the adjacent structures at no additional cost to the City.

F. If oil and/or other hazardous materials are encountered after dewatering begins, dewatering procedures should be halted immediately, and the Engineer should be notified immediately and before any dewatering activities resume.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Provide groundwater monitoring wells in accordance with the submitted dewatering plan or as specified.

B. Provide casings, well screens, piping, fittings, pumps, power and other items required for dewatering system.

C. Provide sand and gravel filter around the well screen. Wrapping geotextile fabric directly around the well screen shall not be allowed.

D. When deep wells, well points, or vacuum well points are used, provide pumping units capable of maintaining high vacuum and handling large volumes of air and water at the same time.

E. Provide and store auxiliary dewatering equipment, consisting of pumps and hoses on the site in the event of breakdown, at least one (1) pump for every five (5) used.

F. Provide dewatering equipment, including an appropriately sized settling tank, and maintain erosion/sedimentation control devices as indicated or specified and in accordance with the dewatering plan.

G. Provide temporary pipes, hoses, flumes, or channels for the transport of discharge water to the discharge location.

H. Provide cement grout having a water cement ratio of 1 to 1 by volume.

PART 3 – EXECUTION

3.1 GENERAL

A. Execution of any earth excavation, installing earth retention systems, and dewatering shall not commence until the related submittals have been reviewed by the Engineer with all Engineer's comments satisfactorily addressed, the geotechnical instrumentation has been installed and baselines established and submitted to the Engineer, and the Dewatering Professional is on site and has begun the duties specified herein.

B. Furnish, install, operate, and maintain dewatering, re-infiltration, treatment and discharge systems as indicated or specified and in accordance with the dewatering plan and the applicable permit. As no dewatering flows shall be discharged to surface waters either directly or indirectly without appropriate treatment measures as required by the permit, at a minimum, the Contractor shall provide a settling tank, with a minimum capacity of 10,000 gallons, such that if pumping rates exceed discharge rates, additional storage capacity is available. Delays due to insufficient storage capacity will be at no additional cost to the City. The Contractor is responsible to evaluate available data and determine the necessary storage capacity so as to not impede construction activities.

C. Carry out dewatering program in such a manner as to prevent undermining or disturbing foundations of existing structures or of work ongoing or previously completed.

D. Do not excavate until the dewatering system is operational.

E. Unless otherwise specified, continue dewatering uninterrupted until all structures, pipes, and appurtenances below groundwater level have been completed such that they will not be floated or otherwise damaged by an increase in groundwater elevation.

F. Discontinue open pumping from sumps and ditches, if such pumping is resulting in boils, loss of fines, softening of the ground, or instability of the slopes. Modify dewatering plan and submit to the Engineer at no additional cost to the City.

G. Where subgrade materials are disturbed or become unstable due to dewatering operations, remove and replace the materials in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING at no additional cost to the City.

H. In the event the project needs and secures either an EPA NPDES RGP or DRGP Permit, requirements and procedures for dewatering outlined in said permit supersede the procedures outlined in this specification.

3.2 DEWATERING DISCHARGE

A. Water to be infiltrated need not be treated unless directed by the applicable permit requirements. Contractor shall provide infiltration that complies with relevant local, state and federal regulations.

B. Transport pumped or drained water to discharge location in compliance with applicable permits and without interference to other work; damage to or contamination of pavement, other surfaces, or property; erosion; or siltation.

C. Provide separately controlled pumping lines.

D. Immediately notify the Engineer if groundwater is encountered that is suspected to be contaminated with substances other than those for which the treatment system has been designed. Do not pump water found to be contaminated with oil or other hazardous material to the discharge locations without prior treatment and permits.

3.3 COMPLIANCE WITH DEWATERING AND RELATED PERMITS AND REGULATIONS

A. Discharging groundwater and allowing for natural infiltration may not be a viable option for controlling groundwater in the project area. Should dewatering activities be required where the Contractor needs to discharge groundwater to a location other than the point of origin, then the Contractor shall be prepared to store, treat and discharge the water in accordance with applicable permits and regulations. Periodic sampling, as may be required to demonstrate treatment effectiveness and compliance with discharge and/or pretreatment standards specified in any local, state, or federal discharge permit required shall be the responsibility of the Contractor and its Dewatering Professional. Water that cannot be infiltrated is anticipated to be discharged to the existing City of Cambridge Storm Drain system and discharged must be permitted under an EPA NPDES RGP Discharge Permit, Dewatering and Remediation General Permit (DRGP), and/or MWRA Construction Site Dewatering Discharge Permit, as applicable. The Contractor shall be responsible for seeking coverage under the appropriate EPA or MWRA Permit. At a minimum, the Contractor shall be prepared to comply with the permit influent/effluent testing requirements. The Dewatering Plan shall include a description of procedures and information related to the collection of readings, maintenance of logs and other required documents. At a minimum, the dewatering plan shall describe compliance with relevant provisions of the EPA NPDES RGP Discharge Permit or MWRA Construction Site Dewatering Discharge Permit obtained by the Contractor.

B. The Contractor, through its Dewatering Professional:

1. Shall furnish all labor, equipment and materials necessary to obtain accurate representative samples of the groundwater and for analysis for

the set of analytical parameters specified above and as required by local, state and federal permits and regulations.

2. Shall coordinate sampling activities with the Engineer. The engineer reserves the right to sample treated and untreated dewatering flows at any time.

3. Shall take readings from the treatment system in accordance with the dewatering plan.

4. Shall collect an initial sample of untreated and treated groundwater at the beginning of dewatering activities within the construction area.

5. Shall prepare and keep in proper order all records required by regulatory authorities and permits.

6. Shall maintain logs and other records in accordance with the Specifications, regulatory agency and permit requirements, and the Dewatering Plan.

7. Shall coordinate analysis of samples by an appropriately certified analytical laboratory in accordance with the Specifications, regulatory agency and permit requirements, and the Dewatering Plan, and ensure that laboratory detection limits meet permit requirements.

8. Shall comply with reporting requirements in a timely manner and in the format required by the relevant permit. Reporting in compliance with permit requirements includes, but is not limited to, notification to the appropriate regulators and the City and Engineer prior to discharge; submittal of laboratory analytical reports for each sampling event; submittal of reports for each reporting period during which no discharge occurs; notification of non-compliant discharges; notification of termination of discharge; and response to permit-related questions posed by regulators or the City and Engineer.

    a. Water will be discharged under an EPA NPDES RGP Discharge Permit or MWRA Construction Site Dewatering Discharge Permit or Dewatering and Remediation General Permit (DRGP), as applicable. The Contractor shall submit notifications and reports to the entities identified in the permit. Comply with pre-discharge notification, discharge reporting, notification of no discharge, and termination of discharge notification requirements; and respond to inquiries or correspondence from agencies regarding permit issues.

    b. For monthly or less frequent reporting deadlines, provide the Engineer with copies of all reports fourteen (14) days prior to the reporting deadline, and submit reports to the appropriate agency(ies) at the same. Provide copies of other dewatering

documents to the Engineer immediately.

9. Install and maintain erosion/sedimentation control devices at the point of discharge as indicated or specified and in accordance with the dewatering plan.

10. The Contractor shall obtain all federal, state, county, and local permits and variances to allow transport of materials on public roadways, should such transport be necessary.

11. The Contractor shall dispose of all wastes resulting from construction dewatering activities in accordance with local, federal and state regulations.

12. The Contractor is solely responsible for the implementation of the permit requirements and is solely responsible for any punitive action resulting from any violation of the permit. The actual permit issued by EPA or MWRA shall become part of this Contract by either addendum or by change order. If the actual permit is included by change order, no additional costs for implementing the permit will be considered by the City, when the actual permit is issued.

3.4 REMOVAL

A. Do not remove dewatering system without written approval from the Engineer.

B. Backfill and compact sumps or ditches with crushed stone wrapped with geotextile fabric in accordance with the Remedial Contract.

C. All dewatering wells shall be abandoned upon completion of the work, and completely backfilled with cement grout.

PART 4 – COMPENSATION

2140.1 - Treatment of Construction Dewatering

METHOD OF MEASUREMENT:
Measurement for payment for Treatment of Construction Dewatering will be on a per work day basis for treatment of dewatering, as measured by the Engineer. The Contractor shall be paid per work day that the dewatering treatment system(s) is onsite and operational, as defined by this Section, as required by the applicable dewatering permits, and as required by the City or Engineer. The Contractor shall not be compensated when the dewatering treatment system is onsite when not required by the Engineer or not required by the applicable dewatering permits. A dewatering treatment system shall be assumed to include a settling tank, granular activated carbon (GAC) unit, filters, meters, hose connections, hoses and other treatment apparatus.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Treatment of Construction Dewatering will be based on the unit price bid for this

item in the proposal. Under the unit price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, analytical testing, permit preparation and filing, and incidentals required for treatment of construction dewatering complete, as required and as required by the Engineer. The work includes but is not limited to mobilization and demobilization of the complete system(s); design of the system(s); furnishing and installing treatment system(s); maintenance of the treatment system(s); "breakdown", transportation and set-up of the treatment system(s) between on-site areas requiring treatment; sampling; reporting; maintenance of all logs and other documentation required; laboratory testing; coordination with permitting agencies and the City and Engineer; compliance with all permit requirements; removal, transportation, stockpiling, testing and disposal of all collected sediment; Dewatering Professional services; Dewatering Specialist services and all incidental work not included for payment elsewhere.

EXCLUSIONS

The Contractor shall not be compensated for construction dewatering under this item; including but not limited to re-infiltrated construction dewatering; providing, installing and maintaining pumps and hoses; installation and maintenance of well points, deep wells and pump filters and screens; temporary power sources and all incidental work. Construction dewatering shall be covered in the Contractor's base bid, at no additional cost to the City. This is a Treatment Item only.

END OF SECTION 02140

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SECTION 02160

TEMPORARY EXCAVATION SUPPORT SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Design, furnish and install temporary excavation support systems as required to maintain lateral support, prevent loss of ground, limit soil movements to the allowable limits indicated, and protect from damage existing and proposed improvements including, but not limited to, pipelines, utilities, structures, roadways, and other facilities.

2. The location, configuration, design, construction and maintenance of the excavation support walls and internal bracing shall be the sole responsibility of the Contractor.

3. The temporary excavation support system to be used on this project may include singular or multiple stages comprised of internally braced timber or steel sheeting, soldier piles and timber lagging, or trench boxes. Temporary excavation support system is, at a minimum, required at excavation locations within 25 feet of above-ground structures or active roadways, and where buried utilities are located within the soil wedge extending from the base of the excavation, upward to the ground surface at a slope of 2 horizontal to 1 vertical. Soldier piles and timber or steel sheeting shall be drilled or hydraulically pushed in place. No vibratory or impact hammers shall be used to install the excavation support system.

4. Wherever the word "sheeting" is used in this section or on the Contract Drawings, it shall be in reference to soldier piles and lagging, or steel and timber sheeting support systems.

5. Construction of the temporary excavation support system shall not disturb the existing structures or the completed proposed structures. The Contractor, at no additional cost to the City, shall repair damage to such structures.

6. The Contractor shall bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval or cave-ins as a result of improper installation, maintenance or design of the temporary excavation support systems. The Contractor shall pay for all claims, costs and damages that arise as a result of the work performed at no additional cost to the City.

7. Monitoring movement of the lateral support systems by optical survey techniques is required by an independent geotechnical monitoring consultant until installation and backfilling is complete. Additional survey monitoring of the lateral support system may be required if movement (lateral or vertical) is measured following backfilling to the existing grade.

8. If, in the Engineers judgment, the performance of the excavation support system is unacceptable, the City may instruct the Contractor to stop work and implement remedial measures to arrest further movements or restore groundwater levels to pre-construction levels. The Contractor shall take immediate steps to implement the remedial measures designed by the Contractor and reviewed by the Engineer. The costs for these measures shall be at no additional cost to the City.

9. Temporary excavation support systems shall be designed and installed in accordance with OSHA excavation safety standards.

1.2 RELATED WORK

A. Section 01300 - SUBMITTALS
B. Section 01390 – PRE-CONSTRUCTION SURVEY
C. Section 02080 - SOIL AND WASTE MANAGEMENT
D. Section 02010 – SUBSURFACE INVESTIGATION
E. Section 02015 – GEOTECHNICAL MONITORING AND INSTRUMENTATION
F. Section 02095: TRANSPORTATION AND DISPOSAL OF SOIL AND FILL
G. Section 02140: DEWATERING
H. Section 02210: EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS.

1. Submit the following qualifications three weeks prior to the construction:

a. Qualifications of Contractor’s temporary excavation support system designer as specified below.

b. Qualifications of Contractor’s temporary excavation support system installer as specified below.

2. Submit a temporary excavation support plan stamped and signed by a

Professional Civil Engineer registered in the Commonwealth of Massachusetts at least two (2) weeks prior to start of the construction. Submit design calculations for review that will be only for the information of the City and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

a. Drilled or hydraulically pushed in place excavation support system, details, location, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.

b. Certificate of Design

c. Requirements of dewatering during the construction.

d. Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.

e. List of equipment used for installing the excavation support systems.

3. Submit a Construction Contingency Plan specifying the methods and procedures to maintain excavation support system stability if the allowable movement of the adjacent ground and adjacent structures is exceeded.

4. For excavation support systems left in place, submit the following as-built information prior to backfilling and covering the excavation support systems:

a. Survey locations of the temporary excavation support systems, including coordinates of the ends and points of change in direction.

b. Type of the temporary excavation support system.

c. Elevations of top and bottom of the excavation support systems left in place.

5. Calculations and design drawings showing estimates of the lateral and vertical displacements of the excavation lateral support systems under applied loads at critical stages.

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring", and all other applicable laws, regulations, rules, and codes.

C. All welding shall be performed in accordance with AWS D1.1.

D. Prepare design, including calculations and drawings, under a Professional Civil Engineer registered in the Commonwealth of Massachusetts and having the following qualifications:

1. Not less than five (5) years experience in the design of soldier pile and lagging and steel or timber sheeting temporary excavation support systems of at least ten (10) feet deep in urban areas of comparable type, size, and complexity as this project.

2. Completed not less than five (5) successful soldier pile and lagging and steel or timber sheeting temporary excavation support system projects of comparable type, size, and complexity as this project within the last five (5) years.

E. Temporary Excavation Support System Installer's Qualifications:

1. Not less than five (5) years' experience in the installation of soldier pile and lagging and steel or timber sheeting temporary excavation support systems of at least ten (10) feet deep in urban areas of comparable type, size, and complexity as this project.

2. Completed not less than five successful soldier pile and lagging and steel or timber sheeting temporary excavation support system projects of comparable type, size, and complexity as this project within the last five years.

F. Install all temporary excavation support system under the supervision of a supervisor having the following qualifications:

1. Not less than five (5) years' experience in installation of soldier pile and lagging and steel or timber sheeting temporary excavation support systems of at least ten (10) feet deep in urban areas of comparable type, size, and complexity as this project.

2. Completed at least five (5) successful soldier pile and lagging and steel or timber sheeting temporary excavation support system projects of

comparable type, size, and complexity as this project within the last five (5) years.

G. Provide pre-construction surveys in accordance with Section 01390 – PRE-CONSTRUCTION SURVEY.

1.5 DESIGN CRITERIA

A. Design of temporary excavation support systems shall meet the following minimum requirements:

1. Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, traffic, temporary stockpiles, construction loads, and other surcharge loads in accordance with the current AASHTO (American Association of State Highway and Transportation Officials) Design Criteria.

2. Design internal bracing as needed to provide sufficient reaction to maintain stability.

3. Limit movement of buildings and buried utilities adjacent to the excavation support system to be within 0.5 inches.

4. Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of unbraced temporary excavation support systems shall not be less than five (5) feet below the bottom of the excavation.

5. Design temporary excavation support system shall withstand an additional three (3) feet of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.

6. Maximum width of pipe trench excavation shall be as indicated on the Drawings.

7. Permanent structure walls shall not be directly cast against excavation support walls.

1.6 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – Products, Materials and Equipment and as specified.

B. Store sheeting and bracing materials to prevent sagging, which would produce permanent deformation. Keep concentrated loads, which occur, during stacking or lifting below the level, which would produce permanent deformation of the material.

1.7 PROJECT/SITE CONDITIONS

A. Subsurface exploration data are provided as referenced in Section 02010 – SUBSURFACE INVESTIGATION. **Attention is directed to the presence of 30-Inch and 36-Inch gas transmission mains and a 115 kV electric transmission facility on River Street.**

B. The Contractor shall notify the Engineer immediately if obstructions are determined to conflict with the location of the excavation support system. Cobbles and boulders within dense well-bonded soils or other competent naturally deposited soils will not be considered obstructions.

C. The Contractor shall protect adjacent structures (above ground and buried) from damage associated with temporary excavation support systems and other operations. Damage due to temporary excavation support systems or other Contractor activities shall be repaired immediately by the Contractor at his own expense.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Structural Steel

1. All soldier piles, Wales, rakers, struts, wedges, plates, waterstop and accessory steel shapes shall conform to ASTM A36.

B. Timber Lagging Left-in-Place

1. Structural grade having a nominal thickness of 3 inches and a minimum allowable working stress of 1100 psi.

C. Timber Sheeting Left-in-Place

1. Structural grade having a nominal thickness of 4 inches and a minimum allowable working stress of 1100 psi.

D. Other Materials

1. Tamping tools adapted for backfilling voids after removal of the excavation support system.

2. Hydraulic, pneumatic or screw-jack shoring systems (Speed Shores) used to support excavations shall be in good working order and shall conform to all of the manufacturer's requirements for new equipment; bent or otherwise damaged supports, leaking hydraulic cylinders, or damaged sheeting shall not be used, and the Contractor shall

immediately remove such damaged materials/equipment from the work site.

3. Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in OSHA's 29 CFR Part 1926 Subpart P.

PART 3 – EXECUTION

3.1 GENERAL

A. Installation of the temporary excavation support system shall not commence until the Engineer has reviewed the related earth excavation and dewatering submittals with all Engineers' comments satisfactorily addressed.

B. Install excavation support system in accordance with the Contractor's temporary excavation support plan.

C. Carry out program of temporary excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures, and of work ongoing or previously completed.

D. Perform preparatory work to discover, protect, maintain and restore, or remove utilities, foundations or other facilities located in close proximity of the proposed excavation lateral support system.

E. Conduct pre-excavation as necessary to remove obstructions and identify exiting utilities along the alignment of the excavation lateral support system which will interfere with installation in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

F. The Contractor shall provide fully equipped rig(s) and appropriate tools in full-time operation at the site during the work, and shall mobilize additional equipment, if necessary, to complete the work on schedule.

G. Excavation shall not proceed more than 2 ft below the bracing level, anywhere within the excavation support limits, until the entire level of bracing is completely installed, including prestressing.

H. Notify utility owners if existing utilities interfere with the temporary excavation support system. Modify the existing utility with the utility owner's permission or have the utility owner make the modifications at no additional cost to City.

I. All trench support shall be installed and maintained so it is in continuous contact with the earthen trench walls being supported.

3.2 SOLDIER PILES AND TIMBER LAGGING

A. Install steel soldier piles before starting excavation. Install soldier piles by drilling or hydraulically pushing to the design tip elevation. Driving by impact or vibratory hammers shall not be allowed. Drilled methods shall prevent loss of ground around the hole. Each soldier pile shall be installed in its drilled hole within 2 hours after drilling is completed to the required depth.

B. The Contractor shall have equipment on-site able to advance the drilled hole, for installation of the soldier piles, through sand below the water table, through concrete, and through large boulders and other obstructions which may be encountered.

C. Space soldier piles at intervals indicated on the Shop Drawings. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

D. Within the same day of seating the soldier piles in the drilled holes, encase the piles with MHD (1995) M4.08.0 – Controlled Density Fill, Type 1E from the tip elevations to the currently existing ground surface. Crushed stone or other granular materials are not acceptable.

E. Prior to completion of the final backfilling operations, soldier piles shall be cut off five feet below the final ground surface.

F. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. As installation progresses, backpack the voids between the excavation face with sand and on-site soils to establish a tight contact. Pack louver openings between lagging with hay or other porous material to allow free drainage of groundwater without loss of retained soil or backpacking. In no case shall the louvered openings be allowed to exceed 1-inch.

G. Beginning at the top of the soldier piles, the maximum permissible height of unlagged face of excavation shall not exceed 2-feet in all soil types encountered at the site. If water is flowing from the face of the excavation, or if soil to be retained moves toward the excavation, the maximum height of unlagged face shall not exceed 8-inches.

H. If unstable ground is encountered, take suitable measures (grouting behind the lagging or other approved method) to retain the material in place and prevent loss of ground or movements, which may cause damage to adjacent structures or utilities.

3.3 STEEL OR TIMBER SHEETING

A. Length Markings: Before installation is started each steel or timber section shall be marked so that the depth of the tip can be readily determined. This shall be accomplished by a method that is approved by the Engineer.

B. Sheeting shall be installed by means of hydraulically pushing each sheet piling to the required design depth. No impact or vibratory hammers will be allowed for installation of steel or timber sheeting on this project. The Contractor shall take all precautions against excessive vibrations in all areas. The Contractor shall be solely responsible for any damages caused directly or indirectly to structures, sewer and other utilities, and shall repair any such damage occurring due to his operations to the requirements of the City.

C. All sheeting shall be protected from damage during installation.

D. All sheeting shall be hydraulically pushed to its full depth ahead of the excavation so as to avoid the loss of material from behind the sheeting; where voids occur outside of the sheeting, they shall be filled immediately with structural fill and thoroughly compacted.

E. The Contractor shall provide all inspection equipment to determine whether the sheeting has been started in their planned location, are vertical, and are within the allowable tolerance for position after installation.

F. Requirements for the sheeting include the following:

1. Install sheeting in the plumb position.

2. Install sheeting such that the piling is in direct contact with the material to be retained.

3. Install sheeting to the depths indicated on approved Shop Drawings.

4. Methods and equipment used in pushing, setting, cutting and splicing shall conform to approved Shop Drawings.

5. Use templates or other temporary alignment facilities to maintain piles plumb and on line.

6. Control vibrations and noise associated with installation.

7. Pre-excavate as necessary to remove existing structures along alignment of the sheeting.

8. Sheeting shall be positioned within 3 inches of the design plan location along its length from top down to bottom of excavation grade. Design plan locations are to be established by the Contractor's Professional Engineer and submitted to the Engineer for review.

3.4 INTERNAL LATERAL WALL BRACING (WALES AND STRUTS)

A. Use walers and struts as necessary to provide support of the excavation lateral support walls as required. Include web stiffeners, plates, brackets, or angles as required to prevent rotation, crippling or buckling of connections and points of

bearing between structural steel members. Allow for eccentricities due to fabrication and assembly. Consider effects of temperature changes.

B. Install and maintain all support members in continuous tight contact with each other and with the earth wall being supported.

C. Coordinate locations of all bracing and components thereof for temporary lateral excavation support with locations of permanent structures.

D. Control rate of excavation and installation of support members to minimize movement of adjacent ground surface.

E. Excavation shall proceed in accordance with the detailed sequence submitted by the Contractor and reviewed by the Engineer. It shall be the responsibility of the Contractor to schedule and sequence the work accordingly.

3.6 MONITORING

A. Temporary excavation support systems, excluding trench boxes, shall be monitored for vertical and lateral movement per the requirements of Section 02015 – GEOTECHNICAL MONITORING AND INSTRUMENTATION.

B. In the event the monitoring system proposed by the Contractor proves ineffective, the Contractor shall implement additional measures as required by the Engineer at no additional cost to the City.

3.7 REMOVAL OF EXCAVATION SUPPORT SYSTEM

A. Where removal of sheeting cannot be removed without damage to nearby utilities or work recently installed or other facilities it shall be left in place with the exception of the top 4 ft. of excavation support wall below final grades, which shall be removed, unless otherwise approved by the Engineer. Contractor shall provide a plan indicating the location, top elevation, and tip elevation of sheeting left in place.

B. Remove excavation support in a manner that will maintain support as excavation is backfilled and will not leave voids in the backfill.

C. Do not begin the removal of the excavation support system until it can be safely removed damage to existing facilities, completed work or adjacent property.

D. Fill any void left by the shoring system or voids created by the removal of the shoring system to provide soil support between the trench backfill and the native soil.

E. Sheet piling removal must be performed in a manner that will avoid “vibro-consolidation” (densification) of sandy or granular material below or adjacent to the excavation that could lead to settlement and damage of the pipeline, the gas transmission main, other works of construction and adjacent property.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 02160

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SECTION 02210

EARTH EXCAVATION, BACKFILL, FILL AND GRADING

2210.1	**TEST PITS**	**CUBIC YARD**
2210.2	**CONTROL DENSITY FILL FOR BACKFILL**	**CUBIC YARD**
2210.3	**GRAVEL BORROW (TYPE B)**	**CUBIC YARD**
2210.4	**DENSE GRADED CRUSHED STONE**	**CUBIC YARD**
2210.5	**UNCLASSIFIED EXCAVATION**	**CUBIC YARD**
2210.6	**ROADWAY EARTH EXCAVATION**	**CUBIC YARD**
2210.7	**EXCAVATION FOR SBSS FOR TREES IN PAVEMENT – TO DEPTH OF 4.5-FT BELOW FINISHED GRADE**	**CUBIC YARD**
2210.8	**EXCAVATION FOR PLANTING BEDS – TO DEPTH OF 3.5-FT BELOW FINISHED GRADE**	**CUBIC YARD**

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:

1. The Work shall consist of excavation of all materials removed within the limits of the Contract in accordance with the Specifications and in close conformity with the lines, grades, thickness and cross sections shown on the plans or established by the Engineer.

2. The Contractor shall comply with all applicable laws, rules, ordinances, and general regulations of the Federal Government, the Commonwealth of Massachusetts, the City of Cambridge, the Cambridge Department of Public Works, DEP, EPA, OSHA, and other regulatory agencies having jurisdiction over the Work.

3. Provide materials for backfilling excavations as indicated and specified.

4. Grade surfaces to meet finished grades indicated. Grade roadway and site as to maintain them in a level unrutted condition and to eliminate puddling of surface and subsurface water.

5. Test pits per the drawings and as directed by the Engineer.

1.2 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Submit an Excavation, Backfilling, Grading and Compaction plan at least two weeks prior to start of any earth moving activities. The review will be only for the information of the City and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include, but not be limited to the following items:

a. Detailed sequence of work.

b. General description of construction methods.

c. Numbers, types, and sizes of equipment proposed to perform excavation, backfilling, grading and compaction.

d. Details of dust control measures.

e. Proposed locations of stockpiled excavation and/or backfill materials.

f. Proposed surplus excavated material off-site disposal areas and required permits.

g. Erosion and sedimentation control measures, which will prevent erosion and sedimentation during the earth moving and soil stockpile activities.

2. Backfill Materials: Submit grain size analysis and performed in accordance with ASTM D422 and compaction moisture density curve (ASTM D1557) for each proposed source of backfill, imported material and on-site material to be reused, for review by the Engineer at least one week prior to use of the material. The grain size analysis shall indicate that the backfill material conforms to the gradation requirements specified.

a. In addition, a certification statement and analytical results shall accompany each physical sample of earth materials to be imported onto the site, including but not limited to crushed stone, loam, bedding sand, gravel sub-base, common fill and

structural backfill. At a minimum the certification shall state the point of origin and that the material is free of contaminants.

The certification shall include representative sample analysis from each point of origin of backfill to be used on the site. The sample(s) shall be analyzed by a certified laboratory for total metals (MCP 14 Metals), volatile organic compounds (EPA Method 8260), semi-volatile organic compounds (EPA Method 8270), petroleum hydrocarbons (EPA Method 8100), and Total PCBs and pesticides (EPA Method 8081 and 8082). On-site soils defined as suitable for reuse in this Section and in Section 02080 – SOIL AND WASTE MANAGEMENT can be used as backfill without providing the certification required above.

b. All sampling of soils for chemical testing shall be performed by a person experienced in sample collection and shall be either: 1) a Licensed Site Professional registered in the Commonwealth of Massachusetts; 2) a Professional Engineer registered in the Commonwealth of Massachusetts; 3) a professional Geologist registered in the Commonwealth of Massachusetts; 4) a certified groundwater/environmental professional; or 5) an authorized representative of the one of the persons listed above. Samples of each material shall be submitted to a chemical analytical laboratory, certified by the Massachusetts Department of Environmental Protection.

c. Submit additional samples and geotechnical and analytical test data and certifications for every 1000 cubic yards (every 500 cubic yards for moisture density curves) of material imported or reused on-site or anytime consistency of material changes in the opinion of the Engineer. Submit associated chemical laboratory data on the imported materials throughout the course of the Work, if requested by the Engineer, to evaluate the consistency of the source or process, at no additional cost to the City.

d. Controlled Density Fill Mix Design: Prior to beginning the work the Contractor shall submit for review, controlled density fill mix designs which shall show the proportions and gradations of all materials proposed for each class and type of controlled density fill specified herein.

e. Filter Fabric: Submit shop drawings and product data sheets.

3. During Construction, submit written confirmation of fill lift thickness, in-place soil moisture content, and percentage of compaction to the Engineer before placing the next lift or constructing foundations.

4. Submit Qualifications of the Contractor's Independent Testing Laboratory as specified in Paragraph 1.5.K, three weeks prior to the execution of any earth excavation, backfilling, filling, or compaction process.

5. Blasting shall not be permitted.

B. Test Pit Logs

1. Prepare and submit a log of the existing conditions observed. Each test pit log shall be submitted as its own document. The following information shall be indicated on the log at a minimum:

a. Plan sketch indicating size, material, quantity, function, ownership and direction of flow for each structure and utility. Include a north arrow and approximate STA number.

b. Swing ties indicating the horizontal location of each structure, utility and duct bank. Where horizontal alignment is found to vary, swing ties shall be recorded at appropriate intervals.

c. Top and bottom elevations of each structure and utility, and the dimensions of any encasement. Where vertical elevations are found to vary, elevations shall be recorded at appropriate intervals.

d. Where test pits are conducted to establish a vertical corridor for a proposed pipeline through conflicting utilities, include a profile sketch indicating the vertical separation between utilities.

2. Submit photographs that document wide-angle and close-up views of the existing conditions observed.

1.3 DEFINITIONS

A. Acceptable Material: Material which does not contain organic silt or organic clay; peat; vegetation; wood or roots; stones or rock fragments over 6-inch in diameter; porous biodegradable matter; loose or soft fill; excavated pavement; ice or frozen material; or refuse. Stones or rock fragments shall not exceed 40 percent by weight of the backfill material. Clay or silt content shall not exceed 25 percent by weight of the backfill material.

B. Unacceptable Materials: Materials that do not comply with the requirements for the acceptable material or which cannot be compacted to the specified or indicated density.

C. Percentage of compaction is defined as the ratio of the field dry density, as determined by ASTM D1556 or ASTM D6938 to the maximum dry density determined by ASTM D1557, multiplied by 100.

D. Proof Roll: Compaction to a firm and unyielding condition with a minimum of four passes of a vibratory steel drum roller. Vibratory plate compactors shall be used in small areas where a vibratory steel drum roller cannot be used.

E. Rock Excavation:

1. Rock excavation in trenches and pits includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, 42-inch wide bucket on track-mounted power excavator equivalent to Caterpillar Model 215, rated at not less than 90HP flywheel power and 30,000 lb. drawbar pull. Trenches in excess of 10 foot 0-inches in width and pits in excess of 30 feet 0-inches in either length or width are classified as open excavation.

2. Rock excavation in open excavations includes removal and disposal of materials and obstructions encountered which cannot be dislodged and excavated with modern track-mounted heavy-duty excavating equipment without drilling, blasting or ripping. Rock excavation equipment is defined as Caterpillar Model No. 973 or No. 977K, or equivalent track-mounted loader, rated at not less than 170HP flywheel power and developing 40,000 lb. break-out force (measured in accordance with SAE J732C).

3. Determination of rock excavation classification will be made by the Engineer. Typical of materials classified as rock are boulders 1.0 cu. yd. or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits. Intermittent drilling, blasting or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation. Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by Engineer. If the area to be excavated is preblasted prior to the excavation of overburden soils, the Engineer shall be notified at least two days in advance to allow observation of the preblast drilling by the Engineer in order to classify the excavation. Visual observation of the completed excavation may be made by the Engineer to modify the excavation classifications. Removal of rock excavation prior to classification by the Engineer shall be considered as earth excavation unless accepted by the Engineer in writing. Such excavation will be paid on the basis of contract unit rates for this classification.

1.4 REGULATIONS

A. The Contractor shall be solely responsible for making all excavations in a safe manner. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) and State requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

B. Comply with all applicable laws, rules, ordinances, and general regulations of the Federal Government, the Commonwealth of Massachusetts, the City of Cambridge, the Cambridge Department of Public Works, the Cambridge Water Department, DEP, EPA, OSHA, and other regulatory agencies having jurisdiction over the Work.

1.5 QUALITY ASSURANCE

A. Dewatering and Groundwater Control: Provide and maintain as specified in Section 02140 - DEWATERING.

B. Excavations shall be performed in the dry, and kept free from standing water, snow and ice during construction.

C. Temporary Excavation Support Systems: Provide and maintain as specified in Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

D. Do not excavate or fill until the Engineer has reviewed all the required submittals.

E. Formulate excavation, backfilling, and filling schedule and procedures to eliminate possibility of undermining or disturbing foundations of partially and completed structures, pipelines and embankments or existing structures and pipelines.

F. Cut pavement and all surface materials to the top of the existing fill material with a saw to prevent damage to remaining pavement without extra compensation. Surface materials may include concrete slabs, cobblestones, rails and other miscellaneous materials. Where pavement is removed in large pieces, dispose of pieces before proceeding with excavation.

G. Dig test pits considered separate to the normal excavation as required to locate underground utilities, obstructions or water table.

H. If material for foundation or pavement support is found to be unacceptable, as defined in these Specifications, at or below the grade to which excavation would normally be carried in accordance with the drawings and/or specifications, remove such material to the required width and depth as

required by the Engineer and replace it with crushed stone.

I. During progress of work, conduct earth-moving operations and maintain work site so as to minimize the creation and dispersion of dust.

J. Bedding and backfill material shall not be placed in water. Water shall not be allowed to rise upon or flow over the bedding and backfill material.

K. Employ an independent testing company to perform field and laboratory testing. The independent testing laboratory shall have the following qualifications:

1. Be accredited by the American Associates of State Highway and Transportation Officials (AASHTO) Accreditation Program;

2. Have three years experience in sampling, testing and analysis of soil and aggregates, and monitoring field compaction operations;

3. Able to provide three references from previous work.

1.6 PROJECT/SITE CONDITIONS

A. Subsurface investigation data are available as referenced in Section 02010.

1.7 MATERIAL TESTING

A. Moisture Density - One per source, except for crushed stone. Repeat the moisture density test for every 500 cubic yard of material used, and whenever visual inspection indicates a change in material gradation as required shall be as determined by the Engineer.

B. Gradation Analysis - A minimum of one per source, for each moisture density test, for every 100 cubic yards of material used, and whenever visual inspection indicates a change in material gradation. For on-site fill soil, the Engineer shall determine frequency of tests required.

C. Construction Tolerances: Construct finished surfaces to plus or minus 0.5 inches of the elevations indicated. Provide the Engineer with adequate survey information to verify compliance with above tolerances.

1.8 FIELD TESTING

A. Field Testing and Inspections: By Contractor’s independent testing company, acceptable to the Engineer, at Contractor's expense as specified. Location of tests shall be mutually acceptable to testing laboratory and the Engineer or as required by the Engineer. In the event compacted material does not meet specified in-place density, recompact material and retest this area until specified results are obtained at no additional cost to the City.

B. Methods of Field Testing: In-Place Density: ASTM D1556, ASTM D2167, or ASTM D2922; In-Place Moisture Content: ASTM D3017, ASTM D4944, or ASTM D4959; Material Testing Frequency: The following testing frequencies are minimum required for all fill materials.

C. Field In-Place Density and Moisture Content - Crushed stone shall be compacted as specified and indicated. For other backfill and fill materials, minimum test frequency shall be as follows, and no less than two tests per lift:

1. Trenches under structures, foundation preparation, or roadways subbase: Every 30 linear ft. per lift.

2. Trenches in areas without structures or roadways: Every 50 lin. ft. per lift

3. Under Structure: Every 300 sq. ft. per lift.

4. Adjacent to Structure Exteriors: Every 300 sq. ft. per lift.

PART 2 – PRODUCTS

2.1 SAND BORROW

A. Sand borrow shall consist of clean, inert, hard, durable grains of quartz or other hard durable rock free from clay and loam or other deleterious or organic material.

B. The sand borrow shall conform to Massachusetts Highway Department (MHD) Specification Designation, M1.04.1, and the following gradation:

Sieve Size	Percent Passing by Weight
½-inch (12.7mm)	100
3/8-inch (9.525mm)	85-100
No. 4	60-100
No. 16	35-80
No. 50	10-55
No. 200	2-10

2.2 COMMON FILL AND ON-SITE MATERIAL GEOTECHNICALLY SUITABLE FOR REUSE ON-SITE AS BACKFILL:

A. Common fill and on-site material geotechnically suitable for reuse on-site as backfill shall consist of sand and gravel consisting of hard durable particles, and free from trash, ice and snow, tree stumps, roots and other organic matter.

B. Common fill and on-site material geotechnically suitable for reuse on-site as backfill shall be used from the top of the sand borrow or crushed stone layer up to the bottom of the gravel subbase or landscaping layer.

C. Common fill and on-site material geotechnically suitable for reuse on-site as backfill shall conform to the following gradation requirements:

Sieve Size	Percent Finer by Weight
6-inch (152.4mm)	100
No. 4	30-80
No. 40	30-50
No. 200	0-25

2.3 CRUSHED STONE

A. As per MHD Standard Specifications for Highway and Bridges, as amended, M2.01.0, crushed stone shall consist of durable crushed rock or durable crushed gravel stone, angular in shape and free from structural defects, comparatively free of chemical decay, and free of any foreign material including, but not limited to ice and snow, sand, silt, clay, loam, or other deleterious or organic material

B. Crushed stone shall be wrapped in filter fabric.

C. The crushed stone shall be uniformly blended and shall conform to MHD Specification Designation, M2.01, and the following gradation requirements:

Sieve Size	Percent Passing by Weight M2.01.4 ¾ inch crushed stone
1-inch (25.4 mm)	100
3/4-inch (19.05 mm)	90-100
5/8-inch (15.875 mm)	---
½-inch (12.7 mm)	10-50
3/8-inch (9.5 mm)	0-20
No. 4	0-5
No. 8	---

2.4 DENSE GRADED CRUSHED STONE

A. As per MHD Standard Specifications for Highway and Bridges, as amended, M2.01.7, dense graded crushed stone shall consist of hard, durable fragments of stone. Dense graded crushed stone shall be angular in shape and free from structural defects, comparatively free of chemical decay, and free of any

foreign material including, but not limited to ice and snow, sand, silt, clay, plastic, loam, or other deleterious or organic material.

B. The crushed stone shall be uniformly blended and shall conform to MHD Specification Designation, M2.01.7, and the following gradation requirements:

Sieve Size	Percent Passing by Weight M2.01.7 Dense Graded Crushed Stone
2-inch (50 mm)	100
1.5-inch (37.5 mm)	70-100
3/4-inch (19.0 mm)	50-85
No. 4 (4.75 mm)	30-55
No. 50	8-24
No. 200	3-10

2.5 CONTROLLED DENSITY FILL (CDF)

A. Controlled density fill shall consist of a cementitious hard excavatable mixture of aggregate, Portland Cement conforming to ASTM C-150, Type II, and air entraining admixtures. Controlled density fill may have coarse and fine aggregate consisting of well graded crushed stone.

B. Controlled density fill shall be a maximum of 100 psi, consist of no fly ash and shall have clean water free from oils, acid, and organic matter.

C. Controlled density fill shall be of the type specified in MHD 1995 Standard Specifications for Highway and Bridges, as amended, Type 2E.

D. Controlled density fill shall be used as trench backfill material in areas inaccessible to compaction equipment such as below existing utilities and in narrow excavations for structures or as directed by the Engineer.

E. Controlled density fill shall also be used to fill abandoned utilities and around the excavation support systems as directed by the Engineer.

2.5 GRAVEL BORROW (TYPE B)

A. As per MHD Standard Specifications for Highway and Bridges, as amended, M1.03.0, Gravel Borrow (Type B) shall consist of hard, durable stone and coarse sand free from trash, ice and snow, loam and clay, surface coatings, tree stumps, roots and other organic and deleterious matter.

B. Gravel Borrow shall conform to MHD Specification Designation, M1.03.0 Type B and the following gradation requirements:

Sieve Size	Percent Passing by Weight
3-inch (76.2 mm)	100
½-inch (12.5 mm)	50-85
No. 50	8-28
No. 200	0-10

2.6 FILTER FABRIC

A. Filter Fabric shall consist of a nonwoven fabric made from polypropylene or polyethylene filaments or yarns.

B. Filter Fabric shall be inert to organic chemicals commonly encountered in the soil.

C. Edges and ends of filter fabric shall overlap a minimum of two feet.

D. Filter Fabric used as a drainage medium shall conform to MHD Specification Designation, M9.50.0 Type III and the following recommended property tests:

Property	Unit	Test Method	Minimum Value
Grab Strength	Lbs	ASTM D-4632	80
Grab Elongation	Percent	ASTM D-4632	15
Sewn Seam Strength	Lbs	ASTM D-4632	70
Puncture Strength	Lbs	ASTM D-4833	25
Trapezoid Tear Strength	Lbs	ASTM D-4533	25
Mullen Burst Strength	Psi	ASTM D-3786	130

E. Filter Fabric used as a separation medium shall conform to MHD Specification Designation, M9.50.0 Type I and the following recommended property tests:

Property	Unit	Test Method	Minimum Value
Grab Strength	Lbs	ASTM D-4632	180
Grab Elongation	Percent	ASTM D-4632	15
Sewn Seam Strength	Lbs	ASTM D-4632	160
Puncture Strength	Lbs	ASTM D-4833	70
Trapezoid Tear Strength	Lbs	ASTM D-4533	70
Property	Unit	Test Method	Minimum Value
Mullen Burst Strength	Psi	ASTM D-3786	210

2.7 GRAVEL SUBBASE

A. Gravel Subbase shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials.

B. Gravel Subbase shall be graded in accordance with Massachusetts Highway Department (MHD) specification section M1.03.1 as indicated below:

Sieve Size	Percent Passing by Weight
3-inch	100
1-1/2-inch	70-100
3/4-inch	50-85
No. 4	30-60
No. 200	0-10

PART 3 – EXECUTION

3.1 GENERAL

A. Do not excavate or fill until the Engineer has reviewed all the required submittals.

3.2 SITE MAINTENANCE

A. Roadway and Site Leveling: Grade roadway and site as to maintain them in a level unrutted condition and to eliminate puddling of surface and subsurface water.

3.3 SUBGRADE PREPARATION AND PROTECTION

A. As directed by the Engineer, over-excavate any unacceptable materials below the subgrade, and replace with compacted Gravel Borrow.

B. Utilize excavating equipment equipped with a toothless or smooth edged, excavating bucket to expose the pipe trench subgrade to minimize disturbance of the bearing surface.

C. Proof roll the exposed subgrade below pipes and structures prior to backfilling and filling operation, or placing crushed stone or sand borrow.

D. Proof roll to a firm and unyielding condition with a minimum of 4 passes of a vibratory plate compactor or double drum roller the exposed subgrade prior to backfilling and filling operation or placing soil-supported pipeline.

E. In areas where the bottom of the excavation is in silt and clay, and is below the groundwater table, a working mat and drainage layer of 12 inches of compacted crushed stone wrapped in filter fabric shall be placed.

3.4 TRENCH EXCAVATION

A. For pipe installation in a cradle or within bedding, excavate trench by machinery to, or just below designated subgrade. If material remaining at bottom of trench is disturbed, recompaction shall be required.

B. When pipe is to be laid directly on bottom of trench, do not excavate lower part of trenches by machinery to subgrade. Remove remainder of material to be excavated by use of hand tools just before placing of pipe. Form a flat or shaped bottom, true to grade, so pipe will have a uniform and continuous bearing. Support on firm and undisturbed material between joints, except for limited areas where use of pipe slings have disturbed bottom.

C. Excavate trenches to depths so as to permit pipe to be laid at elevations, slopes, or depths of cover indicated on drawings, and at uniform slopes between indicated elevations.

D. Make trenches as narrow as practicable and do not widen by scraping or loosening materials from the sides. Make every effort to maintain sides of trenches firm and undisturbed until backfilling has been placed and compacted.

E. Excavate trenches with approximately vertical sides between springline of pipe and elevation 1 ft. above top of pipe.

3.5 EXCAVATION NEAR EXISTING STRUCTURES

A. Discontinue digging by machinery when excavation approaches pipes, conduits, or other underground structures. Continue excavation by use of hand tools. Include such manual excavation in work to be done when incidental to normal excavation and under items involving normal excavation.

B. Excavate test pits when determination of exact location of pipe utilities or other underground structures is necessary for doing work properly.

1. Conduct test pits in accordance with Specification Section 01500-1.7 TEST PITS.

2. Record all information required under Part 1.2.B - Test Pit Logs of this Specification Section.

3. Perform an instrument survey of all horizontal and vertical alignments.

4. Photograph the existing conditions observed. Mark any utilities, structures or encasement that is difficult to discern with orange paint prior to photographing.

C. Execution of any earth excavation shall not commence until the related dewatering, soil and fill management, excavation support systems, and required backfill and fill materials submittals are reviewed by the Engineer and all Engineers' comments addressed.

D. Carry out program of excavation, dewatering, and excavation support systems to eliminate possibility of undermining or disturbing foundations of existing structures or utilities of the work previously completed under this contract.

E. Excavate to widths that give suitable room for constructing structures or laying and jointing piping.

F. Do not plow, scrape or dig by machinery near to finished subgrade in a manner that would result in disturbance of subgrade.

G. Excavate to lines and grades indicated in an orderly and continuous program.

H. Establish limits of excavation to allow adequate working space for installing forms and for safety of personnel.

I. Excavate to elevations indicated, or deeper, as required by the Engineer, to remove unacceptable subgrade material.

J. Exercise care to preserve material below and beyond the lines of excavations.

K. Boulders, rock fragments, and concrete less than one-half cubic yard encountered during excavation shall not be included for payment as rock.

3.6 REMOVAL OF SUBSURFACE OBSTRUCTIONS

A. Remove indicated or approved subsurface structures and related obstructions to complete the work.

B. Promptly notify the Engineer when any unexpected subsurface facilities are encountered during excavation such as utility lines and appurtenances, walls and foundations.

3.7 UNAUTHORIZED EXCAVATION

A. When the bottom of any excavation is excavated beyond limits indicated or specified, backfill with crushed stone wrapped with non-woven geotextile fabric. No additional payment will be made for the excavation of backfill or unauthorized excavation.

3.8 SEPARATION OF EXCAVATED MATERIAL FOR REUSE

A. Carefully remove acceptable material from excavated areas and store separately for further use as backfill material or for disposal or immediately reuse at the area of excavation as backfill.

B. Reuse surplus acceptable excavated materials for backfill as indicated and in accordance with Section 02080 – SOIL AND FILL MANAGEMENT; deposit neatly and grade.

3.9 COMPACTION EQUIPMENT

A. The compaction equipment shall be selected by the Contractor, and shall be capable of consistently achieving the specified compaction requirements. The selected compaction equipment shall meet the following minimum requirements:

1. Manually operated vibratory plate compactors weighing no less than

200 pounds with vibration frequency no less than 1600 cycles per minute.

2. Vibratory steel drum roller weighing at least 12,000 pounds.

3. Water jetting and puddling will not be allowed.

3.10 COMPACTION REQUIREMENTS

A. The degree of compaction is expressed as a percentage of the maximum dry density at optimum moisture content as determined by ASTM Test D1557, Procedure C. The compaction requirements are as follows:

Area	**ASTM Density Degree of Compaction**
Natural subgrade	Proof roll
Area	**ASTM Density Degree of Compaction**
Crushed stone	As specified herein
Sand Borrow	95%
Gravel subbase	95%
General backfill with CDF adjacent to structures other than manholes or catch basins	As specified herein
Trench backfill (on-site fill) - below pavements - below landscaped areas	 95% 90%
Other areas	90%

B. Moisture Control: Fill that is too wet for proper compaction shall be desiccated, harrowed, or otherwise dried to a proper moisture content to allow compaction to the required density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill at no additional cost to the City.

C. Fill that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density.

D. Unfavorable Conditions: In no case shall fill be placed in standing water, over organic silt or peat or material that is frozen. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.

E. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of the day's operations. Prior to terminating work for the day, the final layer of compacted fill shall be rolled with a smooth wheeled roller to eliminate ridges of soil left by compaction equipment.

F. Compaction Control: In-place density tests shall be made at the Contractor's expense in accordance with ASTM D1556, D2922 or D2167 as the work progresses, to determine the degree of compaction being attained by the Contractor. Any corrective work required as a result of such tests, such as additional compaction, or a decrease in the thickness of layers, shall be performed by the Contractor at no additional expense to the City.

G. The Engineer's duties do not include supervision or direction of the actual work by the Contractor, his employees or agents. Neither the presence of the Engineer nor any observation and testing performed by him shall excuse the Contractor from defects discovered in his work at that time or subsequent to the testing.

H. Placement: All fill shall be placed in horizontal layers. Fill shall not be placed following the natural contours of the ground. Fill shall be placed starting in the lowest areas working up to finish grades in horizontal layers in the manner specified herein. Each layer of fill should be benched into the existing slope in order to avoid the formation of a shear plane.

I. Surfaces: After backfilling trenches and excavations, the Contractor shall maintain the surfaces of backfill area in good condition so as to present a smooth surface at all times level with adjacent surfaces. The Contractor shall repair any subsequent settling over backfilled area immediately, in a manner satisfactory to the Engineer, and such maintenance shall be provided by the Contractor for the life of this Contract, at no additional expense to the City.

J. The finished subgrade of the fills and filled excavations upon which topsoil is to be placed, or pavements are to be constructed, shall not be disturbed by traffic of other operations and shall be maintained in a satisfactory condition until the finished courses are placed. The storage or stockpiling of materials on finished subgrade will not be permitted.

3.11 BACKFILL MATERIAL SELECTION

A. Backfill Material Selection: Unless otherwise specified or required, material used for filling and backfilling shall meet the requirements specified under Backfill materials. In general, the material used for backfilling trench excavations within the zone above structures and 6 inches above pipe crowns shall be material removed from the excavation provided that the reuse of these materials result in the required trench compaction and meets the gradation requirements specified for on-site fill. In areas where the bottom of the

excavation is in silt and clay, and is below the groundwater table, a working mat and drainage layer of 12 inches of compacted crushed stone wrapped in filter fabric shall be placed.

B. Place backfill to a maximum loose lift thickness of 9 inches except where used as pipe bedding. Maintain backfill material with a uniform moisture content, with no visible wet or dry streaking, between plus 2 percent and minus 3 percent of optimum moisture content. The final filled soil mass shall be as uniform as possible in lift thickness, moisture content, and effort required to compact soil mass.

3.12 STRUCTURE AND TRENCH BACKFILL

A. The trenches shall be backfilled as soon as practicable with the material specified herein. All trench backfilling shall be done with special care, in the following manner and as required by the Engineer.

B. Backfill material for pipe bedding shall be placed in the trench, uniformly on both sides of the pipe, for the entire width of the trench as indicated on the drawings. Sand borrow bedding shall be placed by hand shovels, in layers not more than 4-inches thick in loose depth, and each layer shall be thoroughly and evenly compacted by tamping on each side of the pipe to provide uniform support around the pipe, free from voids. Crushed stone bedding material shall be placed in layers not more than 6-inches thick in loose measure, and compacted with at least 4 passes using a vibratory plate or roller compactor.

C. The common fill material shall be spread in layers not exceeding 9-inches in loose depth and each layer thoroughly compacted by mechanical methods and shall contain no rock, stones or boulders larger than 6- inches in their greatest dimension. The balance of the trench with no structures shall be common fill material placed in 9-inch think lifts and compacted up to the bottom of the gravel subbase layer.

D. All trench backfill under, and service lateral trench backfill within 3 feet of the large diameter (>18-inches) water transmission mains shall be quick-set CDF. Backfill shall be placed in appropriately sized lifts and on both sides of the transmission main simultaneously to ensure that all loads applied to the main by the backfill are properly balanced and that they do not exceed the safe load carrying capacity of the main at any time.

E. All trench backfilling shall be done with special care and must be carefully placed so as not to disturb the work at any time if necessary, timber grillage or other suitable method shall be used to break the fall of material. The moisture content of the backfill material shall be such that proper compaction will be obtained. Backfill shall be made to grades required to establish the proper subgrade for the placement of topsoil or pavement base courses.

F. In backfilling trenches, each layer of backfill material shall be moistened and compacted to a density as specified herein, and in such a manner as to permit the rolling and compaction of the filled trench or excavation with the adjoining earth to provide the required bearing value.

G. Any trenches or excavations improperly backfilled or where settlement occurs shall be reopened, to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and condition, at no additional expense to the City.

H. During filling and backfilling operations, pipelines will be checked by the Engineer to determine whether any displacement of the pipe has occurred. If the observation of the pipelines shows poor alignment, displaced pipe or any other defects they shall be remedied to meet Engineer and Owner requirements at no additional cost to the City.

3.13 BACKFILLING AGAINST STRUCTURES

A. Backfilling against masonry or concrete shall not be done until permitted by the Engineer. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking or other damage. As soon as practicable after the structures are structurally adequate and other necessary work has been satisfactorily completed, the Contractor, as required by the Engineer, shall make special leakage tests of the structures. After the satisfactory completion of leakage tests and the satisfactory completion of any other required work in connection with the structures, the backfilling around the structures shall proceed.

B. Symmetrical backfill loading shall be maintained. Special care shall be taken to prevent any wedging action or eccentric loading upon or against the structures.

C. In compacting and other operations, the Contractor shall conduct his operations in a manner to prevent damage to structures due to passage of heavy equipment over, or adjacent to, structures, and any damage thereto shall be remedied by the Contractor at no additional expense to the City.

3.14 CDF QUALITY CONTROL TESTING DURING CONSTRUCTION

A. Slump: ASTM C143; one test at point of discharge for each day's placement; additional tests when CDF consistency seems to have changed.

B. Compression Test Specimen: ASTM C31; one set of four (4) standard cylinders for each compression strength test, plus additional sets for each 100 cu yds more than the first 50 cu yds placed in any one day unless otherwise required.

C. Compressive Strength Tests: ASTM C39; one set for each day's pour plus additional sets for each 100 cu. yds more than the first 50 cu. yds placed in any one day; two specimens tested at 28 days, and two specimens tested at 90 days.

D. Test results will be reported in writing to Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of placement, name of testing service, fill type and class, location of fill batch along route, design compressive strength limits at 28 days and 90 days, fill mix proportions and materials, compressive breaking strength, and type of break for both 28 day tests and 90 day tests.

3.15 CARE AND RESTORATION OF PROPERTY

A. Do not use or operate tractors, bulldozers, or other power-operated equipment on paved surfaces when their treads or wheels of which are so shaped as to cut or otherwise damage such surfaces. Restore surfaces damaged by the Contractor's operations to a condition at least equal to that in which they were found immediately before work commenced. Use suitable materials and methods for such restoration.

3.16 POLLUTION CONTROL

A. During progress of work, conduct earth-moving operations and maintain work site so as to minimize the creation and dispersion of dust.

B. Separation of Excavated Material for Reuse: Remove only existing pavement and all other surface materials, which may include concrete slabs, cobblestones, rail ties, by saw cutting that is necessary for prosecution of work.

PART 4 – COMPENSATION

Item 2210.1 - Test Pits

METHOD OF MEASUREMENT:
Measurement for payment for Test Pits will be based on the computed volume in cubic yards of material displaced during test pit excavation as required and measured by the Engineer. Depth of excavation will be measured to the average depth of the excavation. Irregularly deep parts of the exaction will not be used as the excavation depth. The width of the excavation will be measured to an average width across the excavation. Irregularly wide parts of the excavation will not be considered the width of the excavation. Test Pits, completed for the Contractor's convenience, not approved by the Engineer, will be at the Contractor's expense and at no additional cost to the City.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Test Pit shall be based on the cubic yards excavated complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Test Pits. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavate and backfill such materials as necessary to locate pipe, utilities and other possible obstructions as indicated on the Drawings, as required by the City or Engineer, or as approved by the City or Engineer prior to performing the test pit; temporary excavation support; furnishing and placing backfill per one of the approved methods; compaction and compaction testing; coordination with utility companies/owners; survey of existing conditions including horizontal and vertical utility alignments and reflecting the actual conditions on the Project's As-built Drawings; and construction dewatering and all work incidental thereto and all work not specifically included for payment under other items.

EXCLUSIONS:
Test Pits completed for the purpose of soil characterization shall not be paid for under this item. Pre-trenching prior to the installation of temporary support of excavation or for any other

purpose shall not be paid for herein unless approved by the City and Engineer prior to the pre-trenching or test pitting. Test pitting related to transferring existing water services to an existing water main are not paid for here and are paid for elsewhere.

Item 2210.2 - Controlled Density Fill for Backfill

METHOD OF MEASUREMENT:
Measurement for payment for Controlled Density Fill for Backfill shall be made on the basis of cubic yards placed within the trench width pay limits shown indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Controlled Density Fill for Backfill shall be based on the cubic yards installed complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Controlled Density Fill for Backfill. The work includes, but is not limited to; furnish and install controlled density fill for backfill under existing utilities, in areas of difficult compaction, and where required by the Engineer; temporary bulkheads and forms; furnishing and installing filter fabric; and material testing.

SPECIAL NOTES/EXCLUSIONS:
Controlled Density Fill used for the abandonment of pipes and structures will not be paid for under this item. Gravel subbase shall only be paid for work related to full depth roadway construction work outside trench limits.

Item 2210.3 – Gravel Borrow (Type B)

METHOD OF MEASUREMENT:
Measurement for payment for Gravel Borrow Type B shall be made on the basis of cubic yards placed during full depth construction between limits of proposed curbing as indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Gravel Borrow Type B shall be based on the cubic yards installed complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for placement of Gravel Borrow Type B. The work includes, but is not limited to; furnish and install Gravel Borrow Type B where there is insufficient existing roadway base material and where required by the Engineer; material testing; compaction; and compaction testing.

SPECIAL NOTES/EXCLUSIONS:
Gravel Borrow Type B used as trench backfill and for sidewalk construction will not be paid for under this item and are covered under separate pay items. Gravel Borrow Type B shall only be paid for work related to full depth roadway construction work.

Item 2210.4 – Dense Graded Crushed Stone

METHOD OF MEASUREMENT:
Measurement for payment for Dense Graded Crushed Stone shall be made on the basis of cubic yards placed during full depth construction between limits of proposed curbing as indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Dense Graded Crushed Stone shall be based on the cubic yards installed complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for placement of Dense Graded Crushed Stone. The work includes, but is not limited to; furnish and install Dense Graded Crushed Stone where there is insufficient existing roadway base material and where required by the Engineer; material testing; compaction; and compaction testing.

SPECIAL NOTES/EXCLUSIONS:
Dense Graded Crushed Stone shall only be paid for work related to full depth roadway construction.

Item 2210.5 – Unclassified Excavation

METHOD OF MEASUREMENT:
Measurement for payment for Unclassified Excavation shall be made on the basis of cubic yards of bituminous pavement, concrete subbase, concrete, remnants of foundation walls or slabs, cobblestones, and railroad ties and tracks excavated to final grade as indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the removal of bituminous pavement, concrete subbase, concrete, remnants of foundation walls or slabs, cobblestones, and railroad ties and tracks excavated to final grade. The work includes, but is not limited to; saw cutting, torch cutting and excavating bituminous pavement, concrete subbase, concrete, remnants of foundation walls or slabs, cobblestones, and railroad ties and tracks; and all work incidental thereto and all work not specifically included for payment under other items.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Unclassified Excavation shall be based on the cubic yards excavated complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the removal of bituminous pavement including removal of authorized temporary pavement placed under this Contract, concrete subbase, concrete, remnants of foundation walls or slabs, cobblestones, and railroad ties and tracks excavated to final grade. The work includes, but is not limited to; saw cutting, torch cutting and excavating bituminous pavement, concrete subbase, concrete, remnants of foundation walls or slabs, cobblestones, and railroad ties and tracks; and all work incidental thereto and all work not specifically included for payment under other items.

EXCLUSIONS OR SPECIAL NOTES:
This item does not include payment for the initial removal of pre-existing bituminous pavement and concrete subbase within the trench limits of structures, manholes, or pipe, as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of existing sidewalks (all types) as it is paid for elsewhere in the Contract Documents. This item does not include transportation and disposal of Unclassified Excavation, as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of soil or gravel, as it is paid for elsewhere in the Contract Documents.

Item 2210.6 – Roadway Earth Excavation

METHOD OF MEASUREMENT:
Measurement for payment for Roadway Earth Excavation shall be made on the basis of cubic yards of gravel and soil, excavated to final grade as indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the removal of gravel and soil excavated to final grade within limits of full depth construction. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavating, and all work incidental thereto and all work not specifically included for payment under other items.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Roadway Earth Excavation shall be based on the cubic yards excavated complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the removal of gravel and other soils excavated to final grade, including removal of authorized temporary backfill materials placed under this Contract. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavating gravel and soil; transporting material to/from soil staging area; reuse of existing gravel or soil suitable for subbase; and all work incidental thereto and all work not specifically included for payment under other items.

EXCLUSIONS OR SPECIAL NOTES:
This item does not include payment for the initial removal of pre-existing asphalt, gravel and/or soil within the trench limits of structures, manholes, or pipe, as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of existing sidewalks (all types) as it is paid for elsewhere in the Contract Documents. This item does not include transportation and disposal of Roadway Earth Excavation, as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of concrete, asphalt, and cobbles, as it is paid for elsewhere in the Contract Documents. This item does not include final grading of subbase and work related to cold planing, as it is paid for elsewhere in the Contract Documents. Excess or unsuitable Roadway Earth Excavation shall be disposed of under soil management and disposal items.

Item 2210.7 – Excavation for SBSS for Trees In Pavement – To Depth of 4.5-ft Below Finished Grade

Item 2210.8 – Excavation for Planting Beds – to Depth of 3.5-ft Below Finished Grade

METHOD OF MEASUREMENT:
Measurement for payment for Excavation for SBSS and Planting Beds shall be made on the basis of cubic yards of gravel and soil, excavated to final grade as indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the removal of gravel and soil excavated to final grade within limits of specialty soil placement. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavating, and all work incidental thereto and all work not specifically included for payment under other items.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Excavation of SBSS and Planting Beds shall be based on the cubic yards excavated complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the removal of gravel and other soils excavated to final grade. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavating gravel and soil; transporting material to/from soil staging area; and all work incidental thereto and all work not specifically included for payment under other items.

EXCLUSIONS OR SPECIAL NOTES:
This item does not include payment for removal of asphalt, temporary asphalt, gravel and/or soil within the trench limits of structures, manholes, or pipe, as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of existing sidewalks (all types) as it is paid for elsewhere in the Contract Documents. This item does not include excavation, transportation and disposal of Roadway Earth Excavation, as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of concrete, asphalt, and cobbles, as it is paid for elsewhere in the Contract Documents.

END OF SECTION 02210

SECTION 02252

MANHOLES

2252.1	**TYPE 1 MANHOLE PRECAST 4-FOOT DIAMETER**	**EACH**
2252.3	**TYPE 4 SUMP MANHOLE PRECAST 4-FOOT DIAMETER**	**EACH**
2252.4	**TYPE 1 MANHOLE PRECAST 5-FOOT DIAMETER**	**EACH**
2252.5	**TYPE 1 MANHOLE PRECAST WITH KNOCKOUT BASE**	**EACH**
2252.6	**TYPE 7 MANHOLE PRECAST 3'X4'**	**EACH**
2252.7	**TYPE 1 MANHOLE – PRECAST DROP MANHOLE**	**EACH**
2252.8	**EXISTING DRAINAGE OR SEWER STRUCTURE ADJUSTED**	**EACH**
2252.9	**MANHOLE – REMOVE AND REPLACE EXISTING FRAME AND COVER**	**EACH**
2252.10	**EXISTING DRAINAGE OR SEWER STRUCTURE REMODELED**	**EACH**

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing of precast concrete sanitary sewer manholes and storm drain manholes, complete and in place, within the limits and to the lines and grades indicated.

1.2 RELATED TECHNICAL SECTION

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND

GRADING

C. Section 02590 – BRICK MASONRY

D. Section 03300 – CONCRETE

E. Section 03410 – PLANT-PRECAST STRUCTURAL CONCRETE

F. Section 07160 – BITUMINOUS DAMPPROOFING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Complete shop drawings for all precast manhole sections, cast iron frames and covers and appurtenances.

2. Prior to fabrication, submit shop drawings showing details of precast monolithic base sections; risers; eccentric cone and flat slab manhole tops; joints and gaskets; and construction details, tolerances, and other information as required by the City.

3. Submit manufacturer's recommended installation procedures for informational purposes.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. City reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

C. Engineer reserves the right to direct the Contractor to use blank base and riser sections in lieu of sections with pre-cast holes, should unknown site conflicts require field cutting of concrete for the connection of laterals.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

B. Removed manhole fixtures must not be reused and shall be salvaged and delivered to the City of Cambridge Public Works storage yard unless directed by the City to dispose off site.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Precast Bases, Risers, and Tops:

1. Except as otherwise indicated, precast reinforced concrete manhole bases and risers shall be 48 inches diameter with top sections of types indicated or as directed.

2. Manhole sections shall conform to the requirements of ASTM C478, latest revision, except as modified herein and/or on the drawings.

3. Each manhole section shall be constructed with a bell-and-spigot or tongue-in-groove joint.

4. The manhole sections shall be manufactured by the centrifugal, roller suspension or vertical cast process; workmanship and methods shall be in accordance with the best practices of modern shops for this type of work.

5. The height and diameter of manhole bases shall be as required to accommodate size of pipe used, as approved. The manhole risers shall be available in 2, 3, and 4-foot lengths.

6. Manhole tops of the eccentric cone type shall be 3 or 4 foot lengths, with 30-inch inside diameter opening at top, unless otherwise noted as shown in the details.

7. Manholes larger than 4 feet in diameter at the base shall be reduced in diameter to 4 feet at the top riser section unless noted otherwise on the plans.

8. Manhole tops of the flat slab type, where space restrictions exist or where directed, shall not be less than 8 inches thick and reinforced as indicated, and shall have an opening having a minimum inside diameter of 24 inches.

9. Manhole bases and risers shall have the wall thicknesses as stated in the Drawings; cone type units shall taper to a minimum wall thickness of 8-inches at top.

10. All exterior concrete surfaces shall be coated with bituminous dampproofing as per Section 07160 – BITUMINOUS DAMPPROOFING.

B. Concrete:

1. Cement shall be moderate heat-of-hydration Portland cement conforming to ASTM C150, latest revision, Type II. Absorption, determined by absorption test described in ASTM C478, latest revision, shall not exceed 8 percent of dry weight.

2. The concrete for precast manhole sections shall have an average strength of not less than 4,000 psi at 28 days. Strength shall be determined by tests on 6-inch by 12-inch vibrated test cylinders cured in the same manner as the manhole sections, cores cut from the manhole sections, or by other approved methods. Not less than two concrete strength tests shall be made for each 100 linear feet of manhole sections and the test results submitted to the City. Testing may be conducted at the manufacturer's plant or at an approved testing laboratory and shall be the responsibility of the Contractor, at no additional expense to the City.

C. Frames and Covers:

1. All frames shall have a minimum clear opening of 24 inches.

2. Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects affecting the strength and value for the service intended. The finished coating shall be tough and tenacious when cold and not brittle or with any tendency to scale off under seasonable temperature changes.

3. Frames and Covers shall be Cast Iron, conforming to ASTM A48, Class 35B and as follows:

   a. Castings to be free from scale, lumps, blisters and sandholes.

   b. Machine contact surfaces to prevent rocking.

   c. Thoroughly clean and hammer inspect.

4. Two pickhole cast 180° apart shall be closed loops to facilitate removing cover allowing manhole pick to “hook” the loops.

5. Manhole covers shall have the Cambridge Department of Public Works custom logo and the word “SEWER” or “DRAIN” embossed on the cover with one and a quarter inch (1-1/4”) Sharp Face Gothic lettering. Frames and covers shall be EJ Co. 2111AGS, or approved equivalent.

6. Frames and covers shall be capable of withstanding AASHTO H-20 loading unless otherwise indicated or specified.

7. The Contractor shall furnish all manhole frames and covers conforming to the details shown on the drawings, or as herein specified. Frames and covers shall be of cast iron with diamond cover surface design. Manhole covers shall be machined to fit securely and evenly on the frame.

D. Jointing:

1. Precast machine-made solid segments shall conform to ASTM C139.

2. Ends of each length of manhole riser, the bottom end of manhole tops of the cone type, base slabs, and the tops of monolithic bases shall be provided with bell-and-spigot or tongue-and-groove ends of concrete formed on machined rings to insure accurate joint surfaces.

3. Jointing shall be O-ring gaskets or butyl rubber molded sealants. All joints shall be provided so as to be watertight under all conditions of service. The ends of base, riser, and cone sections to be jointed using neoprene "O-ring" type joints shall be designed to enclose the gasket on four surfaces when the joint is in its final position.

E. Gaskets:

1. Gaskets for sealing joints using the "O-ring" type gaskets shall conform to ASTM C443, latest revision, and shall be of rubber of a special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five years experience in the manufacture of neoprene gaskets for pipe joints, or shall be vulcanized butyl rubber sealants meeting or exceeding Federal Specifications SS-S-210.

2. Each gasket shall be a continuous ring of round solid cross-section having smooth surfaces free from blisters, porosity and other imperfections. The joint sealing gasket shall be of a composition and texture which shall be resistant to sewage, industrial wastes including gasoline, oils and groundwater, and which will endure permanently under the conditions likely to be imposed by this use. The tensile strength shall be at least 1,200 psi. The elongation shall be such that 2-inch gauge marks shall stretch to not less than 9 inches. The compression set (constant deflection) shall not exceed 25 percent of the original gauge length. The tensile strength after accelerated aging shall be not less than 80 percent of the original strength.

3. The butyl rubber sealant shall have a self adhesive nature and shall have a diameter of 1 inch and shall be furnished in coils. The sealant shall meet the following properties:

DESCRIPTION	SEALANT PROPERTY
Base	Vulcanized Butyl Rubber
Percent of Solids	100%
Shore "A" Durameter:	
- Initial	10
- Aged	20
Adhesion to Clean Surfaces	Excellent
Temperature Range:	
- Application	-20° F to 120° F
- Service	-65° F to 200° F
Water Absorption after 14 days immersion:	Less than 5%
Chemical Resistance after 7 days immersion in 5% Potassium Hydroxide and 5% Hydrochloride Acid	Excellent
Resistance to Water and Organic Solvents	Excellent
Resistance to Shock, Heat, and Cold	Excellent
Color	Black
Shelf Life	Excellent
Elongation	
- Initial	30%
- 2 weeks at 190° F, drying	250%
- 2 weeks in water	300%
Weather Resistance	Excellent
Moisture Diffusion Resistance	Excellent
Specific Gravity	1:18
Flash Point	None
Fire Point	Over 620° F

F. Grout for Sealing Joints:

1. Grout for sealing mortar-type joints or grouting field made pipe openings, shall be a non-shrink grout which shall be a factory-mixed ready-to-use product containing especially prepared aggregate, cement and sand and other components which will produce a mortar or grout with properties to counteract shrinkage, increase density, withstand impact, improve workability, produce watertight joints, and which will be suitable for jointing around pipes entering manholes.

G. Mortar for Brickwork:

1. Per Section 02590 – BRICK MASONRY

H. Brick

1. Per Section 02590 – BRICK MASONRY

I. Bituminous Dampproofing

1. Per Section 07160 – BITUMINOUS DAMPPROOFING

J. Flexible Seals

1. Flexible manhole seals shall be:

a. New Lok Joint Flexible Sleeve by Interpace,

b. A-Lok Manhole Sleeve by L & L Concrete Products,

c. Press Wedge II by Pre-Seal Basket Corporation,

d. or approved equal.

2. Field applied seals shall be similar to a style typified by Kor-N-Seal boot or an approved equal.

3. Manhole sleeves, gaskets and sealants shall be furnished complete with lubricants, stainless steel stops, inserts, clamps, etc.

PART 3 – EXECUTION

3.1 PROCUREMENT:

A. In addition to riser sections identified in the pre-cast manufacturer's clock drawings, procure an additional one each of every nominal height of 4-ft diameter base section for use as blanks when field cutting openings for pipe connections.

3.2 HANDLING:

A. Manhole sections shall not be shipped for at least five days after manufacture.

B. All manhole sections which have been damaged after delivery, and manhole sections installed in the work which are found to be damaged will be rejected and shall be removed and replaced by the Contractor with new, sound and approved material, at no additional expense to the City. At the time of inspection, the surfaces of the sections shall be dense and close-textured. Cores shall serve as a basis for rejection of manhole sections if poor bond or reinforcement is exposed.

C. Each manhole section shall be handled into its position in the trench only in such manner and by such means as recommended by the manufacturer of the

manhole sections, and as approved. Provide all necessary slings, straps and other devices for the safe and satisfactory handling and support of the manhole sections during lifting, installation and final positioning of the sections. Lifting holes may be permitted provided suitable rubber or concrete stopper or other approved devices are provided for plugging and sealing the holes and watertight, all as approved.

3.3 INSPECTION

A. All manhole sections will be inspected upon delivery; manhole sections which do not conform to specification requirements will be rejected and shall be removed immediately from the site by the Contractor at no additional cost to the City. The Contractor shall furnish all labor and facilities necessary to assist the City in inspecting the material.

B. The quality of all materials, processes of manufacture, and the finished manhole sections shall be subject to inspection and approval of the City. Such inspection may be made at the place of manufacture and/or on the site, and the manhole sections shall be subject to rejection at any time because of failure to meet any of the specification requirements, even though sample manhole sections may have been accepted as satisfactory.

3.4 INSTALLATION

A. Manhole sections shall be installed level and plumb and set on 12 inches compacted crushed stone or gravel base as indicated on the Drawings.

B. Manhole sections shall be installed using approved type neoprene "O-Ring" type gasket or butyl rubber sealants for sealing joints of manhole sections; jointing shall be performed in accordance with the pipe manufacturer's recommendations, and as approved.

C. Water shall not be permitted to rise over newly made joints until after inspection as to their acceptability. All jointing shall be done in a manner to insure watertight joints.

D. All holes in sections used for handling shall be thoroughly plugged with non-shrink grout.

E. The manhole frames shall be set with tops conforming accurately to the grade of the pavement or finished ground surface or as indicated on the drawings utilizing brick and mortar or precast concrete risers as per Section 02590 – BRICK MASONRY. Frames shall be set in a full bed of mortar so that the space between the top of the brick and mortar and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the

bottom flange. The mortar shall be smoothly finished to a height of 4-inches above the flange. Exterior surfaces of brick masonry shall be plastered with 1/2 inch of cement mortar.

F. Opening in precast manhole sections to extent indicated on the drawings to receive entering pipes shall be made at the place of the manufacturer. Where opening cannot be determined, they shall be cut in the field. Depending upon the type of pipe seals to be furnished, pipe openings shall be provided with manhole seals of proper sizes to accommodate pipe sizes and shall be cast into the manhole at the time of manufacture. When openings are made in the field, the openings for entering pipes shall be of a size to provide a uniform annular space between the outside of pipe wall and the opening in the manhole section of 3/4 inch, and after the pipe is in position the annular space shall be solidly filled with non shrink grout. Care shall be taken to assure that the openings are made to permit setting of the entering pipe at its correct elevation as indicated or directed. Openings which are cut in the manhole sections in the field shall be carefully made so as not to damage the sections; damaged sections will be rejected and shall be replaced at no additional expense to the City.

G. Manhole inverts shall be brick masonry for sewer or concrete for drain and shall have a cross-section shaped to conform to connecting pipes; changes in size shall be made gradually and evenly. Concrete and brick masonry for manhole inverts shall conform to Section 03300 – CONCRETE and Section 02590 – BRICK MASONRY, constructed as indicated and as specified.

3.5 BACKFILLING

A. Conduct backfill operations of open cut trenches closely following laying, jointing, and bedding of pipe, and after initial inspection and testing are completed, all in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING.

3.6 INSPECTION AND TESTING

A. Acceptance of precast reinforced concrete manhole sections will be made on the basis of plant tests, material tests, and inspection of the completed product, in accordance with the requirements of ASTM C478, latest revision, with the following modifications.

B. Manhole sections shall not be shipped for at least five days after manufacture when cured by subjecting them to thoroughly saturated steam at a temperature between 100 and 150° F for a period of not less than 8 hours, or when necessary, for such additional time as may be required to enable the manhole sections to meet specification requirements.

C. Leakage Tests

1. Refer to Article 51 – "Leakage Tests" in Section 00825A – SPECIAL CONDITIONS.

2. If Leakage Test method consists of visual or Close Circuit Television Inspection, the contractor shall perform at no additional cost to the City. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

3.7 CLEANING

A. All excess material including dirt, loose concrete, bricks, grit, stones and any other material, shall be removed from all manholes prior to final review by the Engineer. A final cleaning shall be performed, to include complete removal of all accumulated debris and fluids from each catch basin, upon complete project completion.

PART 4 – COMPENSATION

Item 2252.1 Type 1 Manhole Precast 4-Foot Diameter

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of 4-foot diameter precast concrete manholes complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater and proper discharge; filter fabric as required; furnishing and placement of bedding, including compaction; precast manhole sections with frames, covers, masonry chimney, appurtenances, bench, and sanitary sewer (if applicable) pipe sleeve (if applicable); furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work. Adjustment of the frame and cover to final grade, and any adjustments to intermediate grades, are included in this pay item.

METHOD OF MEASUREMENT:
Payment for Type 1 Manhole Precast 4-Foot Diameter shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional manholes as shown on the Contract Drawings or as directed by the City or Engineer. **Assume manholes to have a vertical depth of 10 feet as measured from inside bottom of**

base section to finished grade.

Manholes installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: manholes of different diameters; drop manholes of the same diameter; disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 2252.3 Type 4 Sump Manhole Precast 4-Foot Diameter

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of 4-foot diameter precast type 4 concrete manholes complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater and proper discharge; filter fabric as required; furnishing and placement of bedding, including compaction; precast manhole sections with frames, covers, masonry chimney, appurtenances, bench, and sanitary sewer (if applicable) pipe sleeve (if applicable); furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work. Adjustment of the frame and cover to final grade, and any adjustments to intermediate grades, are included in this pay item.

METHOD OF MEASUREMENT:
Payment for Type 4 Sump Manhole Precast 4-Foot Diameter Type 4 shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional manholes as shown on the Contract Drawings or as directed by the City or Engineer. **Assume manholes to have a vertical depth of 10 feet as measured from inside bottom of base section to finished grade**.

Manholes installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: manholes of different diameters; drop manholes of the same diameter; disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 2252.4 Type 1 Manhole Precast 5-Foot Diameter

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of 5-foot diameter precast concrete manholes complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater and proper discharge; filter fabric as required; furnishing and placement of bedding, including compaction; precast manhole sections with frames, covers, masonry chimney, appurtenances, bench, and sanitary sewer (if applicable) pipe sleeve (if applicable); furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work. Adjustment of the frame and cover to final grade, and any adjustments to intermediate grades, are included in this pay item.

METHOD OF MEASUREMENT:
Payment for Type 1 Manhole Precast 5-Foot Diameter shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional manholes as shown on the Contract Drawings or as directed by the City or Engineer. **Assume manholes to have a vertical depth of 8 feet as measured from inside bottom of base section to finished grade.**

Manholes installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: manholes of different diameters; drop manholes of the same diameter; disposal of bituminous concrete and construction debris; treatment of groundwater discharged

under a Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 2252.5 Type 1 Manhole Precast with Knockout Base

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of Type 1 Manhole Precast 6-Foot Diameter Precast with Knockout Base complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater and proper discharge; filter fabric as required; furnishing and placement of bedding, including compaction; precast knockout section with sand fill, precast manhole sections with frames, covers, masonry chimney, appurtenances, bench, and sanitary sewer (if applicable) pipe sleeve (if applicable); furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work. Adjustment of the frame and cover to final grade, and any adjustments to intermediate grades, are included in this pay item.

METHOD OF MEASUREMENT:
Payment for Type 1 Manhole Precast 6-Foot Diameterwith Knockout Base shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional manholes as shown on the Contract Drawings or as directed by the City or Engineer. **Assume manhole to have a vertical depth of 15 feet as measured from inside bottom of base section to finished grade**.

Manholes installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: manholes of different diameters; drop manholes of the same diameter; disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 2252.6 Type 7 Manhole Precast 3'X4'

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of rectangular 3-Foot by 4-Foot precast concrete manholes complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater and proper discharge; filter fabric as required; furnishing and placement of bedding, including compaction; precast manhole sections with frames, covers, masonry chimney, appurtenances, bench, and sanitary sewer (if applicable) pipe sleeve (if applicable); furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work. Adjustment of the frame and cover to final grade, and any adjustments to intermediate grades, are included in this pay item.

METHOD OF MEASUREMENT:
Payment for Type 7 Manhole Precast 3'X4' shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional manholes as shown on the Contract Drawings or as directed by the City or Engineer. **Assume manholes to have a vertical depth of 12 feet as measured from inside bottom of base section to finished grade**.

Manholes installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: manholes of different diameters; drop manholes of the same diameter; disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 2252.7 Type 1 Precast Drop Manhole

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of precast concrete manholes with drop pipe connections and

masonry dam complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater and proper discharge; filter fabric as required; furnishing and placement of bedding, including compaction; precast manhole sections with frames, covers, masonry chimney, appurtenances, bench, and sanitary sewer (if applicable) pipe sleeve (if applicable); masonry dam, drop pipe and appurtenances and connections, furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work. Adjustment of the frame and cover to final grade, and any adjustments to intermediate grades, are included in this pay item.

METHOD OF MEASUREMENT:
Payment for Type 1 Precast Drop Manhole shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional manholes as shown on the Contract Drawings or as directed by the City or Engineer. **Assume drop manholes to have a vertical depth of 8 feet as measured from inside bottom of base section to finished grade**.

Manholes installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: manholes of different diameters; drop manholes of the same diameter; disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 2252.8 Existing Drainage or Sewer Structure Adjusted

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and inspection of adjusted frame and cover on existing manhole(s) complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; protection of existing

manhole; adjusting castings; masonry chimney; bituminous damp proofing (if applicable); furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Existing Drainage or Sewer Structure Adjusted shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional, manholes frames and covers adjusted as shown on the Contract Drawings or as directed by the City or Engineer.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; procurement, installation, and compaction of CDF; frames and cover for proposed manholes; adjusting castings for paving.

Item 2252.9 Manhole – Remove and Replace Existing Frame and Cover

BASIS OF PAYMENT/INCLUSIONS:
Payment for Manhole Frame and Cover Replacement shall be based on the number of individual installations completed for this item in the proposal. Under the per each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required. The work includes, but is not limited to; saw cutting existing bituminous or cement concrete; excavation; furnishing and placing backfill per one of the approved methods; compaction and compaction testing; temporary excavation support; install new frame and cover; remove and salvage or dispose existing castings as directed; removing and replacing brick and mortar to an extent to facilitate lowering of the roadway; field repair with high-strength grout; and any incidental work not included for payment elsewhere.

METHOD OF MEASUREMENT:
Payment for Manhole – Remove and Replace Existing Frame and Cover shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional manhole frame and covers removed and replaced as shown on the Contract Drawings or as directed by the City or Engineer.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged under the DEP Dewatering Permit; procurement of off-site common fill; procurement, installation, compaction of CDF; removal and replacement of existing catch basin frame and covers; and removal of existing manholes or catch basins included elsewhere.

Item 2252.10 Existing Drainage or Sewer Structure Remodeled

BASIS OF PAYMENT/INCLUSIONS:
Payment for Existing Drainage or Sewer Structure Remodeled shall be based on the number of individual installations completed for this item in the proposal. Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and inspection of adjusted frame and cover on existing manhole(s) complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; protection of existing manhole; adjusting castings; masonry chimney; bituminous damp proofing (if applicable); furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Existing Drainage or Sewer Structure Remodeled shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional, manholes frames and covers remodeled as shown on the Contract Drawings or as directed by the City or Engineer.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; procurement, installation, and compaction of CDF; frames and cover for proposed manholes; adjusting castings for paving.

END OF SECTION 02252

SECTION 02310

FINE GRADING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Fine Grading including, but not limited to, the following:

1. Fine Grading.

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02901 – Planting Soils
3. Section 02930 – Planting
4. Section 02970 – Landscape Maintenance

1.3 REFERENCES

A. Comply with applicable requirements of:

1. Commonwealth of Massachusetts, Standard Specifications for Highways and Bridges, Department of Public Works, latest edition.

1.4 EXAMINATION OF SITE AND DOCUMENTS

A. Contractor responsible for judging extent of work requirements involved. By submitting bid, Contractor affirms he has carefully examined the site and conditions affecting work.

1.5 PERMITS AND CODES

A. Work shall conform to Contract Documents and comply with applicable codes and regulations.

B. Comply with rules, regulations, laws and ordinances of City of Cambridge, of the Commonwealth of Massachusetts and other authorities having jurisdiction.

C. Arrange for and obtain permits and licenses required to complete Work. Fees not waived shall be paid by Contractor.

D. Do not close or obstruct streets, sidewalks, alleys or passageways without prior notification and permission. Conduct operations to minimize interference with use of roads, driveways, alleys, sidewalks, or other facilities near enough to Work to be affected.

1.6 QUALITY ASSURANCE

A. Qualifications: Contractor shall have minimum five years experience in fine grading.

B. Pre-Installation Conference: Contractor shall convene a meeting with Engineer present prior to start of fine grading.

1.7 PROJECT/SITE CONDITIONS

A. Environmental Requirements: do not deliver, handle or place soils when dry, wet, or frozen.

1. Field Test

a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, soil may be worked.

b. If the soil will not retain shape it is too dry and should not be worked.

c. If the soil retains shape and will not crumble, it is too wet and should not be worked.

1.8 SEQUENCING AND SCHEDULING

A. Fine Grading

1. Finish grade after soil preparation is accepted and prior to planting.

PART 2 MATERIALS

2.1 SOILS

A. See Section 02901 – Planting Soils

2.2 EQUIPMENT

A. Fine Grading: Grading Tractor or other approved equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: in the event field conditions are not in conformance with the Contact Documents, notify Owner's Representative in writing.

1. Spot and Invert Elevations: verify field elevations of site improvements such as drainage and utility fixtures, pavements, curbs, subsurface piping, etc. conform to Drawings.

3.2 PREPARATION

A. Protection:

1. Prior to fine grading operations, field locate and protect from damage site improvements such as drainage and utility fixtures, pavements, site furnishings, curbs, etc.

2. Dust Control: upon acceptance of soil preparation provide dust control.

3. Agricultural Chemicals: protect site improvements from contact with agricultural chemicals, soil amendments, and fertilizers.

4. Protect benchmarks.

3.3 FINISH GRADING

A. Subgrade: top of subgrade to be parallel to finish grade and of uniform depth with the finish grade.

B. Positive Drainage: provide free and uninterrupted flow of surface waters without erosion.

C. Gradients: finish grade between spot elevations and between contours shall be constant. Eliminate mounds and depressions.

D. Slope: finish grade shall be smooth with gradual transitions between top and bottom of slopes.

E. Tolerances: +0.05' to -0.05' of grades shown on the drawings.

F. Contours: follow contours shown on drawings to shape and trim the soil surface.

G. Maintain levels, profiles, and contours of rough grades.

H. Removal: clear stones, roots, weeds, and debris while grading landscape soil materials. Rake surface clean of stones 1" or larger and debris.

3.4 FIELD QUALITY CONTROL

A. Notify Engineer upon completion of fine grading. Engineer shall review the work for conformance to Contract Documents and if the work is approved, subsequent lawn and planting work shall proceed.

B. Soil compaction at moisture content near field capacity based on measurements with a CL 700 pocket penetrometer shall not exceed 2.5 tons per square foot.

3.5 ADJUSTING

A. Repair and re-establish grades in settled, eroded, and damaged areas.

B. Where completed areas are disturbed by construction operations or adverse weather, and regrade.

3.6 CLEANING

A. Clean up debris generated under work of this section.

B. Site Improvements

1. Wash and sweep clean site improvements such a as drainage and utility fixtures, pavements, existing plantings, and site furnishings.

3.7 PROTECTION

A. Protect work of this section until Final Acceptance.

B. Protect prepared soils from compaction by construction traffic and from contamination by construction materials.

PART 4 COMPENSATION

METHOD OF MEASUREMENT
Separate measurement will not be made for the work of this Section complete in place, but all costs, therefore, shall be included in the work of other sections. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the work of other sections.

BASIS OF PAYMENT / INCLUSIONS
Separate Payment will not be made for the work of this Section complete in place, but all costs, therefore shall be included in the work of other sections. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the work of other sections.

END OF SECTION

SECTION 02456

HELICAL PILES

2456.1	MOBILIZATION/DEMOBILIZATION	LS
2456.2	**HELICAL PILE**	**EA**

PART 1 GENERAL

1.01 SUMMARY

A. The design locations of the piles are shown on the contract drawings. The helical pile foundation system will be used to support the Green Street Shelter, Art foundation, and just the mainline drainage and sewer work. The foundations will not be needed for catch basin or laterals.

B. Provide all plant, labor, materials, equipment, and services for the complete design and installation of helical piles as specified herein. The Contractor will be responsible for furnishing piles of sufficient length to obtain the required bearing capacity. The helical piles shall be designed and installed to bear in the sand or clay layer below the fill and organic soils, with a minimum design bearing capacity of:

1. Mainline drainage and sewer support: 10 kips per pile.
2. Art Foundations: 3.8 kips per pile.
3. Green Street Shelter: axial service compression load of 25 kips and a service moment of 10 kip*ft.

C. The work includes, but is not limited to, the following:

1. Providing final design and shop drawings for helical piles.
2. Fabricating and delivering piles in accordance with approved shop drawings.
3. Installing the piles to the required torque resistance, as determined by the Contractor's design engineer, and the minimum required depth indicated on the contract drawings.
4. Cutting off piles at the elevations shown on the contract drawings and disposing of cutoff portions.

1.02 REFERENCES

A. Without limiting the generality of other requirements of these specifications, perform all work in accordance with the requirements of the *Massachusetts State Building Code* and the requirements of the other referenced documents to the extent that the provisions of such other documents are not in conflict with the requirements of said Code.

B. ASTM: Specifications of the American Society for Testing and Materials.

1.03 CONTRACTOR SUBMITTALS

A. Shop Drawings and Design Calculations - Submit to Engineer at least three weeks before installing any piles. Design shall be performed by and shop drawings shall be stamped by a Professional Engineer registered in the Commonwealth of Massachusetts. Shop drawings shall include:

1. Type and size of central steel shaft. Select the helical pile shafts to provide a torque capacity at least 50 percent greater than the calculated torque needed to obtain the required bearing capacity.

2. Helix details and configuration (number, diameter and spacing of helical plates).

3. Helical pile bridge details over existing MWRA utility infrastructure.

4. Connection details and details of the pipe supports at top of pile.

5. Minimum installation depth required to ensure that all helices bear in the natural soils below the organic soils and fill.

6. Design bearing calculations using a design safety factor of 3.0 applied to the calculated ultimate bearing capacity. The safety factor need not be applied to the design moment.

7. Minimum final field installation torque resistance. During construction, the final installation torque resistance shall not be less than the value required for a safety factor of 2.0 on the ultimate bearing capacity determined using the following correlation (Perko, 2009):

$$Q_u = \frac{22T}{d^{0.92}}$$

Where, Q_u = Ultimate bearing capacity (lbs)

T = torque resistance (ft-lbs)

d = pile shaft diameter or diameter of a circle circumscribed around a square shaft (inch)

8. The helical piles used for the foundation of the Green Street Shelter shall be designed for an axial service compression load of 25 kips and a service moment of 10 kip*ft.

B. Detailed description of the pile and bridge installation procedures, including minimum installation torque.

C. Manufacturer's literature for installation equipment.

D. Standard mill test reports shall be submitted to the Engineer in advance of shipment of any steel elements. Separate reports shall be submitted for each batch of steel represented in the structure. Reports shall cover test results indicating compliance with the chemical and physical requirements of ASTM A588.

E. Calibration reports for each torque indicator to be used on the project shall be submitted to the Engineer before installing any piles. The calibration tests shall have been performed within 3 months of the date submitted. These calibration reports shall include, but are not limited to, the following information:

1. Name of testing agency.

2. Identification (serial number) of device calibrated.

3. Description of calibrated testing equipment.

4. Date of calibration.

5. Calibration data.

F. As-Installed Pile Data:

1. Final as-installed pile location plan. Show locations of the centers of as-installed piles on a drawing in relation to the design location and submit to the Engineer within five days after the pile is installed. Include the following on the drawings:

a. Each pile identified by a separate number.

b. Elevation of top of each pile, prior to cutting, to nearest 0.1 foot.

c. Elevation of tip of each pile to nearest 0.1 foot.

d. Deviation from plan location in inches, measured to nearest ½ inch.

2. Pile installation records for each pile as the work progresses, as described in this specification.

3. As-installed plans and records for any piles that are placed beyond the specified tolerances shall be provided as work progresses so that other pile locations can be adjusted for a balanced pile group.

G. The details for the helical pile and bridge designs in the plan set are for bidding purposes only. Final design may be subject to MWRA review and approval for work withing five feet of MWRA infrastructure.

1.04 DELIVERY, STORAGE AND HANDLING

A. All products shall be handled and transported carefully to prevent any deformation or damage. Care should be taken to prevent the accumulation of dirt, mud, or other foreign matter on the steel materials. Such accumulation shall be completely removed prior to installation.

1.05 EXAMINATION OF SITE

A. Inspect the site personally to evaluate the conditions affecting the work. No claim for additional costs will be allowed because of lack of knowledge of any existing conditions discernible from observation at the site, adjoining properties, and available sources of information.

1.06 SUBSURFACE CONDITIONS

A. The results of subsurface exploration programs and subsurface utility data provided included in the Appendices.

B. The subsurface information was obtained primarily for use in evaluating subsurface conditions and preparing geotechnical recommendations. Interpretation of the subsurface data for purposes of the work of the Contract shall be the sole responsibility of the Contractor. The Contractor should note that the subsurface data pertains only to the conditions at the exploration locations at the time of the explorations.

1.07 INSPECTION

A. Observation of pile and bridge installation operations will be performed by the Engineer. Install no piles or bridge except in the presence of the Engineer. Provide notice to Engineer at least two business days before commencing pile installation work.

B. Approvals given by the Engineer shall not relieve the Contractor of responsibility for performing the work in accordance with the plans and specifications.

1.08 TOLERANCES AND CRITERIA FOR ACCEPTANCE

A. Install piles as close as practicable to the plan location. A maximum lateral deviation from the correct location at cutoff elevation equal to 3 inches will be permitted. A maximum deviation from design cutoff elevation equal to 1 inch will be permitted. Piles shall be installed to within 2 degrees of design alignment. Pulling piles into position will not be permitted.

B. When otherwise acceptably installed piles exceed the specified tolerances and are subject to eccentric loading, the Engineer will then analytically determine the total loads on individual piles. If the load on any pile exceeds 110 percent of the specified load capacity, corrections shall be made in accordance with a design provided by the Engineer at no additional cost to the City. The cost of analysis and redesign of the pile cap shall be charged to the Contractor.

PART 2 PRODUCTS

2.01 HELICAL PILES

A. All steel shall conform to an appropriate ASTM standard specified by the pile designer.

B. Provide hot dip galvanizing on all surfaces of the piles.

C. The central shaft shall consist of round pipe or tube sections with bolted couplers.

D. Helices shall be welded to the lead (bottom) section of the shaft with a pitch and spacing designed to screw into the soil without auguring.

E. The tip of the lead section shall be beveled to aid in advancing the pile.

F. All pile components shall be hot dip galvanized per ASTM A153 with a minimum coating thickness of 3 mils.

PART 3 EXECUTION

3.01 INSTALLATION EQUIPMENT

A. Shall be rotary type, hydraulic power-driven torque motor with clockwise and counter-clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's) during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.

B. Equipment shall be capable of applying adequate down pressure (crowd) and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment to maintain proper pile alignment.

C. A torque indicator shall be used during pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. The torque indicator:

1. Shall be capable of providing continuous measurement of applied torque throughout the installation.

2. Shall be capable of torque measurements in increments of at least 500 ft-lb.

3. Shall be re-calibrated, if in the opinion of the Engineer and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

3.02 PILE INSTALLATION

A. Prior to positioning and initiation of pile placement, all locations are to be pre-excavated and vacuumed to a depth clear of the utility impact. Once confirmed, initiation of pile placement may commence.

B. The lead section shall be positioned at the location as shown on the contract drawings. Battered piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required batter angle shall be established. The pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 20 RPM's. Extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the shop drawings.

C. Sufficient down pressure shall be applied to uniformly advance the pile sections approximately 3 inches per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.

D. Install the piles to a depth where all of the helices are below the bottom of the organic soils.

3.03 TERMINATION CRITERIA

A. The torque as measured during the installation shall not exceed the allowable torsional strength rating of the central steel shaft.

B. The criteria for minimum installation torque, as shown on the shop drawings, and minimum overall length, as shown on the contract drawings, shall be satisfied prior to terminating the pile.

C. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:

1. Terminate the installation at the depth obtained subject to the review and acceptance of the Engineer, or

2. Remove the existing pile and install a new one with fewer and/or smaller diameter helical plates. The new helix configuration shall be subject to review and acceptance of the Engineer.

D. If the minimum installation torque as shown on the shop drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:

1. Install the pile deeper using additional extension sections or displacement plates.
2. Remove the existing pile and install a new one with additional and/or larger diameter helical plates. The new helix configuration shall be subject to review and acceptance of the Engineer.
3. If acceptable to the Engineer, assign a reduced capacity to the pile based on the installation torque resistance that was achieved and supplement with additional piles.

E. The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the shop drawings. The average torque shall be defined as the average of the last three readings recorded at one-foot intervals.

3.04 OBSTRUCTIONS

A. If the pile is refused or deflected by a subsurface obstruction, the installation shall be terminated, and the pile removed. The obstruction shall be removed, if feasible, and the pile re-installed. If obstruction can't be removed, the pile shall be installed at an adjacent location, subject to prior review and acceptance of the Engineer.

B. If the Engineer determines that additional piles are required due to relocation required by obstructions, the Contractor will be reimbursed for the additional piles ordered by the Engineer.

3.05 TRIMMING FINAL EXTENSION SECTION:

A. After installation to the required depth, the top of the pile shall be cut to the specified elevation.

B. Cut off the tops of all piles square within 1 inch of the elevations shown on the Drawings. The pile cutoffs shall become the property of the Contractor, who shall remove them from the site.

C. Install Pile Top Bearing Plates at the tops of the cut-off piles as shown on the shop drawings.

3.06 DOCUMENTATION

A. Keep a record, independent of that which may be made by the Engineer, of all pertinent data relative to the installation of each pile. The record for each pile shall include:

1. Name of project and Contractor.
2. Date and time of installation.
3. Name and model of installation equipment.
4. Type of torque indicator used and calibration documentation.
5. Location of pile by assigned identification number.

6. Actual pile type and configuration – including lead section (number and size of helical plates), number and type of extension sections (manufacturer's SKU numbers).

7. Pile installation duration and observations.

8. Total length of installed pile.

9. Tip and cut-off elevations.

10. Inclination of pile.

11. Installation torque at one-foot intervals for the final 10 feet.

12. Comments pertaining to interruptions, obstructions, unusual behavior, or other relevant information.

13. Rated load capacities.

3.07 DEFECTIVE, DAMAGED, AND MISINSTALLED PILES

A. Piles damaged due to internal defects or improper installation or lack of strength will not be accepted. Such defective and damaged piles, as well as piles installed out of proper location or in excess of the tolerances specified, shall be abandoned, and shall be replaced by additional piles which shall be installed adjacent thereto, all as directed by the Engineer and at no additional cost to the City.

B. At the option of the Engineer, measures for correcting any deficient pile shall consist of one of the following without any additional compensation.

1. Completely removing the defective pile and installing a new pile.

2. Abandoning the defective pile and installing additional piles. The abandoned pile shall be cut 3 feet below the given cutoff elevation.

3. Modification of pile caps.

PART 4 MEASUREMENT AND PAYMENT

4.01 BASIS OF PAYMENT

A. Mobilization and demobilization will be paid for at the contract lump sum price for Mobilization/Demobilization.

B. Piles will be paid for at the contract unit price per pile, complete in place, which shall include all labor, equipment, installation including bridging, all materials, cutoff, transportation, and such other appliances, equipment, materials, and labor not otherwise provided for, that may be required to execute the work properly in accordance with these specifications.

4.02 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
2456.1	MOBILIZATION/DEMOBILIZATION	LS
2456.2	HELICAL PILE	EA

END OF SECTION

SECTION 02500

PAVING AND SURFACING

2500.1	**TEMPORARY HOT MIX ASPHALT (TRENCH WIDTH AND TEMPORARY RAMPS)**	**TON**
2500.2	**HOT MIX ASPHALT BASE COURSE – FULL WIDTH**	**TON**
2500.3	**HOT MIX ASPHALT INTERMEDIATE COURSE – FULL WIDTH**	**TON**
2500.4	**HOT MIX ASPHALT TOP COURSE – FULL WIDTH**	**TON**
2500.5	**HAND PLACED HOT MIX ASPHALT**	**TON**
2500.6	**COLD PLANE 2-IN, FULL WIDTH**	**SQUARE YARD**
2500.7	**FINE GRADING AND COMPACTING**	**SQUARE YARD**
2500.8	**HOT POURED RUBBERIZED ASPHALT SEALING**	**LINEAR FOOT**
2500.9	**HOT MIX ASPHALT INFRARED ASPHALT SEALING**	**LINEAR FOOT**

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes the following:

1. Removal of existing bituminous pavementby cold planing.

2. Installation of temporary pavement.

3. Installation of permanent trench and full-width pavement.

B. Furnish and install paving on all areas as indicated and specified.

C. Pavement and surfacing shall be constructed in courses as shown on the plans and as required in accordance with these specifications and in close conformity with the lines, grades, compacted thickness and cross sections shown on the plans.

D. The Contractor shall take all reasonable measures to assure proper drainage on the final surface of the roadway. Pavement that does not drain properly due to poor workmanship shall not be accepted by the City and shall be replaced by the Contractor at no additional cost to the City.

E. Where required by the Engineer, the roadway surface shall be repaired by the infrared method. The repairs shall include the cleaning of the area, infrared heating, the addition of recycling agent and additional hot mix asphalt as required, raking to grade, compacting, and the addition of rejuvenating sealer with sand cover. The work shall be done in accordance with these Specifications and/or as required by the Engineer.

F. Roadway restoration shall not proceed prior to acceptance of CCTV and testing of subsurface infrastructure by the Engineer and City.

1.2 RELATED WORK

A. Division 1 – General Requirements

B. Section 01200 – GENERAL REQUIREMENTS FOR UTILITY WORK

C. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

D. Section 02524 – CURBS, WALKS AND DRIVEWAYS

E. Section 02577 – PAVEMENT MARKINGS

F. Section 03300 – CONCRETE

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Reference is made herein to the MassDOT Highway Division, Standard Specifications for Highways and Bridges, latest edition, and all addendums/supplemental specs hereinafter referred to as the "Standard Specifications." All references to method of measurement, basis of payment, and payment items in the Standard Specifications are hereby deleted. References made to particular sections or paragraphs in the Standard Specifications shall include all related articles mentioned therein.

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with the General Conditions of Contract and Section 01300 – SUBMITTALS:

1. Product Data: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

2. Design Data: Submit design mix for asphalt base, intermediate and surface course.

1.4 GRADE CONTROL

A. Establish and maintain required lines and elevations.

1.5 QUALITY CONTROL

A. Provide in accordance with Section 01400 and as specified.

B. The Engineer may require the Contractor to remove at their own expense, any defective mix not conforming to the specified job mix formula within the stipulated tolerances. Samples of the actual mixture in use will be taken as many times daily as necessary and the mixtures shall be maintained uniform for the project. The Engineer may suspend further approval for use of the Plant mixtures if the mixtures do not conform to the specified requirements.

C. Do not place materials when underlying surface is muddy, frozen, or has frost, snow, or water thereon.

1.6 PROJECT SITE CONDITIONS/PROJECT DESCRIPTION

In general, the following pavement repairs shall be made:

1. In areas where test pits or exploratory excavations occur, locations of temporary pavement, or where the road is to be reconstructed by others, a 4-inch temporary pavement is to be placed. When, and if, this material is disturbed during additional excavation work required for utility installation it shall be replaced. Excavations related to these activities shall be paved with temporary pavement on a weekly basis.

2. All road and streets shall be temporarily paved on a weekly basis.

3. Temporary driveway aprons and waterways shall be paved as part of the work.

4. The paving thicknesses specified above may be increased based on permit or field requirements.

5. Contractor to repair all potholes in project area once project commences. Payment for repair of potholes shall be considered incidental.

1.7 SEQUENCING AND SCHEDULING

A. All roadway excavated areas shall be paved weekly with temporary trench pavement as specified. Paving on a weekly basis will be required unless permission not to do so is received from the applicable permit agency and City. Contractor shall pave any uneven surfaces at the end of each week. Temporary pavement shall be maintained a minimum of 90 days in local streets. The temporary pavement shall be repaired as necessary to maintain the surface of the pavement until replaced by permanent pavement.

B. The Contractor shall provide temporary markings on the temporary pavements where existing markings are removed, at no additional cost to the City.

C. Use of steel plates require the Contractor to notify the City. If approved, steel plates shall be recessed into the roadway and welded as required.

1.8 GUARANTEE

A. During the one-year guarantee period, the Contractor shall maintain the surfacing and shall promptly fill with similar material in compliance with the Specifications, any depressions and holes that may occur so as to keep the surfacing in a safe and satisfactory condition for traffic.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Subbase

1. Materials including preparation of subgrades shall meet the requirements of the applicable sections of the Specifications, including Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

2. The trench subbase shall be used in the upper 1-foot of trench backfill material immediately below pavements and graded in accordance with MassDOT Highway Division "Standard Specifications" Section M1.03.1 and applicable subsections of Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Hot Mix Asphalt Pavement – Base Course

1. Asphalt Base Course and Asphalt Tack Coat shall conform to the applicable subsections of Section 460, Hot Mix Asphalt Pavement for Local Streets, of the MassDOT Highway Division's "Standard Specifications".

2. Tack coat shall be RS-1 emulsion.

C. Hot Mix Asphalt Pavement – Intermediate Course

1. Asphalt Intermediate Course shall conform to the applicable subsections of Section 460, Hot Mix Asphalt Pavement for Local Streets, of the MassDOT Highway Division's "Standard Specifications."

D. Hot Mix Asphalt Pavement – Surface Course

1. Asphalt Surface Course shall conform to the applicable subsections of Section 460, Hot Mix Asphalt Pavement for Local Streets, of the MassDOT Highway Division's "Standard Specifications."

E. Hot Poured Rubberized Asphalt Sealer

1. Hot Poured Rubberized Asphalt shall meet the requirements of ASTM D6690 Type II and products shall be evaluated by the NTPEP as an HMA Crack Sealer (CS) and be listed on the MassDOT Qualified Construction Materials List (QCML) as required in Section 460, Hot Mix Asphalt Pavement for Local Streets, of the MassDOT Highway Division's "Standard Specifications."

PART 3 – EXECUTION

3.1 GENERAL

A. Pavement depths shall be as shown on the drawings or as specified herein.

3.2 TRANSPORTATION AND DELIVERY OF MIXTURES

A. The mixtures shall be transported from the plant to the work in vehicles previously cleaned of all foreign materials. During transportation of the mixture from the plant to the spreader on the work, each load shall be covered at all times, without exception, with canvas or other suitable material of sufficient size and thickness to furnish complete protection. The mixture shall not be transported such a distance that segregation of the ingredients takes place or that any crust is formed on the surface, bottom or sides of said mixture which will not crumble or flatten out when the mixture is dumped or shall otherwise be deleterious to the mixture in place on the roadway.

B. The vehicles for transporting shall be cleaned between uses of transportation of asphalt and soil.

C. The vehicles for transporting the mixture shall be tight and inside of the bodies shall be evenly and lightly coated with suitable thin oil or approved soap solution, but no excess of lubricant shall be allowed to accumulate in low spots in the body.

D. During paving operations, the Contractor shall provide continuous radio communication between the plant and the project to ensure immediate response due to breakdowns, emergencies such as accidents, and to insure the best quality results possible.

E. When necessary, proper insulation of the vehicles transporting the mixture shall be made to ensure that the mixture is delivered for pacing at the proper temperature.

F. The dispatching of trucks from the plant shall be so arranged that all material which is to be delivered at or on the road surface during any day may be placed and shall have received final compaction before nightfall of the same day; unless artificial light, satisfactory to the Engineer is provided.

G. The temperature of the mixture, within a tolerance plus or minus 15°, when delivered at the project site will be governed by the temperature of the base upon which the mix is placed as follows:

Base Temp °F on Which Mix is Placed	MAT THICKNESS					
	1/2”	3/4”	1”	1-1/2”	2”	3” or Greater
35-40				305	295	280
40-50			310	300	285	275
50-60		310	300	295	280	270
60-70	310	300	290	285	275	265
70-80	300	290	285	280	270	265
80-90	290	280	275	270	265	260
90+	290	275	270	265	260	255

3.3 SUBGRADE PREPARATION AND PROTECTION

A. Bring subgrade to required grade as necessary, including dynamic compaction, prior to placing subbase material.

B. As required by the Engineer, over-excavate on-site fill material and any unacceptable materials below the subgrade. Utilize excavating equipment equipped with a toothless or smooth edged, excavating bucket to expose the on-site fill material and unacceptable materials to avoid disturbance of the bearing surface.

C. Proof roll the overexcavated subgrade prior to placing crushed stone.

D. Prepare subgrade in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

E. Stabilize grades in accordance with Section 02210 so that loaded construction vehicles do not cause rutting or displacement when depositing materials.

3.4 PLACEMENT OF SUBBASE

A. Do not begin placement of subbase and paving work until deficient subgrade areas have been corrected and are ready to receive paving.

B. Subbase under roadway shall be installed and compacted as covered in the Contract Drawings and in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. The subbase to be placed under pavement shall be a minimum thickness as indicated on the Contract Documents after compaction. Subbase shall be evenly spread and thoroughly compacted in accordance with the Contract Documents.

D. The subbase shall be spread in layers with thickness indicated on the Contract Documents. All layers shall be compacted to not less than 95 percent of the maximum dry density of the material as determined by ASTM D1557 Method C at optimum moisture content.

E. Complete subbase preparation, including dynamic compaction, for full width before placing surfacing materials.

3.5 HOT MIX ASPHALT BASE COURSE

A. Weather Limitations

1. Apply prime and tack coats when ambient temperature is above 50 deg.F (10 deg.C), and when temperature has not been below 35 deg.F (1 deg.C) for 12 hours immediately prior to application. Do not apply when subbase is wet or contains an excess of moisture.

2. Base course pavement for temporary pavement may be placed when air temperature is above 30 deg.F (-1 deg.C) and rising.

B. Placement

1. Base course shall be spread and compacted to a finished thickness indicated on the Contract Drawings. A smooth even surface shall be produced.

2. Base course placement for temporary paving and trench paving shall

be performed on a weekly basis or as otherwise approved by the City and Engineer. Cold Patch for temporary pavement shall not be allowed with the exception of in an emergency or to cover steel road plate edges.

3. Base course placed as temporary paving shall be maintained until removed prior to final paving.

3.6 HOT MIX ASPHALT SURFACE COURSE

A. Weather Limitations

1. Construct asphalt surface course when atmospheric temperature is above 40 deg.F (4 deg.C) and when base is dry.

B. Placement

1. Surface course shall be spread and compacted, to the width required in the Contract Documents and to a finished thickness indicated in the Contract Documents. A smooth, even surface shall be produced. Full width overlays shall be installed after the street has been cold planed or as approved by the City and Engineer. Compact and finish pavement to provide a smooth transition between new and existing surfaces.

a. Prior to placement of the surface course, the entire surface which the surface course is to be placed shall be broom cleaned and tack coated.

b. Apply tack coat at a rate of 0.05 to 0.10 gallons per square yard over the base and intermediate courses. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

C. Placing Mix

1. Place hot mix asphalt mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225 deg.F (107 deg.C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness. Protect all adjacent construction from staining with mix or damage by mechanical equipment. Clean, repair or replace any construction stained or damaged at no additional cost to the City.

2. Place pavement in strips not less than 2-feet wide, unless otherwise acceptable to Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.

3. The Contractor shall supply an approved Dial Type Asphalt Thermometer (Range 10º C to 260º C) for each paving machine in

operation on the project. The thermometer shall remain the property of the Contractor upon completion of the project.

D. Rolling

1. Begin rolling when mixture will bear roller weight without excessive displacement. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

2. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

3. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

4. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density. Final rolling of the pavement shall be performed by a steel wheel roller weighing not less than 285 pounds per inch width of tread at a mix temperature and time sufficient to allow for final smoothing of the surface and thorough compaction.

5. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot mix asphalt. Compact by rolling to match the surrounding surface density and smoothness.

6. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked by wheel traffic. Repair damages or other irregularities to satisfaction of Engineer, at no additional cost to the City, before final acceptance by the Engineer.

7. The Contractor shall furnish and install paving to provide transition or aprons for driveway and walkways impacted by new pavement installation.

E. Existing Pavement/Joints

1. The edges of existing pavement, which are to remain, shall be saw cut to even, straight edges. This includes road and trench edges. Any joints at junction of old and new pavements shall be sealed with an asphalt emulsion and covered with sand.

2. Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of asphalt course. Clean contact surfaces and apply tack coat.

F. Compaction

1. The asphalt mixture shall be compacted to at least 95% of the density achieved on the laboratory testing of the design mix for the project. Density will be checked by the Nuclear Density Gage Method, ASTM D2950. Testing shall be completed by Contractor at no expense to City for every 200 square yards of surface area placed.

G. Field Quality Control

1. Thickness: Test in-place asphalt courses for compliance with requirements for thickness. Repair or remove and replace unacceptable paving as required by Engineer, and at no additional cost to the City. In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

a.Base or Intermediate Course: 1/4-inch, plus or minus.

b. Surface Course: 1/4-inch, plus or minus.

H. Crack Sealing

1. Crack sealing shall be performed where required by the Engineer with modified asphalts (e.g. hot poured rubberized asphalt sealer). Prior to sealing a crack all compressible material shall be removed by high-pressure air or routing. If grass or vegetation is present in the crack the Contractor shall inject a liquid herbicide to prevent future growth. For small hairline cracks, an asphalt slurry mixture type SS-1, SS-1h shall be squeegeed over the surface and forced in the cracks. The slurry shall be maintained at a significant fluidity to be able to flow into the hairline cracks. Sealing of cracks shall be considered to be complete upon review and approval by the Engineer.

I. Liquid Asphalt Emulsion

1. Liquid Asphalt Emulsion shall be applied prior to installation of asphalt as incidental to all pavement pay items. Emulsion shall be AC-20 conforming to AASHTO M226 and shall be applied at a temperature over 100 degrees F by an emulsion truck.

2. The emulsion truck shall have pneumatic tires of such width and number that the load produced on the surface shall not exceed 672 lbs/in of tire width, and it shall be designed, equipped, and operated so that at an even heat the emulsion may be applied uniformly on variable

widths of surface at a readily controlled rate of 1/20 gal/square yard or as required by the Engineer.

3. The emulsion shall be applied within a pressure range of 25 psi to 75 psi. Distributor equipment shall include a tachometer, pressure gauges, volume-measuring devices, and a thermometer for reading the temperature of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

3.7 RAISING AND ADJUSTING CASTINGS

A. Prior to base course or surface course paving, all existing or recently installed City owned catch basin and manhole castings and curb and valve boxes shall be raised, if necessary, to the proper grade by the Contractor. The Contractor shall replace all gate valve boxes which are adjusted with boxes meeting the City standards unless the City agrees that the salvaged box is acceptable for reuse.

B. Castings owned by private utilities shall be raised by the responsible utility. The Contractor shall be responsible for coordinating this work. **Note: The Contractor shall provide gas utility owners with sufficient advance notice of paving, such that gas castings can be raised to grade within 24 hours of the completion of paving. In no cases shall gas castings remain inaccessible for more than 24 hours.**

C. The method of adjusting catch basin and manhole castings shall be as follows: Cut around catch basin or manhole castings a minimum of 8 inches from casting. Excavate and, if required, rebuild up to 12 inches of masonry below the bottom of the casting. Backfill with suitable material and compact to bottom of casting. Place high, early strength cement concrete or hot mix asphalt collar, as required by the Authority, to approximately 1½ inches below the raised casting grade. Masonry work shall conform to Section 02252 - MANHOLES and Section 02590 – BRICK MASONRY.

D. The method of raising curb and valve boxes shall be as follows: Cut around valve box a minimum of 8 inches from valve box. Excavate as required and raise the valve box. Pour high early strength cement concrete or hot mix asphalt collar, as required, to approximately 1½ inches below the top of the valve box.

E. Castings which need to be raised or adjusted to complete final surface course full-width paving shall be done immediately prior to paving.

3.8 EXCAVATION BY COLD PLANING

A. The Contractor shall cold plane 2 inches as transitions onto the adjoining streets, and to the limits as established on the Plans. Cold planing shall be done after all excavation affecting the area is complete and prior to final paving.

B. The Cold Planer shall be equipped with an elevating device capable of loading planed material directly into dump trucks while operative. The Cold Planer shall further have all necessary safety devices such as reflectors, headlights, taillights, flashing lights, and back-up signals so as to operate safely in traffic, both in the day or at night. The Cold Planer shall be designed and built for planing flexible pavements and possess the ability to plane cement concrete patches when encountered in bituminous pavement. The Cold Planer shall be self-propelled and have the means for planing without tearing or gouging the underlying surface. The Cold Planer shall be adjustable as to crown and depth and shall meet the standards of the Air Quality Act for noise and air pollution.

C. Variable lacing patterns shall be provided to permit a rough grooved surface as directed. A 2-inch cut is required in one (1) pass. The minimum width of pavement planed in each pass shall be 6-feet, except in areas to be trimmed and edged.

D. The milled or planed surface shall conform generally to the existing grade and cross slope. The surface shall not be torn, gouged, shoved, broken or excessively grooved. It shall be free of imperfections in workmanship that prevent resurfacing after this operation. Excess material shall be swept and removed so that the surface is acceptable to traffic.

3.9 HOT MIX ASPHALT INFRARED PAVEMENT SEALING

A. Area to be repaired shall be swept clean to remove loose and foreign materials.

B. An approved infrared heater shall be positioned over the area to be repaired for a period of time required to soften the existing pavement to a depth of two or more inches. Oxidation of the pavement caused by improper heating techniques shall be avoided. If this condition occurs, the oxidized pavement material shall be considered a defective material, and shall be disposed of and replaced in accordance with Article 16 and Article 20 of Section 00825 – SPECIAL CONDITIONS.

C. The softened area shall have a minimum cutback of one foot on all sides of the excavation. The area shall then be scarified and sprayed with a liquid asphalt emulsion approved by the engineer, and raked to a workable condition.

D. For trenches longer than 20 linear feet with jogs within 50 feet of each other, the contractor shall have a minimum cutback of one foot. The cutback shall be cut in a straight line consistent and equidistant from the opposite outside extremity of the one foot cutback trench line.

E. For street crossings, no jogs are allowed. A one-foot cutback on each side from the widest section of the crossing, and uniform width throughout is required.

F. Any additional hot mix asphalt required, shall be obtained from an engineer approved solid metallic heated asphalt storage unit. No hot mix asphalt, with a temperature of under 200 degrees F, shall be used.

G. After the paving mixture has been properly admixed and raked to grade, compaction with a steel wheeled roller shall be required to establish a uniform density consistent to that of the adjacent surface within the work area. The finished patch shall be level with no depression retaining water on any of its surface.

PART 4 – COMPENSATION

Item 2500.1 --- Temporary Hot Mix Asphalt – (Trench Width and Temporary Ramps)

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt – (Trench Width and Temporary Ramps) shall be based on the tons of base course placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and trench or ramp widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (trench or ramp width) x L' (trench or ramp length) x D' (pavement thickness) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is less than 90% of the tonnage on the pavement slips, the calculated tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents shall be at no additional cost to the City.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt – (Trench Width and Temporary Ramps) shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix asphalt base course within the limits of the trenches to depth and width indicated within the payment limits, complete, as shown in the Contract Documents or at the requirements of the Engineer. The work includes, but is not limited to the following; raising and resetting existing structures, castings and boxes; installation and compaction of hot mix asphalt base course to the depth and width and in the area specified; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; keyways and other jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include, but are not limited to; hot mix asphalt for permanent base course placed full roadway width and within trenches; hot mix asphalt for permanent surface course; hot mix asphalt porous pavement; and pavement installed to replaced asphalt damaged by the Contractor.

Item 2500.2--- Hot Mix Asphalt Base Course – Full Width

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt Base Course – Full Width shall be based on the tons of base course placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and roadway widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (roadway width) x L' (roadway length) x D' (pavement thickness) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is less than 90% of the tonnage on the pavement slips, the calculated tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents shall be at no additional cost to the City.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Base Course – Full Width shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix asphalt base course full roadway width to depth and width indicated within the payment limits, complete, as shown in the Contract Documents or at the requirements of the Engineer. The work includes, but is not limited to the following; raising and resetting existing or recently installed structures, castings and boxes owned by the City; installation and compaction of hot mix asphalt base course to the depth and width and in the area specified; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; keyways and other jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include, but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for permanent base course placed within trenches; hot mix asphalt for permanent surface course; hot mix asphalt porous pavement; and pavement installed to replaced asphalt damaged by the Contractor.

Item 2500.3--- Hot Mix Asphalt Intermediate Course – Full Width

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt Intermediate Course – Full Width shall be based on the tons of intermediate (binder) course placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and roadway widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (roadway width) x L' (roadway length) x D' (pavement thickness) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is less than 90% of the tonnage on the pavement slips, the calculated tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract

Documents shall be at no additional cost to the City.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Intermediate Course – Full Width shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix asphalt base course full roadway width to depth and width indicated within the payment limits, complete, as shown in the Contract Documents or at the requirements of the Engineer. The work includes, but is not limited to the following; raising and resetting existing or recently installed structures, castings and boxes owned by the City; installation and compaction of hot mix asphalt base course to the depth and width and in the area specified; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; keyways and other jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include, but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for permanent base course placed within trenches; hot mix asphalt for permanent surface course; hot mix asphalt porous pavement; and pavement installed to replaced asphalt damaged by the Contractor.

Item 2500.4 --- Hot Mix Asphalt Top Course – Full Width

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt Top Course – Full Width shall be based on the tons of surface course placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and roadway widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (roadway width) x L' (roadway length) x D' (pavement thickness) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is less than 90% of the tonnage on the pavement slips, the calculated tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents shall be at no additional cost to the City.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Top Course – Full Width shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix asphalt surface course to depth and full roadway width, complete, as shown in the Contract Documents or at the direction of the Engineer. The work includes, but is not limited to the following; raising and resetting existing or recently installed structures, castings and boxes owned by the City; installation and compaction of hot mix asphalt surface course to the depth and width and in the area specified; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; keyways and other jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include, but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for permanent base course; hot mix asphalt porous pavement; and pavement installed to replaced asphalt damaged by the Contractor.

Item 2500.5 --- Hand Placed Hot Mix Asphalt

METHOD OF MEASUREMENT:
Measurement for Payment for Hand Placed Hot Mix Asphalt shall be based on the tons of hand placed hot mix asphalt placed complete, to limits as required by the Engineer or City and as measured by the Engineer. Tonnage of pavement paid will be calculated based on the actual thickness measured, width of placement measured and length of placement measured or the pavement thicknesses, widths, and lengths defined in the Contract, if appropriate, whichever is less. Placement of pavement to excess thicknesses and outside the limits directed by the Engineer or defined in the Contract Documents shall be at no additional cost to the City.

BASIS OF PAYMENT:
Payment for Hand Placed Hot Mix Asphalt shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hand placed hot mix asphalt to depths, widths, and lengths required by the City or Engineer. The work includes, but is not limited to the following; raising and resetting existing structures, castings and boxes; hand placement and compaction of hot mix asphalt intermediate , base or surface course to the depth, width and length and in the area required by the City or Engineer; jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere.

This item shall include hand placed hot mix asphalt in locations where paving machines cannot maneuver. All locations of hand placement of hot mix asphalt shall be approved by the Engineer.

SPECIAL NOTES ON EXCLUSIONS:
This item is not used for temporary pavement at tree well locations and temporary ramps at pedestrian ramps or driveway aprons.

This item is NOT used for hand placement of hot mix asphalt in trenches or for other temporary conditions within the roadway or sidewalk including, but not limited to, temporary pavement at tree well locations. Hand placement of hot mix asphalt in trenches and for other uses of temporary placement shall be paid for under Item 2500.1. This item is NOT used for hand placement of hot mix asphalt under wire cut bricks. Hand placement of hot mix asphalt under wire cut bricks shall be considered incidental to the unit price bid for item 2524.4. This item is NOT used for hand placement of hot mix asphalt aprons around castings or other transitions after cold planning and before final paving. Hand placement of hot mix asphalt aprons around castings or other transitions after cold planning and before final paving shall be considered incidental to the unit price bid for item 2500.6. Hand placement of hot mix asphalt at driveways at the back of sidewalk are not paid for in this item and are paid for in Section 02950 – BACK OF SIDEWALK RESTORATION.

Item 2500.6 --- Cold Plane 2-Inch, Full Width

METHOD OF MEASUREMENT:
Measurement for the Cold Plane 2-Inch, Full Width will be based on the square yards of hot mix asphalt pavement cold planed to a depth of 2-inches, as measured by the Engineer to the payment limits described in the Contract Drawings and Specifications.

BASIS OF PAYMENT:
Payment for Cold Plane 2-Inch, Full Width shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to cold plane 2-inches to the pay limits indicated on the Drawings and as specified. The work includes removing, hauling, stockpiling, and disposing or reusing of cold planned asphalt material; sweeping after the cold planning operation; removal of asphalt from around existing or recently installed structures and castings owned by the City; providing transitions at the limits of the cold planning; providing and maintaining; temporary hot mix asphalt aprons at transitions and castings until final paving; maintaining the cold planned surface until final paving; providing temporary pavement markings, as required, until final paving; and all incidental work not included for payment elsewhere.

Item 2500.7 --- Fine Grading and Compacting Subbase

METHOD OF MEASUREMENT:
Measurement for the Fine Grading and Compacting Subbase will be based on the square yards of roadway sub-base graded to its final elevations, as measured by the Engineer to the payment limits described in the Contract Drawings and Specifications.

BASIS OF PAYMENT:
Payment for the Fine Grading and Compacting Subbase shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to final grade the roadway sub-base, to the pay limits indicated on the Drawings and as specified. The work includes removing, hauling, stockpiling, and disposing or reusing of excess road sub-base; final grading; raising existing or recently installed castings owned by the City including frames and covers, frames and grates, curb boxes or gate boxes as required to achieve final grades; remove, stack , and reinstall existing wheel stops; replace damaged castings as required by the City or Engineer including damaged frames and covers; damaged frames and grates, damaged gate boxes and damaged curb boxes; layout by a professional land surveyor registered in the Commonwealth of Massachusetts of final grades, elevations and alignments; maintaining the graded sub-base until final paving; and all incidental work not included for payment elsewhere.

Item 2500.8 --- Hot Poured Rubberized Asphalt Sealer

METHOD OF MEASUREMENT:
Measurement for Hot Poured Rubberized Asphalt Sealer will be based on the linear foot of Hot Poured Rubberized Asphalt Sealer placed, as measured by the Engineer and where indicated on the Contract Drawings.

BASIS OF PAYMENT:
Payment for Hot Poured Rubberized Asphalt Sealer shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to place Hot Poured Rubberized Asphalt Sealer where indicated on the Drawings and as specified. The work includes cleaning the surface prior to placing the sealer; prep all surfaces prior to placing the sealer; furnishing and placing the hot poured rubberized asphalt sealer; protecting areas where the sealer was installed; and all incidental work not included for payment elsewhere.

Item 2500.9 --- Hot Mix Asphalt Infrared Asphalt Sealing

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt Infrared Asphalt Sealing shall be based on the linear feet of Hot mix asphalt Infrared Asphalt Sealing performed complete, where shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Infrared Asphalt Sealing shall be based on the unit price bid for this item in the proposal. Under the Unit Price for Hot mix asphalt Infrared Asphalt Sealing, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to infrared pavement seal, where shown on the Contract Drawings, indicated in the Contract Specifications or at the requirements of the Engineer. The Work shall include; but is not limited to; cleaning and prepping joints prior to sealing the joint; removal and disposal of any surplus asphalt removed to provide an acceptable joint; furnish and install additional hot mix asphalt pavement as may be necessary to provide an acceptable joint; protecting the joint after sealing; and all incidental work required to infrared pavement seal all joints required, not included for payment elsewhere, whether stated here or not.

END OF SECTION 02500

SECTION 02510

HOT MIX ASPHALT POROUS PAVING

2510.1	**HOT MIX ASPHALT POROUS PAVING**	**SQUARE YARD**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor and each Subcontractor and/or supplier providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, titled "Related Documents."

1.2 SUMMARY

A. Hot mix asphalt porous paving is an infiltration BMP used to store and treat stormwater runoff from the roadway. This system is designed with a subdrain that is connected to the City of Cambridge's stormwater system. It is not designed to infiltrate into the adjacent subsoils. The hot mix asphalt porous paving and choker course will be placed over sand based structural soil and sand drainage layer.

B. Work in this Section includes the following:

1. Subgrade Preparation
2. Choker Course
3. Hot Mix Asphalt Porous Paving Course
4. Subdrain
5. Non-woven Geotextile Fabric
6. Protection of Porous Media Beds During Construction
7. Testing of Hot Mix Porous Asphalt Paving Mix by Independent Testing Company
8. Maintenance of Porous Paving systems for one full (1) year following construction

1.3 RELATED WORK

A. Section 01568 – EROSION CONTROL, SEDIMENTATION AND CONTAINMENT OF CONSTRUCTION MATERIALS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02622 – POLYVINYL CHLORIDE PIPE

D. Section 02901 – PLANTING SOILS

1.4 PROJECT CONDITIONS

A. Protection of Existing Improvements:

1. Protect adjacent work from splashing of paving materials. Remove all stains from exposed surfaces of paving, structures, and grounds. Remove all waste and spillage.

2. Do not damage or disturb existing improvements or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work.

3. Restore damaged improvements, including existing paving on or adjacent to the site that has been damaged as a result of construction work, to their original condition or repair as directed to the satisfaction of the Engineer, and authority having jurisdiction at no additional cost.

B. Safety and Traffic Control:

1. Notify and cooperate with local authorities and other organizations having jurisdiction when construction work will interfere with existing roads and traffic.

2. Provide temporary barriers, signs, warning lights, flaggers, and other protections as required to assure the safety of persons and vehicles around the construction area and to organize the smooth flow of traffic.

C. Weather Limitations:

1. **Hot Mix Asphalt Porous Paving shall not be placed between October 31 and May 1.** When it is in the public interest, only the Engineer or his/her agents may adjust the air temperature requirement or extend the dates of the paving season.

2. The material shall not be placed when the ambient air temperature at the paving site in the shade away from artificial heat is below 16° C (60° F) or when the actual ground temperature is below 10° C (50° F).

3. The Contractor shall not pave on days when the ground is damp or rain is forecast for the day unless a change in the weather results in favorable paving conditions as determined by the Engineer.

D. Protection of Porous Paving Beds

1. Porous pavement beds shall not be used for equipment or materials storage during construction, and under no circumstances shall vehicles be allowed to deposit soil on paved porous surfaces.

2. Contractor shall take any other necessary steps to prevent sediment from washing into beds during site development. When the site is fully stabilized, temporary sediment control devices shall be removed. For temporary sediment control devices refer to Section 01568 – EROSION CONTROL, SEDIMENTATION AND CONTAINMENT OF CONSTRUCTION MATERIALS.

1.5 GUARANTEE

A. During the one-year guarantee period, the Contractor shall maintain the surfacing and shall promptly fill with similar material in compliance with the Specifications, any depressions and holes that may occur during that time period.

1.6 SUBMITTALS

A. Submit a list of materials proposed for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.

B. Submit certificates, signed by the materials producer and the paving subcontractor, stating that materials meet or exceed the specified requirements.

C. Submit samples of coarse aggregates and non-woven geotextile fabric for review and approval by the City's Representative.

D. The asphalt mixing plant shall certify the aggregate mix, abrasion loss factor, polymer additive, binder draindown, tensile strength ratio, resistance to stripping by water and asphalt content in the mix.

E. Submit name and contact information of company responsible for performing paving operations as soon as this information becomes available.

1.7 REFERENCES

A. Annual Book of ASTM Standards, 1997 or latest edition; American Society for Testing and Materials, Philadelphia, PA.

B. Commonwealth of MassDOT Highway Division: Standard Specifications for Highways and Bridges, 1988, or latest edition.

C. University of New Hampshire Stormwater Center: Design Specifications for Porous Asphalt Pavement and Infiltration Beds, current edition.

PART 2 – PRODUCTS

2.1 CHOKER COURSE AND BASE COURSE

A. All aggregates within the choker course shall meet the following:

1. Maximum Wash Loss of 0.5%

2. Minimum Durability Index of 35

3. Maximum Abrasion of 10% for 100 revolutions and maximum of 50% for 500 revolutions

B. Unless otherwise approved by the Engineer aggregate for the choker course shall be uniformly graded with the following gradation (AASHTO size number 57):

U.S. Standard Sieve Size	Percent Passing
1 ½" (37.5mm)	100
1" (25mm)	95-100
½" (12.5mm)	25-60
#4 (4.75mm)	0-10
#8 (2.36mm)	0-5

2.2 NON-WOVEN GEOTEXTILE FABRIC

A. Non-woven geotextile fabric shall meet the following properties:

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D 4632	kN (lbs)	0.71 (160)	0.71 (160)
Grab Tensile Elongation	ASTM D 4632	%	50	50
Trapezoid Tear Strength	ASTM D 4533	kN (lbs)	0.27 (60)	0.27 (60)
Mullen Burst Strength	ASTM D 3786	kPa (psi)	2100 (305)	2100 (305)
Puncture Strength	ASTM D 4833	kN (lbs)	0.42 (95)	0.42 (95)
Apparent Opening Size (AOS)	ASTM D 4751	mm (U.S. Sieve)	0.212 (70)	0.212 (70)
Permittivity	ASTM D 4491	sec-1	1.4	
Permeability	ASTM D 4491	cm/sec	0.22	
Flow Rate	ASTM D 4491	l/min/m2 (gal/min/ft2)	4477 (110)	
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	70	

Physical Properties	Test Method	Unit	Typical Value
Weight	ASTM D 5261	g/m2 (oz/yd2)	217 (6.4)
Thickness	ASTM D 5199	mm (mils)	1.9 (75)
Roll Dimensions (w x l)	-	m (ft)	4.5 x 91 (15 x 300)
Roll Area	-	m2 (yd2)	418 (500)
Estimated Roll Weight	-	kg (lb)	99 (217)

2.3 HOT MIX ASPHALT POROUS PAVING COURSE

A. Hot Mix Asphalt Porous Paving Mix shall conform to the Open-Graded Friction Course (OFGC) requirements of the MassDOT Highway Division Standard Specifications M3.11.0 with the exceptions as hereinafter noted.

B. Hot mix asphalt porous paving shall be placed in one 4-inch layer as shown in the Contract Documents. **The hot mix asphalt porous paving may be placed in (2) 2-inch layers.**

C. Contractor shall allow time for testing of porous paving mix by independent testing company at batch plant to assure conformance to project specifications.

2.6 SUBDRAIN

A. Perforated pipe for use as a subdrain under the hot mix asphalt porous paving shall conform to Section 02622 – POLYVINYL CHLORIDE PIPE, 2.1 B (3).

PART 3 – EXECUTION

3.1 POROUS MEDIA BEDS

A. Grade Control:

1. Establish and maintain required lines and elevations. The Engineer shall be notified for review and approval of final stake lines for the work before construction work is to begin. Finished surfaces shall be true to grade and even, free of roller marks and free of puddle forming low spots. All areas must drain freely. Excavation elevations should be within +/-0.1 ft (+/- 3 cm).

2. If, in the opinion of the Engineer, based upon reports of the testing service and inspection, the quality of the work is below the standards which have been specified, additional work and testing will be required until satisfactory results are obtained.

3. The Engineer shall be notified at least 24 hours prior to all porous media bed and porous pavement work.

B. Subgrade Preparation:

1. Native subgrade refers to materials beyond the limit of the excavation. The existing native subgrade material under all bed areas shall be compacted to 98% standard proctor compaction prior to geotextile and sand drainage layer subbase placement.

2. Excavate subgrade to line, grade, and elevations indicated. Fill, regrade and compact to 98% standard Proctor any areas damaged by erosion, ponding, or traffic compaction before the placing of the sand drainage layer subbase.

3. All bed bottoms shall be as level as feasible. For pavement subbases constructed on grade, soil or fabric barriers should be constructed along equal elevation for every 6-12” of grade change to act as internal check dams. This will prevent erosion within the subbase on slope.

C. Porous Media Bed Installation:

1. Subbase refers to materials below the pavement surface and above the native subgrade. Upon completion of subgrade work, the Engineer shall be notified and shall inspect at his/her discretion before proceeding with sand based structural soil installation per section 02901 PLANTING SOILS.

2. All aggregates for use in the porous media bed shall be washed.

3. Geotextile and porous media bed aggregate shall be placed immediately after approval of subgrade preparation. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of geotextile at no extra cost to the City.

4. Place geotextile in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of sixteen inches (16"). Secure geotextile at least four inches (4”) outside of bed and take any steps necessary to prevent any runoff or sediment from entering the storage bed.

5. Install sand subbase per section 02901 PLANTING SOILS. Install sand drainage layer subbase evenly to grades indicated on drawings.

6. Install sandbased structural soil per section 02901 PLANTING SOILS. Install sand based structural soil to grades indicated on the drawings.

7. Install choker course aggregates to a maximum 95% standard Proctor compaction. Choker course shall be placed evenly over surface of the sand based structural soil below it, sufficient to allow placement of the hot mix asphalt porous paving course and notify Engineer for approval. Choker course thickness shall be sufficient to allow for even placement of the porous paving but no less than 4 inches in depth.

8. The density of subbase courses shall be determined per section 02901 PLANTING SOILS.

9. The infiltration rate of the compacted subbase shall be determined as described per section 02901 PLANTING SOILS.

10. Compaction of subbase course material shall be done per section 02901 PLANTING SOILS.

11. Rolling and shaping patterns shall begin on the lower side and progress to the higher side of the subbase course while lapping the roller passes parallel to the centerline. Rolling and shaping shall continue until each layer conforms to the required grade and cross-section and the surface is smooth and uniform.

12. Following placement of the subbase sand drainage layer, the geotextile shall be folded back along all bed edges to protect from sediment washout along bed edges. At least a four inch edge strip shall be used to protect beds from adjacent bare soil. This edge strip shall remain in place until all bare soils contiguous to beds are stabilized and vegetated. In addition, take any other necessary steps to prevent sediment from washing into beds during site development. When the site is fully stabilized, temporary sediment control devices shall be removed.

3.2 TESTING OF HMA POROUS PAVING COURSE DURING PRODUCTION

A. The Contractor shall provide at Contractors' expense and the Engineer's approval an independent laboratory testing company to oversee and document mix production.

B. The testing company shall test for the following:

Test	Min. Frequency	Test Method
Temperature in Truck at Plant	6 times per day	
Gradation	greater of either (a) 1 per 500 tons, (b) 2 per day, or (c) 3 per job	AASHTO T30
Binder Content	greater of either (a) 1 per 500 tons, (b) 2 per day, or (c) 3 per job	AASHTO T164
Air Void Content	greater of either (a) 1 per 500 tons, (b) 2 per day, or (c) 3 per job	ASTM D6752
Binder Draindown	greater of either (a) 1 per 500 tons, (b) 1 per day, or (c) 1 per job	ASTM D6390

If an analyzed sample is outside the testing tolerances immediate corrective action will be taken. After the corrective action has been taken the resulting mix will be sample and tested. If the re-sampled mix test values are outside of the tolerances the Engineer will be immediately informed. The Engineer may determine that it is in the best interest of the project that production is ceased. The Contractor will be responsible for all mix produced for the project.

C. The paving mixture produced should not vary from the design criteria for aggregate gradation and binder content by more than the tolerances in the following table:

U.S. Standard Sieve Size	Percent Passing
¾" (19.0mm)	-
½" (12.5mm)	±6.0
3/8" (9.5mm)	±6.0
No. 4 (4.75mm)	±5.0
No. 8(2.36mm)	±4.0
No. 200(0.075mm)	±2.0
%PGAB	+0.4, -0.2

Should the paving mixture produced vary from the designated grading and asphalt content by more than the above tolerances, the appropriate production modifications are to be made until the hot mix asphalt porous paving mixture is within these tolerances.

Samples of the mixture, when tested in accordance with AASHTO T164 and T30, shall not vary from the grading proportions of the aggregate and binder content designated by the Engineer by more than the respective tolerances specified above and shall be within the limits specified for the design gradation.

D. Should the hot mix asphalt porous paving mixture not meet the tolerances specified in this section upon repeat testing, the Engineer may reject further loads of mix. Mix that is loaded into trucks during the time that the plant is changing operations to comply with a failed test shall not be accepted and should be recycled at the plant.

3.3 HOT MIX ASPHALT POROUS PAVING COURSE

A. The mixing plant, hauling and placing equipment, and construction methods shall be in conformance with the applicable requirements of MassDOT Highway Division Standard Specifications Section M3.11.00, except as modified by this Section.

B. The use of surge bins shall not be permitted.

C. No mix shall be placed on wet or damp surfaces. When surface and ambient temperatures are 15 C and rising, the Contractor shall use mix prepared and placed in accordance with the specified requirements of the mix hereinbefore designated as Hot Mix Asphalt Porous Paving Course.

D. Preparation of Bituminous Material. Mixing temperatures for OGFC shall be between 107 C and 121 C. A continuous supply of bituminous material shall be furnished to the mixer at a uniform temperature.

E. Preparation of Aggregates. The aggregate for the mixture shall be dried and heated at the mixing plant before being placed in the mixer. Flames used for drying and heating shall be properly adjusted to avoid damaging the aggregate and depositing soot or unburned fuel on the aggregate. Mineral filler, if required to meet the grading requirements, shall be added in a manner approved by the Engineer after the

aggregates have passed through the dryer. The above preparation of aggregates does not apply for drum-mix plants.

F. Mixing. The dried aggregate shall be combined in the mixer in the amount of each fraction of aggregate required to meet the job-mix formula and thoroughly mixed prior to adding the bituminous material.

1. The dried aggregates shall be combined with the bituminous material in such a manner as to produce a mixture that when discharged from the pugmill is at a target temperature in the range that corresponds to an asphalt cement viscosity of 700 to 900 centistokes and within a tolerance of ± 11 °C (± 20 °F).

2. After the required quantity of aggregate and bituminous material has been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured. The mixing time will be regulated by the Engineer, and a suitable locking means shall be provided for these regulations.

3. All plants shall have a positive means of eliminating oversized and foreign material from being incorporated into the mixer.

G. Hauling Equipment. Trucks used for hauling bituminous mixture shall have tight, clean, smooth metal bodies. The Contractor shall apply a thin coat of a non-petroleum based or soap solution to prevent the mixture from adhering to the bodies. Each truck shall have a cover of canvas or other suitable material of such size sufficient to protect the mixture from the weather. When necessary to ensure delivery of material at the specified temperature, truck bodies shall be insulated, and covers shall be securely fastened.

H. Placing Equipment. The paver shall be a self-propelled unit with an activated screed or strike-off assembly, capable of being heated if necessary, and capable of spreading and finishing the mixture without segregation for the widths and thicknesses required. The screed shall be adjustable to provide the desired cross-sectional shape. The finished surface shall be of uniform texture and evenness and shall not show any indication of tearing, shoving, or pulling of the mixture. The machine shall, at all times, be in good mechanical condition and shall be operated by competent personnel.

Pavers shall be equipped with the necessary attachments, designed to operate electronically, for controlling the grade of the finished surface.

The adjustments and attachments of the paver will be checked and approved by the Engineer before placement of bituminous material.

Hot mix asphalt pavers shall be equipped with a sloped plate to produce a tapered edge at longitudinal joints. The sloped plate shall be attached to the paver screed extension.

The sloped plate shall produce a tapered edge having a face slope of 1:3 (vertical: horizontal). The plate shall be so constructed as to accommodate compacted mat thickness from 35 to 100 mm (1 1/4 to 4 inches). The bottom of the sloped plate shall be mounted 10 to 15 mm (3/8 to 1/2 inch) above the existing pavement. The plate shall be interchangeable on either side of the screed.

Pavers shall also be equipped with a joint heater capable of heating the longitudinal edge of the previously placed mat to a surface temperature of 95°C (200°F), or higher if necessary, to achieve bonding of the newly placed mat with the previously placed mat. This shall be done without undue breaking or fracturing of aggregate at the interface. The surface temperature shall be measured immediately behind the joint heater. The joint heater shall be equipped with automated controls that shut off the burners when the paving machine stops and reignite them with the forward movement of the paver. The joint heater shall heat the entire area of the previously placed wedge to the required temperature. Heating shall immediately precede placement of the bituminous material.

I. Rollers. Rollers shall be in good mechanical condition, operated by competent personnel, capable of reversing without backlash, and operated at speeds slow enough to avoid displacement of the hot mix asphalt mixture. The mass (weight) of the rollers shall be sufficient to compact the mixture to the required density without crushing of the aggregate. Rollers shall be equipped with tanks and sprinkling bars for wetting the rolls. Rollers shall be two-axle tandem rollers with a gross mass (weight) of not less than 7 metric tons (8 tons) and not more than 10 metric tons (12 tons) and shall be capable of providing a minimum compactive effort of 44 kN/m (250 pounds per inch) of width of the drive roll. All rolls shall be at least 1 m (42 inches) in diameter.

A rubber tired roller will not be required on the open graded asphalt friction course surface.

J. Conditioning of Existing Surface. Contact surfaces such as curbing, gutters, and manholes shall be painted with a thin, uniform coat of Type RS-1 emulsified asphalt immediately before the hot mix asphalt mixture is placed against them.

K. Spreading and Finishing. Placing temperature shall be between 107°C and 121°C. As placing temperature is a critical factor in this type of mix, hauling time to the project should be limited so as to avoid mix temperature from dropping below the required minimum. All mixes should be covered during transportation.

The Contractor shall protect all exposed surfaces that are not to be treated from damage during all phases of the paving operation.

The hot mix asphalt mixture shall be spread and finished with the specified equipment. The mixture shall be struck off in a uniform layer to the full width required and of such depth that each course, when compacted, has the required thickness and conforms to the grade and elevation specified. Paver shall be used to distribute the mixture over the entire width or over such partial width as practical. On areas where irregularities or unavoidable obstacles make the use of mechanical

spreading and finishing equipment impractical, the mixture shall be spread, raked, and luted by hand tools.

No material shall be produced so late in the day as to prohibit the completion of spreading and compaction of the mixture during daylight hours, unless night paving has been approved for the project.

No traffic will be permitted on material placed until the material has been thoroughly compacted and has been permitted to cool to below 38°C (100°F). The use of water to cool the pavement will not be permitted. The Engineer reserves the right to require that all work adjacent to the pavement, such as guardrail, cleanup, and turf establishment, is completed prior to placing the Hot Mix Asphalt Porous Paving course when this work could cause damage to the pavement. On projects where traffic is to be maintained, the Contractor shall schedule daily paving operations so that at the end of each working day all travel lanes of the roadway on which work is being performed are paved to the same limits. Suitable aprons to transition approaches where required shall be placed at side road intersections and driveways as directed by the Engineer.

L. Compaction. Immediately after the hot mix asphalt mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

1. The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking, or shoving.

2. The number, mass (weight), and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. Generally, one breakdown roller will be needed for each paver used in the spreading operation.

3. To prevent adhesion of the mixture to the rolls, rolls shall be kept moist with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

4. Along forms, curbs, headers, walls, and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot or lightly oiled hand tampers, smoothing irons or with mechanical tampers. On depressed areas, either a trench roller or cleated compression strips may be used under the roller to transmit compression to the depressed area.

5. Other combinations of rollers and/or methods of compacting may be used if approved in writing by the Engineer, provided the compaction requirements are met.

6. Unless otherwise specified, the longitudinal joints shall be rolled first. Next, the Contractor shall begin rolling at the low side of the pavement and shall proceed towards the center or high side with lapped rollings parallel to the centerline. The speed of the roller shall be slow and uniform to avoid displacement of the

mixture, and the roller should be kept in as continuous operation as practical. Rolling shall continue until all roller marks and ridges have been eliminated.

7. Rollers will not be stopped or parked on the freshly placed mat.

8. The density of compacted pavement shall be at least 92 percent, but not more than 96 percent of the corresponding daily average maximum specific gravity for each type (i.e., I, II, III, or IV) of hot mix asphalt mix placed during each day.

9. Values above 98 percent and below 90 percent will be evaluated by the Engineer to determine whether the pavement shall be removed and replaced by the Contractor at no expense to the City or if a greater penalty will be imposed.

10. It shall be the responsibility of the Contractor to conduct whatever process control the Contractor deems necessary. Acceptance testing may be conducted by the city-authorized personnel using cores provided by the Contractor.

11. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture. The mixture shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of bitumen shall be removed and replaced. These replacements shall be at the Contractor's expense.

12. Should the Contractor choose to use vibratory rollers, the following additional criteria shall govern their operation. Vibratory rollers may be used when operated at an amplitude, frequency, and speed that produces a mat conforming to specifications and that prevents the creation of transverse ridges in the mat. A vibratory roller may be used as a breakdown roller, an intermediate roller, or a finish roller. A vibratory roller shall not be used as a substitute for a pneumatic-tired roller on leveling courses or to compact lifts of pavement less than 25 mm (1 inch) in depth. The same single vibratory roller shall not be used alone as the breakdown, intermediate, and finish roller, but may be used as any one of the rollers in the roller train.

13. If the Engineer determines that unsatisfactory compaction or surface distortion is being obtained or damage to paving components and/or adjacent property is occurring using vibratory compaction equipment, the Contractor shall immediately cease using this equipment and proceed with the work in accordance with the fourth paragraph of this Subsection.

14. The Contractor assumes full responsibility for the cost of repairing all damages that may occur to roadway or parking lot components and adjacent property if vibratory compaction equipment is used. After final rolling, no vehicular traffic of any kind shall be permitted on the surface until cooling and hardening has taken place, and in no case within the first 48 hours. Provide barriers as necessary at no extra cost to the City to prevent vehicular use; remove at the discretion of the Engineer.

M. Joints:

1. Joints between old and new pavements or between successive days work shall be made to ensure a thorough and continuous bond between the old and new mixtures. Whenever the spreading process is interrupted long enough for the mixture to attain its initial stability, the paver shall be removed from the mat and a joint constructed.

2. Butt joints shall be formed by cutting the pavement in a vertical plane at right angles to the centerline, at locations approved by the Engineer. The Engineer will determine locations by using a straightedge at least 4.9 m (16 feet) long. The butt joint shall be thoroughly coated with Type RS-1 emulsified asphalt just prior to depositing the paving mixture when paving resumes.

3. Tapered joints shall be formed by tapering the last 450 to 600 mm (18 to 24 inches) of the course being laid to match the lower surface. Care shall be taken in raking out and discarding the coarser aggregate at the low end of the taper, and in rolling the taper. The taper area shall be thoroughly coated with Type RS-1 emulsified asphalt just prior to resuming paving. As the paver places new mixture on the taper area, an evenly graduated deposit of mixture shall complement the previously made taper. Shovels may be used to add additional mixture if necessary. The joint shall be smoothed with a rake, coarse material discarded, and properly rolled.

4. Longitudinal joints that have become cold shall be coated with Type RS-1 emulsified asphalt before the adjacent mat is placed. If directed by the Engineer, joints shall be cut back to a clean vertical edge prior to applying the emulsion.

N. Surface Tolerances. The surface will be tested by the Engineer using a straightedge at least 4.9 m (16 feet) in length at selected locations parallel with the centerline. Any variations exceeding 3 mm (1/8 inch) between any two contact points shall be satisfactorily eliminated. A straightedge at least 3 m (10 feet) in length may be used on a vertical curve. The straightedges shall be provided by the Contractor.

O. Work shall be done expertly throughout, without staining or injury to other work. Transition to adjacent impervious hot mix asphalt paving shall be merged neatly with flush, clean line. Finished paving shall be even, without pockets, and graded to elevations shown on drawing.

P. Porous pavement beds shall not be used for equipment or materials storage during construction, and under no circumstances shall vehicles be allowed to deposit soil on paved porous surfaces.

Q. Repair of Damaged Paving. Any existing paving on or adjacent to the site has been damaged as a result of construction work shall be repaired to the satisfaction of the City without additional cost to the City.

3.4 FIELD QUALITY CONTROL

A. The full permeability of the pavement surface shall be tested by application of clean water at the rate of at least 5 gpm over the surface, using a hose or other distribution devicee. Water used for the test shall be clean, free of suspended solids and deleterious liquids and will be provided at no extra cost to the City. All applied water shall infiltrate directly without puddle formation or surface runoff, and shall be observed by the Engineer and City.

B. Testing and Inspection. Employ at Contractor's expense an inspection firm acceptable to the Engineer and City to perform soil inspection services per section 02901 PLANTING SOILS, staking and layout control, and testing and inspection of site grading and pavement work. Inspection and list of tests shall be reviewed and approved in writing by the Engineer prior to starting construction. All test reports must be signed by a licensed Engineer.

C. Test in-place base and surface course for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable work as directed by the City.

D. Surface Smoothness. Test finished surface for smoothness using a 10 foot straightedge applied parallel with and at right angles to the centerline of the paved area. Surface will not be accepted if gaps or ridges exceed 3/16 of an inch.

3.5 GRADE CONTROL

A. Establish and maintain required lines and elevations. The Engineer shall be notified for review and approval of final stake lines for the work before construction work is to begin. Finished surfaces shall be true to grade and even, free of roller marks and free of low spots to form puddles. All areas must drain.

B. If, in the opinion of the City, based upon reports of the testing service and inspection, the quality of the work is below the standards which have been specified, additional work and testing will be required until satisfactory results are obtained.

3.6 POST-CONSTRUCTION MAINTENANCE

A. During the guarantee period, the hot mix asphalt porous paving should be inspected for cracks, water ponding (failure to infiltrate), or other failures.

B. Quarterly (every three months). Pavement surface should be vacuumed to remove sediment and organic debris. The sweeper may be fitted with water jets.

C. Coordinate the installation of sand drainage layer and sand based structural soil with adjacent work installing sand based structural soil at sidewalk locations and within buffer areas.

D. As needed. Ensure that all upgradient landscaping areas are well maintained to prevent soil from being transported onto the pavement. In early Spring remove any

sediment buildup at curbs and driveway aprons. Fill potholes and cracks with traditional patching mixes unless more than 10 percent of the area needs repair. If large areas (10 percent or more of the total porous paving area) need repair, consult the porous paving installer. Spot-clogging can be alleviated by drilling half-inch diameter holes through the porous paving layer every few feet.

E. Do not store materials such as sand/salt, mulch, soil, yard waste, and other stock piles on porous surfaces.

PART 4 - COMPENSATION

Item 2510.1 --- Hot Mix Asphalt Porous Paving

METHOD OF MEASUREMENT*:*
Measurement for Payment shall be based on the square yard of hot mix asphalt porous paving installed by the Contractor as shown on the Contract Drawings and as directed by the Engineer, complete and as measured by the Engineer. Hot mix asphalt porous paving shall have a standard section as shown on the Contract Drawings.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Porous Paving shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete installation of Hot Mix Asphalt Porous Paving as shown on the Contract Drawings or at the direction of the Engineer. The work includes, but is not limited to the following; furnishing and installing hot mix asphalt porous paving course; compacting subgrade; install, grade, and compact pavement base course, and choker course; compaction and compaction testing; furnishing and installing filter fabric as required; independent laboratory testing of hot mix asphalt porous paving mix; maintenance of the porous paving system for one full (1) year following construction; and all incidental work not included for payment elsewhere required to furnish and install hot mix asphalt porous paving whether included here or not including work to successfully integrate adjacent work for sand based structural soil installation under sidewalks and concrete buffer zone locations.

EXCLUSIONS AND SPECIAL NOTES:
Subdrain pipe, subdrain pipe installation, excavation and disposal of material and temporary sediment controls are not included in this bid item. Excavation for Porous Hot Mix Asphalt Paving shall be paid for under SECTION 02210 EARTH EXCAVATION, BACK FILL, FILL, AND GRADING.

END OF SECTION 02510

SECTION 02520

BRICK UNIT PAVERS

2520.1	**BRICK UNIT PAVERS**	**SQUARE YARD**
2520.2	**BRICK UNIT PAVERS - PERMEABLE**	**SQUARE YARD**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Brick Unit Pavers including, but not limited to, the following:

1. Brick Unit Pavers on sand-asphalt setting bed over bituminous concrete base over gravel fill.
2. Brick Unit Pavers – Permeable with permeable joint opening aggregate on permeable setting bed over crushed stone base materials over sand-based structural soil.
3. Joint sand for brick unit pavers on Portland cement concrete base
4. Aggregate base and subbase material.

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02990 – Site Furnishings
3. Section 02780 – Precast Unit Pavers
4. Section 02901 – Planting Soils

1.3 REFERENCES

A. Comply with applicable requirements of:

1. Commonwealth of Massachusetts, Standard Specifications for Highways and Bridges, Department of Public Works, latest edition, Boston, Massachusetts.

2. ASTM: American Society of Testing Materials.

3. AASHTO: American Association of State Highway and Transportation Officials.

1.4 ABBREVIATIONS

A. BIA – Brick Institute of America

1.5 SUBMITTALS

A. Submittals: in accordance with section 01300

B. Design Data: submit design mixes for:

1. Sand-asphalt setting bed

a. Test results from an independent testing laboratory for compliance with ASTM D 448 No. 8, No. 57 and No. 2.

b. Test results from an independent testing laboratory for sieve analysis, including washed gradations per ASTM C 136.

c. Test results for void space percentage per ASTM C 29.

2. Bituminous concrete base

3. Joint sand

a. Test results from an independent testing laboratory for sieve analysis per ASTM C 136 conforming to the grading requirements of ASTM C 144.

C. Product Data: submit manufacturer's specifications and installation instructions for:

1. Brick Pavers on Concrete base
2. Brick Pavers – permeable
3. Geogrid
4. Preformed Joint Filler
5. Joint Sealant
6. Backer Rod

D. Samples: submit:

1. Brick pavers: Provide five brick pavers minimum for each paver type and paver color. Paver samples shall be sufficient to show full range of color, edge finish and texture variation to be expected in finished work.
2. Brick pavers - Permeable: Provide five brick pavers minimum for each paver type and paver color. Paver samples shall be sufficient to show full range of color, edge finish and texture variation to be expected in finished work.

E. Sample Panels: After receipt of Engineer's approval of material samples, construct one sample panel of typical paver construction for each pattern listed below.

1. Panels:

   a. One eight feet by eight foot comprehensive mock-up panel that includes both brick paving and brick paving - permeable systems in equal proportions and constructed adjacent to integral with the stone mock-up.

2. Schedule mock-up construction so that mock-up can be accepted minimum 30 days prior to application of paving surfaces represented by mock-up.

3. Engineer will review color and pattern combinations. Sample panel shall be constructed on site at location directed by Engineer. If approved by the Engineer, the sample panel may be constructed in place and be incorporated as part of the final paver layout. Panel shall have specified joint size and other features of typical construction. Engineer shall have the right to require additional panels of similar size and composition constructed at no additional cost to the Owner if workmanship on the first panel is not acceptable. After Engineer's approval, leave accepted panel on site as standard of acceptable work for permanent construction and remove same only when directed by Engineer.

F. Certificates: submit:

1. certificate(s) indicating compliance of materials with standards designated.

2. Certificate confirming that manufacturer conducts a test sampling of 24 pavers for every 50,000 pavers manufacturer to determine the pavers are in compliance with the dimensional and water absorption characteristics. The 24 paver samples shall be representative of the color mix in the typical finished package and chosen on a consistent basis from one kiln car.

G. Installation Instructions. Provide manufacturer’s recommended instructions, including installation materials and methods.

H. Maintenance Data. Provide recommended maintenance instructions including materials and methods recommended for maintenance of each different type of brick installed.

1.6 QUALITY CONTROL

A. Design Criteria. Provide clean and durable brick work free of cracked, crumbling or discolored joints and loose bricks.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials clearly marked with legible and intact labels, identifying brand names and contents of containers.

B. Provide manufactured setting materials in containers having identification certifying compliance with referenced standards. Products shall be recommended by paver manufacturer for intended application.

C. Damaged pavers will be rejected and replaced with new materials at no additional cost to Owner.

D. Protect finished surfaces adjacent to paving work from soiling, staining, and other damage.

1.8 JOB CONDITIONS

A. Environmental Conditions. Comply with BIA No. 1A.

B. Protection

1. Protect adjacent work, surfaces, and equipment from effects of paving installation procedures.

2. Protect pavers installed on sand-asphalt setting beds with protection course during installation and until final acceptance.

PART 2 - PRODUCTS

2.1 BRICK PAVERS

A. Provide pavers complying with following requirements:

1. Brick Paver Types:

a. Brick Pavers: Pathway HD Full Range Blend manufactured by Pine Hall Brick Company, Post Office Box 11044, 2701 Shorefair Drive, Winston Salem, North Carolina 27116-7500, phone #336-271-1044, or approved equal.

b. Brick Pavers - Permeable: Pine Hall Brick : Stormpave Pathway HD Full Range Blend manufactured by Pine Hall Brick Company, Post Office Box 11044, 2701 Shorefair Drive, Winston Salem, North Carolina 27116-7500, phone #336-271-1044, or approved equal.

2. Physical Properties:

a. Brick Pavers and Brick Pavers - Permeable:

1. Comply with ASTM C1272 Type F, Application PX and the dimensional tolerances for length, width and depth shall be 1/16”.

2. Average Compressive Strength: 12,500 psi

3. Average Cold Water Absorption: 5.5%, with no individual unit greater than 7%. Absorption test results shall not be achieved through the use of sealers or other products applied to the paver.

4. Freeze Thaw Cycles: 150+

5. Passes CSA-A231.2 freeze thaw test in saline solution without the use of sealers or other products applied to the paver.

6. Average Coefficient of Friction (ASTM C1028): 1.06 dry, 0.97 wet

3. Sizes, Surfaces and Edges

a. Brick Pavers:

1. Rectangles: Four by eight inches by 2-1/4 inches thick.
2. Wire-cut finish, die skim, or struck molded finish
3. Edges: Square

b. Brick Pavers - Permeable:

1. Rectangles: Four by eight inches by 2-1/4 inches thick with spacer nubs on four sides.
2. Wire-cut finish, die skim, or struck molded finish
3. Edges: Chamfered

2.2 SETTING BED FOR BRICK PAVERS

A. Sand-Asphalt Setting Bed

1. Asphalt: conform to ASTM Designation D-946-69A with a penetration at 77 degrees F. 100 gram, 5 seconds of minimum 85 millimeters and a maximum of 100 millimeters.

2. Combine dried fine aggregates with hot asphalt cement and heat mix to approximately 300 degrees F at asphalt plant. Appropriate proportion of materials shall be seven percent cement asphalt and ninety-three percent aggregate by weight in approximate ratio of 145 pounds asphalt to 1,855 pounds sand. Determine exact proportions to produce best possible mixture for construction of bituminous setting bed to meet construction requirements.

2.3 MASTIC ADHESIVE

A. Mastic Adhesive for use as tack coat beneath pavers: consist of 2 percent neoprene (Grade WM1) modified asphalt with 10 percent fibers and eighty-eight percent asphalt. Melting point shall be 200 degrees F. minimum in accordance with ASTM D36. Penetration at 77 degrees F., 100 gram load for 5 seconds (.1mm) shall be 23 to 27.

2.4 BITUMINOUS CONCRETE BASE COURSE

A. Bituminous Concrete Base Course: Class I, Type I-1, furnished in accordance with Section 460 of the Standard Specifications.

2.5 PAVER JOINT SAND

A. Paver joint sand for impervious unit vehicular applications: Clean, well-graded coarse concrete sand conforming to requirements of ASTM Specification C-33 with the following gradation. Sand from a single source.

Sieve (by weight)	Percent Passing
3/8”	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

2.6 ¼” SETTING BED FOR PRECAST BRICK PAVERS - PERMEABLE

A. Provide permeable Bedding Course Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 8 as presented in Table 3.

TABLE 3
BEDDING COURSE AGGREGATE GRADATION
REQUIREMENTS FOR PRECAST UNIT PAVERS - PERMEABLE

ASTM No. 9	
Sieve Size	Percent Passing
3/8 in	100
No. 4	85 to 100
No. 8	10 to 40
No. 16	0 to 10
No. 50	0 to 5

2.7 PAVER JOINT MATERIALS FOR BRICK UNIT PAVERS – PERMEABLE

A. Paver joint materials: 1/8” washed stone supplied by Read Custom Soils, Canton, Massachusetts or approved equivalent product.

2.8 GEOGRID FOR PRECAST CONCRETE UNIT PAVERS – PERMEABLE

A. Geogrid for Paving Base Reinforcement to resist settlement: Triaxial Geogrids shall be shall be TiAx TX 140 manufactured by Tensar Inernational Corporation, 5883 Glenridge Drive, Suite 200, Atlanta, GA 30328-5363, tel: 800 836 7271, or approved equivalent product.

2.9 PERMEABLE BASE AGGREGATE FOR PRECAST UNIT PAVERS - PERMEABLE

A. 3/8” Crushed Stone as specified in Section 02901 – Planting Soils.

2.10 SUBBASE AGGREGATE FOR PRECAST UNIT PAVERS - PERMEABLE

A. 3/4” Crushed Stone as specified in Section 02901 – Planting Soils.

2.11 SAND BASED STRUCTURAL SOIL FOR BRICK PAVERS - PERMEABLE

A. Sand-Based Structural soil: as specified in Section 329115 – Planting Soils.

2.12 GRAVEL BASE AND SUBBASE

A. Gravel Borrow: Section 02210 – Earth Excavation, Backfill, Fill and Grading.

2.13 JOINT FILLER

A. Sponge rubber in conformance to AASHTO M-153-65, Type I, Fed. Spec. HH-F- 341 F, Type II, Class A and ASTM D-1752-67, Type I and be one of the following:

1. Sealtight Sponge Rubber Expansion Joint Filler, manufactured by W.R. Meadows, Inc., Elgin, IL.
2. Or Equal.

2.14 BACKER ROD

A. Continuous round rod of 100% closed cell polyethylene foam, complying with requirements of ASTM C-272.

2.15 JOINT SEALANT

A. Single Component Traffic Silicone: Low modulus, high performance, single component, self-leveling sealant, in conformance with ASTM C920, Standard Specification for Elastomeric Joint Sealants, and is classified as Type: S (Single Component), Grade: P (Pourable), Class: 100/50 (+100/- 50% joint movement); Uses T, M, A and O; and be one of the following:

1. Spectrum 900 SL manufactured by Tremco Sealant/Weatherproofing Division of RPM International, Inc,

2. Pecora 300SL Pavement Sealant manufactured by Pecora Corporation, 165 Wambold Road, Harleysville, PA 19438 • 1-800-523-6688

3. Sikasil-728 SL manufactured by Sika Corporation201 Polito Avenue, Lyndhurst, NJ 07071

B. Where joint surfaces contain bituminous materials, provide modified sealant compatible with bituminous materials encountered.

C. Color: to be selected by Engineer.

2.16 WATER

A. Water: Clean and potable, free from impurities detrimental to paving work.

2.17 PROTECTION COURSE

A. Protection Course. Plywood, type as recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

A. General. Examine work-in-place, upon which work specified in this Section is dependent, for defects which may influence application or installation and performance of work specified in this Section. Do not start installation until unsatisfactory conditions have been corrected.

B. Examine surfaces to receive pavers and verify following where applicable:

1. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.

2. Provide written density test results for soil subgrade and to the Owner's Representative.

3. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

4. Verify that concrete slab base meets elevations and specified requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate layout and installation of paving with layout and installation of adjacent paving, curbing, walls and other site improvements to ensure proper alignments.

3.3 PREPARATION BASE COURSES FOR PERMEABLE BRICK PAVERS

A. Coordinate installation of base courses with installation of Sand Based Structural Soil, Subsurface Underdrain, and Crushed Stone Base Courses provided under Section 02901 – Planting Soils.

B. Coordinate with installation of base courses with Steel Edging provided under Section 02990 – Site Furnishings.

3.4 GEOGRID FOR BRICK PAVERS - PERMEABLE

A. Provide geogrid in a continuous horizontal surface between Sand Based Structural Soil and Crushed Stone base with overlaps between materials and as recommended by the manufacturer.

3.5 BEDDING COURSE FOR BRICK PAVERS - PERMEABLE

A. Spread bedding course in loose in a uniform layer to give a depth after compaction of the pavers of three inches, plus or minus ½". The contractor shall screed the bedding course using either a mechanical screed beam apparatus or by the use of screed guides and boards.

B. The screeded bedding aggregate shall not be subjected to traffic by either mechanical equipment or pedestrian use prior to the installation of the pavers. The voids left after the removal of the screed rails shall be filled with loose aggregate as the paver bedding course proceeds.

3.6 BRICK PAVERS - PERMEABLE INSTALLATION

A. The pavers should be installed according to the information on the cube tag. The pavers should be laid from several cubes throughout the installation.

B. Lay pavers in the pattern as shown on the drawings. Lay pavers away from the existing laying face or edge restraint in such a manner as to ensure that the pattern remains square. Chalk lines (use a heavier chalk cord) shall be used upon the bedding course to maintain straight lines. Joint spacing between pavers shall be between 1/8" and ¼"; however the joint width may need to be increased to 3/8" to maintain straight lines. Lines and grades shown on the plans shall be established and maintained during the installation of the pavers.

C. Pavers should be cut according to the instructions on the cube tag. Pavers shall be cut using a table mounted masonry wet saw.

D. Once the pavers have been placed upon the bedding course and all cut pavers have been inserted to provide the complete surface, inspect the pavers for damaged units and remove and replace those units. Once all pattern lines have been straightened, the paver joint material shall then be placed into the paver openings to the top of the chamfer on the pavers and the surface swept broom clean.

E. The pavement surface shall be compacted to achieve consolidation of the bedding course and pavers and brought to design levels and profiles by two passes of a suitable plate compactor. Compaction of the pavers shall be accomplished by the use of a vibratory plate compactor capable of a minimum of 4,500 pounds of compaction force. No compaction shall be permitted within three feet of unrestrained edges of the pavement. After compaction, inspect the pavers for damaged units and remove and replace those units.

F. After completing compaction, the surface tolerances shall be plus or minus 1/4” from finished grades. The pavers shall be flush to ½” above edge restraints. Additional void filler material shall be swept into the joints as required, to within 1/4” from the bottom of the chamfer on the paver. Upon completion, the pavement surface shall be swept clean of excess materials. Remove from the site all surplus materials, equipment and debris resulting from these operations.

3.7 PREPARATION OF GRAVEL BASE

A. Make corrections to base courses provided under Section 02210 – Earth Excavation, Backfill, Fill and Grading, to bring base courses to the proper sections and elevations for Brick Paver Installation.

B. Compact subgrade to achieve a 95% minimum compaction rate consistent throughout subgrade.

C. Place gravel base in 2" to 3" lifts and as specified in Section 02210 – Earth Excavation, Backfill, Fill and Grading.

D. Compact to achieve a 95% minimum compaction rate consistent throughout gravel base.

E. Final surface of gravel base to be left 1/8" higher than adjacent surfaces to allow for settlement.

3.8 BITUMINOUS CONCRETE BASE INSTALLATION

A. Make any corrections necessary to gravel base furnished and installed under Section 02210 - Earth Excavation, Backfill, Fill and Grading, to bring gravel fill to the sections and elevations shown on the Drawings.

B. Bituminous concrete base laid in accordance with Section 460 of the Standard Specifications. Construct base course with a minimum finished depth after rolling of four inches and conform to the requirements of Paragraph M3.11.03, base course.

3.9 SAND-ASPHALT SETTING BED INSTALLATION

A. Place two 3/8 inch by one-inch control bars directly over base. Adjust bars with wood chucks under control bars to bring ¾-inch setting bed or proper grade. Set bars parallel to each other approximately eleven feet apart to serve as guides for striking board (12 feet long, 2 inch x 6 inch board). Set depth control bars to bring pavers, when laid, to proper grade. Place some bituminous bed material between parallel depth control bars. Pull bed with striking board over bars several times. After each passage, low porous spots to be showered with fresh bituminous material to produce smooth firm and even setting bed. As soon as this panel is completed advance first bar to next position ready for striking next panel. Carefully fill depressions remaining after removing depth control bars and wood checks. Elevation shall be adjusted so when pavers are placed, top surface of pavers will be at required finished grade.

B. Roll setting bed with a power roller to ¾-inch depth while still hot. Final surface of setting bed over gravel base to be left 1/8" higher than adjacent surfaces to allow for settlement.

C. Apply coating of asphalt mastic adhesive to setting bed using trowel having 1/16-inch serrations.

D. Final surface of setting bed over gravel base to be left 1/8" higher than adjacent surfaces to allow for settlement.

3.10 INSTALLATION OF BRICK PAVERS

A. Set pavers on setting bed with uniform joints 1/16” to 1/8” wide in patterns shown on Drawings. Continually check surface of finished line and grade with straight edge. Correct deficiencies. Cut pavers to fit in locations noted. Machine cuts only. Minimum paver size to be no smaller than 1/2 unit size. Final surface of pavers to be left 1/8" higher than adjacent surfaces to allow for settlement.

B. Sweep dry joint sand into joints until completely filled and provide a layer of joint sand over pavers. Compact pavers using a low amplitude plate compactor capable of at least 5,000 Ibf compaction at a frequency of 75 hz to 100 hz. and vibrate until completely filled. Two to three passes minimum. Fog surface with water to compact mix into joints. Repeat process until joints are compacted and filled. Clean stains immediately. Do not compact within 3 feet of unrestrained edges of the paving units.

C. Work within 3 feet of the laying face to be left fully compacted with sand-filled joints at end of each day. Cover laying face with plastic sheets overnight.

D. Protect installed units with plywood panels against uneven settlement and misalignment. If settlement occurs producing mismatch of more than 1/16 inch at interface between pavers and other pavements prior to final acceptance, relay pavers near interface for sufficient distance to provide smooth transition between paving surfaces and satisfactory match between pavers and adjacent surfaces.

3.11 ADJUST AND CLEAN

A. Remove and replace paver pieces, which are broken, chipped, stained and otherwise damaged. Remove and replace pavers which are misaligned, not to grade and do not match adjoining granite work. Provide new matching units, install and point-up joints to eliminate evidence of replacement. Repair defective and unsatisfactory joints to provide neat, uniform appearance.

B. Sweep areas of pavers clean of excess sand.

C. Clean entire paver installation with neutral non-alkaline chemical cleaner free from lye or caustics. Clean paver work to remove stains, dirt and other discoloration or blemishes. Commence cleaning operations following granite construction. Follow manufacturer's instructions for use, handling and application of masonry cleaners. Provide polyethylene covers or other temporary protection of lawn, plants and other non-working areas

adjacent to masonry cleaning. Remove coverings immediately following cleaning operations. Collect and remove residual cleaning solutions from site.

PART 4 - COMPENSATION

2520.1 BRICK UNIT PAVERS SQUARE YARD

METHOD OF PAYMENT
Measurement for Brick Unit Pavers on sand-asphalt setting bed over bituminous concrete base course on gravel sub-base shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS
Payment for Brick Unit Pavers on sand-asphalt setting bed over bituminous concrete base course shall be based on the square yard of brick pavers on sand-asphalt setting bed over bituminous concrete base course as detailed in the Contract Documents and installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of brick unit pavers on sand-asphalt setting bed on bituminous concrete base course over gravel sub-base as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to: installation of brick unit pavers, setting bed and mastic tack coat and bituminous concrete base course; excavation to depth shown in the drawings vertically of proposed grade; labor, equipment, materials, safe transportation including loading at storage site and unloading at site of installation; and all incidental work not included for payment elsewhere.

2520.2 BRICK UNIT PAVERS - PERMEABLE SQUARE YARD

METHOD OF PAYMENT
Measurement for Brick unit pavers - permeable with joints filled with 1/8” Washed Open Graded Stone on ¼” Washed Open Graded Crushed Stone Bedding Course over 3/8” Washed Open Graded Crushed Stone Bedding Course over ¾” Washed Open Graded Crushed Stone Base shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS
Payment for Brick unit pavers - permeable with joints filled with 1/8” Washed Open Graded Stone on ¼” Washed Open Graded Crushed Stone Bedding Course over 3/8” Washed Open Graded Crushed Stone Bedding Course, Geogrid layer, over ¾” Washed Open Graded Crushed Stone Base as detailed in the Contract Documents installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of brick unit pavers - permeable as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to: installation of brick unit pavers - permeable with joint material on ¼” Washed Open Graded Crushed Stone Bedding Course over 3/8” Washed Open Graded Crushed Stone Bedding Course over ¾” Washed Open Graded Crushed Stone Base; excavation to depth shown in the drawings vertically of proposed grade; labor, equipment, materials, safe transportation including loading at storage site and unloading at site of installation; and all incidental work not included for payment elsewhere.

EXCLUSIONS

The following items are not included for payment under this item: Sand Based Structural Soil, 6” Sand Layer and Steel Edging to be included for payment elsewhere.

END OF SECTION

SECTION 02521

FLEXIBLE POROUS PAVING

2521.1 FLEXIBLE POROUS PAVING (PROPRIETARY) SQUARE YARD

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Flexible Porous Paving including, but not limited to, the following:

1. Subgrade preparation and installation of flexible porous paving, widths vary.

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02900 - Planting
3. Section 02901 - Planting Soils
4. Section 02970 - Landscape Maintenance

1.3 SUBMITTALS

A. Submit a list of materials proposed for work under this Section including thename and address of the materials producer and the location from which the materials are to be obtained.

B. Submit certificates, signed by the materials producer and the paving subcontractor, stating that materials meet or exceed the specified requirements.

C. Submit name and contact information of company responsible for performing paving operations as soon as this information becomes available.

D. Material samples (1) 12” x 12” sample for the following:

1. Flexible porous paving

E. Sample Panel: Construct a 5' x 5' sample of the Flexible Porous Paving material for approval. The sample shall show all aspects of finish appearance. The sample, upon approval, shall be maintained as the standard of minimal quality for approval of all proposed surfacing and paving work required for the project.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this Section.

B. Codes and Standards

1. All materials, methods of construction and workmanship shall conform to applicable requirements of ASTM Standards unless otherwise specified.

1.5 PROJECT CONDITIONS

A. Protection of Existing Conditions:

1. Protect adjacent work from splashing of paving materials. Remove all stains from exposed surfaces of paving, structures, and grounds. Remove all waste and spillage.

2. Do not damage or disturb existing improvements or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work.

3. Restore damaged improvements, including existing paving on or adjacent to the site that has been damaged as a result of construction work, to their original condition or repair as directed to the satisfaction of the Owner's Representative, and authority having jurisdiction at no additional cost.

B. Safety and Traffic Control:

1. Notify and cooperate with local authorities and other organizations having jurisdiction when construction work will interfere with existing roads and traffic.

2. Provide temporary barriers, signs, warning lights, flaggers, and other protections as required to assure the safety of persons and vehicles around the construction area and to organize the smooth flow of traffic.

C. Weather Limitations:

1. Flexi™-pave shall not be placed when the ambient air temperature at the paving site in the shade away from artificial heat is below 45° F or above 95°F.

2. The Contractor shall not pave on days when rain is forecast for the day, unless a change in the weather results in favorable paving conditions as determined by the Owner's Representative.

1.6 QUALITY ASSURANCE

A. Installers shall be trained, approved, and certified installers of Flexible Porous Paving.

B. All necessary material components and applicable overview required to install the single pass Flexible Porous Paving shall be provided by the certified technicians.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Flexible Porous Paving shall be HD2000 Flexi™-pave, as manufactured by K.B. Industries, Inc., 28100 US Hwy 19 North, Suite 410, Clearwater, FL 33761, Telephone (727)-723-3300, Fax (727) 723-3600. **THIS IS A PROPRIETARY ITEM.**

1. Reference manufacturer's information. The certified installer is responsible for supplying and installing a warranted material that meets the following manufacturer's specifications: The material must consist of and utilized recycle tires, aggregate, and binder

2.3 FILTER FABRIC

A. Filter Fabric: Mirafi 140N, Cevex25, Typar 3351 or approved equal.

2.4 CRUSHED STONE

A. Washed ¾" Crushed Stone: as specified in Section 02210 – Earth Excavation, Backfill, Fill and Grading

PART 3 EXECUTION

3.1 FLEXI-PAVE

A. Reference manufacturer's recommendations.

B. The material must be applied in a minimum 2" thickness in such manner that it is completely free of joints or seams, provides impact absorption, is flexible to substrate movement and root growth and is non cracking during freeze-thaw conditions.

C. The material shall have an available 5 year warranty for pedestrian or non-traffic applications.

D. The material is to be porous to precipitation with an 18% - 22% dynamic flexible void capacity. The placement of material must be able to accommodate up a 30% slope.

E. The material must withstand continual daily foot, bicycle, and wheelchair use with vehicular crossings.

F. Application of the material will occur over various substrate materials with the majority of application occurring over natural earth and existing tree roots. The product must retain durability over the various substrates.

PART 4 - COMPENSATION

2521.1 FLEXIBLE POROUS PAVING (PROPRIETARY) SQUARE YARD

METHOD OF PAYMENT:
Measurement for Flexible Porous Paving shall be based on the Unit square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Flexible Porous Paving shall be based on the Unit square yard of Flexible Porous Paving detailed in the Contract Documents installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment and incidentals required for the installation of Flexible Porous Paving as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to flexible porous paving, crushed stone base course, filter fabric, excavation to depth shown in the drawings vertically of proposed grade, labor, equipment, materials, safe transportation including loading at storage site and unloading at site of installation and all incidental work not included for payment elsewhere.

END OF SECTION

SECTION 02524

CURBS, WALKS AND DRIVEWAYS

2524.1	**4-IN CEMENT CONCRETE SIDEWALKS**	**SQUARE YARD**
2524.2	**6-IN CEMENT CONCRETE SIDEWALKS AT DRIVEWAYS**	**SQUARE YARD**
2524.3	**6-IN CEMENT CONCRETE AT PEDESTRIAN RAMPS AND INTERSECTIONS**	**SQUARE YARD**
2524.4	**6-IN REINFORCED CONCRETE DRIVEWAY AT FIRE STATION**	**SQUARE YARD**
2524.5	**WIRE CUT BRICKS ON 4-IN HOT MIX ASPHALT (SIDEWALKS)**	**SQUARE YARD**
2524.6	**REMOVE AND RESET/RELOCATE GRANITE CURB (STRAIGHT AND CURVED)**	**LINEAR FOOT**
2524.7	**REMOVE AND DISCARD GRANITE CURB (STRAIGHT AND CURVED)**	**LINEAR FOOT**
2524.8	**NEW GRANITE CURB TYPE VA4 (STRAIGHT)**	**LINEAR FOOT**
2524.81	**NEW GRANITE CURB TYPE VA4 (CURVED)**	**LINEAR FOOT**
2524.9	**NEW GRANITE CURB TYPE VA4 TRANSITION (STRAIGHT)**	**LINEAR FOOT**
2524.91	**NEW GRANITE CURB TYPE VA4 TRANSITION (CURVED)**	**LINEAR FOOT**
2524.10	**NEW GRANITE CURB FOR RAISED CROSSWALKS**	**LINEAR FOOT**
2524.11	**NEW BEVELED CURB (STRAIGHT AND CURVED)**	**LINEAR FOOT**
2524.12	**GRANITE CURB CORNER TYPE A**	**EACH**
2524.13	**CAST-IN-PLACE DETECTABLE TILE**	**SQUARE FOOT**
2524.14	**STAMPED CONCRETE TRUCK APRON**	**SQUARE YARD**

2524.15 REMOVABLE FALSE CURB UTILITY COVER EACH

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies the following: cement concrete, hot mix asphalt, and brick sidewalks, driveways, and pedestrian ramps; the removal and resetting of curb and edging; and the construction of new granite curbs, berms, and edging.

1.2 RELATED WORK

A. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

B. Section 02500 – PAVING AND SURFACING

C. Section 02521 – FLEXIBLE POROUS PAVING

D. Section 02900 – PLANTING

E. Section 02950 – BACK OF SIDEWALK RESTORATION

F. Section 02980 – SITE IMPROVEMENTS

G. Section 03300 – CONCRETE

1.3 SUBMITTALS

A. Shop Drawings. Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Manufacturer product data and specifications for all materials, including, but not limited to:

a. Cement Concrete for sidewalks, driveways, and pedestrian ramps including design mix

b. Micro-fiber for sidewalk reinforcement

c. Membrane Curing Compound

d. Penetrating Liquid Concrete Sealer

e. Expansion Joint

f. Granite Curb, Granite Curb Corner and Granite Edging

g. Cement Concrete Design Mix for granite curb work

h. Hot mix asphalt for driveways, including design mix – Refer to Section 02500 – PAVING AND SURFACING for requirements

i. Gravel Subbase – Submit in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

j. Wire Cut Brick

k. Detectable tiles

2. Detail drawings and layout plans for all materials.

B. Submit compaction testing results.

1.4 QUALITY CONTROL

A. Cement concrete and hot mix asphalt placement, weather, and temperature restrictions shall be in accordance with Section 03300 – CONCRETE and Section 02500 – PAVING AND SURFACING.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT.

B. Cement Concrete delivery time and storage time onsite shall be in accordance with Section 03300 – CONCRETE and as specified herein.

C. Batch ticket information shall be submitted to the Engineer upon placement of cement concrete and hot mix asphalt.

1.6 REGULATIONS

A. All pedestrian ramps and sidewalks shall conform to the most current applicable details of the Massachusetts Dept. of Transportation Highway Division (MassDOT); to the latest MA AAB rules and regulations; and to the latest ADA standards for accessible design.

1.7 GUARANTEES

A. The Contractor shall guarantee all work for one year from the date of Substantial Completion from damage due to improper installation and improper use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cement Concrete for Sidewalks, Driveways and Pedestrian Ramps: Cement concrete shall conform to the Standard Specifications, M4.02.00 through M4.02.12 and be 4000 PSI at 28 day test, ¾-inch coarse aggregate, 610 pounds cement per cubic yard, 6 +/- 1.5% air entrained (AASHTO - M154), Type A water reducing admixture (AASHTO - M194), 3 to 4-inch slump, and Type II

dark-colored by adding 1.5 – 2 lbs. of lamp black per cubic yard at the plant, dependent on the concrete supplier. Contractor shall coordinate with City of Cambridge prior to specifying lamp black additive. Cement concrete shall contain micro-fiber added during batching at the plant to insure uniform distribution.

B. Micro-fiber: The cement concrete shall contain 1 pound of polypropylene micro-fiber per cubic yard. Fibers shall be 1/2" or 3/4" 100% polypropylene fibers, maximum 3 denier, complying with ASTM C 1116, Type III, Par. 4.1.3. Fibers per pound shall be not less than 50 million individual fibers. The micro-fiber shall be used in accordance with the manufacturer's specifications.

C. Curing Compound: Shall conform to Section 03300 – CAST-IN-PLACE CONCRETE for evaporation retarder.

D. Penetrating Liquid Concrete Sealer: Shall conform to Section 03300 – CAST-IN-PLACE CONCRETE.

E. Expansion Joints: Shall be 3/8" thick polyethylene foam and ¼" thick polyethylene foam conforming to ASTM D1751.

F. Control Joints: Those indicated to be saw cut shall be cut with a saw specifically designed for that purpose, which will cut into slab at least 1 in., but in no case less than 25% of slab depth, and no more than 33% of slab depth.

Sawing must be coordinated with the setting time of the concrete. It should be started as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw (usually within 4 to 12 hours after the concrete hardens); sawing should be completed before drying shrinkage stresses become large enough to produce cracking. The slab should be cut before the concrete cools, when the concrete sets enough to prevent raveling or tearing while saw cutting, and before drying-shrinkage cracks start to develop.

G. Hot Mix Asphalt for driveways: Shall conform to the applicable subsections of Section 02500 – PAVING AND SURFACING.

H. Granite curb, granite back curb, granite curb corners, granite edging, beveled granite curb, and granite curb transitions at pedestrian ramps: Shall conform to the Standard Specifications Section M9.04.

I. Cement Grout: Shall conform to Section 03315 – GROUT.

J. Cement Concrete for Granite Curb, Granite Back Curb, Granite Curb Corner, Granite Transitions for Pedestrian Ramps, and Granite Edging: Shall conform to Class A Concrete as indicated in Section 03300 – CONCRETE.

K. Water: Potable.

L. Gravel Subbase: Shall be in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

M. Forms: Shall be in accordance with Standard Specification Section 701.61A.

N. Brick: Shall be a full dimension paver conforming to the quality standards, size and color range of: "Pathway Full Range" brick paver as manufactured by Pine Hall Brick, Winston-Salem, NC, or an equivalent approved by the Engineer. Size shall be 4" W by 8" L by 2 1/4" D. Brick shall meet or exceed the requirements of ASTM C902, Class SX, Abrasion Type I, Application PS with average water absorption of not more than 5% with the five hour boil and an average compressive strength of 8,000 PSI (55Mpa) or more. Brick shall pass a minimum of 100 freeze thaw cycles.

O. Setting Bed: Shall contain coarse sand and aggregates mixed with the Portland Cement as processed by Rowe Contracting Company, Malden, Massachusetts or Quinn Perkins Company, Burlington, Massachusetts or approved equivalent, in order to add stability to the brick walk so that bricks will not roll, move, or rock. The sand for joint sweeping shall be mixed with Portland Cement Type II (2 parts sand to 1 part Portland Cement) and be free of coarse aggregates, enabling the fines to freely fill in around all sides of the bricks.

O. Edge Restraints: Edge sections shall be L-shaped galvanized steel paver restraints and are to be notched to provide for smooth curves and crisp angles. Sections shall conform to the following specifications: Height: 1.5”, Flange:1.75”, Lengths:6’0” or 8’0” and Thickness: 3/16”. Edge Restraints to be supplied by Border Concepts, Inc., P.O. Box 471185, Charlotte, NC 28241, Telephone Numbers: 1-800-845-3343 or 1-704-541-5509, Fax Number: 1-704-541-5610 or approved equivalent.

P. The mastic adhesive shall consist of 2% neoprene (grade WM1) oxidized asphalt with 155 degrees F softening point (80 penetration) and 10% asbestos-free fibers and 88% asphalt. Contractor shall follow manufacturer’s installation procedure.

Q. Iron Edge Sections shall be provided at all tree pits, all locations where the back of sidewalk does not abut a hard edge and as directed by the Engineer. Iron Edge sections shall be L-shaped galvanized steel paver restraints and are to be notched to provide for smooth curves and crisp angles. Sections shall conform to the following specifications: Height: 1.5”, Flange:1.75”, Lengths:6’0” or 8’0” and Thickness: 16 gauge. Iron Edge to be supplied by Border Concepts, Inc., P. O. Box 471185, Charlotte, NC 28241, Telephone numbers: 1-800-845-3343 or 1-704-541-5509, Fax Number: 1-704-541-5610 or approved equal.

R. Spikes: Are to be galvanized steel spiral not less than 10” in length.

S. Detectable tiles: The detectable warning strip at concrete pedestrian ramps, raised side street treatments abutting concrete sidewalks, and raised crosswalks abutting concrete sidewalks shall be the Cast Iron Detectable Warning Plates by East Jordan Iron Works (800-626-4653) or approved equivalent product. The Cast Iron Detectable Plate shall meet all ADA Accessibility Guidelines for Detectable Warnings. Plates should have truncated domes and a slip resistant texture with a coefficient of friction rating greater than 0.80. Warning panels shall be at least 24" deep and 60" wide at the point of crossing. The detectable warning strip at brick interfaces shall be yellow dipped.

Size: 24 in. (+/- 1") deep, cut as wide as the pedestrian ramp opening, and as wide of the crosswalk at raised side street treatments and raised crosswalks.

PART 3 – EXECUTION

3.1 PREPARATION

A. The edges of existing pavement, which is to remain, shall be saw cut to an even, straight edge in accordance with Section 01045 – CUTTING AND PATCHING. This includes roadways, sidewalks, and driveways.

B. Excavate, remove, segregate, and stockpile existing asphalt and cement concrete walks and driveways as required for utility installation or as indicated for replacement on the Contract Drawings.

1. Existing walks and driveways shall be sawcut at the limits of removal. Cement concrete walks and driveways shall be sawcut at existing score joint, so entire panel is removed.

2. Prior to excavation for pedestrian ramps, the Contractor shall review the location with the Engineer to determine what is necessary to allow for the installation to be compliant with the standards referenced above. Fixed objects such as utility poles and fire hydrants must be considered in location of pedestrian ramps. The type of pedestrian ramp may vary based on sidewalk width and slope.

3. Removed cement concrete and asphalt pavement including reinforcement shall be disposed of in accordance with Section 02051 – DEMOLITION, MODIFICATION AND ABANDONMENT.

4. Excess soil material removed shall be disposed of in accordance with Section 02080 – SOIL AND WASTE MANAGEMENT.

C. Excavate, remove, protect, and stack existing granite curb, granite edging, granite curb corners, and granite curb inlets as required for utility installations or as

indicated for replacement on the Contract Drawings in accordance with the

Standard Specifications Section 580.

D. Existing granite curb, granite edging, granite curb corners, and granite curb inlets not indicated to be reset shall be disposed of in accordance with Section 02051 – DEMOLITION, MODIFICATION AND ABANDONMENT

E. The Contractor shall exercise special care when excavating near trees and roots. Excavation shall conform to the requirements in Section 02100 – SITE PREPARATION AND TREE PRUNING.

F. Traffic signs shall be removed as required during the excavation. Bike rings, trash receptacles, parking meters and signs, etc. to be reused shall be appropriately protected, stacked, and stored for reuse. Traffic signs to be replaced, as indicated on the Contract Drawings or as required by the Engineer, shall be disposed of by the Contractor. Reinstallation of traffic signs shall be done the prior to the concrete pour. All regulatory signs shall be maintained throughout construction.

G. Subgrade under walks, pedestrian ramps, driveways, and curbs shall be graded to required elevations and proof rolled.

H. <u>Finish Grades</u>: At locations where the Drawings do not indicate proposed sidewalk grades, the grades shall be discussed with the Engineer prior to work, in order to address existing and proposed drainage concerns. The Contractor shall be responsible for ensuring that all new sidewalk area are graded to drain, either to existing structures or new structures.

I. Gravel subbase under sidewalks, pedestrian ramps, driveways, and curbs shall be graded to required elevations and compacted with plate-type mechanical compactors to ninety-five percent (95%) of the maximum dry density at optimum moisture content as determined by the AASHTO Standard Method of Test T99 Method.

J. Existing in-situ material shall be used for gravel subbase only when approved by the Engineer. The Contractor shall provide analytical proctor results of the existing material in accordance with Section 02210 - EARTH EXCAVATION, BACKFILL, FILL, AND GRADING for compaction testing if requested by the Engineer.

K. Imported gravel subbase shall be placed in one six-inch lift, loose measure unless otherwise noted.

L. Add approved material to bring to required grade and compact.

M. The subbase for sidewalks shall be graded to be sloped from the City right of way towards the street in order to meet ADA requirements, or as shown on the Contract Drawings, or as required by the Engineer.

N. Materials shall not be placed when subgrade and subbase is muddy, frozen, or has frost, snow, or water thereon.

O. The Contractor shall raise all water curb stop boxes and sewer, drain, and combined sewer castings to final grade and shall coordinate raising of other utility boxes and castings prior to pouring of concrete. The Contractor shall remove material from curb stop boxes with compressed air, after raising is complete and prior to pouring of concrete. Prior to pouring the concrete, the Contractor shall review locations where curb boxes have been raised with the Engineer.

3.2 CEMENT CONCRETE WALKS AND DRIVEWAYS

A. Concrete shall be installed to a depth of 6" at pedestrian ramps, across driveways, at street intersection corners (5' beyond the point of tangency on either side of the corner curve), and at other locations as directed by the Engineer. At all other locations, concrete shall be installed to a depth of 4".

B. Concrete shall be placed between April 1st (pending no upcoming snow storms) and November 1st only. Do not place concrete when air temperature at time of placement, or anticipated temperature for the following 24 hours, is lower than 40 degrees F or higher than 90 degrees F.

C. Strict compliance with the MassDOT-specified plant-to-placement time of 90 minutes will be enforced. The concrete shall be delivered to the site and discharge shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 1 hour.

D. Forms shall be placed in accordance with Standard Specification Section 701.61A.

E. Concrete placement shall be in accordance with the Standard Specifications Section 701.61B.

1. The concrete shall be placed in alternating slabs 30 feet in length unless otherwise required by the Engineer.

2. The slabs shall be separated by transverse performed expansion joint filler

as specified below:

a. Expansion joints of 3/8" thick foam shall be placed every 30 feet perpendicular to curb alignment extending through the sidewalk depth. Expansion joints of 3/8" thick foam shall also be placed around all appurtenances such as utility poles, hydrants, manholes, and other obstructions extending into and to a depth to match the adjacent sidewalk (4" or 6"). Six-inch expansion joints shall be placed at all locations where six-inch concrete driveways meet four-inch concrete walks. Expansion material protruding above the finished sidewalk shall be trimmed flush with a sharp instrument as soon as the concrete has set.

b. A 3/8" thick expansion joint shall be installed between all new cement concrete installations and existing cement concrete.

3. The slabs shall be separated by the curb by longitudinal expansion joint filler as specified below:

a. Expansion joints of ¼" thick foam shall be placed 4" or 6" deep longitudinally along the granite curb between curb and the concrete and also between buildings and retaining walls and the concrete as required by the Engineer. Six-inch expansion joints shall be placed at all locations where six-inch concrete corner slabs or driveways meet four inch concrete walks. Expansion material protruding above the finished sidewalk shall be trimmed flush with a sharp instrument as soon as the concrete has set.

4. In conveying the concrete from the place of mixing to the place of deposit, the operation shall be conducted in such a manner that no mortar will be lost and the concrete shall so be handled that the concrete will be of uniform composition throughout, showing neither excess not lack of mortar in any one place.

F. Concrete finishing shall be in accordance with the Standard Specifications Section 701.61B.

1. No finishing operation shall be performed while free water is present. Finishing operations shall be delayed until all bled water and water sheen has left the surface and concrete has started to stiffen.

2. Between the expansion joints at 30 foot spacing, the sidewalk shall be divided at five foot intervals (or as shown on the drawings) with sawcut joints, made with sawing tools, having a penetration depth which will cut into slab at least 1 in., but in no case less than 25% of slab depth, and no

more than 33% of slab depthand at 10 foot intervals (or as shown on the drawings) with construction joints. Joints shall be placed 90° transverse

with the direction of traffic and shall be straight within a tolerance of ¼-inch of a straight edge laid along the joint. Longitudinal joints shall be installed, at the requirements of the Engineer when the sidewalk is greater than 6' wide.

3. The surface shall be floated after completion of edging.

4. Immediately after floating the surface shall be steel troweled. If necessary the joints and edges shall be rerun before and after troweling to maintain uniformity.

5. After troweling the surface shall be brushed by drawing a soft-bristled pushbroom with a long handle over the surface of the concrete to produce a non-slip surface.

G. Curing compound shall be a clear, waterborne, membrane-forming compound, 18-22 percent solids. The Contractor shall propose the curing method and specifications for review prior to starting. . The curing compound shall not discolor the concrete, shall be compatible with anti-spalling sealant application after 14 days, and shall be applied according to the manufacturer's specifications. The mixture shall be applied immediately after the finishing is complete and free water has left the concrete's surface.

H. Penetrating Liquid Concrete Sealer: Prepare, apply, and finish penetrating liquid concrete sealer according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than 14 days old.

I. Forms shall be left in place for a period of 12-hours prior to removal. Upon removal, the Contractor shall backfill the void with either loam in accordance with Section 02210 – EARTH EXCAVATION, FILL, BACKFILL AND GRADING and seeded in accordance with Section 02900 – PLANTING or match the existing material and grade as specified.

J. After a minimum of 14 days, and after a 48-hour drying period in the event of precipitation, using pressure-spray equipment, the Contractor shall apply an alkaline resistant, protective penetrating, VOC compliant, solvent-based concrete sealer to the new concrete pavement as an anti-spalling seal. The sidewalk shall be swept and cleaned of any debris, gum, etc. and pressure washed, just prior to application of the sealant compound. Two applications are required, with the second application not being performed until after the concrete has regained its dry appearance.

K. The Contractor shall fully protect all new concrete work for a minimum of forty-eight hours. A representative of the Contractor shall remain on site at least three hours after the last section of concrete is placed. In addition, the contractor shall fully protect the concrete with plastic sheeting or matting. Plastic sheeting shall be installed so that it cannot pull or blow away under windy conditions and not damage installed concrete. Sidewalk vandalized or disturbed within three hours after the last section of concrete is placed shall be replaced by the Contractor at no additional cost to the City.

3.3 CEMENT CONCRETE PEDESTRIAN RAMPS

A. Concrete shall be installed to a depth of 6" depth.

B. The Contractor shall establish grade elevations at all pedestrian ramp locations, and shall set transition lengths as shown on the Contract Drawings and as per ADA and MA AAB requirements.

C. All pedestrian ramps joints and transition sections which define grade changes shall be formed, staked, and checked prior to placing cement concrete. All grade changes are to be made at joints. At driveways, a joint shall be located between the sloping portion of the driveway (15% maximum slope) and the level area where pedestrians will cross the driveway (1.5% maximum cross slope).

D. At intersections, pedestrian ramps shall be located in front of vehicle stop lines and within the crosswalk. The ramp shall be constructed so that the finished elevation of the concrete (curb removed) will meet the roadway flush (less than ½" lip) for a width no less than 42 inches. The elevation at this meeting point shall be properly designed to meet the gutter elevation of the road. The Contractor shall install pedestrian ramps and road grades in a manner which minimizes the potential for puddles in front of them.

E. The Contractor shall use a digital "Smart Level" to check all subbase grades for compliance prior to installation of concrete. The Contractor shall not proceed with concrete installation on a ramp that is out of compliance without first contacting the Engineer.

F. Forming, placement, finishing, curing and alkaline resistant protective penetrating concrete sealer shall be completed in accordance with Paragraph 3.2 of this Section except the pushbroom finish, which shall be perpendicular to the direction of the slope.

3.4 DETECTABLE TILE

A. Set detectable tile plate(s) into wet concrete in accordance with ADA and MA

AAB requirements.

B. Tamp plate(s) thoroughly with rubber mallet until concrete seeps through vent holes.

C. Clean off excess concrete from plate(s) and finish concrete around plate(s).

D. Cast iron detectable tiles shall be installed at time of sidewalk construction per manufacturer's directions and as shown on the plans and specified herein. Retrofit, bolted or surface applied installations shall not be accepted.

3.5 BRICK WALKS AND DRIVEWAYS

A. Hot mix asphalt base shall be installed to a depth of 4" and placed in accordance with the MassDOT Standard Specifications for hot mix asphalt.

1. Hot mix asphalt surface shall be rolled to remove irregularities prior to installing sand-cement setting bed.

B. The iron edge shall be installed as detailed, longitudinally to the granite curb at the back edge of the specified brick walk width and at all tree wells. The iron edge shall be secured by 10" spiral galvanized steel spikes placed every 12".

C. A 3/4" sand-cement setting bed shall be installed on the asphalt base. Wet saw is required for cutting of bricks and filling in pieces where needed. No other method will be acceptable.

D. After all the bricks are in place, stone dust free of coarse aggregates shall be swept into the voids around the bricks.

E. Once the bricks are placed in their specified patterns, they shall be compacted with a plate compactor. The compactor shall have a minimum force of 5000 lbs. and a frequency of 75 to 90 cycles per second.

F. Contractor shall follow manufacturer's installation procedures for the installation of mastic adhesive.

3.6 GRANITE CURB, GRANITE BACK CURB, GRANITE CURB CORNER, GRANITE CURB TRANSITION AT PEDESTRIAN RAMPS, AND GRANITE EDGING

A. Granite Curb, Granite Back Curb, Granite Curb Corners, , Granite Curb Transitions at Pedestrian Ramps,and Granite Edging shall be installed in accordance with the requirements of Section 501 of the Standard Specifications.

B. Existing Granite Curb, Granite Curb Corners, Granite Curb Inlets, Granite Curb Transitions at Pedestrian Ramps and Granite Edging that are to be removed and

reset shall be installed in accordance with the requirements of Section 580 of the Standard Specifications.

1. The Contractor shall verify and record all existing grades at locations where granite will be reset at the existing grade.

C. Installations shall be backfilled with concrete as indicated on the Contract Drawings.

3.7 DRIVEWAYS

A. Hot mix asphalt driveways shall be placed in accordance with the Standard Specifications Section 701.63.

PART 4 – COMPENSATION

Item 2524.1 – 4-Inch Cement Concrete Sidewalks

METHOD OF MEASUREMENT:
Measurement for 4-inch Cement Concrete Sidewalks shall be based on the square yards installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 4-inch Cement Concrete Sidewalks shall be based on the square yards of 4-in Cement Concrete Sidewalks installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of 4-in Cement Concrete Sidewalks as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs, or other items obstructing the construction of the sidewalk; excavate, removal and disposal of existing sidewalks; install, grade, compact, and test compaction of gravel sub-base and sub-grade; raise and adjust gate boxes, frames and covers, and other castings; furnish, install and compact Gravel Sub-base; furnish and install Cement Concrete complete with micro-fiber, expansion joints, and formwork; finish the Concrete; furnish and place the curing compound; protect the concrete after placement; furnish and place penetrating liquid concrete sealer; remove and dispose of formwork; backfilling; furnish and install loam and seed, mulch, or other backing and/or adjacent material specified including tree pits and grass areas; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; sidewalks installed to replace sidewalks damaged by the Contractor during construction; and 6-in sidewalks at driveways and pedestrian ramps.

Item 2524.2 – 6-Inch Cement Concrete Sidewalks at Driveways

METHOD OF MEASUREMENT:

Measurement for 6-inch Cement Concrete Sidewalks at Driveways shall be based on the square yards installed, complete, within the payment limits, as shown on the Contract Drawings or as

required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 6-inch Cement Concrete Sidewalks at Driveways shall be based on the square yards of 6-inch Cement Concrete Sidewalks at Driveways installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of 6-inch Cement Concrete Sidewalks at Driveways as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs or other items obstructing the construction of the sidewalk; excavate, removal and disposal of existing sidewalks; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; raise and adjust gate boxes, frames and covers and other castings; furnish and install Cement Concrete complete with micro-fiber, expansion joints, and formwork; finish the Concrete; furnish and place the curing compound; protect the concrete after placement; furnish and place penetrating liquid concrete sealer; remove and dispose of formwork; reinforcing; backfilling; furnish and install loam and seed, mulch, or other backing and/or adjacent material specified including tree pits and grass areas; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; sidewalks installed to replace sidewalks damaged by the Contractor during construction; 4-in sidewalks; pedestrian ramps; and the driveway in front of the River Street Fire Station.

Item 2524.3 – 6-Inch Cement Concrete at Pedestrian Ramps and Intersections

METHOD OF MEASUREMENT:
Measurement for 6-inch Cement Concrete at Pedestrian Ramps and Intersections shall be based on the square yards installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 6-inch Cement Concrete at Pedestrian Ramps and Intersections shall be based on the square yards of 6-inch Cement Concrete at Pedestrian Ramps and Intersections installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of 6-in Cement Concrete Pedestrian Ramps as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs or other items obstructing the construction of the sidewalk; excavate, removal and disposal of pedestrian ramps; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; raise and adjust gate boxes, frames and covers and other castings; furnish and install Cement Concrete complete with micro-fiber, expansion joints, and formwork; finish the Concrete; furnish and place the curing compound; protect the concrete after placement; furnish and place penetrating liquid concrete sealer; remove and dispose of formwork; reinforcing; backfilling; furnish and install loam and seed, mulch, or other backing and/or

adjacent material specified including tree pits and grass areas; and all other work not included

for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; sidewalks installed to replace sidewalks damaged by the Contractor during construction; 4-in sidewalks; and 6-in sidewalks at driveways.

Item 2524.4 – 6-Inch Reinforced Concrete Driveway at Fire Station

METHOD OF MEASUREMENT:
Measurement for 6-inch Reinforced Concrete Driveway at Fire Station shall be based on the square yards installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 6-inch Reinforced Concrete Driveway at Fire Station shall be based on the square yards of 6-inch Reinforced Concrete Driveway at Fire Station installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of 6-in Reinforced Concrete Driveway at Fire Station as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs or other items obstructing the construction of the sidewalk; excavate, removal and disposal of sidewalk; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; raise and adjust gate boxes, frames and covers and other castings; furnish and install Cement Concrete complete with reinforcement, expansion joints, and formwork; finish the Concrete; furnish and place the curing compound; protect the concrete after placement; furnish and place penetrating liquid concrete sealer; remove and dispose of formwork; reinforcing; backfilling; furnish and install loam and seed, mulch, or other backing and/or adjacent material specified including tree pits and grass areas; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; sidewalks installed to replace sidewalks damaged by the Contractor during construction; 4-in sidewalks; and 6-in sidewalks at driveways and pedestrian ramps excluding the Fire Station driveway.

Item 2524.5 Wire Cut Bricks on 4-In Hot Mix Asphalt (Sidewalks)

METHOD OF MEASUREMENT:
Measurement for Wire Cut Bricks on 4-inch Hot Mix Asphalt Base (Sidewalks) shall be based on the square yards installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Wire Cut Bricks on 4-inch Hot Mix Asphalt Base (Sidewalks) shall be based on the square yards of Wire Cut Bricks on 4-in Hot Mix Asphalt Base installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor,

materials, tools, equipment, and incidentals required for the installation of Wire Cut Bricks on 4-

in Hot Mix Asphalt Base (Sidewalks) as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs or other items obstructing the construction of the sidewalk; furnish, install, grade, compact, and test compaction of gravel sub-base and sub-grade; raise and adjust gate boxes, frames and covers, and other castings; removal and disposing existing bricks or concrete; furnish and install hot mix asphalt base; compaction of the hot mix asphalt base; protect the asphalt after placement; furnish and install wire cut bricks; furnish and install iron edge with spiral galvanized steel spikes; furnish and install ¾" sand-cement setting bed; applying asphalt tack coat and neoprene modified asphalt tack coat; sweeping with dry sand/ cement mix; compaction of bricks; backfilling; furnish and install loam and seed, mulch, or other backing and/or adjacent material specified including tree pits and grass areas; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; brick installed to replace bricks damaged by the Contractor during construction.

Item 2524.6 --- Remove and Reset/Relocate Granite Curb (Straight and Curved)

METHOD OF MEASUREMENT:
Measurement for Remove and Reset/Relocate Granite Curb (Straight and Curved) shall be based on the linear feet of granite curb removed and reset installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer. Payment will be made only after the curb has been reset.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Remove and Reset/Relocate Granite Curb (Straight and Curved) shall be based on the linear feet of granite curb removed and reset or relocate complete for this item in the proposal. Under the linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove and reset and/or relocate existing granite curb as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; saw cut; excavate, remove, transport, stack, protect and reset straight and curved granite curb; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; modifications to the existing granite curb; furnish and install Cement Concrete; point the granite curb; backfilling; furnish and install loam and seed, mulch, or other backing material specified; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; new granite curb; and removing and resetting granite curb transition for pedestrian ramps.
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Item 2524.7 --- Remove and Discard Granite Curb (Straight and Curved)

METHOD OF MEASUREMENT:
Measurement for Remove and Discard Granite Curb (Straight and Curved) shall be based on the linear feet of granite curb removed and from the project limits. Payment will be made only after the curb has been removed from the project site.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Remove and Discard Granite Curb (Straight and Curved) shall be based on the linear feet of Granite Curb removed from an existing alignment and discarded. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove and dispose of existing granite curb as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; saw cut; excavate, remove and transport, existing damaged or unsalvageable straight and curved granite; backfilling; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and discarded to accommodate the Contractor's means and methods; and disposal of existing granite curbing.

Item 2524.8 --- New Granite Curb Type VA4 (Straight)
Item 2524.81 --- New Granite Curb Type VA4 (Curved)

METHOD OF MEASUREMENT:
Measurement for New Granite Curb Type VA4 (Straight and Curved) shall be based on the linear feet of granite curb installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Curb Type VA4 (Straight and Curved) shall be based on the linear feet of Granite Curb (straight and curved) installed complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new granite curb as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; furnish and install new granite curb (straight and curved); install curbing at shallow depths as required; furnish and install cement concrete; point the granite curb; backfilling; furnish and install loam and seed, mulch, or other backing material specified; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the

Contractor; new granite transition curb at pedestrian ramps, driveways, and curb corners; and

removing and resetting granite curb.

Item 2524.9 --- New Granite Curb Type VA4 Transition (Straight)
Item 2524.91 --- New Granite Curb Type VA4 Transition (Curved)

METHOD OF MEASUREMENT:
Measurement for New Granite Curb Type VA4, Transition (Straight and Curved) shall be based on the linear feet of granite transition curb installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Curb Type VA4, Transition Curb (Straight and Curved) shall be based on the linear feet of Granite Transition Curb (straight and curved) installed complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new granite transition curb at pedestrian ramps as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; remove existing damaged and unsalvageable curb; saw cutting; excavation; furnish, install, grade, compact, and test compaction of gravel sub-base and sub-grade; furnish and install new granite transition curb at pedestrian ramps (straight and curved); furnish and install cement concrete; point the granite curb; backfilling; furnish and install loam and seed, mulch, or other backing material specified; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; new granite transition curb corners and curb corners; furnishing imported gravel sub-base; and removing and resetting granite curb.

Item 2524.10 --- New Granite Curb for Raised Crosswalks

METHOD OF MEASUREMENT:
Measurement for New Granite Back Curb for Back of Sidewalks and Raised Crosswalks shall be based on the linear feet of granite curb installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Back Curb for Back of Sidewalks and Raised Crosswalks shall be based on the linear feet of Granite Curb installed complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new granite back curb as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; furnish and install new granite back curb (straight); furnish and install cement concrete; point the granite back curb; backfilling; furnish and install loam and seed, mulch, or other

backing material specified; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; new granite transition curb at pedestrian ramps, driveways, and curb corners; and removing and resetting granite curb. This item includes the raised curbing located between and curbing.

Item 2524.11 --- New Beveled Curb (Straight and Curved)

METHOD OF MEASUREMENT:
Measurement for New Beveled Curb (Straight and Curved) shall be based on the linear feet of granite curb installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Beveled Curb (Straight and Curved) shall be based on the linear feet of Granite Curb installed complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new granite back curb as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; furnish and install new granite back curb (straight); furnish and install cement concrete; point the granite back curb; backfilling; furnish and install loam and seed, mulch, or other backing material specified; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; new granite transition curb at pedestrian ramps, driveways, and curb corners; and removing and resetting granite curb.

Item 2524.12 --- Granite Curb Corner Type A

METHOD OF MEASUREMENT:
Measurement for Granite Curb Corner Type A shall be based on the unit "Each" of granite curb corners installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Granite Curb Corner Type A shall be based on the unit "Each" Granite Curb Corner installed complete for this item in the proposal. Under the unit "Each" price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new

granite curb corners as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; furnish and install new granite curb corner; furnish

and install cement concrete; point the granite curb corner; backfilling; furnish and install loam and seed, mulch, or other backing material specified; and all other work not included for payment elsewhere.

Item 2524.13--- Cast-in-Place Detectable Tile

METHOD OF MEASUREMENT:
Measurement for Cast-in-place Detectable Tile shall be based on the square footage of detectable tile installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Cast-in-place Detectable Tile shall be based on square feet of Cast-in-place Detectable Tile installed complete for this item in the proposal. Under the Each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install detectable tiles as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; furnish install cast iron detectable warning panels; and all other work not included for payment elsewhere.

Item 2524.14 – Stamped Concrete Truck Apron

METHOD OF MEASUREMENT:
Measurement for Stamped Concrete Truck Apron shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Stamped Concrete Truck Apron shall be based on the square yards of Stamped Concrete Truck Apron installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of Stamped Concrete Truck Apron as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs or other items obstructing the construction of Stamped Concrete Truck Apron ; excavate, removal and disposal of sidewalk; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; raise and adjust gate boxes, frames and covers and other castings; furnish and install Cement Concrete complete with reinforcement, micro-fiber, expansion joints, scoring, and formwork; finish the Concrete; furnish and place the curing compound; protect the concrete after placement; furnish and place penetrating liquid concrete sealer; remove and dispose of formwork; reinforcing; backfilling; furnish and install loam and seed, mulch, or other backing and/or adjacent material specified including tree pits and grass areas; and all other work not included for payment elsewhere.

Item 2524.15 --- Removeable False Curb Utility Cover

METHOD OF MEASUREMENT:
Measurement for Removeable False Curb Utility Cover shall be based on the unit "Each" of Removeable False Curb Utility Cover installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Removeable False Curb Utility Cover shall be based on the unit "Each" for Removeable False Curb Utility Cover installed complete for this item in the proposal. Under the Each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to furnish and install new Removeable False Curb Utility Covers as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish, install, grade, compact and test compaction of gravel sub-base and sub-grade; furnish and install new Removeable False Curb Utility Cover; furnish and install cement concrete; adjust the Removeable False Curb Utility Cover; backfilling; furnish and install loam and seed, mulch, or other backing material specified; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new Type VA 4 granite curb; and removing and resetting granite curb.

END OF SECTION 02524

SECTION 02577

PAVEMENT MARKINGS

2577.1	**4-IN TO 8-IN REFLECTORIZED PAVEMENT MARKINGS – YELLOW AND WHITE THERMOPLASTIC**	**LINEAR FOOT**
2577.2	**PAVEMENT ARROWS & LEGENDS REFL. WHITE (THERMOPLASTIC)**	**SQUARE FOOT**
2577.3	**CROSSWALKS AND STOP LINES REFL. WHITE (THERMOPLASTIC)**	**SQUARE FOOT**
2577.5	**COLORED SURFACE TREATMENT**	**SQUARE FOOT**
2577.6	**BIKES YIELD TO PEDS MARKING (PREFORMED THERMOPLASTIC)**	**EACH**
2577.7	**HIGH SRI SURFACE PAINT**	**SQUARE YARD**

PART 1 – GENERAL

1.1 SUMMARY

A. Furnish and apply pavement markings in accordance with the MassDOT Highway Division, Standard Specifications for Highways and Bridges, latest edition, hereinafter referred to as the "Standard Specifications." All references to method of measurement, basis of payment, and payment items in the standard specifications are hereby deleted. References made to particular sections or paragraphs in the Standard Specifications shall include all related articles mentioned therein.

B. Colored Surface Treatment

a. The work to be completed consists of applying the specified colored surface treatments within preferential lanes and areas at the designated locations as shown on the Plans and as directed by the Engineer, in accordance with these specifications.

1.2 RELATED WORK

A. Section 02500 – PAVING AND SURFACING

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Product data and specification submittals.

2. For information purposes only, submit manufacturer’s printed installation

instructions.

PART 2 – PRODUCTS

2.1 MATERIALS

A. M7.01.03 White Thermoplastic Reflectorized Pavement Markings.

B. M7.01.04 Yellow Thermoplastic Reflectorized Pavement Markings.

C. M7.01.07 Glass Beads

D. COLORED SURFACE TREATMENT

1. **Performance Properties**

The following table outlines minimum performance properties for CST:

Characteristic	**Test Specification**	**Measured Result**
Adhesion to Asphalt	ASTM D7234	Substrate Failure
Wet Friction	ASTM E303	>55 BPN
Aggregate Hardness	Moh's Hardness Scale	Corundrum and Calcined Bauxite: 8 minimum Recycled Glass: 6 minimum

The CST shall be capable of application on new and existing asphalt and Portland cement concrete surfaces, and shall:

- Be VOC compliant and lead chromate free.
- Not contain 0.1% or more of any chemical listed by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), or regulated by the US Occupational Safety and Health Administration (OSHA) as a carcinogen.
- Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC).
- Be packaged and stored in accordance with the manufacturer's instructions and requirements for shelf life and storage conditions in original unopened containers. Shipping documents and containers shall have identification numbers or batch dates for confirmation of when products were manufactured, clearly labeled as to the type material and the ratio of the components to be mixed by volume as well as showing resin or hardener components, brand name, name of manufacturer, lot or batch number, temperature range for storage, expiration date and the quantity contained. Include any special instructions regarding mixing and the Material Safety Data Sheets. This information shall be made available for inspection at any time.
- Provide a surface where color and chemical resistance will not degrade under normal exposure to weather, street sweeping, snow plowing, calcium chloride, sodium chloride, oils (automotive or food) and automotive fuels.
- Use color pigments that remain stable under exposure to ultraviolet light and preferably have a positive rating on the LEED Solar Reflective Index.
- The Engineer must approve CST color prior to the purchase of materials by the Contractor. Colors shall be:
    a) Bicycle lanes: Green;
    b) Bus lanes: Terracotta;
    c) As specified by Plans.
- Friction aggregate:
    a) Type: As specified and provided by the CST manufacturer and must match the aggregate types listed in the table below.
    b) Hardness: Aggregate used must have a maximum hardness as listed in the table above. Adequate aggregate hardness will not relieve the Contractor of the Wet Friction performance requirement listed in the table above.
    c) Aggregate particle size must be:
        i. Bicycle facilities: between 0.8mm- 1.2mm;
        ii. Bus facilities: between 1.0mm - 3.0mm.

2. Approved Materials

Only products with a Manufacturer's certification that the product meets the requirements of this specification, or a Product approved equal as determined by the Engineer are deemed acceptable for use. All materials shall be pre- approved by the Engineer prior to purchase.

COLORED SURFACE TREATMENT (CST)- APPROVED MATERIALS LIST

Product	Manufacturer	Contact Information	Approved Aggregate	Manufacturer Recommendations
ColorSafe	Transpo Industries	20 Jones Street New Rochelle, NY 10801 800-321-7870 transpo.com	Calcined bauxite or Corundum	Primer plus two coats
CycleGrip MMAX	Ennis-Flint	115 Todd Court Thomasville, NC 27360 336-475-6600 ennisflint.com	Corundum	Bike lane: one coat (90 mils)
Safe-T-Grip	Epoplex	1000 East Park Avenue Maple Shade, NJ 08052 800-822-6920 epoplex.com	Bauxite / Granite (Mix)	Thin overlay one coat
High Friction Surface Treatment	Ruby Lake	493 State Route 28 Richfield Springs, NY 13439 914-523-3766 rubylakeglass.com	Recycled Glass	One epoxy coat plus one later
Safetrack SC	Stirling Lloyd	Rockwell Road, Building A, Newington, CT 06111 860-666-5008 northamerica.stirlinglloyd.com	Calcined bauxite	
Endurablend	Pavement Surface Coatings, LLC	81 Ball Road Mountain Lakes, NJ 07046 866-215-6120 Pavementsurfacecoatings.com	Calcined bauxite	One layer

3.

HIGH SRI SURFACE PAINT

Shall be Streetbond SB150 as manufactured by GAF, or approved equivalent. Provide warranty of 3 years.

PART 3 – EXECUTION

3.1 GENERAL

A. Apply Pavement Markings as follows:

Material	Material Application Temperature Degrees F	Line Thickness Inches	Reflectorized Application
M7.01.03	400-425	5.0 – 7.5	1lb/10 SF Drop On
M7.01.04	400-425	5.0 – 7.5	1lb/10 SF Drop On

B. The ambient air temperature for thermoplastic application shall be minimum of 45 degrees F and rising at the time of marking operations. If work has started and air temperatures fall below 45 degrees F [7.2 C] and continuous cooling is indicated, work shall be stopped. In cool weather conditions, temporary drops in temperature down to 40 degrees F [4.4 C] may be tolerated, providing temperatures also vary upwards. Sustained striping (greater than one hour) at 40 degrees F [4.4 C] shall not be allowed. Starting work at air temperatures lower than 45 degrees F [7.2 C] shall not be allowed.

C. Apply markings at cross walks and stop lines at the locations required by the Engineer or as shown in the Drawings.

D. Align new markings to match existing in color, dimensions, and spacing, and extend new markings where required.

E. Marking widths for crosswalks and stop lines shall be 24 inches and 12 inches respectively and applied within a tolerance of five percent. Deviation of straight strips shall not exceed ½-inch in 50 feet.

F. Existing pavement markings no longer required shall be completely removed, by grinding method, prior to placement of any temporary lines.

G. Pavement markings for crosswalks, fog lines, and stop lines shall be white. Pavement markings for centerlines shall be yellow.

H. All temporary pavement markings shall be traffic paint. All permanent markings shall be thermoplastic. Pavement markings for centerlines shall be yellow.

I. Pavement markings shall not be installed until a minimum of 15 days after final paving is completed. The Contractor shall notify the City of Cambridge Traffic Engineer at least 72 hours in advance of scheduled pavement marking installation. The exact location of pavement markings will be determined by the City's Traffic Engineer at the time of installation. The City's Traffic Engineer or representative must be present to supervise the pavement marking operations.

J. Broken lines through intersections (vehicular and bicycle) are indicated only graphically on the plans. Actual pattern shall be 4-foot line and 4-foot space.

K. Pavement arrows and legends in areas subject to general vehicle traffic and on bicycle facilities shall be thermoplastic.

L. The green-colored surface treatment shall be installed at bicycle conflict areas and bicycle turn boxes as indicated on the plans and as directed by the Engineer. The terra cotta-colored surface treatment shall be installed at bus lanes as indicated on the plans and as directed by the Engineer. The Contractor shall install the colored surface treatment in accordance with all manufacturers' installation and materials specifications. Copies of the manufacturer's installation procedures and materials specifications shall be provided to the Engineer for approval before placement of the surface treatment is allowed.

3.2 COLORED SURFACE TREATMENT

A. Layout

The Contractor must place CST as shown on the Plans or as ordered by the Engineer. The Contractor shall be responsible for the layout of the work and chalking of lines. The Engineering will approve the actual layout at the time of installation. All applications of preferential colored surface treatments shall be the full width of the lane or designated area within one half inch of the edge line and/or within 6 inches of a curb line. Unless otherwise directed, the Contractor shall always follow existing pavement-marking lines except in the case of crooked or bent lines. In that case, the Contractor shall install a new straight line that approximates the location of the existing marking. Where the City has previously installed colored surface treatments, the Contractor shall paint over the marking to refresh such marking. In any case where the Contractor is not following an existing line or marking, the Contractor shall first layout the new line with a chalk line.

B. General

Before the Contractor may begin any surface treatment work, the Contractor must submit a schedule of operations for the approval of the Engineer. At least five (5) days prior to starting application, the Contractor must provide the Engineerwith the color manufacturer's written instructions for use and provide access to aggregate for random testing. These instructions must include, but not be limited to, material mixing ratios and acceptable application temperatures.

When the Contractor applies CST under traffic, the Contractor must provide all necessary flags, markers, signs, etc. in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) to maintain and protect traffic, and to protect marking operations and the markings until thoroughly set.

The Contractor is responsible for removing, to the satisfaction of the

Engineer, all tracking marks and spilled CST applied in unauthorized areas such as utilities, drainage structures, curbs and manhole covers.

The Contractor must apply the asphalt pavement coating system to the pavement in accordance with the manufacturer's specification. In its hardened state, the color shall be as specified and as approved by the Engineer.

Asphalt pavement must be stable, well compacted and generally in excellent condition for the application of the asphalt pavement coating. The Engineer will make the final determination as to the suitability of the existing asphalt pavement.

The asphalt pavement surface must be dry and free from all foreign matter, including but not limited to dirt, dust, de-icing materials and chemical residue. All pavement shall be swept by a broom until clean prior to installation of any pavement markings. **(No gasoline or electric blower shall be used for cleaning.)** The Contractor shall be responsible for the amount of cleaning that may by required.

The asphalt pavement coating must only be applied in the correct environmental conditions as instructed by the coating supplier and as approved by the Engineer

In the event parked cars block the application of markings, the Contractor will be required to return to the site to complete the markings.

Refer to the instructions provided by the coating supplier regarding when the painted lane may be opened to traffic. Wait time is typically a function of the dry rate of the coating and climate conditions.

Upon suspension or completion of the work, the Contractor shall remove all materials, equipment, and rubbish and shall leave the premises in a neat and orderly condition. The Contractor shall remove all material spilled and any extraneous marks on the pavement made by the agents or employees of the Contractor, or made by others due to improper control or protection of the work area by the Contractor, his agents or employees within 24 hours. In cases where CST has hardened or set, it shall be removed by sand blasting. Painting over with black paint or the use of a grinding machine will not be allowed.

The Contractor must repair or replace at no cost to the City any installation which, in the opinion of the Engineer, is not acceptable, whether by reason of poor workmanship, poor appearance, poor performance, poor materials, improper width or improper alignment. The Contractor must replace rejected installation as directed by the Engineerwithin fifteen (15) days after receiving written notification of the rejection of such completed work. This work will be completed by the Contractor at the Contractor’s own expense. Material

shall be removed by sand blasting. Painting over with black paint or the use of a grinding machine will not be allowed.

Atmospheric Conditions: The Contractor may only apply CST during dry weather conditions and on dry pavement surfaces. At the time of installation, the pavement surface temperature must be at or above manufacturer recommendations.

Surface Preparation: The Contractor must clean the pavement and existing durable markings to the satisfaction of the Engineer. At the time of application, all pavement surfaces and existing durable markings shall be free of oil, dirt, dust, grease and similar foreign materials.

Application Equipment: Per manufacturer's instructions. The Contractor must receive written preapproval from the Engineer before spray applying any CST product.

Application: The Contractor must place CST at the width, thickness and pattern designated by the Contract Documents or work orders. Surface treatment operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions and pavement surface temperature are acceptable to the Engineer. The applied film thickness must comply with manufacturer recommendations.

PART 4 – COMPENSATION

2577.1 - 4-in to 8-in Reflectorized Pavement Markings – Yellow and White Thermoplastic

METHOD OF MEASUREMENT:
Measurement for payment for Reflectorized Pavement Markings shall be per linear foot of lines applied with thermoplastic. Broken lines shall be paid by deducting ¼ of the total linear foot of roadway painted with full deductions for breaks greater than 10-feet.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Reflectorized Pavement Markings shall be based on the linear foot price complete for this item in the proposal. Under the linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing Reflectorized Pavement Markings. The work includes, but is not limited to: sweeping, furnish, apply, and protect all thermoplastic pavement lines; grinding and removing pavement markings and lines no longer required.

EXCLUSIONS:
The following items are not included for payment under this item: Permanent crosswalks; painted lines for temporary or traffic management lines and crosswalks will not be paid for under this item but are to be paid for under Temporary Pavement Markings Yellow And White Paint.

2577.2 - Pavement Arrows & Legends- Refl. White (Thermoplastic)

METHOD OF MEASUREMENT:
Measurement for payment for reflectorized pavement markings shall be per square foot of arrows and legends applied with thermoplastic as specified.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Reflectorized Pavement Markings shall be based on the square foot price complete for this item in the proposal. Under the square foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing Reflectorized Pavement Markings. The work includes, but is not limited to: sweeping, furnish, apply, and protect all surface applied thermoplastic pavement markings; grinding and removing pavement markings and lines no longer required.

2577.3 – Crosswalks and Stop Lines Refl. White Thermoplastic

METHOD OF MEASUREMENT:
Measurement for payment for Crosswalks and Stop Lines Reflectorized Pavement Markings shall be per square foot of lines applied with thermoplastic.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Crosswalks and Stop Lines Reflectorized Pavement Markings shall be per square foot of lines applied with thermoplastic price complete for this item in the proposal. Under the square foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing Reflectorized Pavement Markings. The work includes, but is not limited to: sweeping, furnish, apply, and protect all thermoplastic pavement lines; grinding and removing pavement markings and lines no longer required.

2577.5 - Colored Surface Treatment

METHOD OF MEASUREMENT:
Measurement for payment for Colored Surface Treatment shall be per square foot of surface treatment installed as specified.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Colored Surface Treatment shall be based on the square foot price complete for this item in the proposal. Under the square foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing Colored Surface Treatment. The work includes, but is not limited to: sweeping, furnish, apply, and protect all surface applied tape or thermoplastic pavement markings; grinding and removing pavement markings and lines no longer required.

2577.6 - Bikes Yield to Peds Marking (Preformed Thermoplastic)

METHOD OF MEASUREMENT:
Measurement for payment for Bikes Yield to Peds Marking (Preformed Thermoplastic) shall be per each Bikes Yield to Peds marking installed as specified.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Bikes Yield to Peds Marking (Preformed Thermoplastic) shall be based on the each price complete for this item in the proposal. Under the each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing Bikes Yield to Peds Marking (Preformed Thermoplastic). The work includes, but is not limited to: sweeping, furnish, apply, and protect all preformed thermoplastic.

2577.7 - High SRI Surface Paint

METHOD OF MEASUREMENT:
Measurement for payment for High SRI Surface Paint shall be per square yard of pavement coating installed as specified.

BASIS OF PAYMENT / INCLUSIONS:
Payment for pavement coating shall be based on the square yard price complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing the surface paint. The work includes, but is not limited to: sweeping, furnish, apply, and protect all surface paint; grinding and removing pavement markings and lines no longer required.

END OF SECTION 02577

SECTION 02590

BRICK MASONRY

PART 1 – GENERAL

1.1 DESCRIPTION

A. The work covered under this Section includes the furnishing of all plant, labor, equipment, appliances and materials, and in performing all operations in connection with providing brick masonry, as directed, for furnishing and installing masonry plugs, brick inverts and tables, raising and adjusting castings, and for all other necessary appurtenant work complete and accepted in accordance with the Drawings and Specifications and as directed.

1.2 RELATED TECHNICAL SECTIONS

A. Section 02051 – DEMOLITION, MODIFICATION, AND ABANDONMENT

B. Section 02252 – MANHOLES

C. Section 02604 – CATCH BASINS

D. Section 03410 – PLANT-PRECAST STRUCTURAL CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Submit manufacturer specification sheets for and shop drawings for all masonry items, mortar and appurtenances.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Masonry

1. Masonry shall include brick masonry for extending manhole and catch basin frames to grade, brick masonry plugs for pipes and structures, manhole invert tables, cement mortar plaster on interior and exterior surfaces of masonry walls, mortar and related work. Brick masonry plugs for pipes and structures shall be a minimum of 8-inches thick, unless otherwise shown or directed. Other brick masonry shall be provided to the details and the dimensions specified, indicated or as directed.

B. Bricks

1. Bricks in general shall be clay or shale brick and shall conform in all respects to ASTM C32, latest revision, Grade SS. Bricks that are broken, warped, cracked or of improper size or quality, or otherwise defective shall not be used in the work and shall be removed from the site.

2. Brick for extending manhole frames to grade shall be concrete brick conforming to ASTM C139, latest revision.

C. Cement

1. Cement shall conform to the standard specifications for Portland cement of ASTM C150, latest revision, Type II, unless otherwise directed. Whenever directed by the City, a quick-setting cement (Type III) shall be used for any desired purpose at no additional expense to the City.

D. Sand

1. Sand for mortar shall be graded uniformly from fine to coarse and when dry shall pass a No. 8 sieve. Sand shall consist of aggregate having clean, hard, durable, strong, uncoated grains and free from injurious amounts of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam or other deleterious substances. The sand shall be washed clean before loading on delivery trucks. Natural sand which shows a color darker than the standard color when tested in accordance with the Colorimetric Test for Sands as described in ASTM C40, latest revision, will be cause for rejection.

E. Lime

1. Lime shall be hydrated lime conforming to ASTM C207, latest revision.

F. Water

1. Mixing water for concrete and mortar shall be clean and free from oil, acid, alkali, injurious amounts of vegetable matter and other impurities. Potable water obtained from a municipal supply is preferable.

G. Mortar

1. Mortar and mortar plaster shall be composed of one part Type II portland cement, and two parts sand to which a small amount of hydrated lime, not to exceed 10 lbs. to each bag of cement, shall be added. Only a sufficient amount of water shall be added to make a stiff plastic mortar of a consistency and texture satisfactory to the City. Retempering of mortar in which the cement has started to set will not be permitted.

PART 3 – EXECUTION

3.1 GENERAL

A. All exterior surfaces of masonry walls shall be plastered with mortar plaster to provide a minimum thickness of 1/2 inch. Mortar plaster shall be applied with sufficient pressure to ensure a dense plaster completely filling all voids and thoroughly bonded to the masonry wall. Masonry construction shall be done in a manner to ensure watertight construction and all leaks in masonry shall be sealed.

B. All workmanship shall conform to the best standard practice, and all brick masonry shall be laid by skilled workmen. Brick masonry for extending frames to grade shall be constructed to the thickness indicated. Brick masonry walls shall be constructed to the thickness indicated. All beds on which masonry is to be laid shall be cleaned and wetted properly. Brick shall be wetted as required and shall be damp but free of any surface water when placed in the work. Bed joints shall be formed of a thick layer of mortar which shall be smoothed or furrowed slightly. Head joints shall be formed by applying to the brick to be laid a full coat of mortar on the entire end, or on the entire sides as the case requires, and then shoving the mortar-covered end or side of the brick tightly against the bricks laid previously; the practice of buttering at the corners of the brick and then throwing mortar or scrapings into the empty joints will not be permitted. Dry or butt joints will not be permitted. Joints shall be uniform in thickness and shall be approximately 3/8-inch thick. Joints on the inside face of walls shall be tooled slightly concave with an approved jointer when the mortar is thumbprint hard; the mortar shall be compressed with complete contact along the edges so as to seal the surface of the joints. Brickwork shall be constructed accurately to dimensions, and brickwork at top of manholes shall be to the dimensions of the flange of the cast iron frames.

C. No water shall be allowed to flow against brickwork or to rise on the masonry for 60 hours after it has been laid, and any brick masonry damaged in this manner shall be replaced as directed at no additional expense to the City. Adequate precautions shall be taken in freezing weather to protect the masonry from damage by frost. Plaster shall be troweled to a smooth hard finish and no backfill shall be placed until the mortar has thoroughly hardened.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 02590

SECTION 02604

CATCH BASINS

2604.1	**CATCH BASIN – TYPE 1 SINGLE GRATE (4-FT DIAMETER)**	**EACH**
2604.2	**CATCH BASIN – TYPE 5 DIRECT INLET**	**EACH**
2604.3	**CATCH BASIN – TYPE 7 DRAIN INLET OVER SHALLOW UTILITIES**	**EACH**
2604.4	**CATCH BASIN – REMOVE AND REPLACE EXISTING FRAME AND GRATE**	**EACH**
2604.5	**PLAZA AREA DRAIN INLET AND RISER**	**EACH**

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing of precast concrete catch basins, complete and in place, within the limits and to the lines and grades indicated.
2. Furnishing, installing, and testing of drain inlets over shallow utilities at locations complete and in place, within the limits and to the lines and grades indicated
3. Furnishing, installing, and testing of plaza area drain inlets complete and in place, within the limits and to the lines and grades indicated
4. Removing and replacing existing catch basin frames and grates as indicated on the plans and as directed by the Engineer.

1.2 RELATED TECHNICAL SECTION

A. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

B. Section 02252 – MANHOLES

C. Section 02590 – BRICK MASONRY

D. Section 03300 – CONCRETE

E. Section 03315 – GROUT

F. Section 07160 – BITUMINOUS DAMPPROOFING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Complete shop drawings for all precast catch basin sections, plaza area drain inlet and riser, cast in place shallow catch basin structure, cast iron frames and covers and appurtenances.

2. Prior to fabrication, submit shop drawings showing details of precast monolithic base sections; risers; eccentric cone and flat slab catch basin tops; joints and gaskets; and construction details, tolerances, and other information as required by the City.

3. Submit manufacturer's recommended installation procedures for informational purposes.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. City reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

C. Engineer reserves the right to direct the Contractor to use blank riser sections in lieu of sections with pre-cast holes, should unknown site conflicts require field cutting of concrete for the connection of laterals.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

B. Removed catch basin fixtures must not be reused and shall be salvaged and delivered to the City of Cambridge Public Works storage yard unless directed by the City to dispose off site.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Precast Bases, Risers, and Tops: catch basins shall be constructed as per the requirements specified for manholes in Section 02252 – MANHOLES.

1. Catch basins shall be constructed as detailed. Catch basins shall be designed for a minimum of H-20 loading. Catch basins shall have a minimum of 6 ft sump depth, unless otherwise noted.

B. Concrete: catch basins shall be constructed as per the requirements specified for manholes in Section 02252 – MANHOLES.

C Frames and Grates:

1. Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects affecting the strength and value for the service intended. The finished coating shall be tough and tenacious when cold and not brittle or with any tendency to scale off under seasonable temperature changes.

2. Frames and Grates shall be Cast Iron, conforming to ASTM A48, Class 35B and as follows:

a. Castings to be free from scale, lumps, blisters and sand holes.

b. Machine contact surfaces to prevent rocking.

c. Thoroughly clean and hammer inspect.

3. Frames and grates shall be capable of withstanding AASHTO H-20 loading unless otherwise indicated or specified.

4. Catch Basin Grates Shall be waffle type similar to a style typified by East Jordan Iron Works (Series 5520M5), or approved equal.

5. Single Catch Basin Frames (3 flanged) shall be similar to a style typified by East Jordan Iron Works (Series 5523) or approved equal.

6. Drainage Inlet Frames (3 flanged) shall be as similar to a style typified by East Jordan Iron Works (Series 5525), or approved equal.

7. Single Direct Inlet Catch Basin Frames (3 flanged) shall be as similar to a style typified by East Jordan Iron Works (Series 5525), or approved equal.

8. Double Direct Inlet Catch Basin Frames (3 flanged) shall be similar to

a style by East Jordan Iron Works (Series 5444), or approved equal.

9. Plaza Drain Inlet Frames shall be similar to a style typified by Nyloplast (Series 0801DI), or approved equal

D. Hoods

1. For round structures, Catch Basin Hoods shall be similar to a style typified by East Jordan Iron Works (Series 5902), or approved equal.

E. DON'T DUMP Placards

1. "Don't Dump" Placards – This Section shall include the installation of Cast Iron or Steel "Don't Dump" placards, where new sidewalks abut existing or proposed catch basins and inlets. The placards will be furnished by the City at no cost to the contractor, for installation by the Contractor.

F. Jointing: catch basin jointing shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

G. Gaskets: catch basin jointing shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

H. Grout for Sealing Joints: catch basin sealing grout shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

I. Mortar for Brickwork: catch basin brickwork mortar shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

J. Brick: catch basin chimney bricks shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

K. Waterproofing: catch basin waterproofing shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

L. Bituminous Dampproofing: catch basin dampproofing shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

M. Flexible Seals: catch basin pipe seals shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

PART 3 – EXECUTION

3.1 PROCUREMENT:

A. In addition to riser sections identified in the pre-cast manufacturer's clock drawings, procure an additional one each of every nominal height of 4-ft diameter riser section for use as blanks when field cutting openings for pipe connections.

3.1 HANDLING:

A. Handle catch basin sections as per the requirements specified for manholes in Section 02252 – MANHOLES.

3.2 INSPECTION

A. Inspect catch basins sections as per the requirements specified for manholes in Section 02252 – MANHOLES.

3.3 INSTALLATION

A. Install catch basins sections as per the requirements specified for manholes in Section 02252 - MANHOLES.

3.4 BACKFILLING

A. Backfill catch basins sections as per the requirements specified for manholes in Section 02252 - MANHOLES.

3.5 INSTALLING HOODS AND TRAPS

A. Hoods shall be built into the catch basin wall, shall be watertight, and shall be installed in conformance with the manufacturer's instructions.

B. Hoods with Inserts shall be built into the catch basin wall and into the pipe, shall be water tight and shall be installed in conformance with the manufacturer's instructions.

3.6 INSPECTION AND TESTING

A. Inspect and test catch basins as per the requirements specified for manholes in Section 02252 – MANHOLES.

3.7 CLEANING

A. Clean catch basins as per the requirements specified for manholes in Section 02252 – MANHOLES.

3.8 DON'T DUMP PLACARDS INSTALLATION

A. "Don't Dump" placards shall be installed at all existing-to-remain or proposed catch basins and inlets unless otherwise indicated in the catch basin schedule on the Drawings.

PART 4 – COMPENSATION

Item 2604.1 --- Catch Basin – Type 1 Single Grate (4-foot Diameter)

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of precast concrete catch basin complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: gravel pavement subbase; pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; precast concrete catch basin sections with frames, grates, masonry chimney, appurtenances, pipe sleeve (if applicable); install City-furnished "Don't Dump" placards in adjacent sidewalk; field coring of pipe connections; furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Catch Basins shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional catch basins as shown on the Contract Drawings or as directed by the City or Engineer. **Assume catch basins to have a vertical depth of 12 feet as measured from inside bottom of base section to finished grade**.

Catch basins installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged under the DEP Dewatering Permit; procurement, installation, and compaction of CDF.

Item 2604.2 --- Catch Basin – Type 5 Direct Inlet
Item 2604.3 – Catch Basin – Type 7 Drain Inlet Over Shallow Utilities

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of precast concrete direct inlet catch basin complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; precast catch basin sections with frames, covers, masonry chimney, hoods, appurtenances; pipe sleeve (if applicable); install City-furnished "Don't Dump" placards in adjacent sidewalk; field coring of pipe connections; furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Catch Basin – Direct Inlet shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional catch basins as shown on the Contract Drawings or as directed by the City or Engineer.
Assume direct inlet catch basins to have a vertical depth of 4 feet as measured from inside bottom of base section to finished grade. **Assume drain inlets to have a vertical depth of 2.5 feet as measured from inside bottom of base section to finished grade**

Catch basins installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged under the DEP Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 2604.4 --- Catch Basin – Remove and Replace Existing Frame and Grate

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and inspection of removal and replacement of existing catch basin frame and grate complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: gravel pavement subbase; pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous

sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; catch basin frames, covers, masonry chimney, hoods, appurtenances; furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Catch Basin – Remove and Replace Existing Frame and Grate shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional catch basin frame and covers removed and replaced as shown on the Contract Drawings or as directed by the City or Engineer.

Item 2604.5 --- Plaza Area Drain Inlet and Riser

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement and installation of Plaza Area Drain Inlet and Riser complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. This work shall include furnishing, installing, and/or performing the following: paver or sidewalk sawcutting; removal of paver, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; transporting material to/from soil staging area; temporary excavation support; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; PVC riser sections, drain inlet grate, appurtenances; furnishing, placing and compacting suitable backfill soil; grade and compact pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Plaza Area Drain Inlet and Riser shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual number of complete and functional Plaza Area Drain Inlets and Risers as shown on the Contract Drawings or as directed by the Owner or Engineer.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged.

END OF SECTION 02604

SECTION 02609

REINFORCED CONCRETE PIPE

2609.1 PIPE – RCP (GRAVITY) 30-INCH LINEAR FOOT

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, installing, and testing of precast concrete circular and elliptical pipe, complete and in place, within the limits and to the lines and grades indicated.

1.2 RELATED TECHNICAL SECTIONS

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02252 – MANHOLES

D. Section 02604 – CATCH BASINS

E. Section 03300 – CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Shop drawings of pipe and fittings,

2. Product data and certified dimensional drawings of all pipe, joints, bends, special fittings, and appurtenances.

3. Gasket and pipe manufacturer's joint assembly directions,

4. Certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards,

5. For informational purposes only, submit manufacturer's printed installation instructions.

6. Certification with each delivery, that pipe complies to this specification,

7. Anticipated production and delivery schedule.

8. Results of leakage tests performed prior to final paving.

   a. Test results shall be logs maintained during Infiltration or Exfiltration Tests, or footage and logs of Close Circuit Television Inspection.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Owner reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Reinforced Concrete Pipe

1. The concrete pipes provided shall be of types having bell and spigot or tongue-and-groove ends, and the pipe units modified as required to receive the type of gaskets specified. Except as modified herein or on the Drawings, all precast reinforced concrete pipe shall meet the requirements of ASTM C76, latest revision, for Wall "B" or Wall "C" pre-cast concrete pipe. Pipe shall be of the Class indicated in the table below or as specifically indicated on the Plans. Regardless of the process used in the manufacture of the pipe, all pipe shall be manufactured of concrete having uniform high density and impermeability, and free from any objectionable voids, and shall have uniform positive and complete steel reinforcement bond and shall conform to the additional requirements specified herein. Workmanship and methods shall be in accordance with the best practices of modern shops for this type of work and shall be the product of a manufacturing firm having at least five years experience in the manufacture of this type of pipe. Pipe shall have a smooth and even interior surface free from roughness or irregularities. Prior to fabrication of pipe, submit shop drawings showing lengths of pipe, pipe joint details, construction details and tolerances as required by

the Owner. Each pipe shall be marked with the date of manufacture, mark or trademark of the manufacturer, and the class, wall thickness

of the pipe, and serial number. No slurry mix shall be used on interior of pipe.

Nominal Diameter Inches	Fill Height: Greater than 1'- 0" Not exceeding 3'	Fill Height: Greater than 3' Not exceeding 10'	Fill Heights: Greater than 10' Not exceeding 15'	Fill Height: Greater than 15' Not exceeding 20'	Fill Height: Greater than 20' Not exceeding 25'	Fill Height: Greater than 25' Not exceeding 30'	Fill Height: Greater than 30' Not exceeding 35'
10	NA	NA	NA	NA	NA	NA	NA
12	IV	III	IV	V	V-3160D	V-3790D	V-4000D
15	IV	III	IV	V	V-3080D	V-3390D	V-3575D
18	IV	III	IV	V	V	V-3115D	V-3300D
21	IV	III	IV	V	V	V	V-3100D
24	IV	III	IV	V	V	V	V
27	IV	III	IV	V	V	V	V
30	III	III	IV	V	V	V	V
33	III	III	IV	IV	V	V	V
36	III	III	IV	IV	V	V	V
42	II	III	IV	IV	V	V	V
48	II	III	IV	IV	V	V	V
54	II	III	IV	IV	V	V	V
60	I	II	IV	IV	V	V	V
66	I	II	III	IV	IV	V	V
72	I	II	III	IV	IV	V	V
78	I	II	III	IV	IV	V	V
84	I	II	III	IV	IV	V	V
90	I	II	III	IV	IV	V	V
96	I	II	III	IV	IV	V	V
102	I	II	III	IV	IV	V	V
108	I	II	III	IV	IV	V	V

2. Bends, fittings, and special sections shall be fabricated by cutting the pipe at the required angle and then rejoining the sections. Special pipe sections are defined as manhole pipe with and without a branch wye or tee and manhole pipe bends with both horizontal and vertical rotation. Complete shop drawings shall be submitted to the Engineer before fabrication. Concrete for repairs shall be as specified herein. The interior surface (face) of all repairs shall be smooth finished, equal to the pipe interior finish. All materials and workmanship shall be subject to the approval of the Engineer.

3. Dimensions, Reinforcement, and Strength Requirements: The dimensions, reinforcing steel, and strength requirements of the pipe shall meet the requirements of ASTM C76, latest revision, for Wall "B", Class III and IV pipe and for Wall "C", Class V pipe and the additional requirements specified herein. Reinforced concrete pipe shall be provided in full-length units, except where shorter lengths are indicated and/or required to meet field conditions; field cutting of pipe shall be avoided wherever possible. The cross-section of all ASTM C76 pipe shall be circular with circular reinforcing cages properly held in place with adequate longitudinal members to insure the accurate placement of all steel. The total cross-sectional area of steel in the pipe for the class and wall thickness specified herein shall be not less than that shown in ASTM C76, latest revision.

B. Pipe Joints

1. Each length of pipe shall be provided with bell-and-spigot or tongue- and-groove ends of concrete formed on machined joint rings in a manner to insure accurate joint surfaces. The diameter of the joint surfaces depended upon to compress the gasket shall not vary from the theoretical diameters by more than 1/16 inch. The joint shall be sealed by a round rubber gasket so that the joint will remain watertight under all conditions of service, including movement due to expansion, contraction, and normal settlement. The bell-and-spigot or tongue-and-groove ends of pipe shall be designed to enclose the gasket on four surfaces when the joint is in its final position. Pipe for jacking shall be provided with steel end rings and rubber gaskets.

2. Gaskets for sealing joints shall be the "O-ring" type gaskets meeting requirements of ASTM C443, latest revision, in all respects, and shall be of neoprene of a special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five years experience in the manufacture of rubber gaskets for pipe joints. Gaskets shall be of a composition and texture which shall be resistant to sewage, gasoline, industrial wastes, including oils and groundwater, and which will endure permanently under the conditions likely to be imposed by this use. Each gasket shall be a continuous ring of round solid section having smooth surfaces free from blisters, porosity and other imperfections. The gasket shall be the sole element of sealing and depended upon to make the joint watertight. When the pipe is laid, the gaskets shall be of adequate size to fill the groove on the spigot ring in which the gasket is placed. Cement mortar or other plastic materials, if required to finish the joints, shall not be employed as means for making joints watertight. Each compression ring shall be marked with type of rubber used. The jointing of the precast reinforced concrete pipe and

stoppers using the watertight joints specified above shall be installed in strict accordance with the published recommendations of the pipe manufacturer and as approved. Lubricants shall be used for jointing of pipe and shall be as recommended by the pipe manufacturer. The position of the gasket shall be checked and examined to insure the proper positioning of the gasket; joints that have been improperly made shall be taken apart and remade. It shall be the Contractor's responsibility to install the pipe in a manner that will maintain the gasket joint in adequate compression to insure watertight joints conforming to the test requirements specified herein.

3. Provide flat gaskets when size of pipe requires this type. The gasket manufacturer shall supply test data and affidavits showing compliance with these Specifications.

C. Concrete

1. Concrete used in the manufacture of all precast reinforced concrete pipe shall have an average strength of not less than 4,000, 5,000 and 6,000 pounds per square inch at 28 days as applicable for the size class and wall specified. Strength of concrete used in the manufacture of the pipe shall be determined by tests on 6-inch by 12-inch vibrated test cylinders cured in the same manner as the pipe or by cores cut from pipe wall or by other approved method. Cement shall be moderate heat of hydration Portland cement conforming to ASTM C150, latest revision, Type II. Absorption determined by boiling test described in ASTM C76, latest revision, shall not exceed 5.3 percent of dry weight.

D. Marking

1. Each length of pipe shall be plainly marked with the piping class designation which it is designed for, wall of pipe, its individual identifying serial number, the date of its manufacture, manufacturer's mark or trademark, and in addition, all other identification marking or data required by the Owner.

E. Reinforced Concrete Flared Pipe End

1. The flared pipe end shall be reinforced concrete, matching the ASTM C76 class of the adjoining reinforced concrete pipe. The concrete shall be of uniform high density and impermeability, free from any objectionable voids. The steel reinforcement shall be uniform and satisfying ASTM C76 requirements.

2. The pipe joint shall be compatible with the adjoining reinforced concrete pipe.

E. Reinforced Concrete Elliptical Pipe

1. Elliptical Concrete Pipe shall conform to ASTM C507.

PART 3 – EXECUTION

3.1 PIPE AND PIPE FITTINGS

A. General: Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

B. Handling Pipe: Each pipe unit shall be handled into its position in the trench only in such manner and by such means, as the Engineer accepts as satisfactory. The Contractor will be required to furnish suitable devices to permit satisfactory support of all parts of the pipe unit when it is lifted.

C. Laying Pipe: Except where a concrete cradle or envelope is required, all pipe greater than or equal to 18-inches in diameter shall be laid in a crushed stone cradle in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING. In trenches, no blocking or supporting of the piping by concrete, stones, bricks, wooden wedges, or method other than bedding the pipe on crushed stone will be permitted. Each length of pipe shall be shoved home against the pipe previously laid and held securely in position. Joints shall not be "pulled" or "cramped" without approval of the Engineer.

D. Jointing Pipe: After the pipe are aligned in the trench and are ready to be jointed, all joint surfaces shall be cleaned.

E. Alignment and Placement: All pipe shall be laid with extreme care as to grade and alignment. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.

F. Stakeout of drain work and setting of line and grade is the responsibility of the Contractor. The Contractor shall establish centerline and offset stakes at each manhole, plus one intermediate centerline and offset stake as a checkpoint between manholes. Laser aligning shall not be used to establish a continuous line in excess of 400 feet.

G. For installation near crossing utilities and encasement requirements, refer to Contract Drawings.

H. For Cast-In-Place concrete field closures, refer to Contract Drawings.

I. For lateral service connections, refer to Contract Drawings.

J. Cleaning: Care shall be taken to prevent earth, water and other materials from

entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and manholes being careful to prevent soil, water and debris from entering any existing Drain.

1. Place plugs in end of uncompleted conduit at end of day or whenever work stops.

2 Flush lines between manholes if required to remove collected debris.

K. Review of Completed Storm Drain System: If the visual observation of the completed drain or any part thereof shows any pipe, manhole, or joint to be of defective work or material the defect shall be replaced or repaired as directed. The visual observation shall be conducted by the Engineer and any defects shall be as identified by such. The Contractor shall coordinate and provide site access for the Engineer.

3.2. LEAKAGE TESTS

A. Refer to Article 51 – "Leakage Tests" in Section 00825A – SPECIAL CONDITIONS.

B. If Leakage Test method consists of visual or Close Circuit Television Inspection, the contractor shall perform at no additional cost to the Owner. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

PART 4 – COMPENSATION

Item 2609.1 --- Pipe – RCP (Gravity) 30-Inch

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of precast concrete pipe complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. This work shall include furnishing, installing, and/or performing the following: pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; reinforced concrete pipe, fittings, couplings, and appurtenances; connecting existing and new laterals; connections to structures; furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Precast Concrete Pipe shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual linear feet of complete and functional pipes as shown on the Contract Drawings or as directed by the Owner or Engineer. Measurement shall be taken along the centerline of the pipe from the inside face of structures to inside face of structures, or to the points of connection with existing pipes.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95

percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon

receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged; procurement, installation, and compaction of CDF.

END OF SECTION 02609

SECTION 02615

DUCTILE IRON PIPE FOR SANITARY
AND STORM DRAIN GRAVITY

2615.1 PIPE – DI (GRAVITY) 8-INCH DIAMETER LINEAR FOOT

2615.2 PIPE – DI (GRAVITY) 12-INCH DIAMETER LINEAR FOOT

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes the following:

1. Furnishing, installing, and testing ductile-iron pipe and fittings for gravity sanitary sewers and storm drains complete in place within the limits and to the lines and grades indicated.

B. Options:

1. For joints in buried exterior pipelines, provide either push-on or mechanical-joint. All fittings and valves shall be mechanical joint.

2. Concrete Encasement: For sanitary sewer and/or storm drain installed above water pipe, see Details.

3. CDF Encasement: For shallow depth of cover at catch basins, see Details.

1.2 RELATED TECHNICAL SECTIONS

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02252 – MANHOLES

D. Section 02622 – POLYVINYL CHLORIDE PIPE

E. Section 02640 – VALVES AND APPURTENANCES

F. Section 02704 – PIPELINE PRESSURE LEAKAGE TESTING

G. Section 03300 – CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Shop drawings of pipe and fittings,

2. Product data and certified dimensional drawings of all pipe, joints, bends, special fittings, and appurtenances.

3. Gasket and pipe manufacturer's joint assembly directions,

4. Certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards,

5. For informational purposes only, submit manufacturer's printed installation instructions.

6. Certification with each delivery, that pipe complies to this specification,

7. Anticipated production and delivery schedule.

8. Results of leakage tests performed prior to final paving.

a. Gravity pipe test results shall be logs maintained during Infiltration or Exfiltration Tests, or footage and logs of Close Circuit Television Inspection.

9. Manufacturer's literature stating that the ductile iron pipe and fittings for force mains have been manufactured and tested in accordance with AWWA/ANSI specifications.

10. Detailed description of proposed pressure testing procedures to be used for force mains, if required. The description shall contain the name of the person responsible for pressure testing, and equipment to be used. Review of the description shall not be construed as approval of any methods to be used, the Contractor shall be fully responsible for achieving the specified test results.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Owner reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 GENERAL

A. Listed Manufactures:

1. US Pipe and Foundry Company,

2. Griffin Pipe Products Company,

3. American Cast Iron Pipe Company,

4. or equal.

2.2 DUCTILE IRON PIPE

A. Ductile iron pipe shall be that of a United States manufacturer who can demonstrate at least 5 years of successful experience in manufacturing ductile iron pipe conforming to ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51.

B. The ductile iron pipe shall be Class 52 and furnished in nominal 18-foot lengths. For shallow installations, Class 53 shall be used where indicated in the Details.

C. The ductile iron pipe shall be unlined inside, and asphalt seal coated where used for drainage or gravity service. The pipe shall be furnished along with necessary materials and equipment recommended by the manufacturer for use in joining pipe lengths and fittings.

2.3 FITTINGS

A. Fittings shall be manufactured in the United States and shall be compact ductile iron Class 350 Mechanical Joint, conforming to ANSI/AWWA C153/A21.53, latest edition, for pipe sizes 16 inches and smaller. Pipe sizes larger than 16 24 inches shall be Class 350 standard Mechanical Joint fittings conforming to ANSI/AWWA C110/A21.10, latest edition except as specified, or indicated on the drawings. Fittings shall be suitable for use with restraints as specified hereinafter.

B. Fittings shall be of the same material and have the same lining and coating as the pipe specified above. All fittings shall be marked with the weight and shall have distinctly cast upon them the pressure rating, the manufacturer's

identification, nominal diameter of openings and the number of degrees or fraction of the circle on all bends.

C. Caps and plugs installed in all new work as indicated on the drawings shall be provided with a threaded corporation or bleeder valve so that air and water pressure can be relieved prior to future connection.

D. Solid sleeves shall be ductile iron with 350 psi rating. Sleeves shall conform to ANSI/AWWA C110/A21.1.

2.4 ADAPTERS

A. Furnish and install for joining pipe of different types, unless solid sleeves indicated.

1. Provide ends conforming to above specifications for appropriate type of joint, to receive adjoining pipe.

2. Joining two classes of pipe may be of lighter class provided annular space in bell-and-spigot type joints sufficient for jointing.

2.5 JOINTS

A. Provide mechanical joint or push-on joint pipe with necessary accessories, conforming to ANSI/AWWA C111/A21.11.

B. Provide gasket composition suitable for exposure to liquid within pipe.

C. Restrained joints shall be furnished for installation on all fittings, sleeves, hydrants and valves.

1. Restraints for mechanical joints shall be:

a. Uni-flanged Series 1400 by Ford Meter Box,

b. Stargrip Series 3000 by Star Pipe Products,

c. or equal.

2. Restraints for push-on joints shall be:

a. Uni-Flange Series 1390 by Ford Meter Box,

b. Stargrip Series 3100 by Star Pipe Products,

c. or equal.

2.6 COUPLINGS

A. For gravity applications, couplings shall be shielded flexible type in

accordance with Section 02622 – POLYVINYL CHLORIDE PIPE.

B. For pressure applications, couplings shall be solid sleeve type as follows:

1. Pressure rating at least equal to that of related pipeline with a minimum rating of 150 psi. Couplings shall be provided with; steel sleeve that is fusion bonded epoxy coating; 2 steel followers; 2 nitrile rubbed gaskets; and steel bolts.

2. Couplings shall be similar to a style typified by Style 441 manufactured by Smith Blair, Inc, or an approved equal.

2.7 CONNECTIONS - TAPPED

A. Provide watertight joint with adequate strength against pullout. Use only tapered thread taps. Maximum size of taps in pipe or fittings without bosses not to exceed that listed in appropriate table of Appendix to ANSI A21.51 based on: 2 full threads for ductile iron.

B. Where size of connection exceeds that given above for pipe, provide boss on pipe barrel or use tapping saddle. Make tap in flat part of intersection of run and branch of tee or cross, or connect by means of tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, as indicated or permitted.

2.8 STANDARD LINING AND COATING

A. Inside of pipe and fittings: Provide double thickness cement lining and bituminous seal coat conforming to ANSI/AWWA C104/A21.4.

B. Outside of other pipe and fittings: Standard bituminous coating conforming to appropriate ANSI Standard.

2.9 POLYETHYLENE PIPE ENCASEMENT

A. Material: Virgin polyethylene conforming to ANSI/ASTM D1248.

B. Thickness: Minimum nominal thickness of 8 mils.

C. Material and installation methods to conform to requirements of AWWA C105.

2.10 INSULATION

A. Insulation shall be factory formed-in-place polyurethane foam insulation having nominal thickness of 3”, with an in-place density of 2.5 pcf, and a “K” factor of 0.14 BUT/in./hr/°F/ft². Straight joints between insulated pipe lengths, and the end section of non-insulated pipe shall be 20-gauge

corrugated aluminum performed to be fastened with stainless steel screws and bands. Jackets shall have expansion joints at 25-foot intervals.

B. Jacket shall have one layer of one (1) mil polyethylene film with a protective coat of 40-lb. virgin draft paper to act as a moisture and galvanic corrosion barrier.

C. Insulation shall be manufactured by:

1. Thermal Pipe Systems, Inc,

2. Insul Tek Piping Systems, Inc,

3. Tricon Piping Systems, Inc,

4. or equal.

2.11 THRUST BLOCKING

A. Where applicable or directed, reaction or concrete thrust blocks shall be furnished at all tees, plus bends as directed or as detailed on drawings with 3,000 psi, 1-1/2, 470 cement concrete masonry. The blocks will be poured against undisturbed original ground and shall be so placed that the pipe joints will be accessible for any possible future repairs. The primary means of restraint shall consist of a mechanical joint restraint or push-on joint restraint as specified.

2.12 SERVICE CONNECTIONS

A. For gravity service lateral connections, refer to Section 02622 – POLYVINYL CHLORIDE PIPE.

PART 3 – EXECUTION

3.1 HANDLING PIPE

A. The Contractor shall take care not to damage pipe by impact, bending, compression, or abrasion during handling, and installation. Joint ends of pipe especially shall be kept clean.

B. Pipe shall be stored above ground at a height no greater than 5 feet, and with even support for the pipe barrel.

C. Only nylon-protected slings shall be used for handling the pipe. No hooks or bare cables will be permitted.

D. Gaskets shall be shipped in cartons and stored in a clean area, away from grease, oil, heat, direct sunlight and ozone producing electric motors.

3.2 ALIGNMENT AND PLACEMENT OF PIPE

A. For installation near crossing utilities and encasement requirements, refer to Contract Drawings.

B. Jointing of ductile iron pipe and fittings shall be done in accordance with the printed recommendations of the manufacturer and as specified. The last 8 inches of the outside of the spigot end of pipe and the inside of the bell end of pipe shall be thoroughly cleaned. The joint surfaces and the gasket shall be painted with a lubricant just prior to making up the joint. The spigot end shall then be gently pushed home into the bell. The position of the gasket shall be checked to insure that the joint has been properly made and is watertight. Care shall be taken not to exceed the manufacturer's recommended maximum deflection allowed for each joint.

C. Installation and jointing of push-on ductile iron pipe shall be in accordance with AWWA C600 Sections 9b and 9c, latest revision, as applicable.

D. Mechanical joints for force mains: Restraints shall be installed in full accordance with the manufacturers' instructions. All bolt heads shall be tightened sufficiently so that they shear off to provide indication that proper tightening torque was achieved (if applicable).

E. Ductile iron pipe installed within 5 feet of gas lines or within areas subject to corrosive soils or waters shall be fully encased with polyethylene material. Polyethylene shall be 8-millimeters thick and comply with AWWA C-105.

F. Insulated pipe with jacket is to be installed where shown on the drawings and on any pipe having less than 4-foot cover.

G. Solid sleeves shall be used to join plain ends on ductile iron pipe. Mechanical joints shall be installed as specified herein before.

3.3 INSTALLATION

A. Piping Support:

1. Furnish and install supports to hold piping at lines and grades indicated or specified.

2. Support pipe and appurtenances connected to equipment to prevent any strain imposed on equipment.

B. Pipe and Fittings:

1. Remove and replace defective pieces.

2. Clear of all debris and dirt before installing and keep clean until accepted.

3. Lay accurately to lines and grades indicated or required. Provide accurate alignment, both horizontally and vertically.

4. Provide firm bearing along entire length of buried pipelines.

C. Socket Pipe Clamps, Tierods, and Bridles: Where indicated or necessary to prevent joints or sleeve couplings from pulling apart under pressure, provide suitable socket pipe clamps, tierods, and bridles. Use bridles and tierod at least 3/4 in. in diameter except where they replace flange bolts of smaller size with nut on each side of flange pairs. Coat clamps and tierods or bridles with two coats of bituminous coating after assembly and allow to dry before backfilling.

D. Appurtenances: Set valves, fittings and appurtenances as indicated.

3.4 JOINTS AND COUPLINGS

A. Push-on Joints:

1. Insert gasket into groove bell. Apply thin film of nontoxic gasket lubricant over inner surface of gasket in contact with spigot end.
2. Insert chamfered end into gasket. Force pipe past it until it seats against socket bottom.

3. Where required install restraint and secure in accordance with manufacturer's instructions.

B. Mechanical Joints:

1. Wire brush surfaces in contact with gasket and clean gasket.

2. Lubricate gasket, bell, and spigot with soapy water.

3. Slip gland and gasket over spigot and insert spigot into bell until seated.

4. Seat gasket and press gland firmly against gasket.

5. After bolts inserted and nuts made finger-tight, tighten diametrically opposite nuts progressively and uniformly around joint by torque wrench. Torque bolts to values specified above.

C. Sleeve-Type Coupling:

1. Clean pipe ends for distance of 8 inches.

2. Use soapy water as gasket lubricant.

3. Slip follower and gasket over each pipe to a distance of 6 inches from end and place middle ring on pipe end until centered over joint.

4. Insert other pipe end into middle ring and bring to proper position in relation to pipe laid.

5. Press gaskets and followers into middle ring flares.

6. After bolts inserted and nuts made fingertight, tighten diametrically opposite nuts by use of torque wrench of size and torque specified below:

TORQUE

Nominal pipe size (inches)	Bolt diameter (inch)	Range of torque (ft-lb)
3/24	5/8	75
30-36 (1/2 in. mid ring) (3/8 in. mid ring)	 5/8 5/8	 75 65
30-48	3/4	70
48-72	3/4	70

7. After assembly and inspection and before backfill, coat exterior surfaces of buried couplings with heavy-bodied bituminous mastic.

D. Tapped Connection:

1. Drill and tap normal to longitudinal axis.

2. Drilled by skilled mechanics using proper tools.

3. Use only tapered threads.

E. Joining to Existing Pipe:

1. For connecting proposed pipe to existing pipe, refer to Details.

F. Service Connections:

1. For connection of laterals to proposed or existing pipe, refer to Details.

3.5 TESTING

A. Refer to Article 51 – “Leakage Tests” in Section 00825A – SPECIAL CONDITIONS.

B. If Leakage Test method consists of visual or Close Circuit Television Inspection, the contractor shall perform at no additional cost to the Owner. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

PART 4 – COMPENSATION

Item 2615.1 --- Pipe – DI (Gravity) 8-Inch Diameter
Item 2615.2 --- Pipe – DI (Gravity) 12-Inch Diameter

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of ductile iron pipe complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. This work shall include furnishing, installing, and/or performing the following: gravel pavement subbase; pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; ductile iron pipe, fittings, couplings, and appurtenances; connecting existing and new laterals; connections to structures; furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Pipe – DI (Gravity) 8-Inch and 12-Inch Diameter shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual linear feet of complete and functional pipes as shown on the Contract Drawings or as directed by the Owner or Engineer. Measurement shall be taken along the centerline of the pipe from the inside face of structures to inside face of structures, or to the points of connection with existing pipes.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged; procurement, installation, and compaction of CDF; ductile iron pipe used for water pipe.

END OF SECTION 02615

SECTION 02622

POLYVINYL CHLORIDE PIPE

2622.1	**RECONNECT, REPAIR, OR RELOCATE EXISTING SANITARY SEWER AND STORM DRAIN LATERALS**	**LINEAR FOOT**
2622.2	**PIPE – PVC (GRAVITY) 6-INCH PERFORATED**	**LINEAR FOOT**
2622.3	**PIPE – PVC (GRAVITY) 6-INCH**	**LINEAR FOOT**
2622.4	**PIPE – PVC (GRAVITY) 8-INCH**	**LINEAR FOOT**
2622.5	**PIPE – PVC (GRAVITY) 10-INCH**	**LINEAR FOOT**
2622.6	**PIPE – PVC (GRAVITY) 12-INCH**	**LINEAR FOOT**
2622.7	**PIPE – PVC (GRAVITY) 15-INCH**	**LINEAR FOOT**
2622.8	**PIPE – PVC (GRAVITY) 18-INCH**	**LINEAR FOOT**
2622.9	**PIPE – PVC (GRAVITY) 21-INCH**	**LINEAR FOOT**

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, installing, and testing of PVC pipe and fittings complete and in place, within the limits and to the lines and grades indicated.

1.2 RELATED TECHNICAL SECTIONS

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02252 – MANHOLES

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Shop drawings of pipe and fittings,

2. Product data and certified dimensional drawings of all pipe, joints, bends, special fittings, and appurtenances.

3. Gasket and pipe manufacturer's joint assembly directions,

4. Certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards,

5. For informational purposes only, submit manufacturer's printed installation instructions.

6. Certification with each delivery, that pipe complies to this specification,

7. Anticipated production and delivery schedule.

8. Results of leakage tests performed prior to final paving.

   a. Test results shall be logs maintained during Infiltration or Exfiltration Tests, or footage and logs of Close Circuit Television Inspection.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. City reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General

1. All PVC pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and pressure rating or stiffness in psi (kpa).

2. The Contractor shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.

B. Pipe

1. All PVC pipe shall be joined by compression joints unless otherwise shown or specified, and shall conform to the following requirements:

2. Non Perforated Polyvinyl chloride pipe (PVC) shall conform to the requirements of ASTM D 3034, Class SDR 35. Material for PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or 12454-C as defined therein. All diameters shall be as specified on the Contract Drawings.

3. Perforated PVC pipe shall conform to the requirements of ASTM D 3034, Class SDR 35. Material for perforated PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or 12454-C as defined therein. The pipe shall have 3/8-inch to ½-inch perforations, 6-inch on-center top and sides. The pipe shall be 6 inches in diameter unless otherwise specified on the Contract Drawings.

5. Elastomeric seals for compression type joints for PVC pipe and fittings shall conform to the requirements of ASTM D 3212.

6. Service pipes for storm services shall be minimum of 6 inches and shall match diameter of existing services for reconnections. Service pipes for sanitary services shall be minimum of 6 inches and shall match diameter of existing, services for reconnections.

C. Fittings

1. All fittings shall conform to the requirements of ASTM D 3034 or ASTM F 679. The ring groove and gasket ring shall be compatible with PVC pipe ends. The flanged fittings shall be compatible with cast-iron or ductile iron pipe fittings.

2. The strength class of the fittings shall be not less than the strength class of any adjoining pipe.

3. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are acceptable in accordance with Figure 02622 A and Figure 02622 B. Inserta-tees may be used only where approved by the Engineer and if allowed, shall be cast in 6-inches of concrete.

D. Shielded Flexible Couplings

1. General

a. Shielded flexible couplings shall be used to connect sewer and drain pipe. Typical applications are where new pipe connects to existing pipe or a pipe with dissimilar material or size.

b. Non-shielded flexible couplings are permitted for sewer and drain service laterals 6-inch in diameter or less.

c. Couplings and shields shall be sized to fit the outer diameter of pipe, and be rated for the pipe material and conditions of service by the manufacturer.

d. Eccentric couplings shall be used where connecting pipes of different nominal diameter.

e. The CONTRACTOR will not be allowed to substitute any other type of coupling unless approved by the ENGINEER.

2. Construction

a. Flexible couplings shall be in accordance with ASTM C1173 – Standard Specification for Flexible Transition Couplings for Underground Piping Systems.

b. Rubber sleeves shall be rated for heavy earth loads and be immune to attack by chemicals and impurities normally found in water or wastewater.

c. Shields shall consist of a rigid stainless steel shear ring.

d. Bolts, nuts, straps, and all miscellaneous hardware shall be Type 316 stainless steel.

3. Manufacturer

a. Shielded flexible couplings shall be Fernco (5000 Repair series), Mission Rubber (Flex-Seal Repair series), Indiana Seal (Heavy Duty Repair series) or approved equal.

b. Non-shielded flexible couplings shall be Fernco (Stock and Eccentric series), Mission Rubber (Flex Seal Stock series), Indiana Seal (Stock series) or approved equal.

E. Service Connections

1. Sanitary services shall be connected to new, parallel, replacement or existing sanitary sewer lines with full bodied tees, wye fittings, saddle-type tees in accordance with the following:

    a. For 6-inch dia. sanitary services to 15-inch dia or less sanitary sewer mainlines a saddle type (Romac Style CB or equal) or full bodied fitting with solid transition coupling shall be used;

    b. For 8-inch dia. sanitary services to existing 12-inch dia or less sanitary sewer mainlines a full bodied fitting with solid transition coupling shall be used;

    c. For 8-inch dia. sanitary services to new 15-inch dia or less sanitary sewer mainlines a full bodied fitting with solid transition coupling shall be used;

    d. For 10-inch dia. sanitary services consult with engineer; and

    e. Otherwise reference Figure 02622 A.

2. Storm services shall be connected to new, parallel, replacement or existing storm drain mainlines with full bodied tees, wye fittings, saddle-type tees in accordance with the following:

    a. For 6-inch dia. storm services to 15-inch dia. or less storm drain main lines a saddle type (Romac Style CB or equal) or a full bodied fitting with solid transition couplings is required.

    b. For 8-inch dia. storm services to 15-inch dia.or less storm drain mainlines a full bodied fitting with solid transition coupling is required.

    c. For 10- and 12-inch dia. storm services to storm drain mainlines consult with engineer; and

    d. Otherwise reference Figure 02622 B.

Figure 02622 A

Service Connection On New Mainline Pipes

	Dia. of Mainline Pipe							
	8"	10"	12"	15"	18"	21"	24"	30"
Service Dia.	New Sanitary Sewer							
6"*	FB/S	FB/S	FB/S	FB/S	FB/S	FB/S	FB/S	FB/S
8"	FB	FB	FB	FB	FB/S	FB/S	FB/S	FB/S
10"	C	C	C	C	C	C	C	C
	New Storm Drain							
6"*	FB/S	FB/S	FB/S	FB/S	S	S	S	S
8-10"	C	FB / C	FB / C	FB / C	FB / C	FB/ C	FB/ C	FB/ C
12"	C	C	FB / C	FB / C	FB / C	FB / C	FB/C	FB/C

Note: In every situation a full body fitting is acceptable

* Minimum allowable service diameter

C: consult engineer

FB: full bodied fitting required

S: saddle

Figure 02622 B
Service Connection On Existing Mainline Pipes

	Dia. of Mainline Pipe							
	8"	10"	12"	15"	18"	21"	24"	30"
Service Dia.	Existing Sanitary Sewer							
6"*	FB/S	FB/S	FB/S	FB/@	S	S	S	S
8"	FB	FB	FB	IT w/ CE	S	S	S	S
10"	C	C	C	C	C	C	C	C
	Existing Storm Drain							
6"*	FB/S	FB/S	FB/S	FB/S	S	S	S	S
8-10"	C	FB	FB	FB	FB	S	S	S
12"	C	C	FB	FB	FB	FB	C	C

Note: In every situation a full body fitting is acceptable
* Minimum allowable service diameter
C: consult engineer
FB: full bodied fitting required
S: saddle

F. Bedding Materials

1. Unless otherwise specified or shown, all material used for pipe bedding shall conform to the requirements in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

G. Gaskets

1. Gaskets shall be flexible elastomeric rings conforming with ASTM F 477.

PART 3 – EXECUTION

3.1 PIPE AND PIPE FITTINGS

A. Each pipe unit shall be inspected before being installed. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement for straightness, it shall be rejected and removed from the site. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.

B. All premolded gasket joint polyvinyl chloride pipe of a particular manufacturer may be rejected if there are more than five unsatisfactory joint assembly operations or "bell breaks" in 100 consecutive joints, even though the pipe and joint conform to the appropriate ASTM Specifications as hereinbefore specified. If the pipe is unsatisfactory, as determined above, the Contractor shall, if required, remove all pipe of that manufacturer of the same shipment from the work and shall furnish pipe from another manufacturer which will conform to all of the requirements of these specifications.

3.2 INSTALLATION

A. Install PVC pipe and fittings in accordance with manufacturer's printed instructions.

B. No pipe or fitting shall be permanently supported on saddles, blocking, or stones. Bedding material shall be as specified in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Suitable bell holes shall be provided, so that after placement, only the barrel of the pipe receives bearing pressure from the supporting material. Special care shall be taken to hold the trench width at the crown of the pipe to the maximum indicated on the Trench Detail included in the Details Section of these Specifications.

D. Before any joint is made, the previously installed unit shall be checked to assure that a close joint with the adjoining unit has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to the required grade by striking it with a shovel handle, timber or other unyielding object.

E. All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be checked to see that the rubber ring is properly seated. Apply lubricant to the spigot end only, paying particular attention to the bevel, in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer. The resulting joints shall be watertight and flexible.

F. Where any two pipe units do not fit each other closely enough to enable them to be properly jointed, they shall be removed and replaced with suitable units and new gaskets.

G. Allowable Pipe Deflection

1. Pipe provided under this Specification shall be so installed as to not exceed a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.

2. Upon completion of a section of pipe, including placement and compaction of backfill, the Contractor shall measure the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be reviewed by the Engineer. The section of pipe must be placed and backfilled for a minimum of 90 days before the deflection can be measured.

3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem without additional compensation.

H. Open ends of pipe and branches shall be closed with polyvinyl chloride stoppers secured in place in an acceptable manner.

I. After each pipe has been properly bedded, enough bedding material shall be placed between the pipe and the sides of the trench, and thoroughly compacted, to hold the pipe in correct alignment. Bell holes, provided for jointing, shall be filled with bedding material and compacted, and additional material shall be placed and compacted to complete the pipe bedding.

J. The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench. At all times pipe installation is not in progress, the open ends of the pipe shall be closed with temporary watertight plugs, or by other acceptable means.

1. If water is in the trench when work is to be resumed, the plug shall not be removed until suitable provisions have been made to prevent water, earth, or other substances from entering the pipe. Pipelines shall not be used as conductors for trench drainage during construction.

K. For installation near crossing utilities and encasement requirements, refer to Contract Drawings.

L. For lateral service connections and encasement requirements, refer to Contract Drawings.

M. Cleaning

1. Care shall be taken to prevent earth, water and other materials from entering the pipeline. As soon as possible after the pipe and manholes

are completed, the Contractor shall clean out the pipeline and manholes being careful to prevent soil, water and debris from entering any existing pipe.

O. Shielded Flexible Couplings

1. Where couplings are used, plain ends of pipe shall be made smooth and round for a distance of 12 inches from the ends of the pipe, with an outside diameter not more than 1/64 inch smaller than the manufactured outside diameter of pipe. Install couplings per manufacturer's written instructions.

2. SPARE PARTS - CONTRACTOR shall maintain an on-site inventory of couplings suitable for use with the various nominal diameters and materials of proposed and existing pipe referenced in the CONTRACT DOCUMENTS. CONTRACTOR shall be responsible to verify the outer diameter of pipe in advance through measurements taken at access manholes and test pits. The lead times for fabrication, stocking and shipping of couplings shall not be cause for delay or the use of other types of couplings.

3.3. LEAKAGE TESTS

A. Refer to Article 51 – "Leakage Tests" in Section 00825A – SPECIAL CONDITIONS.

B. If Leakage Test method consists of visual or Close Circuit Television Inspection, the contractor shall perform at no additional cost to the City. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

PART 4 – COMPENSATION

Item 2622.1 --- Reconnect, Repair, or Relocate Existing Sanitary Sewer or Storm Drain Laterals

Item 2622.2 --- Pipe – PVC (Gravity) 4-Inch Perforated

Item 2622.3 --- Pipe – PVC (Gravity) 4-Inch

Item 2622.4 --- Pipe – PVC (Gravity) 8-Inch

Item 2622.5 --- Pipe – PVC (Gravity) 10-Inch

Item 2622.6 --- Pipe – PVC (Gravity) 12-Inch

Item 2622.7 --- Pipe – PVC (Gravity) 15-Inch

Item 2622.8 --- Pipe – PVC (Gravity) 18-Inch

Item 2622.9 --- Pipe – PVC (Gravity) 21-Inch

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of polyvinyl chloride pipe complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: gravel pavement subbase; pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; polyvinyl chloride pipe, fittings, couplings, and appurtenances; connecting existing and new laterals; connections to structures; cleanout assemblies (if required); placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Polyvinyl Chloride Pipe shall be based on the Unit Price bid in the proposal.

Measurement for payment of items 2622.1 through 2622.9 shall be based on the actual linear feet of complete and functional pipes as shown on the Contract Drawings or as directed by the City or Engineer. Measurement shall be taken along the centerline of the pipe from the inside face of structures to inside face of structures, or to the points of connection with existing pipes.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged under the DEP Dewatering Permit; procurement, installation, and compaction of CDF.

END OF SECTION 02622

SECTION 02630

DUCTILE IRON PIPE AND FITTINGS

2630.1	**PIPE – DI (WATER) 4-INCH**	**LINEAR FOOT**
2630.2	**PIPE – DI (WATER) 6-INCH**	**LINEAR FOOT**
2630.3	**PIPE – DI (WATER) 8-INCH**	**LINEAR FOOT**
2630.4	**PIPE – DI (WATER) 12-INCH**	**LINEAR FOOT**
2630.5	**PIPE – DI (WATER) 16-INCH**	**LINEAR FOOT**
2630.6	**PIPE – DI (WATER) 20-INCH**	**LINEAR FOOT**

PART 1 - GENERAL

1.1 SUMMARY

A. Furnishing and installing ductile-iron pipe and fittings, as indicated and specified.

B. Options:

1. For joints in buried exterior pipelines, provide push-on joints.

2. Joints within 10-foot horizontally from any existing or proposed sewer and/or any sewer crossing within 18-inches below, shall be restrained joints (in addition to joints as identified in the enclosed restraint table based on their proximity to bends, valves, tees, reducers and dead ends).

3. All fittings and valves shall be mechanical joint.

C. Related sections include the following:

1. Section 02200 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

2. Section 02640 – VALVES AND APPURTENANCES

3. Section 02645 – HYDRANTS

4. Section 02675 – DISINFECTION OF WATER MAINS

5. Section 02660 – WATER SERVICES

6. Section 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING

E. Permits:

1. Section 01060 – PERMITS AND REGULATORY REQUIREMENTS

2. The Cambridge Water Department (CWD) will not issue new water construction permits until all requirements for previous (i.e., initial CWD permit) CWD permits are met. These requirements ***include accurate and legible swing tie dimensions (using 2 swing ties per item from existing building corners, existing gate valves, and/or existing hydrants only) to all new water main gate valves, tee's and elbows***, required CWD "sign offs" on the contractor's copy of the CWD executed permit (when permitted work is complete), test documentation that includes Massachusetts State certified initial chlorination and bacteria testing of new water main work, and pressure test results of new water main work. The Contractor is hereby advised that the CWD will not be responsible for delays in project schedule if these requirements for permits are not followed.

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTAL PROCEDURES:

1. Submit shop drawings or descriptive literature, or both, showing dimensions, joint and other details for each type and class of pipe, fitting and restraint system to be furnished for the project. All materials furnished under the Contract shall be manufactured only in accordance with the Specifications. Submittals shall include material information, dimensions, pipe class information, weights, coating and lining system data.

2. Submit manufacturer's literature stating that the ductile iron pipe and fittings have been manufactured and tested in accordance with AWWA/ANSI specifications.

3. Perform disinfection and pressure testing of installed mains as specified in Sections 02675 and 02704.

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. The City reserves the right to inspect and test by independent service at manufacturer's plant or elsewhere at its own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT.

PART 2 - PRODUCTS

2.1 PIPE

A. Ductile Iron:

1. Ductile iron pipe shall be that of a United States manufacturer who can demonstrate at least five (5) years of successful experience in manufacturing ductile iron pipe. The pipe shall be equipped with push-on joints.

2. All ductile iron pipe shall conform to AWWA C150-09 (ANSI A21.50) and AWWA C151-09 (ANSI A21.51).

3. The ductile iron pipe shall be Class 52 and furnished in nominal 18-foot lengths, with Push-on Joints as manufactured by U.S. Pipe and Foundry Company, Griffin Pipe Co., or equal with gaskets conforming to AWWA C111-12 (ANSI A21.11) "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings".

4. The ductile iron pipe shall be double cement lined inside and then asphalt seal coated on the outside and inside approximately 1 mil. thick. The cement lining shall conform to AWWA C104-08 (ANSI A21.4). The pipe shall be furnished along with necessary materials and equipment recommended by the manufacturer for use in joining pipe lengths and fittings.

2.2 FITTINGS

A. Ductile iron fittings shall be new and be cement lined. Fittings are required to be equipped with a mechanical joint restraint unless otherwise specified by the CWD. Mechanical joint fittings in sizes 4-inch through 24-inch shall

be ductile iron compact fittings and rated for 350 psi working pressure. Fittings shall be of the same material and have the same lining and coating as the pipe specified above. All fittings shall be marked with the weight and shall have distinctly cast upon them the pressure rating, the manufacturer's identification, nominal diameter of openings and the number of degrees or fraction of the circle on all bends. All nuts and bolts shall be of a type equal to ductile iron or COR-TEN steel T-bolts and nuts.

1. Hydrant tees shall have a rotatable mechanical joint gland on the 6-inch plain end branch to provide positive valve restraint, unless otherwise allowed by the Engineer.

2. Caps and plugs installed in all new work as indicated on the drawings shall be provided with a threaded corporation or bleeder valve so that air and water pressure can be relieved prior to future connection.

3. Solid sleeves shall be ductile iron with the same pressure rating as the fittings. Sleeves shall conform to ANSI/AWWA C110. Contractor shall verify outside diameter of cast iron pipe to determine compatibility with standard mechanical joint solid sleeves. Couplings shall be used when existing cast iron pipe is incompatible with solid sleeve.

2.3 JOINTS

A. Provide mechanical joint, push-on joint, or flanged pipe with necessary accessories, conforming to AWWA C111-12 (ANSI A21.11).

1. Provide gasket composition suitable for exposure to liquid within pipe.

2. Provide gasket composition suitable for exposure to potable water.

3. Provide gasket composition suitable for exposure to fluctuating groundwater conditions.

B. Provide pipe flanges and accessories conforming to AWWA C115-11 (ANSI A21.15).

1. Provide flat faced flanges.

2. Provide 1/8 in. thick, full faced gaskets suitable for exposure to liquid within pipe.

C. Restrained joints shall be furnished for installation on all fittings, sleeves, hydrants and valves. Restraints for mechanical joints shall be Megalug Series 1100 as manufactured by Ebaa Iron Co., MJ Field Lok by US Pipe Company, Uni-flanged Series 1400 Mechanical Joint Restraint or approved equivalent. Restraints for push-on joints shall be Series 1700 as manufactured by Ebaa Iron Co., or Series 1390 as manufactured by Uni-Flange or approved equivalent.

D. Restraint systems for push-on pipe utilizing steel-wedge gaskets will be acceptable.

2.4 COUPLINGS

A. Pressure rating at least equal to that of related pipeline with a minimum rating of 150 psi.

B. Couplings shall be of a type equal to Smith Blair, Style 441; Dresser Style 153; 360 or Romac Style 501 or an approved equivalent. Couplings shall be provided with plain, Grade 27, rubber gaskets and with black steel, track-head bolts with nuts. Couplings shall be manufactured in the United States of America.

C. For connections to existing cast iron pipe:

1. Contractor shall verify coupling model is compatible with outside diameter of cast iron pipe.

2. Restrained couplings shall be provided where indicated on the Drawings or where location is within a required restrained length of water main as indicated in Part 3 of this Section. Couplings shall be restrained using friction clamps and tie rods. For 24-inch diameter cast iron water mains, Contractor shall provide (4) friction clamps and (4) 1-1/4" rods. Rods, friction clamp washers, and heavy hex nuts shall be AISI 316 series stainless steel manufactured in the United States in accordance with ASTM A193 grade B8M class 1. Where 316 stainless steel is not available the Contractor shall provide fusion bonded epoxy coated hardware. Tie rods shall be double nutted on each end.

2.5 FILLING RINGS

A. Provide where necessary.

B. Materials, workmanship, facing, and drilling, conforming to 125-lb. ANSI Standard.

C. Suitable length with nonparallel faces and corresponding drilling, if necessary, for correct assembly of adjoining piping or equipment.

2.6 CONNECTIONS - TAPPED

A. Provide watertight joint with adequate strength against pullout. Use only tapered thread taps.

B. Maximum size of taps in pipe or fittings without bosses not to exceed that listed in appropriate table of Appendix to ANSI A21.51 based on:

1. 2 full threads for ductile iron.

C. Where size of connection exceeds that given above for pipe, provide boss on pipe barrel or use tapping saddle. Make tap in flat part of intersection of run and branch of tee or cross, or connect by means of tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, as indicated or permitted.

2.7 STANDARD LINING AND COATING

A. Inside and outside of pipe and fittings: Provide double cement lined inside and then asphalt seal coated on the outside and inside approximately 1 mil. thick. The cement lining shall conform to AWWA C104-08 (ANSI A21.4).

B. Outside of pipe and fittings within structures: Clean and apply one shop coat of Koppers Pug Primer made by Koppers Co., Inc., Pittsburgh, PA; Chem-Prime 37-77 made by Tnemec Co., North Kansas City, MD; 13-R-50 Chromax Primer made by Valspar Corp. Short Hills, NJ; or acceptable equivalent.

2.8 GASKETS, BOLTS, AND NUTS

A. Provide ring rubber gaskets with cloth insertion for flanged joints,

1. Gaskets 12 in. in diameter and smaller, 1/16 in. thick.

2. Larger than 12 in., 1/8 in. thick.

B. Make flanged joints with:

1. Bolts.

2. Bolt studs with nut on each end.

3. Studs with nuts where flange is tapped.

C. Number and size of bolts conform to same ANSI as flanges.

D. Provide bolts and nuts, except as specified or indicated, Grade B, ASTM A307.

E. Provide bolt studs and studs of same quality as machine bolts.

F. Flanged joints for wall castings flush with masonry made up with Type 316 stainless steel stud bolts and nuts.

G. Submerged flanged joints made up with Type 316 stainless steel bolts and nuts.

2.9 POLYETHYLENE PIPE ENCASEMENT

A. Material: Virgin polyethylene conforming to ANSI/ASTM D1248.

B. Thickness: Minimum nominal thickness of 8 mils.

C. Material and installation methods to conform to requirements of AWWA C105.

2.10 INSULATION

A. Insulation shall be manufactured by Thermal Pipe Systems, Braintree, Massachusetts, Atlas Insulation, Ayer, Massachusetts or Insulated Piping Systems, Inc., Canton, Massachusetts, or equivalent. Insulation shall be factory formed-in-place polyurethane foam insulation having nominal thickness of 3", with an in-place density of 2.5 pcf, and a "K" factor of 0.14 BUT/in./hr/deg./F/sq. ft. Straight joints between insulated pipe lengths, and the end section of non-insulated pipe shall be 20-gauge corrugated aluminum preformed to be fastened with stainless steel screws and bands. Jackets shall have expansion joints at 25-foot intervals. Sections of jacket shall have 2-inch minimum at all seams.

B. Jacket shall have one layer of one (1) mil polyethylene film with a protective coat of 40-lb. virgin draft paper to act as a moisture and galvanic corrosion barrier.

C. Insulation shall be provided for pipes that have less than 5 feet of cover.

2.11 THRUST BLOCKING

A. Where applicable, reaction or concrete thrust blocks shall be furnished at all anchor tees, plus bends as required or as detailed on drawings with 3,000 psi, 1-1/2, 470 cement concrete masonry. The blocks will be poured against undisturbed original ground and shall be so placed that the pipe joints will be accessible for any possible future repairs. The other means of restraint may either be of an interlocking type or mechanical joint restraint as specified by the Cambridge Water Department (CWD) and shall be installed in addition to thrust blocks as required by the CWD.

PART 3 - EXECUTION

3.1 ALIGNMENT AND PLACEMENT OF PIPE

A. Fittings and valves shall be restrained for the minimum lengths listed on the following table:

Lengths shown are based on 150 psi test pressure, 4-foot bury, soil type GP, trench Type 3, a 4-foot low side depth, and 2:1 safety factor. Changes in conditions will require revision in lengths.

MINIMUM RESTRAINED LENGTHS	
Fitting	**Restrained Length**
20" - 45° Bend	23-feet in each Direction
20" – 22.5° Bend	11-feet in each Direction
20" – 11.25° Bend	6-feet in each Direction
16" - 45° Bend	19-feet in each Direction
16" – 22.5° Bend	10-feet in each Direction
16" – 11.25° Bend	5-feet in each Direction
12" - 45° Bend	15-feet in each Direction
12" – 22.5° Bend	8-feet in each Direction
12" – 11.25° Bend	4-feet in each Direction
10" - 45° Bend	13-feet in each Direction
10" – 22.5° Bend	6-feet in each Direction
10" – 11.25° Bend	3-feet in each Direction
8" – 45° Bend	11-feet in each Direction
8" – 22.5° Bend	6-feet in each Direction
8" – 11.25° Bend	3-feet in each Direction
6" – 45° Bend	8-feet in each Direction
6" – 22.5° Bend	4-feet in each Direction
6" – 11.25° Bend	2-feet in each Direction
20" Vertical Offset	
Upper	42-feet in each Direction
Lower	23-feet in each Direction
16" Vertical Offset	

MINIMUM RESTRAINED LENGTHS	
Fitting	**Restrained Length**
Upper	42-feet in each Direction
Lower	23-feet in each Direction
12” Vertical Offset	
Upper	49-feet in each Direction
Lower	15-feet in each Direction
10” Vertical Offset	
Upper	23-feet in each Direction
Lower	13-feet in each Direction
8” Vertical Offset	
Upper	19-feet in each Direction
Lower	11-feet in each Direction
6” Vertical Offset	
Upper	15-feet in each Direction
Lower	8-feet in each Direction
12” x 12” x 12” Tee	65-feet along Branch
12” x 12” x 8” Tee	46-feet along Branch
12” x 12” x 6” Tee	35-feet along Branch
12” x 12” x 4” Tee	25-feet along Branch
10” x 10” x 10” Tee	55-feet along Branch
10” x 10” x 8” Tee	46-feet along Branch
10” x 10” x 6” Tee	35-feet along Branch
8” x 8” x 8” Tee	46-feet along Branch
8” x 8” x 6” Tee	35-feet along Branch
6” x 6” x 6” Tee	35-feet along Branch
12” Valve or Dead End	65-feet back from valve or dead end
10” Valve or Dead End	55-feet back from valve or dead end
8” Valve or Dead End	46-feet back from valve or dead end
6” Valve or Dead End	35-feet back from valve or dead end
10” x 8” Reducer	19-feet back from fitting
10” x 6” Reducer	34-feet back from fitting
8” x 6” Reducer	16-feet back from fitting

3.2 INSTALLATION

A. Piping Support:

1. Furnish and install supports to hold piping at lines and grades indicated or specified.

2. Support pipe and appurtenances connected to equipment to prevent any strain imposed on equipment.

3. In locations where connecting new pipe to existing pipe, the Contractor shall restrain the sections of existing water mains that are being connected to new work.

B. Pipe and Fittings:

1. Contractor shall take all necessary precautions to minimize contamination of water mains while storing, handling and installing the water mains prior to disinfection. The interiors of pipes, fittings and valves shall be kept clean and dry.

2. When storing or stringing pipe on-site, Contractor shall take all necessary precautions to ensure no foreign materials enter the water mains. Contractor shall ensure pipe is not stored on-site longer than 1-week prior to installation to minimize the risk of contamination.

3. If dirt enters the water mains upon installation, material shall be removed and the interior of the pipe cleaned with a 1 to 5 percent hypochlorite solution.

4. Remove and replace defective pieces.

5. Clear of all debris and dirt before installing and keep clean until accepted.

6. Lay accurately to lines and grades indicated or required. Provide accurate alignment, both horizontally and vertically.

7. Provide firm bearing along entire length of buried pipelines.

8. All water mains and service pipe shall be laid in a trench separate from any other utility. The horizontal distance between water mains or service pipe and any other utility shall be at a minimum of no less than two (2) feet, vertical distance shall be no less than one (1) foot, and no less than ten (10) feet from a sanitary sewer or surface water drain unless pre-approved by the Cambridge Water Department.

C. Temporary Plugs: When pipe laying not in progress, close open ends of pipe with temporary watertight plugs. If water in trench, do not remove plug until danger of water entering pipe passed.

D. Appurtenances: Set valves, fittings and appurtenances as indicated.

3.3 JOINTS AND COUPLINGS

A. Push-on Joints:

1. Insert gasket into groove bell. Apply thin film of nontoxic gasket lubricant over inner surface of gasket in contact with spigot end.

2. Insert chamfered end into gasket. Force pipe past it until it seats against socket bottom.

3. Where required, install restraint and secure push-on joint restraint in accordance with manufacturer's instructions.

B. Mechanical Joints:

1. Wire brush surfaces in contact with gasket and clean gasket.

2. Lubricate gasket, bell, and spigot with soapy water.

3. Slip gland and gasket over spigot, and insert spigot into bell until seated.

4. Seat gasket and press gland firmly against gasket.

5. After bolts inserted and nuts made finger-tight, tighten diametrically opposite nuts progressively and uniformly around joint by torque wrench. Torque bolts to values specified above.

C. Sleeve-Type Coupling:

1. Clean pipe ends for distance of 8 in.

2. Use soapy water as gasket lubricant.

3. Slip follower and gasket over each pipe to a distance of 6 in. from end and place middle ring on pipe end until centered over joint.

4. Insert other pipe end into middle ring and bring to proper position in relation to pipe laid.

5. Press gaskets and followers into middle ring flares.

6. After bolts inserted and nuts made fingertight, tighten diametrically opposite nuts by use of torque wrench of size and torque specified below:

3.4 TESTING

A. Clean of all dirt, dust, oil, grease and other foreign material, before conducting pressure and leakage tests.

B. Pressure and Leakage Tests. Refer to Section 02704 for requirements.

3.5 DISINFECTING AND FLUSHING

A. Disinfect potable water lines using procedures and materials conforming to AWWA C651.

B. Refer to Section 02675 for additional requirements.

3.6 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01701.

PART 4 – COMPENSATION

Pipe – DI (Water)

Item 2630.1 - Pipe – DI (Water) 4-inch

Item 2630.2 - Pipe – DI (Water) 6-inch

Item 2630.3 - Pipe – DI (Water) 8-inch

Item 2630.4 - Pipe – DI (Water) 12-inch

Item 2630.5 - Pipe – DI (Water) 16-inch

Item 2630.6 - Pipe – DI (Water) 20-inch

METHOD OF MEASUREMENT:
Measurement for payment for items items 2630.1, 2630.2, 2630.3, and 2630.4, 2630.5, and 2630.6 will be based on the actual linear feet of pipe installed, tested, and accepted, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer along the centerline of the pipe with no reduction for fittings,

valves, or hydrants.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

BASIS OF PAYMENT:
Payment for items items 2630.1, 2630.2, 2630.3, and 2630.4, 2630.5, and 2630.6 will be based on the unit price bid for this item in the proposal. Under the linear foot price for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each pipe complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement; excavation; dewatering; furnishing and placing backfill per one of the approved methods; furnish, install and compact gravel road sub-base; furnish and install all fittings, couplings, and restraints as specified; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete, left in place, and cut off below grade where required; transporting material to/from soil staging area; furnish, install, and compact bedding; furnish and install ductile iron pipe, adaptors, transitions, gaskets and appurtenances; connections to existing and proposed pipes and structures; blow-offs; corporation stops for chlorination, testing, and flushing; chlorination, flushing and testing; disposal of testing materials; furnish and install pipe encasement or insulation as necessary; protective coating; and all work incidental to the installation of Ductile Iron Water Pipe, not specifically included for payment elsewhere.

END OF SECTION 02630

SECTION 02640

VALVES AND APPURTENANCES

2640.2	**4-IN GATE VALVE AND GATE BOX**	**EACH**
2640.3	**6-IN GATE VALVE AND GATE BOX**	**EACH**
2640.4	**8-IN GATE VALVE AND GATE BOX**	**EACH**
2640.5	**12-IN GATE VALVE AND GATE BOX**	**EACH**
2640.6	**16-IN BUTTERFLY VALVE AND BOX**	**EACH**
2640.7	**20-IN BUTTERFLY VALVE AND BOX**	**EACH**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 01060 – PERMITS AND REGULATORY REQUIREMENTS

1. The Cambridge Water Department (CWD) will not issue new water construction permits until all requirements for previous (i.e., initial CWD permit) CWD permits are met. These requirements ***include accurate and legible swing tie dimensions (2 ties per item from existing building corners, existing gate valves, and/or existing hydrants only) to all new water main gate valves, tee's and elbows***, required CWD "sign off's" on the contractor's copy of the CWD executed permit (when permitted work is complete), test documentation that includes Massachusetts State certified initial chlorination and bacteria testing of new water main work, and pressure test results of new water main work. The Contractor is hereby advised that the CWD will not be responsible for delays in project schedule if these requirements for permits are not followed."

1.2 SUMMARY

A. This Section including the following:

1. Providing exterior valves, at the locations indicated and/or as required, complete in place in accordance with the drawings and specifications.

2. All valves, 16-inches and larger, shall be butterfly valves.

3. Valves shall be restrained mechanical joint.

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTAL PROCEDURES:

1. Submit shop drawings and descriptive literature, showing valve dimensions and other details for each type and class of valve to be furnished.

2. Certification that all brass goods and valve materials in contact with potable water comply with the Safe Drinking Water Act Lead Reduction law and comply with NSF Standard 372.

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 and as specified.

B. All valves furnished under the Contract shall be manufactured only in accordance with the Specifications and the approved drawings.

PART 2 - PRODUCTS

2.1 RESILIENT GATE VALVES AND VALVE BOXES

A. Resilient gate valves shall be iron body, bronze mounted, resilient seated type. The valves shall be designed for 250 psi working pressure and 300 psi test pressure. Valves shall have corrosion resistant fusion - bonded interior and exterior coatings.

B. Valve materials in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

C. Valves are to have O-ring seals and a rising stem. Valves shall have a 2-inch operating nut. Bolts on the bonnet and stuffing box shall be stainless steel (304 stainless steel). Valves shall open right (clockwise). Valves installed with greater than 6’-0” of cover shall be provided with valve operating stem extensions per pre-approval of the Cambridge Water Department.

D. Resilient gate valves shall meet the most recent version of the AWWA standard specification AWWA C509.

E. Resilient wedge valves shall have mechanical joint ends and shall be equal to ANSI/AWWA C11/A21.11.

G. Valves shall be Mueller A-2360 or approved equal.

H. The restraining mechanism shall consist of individually actuated wedges that

increase their resistance to pull out as pressure or eternal forces increase. The device shall be capable of full mechanical joint deflection during assembly.

2.2 BUTTERFLY VALVES

A. Butterfly valves for buried service shall conform to AWWA C504, except as otherwise specified herein. Butterfly valves shall be rated for Class 150B and both valve operators shall be especially designed for services buried in ground and shall be of the totally enclosed type. The unit shall be permanently lubricated with grease or oil. A standard AWWA 2-inch square operating nut shall be provided on the input shaft. Valves shall open to the right (clockwise).

2.3 TAPPING SLEEVES AND VALVES

A. Tapping sleeves shall be mechanical joint type and shall be Mueller H-615, American Darling 1004 or approved equivalent.

B. Valve materials in contact with potable water shall be lead free with lead level not exceeding 0.25%". Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

C. Tapping valves shall meet the requirements of AWWA C500. The valves shall be flanged by mechanical joint outlet with non-rising stem and designed for vertical burial. Tapping valves shall be rated at 200 psi working pressure and shop tested at 250 psi. Bolts on bonnet and stuffing box shall be stainless steel (316 stainless steel); stuffing boxes shall be “O” ring type. The operating nut shall be 2-inches square. The valve shall be provided with oversized seat to permit use of full-size cutters. Gaskets shall cover the entire flange surface. Valves shall open right (clockwise). Valves installed with greater than 6’ of cover shall be provided with valve operating stem extensions per pre-approval of the Cambridge Water Department.

2.5 VALVE INSULATION

A. The valve shall be insulated as required by the Engineer and as detailed on the drawings. Insulation shall be cellular glass insulation (Foamglas or equal) with jacketing (Pittwrap, or equal). It shall be structurally strong, corrosion and moisture resistant, vermin proof, fireproof and suitable for burial. The system shall be designed and installed in accordance with manufacturer's recommendations for outside temperature variations from - 40 degrees F to +120 degrees F.

B. All materials and applications work shall be furnished by Pittsburgh Corning Corporation, or equivalent.

2.6 VALVE BOXES

A. Valve boxes shall be provided for each valve.

B. Valve boxes shall be ductile iron and of the telescopic design with two piece construction, a top with a cover and a bottom. The top section shall have a top flange to increase the stability of the box to remain at the present height. The lower section of the box shall have a bell shaped bottom designed to enclose the operating nut and stuffing box of the valve without settling. The valve box shall come complete with a cover on which the word "WATER" shall be cast. The cover of the valve box shall be close fitting and substantially dirt tight and flush with the top of the box rim. Gate boxes shall be installed for each buried valve.

C. Valve boxes shall be straight, plumb, and centered over valve.

D. Valve boxes shall be Bingham & Taylor with Standard Drop-In Lid (4905-L1.5, 13 pounds or 4905-L2.5, 14.5 pounds) or approved equivalent product.

PART 3 - EXECUTION

3.1 CLEANING AND PRIME COATING VALVES AND APPURTENANCES

A. Prior to shop prime coating, all surfaces of the valves and appurtenances shall be thoroughly clean, dry, and free from all mill-scale, rust, grease, dirt, paint and other foreign substances to the satisfaction of the Engineer.

B. All ferrous surfaces shall be sand blasted or pickled according to SSPC-SP6 or SSPC-SP8, respectively.

C. All gears, bearing surfaces and other surfaces not to be painted shall be given a heavy coat of grease or other suitable rust resistant coating unless otherwise specified herein. This coating shall be maintained as required to prevent corrosion during any period of storage and installation and shall be satisfactory to the Engineer through the time of final acceptance.

3.2 INSTALLATION

A. All valves and appurtenances shall be installed in the location shown on the drawings or where required by the Engineer. Valves shall be true to alignment and rigidly supported. Any damaged items shall be replaced before they are installed.

B. Care shall be taken to prevent damage to valves and appurtenances during handling and installation. All materials shall be carefully inspected for defects in workmanship and materials, all debris and foreign material cleaned out of valve openings, and all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced.

C. Restraints shall be installed as per manufacturer's instructions.

D. Butterfly valves shall be pressure tested for 15 minutes on ground prior to installation.

3.3 TAPPING SLEEVE AND VALVE

A. Tapping sleeve and valves shall be installed in accordance with specification Section 02647.

3.4 SHOP PAINTING VALVES AND APPURTENANCES

A. Interior and exterior surfaces of all valves which are not factory epoxy coated shall be given two coats of shop finish of an asphalt varnish conforming to AWWA C504 for Varnish Asphalt. The pipe connection openings shall be capped to prevent the entry of foreign matter prior to application.

3.5 BURIED VALVES

A. Buried valves and boxes shall be set with the operating stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping selected excavated material under and at the sides of the valve.

3.6 VALVE BOXES

A. Valve boxes shall be installed vertically, centered over the operating nut, and the elevation of the top shall be adjusted to conform with the finished surface of roadway or other surface at the completion of the contract. Valve box aligners shall be used in the alignment process.

3.7 VALVE BOX ALIGNERS

A. Valve box aligners shall be installed by removing the operating nut of the valve and sliding it over the valve stem. Care shall be maintained to adequately support system during backfilling to maintain vertical alignment.

PART 4 – COMPENSATION

2640.2--- 4-Inch Gate Valve and Gate Box

METHOD OF MEASUREMENT*:*
Measurement for payment for 4-inch Gate Valves and Gate Boxes, will be based on the actual number of valves and boxes installed, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for 4-inch Gate Valves and Gate Boxes, will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each gate valve and box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavation; furnish and install gate box; furnishing and placing backfill by one of the approved methods; transporting material to/from soil staging area; furnish and install filter fabric as required; compaction; compaction testing;

temporary excavation support furnished and installed complete; furnishing, installing and compacting bedding; furnish and install gate valve and gate box, mechanical joint restraints, gaskets and appurtenances; connections to existing and proposed pipes and structures; chlorination, flushing and testing; disposal of testing materials; concrete setting bed for the gate box; furnish and install encasement or insulation as necessary; protective coating; support of gate valve during installation; and all incidental work required for the installation of 4-in gate valves and boxes not specifically included for payment elsewhere.

2640.3 --- 6-Inch Gate Valve and Gate Box

METHOD OF MEASUREMENT*:*
Measurement for payment for 6-inch Gate Valves and Gate Boxes, will be based on the actual number of valves and boxes installed, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for 6-inch Gate Valves and Gate Boxes, will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each gate valve and box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavation; furnish and install gate valve; furnishing and placing backfill by one of the approved methods; transporting material to/from soil staging area; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete; furnishing, installing and compacting bedding; furnish and install gate valve and gate box, mechanical joint restraints, gaskets and appurtenances; connections to existing and proposed pipes and structures; chlorination, flushing and testing; disposal of testing materials; concrete setting bed for the gate box; furnish and install encasement or insulation as necessary; protective coating; support of gate valve during installation; and all incidental work required for the installation of 6-in gate valves and boxes not specifically included for payment elsewhere.

2640.4 --- 8-Inch Gate Valve and Gate Box

METHOD OF MEASUREMENT*:*
Measurement for payment for 8-inch Gate Valves and Gate Boxes, will be based on the actual number of valves and boxes installed, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for 8-inch Gate Valves and Gate Boxes, will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each gate valve and box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavation; furnish and install gate box; furnishing and placing backfill by one of the approved methods; transporting material to/from soil staging area; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete; furnishing, installing and compacting bedding; furnish and install gate valve and gate box, mechanical joint restraints, gaskets and appurtenances; connections to existing and proposed pipes and structures; chlorination, flushing and testing; disposal of testing materials; concrete setting bed for the gate box; furnish and

install encasement or insulation as necessary; protective coating; support of gate valve during installation; and all incidental work required for the installation of 8-in gate valves and boxes not specifically included for payment elsewhere.

2640.5--- 12-Inch Gate Valve and Gate Box

METHOD OF MEASUREMENT*:*
Measurement for payment for 12-inch Gate Valves and Gate Boxes, will be based on the actual number of valves and boxes installed, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for 12-inch Gate Valves and Gate Boxes, will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each gate valve and box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavation; furnish and install gate box; furnishing and placing backfill by one of the approved methods; transporting material to/from soil staging area; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete; furnishing, installing and compacting bedding; furnish and install gate valve and gate box, mechanical joint restraints, gaskets and appurtenances; connections to existing and proposed pipes and structures; chlorination, flushing and testing; disposal of testing materials; concrete setting bed for the gate box; furnish and install encasement or insulation as necessary; protective coating; support of gate valve during installation; and all incidental work required for the installation of 12-in gate valves and boxes not specifically included for payment elsewhere.

2640.6--- 16-Inch Butterfly Valve and Box

METHOD OF MEASUREMENT*:*
Measurement for payment for 16-inch Butterfly Valves and Boxes, will be based on the actual number of valves and boxes installed, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for 16-inch Butterfly Valves and Boxes, will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each butterfly valve and box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavation; furnish and install valve box; furnishing and placing backfill by one of the approved methods; transporting material to/from soil staging area; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete; furnishing, installing and compacting bedding; furnish and install butterfly valve and box, mechanical joint restraints, gaskets and appurtenances; connections to existing and proposed pipes and structures; chlorination, flushing and testing; disposal of testing materials; concrete setting bed for the valve box; furnish and install encasement or insulation as necessary; protective coating; support of butterfly valve during installation; and all incidental work required for the installation of 16-in butterfly valves and boxes not specifically included for payment elsewhere.

2640.7--- 20-Inch Butterfly Valve and Box

METHOD OF MEASUREMENT*:*
Measurement for payment for 20-inch Butterfly Valves and Boxes, will be based on the actual number of valves and boxes installed, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for 20-inch Butterfly Valves and Boxes, will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each gate valve and box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavation; furnish and install gate box; furnishing and placing backfill by one of the approved methods; transporting material to/from soil staging area; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete; furnishing, installing and compacting bedding; furnish and install gate valve and gate box, mechanical joint restraints, gaskets and appurtenances; connections to existing and proposed pipes and structures; chlorination, flushing and testing; disposal of testing materials; concrete setting bed for the gate box; furnish and install encasement or insulation as necessary; protective coating; support of butterfly valve during installation; and all incidental work required for the installation of 20-in butterfly valves and boxes not specifically included for payment elsewhere.

END OF SECTION 02640

SECTION 02645

HYDRANTS

2645.1	**NEW HYDRANT**	**EACH**
2645.2	**REMOVE AND DISPOSE EXISTING HYDRANT**	**EACH**
2645.3	**REMOVE AND RELOCATE EXISTING FIRE ALARM BOX**	**EACH**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 01060 – PERMITS AND REGULATORY REQUIREMENTS

1. The Cambridge Water Department (CWD) will not issue new water construction permits until all requirements for previous (i.e., initial CWD permit) CWD permits are met. These requirements ***include accurate and legible swing tie dimensions (2 ties per item from existing building corners, existing gate valves, and/or existing hydrants only) to all new water main gate valves, tee's and elbows***, required CWD "sign off's" on the contractor's copy of the CWD executed permit (when permitted work is complete), test documentation that includes Massachusetts State certified initial chlorination and bacteria testing of new water main work, and pressure test results of new water main work. The Contractor is hereby advised that the CWD will not be responsible for delays in project schedule if these requirements for permits are not followed.

1.2 SUMMARY

A. This Section includes the following:

1. Providing hydrants, gate valves and boxes and appurtenant work, complete in accordance with the drawings and specifications.

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTAL:

1. Submit shop drawings and manufacturers descriptive literature, showing

hydrant dimensions and features.

2. Submit certifications that all wetted surface metals in contact with potable water comply with the 2014 Safe Drinking Water Act Lead Reduction law and comply with NSF 372

1.4 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. All hydrants furnished under the Contract shall be manufactured only in accordance with the Specifications and the drawings.

PART 2 - PRODUCTS

2.1 HYDRANTS

A. Hydrants shall conform to the "standard for Dry-Barrel Fire Hydrants" ANSI/AWWA C502-85. Hydrants shall be designed for 150 psi service and for installation in a trench with 5-foot cover (5-1/2 feet bury hydrant). Hydrant barrel extensions shall be furnished and installed as necessary to achieve correct bury depth. The length of the hydrant barrel shall be such that when installed with the proper depth of cover on the branch pipeline, the hydrant will be set with the normal ground line of the barrel within 3-inches of the actual ground grade surface elevation.

B. Hydrants shall be fabricated to manufacturer's standard pattern and size and shall have one 4-1/2 inch steamer and two 2-1/2 inch hose nozzles all with National Standard Thread (NST). Hydrant inlet opening on shoe shall have mechanical joints for accepting 6-inch ductile or cast iron pipe.

C. Hydrants shall open clockwise and shall be marked with an arrow and word “OPEN” to indicate the direction of turn of the stem to open the hydrant.

D. Hydrants shall have a compression type main valve, opening against and closing with water pressure. The main valve opening at the base of the hydrant shall have a minimum area of 39 square inches (5-inch minimum diameter circle). Each hydrant shall have “traffic” type ground line construction (breakaway bolts not acceptable) and permit 360-degree movement of the upper barrel to allow for any alignment without shutting down service and/or removing flange bolts and nuts. Hydrant operating nut shall be 1-1/2 inches, flat to point, pentagonal. Connecting pipe and pipe nipples between the main line tee and hydrant shall be 6-inch ductile iron conforming to the requirements for ductile iron pipe.

E. Hydrants shall be hydrostatically tested as specified in AWWA C502.

F. Hydrant tees shall be anchor type. The branch shall have a plain end with an integral gland and rotating mechanical joint restraints. Hydrant branches shall

be fully restrained from the anchor tee to the hydrant. Every hydrant shall be equipped with a 6-inch shut-off valve, bolted or anchored to the hydrant tee.

G. Hydrants shall be flow tested and painted per Cambridge Water Department requirements. See 3.1.H this Section.

H. Materials used for wetted surface metals in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the 2014 Safe Drinking Water Act Lead Reduction law and comply with NSF 372.

2.2 SAFETY FLANGE REPAIR KITS

A. Safety flange repair kits shall come complete with stem coupling, safety flange, flange gasket, replacement bolts and nuts and hydrant lubricating oil.

B. Safety flange repair kits shall be compatible with hydrant furnished.

2.3 EXTENSION KITS

A. Extension kits shall be provided as necessary and shall come complete with extension barrel, extension stem, stem coupling and hardware, flange, flange gasket, 8 bolts and nuts and hydrant lubricating oil.

B. Extension kits shall be compatible with hydrant furnished.

2.4 RESTRAINTS

A. Hydrants, valves and pipe shall be restrained with EBAA Mega-Lug, Uni-Flange Series 1400 or approved equivalent.

2.5 PAINT

A. Hydrants shall be painted with Hammond, gloss enamel, interior and exterior, industrial maintenance coating, after installation and CWD has flow tested the appurtenance. See 3.1.H for color requirements.

PART 3 - EXECUTION

3.1 HYDRANTS

A. Hydrants shall be installed in conformance to AWWA C600, Section 11, latest revision using tie rods and anchored joints.

B. Hydrants to the bury shall be set line at the locations shown on the Drawings or as designated by the Engineer and shall be bedded on a firm foundation. A 5-cubic foot minimum drainage pit shall be filled with ½-inch crushed stone and satisfactorily compacted. During backfilling, crushed stone shall be brought up

around, and 6-inch over, the drain ports.

C. Each hydrant shall be set in true vertical alignment and shall be properly braced.

D. Restraints shall be installed in accordance with manufacturer's requirements.

E. Hydrants shall be cleaned, finish painted to match City of Cambridge color scheme, and touched up after installation.

F. Hydrants set too high or too low shall be excavated and reset to the proper depth as indicated by the bury line. Hydrant extensions shall be installed where required to maintain proper depth.

G. Remove and stack existing hydrants at as shown on the Drawings or as required by the Engineer. Removed hydrants shall be delivered to the City's storage facility. The existing branch line shall be capped and the hydrant branch valve closed and the box removed.

H. All new hydrants installed by Contractor for the City shall be flow tested by the Contractor in coordination with the City of Cambridge Water Department (CWD). All new hydrants shall be color coded accordingly:

1. Blue/Silver – 1500 gpm or more
2. Green/Silver – 1000 -1499 gpm
3. Orange/Silver – 500-999 gpm
4. Red/Silver – 400-500 gpm
5. Black/Silver – 400 gpm or less

3.2 REMOVE AND RELOCATE EXISTING FIRE ALARM BOX

A. The work required to removed and relocate the existing fire alarm box should be done according to the plans.

B. The Fire Alarm Box foundation should match the detail shown in the specifications.

Specification Sheet for MODEL ACSB-10

Aluminum Sub-Base

From: ALLOY CASTINGS CO., INC.

Quality Aluminum Castings Since 1948

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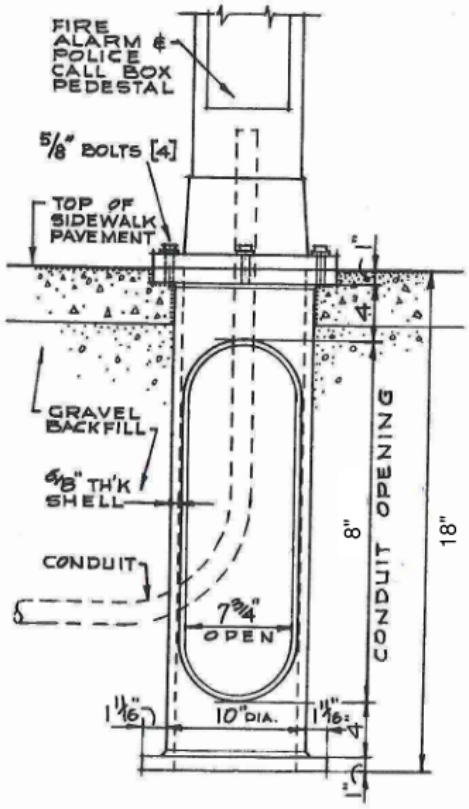
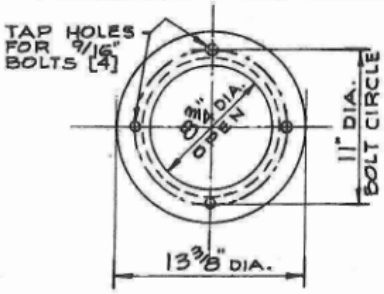


FOUNDATION ELEVATION FOR PEDESTALS

Model ACSB-10
For mounting AC Pedestals and New England Style Pedestals



PLAN OF TOP

As is true of all our castings, this model is warranted to be designed and manufactured to provide dependable, reliable and long-life service under most rigorous conditions.

PART 4 – COMPENSATION

Item 2645.1 – New Hydrant

METHOD OF MEASUREMENT*:*
Measurement for payment for New Hydrant will be based on the actual number of new hydrants furnished and installed, as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for New Hydrant will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to furnish and install each new hydrant as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavation; transporting material to/from soil staging area; furnish and install backfill per one of the approved methods; furnish and install filter fabric as required; furnish and install gravel pavement sub-base; compaction; compaction testing; coordination with Cambridge Fire Department and Cambridge Water Department; temporary excavation support furnished and installed complete, furnish and install the hydrant; furnish and install all fittings and mechanical joint restraints; all permits and fees; and all incidental work required for the providing and the installation of a new hydrant not included for payment elsewhere. Hydrants located in curb extensions will only be paid for once for installation of hydrant and any costs associated with relocating hydrant to new curb line.

Item 2645.2 – Remove and Dispose Existing Hydrant

METHOD OF MEASUREMENT:
Measurement for payment for Remove and Dispose Existing Hydrant will be based on the actual number of hydrants removed and disposed, as shown on the Contract Drawings or as directed by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for Remove and Dispose Existing Hydrant will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove and dispose each hydrant as shown on the Contract Drawings or at the direction of the Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish and install backfill; transporting material to/from soil staging area; furnish and install filter fabric as required; install, grade, and compact gravel pavement sub-base; compaction; compaction testing; coordination with Cambridge Fire Department and Cambridge Water Department; temporary excavation support furnished and installed complete, removal of the hydrant; disposal of the hydrant; all permits and fees; and all incidental work required for the removal and disposal of an existing hydrant not included for payment elsewhere.

Item 2645.3 – Remove And Relocate Existing Fire Alarm Box

METHOD OF MEASUREMENT:
Measurement for payment for Remove and Relocate Existing Fire Alarm will be based on the actual number of Fire Alarm boxes removed and relocated, as shown on the Contract Drawings

or as directed by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for Remove and Relocate Existing Fire Alarm will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove and relocate each fire alarm box as shown on the Contract Drawings or at the direction of the Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish and install backfill; transporting material to/from soil staging area; furnish and install filter fabric as required; install, grade, and compact gravel pavement sub-base; compaction; compaction testing; coordination with Cambridge Fire Department; temporary excavation support furnished and installed complete, removal of the fire alarm box; resetting of the fire alarm box in the final location; all permits and fees; and all incidental work required for the removal and relocating of the existing fire alarm box not included for payment elsewhere.

END OF SECTION 02645

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SECTION 02647

CONNECTING TO EXISTING WATER MAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following:

1. Connecting to existing mains.

B. Related sections include the following:

1. Section 02200 - EARTH EXCAVATION, BACKFILL, FILL AND GRADING

2. Section 02630 - DUCTILE IRON PIPE AND FITTINGS

3. Section 02640 – VALVES AND APPURTENANCES

PART 2 - PRODUCTS

A. Tapping valves shall be flanged by mechanical joint and be as specified in Section 02640.

B. Tapping sleeves shall be ductile iron with a split horizontal flange. Contractor shall verify existing pipe materials and diameter pipe prior to ordering sleeves.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: The Contractor shall verify field conditions by test pits or other methods prior to construction.

3.2 INSTALLATION

A. The Contractor shall make all connections to the existing mains as indicated in the Contract Documents.

B. The Contractor shall develop a program for the construction and putting into service of the new work subject to the approval of the Engineer. All work involving cutting into and connecting to the existing water mains shall be planned so as to interfere with operation of the existing facilities for the shortest possible time.

C. The Contractor shall have all preparatory work done prior to making the connection and shall provide all labor, tools, material, and equipment required to do the work in one continuous operation.

D. The Contractor shall have no claim for additional compensation, by reason of delay or inconvenience, for adapting his operations to the requirements of the City.

E. Under no circumstances shall any customer be without water for a period of more than four (4) hours without prior written approval of the City. Should it appear that any customer will be without water for more than 4 hours, the Contractor shall install temporary water service at no additional cost to the City.

F. The City does not guarantee a tight shut-off for existing local community water valves. No damages shall be claimed by the Contractor for delays in dewatering pipelines nor shall any damages be claimed because of water leaking through closed valves after dewatering is completed. It shall be the responsibility of the Contractor to provide the means to dewater the excavation if required when making connections.

G. The Contractor shall be responsible for the following restrictions on shutdown of water mains:

1. Distribution system valves and hydrants to be operated only by City of Cambridge Water Department personnel.

2. One-week advance notice for shutdown request shall be given to Cambridge Water Department.

3. Contractor shall notify by flyer all affected water customers a minimum of 72 hours prior to any water main shutdown.

H. The Contractor shall apply for and receive all necessary permits with the City of Cambridge Water Department prior to making any connections to the existing water system.

3.3 APPLICATION:

A. Special Techniques: Tapping Connections:

1. Tap connections to existing mains shall be made with service pressure in the main, using tapping sleeve and valve and a suitable tapping machine.

2. Other connections to existing mains shall be made with the main out of service, unless otherwise required by the Engineer.

3.4 CLEANING

A. Contractor shall clean the existing main with wire brush and wash the pipe surface and the tapping sleeve and valve interior with 5% hypochlorite (bleach) solution.

3.5 TESTING

A. Valve and sleeve shall be leak free. Any visible leakage shall be corrected at no additional cost to the City.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 02647

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SECTION 02660

WATER SERVICES

2660.1 1/2-IN TO 3-IN WATER SERVICE REPLACEMENT AND RECONNECT **LINEAR FOOT**

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Provide new water services from the new water main to the property line and connect to existing services, including corporation stops, curb stops and boxes, as shown on the Contract Drawings or as directed by the Engineer. In general, a service shall be brought to each developed parcel of property along the water main route.

2. Provide permanent blow-offs at dead-end water mains.

3. Transfer existing services to an existing water main as shown on the Contract Drawings or as directed by the Engineer.

4. Replace services ¾" and smaller with 1" services as shown on the Contract Drawings or as directed by the Engineer.

5. Replace 1-1/4" services with 1-1/2" services as shown on the Contract Drawings or as directed by the Engineer.

6. Replace all non-copper services with copper as shown on the Contract Drawings or as directed by the Engineer. Perform test pits at the water main and property line to determine if services are non-copper as shown on the Contract drawings or as directed by the Engineer.

7. Contractor shall coordinate with property owners and property owner's contractor for replacement of water services on private property at locations indicated within the utility plans in the Contract Documents.

1.2 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Submit manufacturer's technical product data or descriptive literature, or both, showing services, corporation stops, curb stops, fittings and

other details for each type of service to be furnished for the project.

2. For informational purposes only, submit manufacturer's written installation instructions.

1.3 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – QUALITY ASSURANCE.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of potable water services materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

PART 2 - PRODUCTS

2.1 SERVICES

A. Unless otherwise specified, all pipe for services and 2-inch mains shall be copper tubing, type K, drawn temper.

a. Type K hard-temper in sizes larger than 1-inch;
b. Type K soft-temper for 1-inch services.

B. Copper type shall conform to ASTM B42.

C. Fittings shall be cast bronze for copper pipe and cast bronze or copper stream-lined fittings for copper tubing conforming to ASTM B16.18.

D. Unions shall be bronze with ground joints and shall be semi-finished.

E. Joints for copper fittings shall be made with solder composed of 95 percent tin and five percent antimony. Connections to ductile iron fittings and pressure reducing valves within valve vaults shall be threaded.

F. Pipe and fittings in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

2.2 CORPORATIONS, CURB STOPS AND SADDLES

A. All corporations: The inlet shall be an AWWA (CC) thread. The outlet shall be for a compression joint for Type K copper. Corporations shall be subject to a sustained hydraulic pressure of 200 psi and tested in both the open and closed positions for leakage and ease of turning. Note: All products must meet the City's "NO LEAD" standard, which is more restrictive than Federal, State, and AWWA "Low Lead" standards.

B. Corporations for 1-inch installations shall be heavy pattern, easy turning and of a type equal to Ford FB 1000-4 (no lead brass) series.

C. Corporations for 1-1/2 inch and 2-inch installations shall be of a ball valve type which incorporates Teflon seats to assure self-centering of a Teflon coated bronze ball similar to a style typified by the Ford FAFB-1000 (T-head) series or an approved equal.

D. Curb stops shall be "NO LEAD" of a type equal to Ford B44-444-Q or approved equal. The curb stop shall have a quarter turn stop with check, solid tee head and no waste. No curb stops with plugged solid waste shall be accepted.
.

E. Curb stops shall be Mueller H15219 Mark II Oriseal or approved equivalent with drain suitable for use with polyethylene tubing specified hereinbefore. Stops shall have integral checks, O-ring seal and shall be furnished with rigid liners.

F. Curb stop boxes shall be cast iron Buffalo type with recessed lid with pentagon bolt, adjustable sliding type, with total length from 4 to 5 feet. Cover shall be heavy weight tight-fitting cast iron. Unit shall be Bingham & Taylor I2B9 series, with 2-1/2" New Style Flush Fit Lid, or approved equal.

G. All taps greater than 1 inch will require the use of a tapping saddle. -Service saddles for 2inch taps shall be -SmithBlair 313 Double Strap or approved equivalent-. Bodies shall be ductile iron and straps shall be electrogalvanized carbon steel. Units shall be complete with BunaN gaskets or approved equivalent.

H. Pipe and fittings in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

2.5 FITTINGS

A. Unless otherwise approved, only compression type fittings manufactured by Mueller Inc., or approved equivalent, shall be used.

B. Adapters required to allow connection to existing services shall be provided.

C. Pipe and fittings in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. After successful testing and chlorination, water services shall be installed as a "wet" tap as shown on the drawings, specified, or required by the Engineer. Exact locations of services shall be located in the field by the Engineer. A service shall be provided to the property line of parcels of property along the water main route. All services shall be installed to a minimum depth of 4'-6" unless specifically shown or directed otherwise by the Engineer.

B. Water service trenches shall be excavated and backfilled in accordance with Section 02210 of this Specification and in conformance to the details. Services to be installed beneath paved roadways shall be driven beneath the pavement utilizing a pneumatically driven device such as "Hole Hog", or approved equivalent.

C. Each service shall be flushed thoroughly and the end closed with duct tape prior to backfilling prohibiting soils or groundwater from entering the pipe.

D. Connections to the existing services shall be thoroughly flushed prior to connecting. Contractor shall coordinate and assist Water Department personnel in removal of the household meter and filters and flushing the entire service line to prevent scale-debris from blocking fixtures and appliances when and where applicable.

PART 4 – COMPENSATION

Item 2660.1 – 1/2-in to 3-in Water Service Replacement and Reconnect

METHOD OF MEASUREMENT:
Measurement for payment for 1/2-in to 3-in Water Service Replacement and Reconnect will be based on the actual linear feet of pipe installed, tested, and accepted, from 1-in to 3-in diameter, at all depths, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer along the centerline of the pipe from the centerline of the mainline to the connection with the existing service.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 1/2-in to 3-in Water Service Replacement and Reconnect will be based on the unit price bid for this item in the proposal. Under the unit price for each pipe item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to reconnect, and replace existing water services between ½-in and 3-in in diameter, which are in elevation or alignment conflict with the proposed Work, which require reconnection to replaced water mains, and which are existing ¾" or less in diameter or lead services, at all depths, complete as shown on the Contract Drawings or as required by the Engineer. This item also includes installation of end of line blow-offs at dead-end water mains. The work includes; saw cutting bituminous or cement concrete; excavation; transporting material to/from soil staging area; furnishing and placing backfill per one of the approved methods; furnish, install, and compact

gravel road sub-base; furnish and install filter fabric as required; install, grade, and compact gravel pavement sub-base; compaction; compaction testing; temporary excavation support furnished and installed complete, left in place, and cut off below grade where required or directed; furnishing, placing and compacting bedding; furnish and install type k water service pipe or ductile iron pipe, fittings, couplings, appurtenances and joints; corporation and curb stops and boxes; coordinating with property owner contractor's at locations shown within the contract documents for replacement of water services on private property; connections to existing and proposed pipes; chlorination; flushing/cleaning and testing; and all incidental work not specifically included for payment elsewhere.

END OF SECTION 02660

SECTION 02675

DISINFECTION OF WATER MAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following:

1. Flushing and Disinfection of pipelines.

B. Related section include the following:

1. Section 02630 - DUCTILE IRON PIPE AND FITTINGS.

2. Section 02704 - PIPELINE PRESSURE AND LEAKAGE TESTING.

1.3 SYSTEM DESCRIPTION

A. Disinfect all water mains installed under this contract. Disinfection shall occur subsequent to the installation of the new pipe in accordance with Section 02630.

B. The location of new main line is shown on the Drawings.

C. Pipeline disinfection shall be performed in conjunction with the related work items of dewatering, testing, flushing, dichlorination of water with high concentrations of chlorine, and discharge; prior to placing newly installed water main in service. The Engineer will develop the particulars of the "work plan" to accomplish the above tasks, however, the Contractor's responsibility shall include:

1. Provision of the chlorine product for disinfection at the rate and dose specified shall be in accordance with AWWA standards.

2. Provision of pipeline taps for dosing and testing of chlorinated water, as necessary.

3. Installation and removal of bulkheads required for testing.

4. Labor and equipment necessary to dispense the dose chlorine at points and rates as required by the Engineer.

5. Labor, equipment, and materials required for dichlorination of chlorinated water as required for discharge.

3. 6. Labor and equipment to operate newly installed mainline valves, air release valves, and blowoff valves as necessary and required by the Engineer.

D. The Contractor shall be responsible for disinfecting and putting into service new water mains that shall become the property of the City.

E. All new water main segments longer than 15' shall be tested between 2 new valves per the Cambridge Water Department requirements, unless pre-approved otherwise by the Cambridge Water Department.

F. Contractor shall be responsible for coordinating all activities with the Cambridge Water Department (CWD) when using City hydrants or water for disinfection purposes.

1.4 PROJECT/SITE CONDITIONS

A. All flushing water shall be discharged in accordance with local, state and federal regulations. The DPW shall be contacted prior to flushing. Dichlorination facilities shall be used as required.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate operation of existing valves, timing and duration of shut-down of existing mains, and disinfecting, flushing and re-energizing of the water main with the Engineer and where applicable with the City including notification of the following prior to the stated work:

1. Valve Operations: Notify Engineer and CWD three (3) days prior to stated work.

a. The opening and closing of existing valves shall be performed by CWD personnel only.

2. Disinfecting and Flushing: Notify Engineer three (3) days prior to stated work.

3. Notification shall include location of work, length and diameter of the pipe and other pertinent information.

4. Contractor shall notify by flyer all affected water customers a

minimum of 72 hours prior to any water main shutdown.

1.6 SUBMITTALS

A. Contractor to submit written disinfection plan to Engineer for review. Plan to include flushing/swabbing and disinfection protocol, including by not limited to the following: management of water, chemical data, feed rates, dichlorination plan and disposal methods.

B. Submit data on DEP-certified laboratory to be used for sample collection and testing.

C. Written laboratory analysis reports.

D. Test results for chlorine residuals for times as specified in the method of disinfection shall be submitted to the CWD.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Foam pig or swab shall be of soft polyurethane body with hard polyurethane coating and straps (cross-patterned) with a density of 2 lbs./cf. Swab shall be suitable for use in potable water systems and FDA or NSF 61 approved. Shall be sized and shaped appropriately for cleaning water mains to effectively remove soft and loose debris left in the water main during construction. Swab shall be designed such that the maximum velocity needed to propel the swab through the water main is not more than 1700 gpm for 42-inch water mains and 1000 gpm for 24-inch water mains. Foam pig shall be manufactured by Pipeline Pigging Products, Inc., Tomball TX or approved equal.

B. Calcium hypochlorite shall conform to AWWA B300.

1. Granules with 70 percent available chlorine.
2. Calcium hypochlorite intended for swimming pool disinfection shall not be used.

C. Liquid sodium hypochlorite shall conform to AWWA B300.

D. City-approved backflow preventer devices.

E. Line purge dechlorinator with dichlorination tablets. Dechlorinated shall have 2-1/2 inch NPT coupling and capacity flow rates of up to 1,600 GPM. Dichlorination tablets shall be sodium sulfite or sodium thiosulfate, capable of dechlorinating the flushed water. Dechlorinated shall be Model LPD-250

as manufactured by J. Pollard Co., Hyde Park, NY or approved equivalent.

2.2 LABORATORY

A. Contractor shall employ a DEP-certified laboratory to collect samples and perform bacteriological tests.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:

1. Perform disinfection and flushing in accordance with AWWA C651.

2. The Engineer will review flushing and disinfection procedures, designate dosage and will perform necessary water quality tests to verify that disinfection has been accomplished according to public health standards.

3. If connections are made to municipal water systems, City-approved backflow preventer shall be installed in the line to prevent backflow or siphonage of water into the municipal system.

B. Flushing:

1. Prior to chlorination, mains up to 16-inch in diameter shall be properly flushed by the Contractor. In general, flushing shall be performed at a flow rate required to achieve a minimum velocity of 2.5 feet per second (approximately 3500 GPM in a 24-inch main, approximately 2500 GPM in a 20 inch main, approximately 1600 GPM in a 16-inch main, 900 GPM in a 12-inch diameter main, 400 GPM in 8-inch diameter main and 220 GPM in a 6-inch main, and 30 GPM in a 2-inch main). Flushing shall be performed for a sufficient period of time to allow for a minimum of 3 volume changes of water in the main (approximately 20 minutes per 1000-foot of main at the above flow rate).

2. Mains larger than 16-inch will be cleaned by use of a foam pig or swab. The Contractor shall insert the swab into the section of main to be cleaned upon installation and it shall remain until the pipeline construction is completed. Cleaning and flushing shall be accomplished by propelling the swab through the pipeline to the exit point with use of potable water (maximum flow rate of 1700 gpm for 42-inch water main). Contractor is responsible for furnishing and installing restrained end caps on either end, for the water main to be cleaned, with proper hose/piping connections and vents in order to

propel the swab down the water main and vacate air in the process (4-inch tap for water mains up to 24-inch in diameter and 6-inch tap for water mains above 24-inch diameter). Contractor is responsible for providing connections to the City's hydrant with all necessary permits and appurtenances/backflow preventers to prevent cross contamination of the City's distribution system. Contractor shall manage handling and disposal of water as needed for successful completion of flushing and disinfection procedures in accordance with AWWA standards.

3. Contractor shall be responsible for inserting and removal of swab or pigs from the main. All costs for labor and materials necessary for locating and removal of swabs or pigs which become stuck in the main shall be Contractor's responsibility.

C. Discharge:

1. Following disinfection, water with high concentrations of chlorine shall be discharged as required by the City or the Engineer.

a. The Contractor shall notify the Engineer of the specific location where chlorinated water will be discharged at least one week in advance of proposed discharge. The Engineer will then inform the City.

2. Water with high concentrations of chlorine (residual greater than 2 mg/l) shall be dechlorinated to a level of 2 PPM or less prior to its discharge to storm drains or natural bodies of water.

3.2 INSTALLATION

A. Calcium Hypochlorite:

1. Use only as a solution.

2. Pump into pipe with a suitable chemical feed pump.

3.3 APPLICATION

A. Special Techniques:

1. Disinfect pipes by the continuous feed or slug method.

a. Continuous feed method:

(1) Feed chlorine into pipe so water entering contains at least 25 mg/l of available chlorine.
(2) Apply chlorine continuously until entire pipe is filled

with chlorine solution.

(3) Retain treated water in pipe for at least 24 hours.

(4) Ensure that chlorine residual at end of test is at least 10 mg/l.

(5) Operate all valves and hydrants to insure disinfection. Manipulate valves to prevent super chlorinated water from entering existing distribution system.

b. Slug Method

(1) Slowly feed through the main a slug of water having a chlorine concentration of 100 mg/l so that all parts of the main and appurtenances are exposed to the highly concentrated solution for a period of at least three (3) hours.

(2) Water from existing distribution system or other approved supply source shall be made to flow at a constant measured rate, into the new main.

(3) At a point not more than ten (10) feet downstream from the beginning of the new main, water entering the new main shall receive a constant dose of free chlorine having a concentration of 100 mg/l.

(4) The free chlorine shall be measured as it moves through the main. If the level drops below 50 mg/l, flow shall be stopped chlorination equipment shall be relocated to the head of the slug and as flow is resumed, chlorine shall be applied to restore the free available level to 100 mg/l.

(5) Valves and hydrants shall be operated as the chlorinated water flows past them to insure disinfection occurs.

2. Ensure that appurtenances are fully disinfected.

3.4 FIELD QUALITY CONTROL

A. Tests:

1. Bacteriological test samples shall be collected by a DEP-certified laboratory for the Contractor after the chlorine solution has been flushed out of the pipe.

2. Disinfection shall be repeated, as necessary, to produce satisfactory bacteriological samples.

3. Twenty-four (24) hours after the main has been flushed of chlorinated water, bacteriological samples shall be taken. Water samples shall be

taken from corporation stops along the length of the water main as designated by the Engineer. Sampling piping shall be a suitable length of copper pipe, as required by the Cambridge Water Department. A minimum of two (2) samples shall be taken, per 3,000 foot of pipe and on each street, each in duplicate, in sterile bottles and sent to a State approved private laboratory for analyses. The Contractor shall be responsible for all necessary work including delivery of samples to a certified laboratory, and shall include the cost for sampling and analysis in his bid price. The results of the tests on these samples will determine the acceptance of the work and allow these new mains to be connected to the City's system. The failure of any sample to pass the laboratory tests shall require the Contractor to re-flush and rechlorinate the mains and re-sample and test the water until acceptable results are obtained, all at no additional cost to the City.

B. Main Activation

1. Upon receipt of satisfactory bacteria sample test results and successful pressure tests, Contractor shall notify City to have the City’s personnel operate all valves required to place mains in service.

2. Contractor shall note that work under this Contract shall not be considered completed until satisfactory installation and testing of the water mains have been completed.

PART 4 – COMPENSATION (NOT USED)

END OF SECTION 02675

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SECTION 02704

PIPELINE PRESSURE AND LEAKAGE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Perform field hydrostatic pressure and leakage testing of water distribution pipes.

B. Related section includes the following:

1. Section 02630 – DUCTILE IRON PIPE AND FITTINGS

1.2 DEFINITIONS

A. Leakage - Leakage is defined as total amount of water introduced into pipe during leakage test to maintain test pressure.

1.3 SYSTEM DESCRIPTION

A. The working pressure of the pipeline ranges between 20 psi and 65 psi.

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Testing schedule and test procedure.

a. Indicate proposed time and sequence of testing on schedule.

b. Indicated test procedure requirements as follows:

(1) Limits of each pipe tested.
(2) Position of all valves during testing.
(3) Location of temporary bulkheads.
(4) Meter calibration data.
(5) Pressure gauge calibration data.

(6) A report containing calculations and documentation pertaining to the pressure and leakage testing shall be submitted to the Cambridge Department of Public Works and the Engineer.

1.5 SEQUENCING AND SCHEDULING

A. Complete pressure and leakage testing of pipes prior to final cleaning and disinfection; Engineer shall be present during all testing.

1. Notify Engineer of time and place of testing at least 3 days prior to commencement of work.

PART 2 – PRODUCTS

2.1 GENERAL

A Provide test equipment as follows: Piping connections between pipe tested and water source; Equipment, materials, and facilities required to perform specified tests including but not limited to the following:

1. Pumping equipment

2. Calibrated water meter

3. Calibrated pressure gauges

B. Sectionalizing devices required including but not limited to the following:

1. Flanges

2. Valves

3. Bulkheads

4. Bracing

5. Blocking

PART 3 – EXECUTION

3.1 PREPARATION

A. Provide blocks, anchors, and supports for pipe before test pressure is applied.

3.2 INSTALLATION

A. Water:

1. Schedule filling of line through Engineer at least three (3) days in advance of testing. Do not allow water to enter other parts of the pipeline, not subject to testing, unless approved by the Engineer. Dispose of test water in a manner approved by the Engineer.

B. Venting:

1. Ensure that air release valves and other venting devices are properly installed and placed in open position when filling pipe with water. Do not close hand-operated vent valves until water flows in an uninterrupted stream from each valve.

3.3 APPLICATION

A. Pressure Testing:

1. All pipe and appurtenances installed shall be hydrostatically tested in accordance with ANSI/AWWA C600, latest version unless stated otherwise herein.

2. Test pressure, expressed in terms of feet of water, applied at any point in pipe equals arithmetic difference between specified test pressure plane elevation and elevation of horizontal center line of pipe at selected location. Multiply value by 0.433 to obtain pounds per square inch. Ensure pressure gauges are accurately calibrated. Do not attempt pressure testing until all air has been vented from the mains.

3. All ductile iron pipe shall be pressure tested at 150 psi for a continuous period of two hours.

B. Leakage Testing:

1. Conduct leakage testing in conjunction with pressure tests. Ensure

that joints in piping are watertight and free from visible leaks during leakage test.

2. Leakage Test Pressure: Maintain specified normal operating line pressure for pressure testing of reach during leakage test. Maintain hydrostatic pressure within plus or minus 5 psi during entire time of leakage measurements.

3. Leakage Measurement: Do not attempt measurement of leakage until trapped air has been vented and constant test pressure has been established. Measure leakage by means of an approved water meter installed in the pressure piping on discharge of the pump. Ensure that water meter is accurately calibrated.

4. Allowable Leakage: Ensure that pipe reach does not exceed the allowable leakage rate. Calculate allowable leakage with following formula:

   Q = 0.0075 DLN where
   Q = allowable leakage in gallons per hour
   D = nominal diameter of pipe in inches
   L = length of section tested in thousand feet (304.8 meters)
   N = square root of avg test pressure in psi (12.25 kgs/sq. meter)

5. Calculate allowable leakage separately for each diameter and add resulting allowable leakage rates to obtain total allowable leakage for entire reach.

3.4 FIELD QUALITY CONTROL

A. Inspection: Locate defective joints and pipe materials during pressure testing.

B. Locate and repair leaking joints and other defective items of work to reduce pipe leakage to an amount acceptable to Engineer, or where applicable, the City's requirements. All repairs shall be performed at no additional cost to City.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 02704

SECTION 02761

FLOW BYPASS

2761.1 FLOW BYPASS LUMP SUM

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing a temporary system to bypass the flow of the existing sanitary sewer and storm drain infrastructure around the work in accordance with these Specifications.

2. Maintaining flow from main pipelines without interruption of service, and maintaining flow in lateral connections with minimal interruption of service.

3. Performing the work in a sequence that is the least disruptive to vehicular and pedestrian traffic and in a manner that shall protect the public from damage to persons and property.

B. Contractor shall design the bypass flow handling system.

1.2. RELATED TECHNICAL SECTIONS

A. Section 01500 – TEMPORARY FACILITIES AND CONTROLS

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Shop drawings and/or manufacturer's descriptive literature indicating materials, equipment and methods to complete bypass flow handling operations.

2. Work plan including the following items:

a. Location, configuration and routing of bypass flow handling pipes.

b. Staging area(s) for pumps and other equipment.

c. Upstream flow collection location and/or bulkheads.

d. Downstream discharge location.

e. Method of protecting structures that accept discharge flows.

f. Traffic Management Plan.

g. Roadway crossing details including hose ramps or trench details.

h. Noise Pollution Abatement Plan.

3. List of 24-hour emergency telephone numbers at which the Contractor may be reached.

B. Contractor shall submit a Certificate of Design (refer to SECTION 01300 – SUBMITTALS) for the bypass flow handling system and shall be responsible for the design of the following system components:

1. Pumps,

2. Generators and power sources,

3. Suction and discharge piping,

4. Temporary pipe supports and anchoring,

5. Pipe plugging and bulkheads,

6. Noise control equipment,

7. Calculation of average and maximum daily flows,

8. Calculations of static lift, friction losses, flow velocity and flow rate,

9. Systems testing and start-up,

10. Maintenance of system for off-construction hours,

11. Contingency plan and equipment for system failures,

C. Contractor shall submit complete documentation of qualifications as specified herein.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. The Contractor designing and installing the bypass flow handling system shall have completed at least five (5) projects of similar size and complexity as this project in the United States within the past three (3) years. Contractor may employ the services of a subcontractor that specializes in this work to fulfill this requirement.

C. Rejection of any subcontractor and/or manufacturer by the Engineer due to insufficient qualifications shall not be grounds for modifications to the Contract Documents such as change in scope, time of completion or contract amount.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. The bypass flow handling equipment shall be of sufficient size and material to convey existing flows from one access structure to at least the next access structure immediately downstream of the work without overflow, spillage or discharge to the surrounding environment.

B. Contractor shall be fully equipped to operate and respond to any repair or replacement of the system (24 hours per day and 7 days per week) while the bypass flow handling system is in use.

C. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of emergency or breakdown. One standby pump for each size pump utilized.

D. Contractor shall incorporate noise reduction equipment to minimize impact on the surrounding environment. Such measures shall include insulated enclosures, hospital grade silencers or mufflers, equipment modifications and/or special equipment to limit noise to eighty (80) dBA at seven (7) feet or sixty (60) dBA at the nearest residence or business.

2.2 DESIGN CRITERIA

A. Contractor shall verify flow conditions in the existing system prior to the commencement of construction. The Contractor shall have no claim for additional compensation by reason of delay or inconvenience in adapting its operations to the need for maintaining existing flows.

B. Estimated flows are as follows. Flows are estimated from hydraulic models. Actual flows might vary and shall be verified by the Contractor.

	DWF		1y6h		10y24h	
Peak Flow (MGD)	**EXISTING**	**FUTURE**	**EXISTING**	**FUTURE**	**EXISTING**	**FUTURE**
Drain on River Street from Kelly Road to Memorial Drive	xx	0.00	xx	1.05	xx	2.73
Sanitary Sewer on River Street from Memorial Drive to MWRA Sanitary Sewer Discharge Point	0.10	0.10	0.10	0.10	0.10	0.10

PART 3 – EXECUTION

3.1 PREPARATION

A. Contractor shall perform all work in accordance with municipal, state and federal requirements.

B. Contractor shall obtain all permits required to perform work prior to the commencement of construction, at no additional cost to the City.

C. Prior to the commencement of construction, Contractor shall perform all possible preparatory work. The Contractor shall, at all times, conduct operations to interfere as little as possible with existing flows.

D. Prior to start-up of bypass flow handling system, Contractor shall notify, in writing each property owner whose service shall be shutdown albeit temporarily. Contractor shall prepare notifications in accordance with City's requirements.

E. The Contractor shall protect water resources, wetlands and other natural resources.

3.2 GENERAL

A. Contractor shall design the layout and routing of the bypass flow handling system to minimize disturbance to public and private land and to maintain access for pedestrians and traffic. Traffic shall be maintained throughout the bypass operations according to applicable standards and local requirements.

B. If excavation is required across roadways, all work shall be performed in accordance with municipal and/or state requirements.

C. Contractor shall furnish, install, maintain and operate all temporary facilities such as dams, pumping equipment, conduits and all other labor and equipment necessary to intercept the flow before it reaches points where it would interfere with the work.

D. Contractor may utilize pipelines in an existing parallel system as an alternative to installing a full bypass flow handling system pending approval by the Engineer and the City. Contractor shall submit a Certificate of Design prior to utilizing the parallel system and shall restore the parallel system to pre-construction conditions upon completion of construction.

E. Contractor shall design, furnish and install individual bypass flow handling systems for flowing lateral connections or high occupancy buildings.

F. The Contractor shall protect existing facilities from damage, during pumping activities.

G. Plugging or blocking of flows shall incorporate a primary and secondary plugging device. When plugging is no longer required for performance of the work, it is to be removed in a manner that permits flows to slowly return to normal without surge, surcharge or other major disturbance.

PART 4 – COMPENSATION

Item 2761.1 --- Flow Bypass

METHOD OF MEASUREMENT:
Measurement for payment for Flow Bypass will be based on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the original Contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT:
Payment for Flow Bypass will be based on the unit price bid for this item in the proposal. Under the Lump Sum price for Flow Bypass, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to furnish, install, move, maintain and remove gravity or pumped flow bypasses complete as required to handle existing flows while completing the required elements of the Work at all locations. The work includes, but is not limited to; design of the bypass systems; pumps; suction hoses; discharge hoses; generators; install and remove temporary bulkheads; gravity bypasses including furnishing and installing pipe of all sizes at all depths; excavation for buried hoses or pipe; furnish and placing backfill around buried hoses and pipe; preparation of subgrade; temporary pavement over buried hoses or pipe; ramps; protection of bypass measures; emergency service during non-work hours; manning pumps or other bypasses as may be required; fittings, couplings and appurtenances; connections to existing and proposed pipes and structures; protection of discharge locations; and all incidental work

not specifically included for payment elsewhere required to bypass existing flows in all storm drain, combined sewer or sanitary sewer.

SPECIAL NOTES ON EXCEPTIONS:
Items not included for payment herein include, but are not limited to; permanent bulkheads; bypass for CIPP and cleaning sections of pipe, and water main bypasses.

END OF SECTION 02761

SECTION 02765

CURED IN PLACE PIPE LINING

2765.1	**CURED IN PLACE PIPE LINING PIPE SIZE 6” TO 8”**	**LINEAR FOOT**
2765.2	**CURED IN PLACE PIPE LINING PIPE SIZE 9” TO 12”**	**LINEAR FOOT**
2765.3	**CURED IN PLACE PIPE LINING PIPE SIZE 13” TO 18”**	**LINEAR FOOT**
2765.4	**CURED IN PLACE PIPE LINING PIPE SIZE 19” TO 30”**	**LINEAR FOOT**

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes furnishing all plant, labor, equipment, and materials necessary for completing cured-in-place pipe lining (CIPP); complete in place. Work shall include light pipe cleaning and pre-CIPP lining Closed Circuit Television (CCTV) inspection of the existing sewer and/or drain lines, service connection reinstatement, final CCTV pipe inspection, and all restoration work required for structures, pipes, or surface features.

B. Work under this section shall utilize the rehabilitation reports prepared by the Contractor under Item 02011.1 to 02011.3.

C. Work shall be performed in a sequence that is the least disruptive to vehicular, bicycle and pedestrian traffic and in a manner that shall protect the public from damage to persons or property.

D. A permit from MWRA may be required for this Work if the Contractor chooses to discharge effluent from the lining operation into the sanitary sewer. The Contractor is responsible for obtaining the permit, and costs shall be incidental to the Work.

E. For Odd Shape systems, the contractor will have special liners made to fit the Odd Shape of the proposed lining location.

1.2 SUBMITTALS

A. For the CIPP lining method(s) of pipe rehabilitation, the Contractor shall submit the following information specific to the proposed project within ten (10) days after the Notice to Proceed:

1. Name(s) of all supervisory personnel to be directly involved with each CIPP lining method of pipe rehabilitation for this project. Supervisory personnel shall have a minimum of five (5) years experience and two (2) completed projects for the installation of CIPP lining within the past five (5) years. Attach resumes of each person named. Resume information shall include, as a minimum, educational background, the number of years in a supervisory capacity and a list of projects worked on within the past five (5) years, describing the type of construction, project description, complexity, and contract amounts.

2. Describe the pipe rehabilitation method(s) proposed on this Contract, including, but not limited to, the following:

   a. Name, business, address, and telephone number of each cured-inplace pipelining manufacturer of the pipe rehabilitation method proposed; a description of each method, proposed locations of inversion manholes; and any variances that the Contractor may be proposing from the specified methods.

   b. Any surface activities, including access and staging locations, that will be required and any mitigative measures that will be used to reduce surface impacts as part of each rehabilitation method proposed.

3. The Contractor must submit a complete work plan consistent with the requirements of 02011.1 to 02011.3 and including information about managing flows and required permits. A flow bypass work plan is also required as per Item 02765 Flow Bypass. Based on the Work Plan, the Contractor may be granted a variance by the City to perform the CIPP lining operations outside the restricted working hours of 7:00 AM to 4:00 PM. The Contractor may also be directed by the City to perform the CIPP operations outside the restricted working hours if the City determines a better product will result.

4. The Contractor shall submit plan a Traffic Management Plan consistent with the requirements of the Special Condition Section 8 Traffic Control for maintaining vehicular, bicycle and pedestrian

access, avoiding damage to existing trees, preventing leakage from hoses, and minimizing noise from pumps.

5. The Contractor shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel and method(s) of pipe rehabilitation proposed will be directly involved with and used on this project, respectively. Substitutions of personnel and/or methods will not be allowed without written authorization of the City.

B. The Contractor shall use the inspection and rehabilitation reports from work completed under Item 02011.1 to 02011.3 to prepare and submit shop drawings, details, and descriptions to include construction methods and equipment, process description, access locations, inversion/installation and receiving manhole locations, flow handling, bypass pumping, flow diversion, and or dewatering methods, and design calculations to assure that the work can be accomplished as specified. Manhole connection details, end seal for the CIPP lining system, water source(s), method of water discharge, cleaning methods, traffic management plan, and pre- and post-construction video documentation shall be provided to the City.

C. The Contractor shall provide design submittals to indicate conformance to the applicable subsections of this section and the Contract Documents. At a minimum, this submittal shall include structural design calculations for the cured-in-place liner. The design calculations shall provide a cured-in-place liner that shall withstand all loadings subject to the sewer and/or drain independent of the existing pipeline. The submittal shall provide documentation supporting the basis of the values used in the design calculations. The above calculations shall be prepared under and stamped by a Massachusetts Registered Professional Engineer. Submit to City, for review and approval, the curing schedule for the proposed resin system which will become a permanent part of the work under this Contract.

D. The Contractor shall submit the following documentation:

1. Material Safety Data Sheets (MSDS) for all materials used during preparation and installation.

2. Certification stating that the Contractor is fully licensed by the liner manufacturer (if different).

3. Description of odors anticipated as a result of the curing process and detailed action plan and description of techniques and equipment used to mitigate odors and prevent migration outside of the pipeline.

4. Confined Space Entry Certifications for all Contractor’s personnel entering pipeline or access structures.

5. The Contractor shall provide a certification stating that the source of all lateral connections identified during internal inspection have been investigated within the pipeline as well as in adjacent building and structures and that the Contractor has secured these connections to prevent the migration of odors.

E. The Contractor shall submit the method(s) and equipment it proposes to use for repairs of any uncured areas, defects, test sample section repairs, or other deformities in the completed liner pipe. Such repairs shall be in accordance with the liner manufacturer's recommended written procedures and techniques.

F. The Contractor shall submit curing logs within 24 hours of cool-down completion for each inversion indicating temperature readings at sensors in intervals of at least ½ hour.

G. The Contractor shall submit final CIPP testing reports as specified herein.

1.3 QUALIFICATIONS

A. The Contractor shall provide documentation supporting the qualification criteria specified herein.

1. The City reserves the right to request, inspect, examine, and review information pertaining to a Contractor's proposed method(s) for compliance with the Contract Specifications and industry standards.

B. The qualifications of the Contractor shall be submitted so as to demonstrate that the Contractor meets or exceeds the minimum requirements specified herein. Any Contractor whose qualifications do not meet the minimum qualifications shall be rejected and shall not be permitted to participate in the construction of work specified herein.

C. It is the responsibility of the Contractor to confirm that any subcontractor or manufacturer proposed for performance of the work under this Section of the Specifications can demonstrate the minimum requirements specified herein. Rejection of any subcontractor and/or manufacturer shall not be grounds for modifications to the Contract Documents. No change in contract time of completion or contract cost will be allowed as a result of such rejection of a subcontractor and/or manufacturer to meet the minimum requirements specified herein.

D. The Contractor shall meet the minimum qualifications as specified below for the CIPP liner.

1. The Contractor installing the CIPP liner shall have been in a similar type of CIPP installation business for the past two years.

2. The Contractor installing the CIPP lining shall have successfully completed at least five projects in the past three years, totaling a minimum of 3,000 feet, in the United States in similar urban areas serving similar customers, which included the following provisions:

   a. CIPP installation lengths of at least 300 continuous linear feet for pipes ranging from 6-inches to 60-inches
   b. circular and noncircular pipes that were 15-inches across or greater
   c. completed design of the liner tube wall thickness based on a fully-deteriorated condition

E. The manufacturer of the CIPP system shall have been in the business of manufacturing CIPP linings of equal or greater size for the past two years in the United States.

F. Designated supervisory personnel shall be directly involved with and used on this project. Substitutions of personnel will not be allowed without written authorization of the .City.

G. All Contractor's personnel entering pipeline or access structures shall be Confined Space entry trained per OSHA, Title 29 CFR 1910.46 and shall have a copy of their certification available on site at all times.

PART 2 – MATERIALS

2.1 CURED-IN-PLACE PIPE LINING

A. The liner shall be a smooth, hard, strong and chemically inert internal surface closely following the contours of the existing pipe.

B. The CIPP shall be designed and constructed in accordance with ASTM F1216 "Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube", and these Specifications.

C. The liner shall be fabricated to a size that, when installed, will neatly fit the internal circumference of the sewer and/or drain to be lined. Allowance shall be made for circumferential stretching during insertion.

D. The Contractor shall be fully licensed by the lining process system manufacturer, if different. A copy of this certification shall be submitted to the Engineer.

E. The liner shall consist of one or more layers of flexible needled felt, or an equivalent non-woven or woven material, or a combination of non-woven or woven materials, capable of carrying resin, withstanding installation pressures, and curing temperatures. Upon curing, the liner shall form a continuous, hard, impermeable, tight fitting lining between each installed reach.

F. The Contractor shall furnish a general purpose, unsaturated, styrene-based resin and catalyst system, an epoxy resin and hardener, or an epoxy vinyl ester resin and catalyst system, or other approved material compatible with the inversion/installation process, that provides cured physical strengths and corrosion resistance properties specified herein.

2.2 DESIGN CRITERIA

A. The following design requirements shall be met by the Contractor for this method of construction:

1. The cured-in-place liner shall have sufficient structural strength to support all dead loads, live loads, and groundwater load imposed, including 100-year flood elevation requirements, with the assumption that the existing pipe is fully deteriorated and cannot share any loading or contribute to structural integrity of the liner. All cured-in-place liners shall have a wall thickness tested by the parallel plate deflection method in accordance with ASTM D2412. The liner, when cured, shall have the following minimum values:

	ASTM Standard	**Value / Unit**
Flexural Strength	D790	4,500 MPa
Flexural Modulus	D790 and D 2990	150,000 PSI to 300,000 PSI

Notes:

1) Initial values are determined by ASTM D790
2) Long-Term value is defined as 50 years and is determined by ASTM D2990 test method.
    a. The Contractor shall provide certified copies of all test reports on the properties of the selected resin by the material manufacturer indicating that the supplied materials conform with the above criteria.
    b. The CIPP shall be designed such that the lining shall not fail, collapse, buckle, crack, or delaminate under load. The maximum long-term (50 years) calculated deflection under all loads shall not exceed five percent (5%). For glass, fiber-reinforced liner pipe, the bending strain (50 years) developed shall not exceed the higher of the minimum long-term value in ASTM D3262 for the pipe stiffness supplied, or that substantiated by

long-term strain tests done in accordance with ASTM D3681 using 1.0 *N* sulfuric acid.

c. The following design parameters shall be used:

Parameter	Value	Unit
Depth of Cover	Varies (Refer To Drawings)	N/A
Depth of Groundwater	Varies	N/A
Specific Weighgt of Soil	120	Lbs/ft
Wheel Load	16,000	Lbs
Design Temperature	80	ºF
Deflection Lag Factor	1.5	(50 Years)
Modulus of Soil Reaction	1,000	PSI
Shape Factor	6	Unitless
Bending Deflection	0.103	Unitless

Notes:

1) Design of the CIPP shall be based on prism load on the liner pipe, using the outside diameter of the liner in the calculations.
2) Impact factors to be included when depth of cover is less than 3 feet, per values recommended by AASHTO.
3) The minimum thickness of the cured-in-place liner to be installed shall be as determined for the design conditions imposed. Calculations for the determination of the required liner pipe stiffness shall be the largest pipe stiffness for each CIPP installation reach (inversion/installation manhole to termination point), as determined by calculations provided for the following parameters:
    a. Maximum Deflection;
    b. Minimum Pipe Stiffness;
    c. Ring Bending Strain; and
    d. Constrained Buckling Resistance Using Long-Term Modulus of Elasticity
4) For pulled in systems, submit design calculations for the maximum allowable pulling force on the liner tube.
5) The rehabilitation of the sewers and/or drains shall be performed with minimum disruptions to these systems, and the Contractor shall re-establish connections and minimize the disruptions to neighboring homes, traffic, and surrounding areas.
6) The rehabilitated sewers and/or drains shall have a no visible and/or measured leakage or infiltration.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall perform all work in accordance with municipal, state, and federal requirements.

B. The Contractor shall obtain all permits required to perform work, including discharge permits that may be needed from the MWRA, prior to the commencement of construction.

C. The Contractor shall verify the lengths in the field prior to liner impregnation.

D. The rehabilitation of the sewers and/or drains shall be performed with minimum disruptions to these systems, and the Contractor shall re-establish connections and minimize the disruptions to neighboring homes, traffic, and surrounding areas. Excavation for point repairs or emergencies shall be permitted, but only as approved by the Engineer.

E. Individual inversions/installations may be performed via one or more existing access structures as determined by the Contractor and as approved by the Engineer. Additional access structures, if approved, shall be installed at no additional cost to the City.

F. The Contractor shall utilize inspection and rehabilitation reports prepared by the Contractor under Item 2011.1 to 2011.2 The Contractor shall still be responsible for performing additional inspections as necessary to properly assess pipe condition and locations of all service laterals and connecting pipes in advance of CIPP lining.

G. The Contractor shall commence CIPP operations at the beginning of a period of at least three (3) days of anticipated dry weather and as directed by the Engineer.

H. The Contractor shall provide notifications as specified in Section 3.6 Notifications and the requirements specified in Item 02765 Flow Bypass.

I. The Contractor shall carry out its operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

3.2 INSTALLATION

A. It is the intent of this portion of the Specifications to provide for the reconstruction of the sewer and/or drain lines by the installation of a resin impregnated, flexible felt tube inverted/installed into the existing sewers and/or drains utilizing a vertical inversion standpipe and hydrostatic head method, air pressure inversion method, pulled in and inflate method, or other method approved by the Engineer. The Contractor shall submit information providing details of the procedure and the steps to be followed for the installation of the CIPP. Submittal information shall include: wet out of tube, insertion method and procedure, curing system, and cool down

procedure. Submit process/techniques to be used to progressively round the tube to remove all trapped water between the liner and the existing pipe.

B. Staging and Setup

1. The Contractor shall designate the locations where the reconstruction tube will be vacuum impregnated prior to installation. The Contractor shall allow the Engineer to inspect the materials and "wet-out" procedure. A catalyst system compatible with the resin and reconstruction tube shall be used.

2. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective manholes, unless otherwise specified. The Contractor shall verify the lengths in the field before impregnation. Individual inversion/installation runs can be made over one or more manhole sections, as determined in the field by the Contractor and approved by the Engineer.

3. Inspection of pipelines or laterals shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by videotaping. The interior of the pipeline shall be carefully inspected to determine the location of any conditions that may prevent proper installation into the pipelines or laterals, and it shall be noted so that these conditions can be corrected. A videotape and suitable log shall be kept for later reference by the City. The Contractor shall also produce and provide copies of pre- and post-service connection photographs. The Contractor shall remove and dispose of all debris in the sewers and/or drains to be rehabilitated. The Contractor shall be advised of the possibility of encountering obstructions in the pipe to be rehabilitated, including but not limited to wooden floor boards being uplifted, piles protruding through the invert, heavy erosion, and/or large amounts of exposed aggregate.

4. The Contractor shall provide light cleaning of the pipes prior to lining. Light Cleaning is described as approximately 3 to 4 passes with a standard jetter nozzle. Any non-hazardous debris removed from the pipe will be dumped in a container provided by the Contractor, and transported by the Contractor to a location within the City as directed by the Engineer. The debris will be disposed of by the City at City expense..

5. It shall be the responsibility of the Contractor to clear the line of obstructions, such as solids, dropped joints, loose gaskets, protruding service connections, or collapsed pipe, that will prevent the installation. If inspection reveals an obstruction that cannot be

removed by conventional sewer/drain cleaning equipment, then the Contractor shall immediately contact the Engineer. All repairs and removal of obstructions must be performed from inside the pipe. In the event an obstruction in the pipe is the result of the Contractor's action, it is the Contractor's responsibility to remove or repair the obstruction following requirements by the City.

6. The Contractor shall provide for flow handling and/or bypass pumping around the section or sections of pipe designated for rehabilitation as specified in Item 02765. The bypass pumps shall be positioned to reduce noise and muffled to further minimize noise as directed. The bypass piping shall be in good condition and shall be maintained to avoid leakage. The piping must not restrict vehicular, bicycle or pedestrian traffic. When possible, complete the work during non-precipitation periods such that minimal bypass is required.

C. CIPP INSTALLATION

1. The reconstruction tube shall be inserted through an existing manhole, access pit or cleanout, by approved techniques/process of the installer or the Contractor. It is anticipated that the top of the manhole may need to be removed by the Contractor prior to insertion of the liner tube. Tubes that are pulled in-place shall be done in a manner that will not damage the tube. The winch shall be equipped with a dynometer to record the pulling forces required during installation. Pull forces shall not exceed manufacturer's recommendations, which shall be based on a maximum longitudinal stretch of five percent (5%) of the total tube length. Inversion heads for tubes that are inverted in place shall not exceed manufacturer's recommendations, so as not to overstress the tube material or exceed 5% longitudinal stretch.

2. Progressive rounding of the liner shall be performed, prior to curing, to eliminate all trapped water between the liner and the existing pipeline.

D. CIPP CURING

1. After inversion / installation is complete, curing shall be accomplished by circulating hot water, steam, or other approved methods, to cure the resin in to a hard, impermeable pipe. The equipment shall be capable of delivering hot water/steam throughout the section by means of a prestrung hose to uniformly raise the water/steam temperature above the temperature required to effect a cure for the resin. This temperature shall be determined by the lining

process system manufacturer and based on the resin/catalyst system employed. When cured, the new material shall extend over the length of the inversion/installation reach in a continuous, tight fitting, watertight pipe-within-a-pipe. The hot water used during the curing process shall not be discharged into the surrounding water bodies or wetlands, and shall be disposed of properly, subject to applicable permits which shall be obtained by the Contractor at its expense.

2. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water/steam supply. Another such gauge shall be placed between the impregnated reconstruction tube and the pipe invert at the pipe ends to determine the temperatures during cure. Water/steam temperature in the line during the cure period shall be recommended by the resin manufacturer.

3. The Contractor shall submit procedures and details on the method(s) to be used to obtain water for the installation.

4. When water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed at any time, nor shall a hydrant be used for the work described in these Contract Documents, unless a reduced pressure backflow preventer is provided by the Contractor and prior approvals have been obtained from the Cambridge Water Department for use of the fire hydrant. The Contractor shall be responsible for all related charges for the set-up, including the water usage bill.

5. The Contractor must coordinate notifications to the public and verify multi-family homes. No water services may be shut off without the approval of the Cambridge Water Department and the Engineer.

6. Initial cure shall be deemed to be completed when inspection of the exposed portions of cured pipe appear to be hard and sound, and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the cured-in-place process, during which time the recirculation of the water/steam and cycling of the heat exchangers to maintain the temperature continues.

7. The Contractor shall cool the hardened pipe to a temperature below 100 F before relieving the static head. Cool-down may be

accomplished by the introduction of cool water into the inversion standpipe to replace water being drained from a small hole made in the downstream end. The Contractor shall not be allowed to discharge this drained water (through the hole in the downstream end) to any storm drain or water body. Care shall be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed pipe. The Contractor shall verify with the Engineer that discharging the cure-water directly into the existing system is acceptable. The Contractor must also have a valid permit from MWRA for the discharge. If deemed unacceptable, the Contractor shall collect cure-water in suitable containers and legally dispose off-site at no additional cost to the City.

E. ODOR ABATEMENT

1. The Contractor shall mitigate all odors onto public or private property due to renewal operations immediately after notification from the Engineer including, but not limited to, forced-air ventilation and/or chemical cleaning of buildings at no additional cost to the City.

2. If odors persist on public or private property to a point that air sampling and/or associated testing is required by the Engineer or a regulatory agency, the Contractor shall perform this work at no additional cost to the City.

F. FINISHING / FINAL INSPECTION

1. The finished pipe shall be continuous over the entire length of an

   inversion/installation run, and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination.

2. The CIPP shall make a tight fitting seal with the existing pipe(s) in the manhole. The top half of the pipe shall be neatly cut off at least 4 inches away from the walls. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines or channels, if any. Channel cross-sections shall be U-shaped.

3. The Contractor shall perform an internal CCTV inspection of the sewer and/or drain after rehabilitation work is complete. If uncured areas, defects, bulges, or other deformities are present, as determined by the pipe lining manufacturer or the Engineer, after rehabilitation work is complete after each pipe reach, the Contractor shall repair the defective areas, at no extra cost to the City.

4. The Contractor shall provide a standard 1-year warranty from date of installation.

3.3 SYSTEM REINSTATEMENT

A. Once a section of liner has been cured completely, the Contractor shall reinstate all access structures located along its alignment. For intermediate access structures, the Contractor shall cut the top portion of the liner to match the opening in the riser section providing a smooth, clean cut and continuous transition. At inversion/installation or termination access structures, the Contractor shall extend the liner a sufficient distance into the structure to allow for a smooth, clean cut to match the configuration of the riser and base sections.

B. The Contractor shall minimize the time that an inversion/installation manhole remains open at a particular site. Consideration shall be provided to complete and coordinate all work including cleaning, pre-installation internal inspection, pipe rehabilitation, post-installation internal inspection, and acceptance, so as to minimize surface disruptions.

C. Upon acceptance of the rehabilitation work by the Engineer, the Contractor shall restore the project area affected by its operations by diverting bypassed flows, including landscaping and clean up.

D. Lateral connections shall be reinstated by Remote-Controlled Televised or manually operated Cutting Device and shall be made by experienced operators so that no blind attempts or holes are made in the pipe liner. Exact locations or service laterals shall be determined during internal inspection and re-verified carefully with pre-construction videotapes for accuracy, especially where dimples are not defined or clearly ascertained. The Contractor shall reconnect all lateral connections to the liner pipe, including those unoccupied, abandoned, or from vacant lots, unless otherwise directed by the Engineer. The remote cut shall be smooth and circular in nature with no jagged edges, as seen by a 360-degree television camera. The hole shall be a maximum of 100 percent and a minimum of 95 percent of the service pipe inside diameter. It shall be properly aligned and be concentric to the existing connection. Excess wrong holes or trial cuts shall not be made and must be repaired at no cost to the City.

3.4 TESTING

A. For each separate length of CIPP installed, the Contractor shall prepare at

least one (1) “flat plate” sample in accordance with ASTM F1216, Section

8.1.1 for testing at a laboratory approved by the Engineer. For each separate length of CIPP installed, the Contractor shall also prepare at least one (1) “restrained” sample in accordance with ASTM F1216 Section 8.1.1, Section 8.1.2 for testing at a laboratory approved by the Engineer.

B. Samples tested in accordance with ASTM F1216, Section 8.1.1 shall be

considered as passing if the arithmetic mean of the samples, as defined in

ASTM D790, is greater than or equal to parameters set forth in this Section after the arithmetic means is reduced to 80% of its original calculated value. C. Samples secured as specified shall be tested to verify that the pipe flexural modulus and flexural strength of the CIPP is at least equal to that required by the approved design submittal, and the wall thickness is at least equal to that required in the approved design submittal.

C. If any sample fails the verification tests specified, the Contractor shall take

five (5) additional samples throughout the length of the inversion/installation and retest to ensure the specified criteria has been met. If any sample fails these retests, the entire inversion/installation length shall be rejected.

E. Any rejected inversion/installation shall be relined or replaced by the

Contractor at no additional cost to the City. The Contractor shall submit

method of repair of the rejected inversion/installation length for review and approval by the Engineer prior to construction any repair work. Any samples taken from within the final completed liner pipe shall be repaired by the Contractor, in accordance with the shop drawings, at no expense to the City.

3.5 ACCEPTANCE

A. Pipeline shall be true to line and grade, with no visual bulges, sages, protrusions, deflections, offset joints, leaking joints, or other visible infiltration, or other defects that would impair the intended use of the completed pipeline.

B. The Contractor shall perform a post construction internal inspection. Final acceptance of rehabilitation work shall not be granted until all defective areas are repaired to the pipe lining manufacturer's and Engineer’s satisfaction.

C. The Contractor shall perform testing as specified. Final acceptance of the work

shall not be granted until the appropriately formatted testing results have been reviewed and approved by the Engineer.

D. Any repairs required by the Engineer as a result of the post construction internal inspection shall be performed by the Contractor, at the Contractor's expense.

3.6 NOTIFICATIONS

A. Notify the Engineer:

1. On a weekly basis of scheduled work for the upcoming week. Scheduled work shall be in accordance with approved work plan. Provide at least 24-hour notice for deviations from the approved work plan unless caused by weather or natural causes in which case the Engineer shall be notified as soon as possible.

2. Immediately, when a collapsed pipe or other pipe failure is identified.

3. Immediately, if the conditions for CCTV inspection are found to be unsafe or impractical.

4. Immediately, if a manhole is buried, cannot be found or cannot be accessed. Along with the manhole identification number, provide a map (in PDF format) showing the location of the manhole and what procedures were used to attempt to locate the manhole.

5. Inspection crews shall immediately notify the Engineer of any defects posing imminent danger to the public (missing lids, covers broken during inspection, sink holes, etc.) and any observed pipe blockages, surcharging, or potential overflow conditions.

6. If the pipe configuration in the field is different than shown on the Drawings or in City supplied GIS data. The notification shall include a diagram in PDF format clearly indicating the location of structures in relation to immediately adjacent structures.

7. If any obstructions are found within an easement, even if not impacting work.

B. Notify the public (business and residential properties):

1. A minimum of one week prior to the inspection of any line segment, distribute door-to-door a City-approved Public Notification door hanger describing the work to be performed, schedule and impacts to water usage.

2. No less than 24-hours prior to the start of the work, the Contractor shall provide a final notification in person. Residential properties require notification after 5pm, when occupants are more likely to be present. For example, if the work is to start on a Monday morning, in person notifications should be attempted after 5pm the previous Thursday. If there is no response, the Contractor may leave a second door hanger as a final reminder.

3. The Contractor responsible for determining route of access for the proposed work, unless specified otherwise, and is responsible for coordinating with the Property Owner to obtain any temporary access to perform the work Clearing and other costs related to gaining access (including restoration) should be included in Contractor's pricing.

4. The Contractor to notify Property Owner of any trees or other obstructions within easements that need to be moved to access or perform the work. The Property Owner shall be given a minimum of 7 days to relocate the obstruction off of the easement at their own cost to their own chosen location. After this time period, the Contractor shall be responsible for removing and disposing of the obstruction, and all costs associated with this. The Contractor to coordinate with the Owner on each obstruction found before proceeding.

PART 4 – COMPENSATION

BASIS OF PAYMENT/INCLUSIONS:

Under the Unit Prices bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and inspection of Cured-in-Place Pipe liner, in existing pipes. This work shall include furnishing, installing, and/or performing all work associated with CIPP liner installation including but not limited to the following: all abutter notification and coordination; pipe liner as described in the Contract Specifications; testing; reinstating building service laterals; pipeline cleaning; transportation of the material removed during cleaning operations to a temporary stockpile area; temporary storage and control of stockpiling; pre- and post-installation inspection by closed circuit television; providing inspection photos and logs, sealing around manhole connections; and all incidental work

METHOD OF MEASUREMENT:

Payment for CIPP liner shall be on a linear foot basis on the Unit Prices bid in the proposal. Measurement for payment shall be based on the actual linear feet of complete and functional CIPP liner. Measurement shall be taken along the centerline of the pipe from the inside face of structures to inside face of structures.

CIPP liner installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining five (5) percent shall be paid upon receipt of successful test results by the Owner. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

Special Notes on Exclusions:

All costs associated with heavy cleaning and inspections of pipes and manholes, and the preparation of inspection and rehabilitation reports for pipes and manholes are not included under this pay item. All costs associated with lateral inspections, removal of protruding laterals and root intrusions, and flow bypass are not included with this pay item.

END OF SECTION 02765

SECTION 02766

MANHOLE REHABILITATION

2766.1	**MANHOLE REPAIRS**	**EACH**
2766.2	**STRUCTURAL CEMENTITIOUS LINER FOR MANHOLE REHAB <12”**	**VERTICAL FOOT**
2766.3	**STRUCTURAL CEMENTITIOUS LINER FOR MANHOLE REHAB >12”**	**VERTICAL FOOT**
2766.4	**STRUCTURAL CEMENTITIOUS LINER EPOXY FOR MANHOLE REHAB <12”**	**VERTICAL FOOT**
2766.5	**STRUCTURAL CEMENTITIOUS LINER EPOXY FOR MANHOLE REHAB >12”**	**VERTICAL FOOT**

PART 1 – GENERAL-

1.1 SUMMARY

A. The work covered under this section of the Specifications includes the furnishing of all plant, labor, equipment, appurtenances, and materials, and performing all operations in the internal inspections and rehabilitation of existing manholes. It is the intent of this specification to provide for the waterproofing, sealing and structural enhancement of designated manholes by chemical grout sealing of active water infiltration and by application of an interior uniform cementitious coating of high quality mortar and epoxy coating.

B. The work shall include elimination of active infiltration by external chemical grout sealing; removal and patching of loose and/or unsound material, cleaning and preparation of surfaces, repair and chemical grout sealing of the invert, bench, walls, and application of an interior cementitious coating, and epoxy resin coating for corrosion resistance.

C. Each manhole to be repaired shall receive a complete internal inspection prior to repairs to ensure the manhole is properly cleaned and prepared.

1.2 SUBMITTALS

A. General

1. Prior to beginning the work, submit six (6) sets of the following:

a. Qualifications of the firm/personnel who will perform the work.

b. Descriptions of system proposed for handling existing flows if necessary, during the procedures to be carried out.

c. Description of the system, equipment and material proposed for sewer manhole rehabilitation, including information and descriptions detailing the procedure and the steps to be followed for each repair to be used.

d. Product data as specified including materials; physical properties; surface preparation, mix design, application, repair, curing, testing and field quality control procedures for the following:

1) Patching and plugging materials
2) Cementitious lining material
3) Cementitious lining admixture
4) Chemical sealing material

e. Contractors Work Plan to include:

1) Manufacturer's written and recommended handling, storage, mixing, temperature and weather limitations, surface preparation, application, repair, curing, set time, and testing procedures

2) Description of the system including materials and mix design, method of surface preparation, application, testing, curing, set time, and repair procedures.

3) Method(s) and materials to seal leaks.

4) Equipment to be used.

5) Interface details with pipe renewal system, manhole frame, and invert/bench, including any wastewater flow handling.

6) Environmental safeguards and emergency response plans

7) Sequencing and scheduling plan including work hours and duration

8) Traffic and pedestrian management plan for each location

9) Wastewater flow handling plan for each location as applicable

f. Manufacturer's warranty.

g. Submit MSDS Data Sheets for proposed chemicals to be used.

1.3 QUALIFICATIONS

A. The City reserves the right to request, inspect, examine, verify, and review information pertaining to a Contractor's qualifications and proposed method(s) for compliance with the Contract Specifications.

B. The qualifications of the Contractor shall be submitted so as to demonstrate that the Contractor meets or exceeds the minimum requirements specified herein. Any Contractor whose qualifications do not meet the minimum qualifications shall be rejected and shall not be permitted to participate in the construction of work specified herein.

C. It is the responsibility of the Contractor to confirm that any subcontractor or manufacturer proposed for performance of the work under this section of the Specifications can demonstrate the minimum requirements specified herein. Rejection of any subcontractor and/or manufacturer shall not be grounds for modifications to the Contract Documents. No change in contract time of completion or contract cost will be allowed as a result of such rejection of a subcontractor and/or manufacturer to meet the minimum requirements specified herein.

D. The Contractor or Subcontractor(s) shall each be certified by the manhole rehabilitation system manufacturer(s) that such firm is a licensed installer of their system, and for each rehabilitation method has completed at least five (5) similar projects, in the United States, in the past three (3) years on sewer projects.

1.4 REFERENCES

A. The following standards form a part of this specification as referenced: The National Association of Sewer Service Companies (NASSCO)

1.5 WARRANTY

A. The manhole rehabilitation work shall be warranted against

infiltration, corrosion resistance, and faulty workmanship and materials for one year from the date the project is accepted by the City.

PART 2 - MATERIALS

2.1 SEWER MANHOLE REPAIR MATERIALS

A. Portland Cement: ASTM C150, Type II.

B. Hydrated Lime: ASTM C207, TypeS.

C. Sand: Fine aggregate, for mortar, passes No. 8 sieve.

D. Mortar:

1. For Brickwork:
   Mix Portland cement, hydrated lime and sand in proportion by volume of 1:1/2:4-1/2. Use sufficient water to form a workable mixture to make mortar damp, just short of balling.

2. For Plugging Holes:
   Mix Portland cement and sand in proportion by volume 1:1-1/2, with sufficient water.

3. For Plugging Active Leaks:
   Fast setting, high strength mortar, resistant to freeze-thaw expansion, de-icers, and erosion due to abrasion. Octo-Crete made by IPA Systems, Inc., Philadelphia, PA; Speed-Crete made by Tamms Co., Inc., Itasca, IL; Fast Setting Cement made by W.R. Bonsal Co., Lilesville, NC; or an acceptable equivalent product.

1. Brick:
   ASTM C32, Grade SS, except mean of five tests for adsorption not to exceed 8 percent by weight.

E. Chemical Sealing Materials:

The following is a general listing of chemical sealing materials which the Contractor may use for sealing manholes and the basic requirements, properties and characteristics of each. The Contractor shall use a chemical grout that is environmentally safe for the sealing of sewers.

1. Acrylamide Base Gel:

    a. A minimum of 10 percent acrylamide base material by weight in the total sealant mix. A higher concentration of acrylamide base material may be used to increase strength or offset dilution during injection.

    b. The ability to tolerate some dilution and react in moving water during injection.

    c. A viscosity of approximately 2 centipoise, which can be increased with additives.

    a. A constant viscosity during the reaction period.

    b. A controllable reaction time from 10 seconds to 1 hour.

    c. A reaction (curing) which produces a homogeneous, chemically stable, non-biodegradable, firm, flexible gel.

    d. The ability to increase mix viscosity, density, and gel strength using additives.

2. Acrylic Base Gel:

    a. A minimum of 10 percent acrylic base material by weight in the total sealant mix. A higher concentration of acrylic base material may be used to increase strength or offset dilution during injection.

    b. The ability to tolerate some dilution and react in moving water during injection.

    c. A viscosity of approximately 2 centipoises, which can be increased with additives.

    d. A constant viscosity during the reaction period.

    e. A controllable reaction time from 5 seconds to 6 hours.

    f. A reaction (curing) which produces a homogeneous, chemically stable, non-biodegradable, firm, flexible gel.

    g. The ability to increase mix viscosity, density, and gel strength by the use of additives.

3. Polyacrylamide Base Gel:

   a. A minimum of 10 percent polyacrylamide base material by weight in the total sealant mix. A higher concentration of polyacrylamide base material may be used to increase strength or offset dilution during injection.

   b. The ability to tolerate some dilution and react in moving water during injection.

   c. A viscosity of approximately 30-35 centipoise at 10% solids as applied. The ability to increase mix viscosity, density and gel strength by the use of additives.

   d. A controllable reaction time from 10 seconds to 5 minutes.

   e. A reaction (curing) which produces a homogeneous, chemically stable, non-biodegradable, firm, flexible gel.

4. Urethane Base Gel:

   a. 1-part urethane prepolymer thoroughly mixed with between 5 and 10 parts of water by weight. The recommended mix ratio is 1 part urethane prepolymer to 8 parts of water (11% prepolymer).

   b. A liquid prepolymer having a solids content of 77% to 83%, specific gravity of 1.04 (8.65 pounds per gallon), and a flash point of 20°F.

   c. A liquid prepolymer having a viscosity of 600 to 1200 centipoise at 70°F that can be pumped through 500 feet of ½-inch hose with a 1000 psi head at a flow rate of 1 ounce per second.

   d. The water used to react the prepolymer should have a pH of 5- 9.

   e. Cure time of 80 seconds at 40°F, 55 seconds at 60°F, and 30 seconds at 80°F when 1 part prepolymer is reacted with 8 parts of water only. Higher water ratios give longer cure times.

   e. A cure time that can be reduced to 10 seconds for water temperatures of 40°F to 80°F when 1 part of prepolymer is reacted with 8 parts of water containing a sufficient amount of gel control agent additive.

   g. A relatively rapid viscosity increases of the prepolymer/water mix. Viscosity increases from about 10 to 60 centipoise in the first minute for 1 to 8 prepolymer/water ratio at 50°F.

h. A reaction (curing) which produces a chemically stable and nonbiodegradable, tough, flexible gel.

i. The ability to increase mix viscosity, density, gel strength and resistance to shrinkage by the use of additives to the water.

F. Manhole Coating Materials

1. Manufacturers:

a. Cementitious--Quadex Aluminaliner, Quadex, Inc., Little Rock, AR

b. Epoxy—Raven 405, Raven Lining Systems, Broken Arrow, OK

c. Or approved equal.

2. Product Requirements/Quality Standards:

a. Coating material with corrosion protection admixture capable of being spray applied.

b. Chemically resistant, capable of withstanding internal exposure to corrosive sewage gases without degradation, including but not limited to hydrogen sulfide, at high levels in a domestic sewage environment.

c. Waterproof, capable of providing a durable, waterproof barrier and withstanding maximum hydrostatic pressures exerted on manhole walls.

d. Interior coating material to be non-toxic (solventless), biologically inert, and shall not contain any toxic compounds or release any toxic odors or carcinogenic agents into the surrounding environment.

e. Interior coating material shall be capable of permanently bonding to properly prepared surfaces such as brick, concrete or other materials encountered in sanitary sewer manholes, in dry, damp or wet conditions.

2.2 GASKETS

A. Manhole seal gaskets shall be Plant Pro cushion gasket rope with asphalt impregnation, ½ inch diameter, Model 40364, as described in USA Bluebook, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall submit a work plan to address the items specified below, unless approved otherwise by the Engineer.

B. Safety

1. The Contractor shall carry out his operations in strict accordance with all applicable OSHA, State, and local standards. Particular attention is drawn to those safety requirements involving work entry into a confined space. It shall be the Contractor's responsibility to familiarize himself/herself with OSHA standards and regulations pertaining to all aspects of the work.

C. Flow Control

1. When required for acceptable completion of the manhole repair, the Contractor shall provide for continuous sewage flow around the work area. The pump bypass lines shall be of adequate capacity and size to handle the flow.

D. Cleaning

1. Pressure wash manhole walls and bench using a high pressure water spray with minimum pressure of 3,500 psi.

2. Provide suitable screening and other means of trapping and blocking as required to prevent cleaned material at the manhole bottom from passing into the downstream sewer.

3. Promptly remove any screened, trapped, or blocked material from the manhole bottom by suitable means, place in containers suitable for transport over roads, remove from site and dispose of off-site. The removal and disposal of debris material cleaned from manholes shall be in accordance with all local, state, and federal regulations and laws, and at no additional cost to the City.

3.2 MANHOLE SEALING

A. The manhole interior shall be cleaned and all visible leaks and areas showing evidence of leakage shall be sealed as indicated and as specified.

B. A hole shall be drilled from within the manhole through the thickness of the manhole wall at each leakage point.

C. Where there are multitude leaks around the circumference of the manhole, the Contractor, at his option, may drill fewer holes providing such holes are sufficient in number to seal all leakage into the manhole.

D. A pipe packer shall be fitted into the drilled hole in a manner that will permit sealing the manhole leaks watertight.

E. To each pipe packer a hose shall be attached to allow for the injection of the sealing material.

F. The Contractor shall insure that the pressure exerted by the equipment does not damage the manhole structure. Any damage resulting from the Contractor's operation shall be repaired at the Contractor's expense.

G. The manhole shall be sealed until no visible leaks are observed.

H. When the injection of the sealing material has been completed for the manhole and no visible leakage is observed, the packer pipes shall be removed, the sealing material shall be cleaned from the holes in the manhole wall and the holes filled with portland cement mortar composed by volume of 1 part cement to 1-1/2 parts sand and sufficient water to make a workable stiff mix.

I. After the manhole sealing operations are complete and the portland cement mortar has attained its set, the manhole shall be visually inspected by the Contractor in the presence of the Engineer.

J. The Contractor shall also inspect all sealed manholes in the presence of the Engineer six months after the sealing. Any sealing work which has become defective, in the opinion of the Engineer, shall be resealed at no additional expense to the City.

K. Upon completion of the manhole sealing and testing, the manhole shall be cleaned of all material not permitted to pass downstream in the sewer and all equipment, tools and plugs shall be removed.

3.3 MANHOLE INTERIOR COATING

A. The interior surfaces of the manhole shall be pressure washed as specified

to remove all dirt, grease, sand and surface contaminants, leaving a clean surface, dry open exposed aggregate, free of all visible debris. In addition, a 10 percent muriatic acid or detergent solution shall be applied to the manhole surfaces where required to further remove any surface contaminants. Following the application of the acid or detergent solutions, all manhole surfaces shall be thoroughly rinsed and neutralized prior to application of the interior coating.

B. Once all surfaces have been properly prepared to the satisfaction of the Engineer, all visible leaks and areas showing evidence of leakage shall be sealed utilizing chemical grout as specified herein, hydraulic cements, or other means acceptable to the Engineer and in conformance with the coating manufacturer's recommendations.

C. After cleaning procedures, sealing areas of leakage, and bench and invert repair, the manholes shall receive interior coatings as follows:

1. A minimum of two coatings of cementitious material shall be spray applied from the bottom of the wall to the bottom of the frame. After each application, the surface shall be troweled to a smooth finish. A brush finish shall then be applied to the troweled finish surface after the second coat is applied. The total coating thickness shall be as recommended by the coating manufacturer for the type of surface coated and loads experienced, but in no case shall the coating thickness be less than ½ inch per coat, and shall at least restore the original thickness of the manhole wall.

2. Once the walls are coated, the bench shall be cementitious coated following the procedure described herein and in such a manner that a gradual slope is produced from the walls to the edge of the invert with the thickness at the invert to be no less than ½ inch. The joint between the wall and the bench shall be troweled along the circumference of the manhole to provide a smooth transition. The invert shall also be coated to the degree possible.

3. As directed by the Engineer, following cementitious coating, the walls, bench, and invert, to the degree possible, shall be epoxy coated in accordance with the manufacturers instructions and standards. A minimum total thickness of 120 mils, in two coats, shall be provided.

4. All interior coatings to be spray applied shall utilize equipment and other appurtenant devices approved by the coating manufacturer. The application shall be performed by a certified applicator, if required by the coating manufacturer. The proper cure time shall be allowed for between coats. All coatings shall

be applied in strict accordance with the manufacturer's written instructions and as specified herein.

5. After the manhole coating operations are complete, the manhole shall be visually inspected by the Contractor in the presence of the Engineer. The manhole shall be recoated to cover any pinholes or other defects observed, at no additional expense to the City. All coatings shall be smooth and uniform in appearance, and free of defects.

6. The finished cementitious lining system shall be a continuous, uniform thickness completely covering the entire inside surface of the manhole from the invert and pipe connections, including any exposed pipe in the manhole to the bottom of the manhole frame. There shall be no cracks, voids, visible leaks, high points, low points, bubbles, sags, runs, pinholes or other such defects that could impact the integrity of the finished system. Finished surfaces at invert, bench and wall shall be smooth and free of ridges. Any defects shall be corrected at the Contractor's expense.

7. Protect and cure completed manholes in accordance with lining manufacturer's written instruction.

8. The Contractor shall inspect all coated manholes in the presence of the Engineer six months after the coating. Any coating work which has become defective, in the opinion of the Engineer, shall be coated at no additional expense to the City.

9. Upon completion of the manhole coating and testing, the manhole shall be cleaned of all material not permitted to pass downstream in the sewer and all equipment, tools and plugs shall be removed.

3.4 MANHOLE INVERT AND BENCH REPAIR

A. The manhole shall be thoroughly cleaned and all debris shall be disposed of as specified.

B. Invert and Bench Repair

1. All deteriorated or loose brick and mortar work shall be removed by suitable means and replaced with new brick and mortar as specified herein.

2. Bricks shall be moistened before being placed. Brick shall be laid

in a full bed and joint of mortar without subsequent grouting, flushing or filling; and they shall be thoroughly bonded.

3. Fill material shall be Class A (3,000 psi minimum compressive strength) concrete.
4. Inverts shall be rebuilt to provide a smooth flow transition through the manhole.
5. For manholes with flat bottoms, an invert and bench shall be formed with brick masonry or 3000 psi concrete to the full height of the pipe. Side inverts and main inverts (where direction changes) shall be curved in smooth curves of the longest possible radius tangent to the centerlines of adjoining pipelines.
6. The bench shall be rebuilt with a gradual slope from the wall to the invert.

C. The Contractor shall allow for proper cure time for brick and mortar before reestablishing the flow through the manhole.

3.5 FIELD TESTING AND INSPECTION

A. The Contractor shall inspect each of the manholes rehabilitated during this project. The Contractor shall repair any defects found until there are no defects or visible leaks.

B. If the groundwater level is not, in the opinion of the Engineer, high enough for an accurate visual inspection, the Contractor shall test a 20% sample of the original manhole rehabilitation work using exfiltration as described in SEWER MANHOLE SEALING of the NASCCO Standard Specifications or vacuum methods as described in ASTM C-1244. The manholes in the test sample will be selected and approved by the Engineer and will consist of manholes from throughout the project area that are representative of the manhole rehabilitation work originally performed. Any manholes failing the warranty test shall be sealed and retested until the test is passed and/or the results are satisfactory to the Engineer.

C. If any of the manholes fail the test an additional and equivalent test sample of the original manhole rehabilitation work shall be selected by the Engineer. Additional testing shall be performed until all manholes pass the test. No previously tested manholes shall be included in a subsequent test sample.

1. All inspecting, testing, and reworking within the warranty period shall be provided at no additional cost to the City.

PART 4 – COMPENSATION

Payment for Manhole Repairs shall be based on the unit prices bid for these items in the proposal. Under the Unit Prices bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to repair missing and broken brick and mortar at manhole walls, inverts, and floors. Bypass pumping and plugging or blocking of flow shall be considered incidental to the work and shall not be measured separately for payment. Measurement for payment shall be based on each manhole completed, cleaned, and inspected by the Engineer.

Payment for Structural Cementitous Liner for Manhole Rehabilitation shall be based on the Unit Price bid for this item. Separate bid items are included for manholes for pipe sizes of 12-inches or less or greater than 12-inches, and for the coatings applied (cementious or cementitious with epoxy coating). Measurement for payment for the shall be the actual vertical feet of manhole lined using a cementious coating or a cementious and epoxy coating, cleaned, inspected and tested as measured by the Engineer from the invert of the manhole to the bottom of the frame and cover. Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to grout and seal the manholes and apply a structural cementitous liner and corrosion-resistant epoxy barrier. Bypass pumping and plugging or blocking of flow, sealing all pipeline connections to manholes, repair of miscellaneous structural defects or filling of cracks, as required, prior to lining shall be considered incidental to the work and shall not be measured separately for payment.

Special Notes on Exclusions:

All costs associated with the cleaning, heavy cleaning and inspections of pipes and manholes, including the CCTV work for pre-CIPP lining work, and the preparation of inspection and rehabilitation reports for pipes and manholes are not included under this pay item.

SECTION 02780

PRECAST UNIT PAVERS

2780.1	**PRECAST UNIT PAVERS ON CONCRETE BASE**	**SQUARE YARD**
2780.2	**PRECAST UNIT PAVERS - PERMEABLE**	**SQUARE YARD**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Precast Concrete Unit Pavers including, but not limited to, the following:

1. Precast unit pavers on sand asphalt setting bed over portland cement concrete base on aggregate base.

2. Precast unit pavers - permeable with permeable joint opening aggregate on permeable setting bed over crushed stone base materials over sand-based structural soil.

3. Joint sand for precast unit pavers on Portland cement concrete base.

4. Aggregate base and subbase material.

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02520 – Brick Pavers
3. Section 02990 – Site Furnishings
4. Section 02901 – Planting Soils

1.3 REFERENCES

A. All work and materials shall conform to the requirements of the Massachusetts Department of Transportation, Highway Division Standard Specifications for Highways and Bridges (MDOTSSHB), latest edition.

B. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1. American Society for Testing and Materials (ASTM):
2. C29 Bulk Density and Voids in Aggregate
3. C33 Concrete Aggregates
4. C136 Sieve Analysis of Fine and Coarse Aggregates
5. C936 Solid Concrete Interlocking Paving Units
6. D448 Sizes of Aggregate for Road and Bridge Construction

1.4 SUBMITTALS

A. Precast unit pavers and Precast unit pavers - permeable:

1. Submit samples for verifications:

1. Precast unit pavers: Provide five unit pavers minimum for each paver type and paver color. Paver samples shall be sufficient to show full range of color, edge finish and texture variation to be expected in finished work.

2. Precast unit pavers - permeable: Provide five-unit pavers minimum for each paver type and paver color. Paver samples shall be sufficient to show full range of color, edge finish and texture variation to be expected in finished work.

2. Accepted samples become the standard of acceptance for the product produced.

3. Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C 936.

4. Manufacturer’s catalog product data and installation instructions.

B. Joint and setting bed sand for Precast unit pavers:

1. Provide three representative one-pound samples in containers of joint sand materials.

2. Provide three representative one-pound samples in containers of sand setting bed Sand materials.

3. Test results from an independent testing laboratory for sieve analysis per ASTM C 136 conforming to the grading requirements of ASTM C 144.

C. Base and subbase aggregate for Precast unit pavers - permeable:

1. Test results from an independent testing laboratory for sieve analysis per ASTM C 136.

D. Joint opening and bedding course aggregate for Precast unit pavers - permeable:

1. Test results from an independent testing laboratory for compliance with ASTM D 448 No. 8.

2. Test results from an independent testing laboratory for sieve analysis, including washed gradations per ASTM C 136.

3. Test results for void space percentage per ASTM C 29.

E. Shop Drawings. Submit the following:

1. Layout and detailing of Precast unit pavers indicating sizes, dimensions, layout, finishes, joint locations and types, and relationship to adjacent items. Prepare drawings based on field verified dimensions.

2. Layout and detailing of Precast unit pavers - permeable indicating sizes, dimensions, layout, finishes, joint locations and types, and relationship to adjacent items. Prepare drawings based on field verified dimensions.

F. Sample Panels: After receipt of Engineer's approval of material samples, construct one sample panel of typical paver construction for each pattern listed below.

1. Panels:

a. Precast unit pavers on sand setting bed over portland cement concrete base shall be a 10 feet x 10 feet or larger sample panel as required to show full range of colors, pattern, edge finishes, surface finishes and paver types for each pattern listed below:

b. Precast unit pavers - permeable with permeable joint opening aggregate on permeable setting bed on aggregate base materials over Sand Based Structural Soil shall be a 10 feet x 10 feet or larger sample panel as required to show full range of colors, pattern, edge finishes, surface finishes and paver types for each pattern listed below:

2. Engineer will approve color and pattern combinations for each panel. Sample panels shall be constructed on site at location directed by Engineer. If approved by the Engineer, the sample panels may be constructed in place and be incorporated as part

of the final paver layout. Panels shall have specified joint size and other features of typical construction. Engineer shall have the right to require additional panels of similar size and composition constructed at no additional cost to the City if workmanship on the first panel is not acceptable. After Engineer's approval, leave accepted panels on site as standard of acceptable work for permanent construction and remove same only when directed by Engineer.

G. Metal edging

1. Submit 12” sample for verification.

H. Paving installation contractor:

1. Submit job references from a minimum of three projects similar in size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

1.5 QUALITY ASSURANCE

A. Utilize a manufacturer having at least ten years of experience manufacturing interlocking concrete pavers on projects of similar nature or project size.

B. Source Limitations:

1. Obtain all pavers from one source location with the resources to provide products of consistent quality in appearance and physical properties.

2. Obtain joint and sand setting bed from one source with the resources to provide materials and products of consistent quality in appearance and physical properties.

3. Obtain permeable joint opening and bedding course aggregate from one source with the resources to provide materials and products of consistent quality in appearance and physical properties.

C. Paving Contractor Qualifications:

1. Utilize an installer having successfully completed permeable and non-permeable precast concrete unit paver installation similar in design, material, and extent indicated on this project.

2. Utilize a contractor conforming to all local, state/provincial licensing and bonding requirements.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. In accordance with Conditions of the Contract.

B. Manufacturer required to complete production of materials within 30 days after order has been placed to avoid construction delays.

C. Deliver Unit Pavers in manufacturer's original, unopened and undamaged container packaging with identification labels intact.

1. Coordinate delivery and paving schedule to minimize interference with normal use of streets and sidewalks adjacent to paver installation.

2. Deliver unit pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.

3. Unload pavers at job site in such a manner that no damage occurs to the product or adjacent surfaces.

D. Store and protect materials such that they are kept free from mud, dirt and other foreign materials.

E. Prevent joint and setting bed sand from exposure to rainfall or removal by wind with secure, waterproof covering.

1.7 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Install Precast unit pavers only on unfrozen and dry sand setting bed.

2. Install Precast unit pavers - permeable only on unfrozen and dry permeable setting bed and subbase aggregate materials.

3. Install base or subbase aggregates only over unfrozen subgrade.

4. Install sand setting bed or precast concrete unit pavers only when there is no heavy rain or snowfall.

5. No paving work shall be laid in temperatures below 40° Fahrenheit unless provisions are made to protect adequately the masonry materials and the finished work from frost by heating materials, enclosing the work, and heating enclosed spaces. All masonry materials used in freezing weather shall be at a temperature between 50° and 90° Fahrenheit. Protect masonry against freezing for at least 48 hours after it has been laid. No frozen work shall be built upon. Any completed work found to be affected by frost shall be taken down and rebuilt.

1.8 MAINTENANCE

A. Provide a minimum of 5% additional material for overage to be used during construction.

B. Contractor to provide 100 square feet of each product and size used to owner for maintenance and repair. Furnish Pavers from the same production run as installed materials.

C. Manufacturer to supply maintenance manuals for Concrete Pavers and Permeable Pavers.

PART 2 - PRODUCTS

2.1 PRECAST UNIT PAVERS ON CONCRETE BASE

A. Pavers shall be hydraulically pressed concrete pavers as manufactured by Hanover Architectural Products, 240 Bender Road, Hanover Pennsylvania 17331, phone: (717) 637-0500, or approved equal.

1. Precast unit pavers: Type A

a. Color: Matrix B92960

b. Finish: Tudor

c. Size: Multi-sided Prest® Brick –8” x 2 3/8” hexagonal with 1/16” bevel w/ spacer lugs.

2. Precast unit pavers: Type B

a. Color: Charcoal

b. Finish: Tudor

c. Size: Multi-sided Prest® Brick –8” x 2 3/8” hexagonal with 1/16” bevel w/ spacer lugs.

3. Precast unit pavers: Type C

a. Color: Limestone

b. Finish: Tudor

c. Size: Multi-sided Prest® Brick –8” x 2 3/8” hexagonal with 1/16” bevel w/ spacer lugs.

4. Precast unit pavers: Type D

a. Color: Matrix B9103

b. Finish: Tudor

c. Size: Multi-sided Prest® Brick –8” x 2 3/8” hexagonal with 1/16” bevel with 1/16” spacer lugs.

5. Precast unit pavers: Type E

a. Color: Limestone

b. Finish: Tudor

c. Size: Prest® Brick 4” x 8” paver with 1/16” bevel with 1/16” spacer lugs.

B. When tested for compressive strength in accordance with ASTM 170-90, “Standard Test Method for Compressive Strength of Dimension Stone,“ pavers shall be produced to meet or exceed the following test results: average compressive strength of 9,000 pounds per square inch at 28 days, an absorption rate of less than 5% at 50 cycles of freeze thaw testing, and a density of 155.0 pound per cubic foot.

C. Pavers to be constructed with spacers on sides providing a uniform 1/16" joint around pavers.

D. Pavers to be fabricated of Coplay Cement, Type I, Buff.

E. Paver aggregates to be blend from 200 mesh to 5/8 inch with a light gray color. Aggregate to have a PA S.R.L. test of H, specific gravity of 2.79 and absorption of 2.60. Aggregates to be washed with no deleterious substances and with no thin or elongated pieces. Aggregates to have L.A. abrasion test of 21 and L.A. rattles loss test of 21.8% (at 500 revolutions). Aggregates to have a wash test of less than 1% (this includes materials lost by washing the aggregate, even those aggregates finer than 200 mesh).

F. Paver mix to be prepared in a stationary mixer to a 5-inch slump, mixed a maximum time of two minutes and placed in the mold in a homogenous state. The entire paver is to be of the same design and a single mix system. Hydraulic pressure to be employed to be a minimum of 800,000 pounds without the use of vibration.

2.2 PRECAST UNIT PAVERS - PERMEABLE

A. Pavers shall be hydraulically pressed permeable concrete pavers as manufactured by Hanover Architectural Products, 240 Bender Road, Hanover Pennsylvania 17331, phone # (717) 637-0500, or approved equal.

1. Precast unit pavers - permeable: Type 1

a. Color: Matrix # B92738

b. Finish: Tudor

c. Size: Permeable Prest® Brick - 4 1/2” x 9” x 3” thick with 1/16” bevel and hidden 1/4” spacer lugs

2. Precast unit pavers - permeable: Type 2

a. Color: Matrix # B93730

b. Finish: Tudor

c. Size: Permeable Prest® Brick - 4 1/2” x 9” x 3” thick with 1/16” bevel and hidden 1/4” spacer lugs

B. When tested for compressive strength in accordance with ASTM 170-90, “Standard Test Method for Compressive Strength of Dimension Stone,“ pavers shall be produced to meet or exceed the following test results: average compressive strength of 9,000 pounds per square inch at 28 days, an absorption rate of less than 5% at 50 cycles of freeze thaw testing, and a density of 155.0 pound per cubic foot.

C. Pavers to be constructed with spacers on sides providing a uniform 1/16" joint around pavers.

D. Pavers to be fabricated of Coplay Cement, Type I, Buff.

E. Paver aggregates to be blend from 200 mesh to 5/8 inch with a light gray color. Aggregate to have a PA S.R.L. test of H, specific gravity of 2.79 and absorption of 2.60. Aggregates to be washed with no deleterious substances and with no thin or elongated pieces. Aggregates to have L.A. abrasion test of 21 and L.A. rattles loss test of 21.8% (at 500 revolutions). Aggregates to have a wash test of less than 1% (this includes materials lost by washing the aggregate, even those aggregates finer than 200 mesh).

F. Paver mix to be prepared in a stationary mixer to a 5-inch slump, mixed a maximum time of two minutes and placed in the mold in a homogenous state. The entire paver is to be of the same design and a single mix system. Hydraulic pressure to be employed to be a minimum of 800,000 pounds without the use of vibration.

2.3 JOINT SAND FOR PRECAST UNIT PAVERS

A. Provide natural Joint Sand as follows:

1. Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.

2. Do not use limestone screenings, stone dust, or sand for the Joint Sand material that does not conform to conform to the grading requirements of ASTM C 33.

3. Utilize sands that are as hard as practically available where concrete pavers are subject to vehicular traffic.

4. Gradation as shown in Table 1 below:

TABLE 1
JOINT SAND GRADATION REQUIREMENTS FOR
PRECAST UNIT PAVERS

ASTM C 144		
Sieve Size	**Natural Sand Percent Passing**	**Manufactured Sand Percent Passing**
No. 4 (4.75 mm)	100	100
No. 8 (2.36 mm)	95 to 100	95 to 100
No. 16 (1.18 mm)	70 to 100	70 to 100
No. 30 (0.600 mm)	40 to 75	40 to 75
No. 50 (0.300 mm)	10 to 30	20 to 40
No. 100 (0.150 mm)	2 to 15	10 to 25
No. 200 (0.075)	0 to 1	0 to 10

2.4 SETTING BED FOR PRECAST UNIT PAVERS FOR PRECAST UNIT PAVERS

A. Sand-Asphalt Setting Bed

1. Asphalt: conform to ASTM Designation D-946-69A with a penetration at 77 degrees F. 100 gram, 5 seconds of minimum 85 millimeters and a maximum of 100 millimeters.

2. Combine dried fine aggregates with hot asphalt cement and heat mix to approximately 300 degrees F at asphalt plant. Appropriate proportion of materials shall be seven percent cement asphalt and ninety-three percent aggregate by weight in approximate ratio of 145 pounds asphalt to 1,855 pounds sand. Determine exact proportions to produce best possible mixture for construction of bituminous setting bed to meet construction requirements.

2.5 MASTIC ADHESIVE FOR PRECAST UNIT PAVERS

A. Mastic Adhesive for use as tack coat beneath pavers: consist of 2 percent neoprene (Grade WM1) modified asphalt with 10 percent fibers and eighty-eight percent asphalt. Melting point shall be 200 degrees F. minimum in accordance with ASTM D36. Penetration at 77 degrees F., 100-gram load for 5 seconds (.1mm) shall be 23 to 27.

2.6 PORTLAND CEMENT CONCRETE BASE COURSE FOR PRECAST UNIT PAVERS

A. Portland Cement Paving Mix as specified in Section 03300 – Portland Cement Concrete Paving

2.7 ¼" SETTING BED FOR PRECAST UNIT PAVERS - PERMEABLE

A. Provide permeable Bedding Course Aggregate materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 8 as presented in Table 3.

TABLE 3
BEDDING COURSE AGGREGATE GRADATION
REQUIREMENTS FOR PRECAST UNIT PAVERS - PERMEABLE

ASTM No. 9	
Sieve Size	Percent Passing
3/8 in	100
No. 4	85 to 100
No. 8	10 to 40
No. 16	0 to 10
No. 50	0 to 5

2.8 PAVER JOINT MATERIALS FOR PRECAST UNIT PAVERS – PERMEABLE

A. Paver joint materials: 1/8" washed stone supplied by Read Custom Soils, Canton, Massachusetts or approved equivalent product.

2.5 GEOGRID FOR PRECAST CONCRETE UNIT PAVERS – PERMEABLE

A. Geogrid for Paving Base Reinforcement to resist settlement: Triaxial Geogrids shall be shall be TiAx TX 140 manufactured by Tensar Inernational Corporation, 5883 Glenridge Drive, Suite 200, Atlanta, GA 30328-5363, tel: 800 836 7271, or approved equivalent product.

2.8 PERMEABLE BASE AGGREGATE FOR PRECAST UNIT PAVERS - PERMEABLE

A. 3/8" Crushed Stone as specified in Section 02901 – Planting Soils.

2.9 SUBBASE AGGREGATE FOR PRECAST UNIT PAVERS - PERMEABLE

A. 3/4" Crushed Stone as specified in Section 02901 – Planting Soils.

2.10 GRAVEL BASE AND SUBBASE

A. Gravel Borrow: Section 02210 – Earth Excavation, Backfill, Fill and Grading.

2.10 METAL EDGING

A. Refer to Section 02990 – Site Furnishings

PART 3 - EXECUTION

3.1 EXAMINATION - GENERAL

A. Examine areas indicated to receive paving for compliance with requirements for installation tolerances and other conditions affecting performance before placing the Precast unit pavers or Precast unit pavers - permeable.

1. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.

2. Provide written density test results for soil subgrade and to the Owner's Representative.

3. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

4. Verify that concrete slab base meets elevations and specified requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Verify that the soil subgrade is free from standing water.

B. Verify the Concrete Underlayment is clean and dry, certified by General Contractor as meeting material, installation and grade specifications.

C. Stockpile Joint Sand, Permeable Setting Bed and Joint Aggregate material such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

D. Remove any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities before placing the Permeable Setting Bed material.

E. Keep area where pavement is to be constructed free from sediment during entire job. Remove and replace all permeable joint and setting bed aggregate materials contaminated with sediment with clean materials.

F. Complete all sub-drainage of underground services within the pavement area in conjunction with subgrade preparation and before the commencement of paving installation.

G. Do not damage underdrain pipes, overflow pipes, observation wells, or inlets and other drainage appurtenances during installation. Report all damage immediately.

H. Compact soil subgrade as specified in Section 02910 - Planting Soils.

3.7 PREPARATION OF GRAVEL BASE

A. Make corrections to base courses provided under Section 02210 – Earth Excavation, Backfill, Fill and Grading, to bring base courses to the proper sections and elevations for Brick Paver Installation.

B. Compact subgrade to achieve a 95% minimum compaction rate consistent throughout subgrade.

C. Place gravel base in 2" to 3" lifts and as specified in Section 02210 – Earth Excavation, Backfill, Fill and Grading.

D. Compact to achieve a 95% minimum compaction rate consistent throughout gravel base.

E. Final surface of gravel base to be left 1/8" higher than adjacent surfaces to allow for settlement.

3.3 PREPARATION FOR PRECAST UNIT PAVER INSTALLATION ON PORTLAND CEMENT CONCRETE BASE

A. Portland Cement Concrete Base: as specified in Section 03300 – Portland Cement Concrete Paving.

B. Install PVC weeps at low points and other locations shown on Drawings. Sweep concrete base clean. Fill Weeps with gravel. Install filter fabric over weep holes in concrete base.

C. Expansion Joints: Provide expansion joints using galvanized metal keyway sections where concrete placement is interrupted for more than 1/2 hour and at end of placement and in grid pattern not more than 30 feet on center at locations approved by Engineer. Provide shear dowels and expansion caps at not more than 16 inches on center to transfer vertical loads but permit horizontal movement. Extend joint filler full depth of joint and allow 1/2-inch minimum space at top for insertion of backer rod and sealant. Protect top edge of joint filler with metal cap or other temporary protection. Remove protection after concrete has been placed on both sides of joint.

D. Caulked Construction Joints: Provide caulked construction joints wherever concrete abuts dissimilar material at locations approved by Engineer. Extend joint filler full depth of joint and allow 1/2-inch minimum space at top for insertion of backer rod and sealant. Protect top edge of joint filler with metal cap or other temporary protection. Remove protection after concrete has been placed on both sides of joint.

3.4 SAND ASPHALT SETTING BED INSTALLATION FOR PRECAST UNIT PAVERS

A. Place two 3/8 inch by one-inch control bars directly over base. Adjust bars with wood chucks under control bars to bring ¾-inch setting bed or proper grade. Set bars parallel to each other approximately eleven feet apart to serve as guides for striking board (12 feet long, 2-inch x 6-inch board). Set depth control bars to bring pavers, when laid, to proper grade. Place some bituminous bed material between parallel depth control bars. Pull bed with striking board over bars several times. After each passage, low porous spots to be showered with fresh bituminous material to produce smooth firm and even setting bed. As soon as this panel is completed advance first bar to next position ready for striking next panel. Carefully fill depressions remaining after removing depth control bars and wood checks. Elevation shall be adjusted so when pavers are placed, top surface of pavers will be at required finished grade.

B. Roll setting bed with a power roller to ¾-inch depth while still hot. Final surface of setting bed over gravel base to be left 1/8" higher than adjacent surfaces to allow for settlement.

C. Apply coating of asphalt mastic adhesive to setting bed using trowel having 1/16-inch serrations.

D. Final surface of setting bed over gravel base to be left 1/8" higher than adjacent surfaces to allow for settlement.

3.5 PRECAST PAVER INSTALLATION

A. Set pavers on setting bed with hand tight joints in patterns shown on Drawings. Continually check surface of finished line and grade with straight edge. Correct deficiencies. Cut pavers to fit in locations noted. Machine cuts only. Minimimum paver size to be no smaller than 1/2 unit size. Final surface of pavers to be left 1/8" higher than adjacent surfaces to allow for settlement.

B. Sweep dry joint sand into joints until completely filled and provide a layer of sand over pavers. Compact pavers using a low amplitude plate compactor capable of at least 5,000 Ibf compaction at a frequency of 75 hz to 100 hz. and vibrate until completely filled. Two to three passes minimum. Fog surface with water to compact mix into joints. Repeat process until joints are compacted and filled. Clean stains immediately. Do not compact within 3 feet of unrestrained edges of the paving units. Remove excess Joint Sand broom clean from surface when installation is complete.

C. Work within 3 feet of the laying face to be left fully compacted with sand-filled joints at end of each day. Cover laying face with plastic sheets overnight if not closed wt cut and compacted pavers.

D. Protect installed units with plywood panels against uneven settlement and misalignment. If settlement occurs producing mismatch of more than 1/16 inch at interface between pavers and other pavements prior to final acceptance, relay pavers near interface for sufficient distance to provide smooth transition between paving surfaces and satisfactory match between pavers and adjacent surfaces.

3.6 METAL EDGING INSTALLATION

A. As specified in Section 02990 – Site Furnishings

3.7 INSTALLATION OF PRECAST UNIT PAVERS - PERMEABLE

A. Provide geogrid in a continuous horizontal surface between Sand Based Structural Soil and Crushed Stone base with overlaps between materials and as recommended by the manufacturer.

B. Permeable Base and Subbase Aggregate

1. Provide the Permeable Subbase Aggregate in uniform lifts not exceeding 6 in., (150 mm) loose thickness and compact to at least 95 percent as per ASTM D 4254 to depths as indicated

2. Compact the Permeable Subbase Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 ton vibratory roller until there is no visible movement. Do not crush aggregate with the roller.

3. Tolerance: Do not exceed the specified surface grade of the compacted Permeable Subbase Aggregate material more than ±3/4 in. (20 mm) over a 10 ft. (3 m) long straightedge laid in any direction.

4. Provide the Permeable Base Aggregate material in uniform lifts not exceeding 6 in. (150 mm) over the compacted Permeable Subbase Aggregate material and compact to at least 95 percent as per ASTM D 4254 to depths as indicated.

5. Compact the Permeable Base Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 ton vibratory roller until there is no visible movement. Do not crush aggregate with the compaction device.

6. Tolerance: Do not exceed the specified surface grade of the compacted Permeable Base Aggregate material more than ±1/2 in. (13 mm) over a 10 ft. (3 m) long straightedge laid in any direction.

7. Grade and compact the upper surface of the Permeable Base Aggregate material sufficiently to prevent infiltration of the Permeable Setting Bed Aggregate material both during construction and throughout its service life.

C. Permeable Setting Bed Aggregate

1. Provide and spread Permeable Setting Bed aggregate evenly over the base course and screed to a nominal thickness of 2 in.

   a. Do not disturb Sand Based Structural Soil.

   b. Do not substantially exceed screed area which cannot be covered by pavers in one day.

   c. Do not use Permeable Setting Bed Aggregate material to fill depressions in the base surface.

2. Keep moisture content constant and density loose and constant until pavers are set and compacted.

3. Inspect the Permeable Setting Bed Aggregate course prior to commencing the placement of the permeable concrete pavers.

D. Permeable Pavers

1. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.

2. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

3. Exercise care in handling face mix pavers to prevent surfaces from contacting backs or edges of other units.

4. Provide Permeable Pavers using joint pattern as indicated. Adjust joint pattern at pavement edges such that cutting of edge pavers is minimized. Cut all pavers exposed to vehicular tires no smaller than one-third of a whole paver.

5. Place units hand tight against spacer bars. Adjust horizontal placement of laid pavers to align straight.

6. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

7. Provide space between paver units of 1/32 in. (1 mm) wide to achieve straight bond lines.

8. Do not exceed joint (bond) lines more than ±1/2 in. (±15 mm) over 50 ft. (15 m) from string lines.

9. Fill gaps between units or at edges of the paved area that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.

10. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

11. Do not allow traffic on installed pavers until Permeable Joint Aggregate has been vibrated into joints. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and Permeable Joint Aggregate material.

12. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a to 5000-lbf (22-kN) compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:

    a. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.

    b. Compact installed concrete pavers to within 6 feet (1,800 mm) of the laying face before ending each day's work. Cover pavers that have not been compacted and leveling course on which pavers have not been placed, with non-staining plastic sheets to prevent Permeable Setting Bed Aggregate from becoming disturbed.

13. Remove any cracked or damaged pavers and replace with new units prior to installing Permeable Joint Opening Aggregate material.

14. Provide, spread and sweep Permeable Joint Opening Aggregate into joints immediately after vibrating pavers into Permeable Setting Bed course until full. Vibrate pavers and add Permeable Joint Aggregate material until joints are completely filled, then remove excess material. This will require at least 4 passes with a plate compactor.

15. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage). Do not exceed 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.

16. Remove excess Permeable Joint Aggregate broom clean from surface when installation is complete.

3.8 FIELD QUALITY CONTROL

A. Verify final elevations for conformance to the drawings after sweeping the surface clean.

1. Do not deviate final surface tolerance from grade elevations more than ±3/8 in. (±10 mm) under a 10 ft. (3 m) straightedge or indicated slope, for finished surface of paving.

B. Set surface elevation of pavers 1/8 in. (3 mm) above adjacent drainage inlets, concrete collars or channels.

C. Lippage: No greater than 1/8 in. (3 mm) difference in height between Permeable Interlocking Concrete Pavers and adjacent paved surfaces.

3.9 PREPARING AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Cleaning: Remove excess dirt, debris, stains, grit, etc. from exposed paver surfaces; wash and scrub clean. Clean pavers in accordance with the manufacturer's written recommendations.

3.10 PROTECTION

A. Protect completed work from damage due to subsequent construction activity on the site.

3.11 JOINT AGGREGATE MATERIAL REFILLING FOR PRECAST UNIT PAVERS - PERMEABLE

A. Provide additional Permeable Joint Aggregate material after 120 days and before 150 days after date of Substantial Completion/Provisional Acceptance.

1. Fill Permeable Joint Aggregate material full to the lip of the paver.

PART 4 - COMPENSATION

2780.1 PRECAST UNIT PAVERS ON CONCRETE BASE SQUARE YARD

METHOD OF PAYMENT
Measurement for Precast Unit Pavers on Cast-in-Place Concrete Slab over aggregate base shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS

Payment for Precast Unit Pavers on Cast-in-Place Concrete Slab over aggregate base shall be based on the square yard of concrete pavers on cast-in-place concrete slab as detailed in the Contract Documents installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of concrete pavers on sand-asphalt setting bed on cast-in-place concrete slab over aggregate base as detailed and where indicated or required by the Engineer. The work includes, but is not limited to: installation of precast concrete unit pavers, sand-asphalt setting bed, joint sand, concrete base slab and gravel or crushed stone base; excavation to depth shown in the drawings vertically of proposed grade; labor, equipment, materials, safe transportation including loading at storage site and unloading at site of installation; and all incidental work not included for payment elsewhere.

2780.2 PRECAST UNIT PAVERS - PERMEABLE SQUARE YARD

METHOD OF PAYMENT
Measurement for Precast unit pavers - permeable with joints filled with 1/8" Washed Open Graded Stone on ¼" Washed Open Graded Crushed Stone Bedding Course over 3/8" Washed Open Graded Crushed Stone Bedding Course over ¾" Washed Open Graded Crushed Stone Base shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS
Payment for Precast unit pavers - permeable with joints filled with 1/8" Washed Open Graded Stone on ¼" Washed Open Graded Crushed Stone Bedding Course over 3/8" Washed Open Graded Crushed Stone Bedding Course, Geogrid layer, over ¾" Washed Open Graded Crushed Stone Base as detailed in the Contract Documents installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of precast unit pavers - permeable as detailed and where indicated or required by the Engineer. The work includes, but is not limited to: installation of precast unit pavers - permeable with joint material on ¼" Washed Open Graded Crushed Stone Bedding Course over 3/8" Washed Open Graded Crushed Stone Bedding Course over ¾" Washed Open Graded Crushed Stone Base; excavation to depth shown in the drawings vertically of proposed grade; labor, equipment, materials, safe transportation including loading at storage site and unloading at site of installation; and all incidental work not included for payment elsewhere.

EXCLUSIONS
The following items are not included for payment under this item: Sand Based Structural Soil, 6" Sand Layer and Steel Edging to be included for payment elsewhere.

END OF SECTION

SECTION 02810

IRRIGATION SYSTEMS

2810.1 IRRIGATION SYSTEMS LUMP SUM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Include General Conditions and Supplementary Conditions as part of this Section.

B. Examine other Sections of the specifications for requirements, which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with trades affecting, or affected by, work of this Section. Cooperate with such trades to assure the steady progress and proper sequencing of work under the Contract.

D. Coordinate construction sequence so that irrigation equipment installed under hardscapes are tested before the hardscape material is installed as required by the City of Cambridge.

1.2 WORK INCLUDED

A. Perform work required to complete the work of the Section, as indicated. Such work includes, but is not limited to, the following:

1. Provide, deliver, install and test two (2) soil moisture sensing irrigation systems to water the indicated streetscape landscaping and trees (see Landscape plans).

2. Testing of the irrigation system and moisture sensor operation under hardscape before the hardscape surface is installed.

B. Work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the specifications. Parts necessary for the proper and complete execution of the work, whether the same may have been specifically mentioned or not, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.

1.3 RELATED WORK UNDER OTHER SECTIONS

A. Carefully examine the Contract Documents for requirements that affect the Work of this Section, including:

1. Section 02210 - Earth Excavation, Backfill, Fill and Grading

2. Section 02900 - Landscaping
3. Division 16 - Electrical

1.4 REFERENCES

A. Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:
   1. American Society for Testing & Materials (ASTM)
      a. ASTM: D3261-16 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
      b. ASTM: D3350-14 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
      c. ASTM: F714-13 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
      d. ASTM: D2737-99 Polyethylene (PE) Pressure rated tube.
   2. National Standard Plumbing Code (NSPC)
   3. National Electric Code (NEC)
   4. National Sanitary Foundation (NSF)
   5. American Society of Agricultural and Biological Engineers (ASABE)
   6. Underwriters Laboratories, Inc. (UL)
   7. Occupational Safety and Health Administration (OSHA)
   8. American Society of Irrigation Consultants (ASIC)

1.5 QUALITY ASSURANCE

A. Installer: Firm that has at least five (5) years' experience in work of the size and type required by this section and which is acceptable to the City.

B. References: Supply five references for work of this type and size with bid including names and phone numbers of contact person(s).

1.6 EXAMINATION OF CONDITIONS

A. Contractor shall fully inform himself of existing conditions on the site before submitting his bid and shall be fully responsible for carrying out the work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual Work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed, except those conditions described in the GENERAL CONDITIONS.

1.7 SUBMITTALS

A. Product Data: submit three (3) copies of the following manufacturer's catalog cut/equipment data. Submittals shall be marked-up to indicate features/capacities/sizes/etc. as they apply to this project:

   1. Sprinklers and Nozzles

2. Copper Pipe and Fittings
3. Copper Tube Size HDPE Pipe and Fittings
4. Automatic Valves
5. Isolation Gate Valves (Irrigation)
6. Isolation Ball Valves (Water Supply)
7. Polyethylene Pipe and Fittings
8. HDPE Pipe and Fittings
9. Sleeving Pipe (HDPE and Ductile Iron)
10. Controller
11. Decoders
12. Lightning Arrestors
13. Surge Arrestors
14. Master Valve
15. Flow Sensor
16. In-line Drip Tubing and Accessories
17. Filters
18. Pressure Regulators
19. Deep Drip Stakes
20. Emitters
21. 1/4 Inch Drip Tubing
22. Valve Boxes (Plastic and Polymer Concrete)
23. Wire and Connectors
24. Controller Enclosure w/Mounting Kit
25. Grounding Equipment
26. Moisture Sensors
27. Flushing Valves
28. Aeration Pipe
29. Filter Fabric
30. Aeration Grates
31. Backflow Prevention Devices
32. Water Meters
33. Water Supply Enclosure
34. Miscellaneous Materials

B. Project Record Documents:

1. Provide and keep up-to-date a complete redlined record set of drawings of the system as the project proceeds. Drawings shall be corrected daily, showing every change from the original drawings and specifications. Record drawings shall specify and exactly locate deep drip stakes and driplines installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Water supplies, controllers, isolation valves, rain sensor, quick coupling valves, and other equipment shall be indicated on the drawings. Wire routing, wire size and splices shall be indicated. Mainline pipe, lateral pipe, wire route and dripline shall have four (4) distinctly different graphic symbols (line types). This redlined record set of drawings shall be kept at job site and shall be used only as a record set.

2. Make neat and legible notations on this record set of drawings daily as the Work proceeds, showing the Work as actually installed. For example, should a piece of equipment be installed in a location that does not match the plan, indicate that equipment in a graphic manner in the location of installation and so as to match the original symbols as indicated in the irrigation legend. Should the equipment be different from that specified, indicate with a new graphic symbol both on the drawings and the irrigation legend. The relocated equipment dimensions and northing and easting coordinates should then be transferred to the appropriate drawing in this record set of drawings at the proper time.
3. On or before the date of final field observation, deliver corrected and completed AutoCAD computer plots of "record drawings" on vellum and AutoCAD electronic files on disk to the Engineer as part of contract closeout. Delivery of plots will not relieve the responsibility of furnishing required information that may have been omitted from the prints. Record drawing shall have Contractors own title block and include as installed information only. The record drawing shall not be a marked-up version of the design plan.

C. Complete submittal including wiring circuitry with terminals, components and wiring identified shall be provided with the Maintenance and Operating Manuals.

1.8 SCOPE

A. Irrigation system shown on the drawings and described within these specifications represents a streetscape landscape irrigation system supplied from two potable water irrigation mainline taps. System is designed for 20 gallons per minute maximum, per tap.

1.9 DELIVERY, STORAGE AND HANDLING

A. Store and handle materials in compliance with manufacturer's instructions and recommendations. Protect from possible damage. Minimize on-site storage.

1.10 GUARANTEE

A. Obtain in the City's name the standard written manufacturer's guarantee of materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. These guarantees shall be in addition to, and not in lieu of, other liabilities.

B. In addition to the manufacturers guarantees warrant the irrigation system, both parts and labor for a period of one (1) year from date of acceptance by the City.

1.11 MAINTENANCE AND OPERATING INSTRUCTION

A. Include in Bid an allowance for four (4) hours of instruction of City's personnel upon completion of check/test/start-up/adjust operations by a competent operator.

The Engineer shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).

B. Upon completion of work and prior to application for acceptance and final payment, a minimum of three (3) three ring, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE CITY OF CAMBRIDGE RIVER STREET IRRIGATION SYSTEM, shall be submitted to the Engineer. After review and approval, the copies will be forwarded to the City. Included in the Maintenance and Operating binders shall be:

1. Table of Contents
2. Written description of the System
3. System drawings:
   A. One (1) copy of the Record Drawing;
   B. One (1) reproducible of the Record Drawing;
   C. One (1) copy of the control system wiring diagram
4. Listing of Manufacturers
5. Manufacturer's data where multiple models, type and size listings are included; clearly and conspicuously indicating those that are pertinent to this installation.
   A. "APPROVED" submittals for equipment
   B. Maintenance: including complete troubleshooting charts
   C. Parts list
   D. Operation: User's Manual
   E. Names, addresses and telephone numbers of recommended repair and service companies
6. System Operating Schedule: Provide suggested operating schedule to provide 1 inch per week including precipitation rates for each type of irrigation.
7. Winterization and spring start-up procedures
8. Guarantee data

1.12 ORDINANCES, PERMITS, CERTIFICATIONS, AND NOTICES

A. Work under this Section shall comply with ordinances and regulations of authorities having jurisdiction.

B. Obtain and pay for permits, tests and certifications required for the execution of Work under this Section.

C. Furnish copies of Permits, Certifications and Approval Notices to the Engineer prior to requesting payment.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system. Material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.

B. For warranty purposes, equipment shall be supplied from authorized distributors of the various products.

2.2 DUCTILE IRON PIPE

A. Ductile iron pipe shall be Class 52, cement lined and tar coated per AWWA, ASTM and Harvard University specifications. Pipe shall be mechanical joint connected. Pipe shall be as manufactured by U.S. Pipe and Foundry, Atlantic States, American Pipe and Supply or approved equal.

B. Fittings shall be flanged, conforming to ANSI/AWWA C110/A21.10-98.

2.3 COPPER PIPE AND FITTINGS

A. Copper pipe shall be Type K, hard tempered ASTM B88.

B. Copper fitting shall be wrought copper, solder joint type in accordance with ASTM B828-00.

C. Joints shall be soldered with silver solder ASTM B32, Grade 95TA up to 250 degree using non-corrosive flux.

D. Supply only pipes and fittings that are marked by the manufacturer with the appropriate ASTM designations and pressure ratings and are free from cracks, wrinkles, blisters, dents or other damage.

2.4 COPPER TUBE SIZE HDPE PIPE

C. Pipe to water bottle fill stations where indicated on the drawings shall be copper tube size HDPE conforming to ASTM D2737, AWWA C901 meeting NSF Standards 14 and 61.

D. Fittings shall be compression type for copper tube size HDPE pipe.

2.5 WIRE CONDUIT

A. Conduit for wiring beneath non-soil areas shall be PVC, Schedule 40 conduit with solvent-weld joints, as manufactured by Carlon, Cresline, JMM or equal.

B. Sweep ells shall be standard electrical type PVC Schedule 40 long sweep elbows. Cap sweep ell with tri-plug with the ring for securing nylon pull rope.

2.6 HDPE PIPE AND FITTINGS

A. Mainline and sleeving HDPE pipe shall be HDPE IPS pipe; Flying W, JM Eagle or USPoly, SDR 11, PE 4710, 202 psi rated, ASTM 3350, O.D. controlled. Pipe shall meet the requirements of ASTM F714, D3261 and D3350.

B. HDPE pipe shall be joined by butt fusion method using personnel experienced in the procedure.

C. HDPE molded fittings shall be DR11 meeting the requirements of ASTM D3261 and pressure rated for a minimum of 200 psi. Full size tees shall be used, and if reduction is required, concentric reducer(s) shall be fused to the tee. Molded fittings shall have inside and outside diameters matching the pipe inside and outside diameters. Fittings shall be machined as necessary.

D. Polypropylene mechanical joint compression fittings for HDPE pipe connections shall have a maximum working pressure of 232 psi at 176 degrees Fahrenheit. Fittings shall have a 50-year life expectancy. The joint shall be made by the compression of a ring or sleeve on the outside wall of the pipe with or without additional sealing elements and with or without internal support. The nominal size is the nominal outside diameter of the pipe which can be connected to the fitting. Saddles shall not be used. Fittings comply with NSF/ANSI 61 and be in accordance with ISO 3501. Fittings, 3G compression IPS-OD, shall be as manufactured by, Philmac, FloPast or approved.

E. Threaded connections in and out of valves shall be made using threaded stainless-steel nipples and stiffeners.

F. No fabricated fittings are allowed.

2.7 POLYETHYLENE IRRIGATION PIPE

A. Polyethylene pipe shall be used for lateral pipe and drip irrigation supply and exhaust headers where indicated on the drawings. Pipe shall be polyethylene (PE-3408) pipe, SDR 15, Class 100, Type III, Grade 3, Class C conforming to ASTM D2239, with a minimum pressure rating of 100 psi as manufactured by Charter, Cresline, Oil Creek or equal. Polyethylene pipe shall only be used in landscape areas.

2.8 POLYETHYLENE IRRIGATION FITTINGS

A. Fittings for polyethylene pipe shall be insert PVC or Nylon type fittings. Fittings shall conform to NSF standards and be attached with two (2) offset dog-eared stainless-steel clamps. Clamps shall be as manufactured by Oetiker or approved equal.

B. Supply only pipes and fittings that are marked by the manufacturer with the appropriate ASTM designations and pressure ratings and are free from cracks, wrinkles, blisters, dents or other damage. Fittings shall be per ASTM D2609 as manufactured by Dura, Lasco, Spears or approved equal.

2.9 SPRAY SPRINKLERS

A. Full and part circle pop up spray sprinklers shall be pressure regulating (30-psi), plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle size shall be as indicated on the drawing and in the legend. Pop-up height shall be 6-inches.

B. Nozzle size shall be as indicated on the drawing and in the legend. VAN nozzles shall only be used where a fixed arc nozzle is not available. Fixed arc nozzles shall be Hunter MPR, VAN nozzles where appropriate shall be Rain Bird HE-VAN.

C. Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Hunter Industries model PROS-06-PRS30-CV, Rain Bird model 1806-SAM-PRS or equal.

2.10 PERFORATED CORRUGATED HDPE DISTRIBUTION PIPE FOR STRUCTURAL SOIL

A. Distribution pipe to encase drip tubing and laid on top of filter fabric shall be 4-inch corrugated HDPE, Type C, meeting the cell classification 335420C as defined by ASTM-3350.

B. The minimum parallel plate stiffness values when tested in accordance with D-2412 shall be 35pii.

C. Standard perforations shall be AASHTO M-252 Class 2.

D. The pipe and fittings shall be free of foreign inclusions and visible defects. The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe.

E. Corrugated fittings may be either molded or fabricated by the manufacturer. Fittings supplied by other than the manufacturer of the pipe shall not be permitted. Joints shall be made with snap fittings

2.11 FILTER FABRIC

A. Filter fabric shall be provided under subsurface aeration pipes that contain irrigation drip tubing for the purpose of water dispersion. Filter fabric shall be a woven, calendared, monofilament filtration geotextile made of 100% polypropylene yarns.

B. Filter fabric shall have a percent open area of 4% to 6% and shall satisfy the requirements as outlined in AASHTO M-288-06 for permanent erosion control and subsurface drainage class 2 and 3. Filter fabric shall have a minimum puncture strength of 120 lbs. per ASTM D-4833.

C. Filter fabric shall be as manufactured by US Fabrics, model US 670 or approved equal.

2.12 AERATION GRATES

A. Grates shall be 4-inch x 4-inch stainless steel with aluminum inlet. Grate shall be as manufactured by GreenBlue Urban, RRARBV – medium duty with Chevron pattern.

2.13 ELECTRIC CONTROL VALVES

A. Electric control valves shall be one-inch remote control, diaphragm type, fiber-glass or reinforced nylon body plastic valves with manual flow control, manual bleed screw and 200 psi pressure rating.

B. Valves shall be manufactured by Hunter Industries, model ICV or Rain Bird, Model PEB.

2.14 VALVE BOXES (PLASTIC)

A. Valve boxes in landscape shall be manufactured from unformed resin with a tensile strength of 3,100-5,500 psi conforming to ASTM D638. Boxes shall be green or black in color.

B. Valve boxes for small isolation valves, wire splices and quick coupling valves shall be 10-inch round valve boxes with metal detection, T-top lids and bolt down covers. Splice boxes shall have gray lids.

C. Valve boxes for single and dual drip valve assemblies shall be 18-inch jumbo valve boxes with metal detection, T-top lids and bolt down covers.

D. Valve boxes for manual flush valves shall be 6-inch econo valve boxes with detection.

E. Valve box extensions shall be provided and installed as required for proper box depth. Valve box extensions shall be made by the same manufacturer as the box.

F. Valve boxes shall be manufactured by Dura Plastics, Highline Products, NDS Pro Series or Olde Castle Specification Grade.

2.15 VALVE BOXES (POLYMER CONCRETE)

A. Valve boxes in hardscape shall be manufactured from polymer concrete capable of withstanding a static load of greater than 45,769 pounds, meeting ASTM C857-

95 with a compressive strength of 11,000 psi. Valve boxes shall meet AASHTO H-20 design load.

B. Valve boxes for single 1-inch drip electric valves and flow meter shall be 13-1/4-inch-wide x 24-inch-long x 12-inch-deep valve box with steel checker galvanized locking cover, Model B1324-51GH galvanized as manufactured by Oldcastle – Christy Concrete, Model B1324.

C. Valve boxes for isolation gate valves (mainline and lateral), quick couplers, flush valves, ground rods and wire splices in hardscape areas shall be 13-inch I.D. round x 12-inch-deep with 11-3/16-inch opening and 11-1/8-inch bolt down cast-iron lid with locking grade ring as manufactured by Oldcastle - Christy Concrete, Model G08T box with Model G05CT cast iron lid.

D. Valve boxes for point of connections master valves, isolations and quick couplers and dual 1-inch drip electric valves where indicated on the drawings shall be 17-inch-wide x 30-inch-long x 12-inch-deep valve box with steel checker galvanized locking cover, Model B1730-51GH galvanized as manufactured by Oldcastle – Christy Concrete, Model B1730.

E. Valve box extensions shall be provided and installed as required for proper box depth. Valve box extensions shall be made by the same manufacturer as the valve box.

2.16 AUTOMATIC CONTROLLERS

A. Controllers shall be Manufactured by Baseline Inc, in Meridian, Idaho model BL3200X and installed per Manufacturer's Specifications, and as specified herein.

B. Controllers shall be able to operate:

1. Up to 200 zones along a two-wire path and/or a conventional wire path
2. Up to 25 moisture sensors
3. Up to 6 pause device inputs (3 normally closed along the two-wire path and 3 hard-wired normally closed pause interrupts)
4. Up to 4 normally open or normally closed master valves
5. Up to 4 flow sensors
6. Up to 110 devices on a two-wire path

C. Controllers shall be capable of fully automatic, semi-automatic, and manual operation using a 6-button keypad and 16 position rotary dial that is an integrated part of the controller. Each controller shall be capable of storing irrigation schedules, monitoring and managing flow without the Central Computer (i.e., if the Central Computer is turned off, removed, or if communication from/to the Central Computer fails, the field controllers will continue to perform moisture and flow management functions). Controllers shall display on-screen instructions making it easier for a user to operate the controller.

D. Controllers shall be able to send alerts to central software at an offsite location utilizing supported devices. Alerts shall be processed at both the field controller location and/or the Central Computer location. Communication options shall be as follows:

1. Cellular modem
2. Wireless internet modem
3. Phone modem
4. Ethernet modem
5. Direct connection serial interface

E. Controller's main screen shall be able to display water usage, soil moisture graph, next program run time, temperature of the controller, design flow or actual flow, two-wire current, program reports, pause reports, and a color zone status (watering, soaking, waiting, paused, disabled, and error) without affecting active programs. The controller shall provide an on-screen color code legend that describe each zones state. The controller shall be able to log data collected from each flow sensor and zone (run time, soak time).

F. Controllers shall have the ability to report:

1. The last date a program ran
2. A progress bar for currently running programs describing how much run time is remaining
3. The next run date of a program
4. Water consumption used by program per run estimation
5. 14 days of moisture readings displayed graphically
6. Water flow estimation in gallons per minute
7. Total daily, current month, and previous month's water consumption estimation in gallons
8. Actual water used and flow rate for each flow sensor
9. A report for every pause condition event
10. Monthly water budget.

2.17 DECODERS

A. Decoders shall be installed between the controller and the electric control valves to provide the 24-volt power supply for individual valves. Each decoder shall be available in 1, 2 or 4-station devices. Decoder shall have a unique serial number and controller-assigned address to identify it in the network.

B. Decoders shall be manufactured by Baseline, model biLine.

2.18 SOIL MOISTURE SENSORS

A. Soil moisture sensors shall provide the following:

1. Measure soil moisture using patented modified TDT technology.

2. Self-calibration for various soil types and conditions.
3. Moisture range measurement from 5% moisture to fully saturated soil (45%).
4. Soil temperature measurements.
5. Consistent moisture readings in salty conditions.

B. Sensor shall be completely sealed and shall be resistant to power surges, shock, freezing, heat, salts and fertilizers.

C. Sensor shall have the following accuracy and repeatability:

1. Range: 5% to 45% volumetric (fully saturated)
2. Raw Sensor Resolution: 0.01% volumetric
3. Volumetric Moisture Accuracy: +/- 0.1%
4. Volumetric Calibration: +/- 2% of calibrated sample
5. Soil Temperature: +/- 2C/3.6F

D. Sensor shall be 24 to 28 VAC.

E. Sensor shall be manufactured by Baseline, model biosensor, 18-inch length for landscape and 4-inch for trees.

2.19 SURGE ARRESTOR (TWO WIRE PATH)

A. Arrestor shall directly connect to the two-wire path and requires no power from the two-wire path.

B. Surge arrestor shall be fully sealed and capable of direct burial. It shall have three wires. Red and black wire 12-inches in length connect to the two-wire path and the green ground wire connects to the grounding system.

C. Sensor shall be manufactured by Baseline, Model BL-LA01, or equal.

2.20 AUTOMATIC RAIN SENSOR

A. Rain sensor shall be plastic in construction with adjustable interruption point, 1/2-inch IPS threads and stainless-steel vandal resistant guard. Rain sensors shall be manufactured by Hunter Industries, model Rain-Clik or approved equal with sensor guard.

2.21 FLOW SENSORS

A. Flow sensors (1-inch) shall have ability to track flow through the controller. Flow sensors must be accurate to within plus or minus 1% of full scale and display repeatability of plus or minus 0.5% of full scale for flows or 0.86 to 52 gpm. Flow sensors shall be installed in a PVC tee according to manufacturer recommendations and the detail. Flow sensor to be Creative Sensor Technologies (CST) FSI-T10-001 sensor.

B. Flow sensors shall be provided and installed in accordance with manufacturer's instructions on the HDPE mainlines. Contractor shall be responsible for installation, hook-ups, materials, components and connection of flow sensors.

2.22 NORMALLY OPEN MASTER VALVES

A. Normally open master control valves shall be in 1-1/2-inch in size. Valves shall provide dirty water protection and no minimum flow feature. The valve shall be designed to operate with no minimum flow rate requirement.

B. Valves shall come with two-piece upper diaphragm and lower seat assembly. Valves shall operate within a pressure range of 20psi-200psi and have an in-rush current of 0.45amps and a holding current of 0.30 amps at 24VAC.

C. Valves shall be designed with removable filter and metering rod assembly and non-continuous flow through the solenoid. Rubber parts shall be EPDM rubber parts.

D. Normally open master valves shall be manufactured by Buckner/Superior, Storm Manufacturing Group, Inc., model 3300150-RW or approved equal.

2.23 WIRE

A. Valve control wire from the controller to the decoder shall be through two-wire. Wiring shall be double-jacketed UF-B UL two-conductor solid copper designed for direct burial system. Wire shall be manufactured by Paige Electric (Maxi wire) P7072D or equal. Wire gauge shall be #14/14 AWG.

B. In ground wire connections shall be UL listed (486D), manufactured by Paige, 3M, model DBR/Y-6 splice kits or equal. Wire splices shall be made in valve boxes, electrical junction boxes, at the controller or at valves. Connections shall be installed as per their manufacturers' instructions.

C. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.

D. Wiring shall be in strict accordance with national, state and local electrical codes.

2.24 ISOLATION VALVES

A. Isolation valves shall be gate type, of bronze construction, US Manufacture, 200 WOG with steel cross handle and 200 psi rating. Gate valves to be as manufactured by Apollo model 102T or Nibco, model T-113-K.

B. Water meter assembly and backflow prevention assembly 1-inch ball valves shall be Watts LFB6800 threaded, 3-piece full port lead free.

2.25 DEEP DRIP STAKES

A. Deep drip stake shall be constructed of PVC material. Stake tube shall have an outside diameter of 1¼ inch. Cap material shall be made of ABS and the combination of stake tube and cap shall be able to withstand multiple strikes from a 3-lb. sledge hammer for the purpose of installing.

B. Deep drip stakes shall incorporate a screen filter within the unit to eliminate debris from entering the internal area of the stake. Deep drip stakes shall be designed so as to permit twisting of stakes after installation to dislodge root intrusion.

C. Stake cap shall have an opening to accommodate a ¼ inch diameter drip or low volume distribution tubing. The internal stake tube dimensions shall be able to house a fixed or variable low volume emitter.

D. Attach 1/4-inch distribution tubing to drip ring with Rain Bird XBF1CONN, ¼-inch barb connection. Stainless steel clamps shall be used to secure ¼-inch distribution tubing to insert barbed connection. Clamps shall be constructed of 304-grade stainless steel. Interior clamp wall shall be smooth to prevent crimping or pinching of tubing.

E. Stakes for trees shall have a 2 gph pressure regulating emitter installed in the blank drip ring. Emitter shall be as manufactured by Rain Bird, model Xeri-Bug, XB-20PC.

F. Drip stake assemblies shall be 24 inches long as manufactured by Green King, model A-DD24.

2.26 BLANK DRIP TUBING

A. Blank drip tubing for tree stakes shall be solid 17mm low density polyethylene resin, UV resistant as manufactured by Netafim Irrigation, Model TLD-L0XX.

2.27 DISTRIBUTION TUBING

A. Tubing shall be ¼-inch, 0.160-inch ID and 0.22-inch OD and extruded from UV-resistant and acid resistant polyethylene resin materials.

B. Tubing shall fit over barbed emission devices and ¼-inch transfer fittings, 0.160-inch micro-tubing fittings

C. Tubing shall be rated for minimum 50 psi operating pressure. Wall thickness shall be 0.0030 inches.

D. Distribution Tubing shall be as manufactured by Netafim, model EDTUBE Black, Rain Bird ¼ inch distribution tubing or approved equal.

2.28 IN-LINE DRIP TUBING

A. In-line drip tubing to be 17 mm with 0.60 gallon per hour emitters with integral check valve on pre-installed 12-inch spacing. In-line drip tubing to be as manufactured by Netafim Irrigation, Model TLCV-6-12 or approved equal. Start pressure shall be a minimum of 45 psi.

2.29 IN-LINE AND BLANK DRIP TUBING FITTINGS

A. Fittings for blank and in-line drip tubing shall be constructed of molded brown plastic having a (I.D) of 0.57 inches. Female and male threaded ends shall be capable of mating to standard pipe threads with tapered threads. In-line drip tubing fittings shall be as manufactured by Netafim, TL Series or approved equal.

B. Stainless steel clamps shall be used to secure in-line drip tubing to insert barbed fittings. Nominal size shall be 13/16 inches, Part No. 210. Clamps shall be constructed of 304-grade stainless steel. Interior clamp wall shall be smooth to prevent crimping or pinching of tubing. Wall thickness of clamps shall be 0.236 inches with an overall bandwidth of 1/4-inch. Properly secured clamps shall be capable of withstanding a maximum operating pressure of 441 psi. Clamps shall be one "ear" type. Clamps shall be as manufactured by Oetiker or approved equal.

C. Tubing stakes shall be plastic coated steel, or non-corrosive strong material to secure tubing and filter fabric. Stake filter fabric every five feet and deep watering tree stake blank tubing with a minimum of three tubing stakes.

2.30 DISC FILTER

A. Filters at each drip zone valve shall be a plastic filter consisting of a two-piece threaded housing with O-ring seal. The filter screen shall be 140-mesh size. Filters shall be sized to mid-range flow and not exceed 2.5 psi pressure loss.

B. Filter shall be as manufactured by Netafim, Model DF-xxx-140 or approved equal.

2.31 MANUAL FLUSHING VALVE

A. Dripline and deep drip stake zone manual flush valves shall be manufactured of UV and chemical resistance molded plastic and shall accept hose/tubing with an inside diameter of 0.56-inch to 0.60 -inch. Valve shall be a manual 17mm ball valve Model TLSOV as manufactured by Netafim or approved equal.

B. Flush valves shall be installed at lowest point of polyethylene exhaust header.

2.32 PRESSURE REGULATORS

A. Pressure regulators shall assure an incoming pressure of 45 psi into drip tubing. Discharge pressure shall not be less than 45 psi. Manifold regulators to match flow rate to mid-range flow.

B. Pressure regulator shall be as manufactured by Netafim, Model PRV-XXX-XX-45 or approved equal.

2.33 SWING JOINTS

A. ½ inch sprinklers shall be installed on swing pipe assemblies, minimum length 6 inches, maximum 18 inches as manufactured by Hunter, Irritrol, Rain Bird or equal.

B. Quick coupling valves to be installed on 1-inch prefabricated PVC unitized swing joint assemblies with double O-ring seals, minimum 315 psi rating and minimum length of 12 inches with brass insert and stabilizer (unless stabilizer is an integral part of the quick coupling valve). Prefabricated PVC swing joints shall be as manufactured by Dura, Lasco or Spears.

2.34 QUICK COUPLING VALVES

A. Valve body shall be of cast brass construction with a working pressure of 125 psi. The valve seat disc plunger body shall be spring loaded so that the valve is normally closed under conditions when the key is not inserted.

B. Top of the valve body receiving the key shall be equipped with ACME threads and smooth face to allow the key to open and close the valve slowly. The quick coupling valve shall be equipped with a vinyl cover.

C. Valve body construction shall be such that the coupler seal washer may be removed from the top for cleaning or replacement without disassembling any other parts of the valve.

D. Keys shall be ACME with 1-inch male thread and 3/4-inch female thread at the top.

E. Provide two (2) keys for quick couplers and two (2) 1-inch x 3/4-inch swivel hose ells.

F. Quick coupling valves, keys and swivels shall be manufactured by Hunter Industries, model HQ-44RC-AW, HK-44A and HS-1.

2.35 IDENTIFICATION TAGS

A. Valves shall have ID tags attached. ID tags shall be manufactured from Polyurethane Behr Desopan. Provide one tag for each electric valve. Use one maxi size tag for electric control valve. Each tag shall provide valve and decoder ID information.

B. Tags shall be as manufactured by T. Christy Enterprises or Paige Electric.

2.36 GROUNDING EQUIPMENT

A. Grounding rods for lightning arrestors to be 5/8-inch x 8-foot copper clad, UL Listed.

B. Grounding rods for controllers to be 5/8-inch x 10-foot copper clad, UL Listed.

C. Grounding plates for lightning arrestors to be 4-inch x 36-inch x 0.06-inch copper with integral connection of 10 feet of #10 AWG insulated, solid copper wire, UL Listed conforming to the minimum requirements of Section 250 of the National Electric Code. Connection of the wire to plate shall be performed by the plate manufacturer.

D. Grounding plates for controllers to be 4-inch x 96-inch x 0.06-inch copper with integral connection of 25 feet of #6 AWG insulated, solid copper wire, UL Listed conforming to the minimum requirements of Section 250 of the National Electric Code. Connection of the wire to plate shall be performed by the plate manufacturer.

E. Grounding connections to utilize an exothermic welding process, Cadweld connectors, UL Listed, Model NT1161GPLUS.

F. Grounding wire for lightning arrestors shall be #10 AWG, solid, bare copper wire.

G. Grounding wire for controllers shall be #6 AWG, solid, insulated copper wire.

H. Ground enhancement material shall be PowerSet as manufactured by Loresco, 50 lb. bags.

2.37 CONTROLLER ENCLOSURE

A. Enclosure shall be vandal and weather resistant in nature manufactured entirely of 304-grade stainless steel. The main housing door shall be louvered at the bottom and equipped with a hollow center thermoplastic door seal. The entry lip shall be louvered on the backside. Filter screens shall cover louvers. The top entry lid shall have two gas springs, for easy access, a continuous stainless steel piano hinge, and a three-point locking mechanism with provisions for padlock. Removable stainless-steel tray shall be provided and installed for the mounting of electronics and other equipment.

B. Enclosure shall be a NEMA 3R Rainproof Enclosure as listed by Underwriters Laboratories, Inc.

C. Controller enclosure shall be 16 inches wide x 15.5 inches deep x 38 inches tall, as manufactured by Strong Box, model SB-16SS with Baseline mounting tray.

2.38 WATER METER

A. Water meter shall conform to Cambridge Water Department requirements and shall be 1-inch, Neptune T-10 meter, programmable to 6 digits in conformance with AWWA specification C702, latest revision.

B. Meter shall include Cambridge Water Department approved remote electronic reader.

C. Meter shall be installed within water supply enclosure.

2.39 BACKFLOW PREVENTION DEVICE

A. Backflow prevention device shall be 1-inch Reduced Pressure Assembly as per Cambridge Water Department requirements. Backflow prevention device shall have maximum 12-psi pressure loss at system flow.

B. Backflow prevention device shall be as manufactured by Watts, model LF009QT-S.

C. Backflow prevention device shall be installed within water supply enclosure.

2.40 WATER SUPPLY ENCLOSURES

A. Water supply enclosures shall be of a vandal and weather resistant nature manufactured of epoxy coated steel with locking hasp and hinged doors.

B. Enclosures shall be designed to support a minimum vertical load of 100 lb./sf.

C. Depth of water within the enclosures shall not exceed 6 inches during full flow of the backflow preventer relief discharge.

D. Enclosures shall be designed to be accessed and provide sufficient room for testing and maintenance; shop drawings shall be submitted from the manufacturer.

E. Enclosure color shall be as determined by the City of Cambridge.

F. Enclosure dimensions shall be 37 inches long x 24 inches wide x 36 inches tall. Unit shall be as manufactured by Welch Manufacturing, Chelmsford, Massachusetts or equal.

2.41 CONCRETE/CONCRETE BASE

A. Concrete base shall be standard concrete mix in accordance with ASTM C150, ASTM C-33, and ASTM C-94 with a compressive strength (28 days) of 3,000 psi.

B. Concrete bases for water supply and controller enclosures shall be as indicated on the details for each location.

C. Bases shall be installed on a minimum 6-inch crushed stone.

2.42 CRUSHED STONE

A. 1/2-inch crushed stone shall be washed at the source facility to remove fine-grained soils and shall be well graded within the following limits:

U.S. Sieve No. (ASTM D422)	Percent Passing by Weight
3/4 inch	100
1/2 inch	90-100
3/8 inch	0-20
No. 4	0-5

2.43 SAND

A. Sand shall consist of well-graded natural sand, free from organic, other weak or compressible materials, or frozen materials, conforming to the following gradation:

U.S. Sieve No.	Percent Passing by Weight
#8	100
#50	15-40
#100	2-10
#200	0-5

2.44 SPARE PARTS

A. Supply the following tools and equipment to the Engineer before final observation:

1. Two (2) quick coupling valve keys.

PART 3 - PRODUCTS

3.1 GENERAL

A. Examine contract documents applying to this Section noting any discrepancies and bringing the same to the attention of the Engineer for timely resolution.

B. Make field measurements necessary for the work noting the relationship of the work to the other trades. Coordinate with other trades.

C. Irrigation system installation shall be sequenced with other construction so that the driplines and soil moisture sensors under hardscape are installed and operational before the installation of the hardscape material.

3.2 IRRIGATION PIPE AND FITTINGS INSTALLATION

A. Using proper equipment, excavate a straight (vertical) and true trench to a depth of 2-inch of pipe invert elevation.

B. Loam or topsoil encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.

C. Backfilling shall be accomplished as follows: the first 10-inch of backfill material shall contain no foreign matter and no rock. Carefully place material around pipe and wire and tamp in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction. Compact backfill in trenches to dry density equal to the adjacent soil, and conform to adjacent grades without dips, sunken area, humps, or other irregularities.

D. Restore grades and repair damage where settling occurs.

E. Make fusion connections for HDPE pipe and fittings per ASTM D2657, ASTM F1056, ASTM F905, PPI Technical Reports 33 and 41 and US DOT Pipeline Safety Regulations (CFR 49).

F. Check fusion machine heater plates on a regular basis to make sure they are at proper temperature and adjust as required to meet manufacturer’s requirements.

G. Mainline pipe shall have minimum 22 inches of COVER (excavate to invert as required by pipe size). Lateral pipe shall have minimum 12 inches of cover (excavate to invert as required by pipe size).

H. Cut plastic pipe with handsaw or pipe-cutting tool, removing burrs at cut ends. Pipe cuts are to be square and true. Bevel cut end as required to conform to manufacturer's specifications.

I. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. At times, when installation of the pipe is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. Pipe, which cannot temporarily be joined, shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that day shall not be laid out. Should water enter the trench during or after installation of the pipe, no additional pipe may be installed or backfilled until water is removed from the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 40º F or below. Pipe installed at temperatures below 40º F shall be removed and replaced at no cost to the City. Pipe shall be snaked in the

trench to accommodate for expansion and contraction due to changes in temperature.

J. In installing irrigation pipe the Contractor shall route the pipe as necessary to prevent damage to tree roots. Where trenching must occur near trees, provide proper root pruning and sealing methods to roots 1-inch and larger.

K. Maintain 6-inch minimum clearance between irrigation lines and lines of other trades. Do not install irrigation lines directly above another line of any kind.

L. Maintain 1-inch minimum between lines which cross at angles of 45 to 90 degrees.

M. Throughout the guarantee period it will be the responsibility of the Contractor to refill trenches that have settled due to incomplete compaction.

3.3 ELECTRICAL WIRE CONDUIT INSTALLATION

A. Electrical conduit shall be installed in non-soil areas where wire passes under or through walls, walks and paving/pavers.

B. Conduit shall extend 12 inches beyond edges of walls and pavement/pavers.

3.4 STRUCTURAL SOIL IRRIGATION INSTALLATION

A. Soil media underneath hardscape-specified in Section 02901. See Drawings.

B. Lay filter fabric in 2-foot widths centered on proposed perforated pipe locations as shown on Drawings. Stake filter fabric on both sides of the sleeving pipe every five feet.

C. Lay 4-inch HDPE corrugated perforated pipe at base of aggregate stone level centered on top of filter fabric. Perforations shall be placed toward filter fabric. Use snap fittings to join pipe.

D. Connect 4-inch HDPE corrugated perforated pipe between lines for oxygenation under atmospheric pressure. Bring vent pipe to surface for atmospheric air and install grate. Consult Engineer for vent locations before installing. Vent grates must be aligned with paving.

3.5 PIPE SLEEVING INSTALLATION

A. Sleeving shall be installed where pipe is going under hardscape areas as indicated on the drawings. Minimum cover over sleeving pipe shall be 24 inches as shown on the detail.

B. Sleeving shall extend 12 inches beyond edges of walls and pavers/pavement. Prior to the installation of irrigation pipe and wiring, the ends of sleeving shall be field marked with a vertical wood stake extending above grade to allow field location at the time of irrigation installation.

C. Ensure that required sleeving is installed prior to starting any pavement/paver operations or casting concrete structures which require sleeving to pass through the items. Review sleeve locations in the field to confirm that sleeves are properly located for the required irrigation pipe and wire runs.

3.6 ISOLATION VALVE INSTALLATION

A. Install isolation valves per detail where indicated on the drawings. Install isolation valves on a level crushed stone base so that they can drain and be easily opened or closed with the appropriate valve wrench. Install specified valve box over each isolation valve.

B. Check and tighten valve bonnet packing before valve box and backfill installation.

3.7 VALVE BOX INSTALLATION

A. Furnish and install a valve access box for each electric valve, wire splice, quick coupling valve, isolation valve, maser valve flow meter, flushing valve and wire splice.

B. Valve access boxes shall be installed on a minimum 4-inch crushed stone base. Finish elevation of boxes shall be at grade. Crushed stone to be installed before valve box. Crushed stone shall not be poured into previously installed valve boxes.

C. Valve boxes shall be installed neatly. Boxes shall be parallel or perpendicular to hardscape edges and equidistance to other valve boxes installed in the same location. A sufficient amount of landscape/hardscape shall remain in place between each valve box and between valve boxes and hardscapes.

D. Valve box extensions shall be provided as required on valve boxes in order to install valve box covers at grade.

E. Bricks, stones, etc. shall not be used to support valve boxes.

3.8 24-VOLT CONTROL VALVE INSTALLATION

A. Control valves shall be installed on a level crushed stone base. Grade of bases shall be consistent throughout the project so that finish grades fall within the limits of work. Valves shall be set plumb with adjusting handle and bolts, screws and wiring accessible through the valve box opening. Valves shall be set in a plumb position with 24-inch minimum maintenance clearance from other equipment.

B. Adjust zone valve operation after installation using flow control device on valve.

3.9 CONTROLLER AND ENCLOSURE INSTALLATION

A. Install controller in enclosure with mounting tray (do not install controller cabinet in enclosure), per details using Baseline kit for the specified Strongbox enclosure. Wire decoder cables and rain sensor into controller and set proper programs.

B. Wire controllers to electrical supply at controller location.

C. Controller shall be mounted in the specified VIT Strongbox stainless steel enclosure. Wiring within the enclosure shall be neatly run, bundled, and cinched. Zone wires shall be labeled as to zone/station served at the controller.

D. Controller shall be installed on a new reinforced concrete base of minimum dimensions shown on the details, poured-in-place. Expansion shields shall not be used. Contractor to use template to install poured-in-place stainless steel "J" bolts to fasten enclosure to base. Prefabricated controller bases shall not be approved for installation. Controller shall be installed on the pad to allow the operator to stand on the pad in front and back of the controller during programming and maintenance.

E. Install minimum one (1), 1-1/2-inch PVC conduit sweep ell and spool piece through controller pad as required for decoder and flow sensor cables. Install minimum one (1), 1-1/2-inch PVC conduit sweep ell and spool piece through controller pads for #6 AWG bare copper wire. Install minimum two (2), 1-inch PVC conduit sweep ells and spool pieces through controller pad for power and a spare. Maintain required depth of bury in/out of pad.

F. Controller power wire, decoder cable and #6 AWG bare copper wire shall be brought to the exterior through separate sleeves in the support pad. Grounding wire shall be installed through the controller concrete pad through a separate 1-1/2-inch sleeve and not through the controller enclosure.

G. Contractor shall install control and other irrigation-related wiring; as well as 120-volt service to controller.

H. Above ground wire, other than in controller enclosure shall be installed in conduit.

I. Grounding system shall be minimum as specified and installed per manufacturer's recommendations. A third party shall certify in writing after testing the results of the grounding system megging readings.

J. Surge arrestor ground shall be connected to valve common ground of controller.

K. Seal enclosure sweep holes with expandable foam insulation.

L. Controller shall be installed level on pad and tight to the base (no gaps).

M. Keys shall be turned over to the Engineer.

3.10 SOIL MOISTURE SENSOR INSTALLATION

A. Moisture sensors shall be installed per manufacture’s recommendations and instructions where indicated on the drawings. Sensors shall be buried consistent with the root zone of the material being watered. A splice box for the sensor wires should be no more than 4 feet from the sensors and no closer than 2 feet.

B. Calibrate sensors per manufacturer's instructions.

C. Assign soil moisture sensors to appropriate zones in controller programming.

3.11 SPRINKLER INSTALLATION

A. ½-inch sprinklers shall be installed flush (perpendicular) to grade on swing pipe assemblies, minimum 6-inches, maximum 18-inches. Top of sprinkler body shall be below top of curbs and at mulch grade.

B. Sprinklers shall not exceed maximum spacing indicated

C. Adjust sprinkler zone after installation using flow control device on valve.

3.12 RAIN SENSOR INSTALLATION

A. Install rain sensor on exterior of controller enclosure, where indicated on the detail. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray. Rain sensor shall be installed on enclosure so as not to be obstructed from the prevailing wind.

B. Firmly attach rain sensor receiver within bottom section of the controller enclosure. Install wiring within 1/2-inch inch conduit where exposed. Above ground wire shall be installed in conduit.

C. Install sensor is specified stainless-steel guard.

3.13 WIRING INSTALLATION

A. Service wiring in connection with drawings and local codes for 24-volt service. In-ground wire connections shall be waterproofed with 3M DBR/Y-6 splice kits. Splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided and installed in splice box-valve box shall be used). Splice locations shall be shown on the Record Drawings.

B. Wiring shall be installed along with the mainline. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide and install an additional 8 inches to 12 inches' slack at changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, splice, decoder and connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box.

C. Wire shall be installed with no in-ground splices. Splices shall be at/in junction boxes, electric valves, decoders or controller enclosures.

D. Where wire passes under roadways, walls or other paved or graveled areas, it shall be installed in a separate PVC conduit, minimum 2 inch for communication cables.

E. Wire shall be laid in trenches and shall be carefully backfilled to avoid damage to the wire insulation or wire conductors themselves. In areas of unsuitable material, the trench shall have a 2-inch layer of sand or stone dust on the bottom before the wires are laid into the trench and backfilled. Wires shall have a minimum of 22 inches of cover. Wire not to be installed that day shall not be laid out.

F. In-ground wire connections shall be waterproofed with 3M DBR/Y splice kits.

G. Wiring within the structural soil areas beneath hardscape require sleeving between valve boxes.

H. Provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See section one for the inclusion of wiring diagram in operation and maintenance manuals.

3.14 CONTROLLER GROUNDING INSTALLATION

A. Grounding rod shall be driven into the ground its full length within 12-feet of the controller and connected via a Cadweld connection to #6 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A 4-inch bronze or plastic grated cover as specified, set a minimum of 1-inch below grade, shall be placed over the ground rod and Cadweld connection for periodic maintenance. Cover shall be installed on a minimum of 6 inches of 4-inch ADS corrugated polyethylene, perforated drainage pipe. Plate shall be installed 30 inches below grade with 50 lbs. of PowerSet ground enhancement material spread evenly below the plate and 50 lbs. of PowerSet ground enhancement material spread evenly above the plate in accordance with the manufacturer's requirements. Plate shall be covered with a 4-inch grated cover as specified, set a minimum of 1-inch below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 30 inches of 4-inch ADS corrugated polyethylene, perforated drainage pipe.

B. Contractor must furnish a certified document to the Engineer, that the OHMS reading at the controller grounding location. When tested, grounding grid shall have an earth resistance no greater than 10 ohms. If earth resistance is greater than 10 ohms, additional grounding rods and/or plates and enhancement material shall be added to system until desired test results have been met.

3.15 TUBING STAKE INSTALLATION

A. In-line drip tubing shall be secured with stakes. Stakes shall be spaced to ensure that tubing does not shift location in presence of foot traffic, operations, gravity on slope installations, or environmental effects. Stake in-line drip tubing at minimum 5-foot intervals to prevent movement. Stake blank tubing with deep watering stakes a minimum of three stakes per tree blank tubing loop.

B. Stake filter fabric on five-foot intervals on both sides of the corrugated sleeve.

3.16 FLUSH VALVE INSTALLATION

A. Flush valves shall be installed on end of polyethylene exhaust header where indicated on drawings.

3.17 DRIPLINE INSTALLATION

A. In-line emitter tubing shall be installed in areas designated (see details) and shall have an average depth of 2-4 inches. Tubing should not be visible through the mulch or laid under the mulch.

B. In-line emitter tubing is to be installed 6 inches from planter edges, curbs and walls. Spacing of in-line emitter tube is to be 12 inches center-to-center in irrigated areas.

C. Driplines should be thoroughly flushed. Driplines with aeration pipes should be tested to assure emitters are operating properly before continuing backfilling.

D. Driplines should be thoroughly flushed before closing. Drip lines with sleeve pipes should be tested for 15 minutes to assure emitters are operating properly. Root ball deep watering tree stakes with PC 2 GPH emitters shall be tested for a minimum of 15 minutes.

3.18 DEEP DRIP STAKES

A. Place tree watering stakes generally as indicated on the drawing and details. Tree stakes shall be placed in the edge of the root ball. Install stake as per the manufacturer's recommendations, to a depth where the top of the cap is flush with finish grade.

B. Blank drip ring shall be equipped with barbed connections for pipe to ¼-inch distribution tubing.

C. ¼-inch distribution tubing shall be installed from the blank drip tubing ring to the tree stakes.

D. Drip stakes to be installed three per tree as shown on the details.

3.19 LIGHTNING ARRESTOR INSTALLATION (TWO WIRE PATH)

A. Two-cable communication path shall be grounded at 600-foot maximum intervals, at every termination of a part of the cable path to a surge arrestor decoder and 50 feet from the controller where indicated on the drawings. Surge arrestor shall be connected to a 5/8-inch diameter x 8-foot-long copper clad grounding rod and 4-inch x 36-inch grounding plate with minimum #10 AWG, solid, bare copper cable. Minimum 8-foot separation between rod and other equipment. Connections to rods shall be with exothermic connectors as specified. Each grounding rod is to be

covered by a 4-inch round, grated top, plastic valve cover with metal detection and six inches of 4-inch drainage pipe. Plate shall be installed at a 36-inch depth with 25 lbs. of ground enhancement material spread evenly below the plate and 25 lbs. spread evenly above the plate. Plates shall be covered with 4-inch plastic grated cover with detection and minimum 36 inches of 4-inch drainage pipe. Ground rods and plates shall be UL listed.

B. Ground grid shall be installed in landscape areas.

C. Each surge arrestor shall have a separate ground.

D. Ground rods and plates shall be UL listed.

3.20 FLOW METER/MASTER VALVE INSTALLATION

A. Flow meters shall be installed in a dedicated valve box at each connection in a 1-inch PVC spool piece within the 1-1/2-inch HDPE mainline pipe where indicated on the drawings. Wire flow meter to Baseline controller with flow sensor biCoder per manufacturers requirements.

3.21 WATER SUPPLY ENCLOSURE INSTALLATION

A. Install enclosure on 6-inch concrete pad as indicated on the detail, where indicated on the drawing. Concrete base shall be installed on 6-inch crushed stone base.

B. Base dimensions shall be 48 inches long x 36 inches wide as indicated on the detail.

C. Install PVC sleeves through pad for 1-inch copper water in and water out.

D. Install 1-inch ball valve teed off of inlet pipe downstream of backflow prevention device for system winterization.

E. Pipe within the enclosure shall be type K copper.

F. Use pipe supports to support water supply equipment.

3.22 IRRIGATION CHECK/TEST/START-UP/ADJUST

A. Flushing

1. After pipe, valves, pipelines and risers are in place and connected, but prior to installation of deep drip stakes and driplines, open the control valves and flush out the system under a full head of water.
2. Contractor shall be responsible for flushing the entire system and will be responsible for any clogged equipment for thirty (30) days after substantial completion of this portion of the landscape irrigation system.

B. Testing

1. Leakage tests:
    a. Leakage test: test lines for leaks under operating pressure. Repair leaks and re-test.
    b. Under concrete slab: test driplines lines for leaks and proper operation before concrete slab is poured.

2. Coverage test: perform a coverage test in the presence of the Engineer (notify Engineer at least seven (7) days in advance of scheduled coverage test). The Engineer will determine if the water coverage is complete and adequate. Readjust irrigation as necessary or directed to achieve proper coverage.

3. Testing shall be at no additional expense to the City.

3.23 CLEANING AND ADJUSTING

A. At the completion of the work, parts of the installation shall be thoroughly cleaned. Equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by the operation of the system for testing.

B. Adjust drip stakes, valve boxes, and quick coupling valves to grade as required, so that they will not be damaged by landscape maintenance or pedestrian traffic.

C. Continue irrigation coverage adjustment as required by settlement, etc., throughout the guarantee period.

D. Each control zone shall be operated for a minimum of 5 minutes and irrigation checked for consistency of delivering water. Adjustments shall be made to irrigation that is not consistent to the point that it matches the manufacturer's standards. Irrigation equipment, valves or other mechanical or electrical components, which fail to meet these standards, shall be rejected, replaced and tested until they meet the manufacturer's standards.

3.24 ACCEPTANCE AND OPERATION BY CITY

A. Upon completion of the work and acceptance by the City, train the City's staff in the operation of the system (provide minimum 7 days written notice in advance of test). Furnish, in addition to the Record Drawings and operational manuals, copies of available specification sheets and catalog sheets to the City's personnel responsible for the operation of the irrigation system. Contractor shall guarantee parts and labor for a minimum period of one (1) year from date of acceptance.

3.25 CLEAN UP

A. Upon completion of installation work, remove leftover materials and equipment from the site in a safe and legal manner.

B. Leave area clean and free of debris generated from installation of the system.

PART 4 - COMPENSATION

2810.1 IRRIGATION SYSTEM LUMP SUM

4.1 METHOD OF MEASUREMENT

A. Irrigation system will be measured for payment as a lump sum installed complete in place and fully tested and operational as determined by the Engineer.

4.2 BASIS OF PAYMENT

A. Irrigation system will be paid for at the contract unit price per lump sum. The unit price shall include full compensation for labor, tools, equipment, materials, transportation and incidental costs required to complete the work to the satisfaction of the Engineer.

4.2.1 This price will include earth excavation, backfill materials, pipe, valves, sleeving, drip tubing enclosures, inspection fees and incidentals for complete system installation.

END OF SECTION

SECTION 02890

TRAFFIC SIGNALS

2890.1	**TRAFFIC SIGNAL RECONSTRUCTION – LOCATION 1 RIVER ST @ PUTNAM AVE**	**LUMP SUM**
2890.2	**TRAFFIC SIGNAL RECONSTRUCTION – LOCATION 2 RIVER ST @ HOWARD ST/KELLY RD**	**LUMP SUM**
2890.3	**TRAFFIC SIGNAL RECONSTRUCTION – LOCATION 3 RIVER ST @ FRANKLIN ST/WESTERN AVE @ FRANKLIN ST**	**LUMP SUM**
2890.4	**TRAFFIC SIGNAL RECONSTRUCTION – LOCATION 4 RIVER ST @ GREEN ST**	**LUMP SUM**
2890.5	**TRAFFIC SIGNAL RECONSTRUCTION – LOCATION 5 MASSACHUSETTS AVE @ PROSPECT ST**	**LUMP SUM**
2890.6	**3 INCH ELECTRICAL CONDUIT TYPE NM - PLASTIC (UL)**	**LINEAR FOOT**
2890.7	**PULL BOX 12” X 12”**	**EACH**
2890.8	**PULL BOX 24” X 12”**	**EACH**
2890.9	**SERVICE CONNECTION EVERSOURCE APPROVED HANDHOLE**	**EACH**
2890.10	**RECTANGULAR RAPID FLASHING BEACON (AC POWER)**	**LUMP SUM**
2890.11	**RECTANGULAR RAPID FLASHING BEACON (SOLAR)**	**LUMP SUM**

PART 1 - GENERAL

WHERE REFERENCE IS MADE HEREIN TO THE “MASSDOT STANDARD SPECIFICATIONS”, THIS SHALL BE CONSTRUED TO MEAN THE LATEST EDITION, INCLUDING STANDARD SPECIAL PROVISIONS AND SUPPLEMENTAL SPECIFICATIONS, OF THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION HIGHWAY DIVISION STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES (English Units Version).

Work under the above items shall be performed according to the provisions of Section 800 of the MassDOT Standard Specifications, Traffic signal work includes the following intersections:

- River Street @ Putnam Avenue
- River Street @ Howard Street and Kelly Road
- River Street @ Franklin Street and Western Avenue
- River Street @ Green Street
- Massachusetts Avenue @ Prospect Street

Rectangular Rapid Flashing Beacon (RRFB) work includes the following intersections:

- AC Power Connected RRFB
    - River Street @ Montague Street
    - River Street @ Pleasant Street
- Solar Powered RRFB
    - River Street @ Blackstone Street
    - River Street @ Rockwell Street
    - River Street @ Kinnaird Street
    - River Street @ Pleasant Street
    - River Street @ Auburn Street

The work consists of furnishing and installing traffic control signals at the intersections listed above complete and ready for operation, as shown on the plans.

Included in the work is the furnishing and installing of traffic control signal equipment, local traffic controller, AC and Solar powered pedestrian actuated RRFBs, cabinet and foundation, signal housings, backplates, red, amber, and green signal modules including bicycle signals, posts and bases, anchor bolts and foundations, service connections, emergency preemption, wire and cables, conduit, pull boxes, hand holes, ground rods, saw cuts, electrical connections, and providing all incidental materials necessary for operating and controlling the traffic control signal, as shown on the plans and specified herein.

PART 2 – PRODUCTS AND EXECUTION

3 Inch Electrical Conduit Type NM – Plastic (UL)

The 3-inch Electrical Conduit, Type NM shall be installed as indicated on the plans and as directed by the Engineer.

Conduit to be installed into signal bases, pull boxes, traffic signal control box foundations, and mast arm foundations shall be installed in accordance with the plans and details shown on the MassDOT Standard Drawings.

Conduit in grass or in planted areas

Where new conduits are installed in grass and planted areas, work shall include placement of a minimum of 6 inches of loam borrow, seed, and any other materials replaced in kind to restore disturbed areas to their original condition. Any existing plants (bushes, flowers, etc.) removed or damaged as a result of this project shall be replaced in kind. No separate payment shall be made for this work, but all costs in connection therewith shall be included in Items 2890.6

Conduit under sidewalk
Where conduit is installed in sidewalk areas, the work shall include excavating and restoring the existing surface in kind. No separate payment shall be made for this work, but all costs in connection therewith shall be included in Items 2890.6.

Conduit in Roadways
Trenches in existing bituminous concrete pavements shall be sawcut to 18 inches wide. The existing pavement shall be sawcut through its full depth and the pavement removed.

Trench bed shall be prepared in accordance to MassDOT and City standards. After conduit installation, the trench shall be backfilled with controlled density fill (CDF). CDF shall be Type 2E and shall be as specified in Section M4.08.0 of the MassDOT Standard Specifications. The finished grade of the CDF shall be 4 inches below existing pavement surface or at the sidewalk subgrade elevation, as appropriate. Two 2-inch lifts of hot mix asphalt (top course material) shall be placed over the CDF when hardened in roadway locations.

Traffic Signal Pull Boxes – SD2.022 and SD2.031 (Traffic)

Work under this section shall consist of furnishing and installing traffic signal handholes in accordance with the Contract Drawings, as specified in these Specifications, and as directed by the Engineer.

Materials and methods shall comply with Section 801.40 and 801.61 of the MassDOT Standard Specifications with the exception of excavation. All excavation relative to these items shall be included as part of Items 2890.7 and 2890.8. Units shall be precast concrete as shown on MassDOT Standard Drawings SD2.022 and SD2.031. Handhole covers shall be clearly marked "TRAFFIC".

Rectangular Rapid Flashing Beacon System

RRFB's shall conform to FHWA Interim Approval 21 (IA-21) for Rectangular Rapid Flashing Beacons as Crosswalks, issued March 20, 2018.

Each RRFB shall, at a minimum, consist of the following items, which shall be included in the lump sum bid:

- (1) concrete foundation;
- (1) 15' traffic signal posts and pedestal;
- (1) APS pushbutton system;
- (1) dual rectangular yellow LED beacons in NEMA enclosures with pilot light;
- (1) 9"x12" R10-25 (PUSH BUTTON TO TURN ON WARNING LIGHTS) sign;
- (2) 30"x30" W11-2 (Pedestrian Warning) signs;
- (1) 24"x12" W16-7PR or (1) 24"x12" W16-7PL (Diagonal Downward Arrow) sign;
- (1) NEMA Type 3R or higher enclosures to house:
    - Electrical components, including wiring and solid-state circuit boards
    - On-board user interface
    - Battery (for solar powered RRFB's as specified on the plans)
    - Frequency hopping spread spectrum (or other alternate FCC approved) wireless activation unit with a minimum 150' range;

- (1) Meter socket (for AC powered RRFB's as specified on the plans);
- (1) Solar Panel and electrical components (for solar powered RRFB's as specified on the plans); and
- All mounting and supporting hardware and wiring necessary to complete a working system.

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.

All signs shall be MUTCD-compliant. R10-25 signs shall have a black border and legend on a white background. W11-2, W16-7PR, and W16-7PL signs shall have a black border and legend on a fluorescent yellow-green 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.

W11-2, 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.

Contractor shall perform test pits at each RRFB location to confirm utility conflicts. The Contractor shall identify the locations of test pits in concert with the Engineer. In addition to Dig Safe procedures, the Contractor shall obtain all available records (plans, sketches, etc.) for the utility company to confirm the Dig Safe designation on the surface. The utility company shall be notified prior to starting the test pit. Contractor shall utilize vacuum excavation for RRFB test pits with equipment specifically designed for this operation. The test pits shall uncover the top, side, and if needed the bottom of encountered utilities without damaging the utility. The exposed utility and the surface above the utility shall be located with x, y, z coordinates for future reference.

Based on the findings of the test pits conducted at each RRFB location, Contractor shall select appropriate foundation type and design per existing conditions encountered. Where feasible and appropriate, MassDOT Standard foundations will be used; however, the Contractor shall inform the Engineer of which foundation shall be used at each location as part of the shop drawing review process.

Solar Powered RRFB

RRFB's shall be solar powered as indicated on the plans. The solar panels shall be affixed to an aluminum plate and bracket, adjustable at an angle of 45° to 60°, and each assembly shall be mounted on a 360° rotatable pole cap mount to facilitate adjustment for maximum solar collection and optimal battery strength. The solar panel assemblies shall be rated for 90 mph wind conditions.

The batteries shall conform to Battery Council International specifications and have a capacity allowing up to 30 days of autonomy without sunlight and varying with ambient temperature and number of activations. The batteries shall be rated for a minimum lifespan of three (3) years. Batteries shall be replaceable independently of other components.

The solar panels and battery shall have a minimum operating temperature range of -40° to 122°F (-40° to 50°C).

The Contractor shall provide shop drawings and calculations to confirm solar panel sizing and battery/solar energy storage will meet the functional requirements of the system. Foundation design shall also be provided in shop drawings.

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 each system shall commence and cease operation simultaneously. The length of the flashing cycle upon actuation 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.

All APS buttons shall be installed per Subsection 4E.09 of the MUTCD, and referenced in Special Provision 02890 for installation of APS Pedestrian Push Buttons. 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.

The predetermined flash period shall be immediately initiated each and every time that a pedestrian is detected either through passive detection or as a result of a pedestrian pressing a pushbutton detector, including when pedestrians are detected while the RRFBs are already flashing and when pedestrians are detected immediately after the RRFBs have ceased flashing.

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 02890.

Pull box installations shall be per Subsection 02890.

Foundation installations shall be per Subsection 02890. 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 Subsection 02890.

Service connection shall be per Subsection 02890. 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 City of Cambridge 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 above.

Traffic Signal System

A list of the major traffic signal items required is included on the plans.

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 all foundations in sidewalk areas shall be located 3 inches ± below finish grade. The top of each mast arm foundation shall not be exposed in the sidewalk.

Within 30 days following execution of the Contract, the Contractor shall submit shop drawings for signal supports, a list of equipment, and manufacturer's equipment specifications to the Engineer in accordance with the relevant provisions of Section 815.20 of the MassDOT Standard Specifications. Unless otherwise specified by the City of Cambridge, all signal equipment shall conform to the latest version of the MassDOT Qualified Traffic Control Equipment (QTCE) list.

No work shall be commenced by the Contractor until approval of the shop drawings and manufacturer's data has been received in writing from the Engineer. Approval of these drawings will be general in character and shall not relieve the Contractor from the responsibility of, or the necessity of, furnishing materials and workmanship conforming to the plans and specifications.

The Contractor shall deliver to the Engineer a certificate of compliance with the manufacturer for all materials purchased from the manufacturer.

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.

Controller and Cabinet
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 controller cabinet foundation shall not obstruct a sidewalk or crosswalk such that accessibility requirements are compromised. Anchor bolts shall be internal to the cabinet.

A slide-in/slide-out shelf or swing-out/swing-in shelf appropriate for the size and load of a laptop computer shall be installed in each controller cabinet to allow maintenance personnel to work in the cabinet in a safe, effective, and comfortable manner.

TS 2 Type 1 Controller and Cabinet Assemblies:
Controller shall conform to Section 3, Controller Units of NEMA No. TS 2, Traffic Controller Assemblies. The controller shall be a Siemens m60 Series Controller or approved equal. The controller and cabinet assemblies shall be supplied in a TS 2 Type 1 configuration. Controller shall utilize an input/output interface conforming to Section 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 traffic controller unit shall have Peer-to-Peer (P2P) capabilities to communicate with controllers at adjacent intersections. Controller cabinet shall be size “M” type box.

The TS 2 Type 1 cabinet shall meet the requirements of Configuration 3 as defined in Table 5.3.1-1, "Type 1 Configurations" of the NEMA TS 2 Standard. The cabinet shall be fabricated of sheet aluminum to size five (5) dimensions as specified in Table 7.3-1 of the NEMA TS 2 Standards. 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 cabinet’s door open status.

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 controller unit shall meet all applicable requirements of the NEMA Standard Publication No. TS 2, Type 1, the MassDOT Standard Specifications and include the following as minimum requirements for the "Keyboard Entry Controller Unit."

1. The Keyboard Entry Controller Unit must be type-tested and approved by the City.
2. 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 Section 815.41 of the MassDOT Standard Specifications.
3. **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.**
4. The controller shall have a security code function.
5. The phase or phases selected for "call to non actuated" (C.N.A.) modes shall be determined as needed by keyboard entries.
6. The controller shall have an Ethernet port for coordination.

The Contractor's attention is directed to Table 2, Required Signal Light Switching Assemblies, Section 815.41 of the MassDOT Standard Specifications. The Contractor shall furnish the appropriate type and number of load switches and flash transfer relays and place unutilized load switches and flash transfer relays 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. In addition to the number of BIU’s required for the detector racks, and terminals and facilities, two (2) spare Bus Interface Units shall be supplied with each controller cabinet.

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 (2) 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: 2 Spare BIU's shall be provided for each location.

TS 2 Cabinet Power Supply

A separate power supply shall be supplied and installed in the TS 2 cabinet. The unit shall be AC line powered and provide regulated DC power, unregulated AC power, a line frequency reference for the rack mounted loop amplifiers, 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 keyhole 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: +12VDC ± @ 2.0 amps, + 24VDC ± 2VDC @ 2.0 amps, 12VAC @ 250 milliamps, and 60 Hz line frequency reference. A test point terminal shall also be located on the unit's 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'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.

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 a two-circuit flasher is as balanced as possible within the limitations of the signal phasing.

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.

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.

Data Base Programming

Each programmable local hardware component 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 the controller cabinet. In addition, at least two (2) sets physical data keys, programming cables, corresponding software and applications, and all other accessories required to monitor or modify controller programming shall be provided to the City at no additional cost.

Labels

All time settings, switches, harnesses, relays, terminals and fuses shall be clearly and permanently labeled.

Vehicle and Bicycle Signal Heads

All proposed vehicle and bicycle signal heads shall be aluminum. When, in the 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 City layout, and as directed by the Engineer.

Pedestrian Signal Heads, Indications, and Appurtenances

All pedestrian signal heads shall be LED types with the ITE international symbolic displays, including the hand symbol for *flashing don't walk* and *don't walk* indications and the walking person for *walk* indications.

Each pedestrian push button shall be equipped with a tactile indicator to provide visually impaired pedestrians with an indication of pedestrian actuations. In addition, the pedestrian pushbutton shall be equipped with an indicator light, provided through the use of an LED, which will provide pedestrians with confirmation of a pending pedestrian phase. The confirmation LED shall meet or exceed the specifications of the model PPB-LED or approved equal.

Tactile pedestrian push buttons shall be 4-wire accessible pedestrian signal with vibro-tactile and directional (right or left) arrow with Red LED confirmation light, ped head control unit and 12' harness – painted yellow with rapid tock walk sound. The assembly shall include a saddle to accommodate a 5"x7" standard sign providing guidance on pedestrian signals, including in Braille for visually impaired persons.

Each visual pedestrian indication shall be complemented by an audible pedestrian indication. The audible indication shall meet or exceed the specifications for the BPC type indication.

1. Each separately phased pedestrian movement shall have its own distinctive audible emanation in order for visually impaired pedestrians to discriminate which phase is appropriate given his or her destination and/or direction of travel.
2. The audible emanation shall be a cowbell type sound. No buzzer or ringing type sounds will be acceptable. The output level of the audible pedestrian signal shall vary in intensity with significant fluctuations in ambient noise conditions. At a minimum, the output level shall vary in intensity from daytime to nighttime operations.
3. The housings of both the visible and audible pedestrian indicators shall be painted matte black.

Each visual pedestrian indication shall be complemented by a time display indication. Each time display indication shall be self-programming and microprocessor based, with red LEDs used in the display. The time display will countdown the amount of time remaining in each *walk* and *flashing don't walk* time interval for viewing by the ambulatory public. The time display pedestrian indication shall meet or exceed the specifications of the TASSIMCO Countdown Pedestrian Signal.

Red, Amber and Green LED Vehicle Signal Modules

All Red, Amber and Green signal housings with the exception of optically-programmed and fiber optic housings shall conform to the following:

The LED signal module shall conform to "Interim LED Purchase Specification of the Institute of Transportation Engineers, Vehicle Traffic Control Signal Heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules", July, 1998, or most current version, Institute of Transportation Engineers (ITE), 1099 14th St., N.W., Suite 300 West, Washington, DC 20005-3438, Telephone: (202) 289-0222, FAX: (202) 289-7722, and shall conform to the following: (In the case of a conflict, the following special provision shall overrule.)

An independent laboratory shall certify that the LED signal module complies with Section 6 Quality Assurance of the above stated ITE LED Purchase Specification.

LED signal modules must be type-tested and approved by the Department according to the requirements of Subsection 815.21 of the Standard Specifications for Highways and Bridges.

On the backside of the LED signal module there shall be a permanently marked "up" arrow to aid in the proper orientation of the module during installation.

The manufacturer's name, trademark, serial number and other necessary identification shall be permanently marked on the backside of the LED signal module.

Physical and Mechanical Requirement

LED signal modules shall fit without modifications into existing traffic signal housings conforming to "Vehicle Traffic Control Signal Heads" (VTCSH) published in the Equipment and Materials Standards of the Institute of Transportation Engineers. The LED signal module shall be a single, self-contained device, not requiring on-site assembly for installation. The

LED signal assembly construction shall conform to the applicable ASTM specifications for the materials used to fabricate the module.

Each LED signal module shall comprise a smooth surfaced red, amber, or green UV stabilized polycarbonate outer shell, multiple LED light sources, a power supply, and a polycarbonate back cover assembled in a gasketed or silicon sealed unit.

Optical and Light Output Requirements

The minimum luminous intensity values and light output shall be maintained within the rated input voltage of 117 Volts AC. LED signal modules shall not be allowed to fall short of the minimum intensity values at any of the 44 measuring points of the standard when lamp is turned on cold for measurements and after a 30 minute warm-up time period at 100% duty cycle.

Electrical

The maximum wattage for 12" ball shall be 20 Watts and 10 Watts for the 12" arrow.

The LED sources shall not be powered above 70% of the manufacturer's specified rated load. This shall be clearly shown in layman's terms through calculations, schematics, catalogue cuts, etc.

Red and Yellow LED sources shall be made of the AlInGaP (Aluminum Indium Gallium Phosphide) type shown clearly in a catalogue cut or similar literature.

Green LED sources shall be made of the InGaN (Indium Gallium Nitride) type shown clearly in a catalogue cut or similar literature.

Warranty

The LED signal module will be replaced or repaired by the manufacturer if it exhibits a failure due to workmanship or material defects within the first 60 months of field operation.

The LED signal module will be replaced by the manufacturer if it exhibits any partial outage before the final inspection or it exhibits either a greater than 40 percent light output degradation or a fall below the minimum intensity levels within the first 36 months of field operation.

Backplates

Backplates shall have a louvered profile. Backplates shall have a 5 inch border width and a dull flat black color. Only backplates that are listed in the latest MassDOT QTCE List will be used on this project.

Mast Arm Poles and Foundations

Mast arm poles and foundations shall be fabricated and constructed in conformance with the MassDOT Standard Drawings, dated December 2015.

All mast arm poles shall be galvanized steel monolevers with shoe bases.

Acceptance of Type II mast arm poles will be contingent upon review and approval of shop drawings submitted by the Contractor. Long-hand design calculations shall be submitted by the Contractor with the shop drawings for all Type II mast arm poles.

The lump sum prices bid should assume the dimensions shown on the MassDOT Standard Drawings for a three and a half foot (3.5') diameter foundation. Soil exploration borings shall be conducted by the Contractor and paid for under Item 2210.1. The lump sum bid prices should assume wet sandy soil.

Where soil conditions are such that, in the opinion of the Engineer, the typical foundation design is not suitable, the Engineer will provide a modified design for the foundation.

Mast arm foundations shall not obstruct a sidewalk or crosswalk so that pedestrian accessibility is impaired.

Posts and Bases

All traffic signal posts and bases shall be aluminum. Bases shall be of the square shape and include a cast iron threaded insert for strength. Signal post foundations in grass areas shall be exposed ± 2 inches. In sidewalk or paved areas, the top of all signal post foundations shall not be exposed.

Video Detection System

The video detection (VD) system shall be Miovision Smartview 360 or approved equal.

The VD system shall detect vehicles, buses, and bicycles on approach roadways utilizing advanced, omni-directional, vehicle tracking algorithms along with three-dimensional vehicle modeling to supply accurate and consistent stop line detection.

The VD system shall include all necessary software and hardware to allow the end user to program, setup, and/or modify detection zones within the video camera image. The Contractor shall also supply any necessary cables, interface devices and software for monitoring video detection via laptop computers.

The cameras shall be mounted on the mast arm, as shown on the plan or as directed by the Engineer. The cameras shall be within 75 feet of the center of the intersection and within 150 feet from all stop bars.

The VD system shall create reports that will upload daily to a cloud server. The reports shall be exportable from the cloud in PDF, Microsoft Excel, Rich Text format, TIFF, and Web Archive. The reports shall include:

- Volume Reports (including average and summation)
- Turning Movement Count Reports (including average and summation)
- Vehicle Classification Reports
- Incident Reports
- Raw Data Export
- Performance Reports
    - Seven Day Volume
    - Green Occupancy
    - Red Occupancy
- Future Reports

The VD system shall allow the user to specify that any of the above reports be sent via email to the user. The VD system shall send alerts regarding system events to the cloud on a daily basis.

At a minimum, the VD shall meet the following requirements:

Camera

a. Power: 5W
b. Connections: Cat5e cable
c. Communications: DCAM I/F

Video Processor Unit

a. 110 VAC
b. Video Output: MJPEG
c. Detector I/O: 24 optically isolated I/0, SDLC interface
d. Status Indicators:
   Primary Power
   Video Input Status
   Detection Outputs
e. Communications: TCP/IP

General

a. Environmental:
    a. -40F to +122F
    b. 10% to 90% humidity non-condensing
b. Warranty: 3 years limited warranty
c. Regulatory: ATC compliant

The VD system shall be installed in accordance with the manufacturer's recommended procedure for installation.

The VD system shall be installed by factory certified installers and as recommended by the manufacturer and documented in installation materials provided by the manufacturer. Proof of factory certification shall be provided. Installation includes connecting the VD to the traffic signal controller and power supply in the associated controller cabinet assembly. When the setup is complete and the VD system is ready for operation, the values of all parameters that were set during the process shall be delivered to the Engineer in printed and computer readable form. All equipment such as software, laptop computer, tools and cables, needed for setup work shall be provided by the Contractor.

The Contractor shall be responsible for the proper programming of the VD, orientation of the VD, and all other work necessary to provide a complete vehicle detection system. The Contractor may be required to field adjust the location of the VD system in the presence of the Engineer to properly detect approaching vehicles.

The cabinet documentation (box prints) shall show all wiring between the VD system and the controller cabinet.

Meter Boxes
The meter boxes shall include a by-pass meter switch.

Intersection Wiring
All cable shall meet the requirements of IMSA Specifications or 20-1 and shall be twisted copper conductors. A minimum of five spare conductors shall be installed to all signal heads.

Wiring Diagrams
Five sets of wiring diagrams with both internal and external wiring for the control cabinet and all accessories as actually used in the field shall be furnished, including one mylar reproducible copy for the control cabinet when installed. All actual and potential terminal strip connections shall be shown. Accessory equipment includes all components internal to the cabinet. All identification on the diagrams shall be as installed, and all field labeling shall be consistent with the diagrams. Before acceptance of the job, four copies of all operation and maintenance manuals and complete, accurate parts lists shall be supplied.

Service Connection
The service connection shown on the plans is approximate only. The contractor shall determine the exact location from the servicing utility, arrange and coordinate with the utility company to complete the service connection, and be responsible for all charges incidental thereto. The underground service connection to the traffic controller shall terminate in an underground handhole prior to entering the meter socket. The handhole shall be Eversource Catalog ID 521914, 30”x17”x18” H20 rated composite handhole, unless otherwise approved or directed by Eversource or the Cambridge Electrical Department.

Electric Service
An approved meter socket shall be mounted on the side of the cabinet of the controller. The Contractor shall furnish and install the meter socket and the utility company shall furnish and install the meter. The conduit between the service handhole and the meter socket shall not enter the traffic control cabinet and shall be rigid galvanized steel where exposed. The controller cabinet foundation shall be sized so that the conduit riser to the meter socket emerges from the foundation, and not directly from the adjacent sidewalk or landscape surface. A separately fused, 60 amp, grounded duplex outlet and a light receptacle shall be installed. A separate fused disconnect switch shall be provided with lightning protection. Adequate 120 VAC power terminals shall be provided within the controller cabinet.

Cooling Fan
The thermostatically controlled fan shall be sized and set as to limit the upper interior cabinet temperature to a difference of 30 degrees Fahrenheit above the exterior ambient temperature.

Duplex Convenience Receptacle
The duplex receptacle container within the controller cabinet shall be rated for 120 vac, 15 amp and shall be of the Ground Fault Circuit Interrupter (G.F.C.I.) Type.

Work Light

The work light contained within the controller cabinet shall be toggle switch controlled. This toggle switch shall be mounted on the inside of the cabinet door.

Painting

Vehicle signal housings, Visors	-	Black
Signal housing supports (posts)	-	Black
Mast Arms, posts and bases	-	Black
Controller cabinet (exterior) & Meter Socket	-	Black
Controller cabinet (interior)	-	Aluminum
Front of Signal Housings, and Backplates	-	Flat Black

Keys

Two controller cabinet door keys and police door keys shall be supplied for each controller cabinet on the project.

Removing and Stacking Existing Signal Equipment

Existing traffic signal equipment within the project limits shall be removed and stacked by direction of the Engineer. Existing traffic signal equipment to be removed and stacked shall include, but not be limited to, traffic signal heads, backplates, pedestrian push buttons, signs and saddles, traffic signal posts, mast arms, traffic signal controller, cabinet, loop detector amplifiers, hangers or brackets, and any other materials not necessary for the final signal operation.

All traffic signal equipment to be removed and stacked shall be delivered to the City of Cambridge DPW yard, or an alternate location as designated by the Engineer.

As-built Traffic Layout Plans

It will be the responsibility of the Contractor to provide the Design Engineer with as-built traffic signal layout plans at a scale of 1"=20' indicating all changes made during the construction. The plans shall indicate the final location of all traffic signal equipment installed including detectors, signal posts, mast arms, pedestrian and vehicular signal heads, controller cabinets, conduit, pull boxes, hand holes and service connections. The plans shall also indicate the final as-built timing and sequence, major item list, power pole number and meter number. Upon receipt of the above as-built information from the Contractor, the Design Engineer will field verify the as-built information and plans. Following field verification, the Design Engineer will prepare the as-built Traffic Signal Layouts and/or Permits for submission to the City of Cambridge Traffic Engineer prior to the final acceptance of the project.

Miscellaneous Requirements

Because this is often overlooked, the Contractor's attention is drawn to the requirements of the following sections of the MassDOT Standard Specifications: Section 813.60C Splicing, relative to four optional methods of splicing in signal bases, Section 813.40C Ground Electrodes, relative to Requirement 1 - connection to a water piping system, and Section 813.61 Equipment Grounding.

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.

PART 4 - COMPENSATION

Item 2890.1 – Traffic Signal Reconstruction Location 1 River St @ Putnam Ave
Item 2890.2 – Traffic Signal Reconstruction Location 2 River St @ Howard St/Kelly Rd
Item 2890.3 – Traffic Signal Reconstruction Location 3 River St @ Franklin St/Western Ave @ Franklin St
Item 2890.4 – Traffic Signal Reconstruction Location 4 River St @ Green St
Item 2890.5 – Traffic Signal Reconstruction Location 5 Massachusetts Ave @ Prospect St

METHOD OF MEASUREMENT:
Measurement for payment of Items 2890.1 through 2890.5 will be based on full completion as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
The lump sum prices bid for Items 2890.1 through 2890.5 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 local traffic controller, controller cabinet, electrical conduit and wiring, electric handholes, frames and covers, vehicle signal heads, loop detectors and amplifiers, mast arms/bases, signal posts/bases, signal wiring and electrical connections, phasing and timing adjustments, removal and stacking of existing equipment, foundations, excavation and backfill, service connections, and all charges therefore.

EXCLUSIONS:
No separate payment shall be made for sand bedding, marking tape, controlled density fill, temporary top course hot mix asphalt pavement, or any incidental materials, but all costs in connection therewith shall be included in the Contract unit price for Items 2890.1 through 2890.5.

Item 2890.6 – 3 Inch Electrical Conduit Type NM – Plastic (UL)

Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and cleaning as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: gravel pavement subbase; pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; 3 inch electrical conduit pipe, fittings, couplings, and appurtenances; connections to structures; cleanout assemblies (if required); placing and compacting suitable

backfill soil and controlled density fill; grade and compact gravel pavement sub-base; and all appurtenances and incidental work.

Payment for 3 Inch Electrical Conduit Type NM - Plastic (UL) shall be paid at the Contract unit price per linear foot of complete and functional conduit installed as shown on the Contract Drawings or as directed by the City or Engineer. Measurement shall be taken along the centerline of the pipe from the inside face of structures to inside face of structures, to the points of connection with existing pipes.

Item 2890.7 – Pull Box 12" X 12"
Item 2890.8 – Pull Box 24" X 12"

Payment for Pull Box 12" X 12" and Pull Box 24" X 12" shall be paid at the Contract unit price per each pull box installed under Items 2890.7 and 2890.8, which shall include all labor, material, equipment and incidental costs required to complete the work.

Item 2890.9 – Service Connection Eversource Approved Handhole

METHOD OF MEASUREMENT:
Measurement for payment of Item 2890.9 will be based on the number of completed Service Connections to Eversource Approved Handholes as specified herein and as measured by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Payment for Item 2890.9 shall be based on the per number of individual Service Connections made to Eversource Approved Handholes for the traffic signal system. Under the per each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required complete the service connection. The work includes, but is not limited to; saw cutting existing bituminous or cement concrete; excavation; furnishing and placing backfill per one of the approved methods; coordination with Eversource including obtaining an Eversource Work Order; payment for any fees associated with the Eversource Work Order; and incidental work not included for payment elsewhere.

Item 2890.10 – Rectangular Rapid Flashing Beacon (AC Power)
Item 2890.11 – Rectangular Rapid Flashing Beacon (Solar)

METHOD OF MEASUREMENT:
Measurement for payment of Items 2890.10 and 2890.11 will be based on full completion as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
The lump sum prices bid for Items 2890.10 and 2890.11 shall constitute full compensation for all labor, materials and equipment necessary or incidental to the installation of a complete RRFB system functioning as specified and as shown, including signs, local traffic controller, controller cabinet, electrical conduit and wiring, electric handholes, frames and covers, beacons, signal posts/bases, signal wiring and electrical connections, timing adjustments, removal and stacking of existing equipment, foundations, excavation and backfill including test pits, service connections, and all charges therefore.

EXCLUSIONS:
Conduit, pull boxes, service connections, and equipment grounding shall be paid for separately under their respective pay items.

END OF SECTION 02890

SECTION 02900

PLANTING

2900.1 PLANTING LUMP SUM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Planting including, but not limited to, the following:

1. Furnish and install all trees, shrubs, groundcovers, and other woody and herbaceous plant materials.

2. Subsurface tree stabilization

3. Fertilizing, incorporating of planting additives, pruning, mulching, fertilizing and watering new plantings.

B. Related Sections include the following:

1. Section 022100 – Earth Excavation, Backfill, Fill and Grading
2. Section 02310 – Fine Grading
3. Section 02901 – Planting Soils
4. Section 02970 – Landscape Maintenance

1.3 REFERENCES

A. Comply with applicable requirements of:

1. Commonwealth of Massachusetts, Standard Specification for Highways and Bridges, Department of Public Works latest edition.

2. ASTM: American Society of Testing Materials.

3. AAN: American Association of Nurserymen.

4. ISA: International Society of Arboriculture.

5. ANSI: American National Standards Institute.

6. AOAC: Association of Official Agricultural Chemists.

7. USDA: United States Department of Agriculture.

1.4 SUBMITTALS

A. Submittals: in accordance with Section 01300

B. Product Data: Submit most recent printed information from manufacturers for:

1. Antidesiccant
2. Root Barrier
3. Liquid Seaweed Concentrate
4. Plant Growth Biostimulant
5. Mycorrhizae Granules

C. Samples: Submit samples of:

1. Bark Mulch: Submit one cubic foot sample and manufacturer/supplier's name.

2. Subsurface tree stabilization: One set.

D. Certificates:

1. Submit certification of Massachusetts or international certified arborist.

E. Plant List:

1. Within 30 days of receipt of Contract, submit plant list for review by Engineer which includes:

a. Plant materials proposed for project and corresponding nursery source where plants are to be selected.

b. Written documentation indicating nursery(s) have available the plants in the species, quantity and size(s) shown on Drawings.

2. Schedule for review at nursery source by Engineer with Contractor present.

3. Substitutions: plant list shall indicate unavailable materials and document a thorough search for materials. For unavailable materials list sources contacted with telephone number, date and person's name at source.

F. Schedules

1. Submit planting schedule for approval.

1.5 QUALITY ASSURANCE

A. Planting shall be performed by a certified landscape contractor with a minimum of five years planting work experience and under full time supervision of a qualified supervisor. Trees shall be planted under the on-site supervision of a Massachusetts or International Certified Arborist.

1.6 SELECTION AND INSPECTION OF PLANTS

A. Plants shall be selected by Engineer at place of growth for conformity to specification requirements as to quality, size and variety. Such approval shall not impair right of inspection and rejection upon delivery at site or during progress of work. Cost of replacement shall be borne by Contractor.

B. Notify Engineer in writing upon selection of planting subcontractor. State name, address, telephone number and supervisor for planting subcontractor.

C. Schedule selection and tagging of nursery stock so Engineer can tag trees and representative shrubs for project at place of growth. Advise Engineer of schedule a minimum of one month (30 day minimum) in advance of selection/tagging dates so Engineer and City can make proper travel arrangements. If Contractor fails to provide one-month (30 day minimum) notice, any additional travel expenses shall be backcharged to Contractor. If Engineer is required to make additional trips to select/tag plants in the event that inadequate, insufficient or unacceptable plant material was available at the inspection location, then additional travel expenses shall be backcharged to Contractor.

D. Planting subcontractor shall provide representative to travel with Engineer while tagging plant material.

E. Arrange for adequate labor and equipment on site at time of plant material inspection and installation to provide complete staked layout and to unload, open and handle plant material during inspection.

1.7 DELIVERY, STORAGE AND HANDLING OF FERTILIZER AND MULCH

A. Packing and Shipping: deliver materials in unopened containers bearing manufacturer's name and guaranteed statement of analysis. Transport materials without damage. Protect finishes from abrasion, dirt, oils, grease, and chemicals. Pack materials to protect from weather.

B. Acceptance at Site: verify in writing that delivered materials conform to specifications and approved submittals.

C. Storage and Protection:

1. Materials shall be uniform in composition, dry and free flowing. Store materials in dry place, on pallets, off ground; protect from sun. Store materials in a manner which does not diminish their usability and effectiveness.

2. Protect materials from theft, damage, weather, dirt, oils, grease, and construction.

1.8 DELIVERY, STORAGE AND HANDLING OF PLANTS

A. Plants during shipping and delivery and plants requiring storage on site shall be properly wrapped and covered to prevent wind-drying and desiccation of branches, leaves, or buds. Plant balls shall be firmly bound, unbroken, reasonably moist to indicate watering prior to delivery and during storage. Trees shall be free from fresh scars and damage in handling. Root masses of container grown plants shall be kept moist and containers screened from direct sun.

B. Wrap tree trunks at nursery prior to shipping, then unwrap for inspection by Engineer prior to installation. Report damaged plants to Engineer.

C. Apply antidesiccant to plants before digging at nursery and/or as directed by Engineer once plants are delivered to site.

1.9 PROJECT/SITE CONDITIONS

A. Environmental Requirements: do not deliver or handle soils when dry, wet, or frozen.

1. Field Test

a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.

b. If the soil will not retain shape it is too dry and should not be worked.

c, If the soil retains shape and will not crumble, it is too wet and should not be worked.

B. Planting Season: planting seasons shall be those indicated below. Plants planted out-of-season shall receive special attention as directed. Out-of-season planting and or transplanting shall be at Contractor's risk and expense No planting shall be done in frozen or muddy ground or when snow covers ground, or soil is otherwise in an unsatisfactory condition for planting.

1. Seasons for Planting:

Spring:	Deciduous materials - March 21 - May 1 Evergreen Materials - April 15 - June 1
Fall:	Deciduous materials - October 1 - December 1 Evergreen Materials - August 15 - October 15

1.10 SEQUENCING AND SCHEDULING

A. Applicant agrees to schedule an on-site meeting with all contractor(s) and/or subcontractor(s) responsible for any tree or shrub installations in the public right of way and/or City owned property, with David Lefcourt, City Arborist (dlefcourt@cambridgema.gov or 617-349-6433), to discuss proper installation techniques per City of Cambridge specifications and details. This meeting must take place prior to any tree or shrub installation work.

B. Plant after acceptance of fine grading.

1.11 SUBSTANTIAL COMPLETION

A. See Section 02970 – Landscape Maintenance.

1.12 MAINTENANCE

A. See Section 02970 – Landscape Maintenance.

1.13 ACCEPTANCE

A. See Section 02970, Landscape Maintenance.

1.14 GUARANTY

A. See Section 02970 – Landscape Maintenance.

PART 2 PRODUCTS

2.1 PLANTS

A. Plant Identification and Standards: Nomenclature conforms to current edition of Standardized Plant Names, published by American Joint Committee on Horticultural Nomenclature. Plants conform to varieties and sizes specified in plant list, and to code of standards set forth by American Association of Nurserymen, Inc. in American Standard for Nursery Stock, ANSI Z60.1 - latest edition. Substitutions shall not be permitted without consent of Engineer. Plants shall be properly identified with plant labels securely attached to plants, in order to identify plants on site. Information regarding sources of plant material shall be furnished to Engineer.

B. Plant List: If there are discrepancies between the quantities shown on plant list and work shown on Drawings, Contractor shall supply plants necessary to complete work as intended on Drawings. Where size of plant on the plant list is a variation between a minimum and maximum dimension, the sizes of plants furnished shall be equal to average of two dimensions. Where a single dimension is given, dimension represents the minimum size of plants to be furnished.

C. General Plants: Unless specified otherwise, plants shall be nursery grown under climatic conditions similar to those in locality of project and shall have been previously been transplanted or root pruned at least once in last three years. Plants shall possess a normal balance between height and spread. Plants shall be typical of their species and variety with a normal habit of growth, densely foliated when in leaf, and a well-developed branch structure with a fibrous, healthy root system with no girdling roots. Plants shall be sound and healthy, free from dead wood, defects, disfiguring knots, sun scald, injuries or abrasions of roots or bark. Plants shall be freshly dug. No heeled-in plants or plants from cold storage shall be used. Parts of plant shall be moist and show active green cambium when cut. Plants shall be free of plant diseases, insects, pests, eggs, larvae, and forms of infestations.

D. Balled and Burlapped Plants: Plants designated on plant list as "B&B" shall be dug with root systems as solid units. Diameter and depth of balls of soil must be sufficient to encompass fibrous and feeding root system necessary for healthy development of plants. Balls shall be wrapped firmly with biodegradable material, and bound carefully with twine or cord. Tree balls may also be placed in a wire basket of diameter suitable for the size of the root ball. No plant shall be accepted when ball of earth surrounding roots has been badly cracked or broken, either before or during process of planting, or after burlap, ropes, etc., required for transplanting have been unfastened. Plants and root balls shall remain intact as a unit during operations. Plants that cannot be planted at once must be protected and watered.

E. Bare Root Plants: Plants designated "BR" on the plant list shall be dug while dormant. Bare root plants shall be maintained in a healthy condition during storage, transportation, and operations.

F. Container-Grown Plants: Container plants shall have been acclimatized for one growing season in container. Container plants shall be well established in container, and shall have sufficient roots to hold earth intact after removal, without being in a rootbound condition. Plants shall remain in container until planted.

G. Trees: Trees to be hand dug and balled and burlapped rootballs. Root balls shall be custom dug to special widths and depths to accommodate shallow soil conditions of this Project. Trees, except when a clump form is designated, shall be straight and symmetrical with a crown having a persistent single, main leader, and growing from a single, unmutilated crown of roots. No part of trunk shall be conspicuously crooked as compared with normal trees of same variety. Trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire, or other causes. No pruning wounds shall be present having diameter of more than two inches (2") and wounds must show vigorous bark on edges. Pruning wounds over 3/4 inch in diameter must be completely calloused over. Evergreen trees shall be branched to within one foot of ground. Height of trees, measured from crown of roots to top of top branch, and caliper, measured as specified herein, shall not be less than minimum size designated in plant list. Take caliper measurements 6 in. above ground on trees up to and including 4 in. caliper, and at 12 in. above ground for larger sizes.

H. Shrubs and Small Plants: Shrubs and small plants, unless otherwise designated, shall be well-formed and bushy with well-spaced side branches, and shall have a crown and stem(s) typical of species and variety. Plants shall be well-branched to ground. Plants shall meet requirements for spread and/or height stated in Plant List. Measurements for height are to be taken from ground level to average height of top of shrub and not to longest branch. Thickness of each shrub shall correspond to trade classification "No. 1". Single stemmed or thin plants will not be accepted.

I. Plants larger than those specified in the Plant List may be used if approved by Engineer, but use of such plants shall not increase the Contract Price. If use of larger plants is approved, spread of roots or ball of earth shall be increased in proportion to size of plant.

2.2 PLANTING ADDITIVES

A. Liquid Seaweed Concentrate: Dry, water soluble seaweed extract powder from Ascophym nodosum. Stress-X as manufactured by North Country Organics, Bradford, Vermont 05033, ph# 802.222.4277.

B. Plant Growth Biostimulant: Dry, water soluble plant growth biostimulant made form beneficial bacteria humic extracts, cold water sea kelp extract, essential amino acids,

vitamins, root growth factors and sugars. Bio- Magic as manufactured by North Country Organics, Bradford, Vermont 05033, ph# 802.222.4277.

C. Mycorrhizae granules: transplant granules for inoculating plants with beneficial mycorrhizal fungi prior to planting. Myco-Magic as manufactured by North Country Organics, Bradford, Vermont 05033, ph# 802.222.4277.

2.3 BARK MULCH

A. Bark mulch: shredded granular outer bark of evergreen trees and minimum of hardwood bark and shall be aged for period of at least 6 months and not longer than two years. Bark mulch shall not have be subjected to anaerobic conditions and must be partially decomposed and dark brown in color, Bark chunks shall average 1/2 inch to 2 inches in length and no chunks three inches or more in size and thicker than 1/4 inch shall be left on site. Moisture content shall be 40 percent or more, retained with normal watering and/or rainfall. Mulch shall be free of dirt, leaves, twigs, and other materials deleterious to plant life. Mulch shall not contain chipped construction materials.

2.4 WATER

A. Water: furnished by Contractor, unless otherwise specified, and suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for work shall be furnished by Contractor.

2.5 SUBSURFACE TREE STABILIZATION

A. Subsurface Tree Stabilization: Duckbill Tree Guy System manufactured by Foresight Products, 6430 East 49th Drive, Commerce City, CO 80022 or approved equal

B. Provide a subsurface tree stabilization system which uses below grade shed anchors/ ground stakes at four corners augured to a 4’ minimum depth with straps located below grade over the root ball, connected to the anchors/ stakes to secure the tree and root ball in place. Maintain planting in plumb condition and in order to withstand the environmental conditions of the site.

2.6 ANTIDESICCANT

A. Antidesiccants: emulsions or materials which provide a protective film over plant surfaces permeable enough to permit transpiration and specifically manufactured for that purpose. Antidesiccant shall be delivered in manufacturer's containers and used according to manufacturer's instructions.

2.7 CHEMICALS, HERBICIDES, FUNGICIDES AND INSECTICIDES

A. Provide chemicals, herbicides, fungicides and insecticides as needed for fungus or pest control. Chemicals and insecticides shall be approved by Massachusetts Department of Environmental Protection for intended used and application rates. No pesticides shall be used on site without knowledge and approval of Engineer. Pesticides shall be handled by State licensed operators only.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: in the event field conditions are not in conformance with Contract Documents, notify Engineer in writing.

1. Spot and Invert Elevations: verify field elevations of site improvements such as drainage and utility fixtures, pavements, existing plantings, and subsurface piping conform to Drawings.

2. Finish Grade: verify specified elevations and prior grading operations have shaped, trimmed, and finished gradients.

3.2 PREPARATION

A. Protection:

1. Contact "Dig Safe" prior to doing excavation on site. If work is to be done around underground utilities, appropriate authority of utility must be notified of impending work. Hand excavate areas adjacent to utilities. Contractor shall be responsible for damages done by himself or his personnel to existing utilities, which shall be repaired or paid for by Contractor.

2. Dust Control: upon acceptance of finish grades provide dust control.

3. Erosion Control: upon acceptance of finish grades provide erosion control.

4. Agricultural Chemicals: protect site improvements from contact with agricultural chemicals, soil amendments, and fertilizers.

3.3 DIGGING, HANDLING, AND PROTECTION OF PLANTS

A. Dig balled and burlapped (B&B) plants with firm natural balls of earth, of sufficient diameter and depth to include fibrous roots and conforming to standards of American Nurserymen Association. No synthetic burlap will be accepted. No plant moved with a ball will be accepted if ball is cracked or broken before or during planting operations.

B. Protect roots or balls of plants from sun and drying winds.

C. Set plants on ground in shady location and protect with soil, bark mulch, or other acceptable materials, balled and burlapped plants which cannot be planted immediately upon delivery. Water stored plants and regularly verify rootballs are moist. Engineer will reject stored plants found with dried rootballs.

D. Open bundles of plants immediately and plants and separate before roots are covered. Care shall be taken to prevent air pockets among roots. During planting operations, bare roots shall be covered with canvas, hay or other suitable material. No plant shall be bound with wire or rope as to damage the bark or break branches.

3.4 OBSTRUCTIONS BELOW GROUND

A. If rock, underground construction work, or other obstructions are encountered in plant pit excavation work, alternate locations may be selected by Engineer at no additional cost to Owner.

B. Where locations cannot be changed, obstruction shall be removed, subject to Engineer's approval, to a depth of not less than three feet (3') below grade and no less than six inches (6") below bottom of ball or roots when plant is properly set at required grade.

3.5 PREPARATION AND PLACEMENT OF PLANTING MIXTURE

A. See Section 02901 – Planting Soils.

3.6 FINE GRADING

A. See Section 02310 – Fine Grading.

3.7 PLANTING OPERATIONS

A. Stake out locations of plants and secure Engineer's approval before excavating plant pits.

B. Excavating

1. Dig plant pits by hand and take care not to disturb utilities or irrigation lines. If utilities, or irrigation lines are disturbed during planting operation, Contractor shall repair damage at Contractor's expense.

2. Excavate plant pits with sloping sides so planting hole is saucer shaped. Plant pit shall be no deeper than root ball.

3. Tree pits shall be four times diameter of soil ball in width.

C. Setting, Backfilling and Fertilizing

1. Backfill plant pits after approval by Engineer. If pits are prepared and backfilled to grade prior to planting, their location shall be marked and recorded on Drawings so when planting proceeds they can readily be found.

2. Set plants in center of pits plumb, straight and at an elevation where after settlement the root flare of plant will be at surrounding finished grade. Root ball shall not be broken. When trees are set, compact base material under the root balls to fill voids and support plants at proper height. Remove burlap, ropes or wires from upper third of balls. Have Engineer inspect removal prior to backfilling.

3. Remove groundcovers and perennials from containers immediately before planting. Handle plants carefully to prevent damaging roots. Groundcover plants may be planted after bark mulch is placed.

4. Sprinkle michorrhizal granules continuously around perimeter of root ball as well as incorporating granules into top of rootball following removal of top 1/3 of burlap in accordance with manufacturer's recommend

5. Mix liquid seaweed concentrate or plant growth bio-stimulant with water at a rate of 3 grams of liquid seaweed concentrate powder per gallon of water or 1 teaspoon of plant growth biostimulant per gallon of water.

6. Backfill hole around plants to two-thirds full, firm soil, flood with water mixed with additives, after water has drained away backfill to finished grade without additional firming. Immediately after plant pit is backfilled, a shallow basin slightly larger than pit shall be formed with ridge of soil to facilitate and contain water. After planting, cultivate soil in shrub beds between shrub pits, rake smooth and outline beds neatly.

3.8 DRAINAGE TEST

A. Perform drainage test on trees and in representative shrub beds.

1. After excavation, fill pit twice successively with water.

2. Water shall drain out of plant pit minimum 2 inches per hour.

3. Plant pits draining slower than 2 inches per hour will require provision for drainage.

B. Documentation: note on the planting plan, pits that pass drainage test and plants that fail drainage test.

3.9 FIELD QUALITY CONTROL

A. Observation:

1. Engineer to review plant pits without positive drainage.
2. Engineer to review plant pit excavation and planting.

3.10 SUBSURFACE TREE STABILIZATION

A. Contractor responsible for maintaining plants in upright, vertical position and for maintaining stabilization materials.

3.11 PRUNING

A. Prune trees and shrubs only with approval of Engineer. Prune according to American Nurserymen's' Association Standards to preserve natural character of plant and as directed by Engineer. No leaders shall be cut.

B. Pruning shall be done with clean, sharp tools. Dead wood or suckers and broken or badly bruised branches shall be removed back to live bud, branch, or stem.

3.12 PLACEMENT OF BARK MULCH

A. Immediately after planting operations are completed, cover tree and shrub pits and planting beds with a two-inch layer of specified mulch. Taper depth of mulch to be two inches at mulched perimeter and decreasing in depth toward trunk to be flush where trunk or stem meets root ball. Do not place mulch against trunk or stem. Cover tree, shrub and groundcover planting beds with bark mulch.

3.13 WATERING

A. Flood plants with water twice within first 24 hours of time of planting, and water plants during the maintenance period at lease twice per week. At each watering thoroughly saturate the soil around each tree or shrub. If sufficient moisture is retained in soil, as determined by Engineer, required watering may be reduced. Each tree will require a minimum of ten gallons of water.

3.14 POST PLANTING FERTILIZER

A. Apply fertilizer at rate if 5 pounds per 1000 square feet, 30 days after planting.

3.15 CLEANING

A. Wash and sweep clean paving, site improvements and building surfaces. Clean spills and overspray immediately. Remove and dispose off-site excess planting mixture, soil and debris.

B. Following Acceptance at the end of 90 Maintenance Period of planting areas, remove materials and equipment not required for other planting or maintenance work. Materials and equipment remaining on site shall be stored in locations which do not interfere with Owner's maintenance of accepted lawns or other construction operations.

PART 4 COMPENSATION

2900.1 PLANTING LUMP SUM

METHOD OF MEASUREMENT
Plantings and maintenance of all trees, shrubs, perennials and groundcovers will be measured by the unit Lump Sum. The unit bid price per lump sum item shall constitute full compensation for providing all plant materials, mulch, planting accessories, equipment, labor and incidentals required to perform the work of this Item, including but not limited to coordinating the work with other relevant items; locating sources of plants; excavation of previously placed planting soils; furnishing and installing plant materials; furnishing and installing mulch; providing potable water; performing initial pruning; providing inspection and maintenance on plant materials and replacing dead plants during guarantee period; resetting plants which have settled during guarantee period.

BASIS OF PAYMENT
Payment for planting and maintenance of all trees, shrubs, perennials and groundcovers shall be based on the unit Lump Sum, as detailed in the Contract Documents installed complete for these items in the proposal. Under the unit Lump Sum for this item, the Contractor shall furnish all labor, materials, tools, equipment and incidentals required for the installation of Plantings and mulch and planting maintenance as detailed and where indicated or required by the Owner or Engineer

EXCLUSIONS
The following items are not included for payment under this item and are included elsewhere: Planting Soils is included in Section 02901 – Planting Soils.

END OF SECTION

SECTION 02901

PLANTING SOILS

2901.1	**SAND BASED STRUCTURAL SOIL**	**CUBIC YARD**
2901.2	**HORTICULTURAL SUBSOIL**	**CUBIC YARD**
2901.3	**PLANTING SOIL**	**CUBIC YARD**
2901.4	**SAND DRAINAGE LAYER**	**CUBIC YARD**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of this Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for manufactured planting soils including, but not limited, to the following:

1. Subgrade preparations.
2. Planting soil material acquisition.
3. Testing and analysis for specification conformance.
4. Preparation of mixes and testing for conformance.
5. Mock-ups.
6. Installation and placement of soils.
7. De-compaction and re-compaction of soils.
8. Final in-place testing of soils.
9. Coordination with other contractors.
10. Clean-up.

B. References to other Sections are given that would duplicate provisions in this Section.

1.3 RELATED WORK UNDER OTHER SECTIONS

A. Section 02210 – Earth Excavation, Backfill, Fill and Grading
B. Section 02900 – Planting

1.4 QUALITY ASSURANCE/DEFINITIONS

A. Definitions:

1. Refer to Section 02900 – Planting.

2. ASA: American Society of Agronomy.

3. Soil Scientist: The project Soil Scientist shall be Pine and Swallow Environmental, 867 Boston Rd., Groton, MA 01450, 978-448-9511, www.pineandswallow.com

4. Subgrade: Soil material and levels resulting from the approved rough grading work.

5. Drainage Layer/Drainage Blanket: A layer of specified sand/sand and gravel to facilitate drainage and control of groundwater below planting soils.

6. Planting Soils: Planting Soils are composed of a blend of three base components: base loam, organic material and sand. The quality of the blend depends on the quality of the original components. Locate and obtain approval of sources for base loam, organic material and sand that meet the Specification requirements. Contractor is then responsible for mixing the components. Approximate mixing ratios are provided, but may require adjustment, depending on the final materials and with the approval of the Architect or their representative, in order to meet Specification requirements for each blend.

B. Testing/Testing Agency

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Refer to this section, 1.5 B.

C. Contractor is solely responsible for quality control of the Work.

D. The installer shall be a firm having at least 5 years of successful experience of a scope similar to that required for the Work, including the preparation, mixing and installation of custom Planting Soil and planting mixes in urban locations.

1. The installing Contractor shall be the same firm that is installing planting as described in Section 02900 – Planting.

2. Installer Field Supervision: Installer to maintain an experienced full-time supervisor on Project site when any Planting Soil preparation work is in progress.

3. The installer's crew shall be experienced in the installation of soil, grading and interpretation of grading plans in urban areas.

E. Soil work shall be performed by a firm that has sufficient earthwork machinery at the job site simultaneously to amply provide for the vigorous execution of the site work without interruption or delay, except for unforeseen circumstances, such as weather. Machinery operators shall be well experienced in this type of work.

F. Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, State and municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

G. Comply with all requirements for control of silt and sediment during soil installation work as indicated in the contract documents. Provide additional silt and sediment control to maintain silt and sediments within the working area as required by the progress of the work or as directed by the Landscape Architect and Soil Scientist.

H. Pre-installation Conference: Conduct conference at project site prior to the start of any work related to Planting Soil preparation and shall meet the requirements of this Section 3.1(D).

I. Layout and Grading:

1. Permanent benchmarks shall be established by a registered land surveyor or professional civil engineer, at the Contractor's expense. The Contractor shall maintain established bounds and benchmarks and replace them, if any are destroyed or disturbed.

2. The Contractor shall maintain at the site, sufficient surveying equipment to accurately excavate to the required subgrade and install soil to the required finish grade. The Contractor shall be responsible to install soil profiles at the elevations and thickness shown on the Plans.

1.5 TESTING, SUBMITTALS, MOCK-UPS AND INSPECTIONS

A. Testing for Subgrade, Planting Soil Components and Planting Soil Mixes: Testing is required at the following intervals:

1. Testing of individual components (Base Loam, Sand, and Compost) for planting soil mixes prior to blending of any soils for use at the Project Site. Tests are as described in this Section.

2. After test results for components have been accepted, create sample Planting Soil Mixes of each planting soil mix and perform tests described in this Section.

3. After the test results for each Planting Soil Mix have been accepted, and during the production of planting soils, test every 200 cubic yards of every Planting Soil Mix blended for: organic matter content, gradation, and pH. Before shipping of any Planting Soil Mix, the Contractor shall confirm that the Soil Scientist has accepted the mix. Testing applies to all soil layers of the planting profile. After three consecutive compliant tests, the Contractor may increase the interval of testing to 500 cubic yards.

4. After horticultural tests have been approved, contractor shall submit representative samples of each soil blend to a geotechnical testing laboratory for ASTM 698 Standard Proctor tests to obtain optimum moisture content and maximum dry density values and Saturated Hydraulic Conductivity, ASTM 5856.

5. In-place tests: Compaction tests of each type of material (soil layer) placed shall be in accordance with this Section. Infiltration tests shall be in accordance with this Section.

6. Installation of Drainage Layer: Contractor shall notify the Engineer and Soil Scientist at least 5 days prior to the installation of drainage layers. Contractor shall demonstrate layout and installation of drainage lines and drainage layer. Sand Based Structural Soil or other Planting Soils shall not be installed until drainage layer is accepted.

B. Test Reports: Submit certified reports for tests as described in this Section.

1. Mechanical gradation (sieve analysis) shall be performed for sand, silt, and clay content and compared to the USDA Soil Classification System using sieve size numbers: 10, 18, 35, 60, 140 and 270. The silt and clay (0.002 mm) content shall be determined by a Hydrometer Test (ASTM D-422-63) of soil passing the #270 sieve.

2. Chemical analysis shall be undertaken for Phosphorus, Potassium, Calcium, Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, organic matter content, acidity (pH) and buffer pH.

3. Tests shall be conducted in accordance with Recommended Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeastern Regional Publication No. 493; Agricultural Experiment Stations of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia. Tests include the following:

a. Test for soil Organic Matter by loss of weight on ignition, as described in Northeastern Regional Publication No. 493.

b. Test for soil CEC by exchangeable acidity method as described in Northeastern Regional Publication No. 493.

c. Test for soil Soluble Salts shall be by the 1:2 (v:v) soil:water Extract Method as described in Northeastern Regional Publication No. 493.

d. Test for Buffer pH by the SMP method as described in Northeastern Regional Publication No. 493.

e. Tests for pH shall be conducted on a 1:1 soil to distilled water ratio.

4. Certified reports on analyses from producers of composted organic materials shall be required and new test reports shall be submitted when compost sources are changed. Analyses shall include all tests for criteria specified in 2.1, K.

5. Saturated Hydraulic Conductivity: Test procedure ASTM D5856 (2000).

6. Testing Agencies: The following firms are acceptable testing agencies for the various components and blends.

a. Leaf Yard Waste Compost Comprehensive and Stability Test: Woods End Research Laboratory, P.O. Box 297, Mt. Vernon, ME, 04352, tel: 201.293.2457, fax: 201.293.2488 or alternate approved STA certified testing laboratory by the US Composting Council, www.compostcouncil.org.

b. Mechanical Gradation, Chemical Analysis and Organic Matter Content, All Soil Components and Planting Soil Mixes: University of Massachusetts, 203 Paige Laboratory, 161 Holdsworth Way, Amherst, MA 01003, http://soiltest.umass.edu, tel: 413.545.2311, fax: 413.545.1931 or approved equal.

c. Recommended Testing Laboratory for Standard Proctor and Hydraulic Conductivity testing, Certified Testing Labs, 155 US Route 130, Bordentown, NJ, 08505, 609-298-3255, www.certifiedtestinglabs.com

7. Laboratory Density Testing: ASTM D698 - 12 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

a. Density tests shall be performed on samples collected at the Soil Supplier's facility, to obtain the optimum moisture content and maximum dry density values.

C. In-Place Testing

1. Density Tests: ASTM D6938-08a Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth). ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. (Standard Proctor).

a. In-place density tests shall be carried out at a rate of one test per each plant bed.

b. Soil density shall meet the requirements specified herein, see PART 3.

2. As required, in-place infiltration tests shall be performed using the equipment and methods described in Section 3 Execution.

3. At the discretion of the Engineer and Soil Scientist, in-place planting soil blends shall be sampled and tested by the City for compliance with gradation and organic matter content as specified herein. Non-compliant materials shall be removed from the site or amended as specified by the Engineer and Soil Scientist.

D. Samples: Prior to ordering the below listed materials, submit representative composite samples to the Engineer and Soil Scientist for selection and approval. Representative composite samples shall be composed of at least five equal-sized subsamples mixed thoroughly and resampled for submittal. Do not order materials until Engineer's, and Soil Scientist's acceptance has been obtained. Delivered materials shall closely match the approved samples.

1. Components

    a. Compost: duplicate samples of 1 gallon.
    b. Base Loam: duplicate samples of 1 gallon.
    c. Medium to Coarse Sand: duplicate samples 1 gallon.

2. Test Blends
    a. Planting Bed Soil: duplicate samples of 1 gallon
    b. Sand-Based Structural Soil: duplicate samples of 1 gallon.
    c. Horticultural Subsoil: duplicate samples of 1 gallon.

3. Production Stockpiles

    a. Planting Bed Soil: duplicate samples of 1 gallon
    b. Sand-Based Structural Soil: duplicate samples of 1 gallon.
    c. Horticultural Subsoil: duplicate samples of 1 gallon.

4. Materials

    a. 3/4" Crushed Stone: duplicate samples of 1 gallon
    b. 3/8" Crushed Stone: duplicate samples of 1 gallon
    c. Filter Fabric Mirafi 140N or equal: duplicate one square foot samples.
    d. Perforated Aeration 4-inch pipe: duplicate one foot samples.
    e. Nonperforated Aeration 4-inch pipe: duplicate one foot samples.

E. Sources for Base Loam, Sand, and Compost: Submit information identifying sources for all soil components and the firm responsible for mixing of planting soil mixes.

1. Engineer, Soil Scientist, and City shall have the right to reject any soil supplier or mixing facility.

2. Soil mix supplier shall have a minimum of five years-experience at supplying custom planting soil mixes.

3. Submit supplier name, address, telephone and fax numbers and contact name.
4. Submit certification that accepted supplier/ mixer is able to provide sufficient quantities and qualities of materials for the entire project.

5. Final approval of soil supplier/ mixer shall be made after on-site review of supplier's and mixer's facility(ies) by the Soil Scientist.

6. Recommended Soil Suppliers

    a. Read Custom Soils, 5 Pond Park Road, Suite L, Hingham Massachusetts, 02042 781-828-6300, sales@readcustomsoils.com Contact: Mark Pendergast

    b. D & H Loam, 2352 Main Street, Concord, Massachusetts, 978-897-4901, sales@dhloam.com Contact: Tom Dexter

c. AgreSource Inc., 100 Main Street, Amesbury, MA 01913 Tel: 800-313-3320; Tel:978.388.5110, info@agresourceinc.com. Contact: Dave Harding

F. Subgrade Survey

1. Contractor shall submit for approval by the Engineer a survey of final subgrade in all areas where planting soils will be placed. Placement of any drainage layer or planting soil shall not precede acceptance by the Engineer.

G. Mock-up and Inspection

1. At the beginning of site work, the contractor shall demonstrate, in the presence of the Engineer and Soil Scientist, subgrade preparations, including de-compaction and re-compaction methods and placement of sand blanket and drain lines that achieve the requirements of this Section. All subsequent subgrade preparations shall be in accordance with approved methods.

2. The Contractor shall not place Planting Soil, Sand Based Structural Soil or Horticultural Subsoil on prepared subgrade or drainage layer prior to inspection and approval of Engineer and Soil Scientist for compliance with depth, compaction and percolation rate. The Contractor shall request inspection before proceeding at least ten working days prior to placement of soils.

3. The Contractor shall not plant any plant material prior to inspection and approval of Engineer and Soil Scientist for compliance with soil depth and compaction specifications. The Contractor shall request inspection before proceeding at least ten working days prior to placement of soils.

4. The Contractor shall construct a mock-up of the initial installation of Sand Based Structural Soil in the presence of the Engineer and Soil Scientist. The Mock-up may be part of the permanent installation if the Engineer and Soil Scientist approves it. The Mock-up shall be conducted with the same equipment that will be used for the duration of the Sand Based Structural Soil installation. Mock-up must be conducted with material compliant with the soil moisture requirements provided in 1.6 H. A geotechnical testing agency shall be on site to conduct soil moisture and compaction/density tests for each lift installed during the Mock-up and subsequent soil placement.

1.6 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 02210 – Earth Excavation, Backfill, Fill and Grading for overall material handling requirements.

B. In addition, the following provision is established: Material shall not be handled or hauled, placed or compacted when it is wet as after a heavy rainfall, early spring or if frozen. Soil shall be handled only when the moisture content is compliant with Section 02901 1.6.H. The Engineer and the Soil Scientist shall be consulted to determine if the soil is too wet to handle.

C. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Protect all materials from weather, damage, injury and theft.

D. Sequence deliveries to avoid delay. On-site storage space is permissible only with written notice from Engineer. Deliver materials only after preparations for placement of planting soil have been completed.

E. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soil.

F. Planting Soil that is to be stockpiled longer than two weeks, whether on or off site, shall not be placed in mounds greater than six feet high.

G. Vehicular access to the site is restricted. Before construction, the Contractor shall submit for approval a plan showing proposed routing for deliveries and site access.

H. Soil Moisture Content

1. Contractor shall not move, blend or grade soil when moisture content is so great that free moisture is apparent, nor when it is so dry that dust will form in the air or that clods will not break readily, nor when it is frozen. Apply water, if necessary, or allow to dry to bring soil moisture between 60% of optimum moisture content (OMC) and optimum moisture content as determined by ASTM D698 prior to compaction, grading or planting.

    a. Sand Based Structural Soil must be tested and be compliant for soil moisture content immediately prior to delivery or placement at the site. SBSS shall not be installed when over OMC.

    b. Sand Based Structural Soil should be as close to optimum moisture content as possible for best results during compaction.

2. Field Soil Moisture Test procedure is applicable for general soil moving and placement only and shall not be considered appropriate for compaction of soils, nor is a replacement for the above testing procedure.

    a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.

    b. If the soil will not retain shape it is too dry and should not be worked.

    c. If the soil retains shape and will not crumble, it is too wet and should not be worked.

    d. If the soil glistens or free water is observed when the sample is patted in the palm of hand the soil is too wet and should not be worked.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. General

1. All plant mix material shall be imported and fulfill the requirements as specified and be tested to confirm the specified characteristics.

2. Samples of individual components of soil mixes in addition to blended soil mixes including mulch materials shall be submitted by the Contractor for testing and analysis to the approved testing laboratory. Comply with specific materials requirements specified.

a. No base component material or soil components for soil mixes shall be used until certified test reports by an approved soil testing laboratory and have been received and approved by the Engineer and Soil Scientist.

b. As necessary, make any and all soil mix amendments and resubmit test reports indicating amendments until approved.

3. The Engineer and Soil Scientist may request additional testing by Contractor for confirmation of mix quality and/or soil mix amendments at any time until completion. Changes in mix ratios may be required.

B. Soil Testing and Soils Testing Report Submittal

1. All testing of the soil mix components shall be carried out by the Soils Testing Laboratory. Recommendations for amending and/or correcting the soil mix will be provided to the Contractor by the Engineer and Soil Scientist after approval by the Engineer and Soil Scientist.

2. Failure of any material by testing and/or amendment procedure to meet Specification requirements shall require the Contractor to seek another source for the failed material and the initiation of all testing procedures for the new replacement material shall immediately take place.

3. The Contractor shall be responsible for recognizing that these critical project materials warrant timely and serious attention, that the testing process to achieve Approved materials should be considered a lead time item, and that under no circumstance shall failure to comply with all specification requirements be an excuse for “staying on project construction schedule.”

4. Refer to the “Planting Soil Testing Protocol”, located in the Appendix of this Specification.

C. Soil Samples: Contractor is responsible for paying costs for testing. Submit 1 gallon planting soil samples in two phases. Submit samples concurrent with horticultural soil test reports in both phases. Submit as phase one, planting soil base components for approval. Only after approval of phase one components, submit as phase two, soil blend mixes /

mediums for approval. All reports must be from recent analyses, less than 90 days old, and represent materials that are available for delivery to the site.

1. Phase One Submittals of Planting Soil Base Components:

    a. Base Loam (Imported Topsoil)
    b. Organic Amendment Materials (Compost)
    c. Coarse Sand for Amending Soil
    d. Crushed Stone for Use Over Sand Based Structural Planting Soil

2. Phase Two Submittals of Planting Mediums: mixing and batching of soil mediums to be submitted in the same manner as bulk soils and will be prepared prior to delivery to site.

    a. Horticultural Subsoil
    b. Planting Bed Soil
    c. Sand Based Structural Planting Soil

3. Phase Three Submittals shall be identical to Phase Two Submittals and be conducted for each 500 cubic yards of soil material prepared for the project site.

4. Submit reports for each of the above samples: Submit sample from each proposed source for testing and approval. Deliver samples to both the testing laboratory and the project Soil Scientist and pay costs. Send report directly to the Engineer.

5. Soil Sample Submittals: Sampling shall be done by the Contractor. The size of the samples and method of sampling shall be as follows: Samples shall be representative of the material to be brought to the site. Each sample shall be a Composite Sample, which consists of 5 separate sub samples taken from a minimum of (5) different locations at each source and mixed together to make the test sample.

6. **The Contractor shall schedule this testing in order to permit reasonable time for testing, evaluation, and approvals prior to scheduled installation. Allow for a minimum of 4 weeks to perform testing and obtain approvals.**

D. Imported Base Loam

1. Imported Base Loam, as required for blending with sand and compost, shall be a naturally occurring A-Horizon soil formed from geologic soil forming processes without admixtures of sand or organic matter sources (composts). Base Loam, which has been contaminated by incorporation of subsoil, shall not be acceptable for use. 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:

Percent Passing

U.S. Sieve Size Number	Minimum	Maximum
10	---	100
18	85	100
35	70	95
60	50	85
140	36	53
270	32	42
0.002mm	3	6

2. The ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 8 or less (D80/D30 < 8).

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

4. The organic content shall be between 4.0 and 8.0 percent by weight.

5. pH shall be between 5.8 and 7.0.

6. Chemical analysis shall be undertaken for Phosphorus, Potassium, Calcium Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, acidity (pH) and buffer pH.

E. Medium to Coarse Sand

1. Sand for Planting Soil Blends, protection of filter fabric and for drainage as required, shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded to sub-angular grains of quartz or other durable rock free from loam or clay, mica, surface coatings and deleterious materials with the following grain size distribution for material passing the #10 sieve:

	Percent Passing	
U.S. Sieve Size Number	Minimum	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 20% by weight of the total sample.

3. The ratio of the particle size for 70% passing (D_{70}) to the particle size for 20% passing (D_{20}) shall be 2.8 or less (D_{70}/D_{20} <2.8). Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422.

4. pH shall be less than 7.5.

F. Alternate Sand Layer Drainage Material

1. Sand for Drainage shall meet the requirements of Coarse Sand above, or Alternate Sand Drainage Material may be substituted, provided it meets the Specification ranges below, and is submitted and accepted by the Soil Scientist and Engineer.

2. Free-draining sand and gravel borrow shall consist of inert, hard, durable stone and coarse sand, free from loam, clay, mica, surface coatings and deleterious materials and shall conform with the following gradation:

U.S. Sieve No.	% Passing by Weight	
	Minimum	Maximum
3 inch	100	-
1/2 inch	60	-
# 4	40	100
# 50	8	28
# 200	0	5

3. Sand and gravel borrow shall be placed in lifts not more than nine inches thick before compaction. Compaction shall be by vibration to a density between 90 and 95% Standard Proctor. Saturated hydraulic conductivity of the sand and gravel shall be not less than 15 inches per hour according to ASTM D5856-95 (2000) when compacted to a minimum of 95% Standard Proctor, ASTM 698.

G. Organic Amendment (Compost)

1. Organic Matter for amending planting soils shall be a stable, humus-like material produced from the aerobic decomposition and curing of Leaf Yard Waste Compost, composted for a minimum of one year (12 months). The leaf yard waste compost shall be free of debris such as plastics, metal, concrete or other debris. The leaf yard waste compost shall be free of stones larger than 1/2", larger branches and roots. Wood chips over 1" in length or diameter shall be removed by screening. 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 laboratory tests.

   a. The ratio of carbon to nitrogen shall be in the range of 12:1 to 25:1.

   b. Stability shall be assessed by the Solvita procedure. Protocols are specified by the Solvita manual (version 4.0). The compost must achieve a maturity index of 6 or more as measured by the Solvita scale. Stability tests shall be conducted by Woods End Research Laboratory, Mt. Vernon, Maine.

c. Organic Content shall be at least 20 percent (dry weight). One hundred percent of the material shall pass a 1/2-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 the West Experiment Station at the University of Massachusetts, Amherst or equal.

d. pH: The pH shall be between 6.5 to 7.4 as determined from a 1:1 soil-distilled water suspension using a glass electrode pH meter American Society of Agronomy Methods of Soil Analysis.

e. Salinity: Electrical conductivity of a one to five soil to water ratio extract shall not exceed 2.5 mmhos/cm (dS/m).

f. The compost shall be screened to 1/2-inch maximum particle size and shall contain not more that 3 percent material finer that 0.002mm as determined by hydrometer test on ashed material.

g. Nutrient content shall be determined by the Testing 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 buffer pH.

h. Compost shall not contain phytotoxic levels of residual herbicides or other OHM that exceed Massachusetts regulatory limits for soil used in residential zones.

H. 3/8" Crushed Stone for use over Sand Based Structural Planting Soil

1. Crushed stone (3/8 inch) shall consist of durable double washed crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered rock and free from a detrimental quantity of thin, flat or elongated or other objectionable pieces. Crushed stone shall be reasonably free from clay, loam or deleterious material and shall conform to the following gradation (Massachusetts Highway Specification M2.01.6.)

	Percent Passing	
U.S. Sieve Size Number	Minimum	Maximum
1/2 inch	100	-
3/8inch	85	100
#4 Sieve	10	30
#8 Sieve	0	15
#16 Sieve	0	5

I. ¾" Crushed Stone for use over Sand Based Structural Planting Soil

1. Crushed stone (3/4 inch) shall consist of durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered rock and free from a detrimental quantity of thin, flat or elongated or other objectionable pieces.

Crushed stone shall be reasonably free from clay, loam or deleterious material and shall conform to the following gradation.

U.S. Sieve No.	% Passing by Weight	
	Minimum	Maximum
1 inch	100	-
3/4inch	90	100
1/2 inch	10	50
3/8 inch	0	20
# 4 Sieve	0	5

J. Filter Fabric, as required, shall be Mirafi 140N or approved equivalent.

K. Perforated Aeration Pipe & Cap

1. Aeration pipe shall be 4" ADS Perforated Single Wall Corrugated Polyethylene Pipe, manufactured by ADS Company, Columbus, OH 43221, or approved equal. Pipe shall be manufacturer's standard perforated configuration. Jointing shall be made using manufacturer's standard snap coupling type fittings.
2. Aeration Pipe Cap: Provide metal pipe cap, Zurn Z400B Type 'B' Round Strainer with heel proof square openings and secured grate, provided by Zurn Industries, Specification Drainage Operation, 1801 Pittsburgh Avenue, Erie, PA, Tel: 855.663.9876, www.zurn.com, or approved equal.

L. Non-perforated Pipe

1. Pipe shall be 4" ADS Single Wall Corrugated Polyethylene Pipe, manufactured by ADS Company, Columbus, OH 43221, or approved equal. Pipe shall be manufacturer's standard non-perforated configuration. Jointing shall be made using manufacturer's standard snap coupling type fittings.

2.2 PLANTING SOIL MIXES

A. All existing vegetation shall be removed from stockpiles prior to blending. Uniformly mix ingredients by windrowing/tilling on an approved hard surface area or by alternately processing materials through a screening plant. All soil components and Organic Amendment shall be maintained moist, not wet, during mixing. Amendments shall not be added unless approved to extent and quantity by the owner and additional tests have been conducted to verify type and quantity of amendment is acceptable. Percentages of components are approximate and will be verified upon completion of individual test results for components of the various mixes. Due to variability of soil materials, mix ratios may require adjustment and re-submittal at the expense of the Contractor.

B. After component percentages are determined by the Soil Scientist, each planting soil mix shall be tested for physical and chemical analysis. Component percentages may be modified at any time by the soil scientist dependent upon the results of testing of the various components or final blends.

C. Sand Based Structural Soil

1. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of four parts by volume Sand to one part by volume Imported Base Loam to one and one half part by volume Compost (4S:1L:1.5C) to create a uniform blend which meets the following requirements.

2. Gradation for Material Passing the Number 10 Sieve:

	% Passing by Weight	
U.S. Sieve Size Number	Minimum	Maximum
10	100	-
18	68	90
35	38	63
60	18	39
140	9	18
270	8	10
0.002mm 1	2	

3. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.

4. Ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 3.2 or less. (D70/D20 <3.2)

5. Saturated hydraulic conductivity of the mix: not less than 6 inches per hour, according to ASTM D5856-95 (2000) when compacted to a minimum of 92% Standard Proctor, ASTM 698.

6. Organic content: between 2.5 and 3.5 percent by weight.

7. The pH shall be between 6.0 and 6.5.

8. After approval of the above horticultural testing, conduct Standard Proctor Test (ASTM 698) to obtain maximum dry density and optimum moisture content values.

D. Planting Bed Soil

1. Planting Bed Soil shall consist of a combination of approximately equal parts by volume Stripped Existing or Imported Base Loam, Coarse Sand and Organic Amendment/Compost (1L:1S:1C) to create a uniform blend which meets the following requirements.

2. Gradation for material passing a Number 10 Sieve shall be achieved in the final mix.

	Percent Passing	
U.S. Sieve Size No.	Minimum	Maximum
10	100	
18	85	95
35	60	85
60	42	65
140	21	44
270	18	24

0.002 mm	2	4

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

4. The ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 6 or less (D80/D30 <6).

5. The final mix shall have an organic content between 5 and 7 percent by weight.

6. The final mix shall have a hydraulic conductivity of not less that 1.5 inches per according to test procedure ASTM D5856-95 (2000) hour when compacted to a minimum of 86 percent Standard Proctor ASTM D 698. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

7. Chemical analysis shall be undertaken for Phosphorus, Potassium, Calcium Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, acidity (pH) and buffer pH.

8. pH shall be between 6.0 and 6.8

E. Horticultural Subsoil

1. Horticultural Subsoil for the lower layer of planting soil in Planting Beds shall consist of a combination of approximately 2 parts by volume Coarse Sand to one part by volume Stripped Existing or Imported Base Loam to one half part by volume Compost (2S:1L:0.5C). Sand Based Structural Soil blend may be substituted for Horticultural Subsoil if approved by the Engineer and Soil Scientist.

2. Gradation for material passing the #10 sieve:

Percent Passing U.S. Sieve Size No.	Minimum	Maximum
10	100	--
18	85	95
35	55	80
60	30	60
140	18	33
270	12	16
0.002mm	1	3

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. Ratio of the particle size for 80% passing (D_{80}) to the particle size for 30% passing (D_{30}) shall be 6.0 or less (D_{80}/D_{30} <6.0).

5. Saturated hydraulic conductivity of the mix: not less than 2 inches per hour according to ASTM D5856-95 (2000) when compacted to a minimum of 86% Standard Proctor, ASTM 698.

6. Organic content: between 1.5 and 3.0 percent by weight.

7. pH shall be between 6.0 and 6.8

PART 3 – EXECUTION

3.1 PRE-INSTALLATION EXAMINATION AND PREPARATION

A. Reference Other Sections as necessary.

B. Coordinate activities with other project contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement.

C. The Contractor shall not place any planting soil until all utility and adjacent work that may impact planting soils is completed.

D. Kickoff Meeting: At least 10 working days prior to the start of work, the Contractor shall request a landscape construction kickoff meeting with the Engineer, landscape architect, soil scientist and any other parties involved with landscape construction. The Contractor must demonstrate familiarity with this Section 02901 Planting Soils, and other relevant sections of the construction documents. The Contractor shall articulate the means and methods of soil blending, subgrade preparation, soil placement and other steps outlined in the Specification.

E. Examination of Subgrade: The subgrade shall be examined by the Contractor prior to the start of subgrade preparation, soil placement and planting. Notify the Engineer if:

1. Construction debris is present within the planting areas.
2. Conflict with underground utilities.
3. Subgrade contaminated with oils, compressible material, silt or clay.
4. Subgrade without drainage layer must infiltrate water at the rate of at least one inch per hour.

F. 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 drawings.

1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace slopes where required and maintain sides of slopes of excavations in safe condition until completion of backfilling. Provide protection measures as required for public safety.

2. All subgrade areas to be filled with Drainage Layer or Planting Soil shall be free of construction debris, refuse, vegetation, compressible or decay able materials, all stones greater than 6 inches, concrete washout or soil crusting films of silt or clay

that reduces or stops drainage from the Planting Soils into the subsoil; and/or standing water. Such material shall be removed from the site.

3. The subgrade must slope at a minimum of two percent towards the bottom of slopes and subdrains. Subgrade levels shall be adjusted as required to ensure that all planting areas have adequate drainage.

G. Do not proceed with the installation of Drainage Layer or Planting Soils until all utility work in the area has been installed.

1. The Contractor shall identify the locations of underground utilities prior to proceeding with soil work and shall protect all utilities from damage.

H. Planting Soil Preparation: Refer to Section 02901, 2.2 for planting soil and mixtures. Examine soil and remove foreign materials, stones and organic debris over 1/2" in size. Remove all vegetation from stockpiles prior to blending. Mix-in fertilizers and amendments as required by tests and as approved by the Engineer and Soil Scientist. All preparation and mixing shall be accomplished when the soil moisture content is compliant with Section 02901, 1.6.H and at a moisture content approved by the Landscape Architect and Soil Scientist. If lime is to be added, it shall be mixed with dry soil before fertilizer is added and mixed.

3.2 EXCAVATION AND REMOVAL

A. Refer to Earthwork Division and/or Demolition

3.3 MIXING OF PLANTING SOIL MIXES

A. Soil blends shall be produced with equipment that blends together each component in a thorough and uniform manner. This may be accomplished by a minimum of three handling events on a hard-surfaced area with earth moving equipment or by alternately passing soil components through a screener.

B. Base components and Soil Mix stockpiles should be protected from wind and rain and shall not be permitted to be stored in standing water.

C. Planting Soil and Sand Based Structural Soil shall be protected from precipitation until soil placement is completed.

3.4 WORKING AROUND UTILITIES

A. Carefully examine the civil, record and survey drawings to become familiar with the existing underground conditions before digging.

B. Known underground and surface utility lines are indicated on the utilities drawings – See Civil and Architect's plans. Contact the local Dig Safe organization and give them their required time to respond and mark the property. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand-excavate, as

required. Maintain grade stakes set by others until parties concerned mutually agree upon removal.

C. Perform work in a manner that will protect utilities from damage. Hand-excavate as required and provide adequate means of support and protection of utilities during soil installation operations. Maintain grade stakes set by others until parties concerned mutually agree upon removal. The Contractor shall repair all utilities damaged by soil operations at the Contractor's expense.

3.5 SUBGRADE PREPARATION, INSPECTION AND PERCOLATION TESTING

A. In areas with no drainage layer, after subgrade levels have been reached, the Engineer or Soil Scientist shall observe a mockup of de-compaction and preparation of the subgrade according to this Section and inspect soil conditions to evaluate subsurface drainage conditions. All subsequent preparations for subgrade shall be done per the mockup.

B. Coordinate the following scarification work to eliminate subgrade compaction when located in planting areas without a drainage layer. Maintain 12" clearance from any underground utilities during subgrade de-compaction.

1. Heavy Site Subgrade Compaction Mitigation:

a. Heavily compacted subgrade areas such as, but not limited to, temporary parking areas, material stockpile areas, existing roadways, construction areas and areas around structures and other similar areas.

b. Prior to establishing the final subgrade, these areas shall be dug up or ripped to a depth of (18) inches to break up the soil hard pan, then re-compacted with two passes of the tracks of a wide track bulldozer size D-6 or smaller, or other approved equipment. Vibratory compaction of subgrade in planted areas is prohibited.

2. General Site Subgrade Compaction Mitigation for all planting areas in fills or that are not heavily compacted and would be mitigated as specified in Item 1 above:

a. Immediately prior to placing drainage layer or Planting Soil, the entire subgrade shall be loosened to a minimum depth of 8-inches using the teeth of a backhoe or other suitable equipment, then re-compacted with the curled bucket of an excavator, or other approved equipment. Vibratory compaction of subgrade in planted areas is prohibited.

C. After Subgrade has been scarified as described above, it shall be recompressed by using the tracks of a wide-tracked bulldozer, multiple passes of a skid steer loader, or the curled bucket of an excavator. In areas of subgrade with no drainage layer, verify the subgrade passes water at or greater than the minimum requirement of 1"/hour.

D. Remove all stones or debris greater than 6" in any dimension from the subgrade prior to placing Drainage Layer or Planting Soils.

E. After the subgrade has been prepared, in areas with no drainage layer, Percolation Tests shall be performed according to the following test procedures. Percolation testing shall be conducted a minimum of every 250 lineal feet, or at any area where subsoil conditions are observed that may exhibit poor drainage conditions. Notify Soil Scientist of any planting soil installation area where free water or saturated soil. is observed at the bottom of the excavation

1. Utilize perforated canisters or buckets seven to ten inches in diameter and a minimum of six inches high.

2. A test hole shall be hand dug at the soil horizon to be tested approximately one-inch larger than the diameter of the test canister and approximately six inches deep. The sides of the test hole shall not be smoothed.

3. Place one-half inch of clean coarse sand in the bottom of the hole and place the canister firmly into the hole. The space around the canister shall then be filled with coarse sand. Tamp the coarse sand to firmly fill any void space around the test canister.

4. Fill the canister with water to the soil horizon level and allow to drain until approximately one inch of water remains, or a minimum of 1 hour.

5. Refill the canister to the soil horizon level. After the water level drops approximately one inch, start the test. Record time versus water level as the water level drops. The percolation rate is the length of time for the water level to drop per inch. The field scientist shall record the rate of percolation for a minimum of one hour or until the water level has dropped a minimum of three inches after the start of measurements.

6. Subgrade must infiltrate water at a minimum rate of 1-inch per hour. If subgrade does not meet the minimum infiltration capacity, notify the Design Team for further instructions.

3.6 INSTALLATION OF DRAINAGE LAYER

A. Drainage Layer

1. After subgrade preparation, layout drainage lines as shown on the plans. Excavate subgrade to achieve a minimum slope of 3% toward drain lines. Drain lines must slope downward at a minimum of 0.5 percent, with 1 percent or greater preferred.

2. Use manufacturer snap type fittings for all drain line connections.

3. After layout and inspection of drain lines, place drainage sand layer over drain lines in areas and in thicknesses depicted on the plans.

4. In areas with no drainage layer, drain piping must be surrounded by a minimum of 2 inches of sand for protection of filter fabric.

5. Notify Engineer and Soil Scientist and obtain acceptance of drainage layer prior to installation of planting soils.

6. In areas with Sand Based Structural Soil, the drainage layer shall be vibratory compacted with two passes of a plate compactor.

3.7 BACKFILLING OF HORTICULTURAL SOIL LAYERS

A. Soil Placement Preparation:

1. Verify that the plumbing for the irrigation system has been installed and accepted.

2. Verify that the subgrade preparations have been reviewed and accepted, including de-compaction and removal of large stones and spot elevation checks to ensure proper depth of excavation.

3. Notify the Engineer and Soil Scientist of soil placement operations at least seven calendar days prior to the beginning of work.

4. In areas with no drainage layer, verify that the subgrade passes the minimum water infiltration requirement.

5. Do not proceed with the installation of Planting Soils, until all utility work in the area has been installed.

6. The Contractor shall identify the locations of underground utilities prior to proceeding with soil work and shall protect all utilities from damage.

7. Do not begin Planting Soil installation until all drainage, irrigation main lines, lateral lines, subgrade preparations and irrigation risers shown on the drawings are viewed and approved by the Engineer and Soil Scientist.

8. Protect adjacent walls, walks and utilities from damage or staining by the soil. Use plywood and/or plastic sheeting as directed to cover existing asphalt, concrete, metal and masonry work.

a. Clean up any soil or dirt spilled on any paved surface, including at the end of each working day.

b. Any damage to the paving or architectural work shall be repaired by the Contractor at the Contractor's expense.

B. After the subgrade soils have been loosened, re-compressed and inspected, and/or Drainage Layer has been approved, Planting Soils may be spread by using a wide track bulldozer size D-5 or smaller or may be dumped and spread with the bucket of a backhoe from the edge of the loosened area. No rubber-tired equipment or heavy equipment except for a small bulldozer shall pass over the subsoils (subgrade) after they have been loosened and recompressed. If the Contractor plans to utilize such areas for any use of heavy equipment, this work should be carried out prior to beginning the process of loosening soils or filling in that area.

C. Placement of Planting Bed Soil, Sand Based Structural Soil and Horticultural Subsoil:

1. Placement of Planting Bed Soil and tree stock shall be carried out simultaneously to prevent excessive traffic over soil lifts and to maintain the integrity of the soil layers. The contractor shall install plants simultaneously with the installation of the lower soil layers. The upper soil layers shall not be installed before all plants are installed and before the acceptance by the Engineer and Soil Scientist.

    a. After subgrade preparation and approval, in areas of tree and shrub planting with rootballs 12" in diameter or greater, create a transition layer and place and compact Horticultural Subsoil (or the SBSS being used as Horticultral Subsoil) as described in this Section.

    b. After inspection and approval of Horticultural Subsoil, place trees and shrubs in locations shown on the plans and at the proper elevations.

    c. Create a transition layer as described in this Section. Place and compact Planting Bed Soil around trees and shrubs as described in this Section.

2. To simplify construction of the soil profiles, Sand Based Structural Soil (SBSS) may be substituted for Horticultural Subsoil for the lower layer of soil in planted areas when used adjacent to each other. Sand Based Structural Soil should only be vibratory compacted at areas beneath sidewalks. Sand Based Structural Soil for use as horticultural subsoil shall not be vibratory compacted.

3. Planting Bed Soil, Sand Based Structural Soil, Horticultural Subsoil shall be placed in lifts not to exceed 8 inches in thickness and compacted to meet minimum and maximum requirements as specified below:

    a. A transition zone shall be formed between the prepared subgrade, drainage layer, Sand Based Structural Soil and Planting Bed Soils by placing one inch of the upper-layer soil and raking into the lower soil to a two-inch thickness.

    b. Horticultural Subsoil (or SBSS in Planted Areas) shall be compacted to between 84 and 87 percent Standard Proctor, except soils beneath the rootballs shall be compacted to between 87 and 90 percent Standard Proctor to create a firm pedestal and prevent settlement of the rootballs.

    c. Planting Bed Soil and Horticultural Subsoil shall be compacted to between 82 and 85 percent Standard Proctor.

    d. Planting Soils shall not be compacted with vibratory equipment. Sand Based Structural Soil below structures must be compacted with vibratory equipment provided the moisture content is compliant with Section 02901 1.6H.

4. Sand-Based Structural Soil shall be spread in lifts not greater than eight inches and compacted with a minimum of three passes of vibratory compaction equipment to a density between 92 and 96 percent Standard Proctor Maximum Dry Density. Notify

Engineer and the Soil Scientist if more than 8 passes are required to achieve minimum density requirement.

a. Prepare Mock-Up of initial Sand Based Structural Soil Installation as provided in this Specification. After approval of the Mock-Up, all subsequent installation of Sand Based Structural Soil shall be placed according to approved methods.

b. A medium to large sized vibratory plate compactor should be used to compact Sand Based Structural Soil. Moisture content of Sand Based Structural Soil should be as close to optimum moisture content (OMC) (as determined by Standard Proctor Test) as possible for best results.

c. Rake the surface of each accepted lift of Sand Based Structural Soil to break the surface glaze caused by the compaction equipment, prior to placing subsequent lifts.

d. Density testing for Sand Based Structural Soil must be ASTM D6938-10 Nuclear Methods, after ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. Density testing shall be conducted at a minimum of one test for every 150 lineal feet for each lift. Geotechnical testing agency must be on-site to conduct soil moisture and density tests during installation of Sand Based Structural Soil.

e. Sand-Based Structural Planting Soil shall be placed in 8" lifts within the areas shown on the Drawings, except as otherwise indicated. A minimum of eight inches of 3/4 inch crushed stone shall be placed over the Sand-Based Structural Planting Soil in areas shown on the Plans.

f. A filter fabric irrigation dispersion strip and aeration and irrigation lines shall be installed at the bottom of crushed stone layer at the locations shown on the plans.

4. In all cases, the soil being placed shall be in a dry to damp condition. No wet soils shall be placed. Soil moisture content must be compliant with Section 02901 1.6.H prior to compaction. All testing of in-place density for planting materials shall be made by the soil scientist or according to ASTM D6938-10 Nuclear Methods after conducting ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

   a. Sand Based Structural Soil must be tested for moisture content and compaction by ASTM Methods by an approved geotechnical testing firm at the time of installation.

   b. Sand Based Structural Soil must be at or below Optimum Moisture content (OMC) for placement and compaction.

5. Prevention of compacted soils can be accomplished by beginning the work in corner, against walls, or the center of isolated beds, and progressing outwards towards the borders.

6. Planting Soils shall never be moved or worked when wet or frozen.

7. The Contractor shall place barricades or steel plates as required to prevent any unnecessary compaction of planting soil from vehicles, equipment, or pedestrian traffic.

8. After Planting Soils have been spread, it shall be carefully prepared by hand raking. Stones and debris over one inch in any direction shall be removed from the premises. Fine grade planting beds to a smooth even surface with loose uniformly fine texture. Remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas that can be planted immediately after grading. Maintain the finished surfaces at the grades shown and spread additional soil to correct settlement or erosion. Surface drainage shall be maintained. Soil shall be damp and free from frost during fine grading operations.

3.7 PROTECTION

A. The Contractor shall protect landscape work and materials from damage due to landscape operations, operations by other Contractors or trespassers. Maintain protection during installation until acceptance. Treat, repair or replace damaged Planting Soil installation work immediately.

B. Provide all means necessary, including fences, to protect all soil areas from compaction and contamination by trash, dust, debris, and any toxic material harmful to plants or humans after placement. Any area that becomes over-compacted, shall be de-compacted and tilled to the extent determined by the Engineer and Soil Scientist and recompressed to the density ranges specified. Any uneven or settled areas shall be filled, re-graded and re-compacted to meet the requirements of this Specification. Soil that becomes contaminated shall be removed and replaced with specified soil material.

C. Phase the installation of the planting soil blends such that equipment does not have to travel over already installed planting soil. Use of haul roads is acceptable provided that the haul road is completely re-worked to meet the requirements of this Specification.

D. Apply filter fabric covering and planking or other engineering controls over soil to minimize compaction and collect dust and debris in any area where the Contractor must work after the installation of Planting Soil.

E. Till compacted Planting Soil(s) and replace Planting Soil that has become contaminated as determined by the Engineer. Planting Soil that has been compromised by construction activities shall be tilled or replaced by the Contractor at no expense to the City.

3.8 CLEAN-UP

A. During installation, keep pavements clean and work area in an orderly condition.

B. Keep the site free of trash and debris at all times. Immediately dispose of wrappings or waste materials associated with products necessary for the completion of the work.

C. All trash and debris shall be kept in a central collection container. Do not bury trash and debris in back-fill.

D. Once installation is complete, remove any excess soil from pavements or embedded in fixtures.

3.9 COORDINATION AND EXCESS MATERIALS

A. Coordinate activities with other project contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement.

B. Excess Planting Soil Mixtures and Materials: Remove the excess planting soil mixture and materials from the site at no additional cost to the City unless otherwise requested.

3.10 POST-INSTALLATION TESTING

A. In-place density testing is required in all areas. Placed and planting soils must be inspected for compaction level by the soil scientist or by the following acceptable Density Test Methods: ASTM D1556 Density of soil and rock in place using Sand Cone Method, ASTM D6938-10 Nuclear Methods, ASTM D2167-08 Rubber Balloon method, after ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

B. Density testing for Sand Based Structural Soil must be by ASTM D6938-10 Nuclear Methods, after ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. Density testing shall be conducted at a minimum of one test for each lift in each plant bed or a minimum of every 300 square feet.

C. Placed Planting Soils must be capable of infiltrating water at the minimum rate provided in this Specification for each type of planting soil

PART 4 - COMPENSATION

2910.1 SAND BASED STRUCTURAL SOIL CUBIC YARD

METHOD OF MEASUREMENT
Measurement for Sand-Based Structural Soil shall be based on the cubic yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS
Payment for Sand-Based Structural Soil shall be based on the cubic yard of Sand-Based Structural Soil as detailed in the Contract Documents installed complete for this item in the proposal. Under the cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of Sand-Based Structural Soil as detailed and where indicated or required by the Engineer. The work includes, but is not limited to: Soil Components, including Compost, Base Loam, and Medium to Coarse Sand; Test Blends of Sand-Based Structural Soil (SBSS); Production Stockpiles of Sand-Based Structural Soil (SBSS); Placement in lifts, vibratory compaction and field density testing by ASTM methods; any required filter fabric between soil types as noted on the drawings; Nonperforated

Aeration 4-inch pipe; Underdrainage 4” perforated pipe with Filter Fabric; Underdrainage 4” non-perforated pipe, required to complete the installation as indicated and specified; and all incidental work not included for payment elsewhere.

EXCLUSIONS
The following items are not included for payment under this item: None

2910.2 HORTICULTURAL SUBSOIL CUBIC YARD

METHOD OF MEASUREMENT
Measurement for Horticultural Subsoil shall be based on the cubic yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS

Payment for Horticultural Subsoil shall be based on the cubic yard of Horticultural Subsoil as detailed in the Contract Documents installed complete for this item in the proposal. Under the cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of Horticultural Subsoil as detailed and where indicated or required by the Engineer. The work includes, but is not limited to: Soil Components, including Compost, Base Loam, and Medium to Coarse Sand; Test Blends of Horticultural Subsoil; Production Stockpiles of Horticultural Subsoil, placement and compaction of material per Specifications.

EXCLUSIONS
The following items are not included for payment under this item: None

2910.3 PLANTING SOIL CUBIC YARD

METHOD OF MEASUREMENT
Measurement for Planting Soil shall be based on the cubic yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS
Payment for Planting Soil shall be based on the cubic yard of Planting Soil as detailed in the Contract Documents installed complete for this item in the proposal. Under the cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of Planting Soil as detailed and where indicated or required by the Engineer. The work includes, but is not limited to: Soil Components, including Compost, Base Loam, and Medium to Coarse Sand; Test Blends of Planting Soil; Production Stockpiles of Planting Soil, placement and compaction of Planting Soil material per Specifications.

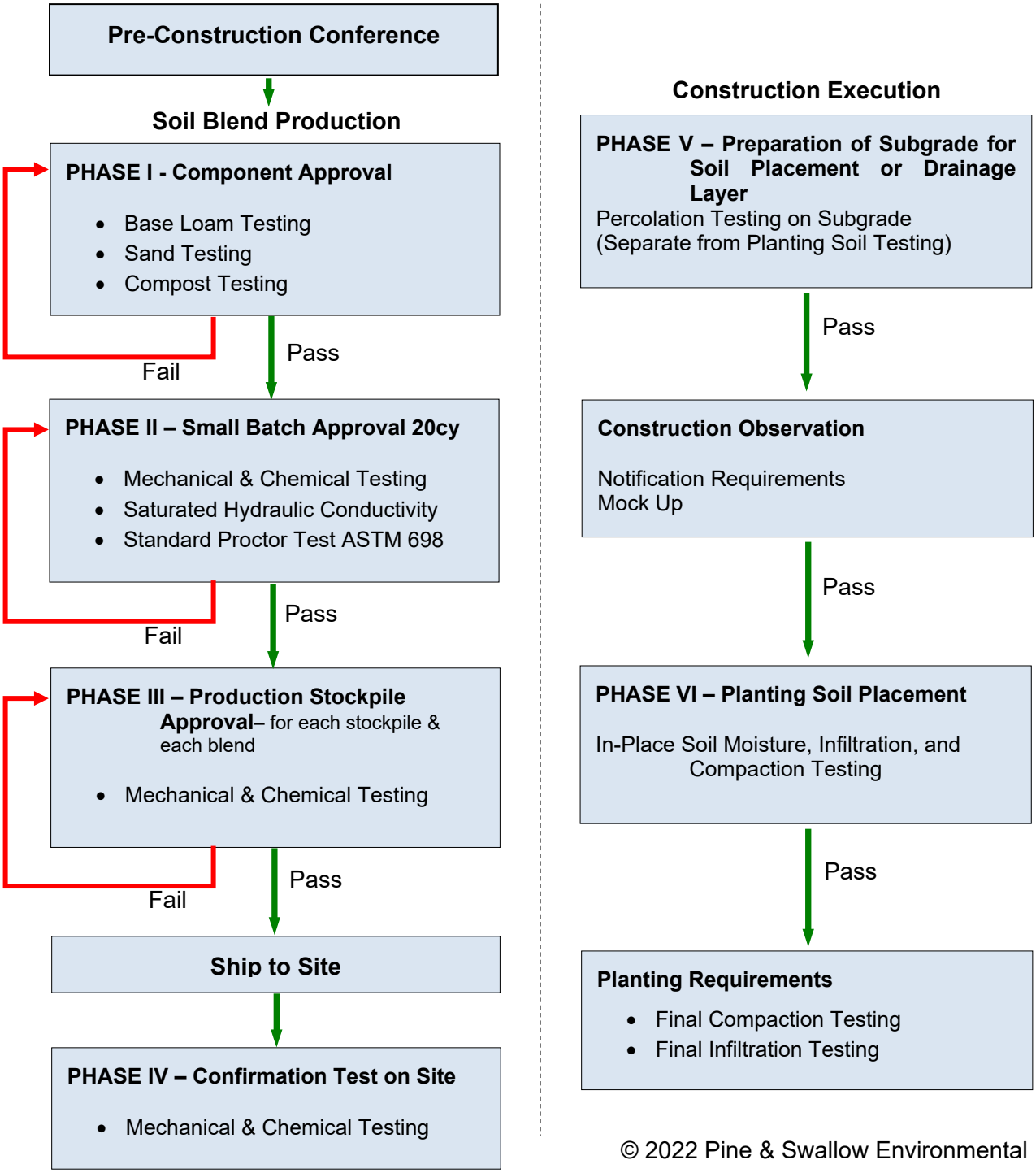
EXCLUSIONS
The following items are not included for payment under this item: None

2910.4 SAND DRAINAGE LAYER CUBIC YARD

METHOD OF MEASUREMENT
Measurement for Drainage Sand shall be based on the cubic yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS
Payment for Drainage Sand shall be based on the cubic yard of Drainage Sand as detailed in the Contract Documents installed complete for this item in the proposal. Under the cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of Drainage Sand as detailed and where indicated or required by the Engineer. The work includes, but is not limited to: Material Testing, placement and compaction of Drainage Sand material per Specifications.

APPENDIX: PLANTING SOIL TESTING PROTOCOL



END OF SECTION

SECTION 02920

LAWNS

02920.1 LAWNS SQUARE YARD

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Lawns including, but not limited to, the following:

1. Sodded Lawn
2. Watering, fertilizing and mowing and maintenance of lawn.

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02901 – Planting Soils
3. Section 02930 – Planting
4. Section 02970 – Landscape Maintenance

1.3 REFERENCES

A. Comply with applicable requirements of:

1. Commonwealth of Massachusetts, Standard Specifications for Highways and Bridges, Department of Public Works, latest edition.

1.4 REFERENCES

A. Comply with applicable requirements of:

1. Commonwealth of Massachusetts, Standard Specifications for Highways and Bridge Construction, Department of Public Works, latest edition.

2. ASTM: American Society of Testing Materials:

a. ASTM: American Society of Testing Materials.
b. ANSI: American National Standards Institute.
c. AOAC: Association of Official Agricultural Chemists.
d. USDA: United Stated Department of Agriculture.

1.5 PERMITS AND CODES

A. Work shall conform to Contract Documents and comply with applicable codes and regulations.

B. Comply with rules, regulations, laws and ordinances of City of Cambridge, of the Commonwealth of Massachusetts and other authorities having jurisdiction.

C. Arrange for and obtain permits and licenses required to complete Work. Fees not waived shall be paid by Contractor.

D. Do not close or obstruct streets, sidewalks, alleys or passageways without prior notification and permission. Conduct operations to minimize interference with use of roads, driveways, alleys, sidewalks, or other facilities near enough to Work to be affected.

1.5 SUBMITTALS

A. Submittals: in accordance with Section 01300

B. Product Data: Submit manufacturer's information for:

1. Maintenance Fertilizer
2. Seed Mixture
3. Protective fencing materials.

C. Certificates: Submit:

1. Sod grower's certification. Submit certificate with each shipment of sod indicating certification of grass species, source, grower location, date of harvest and shipment. No sod may be placed until certificates have been submitted.

D. Schedules: Submit:

1. Sod installation schedule for approval

1.6 QUALITY ASSURANCE

A. Qualifications: contractor shall have minimum five years experience in seed and sod installation.

B. Regulatory Requirements

1. Secure permits, licenses, and pay fees including traffic control.

2. Comply with laws, regulations, and quarantines for agricultural and horticultural products.

1.7 DELIVERY, STORAGE AND HANDLING OF SOD, FERTILIZER AND SOIL AMENDMENTS

A. Packing and Shipping: deliver materials in unopened containers bearing the manufacturer's name and guaranteed statement of analysis. Transport materials without damage. Protect finishes from abrasion, dirt, oils, grease, and chemicals. Pack materials to protect from weather.

B. Acceptance at Site: verify in writing that delivered materials conform to specifications and approved submittals.

C. Storage and Protection:

1. Materials shall be uniform in composition, dry and free flowing.

2. Store materials in dry place, on pallets, off the ground; protect from sun. Store materials in a manner, which does not diminish their usability and effectiveness.

3. Protect materials from theft, damage, weather, dirt, oils, grease, and construction.

1.8 PROJECT CONDITIONS

A. Environmental Requirements: do not deliver, handle or place soils when dry, wet, or frozen.

1. Field Test

a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.

b. If soil will not retain shape it is too dry and should not be worked.

c. If soil retains shape and will not crumble, it is too wet and should not be worked.

B. Sod Planting Seasons:

1. Spring (April 15 to July 15)

2. Autumn (August 15 to November 1)

3. Sodding outside of the above seasons shall be permitted when ordered by Landscape Architect or when Contractor submits written request and permission is granted. Seeding outside dates established above shall be at Contractor's risk.

1.9 SEQUENCING AND SCHEDULING

A. Perform lawn work only after planting and other work affecting ground surface has been completed.

1.10 SUBSTANTIAL COMPLETION

A. Upon completion of sod installation, request Owner's Representative's review to determine if work is substantially complete. Submit request a minimum of five days prior to anticipated inspection date. If work is substantially complete, Owner's Representative will issue a Substantial Completion letter identifying commencement of 90 day Maintenance Period.

1. If work is not substantially complete, Landscape Architect will issue a written list of outstanding work to be done on a timely schedule agreed upon by Contractor and Landscape Architect.

2. Contractor shall notify Landscape Architect when outstanding work is completed and ready for review. When outstanding work is complete, as determined by Landscape Architect, a letter of Substantial Completion will be issued.

1.11 90 DAY MAINTENANCE PERIOD

A. Maintain lawn areas until Final Acceptance.

1.12 FINAL ACCEPTANCE

A. After the 90 day maintenance period sod lawn areas will be reviewed for final acceptance.

B. Conditions of Final Acceptance

1. Lawn acceptance shall be given for entire lawn area. No partial acceptance shall be given.

2. Lawns shall exhibit uniform, thick, well- developed stand of grass. Lawn areas shall have no bare spots in excess of four inches in diameter and bare spots shall comprise no more than two percent of total area of lawn.

3. No lawn areas shall exhibit signs of damage from erosion, washouts, gullies, or other causes.

4. Pavement surfaces and site improvements adjacent to lawn areas shall be clean and free of spills from placing or handling of loam borrow and seeding operations.

C. Inspection and Final Acceptance

1. Upon completion of 90 Day Maintenance Period, request Landscape Architect's review to determine if work is acceptable. Submit request a minimum of five days prior to anticipated inspection date. If work is acceptable, Landscape Architect will

issue a Final Acceptance letter. From this date forward, lawn maintenance will be the responsibility of the Owner. Following acceptance of lawns, Owner will be given access to lawn areas for maintenance work.

a. If work is not accepted, Landscape Architect will issue a written list of outstanding work. Maintenance period to be extended until completion of work.

b. Contractor shall notify Landscape Architect when outstanding work is completed and ready for review. When work is complete, as determined by Landscape Architect, a letter of Final Acceptance will be issued.

PART 2 - PRODUCTS

2.1 LANDSCAPE SOILS AND AMENDMENTS

A. See SECTION 02901 – PLANTING SOILS.

2.3 POST PLANTING FERTILIZER

A. Post Planting Fertilizer to be mixed with soil:

1. Complete, fertilizer made from all-natural ingredients complying with State and Federal fertilizer laws. Fertilizer shall contain the following available plant food by weight, unless soils test indicate a need for different composition:

	Nitrogen	Phosphorus	Potash
Lawns	5%	3%	4%

2. Fertilizer: Pro Start 2-3-3 manufactured by North Country Organics, Bradford, Vermont 05033. Phone: 802.222.4277.

3. Fertilizer to be delivered in original unopened standard size bags showing weigh, analysis ingredients and manufacturer's name.

2.4 WATER

A. Water: furnished by Contractor, suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment furnished by Contractor.

2.5 SOD

A. Sod: nursery grown sod composed of two or more proprietary Kentucky bluegrass cultivars with a 30 percent minimum composition of fine leaf fescues (chewings, creeping red, of hard fescues). Submit cultivar names to Engineer for approval. Sod to be 1 year old minimum from time of original seeding.

1. Sod shall be grown and provided by one of the following turf farms:

a. Tuckahoe Turf Farms Berwick Maine Fields, 305 Hubbard Road, Berwick, ME 03901. Phone: (800) 556-6985

b. Downeast Turf Farms, 421 Alfred Road, Kennebunk, ME 04043. Phone: (207) 985-0100.

c. Or approved equal.

2. Sod Farm Growing Medium: sod farm growing medium shall meet the following sod farm growing media requirements:

a. Soil in which sod was grown at the Sod Farm shall be USDA classified as sand and shall conform to the following grain size distribution for material passing the #10 sieve:

	Percent Passing	
U.S. Sieve Size Number	Minimum	Maximum
10	100	-
18	85	100
35	60	85
80	25	40
140	6	26
270	4	18
0.002mm	2	5

3. The maximum particle size shall be 1/2 inch.

4. The maximum retained on the #10 sieve shall be 10% by weight of the total sample. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422.

B. Provide well-rooted, healthy sod, free of diseases, nematodes and soil borne insects. Provide sod uniform in color, leaf texture, density, free of weeds, undesirable grasses, stones, roots, thatch and extraneous material; viable and capable of growth and development when planted.

C. Machine cut sod at uniform soil thickness of 3/4 inch, plus or minus 1/4 inch at time of cutting. Thickness measurement excludes top growth and thatch. Cut individual pieces to supplier's standard width and length with maximum allowable deviation of 5%. Broken pads and torn or uneven ends are unacceptable.

D. Install sod in the following dimensions:

1. In linear sod strips measuring 12 inches or 16 inches in width and 4 feet to 6 feet long. Stored in rolls with grass topside inverted so topsoil is to the exterior.

2.7 TEMPORARY PROTECTIVE FENCING

A. Protect sodded areas with snow fencing or other approved temporary fencing material. Maintain fence in place.

PART 3 - EXECUTION

3.1 LAWN WORK SCHEDULE

A. Lawn work shall proceed on schedule in conformance with project phasing. These requirements will be strictly adhered to.

B. Lawn work must be completed on schedule to allow at least one full growing season prior to Final Acceptance.

C. Contractor responsible for maintenance work on installed lawn until an acceptable lawn is established for a minimum of 60 days.

3.2 EXAMINATION

A. Verification of Conditions: in the event field conditions are not in conformance with Contract Documents, notify Owner's Representative in writing.

1. Spot and Invert Elevations: verify field elevations of site improvements such as drainage and utility fixtures, pavements, existing plantings, and subsurface piping conform to Drawings.

2. Finish Grades: verify specified elevations to ensure that fine grading operations have shaped, trimmed, and finished sod bed true to elevation with smooth sloped parallel to finished grade.

3.3 PREPARATION FOR LAWN INSTALLATION

A. Protection:

1. Dust Control: upon acceptance of finish grade provide dust control.

2. Erosion Control: upon acceptance of finish grade provide erosion control.

3. Agricultural Chemicals: protect site improvements from contact with agricultural chemicals, soil amendments, and fertilizers.

B. Surface Preparation:

1. Clean sod bed, pavement or other site improvements prior to installation.

3.4 SOIL PREPARATION AND PLACEMENT OF PLANTING SOILS

A. See SECTION 02901 – PLANTING SOILS.

B. Thoroughly irrigate areas to receive sod.

C. Scarification: cross rake areas to receive seed and sod so surface of soil will be receptive to holding seed.

D. Grade sod areas smooth, free draining and even surface with a loose, uniformly fine texture. Roll and rake; remove ridges and fill depressions to drain.

E. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to seeding and sodding.

3.5 APPLICATION OF PRE PLANTING FERTILIZER

A. Pre-plant Fertilizer application: specified in SECTION 02901 – PLANTING SOILS.

3.6 SOD INSTALLATION

A. Install initial row of sod in a straight line and place subsequent rows parallel to previously installed row. Lay sod edge to edge with tightly fitted joints with longest dimension parallel to contours. Stagger strips to offset joints in adjacent courses. Top of sod thatch line to be flush with surface of adjacent finished grade.

B. On sloped areas (slopes greater than 4:1), lay sod with length perpendicular to slope, starting at base and continuing upwards with every length pegged.

C. Immediately after laying, roll sod firmly into contact with sod bed with 100 pound per foot of width hand roller or other approved method to eliminate air pockets.

D. Finish surface to be uniformly, smooth and even.

E. Water sod with a fine spray at a rate of 5 gallons per square yard until the underside of new sod pad and soil below sod are thoroughly wet.

3.7 WATERING

A. First Week: First Week: Provide labor and arrange for watering necessary to establish acceptable lawn. In absence of adequate rainfall, watering shall be performed daily and as necessary during first week and in sufficient quantities to maintain moist soil to two inch minimum depth.

B. Second and Subsequent Weeks: Water lawn to maintain moisture in upper 5 inches of soil.

C. Water with uniform coverage while preventing erosion due to application of excessive quantities over small areas, and prevent damage to finished surface by watering equipment. Provide sufficient watering equipment to apply one complete coverage to seeded areas in eight-hour period.

3.8 MAINTENANCE

A. Maintenance begins immediately after seed and sod is installed and continues until Final Acceptance as follows:

1. a uniform, thick, well-developed stand of turf grass is established.

2. Mow turf grass at seven-day intervals.

   a. First mowing: when grass has grown to 2" to 2 1/4" height. Cut grass to 1 3/4" height.

   b. Subsequent mowings shall cut grass to 1 3/4" height.

   c. Mow in Autumn until growth of grass ceases, and resume in Spring when grass grows to 2 1/4" height.

3. Mow sloped areas a minimum of once during maintenance period. 90 day maintenance period shall be extended to include required cutting. Cut grass to 3" height.

4. Apply uniform application of Post Planting Fertilizer at rate of 44 pounds nitrogen per acre throughout maintenance period. Initial application 3 to 4 weeks after seeding. Additional applications shall occur at four week intervals or as directed Owner's Representative.

5. Lawn areas shall continue to be watered as described above.

6. After grass has started, areas failing to show uniform, thick, well-developed stand of grass shall be immediately re-seeded until areas are covered with satisfactory growth of grass as determined by Landscape Architect.

7. Repair damage from erosion, gullies, washouts, or other causes immediately by filling with loam borrow, tamping, re-fertilizing and re-seeding.

3.9 CLEANING

A. Wash and sweep clean paving, site improvements and building surfaces. Clean spills and oversprays immediately. Remove and dispose off-site excess planting mixture, soil and debris.

B. Following Final Acceptance of lawn areas, remove materials and equipment not required for other planting or maintenance work. Materials and equipment remaining on site shall be stored in locations that do not interfere with Owner's maintenance of accepted lawns or other construction operations.

3.10 PROTECTION

A. Protect lawn areas against damage with fencing. Fencing to remain in place for minimum 30 days or as directed by owner to ensure complete establishment of sodded lawn. Contractor to maintain fencing in upright position, stretched tightly, and neatly.

PART 4 - COMPENSATION

0292.1 LAWNS SQUARE YARD

METHOD OF PAYMENT
Measurement for lawn over planting soil with shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS
Payment for lawn over planting soil shall be based on the square yard of sod lawn as detailed in the Contract Documents and installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of lawn as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to: installation of sod lawn, labor, equipment, materials, safe transportation including loading at storage site and unloading at site of installation; and all incidental work not included for payment elsewhere.

END OF SECTION

SECTION 02950

BACK OF SIDEWALK RESTORATION

2950.1	**HARDSCAPE BACK OF SIDEWALK RESTORATION**	**SQUARE YARD**
2950.2	**ASPHALT BACK OF SIDEWALK RESTORATION**	**SQUARE YARD**
2950.3	**LANDSCAPE BACK OF SIDEWALK RESTORATION**	**SQUARE YARD**

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered under this Section includes the furnishing of all labor, equipment, appliances and materials, and in performing all operations in connection with restoration and reconstruction of back of sidewalk site features to their original condition and location including matching the original patterns of walkway and driveways such as herringbone, basket weave, running bond, etc. Back of Sidewalk material may consist of, but not be limited to, brick, flagstone, concrete, asphalt, gravel, cobble stone, wood, and limestone walkways and driveways, and various types of lawn, mulched, or planted areas.

1.2 RELATED WORK

A. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

B. Section 02500 – PAVING AND SURFACING

C. Section 02524 – CURBS WALKS, AND DRIVEWAYS

D. Section 02520 – BRICK UNIT PAVERS

E. Section 02970 – LANDSCAPE MAINTENANCE

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS.

B. Certify, invoice, and order plants for each shipment grown, free of disease and insect pests. Submit certificates to Engineer.

PART 2 - MATERIALS

2.1 General

A. Materials for all Non-Standard Back of Sidewalk Restoration shall be of the type, size, grade, and class to match the existing material and pattern as directed by the engineer.

PART 3 - EXECUTION:

3.1 All workmanship shall conform to the best standard practice, and all work shall be conducted by skilled workmen. The contractor shall repair/reconstruct all disturbed areas as shown on the plans or as directed by the Engineer .

3.2 Landscape restoration shall be completed between April and October.

3.3 Refer to Section 02970- Landscape Maintenance for landscaping maintenance requirements.

PART 4 – COMPENSATION

Item 2950.1 – Hardscape Back of Sidewalk Restoration

METHOD OF MEASUREMENT:
Measurement for Hardscape Back of Sidewalk Restoration shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Hardscape Back of Sidewalk Restoration shall be based on the square yard of Hardscape Back of Sidewalk installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the Restoration of all Hardscape Back of Sidewalk areas as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; the furnishing of all labor, equipment, appliances and materials, and in performing all operations in connection with restoration and reconstruction of private property site features to their original condition and location including matching the original patterns of walkways and driveways such as herringbone, basket weave, running bond, etc. Back of Sidewalk material may consist of, but not limited to, brick, flagstone,

cobble stone, concrete, wood, limestone, and gravel walkways and driveways, removing and resetting curbing, walls, stairs, as directed by the engineer and all other work not included for payment elsewhere.

SPECIAL NOTES ON INCLUSIONS/EXCLUSIONS:
The following items are not included for payment under this item; sidewalks, walkways, driveways and all other back of sidewalk areas installed to replace areas damaged by the Contractor during construction. Driveways and walkways within the right of way are not included for payment under this item and are paid for elsewhere. This item includes restoration of private property related to adjacent sidewalk and driveway restoration work within the right of way.

Item 2950.2 – Asphalt Back of Sidewalk Restoration

METHOD OF MEASUREMENT:
Measurement for Asphalt Back of Sidewalk Restoration shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Asphalt Back of Sidewalk Restoration shall be based on the square yard of Asphalt Back of Sidewalk installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the Restoration of all Asphalt Back of Sidewalk areas as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; the furnishing of all labor, equipment, appliances and materials, and in performing all operations in connection with restoration and reconstruction of hot mix asphalt walkways and driveways located on private property, and all other necessary appurtenant work to reconstruct back of sidewalk areas to their original condition, as directed by the engineer and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; sidewalks, walkways, driveways and all other back of sidewalk areas installed to replace areas damaged by the Contractor during construction. Hot mix asphalt driveways and walkways within the right of way are not included for payment under this item and are paid for elsewhere. This item includes restoration of private property related to adjacent sidewalk and driveway restoration work within the right of way.

Item 2950.3 – Landscape Back of Sidewalk Restoration

METHOD OF MEASUREMENT:
Measurement for Landscape Back of Sidewalk Restoration shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:

Payment for Landscape Back of Sidewalk Restoration shall be based on the square yard of landscape Back of Sidewalk installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the Restoration of all Landscape Back of Sidewalk areas as detailed and where indicated or required by the City or Engineer. The work includes, but is not limited to; the furnishing of all labor, equipment, appliances and materials, and in performing all operations in connection with restoration and reconstruction of grass, mulched, and planting areas located on private property, and all other necessary appurtenant work to reconstruct back of sidewalk areas to their original condition, as directed by the engineer and all other work not included for payment elsewhere.

SPECIAL NOTES ON INCLUSIONS/EXCLUSIONS:

The following items are not included for payment under this item; landscape, grass, and mulch areas located within the right of way, and locations installed to replace areas damaged by the Contractor during construction. This item includes restoration of private property related to adjacent sidewalk and driveway restoration work within the right of way.

END OF SECTION 02950

SECTION 02970

LANDSCAPE MAINTENANCE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Planting Maintenance including, but not limited to, the following:

1. Plant maintenance including pruning, drainage, irrigation, fertilizing, weed and pest control, and adjusting tree guys.

2. Guarantee periods and replacement of unacceptable plants.

3. Providing City with Maintenance Manual.

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02310 – Fine Grading
3. Section 02900 – Planting
4. Section 02901 – Planting Soils

1.3 REFERENCES

A. Comply with applicable requirements of:

1. Commonwealth of Massachusetts, Standard Specifications for Highways and Bridges, Department of Public Works, latest edition.

2. American Association of Nurserymen, American Standards for Nursery Stock, (ANSI Z60.1), latest edition, published by the American Association of Nurserymen, 1250 I Street, N.W., Suite 500 Washington, D.C. 20005.

1.4 SUBMITTALS

A. Submittals: in accordance with Section 01300

B. Materials List: provide list of materials to be used in maintenance; materials shall be the same as approved in related sections:

1. Fertilizers, soil amendments, testing see Section 02901 – Planting Soils.
2. Plant materials, mulch, and related materials, see Section 02900 - Planting.

C. Pest and Disease Treatment

1. Submit plan for pest and disease treatment; identify proposed materials and methods.

2. Explain why a problem does or may exist.

D. Maintenance Manual

1. Provide a maintenance manual to the City describing operations for on-going upkeep of the installed plants. The manual shall address itself to specified types and uses of plants installed and provide information for care of both newly installed plants and long-term maintenance.

2. Provide specific information on the following items:

a. Watering: Watering season; diagnosis of watering need; frequency of watering; amount; time of day; methods and equipment; equipment maintenance.

b. Fertilization: Fertilizing seasons; analysis for fertilizer selection; application rates and methods; preparation and conditions; application times; application equipment; post-application operations and care; precautions for fertilizer use.

c. Liming: Liming season; analysis for liming; application rate; method and equipment for application.

d. Pruning: Pruning goals and purposes; methods and techniques (relate to species); equipment; season; cleanup and disposal; precautions.

e. Mulching of beds: Depths of mulch; refreshment and replacement of mulch.

f. Miscellaneous plant maintenance: Weeding and weed control; pest and disease control; leaf and litter removal; bed edging; professional assistance for plant care; and plant replacement as necessary.

3. Include a month-by-month calendar of maintenance procedures, indicating operations listed above.

4. Submit a copy of maintenance manual to Engineer for approval. Submit prior to planting completion. Engineer may request revisions to manual to meet intent of project design.

5. Submit three copies of manual to the City at acceptance meeting for planting work. Acceptance shall not be granted until manual has been submitted and approved.

1.5 DEFINITIONS

A. Maintenance: consists of keeping plants in healthy growing condition including watering, weeding, cultivating, re-mulching, tightening and repairing of guys, removal and replacement of dead plant material, resetting plants to proper grades or upright positions and maintaining saucer.

1.6 QUALITY ASSURANCE

A. Qualifications: contractor shall have minimum five years experience in landscape maintenance.

B. Regulatory Requirements

1. Secure permits, licenses, and pay fees including traffic control.

2. Comply with laws, regulations, and quarantines for agricultural and horticultural products.

1.7 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: deliver materials in unopened containers bearing the manufacturer's name. Transport materials without damage. Protect finishes from abrasion, dirt, oils, grease, and chemicals. Pack materials to protect from weather.

B. Acceptance at Site: verify in writing that delivered materials conform to specifications and approved submittals.

C. Storage and Protection:

1. Store materials in dry place, on pallets, off the ground; protect from sun.

2. Protect materials from theft, damage, weather, dirt, oils, grease, and construction.

1.8 PROJECT/SITE CONDITIONS

A. Environmental Requirements: do not work soils when dry, wet, or frozen.

1. Field Test

a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.

b. If soil will not retain shape it is too dry and should not be worked.

c. If soil retains shape and will not crumble, it is too wet and should not be worked.

B. Planting Seasons: see Section 02900 - Planting

1.9 SUBSTANTIAL LANDSCAPE COMPLETION

A. Upon completion of planting, request Engineer's review to determine if work is substantially complete. If work is complete, Engineer will issue a letter of Substantial Landscape Completion that identifies the effective dates of the start of the 90-day Maintenance Period.

1. If work is not substantially complete, Engineer will make a list of outstanding work to be done on a timely schedule agreed upon by Contractor and Engineer.

2. Contractor shall notify Engineer when outstanding work is accomplished and ready for review. When outstanding work is complete in the judgment of Engineer, a letter of Substantial Completion will be issued.

1.10 90-DAY MAINTENANCE PERIOD / PRELIMINARY ACCEPTANCE

A. Maintain planting until the end of 90-day maintenance period and until the receipt of the Letter of Preliminary Acceptance. After the 90-day Maintenance Period, work will be reviewed for completeness.

B. Plantings shall be in thriving and vigorous condition at the time of review for Preliminary Acceptance.

1. If plantings are acceptable, Engineer will issue a Letter of Preliminary Acceptance establishing the effective date of the Guaranty Periods.

2. Replace plants that are dead or, as determined by Engineer, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes.

3. Replacement work shall be done immediately and in accordance with related work of other sections.

4. At the conclusion of remedial work, Engineer will review work and extend the Maintenance Period another 90 days to incorporate new plantings.

1.11 GUARANTEE PERIODS / FINAL ACCEPTANCE

A. Start of Guarantee Period: when Engineer issues letter of Preliminary Acceptance.

1. Required one-year guarantee and establishment period for all shrubs, perennials, ornamental grasses and bulbs.

2. Required two-year guarantee and establishment period for all trees.

B. Quarterly reviews will be made with Contractor and Engineer during guarantee periods. Reviews will assess condition of installed plant materials.

C. Plant material to be alive and in healthy, vigorous condition.

D. Replace plants that are dead or, as determined by Engineer, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes.

E. End of Guarantee Periods:

1. One year from date of Preliminary Acceptance, Engineer will review shrub, perennial, ornamental grasses and bulb plantings. If plantings are acceptable, Engineer will issue a letter of Provisional Acceptance. If plantings are unacceptable, plantings shall be replaced until condition of plantings are acceptable as determined by Engineer.

2. Two years from date of Preliminary Acceptance, Engineer will review tree plantings. If tree plantings are acceptable, Engineer will issue a letter of Provisional Acceptance. If trees are unacceptable, trees shall be replaced until condition of trees are acceptable as determined by Engineer.

F. Upon receipt of letter of Provisional Acceptance, the project becomes responsibility of the City.

PART 2 MATERIALS

2.1 MATERIALS

A. Materials utilized during the maintenance period shall be the same specified in the work of the related sections:

1. Fertilizers, soil amendments, testing, see Section 02901 – Planting Soils

2. Plants, mulch, and related materials: see Section 02900 – Planting.

2.2 BIOLOGICAL, HORTICULTURAL, HERBICIDAL AND OTHER PEST CONTROL

A. Material Specification: shall be by a licensed pest control operator, with authority to purchase, utilize, and specify agricultural chemicals and agricultural products.

B. Use the least hazardous, least intrusive materials and methods.

2.3 EQUIPMENT

A. Vehicles: in good working order so oil and grease does not stain pavements and poison plantings. Signs identifying the vehicles shall be clearly displayed.

B. Machinery: in good working order so oil and grease does not stain pavements and poison plantings.

2.4 WATER

A. Water: Furnished by Contractor, suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering furnished by Contractor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: in the event field conditions are not as shown on Drawings and outlined in the Specifications, notify Engineer in writing.

3.2 PREPARATION

A. Protection:

1. Agricultural Chemicals: protect site improvements from contact with agricultural chemicals, soil amendments, and fertilizers.

3.3 PRUNING

A. Pruning: prune with approval of Engineer.

1. Remove dead branches, rubbing branches, and branch work growing towards the center of the tree.

3.4 DRAINAGE

A. Observe drainage in plant pits with hand soil augur.

B. Verify plant pits are draining; plant pits not draining shall be identified on the plan and brought to the attention of Engineer.

3.5 PLANTS

A. Maintain plants in vigorous condition throughout maintenance period.

B. Replace plants that are missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by Engineer. Replace plants found unacceptable within one month or in first month of next growing season, whichever comes first.

C. Plants must show a minimum of 75% healthy head with obvious growth since planting. Signs of disease, injury, or damage shall have been successfully treated or plant shall be rejected as determined by Engineer.

D. Replacements plants shall be same kind and size as specified in plant list. Furnish and plant. Cost of replacement borne by Contractor except where it can be shown loss resulted from vandalism, fire, theft, or other causes beyond Contractor's control. Restore areas damaged or disturbed by replacement operations to their original condition.

3.6 IRRIGATION

A. Water at a rate of one inch of water every five to seven days. Apply water such that it penetrates the soil to a depth of 6". Trees require a minimum of ten gallons each and shrubs a minimum of five gallons each per week. If spring or fall months experience below average rainfall, periodic watering could be extended as requested by Engineer. If natural rainfall provides water to meet watering requirements, weekly watering could be reduced but only at the request of Engineer.

3.7 PLANT BASINS

A. Keep foot tamped and shaped earth dikes around plantings.

3.8 TREE GUYS

A. Tree stakes: maintain plumb; adjust flexible ties.

B. Guys: maintain wires taut; adjust turnbuckles; keep flags on wires.

3.9 FINISH GRADE

A. Maintain finish grades around plantings, at pavement edges, and at irrigation fixtures.

3.10 MULCH

A. Maintain mulch at 2" depth in planting areas with the exception of at stems and trunks of plants where mulch to be placed to a 0" depth and increasing to a depth of 2" at edge of rootballs and beyond.

3.11 TREATMENT OF PEST AND DISEASES

A. Spray for both insect pests and diseases during maintenance period with permission of Engineer. Apply herbicides, insecticides and fungicides as prescribed by their manufacturer and in accordance with The Commonwealth of Massachusetts laws. Contractor shall possess from the Commonwealth of Massachusetts the proper registrations and permits for application of materials or have applications made by approved, qualified firm holding registrations and permits. Furnish copies of permits in connection with materials to Engineer. Spraying to be considered only after full consideration has been given to alternative pest control strategies. The least toxic approach to pest control shall be used.

3.12 FIELD QUALITY CONTROL

A. Post Plant Soil Tests: see Section 02900 - Planting

3.13 ADJUSTING

A. Re-set settled plants to proper grade and position.

B. Restore planting saucer and adjacent material.

3.14 CLEANING

A. Clean up, remove and dispose off-site excess planting mixture, soil and debris generated under work of this section.

B. Remove and dispose of stakes, guys and other accessories at end of guaranty period.

C. Wash and sweep clean site improvements and building surfaces. Clean spills and overspray immediately.

D. Repair damage caused by maintenance operations.

3.15 PROTECTION

A. Protect work of this section until Final Acceptance.

B. Protect planted areas and soils from compaction by construction traffic and from contamination by construction materials.

PART 4 COMPENSATION

METHOD OF MEASUREMENT

Separate measurement will not be made for the work of this Section complete in place, but all costs, therefore, shall be included in the work of other sections. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the work of other sections.

BASIS OF PAYMENT / INCLUSIONS

Separate Payment will not be made for the work of this Section complete in place, but all costs, therefore shall be included in the work of other sections. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the work of other sections.

END OF SECTION

SECTION 02980

SIGNS AND POSTS

2980.1	**STEEL SIGN POST**	**EACH**
2980.2	**WARNING REGULATORY AND ROUTE MARKER – ALUMINUM PANEL (TYPE A)**	**SQUARE FOOT**
2980.3	**STREET NAME SIGN**	**EACH**
2980.4	**PARKING METER POST**	**EACH**

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of furnishing and installing site signage and posts and related items as indicated on the Drawings and/or as specified herein and includes, but is not limited to, the following:

1. Warning Regulatory and Route Marker – Aluminum Panel (Type A)
2. Street Name Sign
3. Steel Sign Post
4. Parking Meter Post

1.2 RELATED WORK

A. Section 02210, EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

B. Section 02500, PAVING AND SURFACING

C. Section 02524, CURBS WALKS, AND DRIVEWAYS

D. Section 03300, CONCRETE

1.3 REFERENCES

A. Unless otherwise specified or indicated, materials and workmanship shall conform with the latest edition of the following standards, codes, specifications, requirements and regulations:

B. Standard Specifications: Massachusetts Department of Transportation, Highway Division, Standard Specifications for Highways and Bridges, latest

edition.

C. American Society for Testing and Materials (ASTM):

A36	Structural Steel
A53	Pipe, Steel, Black and Hot-dipped, Zinc-coated
A120	Standard Galvanized Steel Pipe
A153	Zinc Coating (Hot-dip) on Iron and Steel Hardware
A386	Zinc Coating (Hot-dip) on Assembled Steel Products
A325	High Strength Bolts
B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
F626	Fence Fittings
F668	Polyvinyl Chloride Coated Steel Chain Link Fence Fabric
F900	Industrial and Commercial Swing Gates
F934	Standard Colors for Polymer Coated Chain Link Fence Materials
F1043	Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework

D. American Steel and Iron Institute (ASI)

E. American Welding Society (AWS):
D1.1 Structural Welding Code

F. Steel Structures Painting Council (SSPC)

G. American Welding Society (AWS):
D1.1 Structural Welding Code

H. Steel Structures Painting Council (SSPC)

1.4 SUBMITTALS

A. At least thirty (30) days prior to intended use, the Contractor shall provide the following submittals for approval.

B. Shop Drawings, Manufacturer's Literature, and installation instructions for each item included within this specification section. Refer to Specification Section 01300-SUBMITTALS for submittal requirements.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver and store work under this Section in a manner to prevent wracking or stress of components, and to prevent mechanical damage or damage by the elements.

B. Items which become rusted or damaged because of non-compliance with these conditions will be rejected and shall be replaced without additional cost to the City.

C. Deliver bolts and other small items required for erection of work under this Section bundled with their respective items.

1.6 GUARANTEE

A. Furnish and deliver standard written manufacturer's guarantee in City's name covering all materials and workmanship under this Section, in addition to, and not in lieu of, guarantee requirements set forth under GENERAL CONDITIONS and SPECIAL PROVISIONS, and other liabilities which the Contractor may have by law or other provisions of the Contract Documents.

B. Supplier shall guarantee, in writing, the satisfactory condition of the metal finish of his work in all parts for a period of twenty (20) years after date of final acceptance, and shall agree to promptly repair or replace any finish work which is found to be defective during this period.

C. Supplier shall pay for repairs of any damage to any part of the project caused by defects in his work and for any repair to the materials or equipment caused by replacement. All repairs are to be done to the satisfaction of the Engineer.

D. Any part of the work installed under this contract requiring excessive maintenance shall be considered as being defective, and shall be replaced by the Supplier during the one year period at no cost to the City.

PART 2 - PRODUCTS

2.1 REGULATORY SIGNAGE

A. Signs shall be fabricated per Contract Document requirements and conform to MUTCD, latest edition, standards.

B. The legend, border, and background of sign panels (except as modified below) shall be Type “C”, permanently applied legend, or Type "D”, silk screen processed, according to the requirements of Section M9.30.0 of the MassDOT Standard Specifications, Type III or Type IV.

C. Legends and dimensions for City of Cambridge Standard Regulatory signs are included in Appendix “D” of these Specifications.

2.2 SIGN POST

A. New traffic sign posts shall be galvanized steel “U-channel” posts conforming to Section M8.18.3 of the MassDOT Standard Specifications except minimum post weight shall be 3 lbs/foot.

2.3 STREET NAME SIGN

A. Street name signs shall conform to City of Cambridge specifications, and shall be 9" high. Signs shall be 24" to 36" long, depending on the length of legend required. Lettering shall be 5"-6" height FHWA series B lettering. Signs shall have white high intensity lettering on green EC film.

2.4 PARKING METER POST

A. Parking meter posts shall be Schedule 40 galvanized steel pipe; 2 inches inside diameter; 2 3/8 inches outside diameter. Length shall be 50 to 51 inches. Weep hole and anti-deformation bolt shall be provided as shown on the Cambridge Standard Details.

PART 3 - EXECUTION

3.1 PERMANENT SIGNAGE AND PARKING METER POSTS

A. The location, number and legend of new signs which are required shall be as shown on the Drawings or as directed by the Engineer. Signs will be mounted on posts which are furnished and paid for under Item 2980.1.

B. The Contractor shall lay out the proposed locations of parking meter posts for review and approval by the Engineer prior to installation. Proposed parking meter posts shall be installed in a 4,000 psi concrete base in accordance with the City of Cambridge Department of Traffic, Parking and Transportation specifications and detail drawings.

PART 4 - COMPENSATION

Item 2980.1 Steel Sign Post

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the actual number of steel sign posts installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install street name signs and sign posts.

Item 2980.2 Warning Regulatory and Route Marker – Aluminum Panel (Type A)

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the area (in square feet) of each sign installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full

compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install signs.

Item 2980.3 Street Name Sign

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the actual number of street name signs installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install street name signs and sign posts.

Item 2980.4 Parking Meter Post

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the actual number of parking meter posts installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install parking meter posts. No separate payment will be made for restoration of sidewalk areas which shall be considered incidental to the appropriate sidewalk item.

END OF SECTION 02980

SECTION 02990

SITE FURNISHINGS

2990.1	**WOOD BENCH AT GRANITE SEAT WALL**	**LINEAR FOOT**
2990.2	**STEEL EDGING**	**LINEAR FOOT**
2990.3	**METAL BENCH WITH BACK**	**EACH**
2990.4	**BICYCLE RACK – TYPE 1**	**EACH**
2990.5	**BICYCLE RACK – TYPE 2**	**EACH**
2990.6	**TRASH AND RECYCLING RECEPTACLE**	**EACH**
2990.7	**WATER FILL STATION**	**EACH**
2990.8	**PLANTER – FREE STANDING -TYPE 1**	**EACH**
2990.9	**PLANTER – FREE STANDING -TYPE 2**	**EACH**
2990.10	**CHAIRS**	**EACH**
2990.11	**TABLES**	**EACH**
2990.12	**PAVER TREE GRATE – 8 FOOT**	**EACH**
2990.13	**PAVER TREE GRATE – 6 FOOT**	**EACH**
2990.14	**PAVER TREE GRATE – 5 FOOT**	**EACH**
2990.15	**SCULPTURAL SEATING FEATURES (SMALL)**	**EACH**
2990.16	**SCULPTURAL SEATING FEATURES (MEDIUM)**	**EACH**
2990.17	**RELOCATED TUBMAN SQUARE SIGN**	**EACH**
2990.18	**AERATION GRATE**	**EACH**
2990.19	**CARL BARRON MEMORIAL SIGN**	**EACH**
2990.20	**RODENT CONTROL GEOTEXTILE**	**EACH**
2990.21	**RELOCATED BENCH**	**EACH**
2990.22	**BOLLARD – OVER STRUCTURE**	**EACH**
2990.81	**PUBLIC ART INSTALLATION**	**LUMP SUM**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for providing all labor, materials, equipment, services and accessories necessary to furnish and install the work of this Section, complete and functional, as indicated in the Contract Documents and as specified herein, including, but not limited to, the following:

1. Wood Bench at Granite Seat Wall – Tubman
2. Metal Bench with Back
3. Bicycle Rack Ring and Post
4. Trash and Recycling Receptacle
5. Water Fill Station
6. Planter – Free Standing
7. Chairs
8. Tables
9. Paver Tree Grate – 8 Foot, 6 Foot and 5 Foot
10. Sculptural Seating Features (Small, Medium)
11. Relocated Tubman Square sign
12. Aeration Grate
13. Carl Barron Memorial
14. Rodent Control Geotextile
15. Relocated Bench
16. Bollard – Over Structure

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02520 – Brick Pavers
3. Section 02780 – Precast Unit Pavers

1.3 DEFINITIONS

A. Comply with applicable requirements of:

1. Standard Specifications: Commonwealth of Massachusetts, MHD, Standard Specifications for Highways and Bridges, latest edition.

2. AASHTO: American Association of State highway and Transportation Officials.

3. American Society for Testing and Materials:

   a. A36 Structural Steel.
   b. A304 Stainless steel.
   c. AWS: American Welding Society

1.4 SUBMITTALS

A. Submittals: in accordance with Section 01300

B. Performance Criteria: components to be engineered and fabricated to accommodate the following minimum loading: live load = 300 pounds vertical on horizontal surfaces and 200 pounds horizontal on vertical surfaces. Concurrent static point loads assumed to be located anywhere along the surfaces to produce the highest stress.

1. Product Data: Submit copy of manufacturer's specifications and installation instructions for:

   a. Metal Bench with Back
   b Bicycle Rack Ring and Post
   c. Trash and Recycling Receptacle
   d. Water Fill Station
   e. Planter – Free Standing - Type 1 and Type 2
   f. Chairs
   g. Tables
   h. Paver Tree Grate – 8 Foot, 6 Foot and 5 Foot
   i. Sculptural Seating Features (Small, Medium)
   j. Aeration Grate
   k. Rodent Control Geotextile

3. Shop Drawings: Submit shop drawings for the following components showing attachment methods, fabrication, casting and hardware from field measurements:

   a. Wood Bench at Granite Seat Wall – Tubman
   b. Water Fill Station
   c. Chairs
   d. Tables
   e. Paver Tree Grate – 8 Foot, 6 Foot and 5 Foot
   f. Sculptural Seating Features (Small, Medium)
   g. Aeration Grate
   h. Carl Barron Memorial
   i. Bollard – Over Structure

4. Samples: Large fabricated items shall be completed, finished and delivered to site for viewing. Submit:

a. Wood Bench at Granite Seat Wall – Tubman - wood material and finish sample: four samples of 12” x 1.5” x 2.5” wide long typical wood section in natural finish and two samples with specified varnish finish.

b. Carl Barron memorial –
   1. Stainless wrap w/ finish and typical welded corner condition
   2. Bronze letters, in project size, one at each size. Provide sample with drilled/tapped letters mounted to stainless plate w/ countersunk screws
   3. Photo image plaque of Carl Barron to show example of finished piece, including etched and dye filled copy

c. Planter – free standing – Type 1 and Type 2 provide samples of GFRC/Fiberstone for the colors Iron, Ferric, Terron and Zinc.

d. Bollard – Over Structure – provide (3) 4” x 6” samples of blackened stainless steel finish exhibiting a range of textured dark Finishes

C. Certificates: submit material certificates signed by material producer and Contractor. Provide certifications stating materials comply with requirements.

D. Wood Certification, Chain of Custody Paperwork and Schedule of Acquisition, Acclimation and Fabrication:

1. Wood: submit Forest Stewardship Council Certification, certification numbers and complete chain of custody paperwork.
2. Wood: submit schedule identifying wood acquisition, acclimation and fabrication.

E. Schedule for Art Installation: At least 30 days prior to intended installation day, the Contractor shall provide a written schedule and coordination strategy including equipment, labor related to the public art sculpture by artist Mark Reigelman.

F. Schedule and Protection Plan for Monument: At least 30 days prior to intended removal and storage of monument, submit plans for transport, storage and cutting of bottom of granite base to accept new pedestal base.

1.5 QUALITY ASSURANCE

A. Work under this Section shall be performed by a firm which has at least five (5) years’ experience in work of the type and size required by this Section, workmen experienced and familiar with required construction procedures and under full time supervision of a qualified foreman and acceptable to the Owner's Representative

B. Metal finishing and patina work performed under this Section shall be performed by workmen experienced and familiar with media blasting, application of patinas and microcrystalline wax including and under full time supervision of a qualified foreman.

C. Wood work performed under this Section shall be performed by workmen experienced and familiar with acquisition of sustainably grown tropical hardwoods including wood certification and Chain-of-Custody Paperwork, acclimation of wood, fabrication and

sealing of end grain during fabrication including and under full time supervision of a qualified foreman.

D. Check dimensions shown on Drawings. Field verify by accurate field measurements before shop drawings preparation and submittal and fabrication of the work. Coordinate installation tolerances to ensure proper fit of items.

1.6 DELIVERY, HANDLING AND STORAGE

A. Protect materials during storage and construction against moisture, soiling, staining, and physical damage.

B. Handle materials to prevent chipping, breakage, soiling or other damage. Do not use pinch or wrecking bars without protecting edges with wood or other rigid materials. Lift with wide-belt type slings or vacuum lifts wherever possible; do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slides.

C. Store materials on wood skids or pallets, covered with non-staining, waterproof membrane. Place and stack skids to distribute weight evenly and to prevent breakage. Protect stored materials from weather with waterproof, non-staining covers or enclosures, but allow air to circulate around materials.

1.7 JOB CONDITIONS

A. Protect brick and masonry work against freezing when ambient temperature is 37 degrees F and falling. Heat materials and provide temporary protection. Comply with "Construction and Protection Recommendations for Cold Weather Masonry Construction" of the Technical Notes on Brick and Tile Construction by the Brick Institute of America, latest edition.

B. Do not use frozen materials or materials mixed or coated with ice or frost. Do not use salt to thaw ice in anchor holes or slots. Do not lower freezing point of mortar by use of admixtures or antifreeze agents, and do not use calcium chloride in mortar or grout.

C. Do not build on frozen work; remove and replace granite damaged by frost or freezing.

D. Protect partially completed work against weather when work is not in progress.

1.8 SCHEDULING

A. Prior to beginning installation, submit schedule listing items to be installed and an explanation of procedures used.

PART 2 PRODUCTS

2.1 WOOD BENCH AT GRANITE SEAT WALL

A. Manufacturer: Landscape Forms, Inc., 7800 East Michigan Avenue, Kalamazoo, MI, 49048.; or approved equal.

B. Products: Engineered and manufactured backed and backless bench seat wall toppers

1. Styles:

a. SF4010-001 – Backless Bench seat wall topper

1. Overall height: 1’ – 3 ¼”
2. Section length: Varies – refer to details
3. Section width: 2’ – 6”
4. Radius: Varies – refer to details
5. Mounting: Surface mounted into granite seat wall

a. SF4010-002 – Backed Bench seat wall topper

1. Overall height: 2’ – 7 ¼”
2. Section length: Varies – refer to details
3. Section width: 2’ – 6”
4. Radius: Varies – refer to details
5. Mounting: Surface mounted into granite seat wall

2. Material:

a. SF4010-001 – Backless Bench seat wall topper

1. Frame: #316 Stainless Steel
2. Hardware: 18-8 Stainless Steel
3. Wood: Clear, highest grade Ipe, FSC certified wood. Solid pieces, no laminated material/boards permitted. Wood fabrication from full timbers. Wood Certifications: Wood certified by Forest Stewardship Council, Washington, DC.

b. SF4010-002 – Backed Bench seat wall topper

1. Frame: #316 Stainless Steel
2. Hardware: 18-8 Stainless Steel
3. Wood: Clear, highest grade Ipe, FSC certified wood. Solid pieces, no laminated material/boards permitted. Wood fabrication from full timbers. Wood Certifications: Wood certified by Forest Stewardship Council, Washington, DC.

3. Recycled Content:

a. Recycled Material Content: Minimum 65 percent.
b. Post-Consumer Material Content: Minimum 50 percent.
c. Pre-Consumer Material Content: Minimum 15 percent.
d. Recyclable: 100 percent.

4. Fabrication:

    a. Shop fabricated backed and backless bench seat wall toppers

5. Finishes:

    a. Finish on Metal: Landscape Forms, Inc. Satin Finish (electro polish and beadblast)

    b. Wood: Ipe to be left natural to fade to a silver grey color

2.2 STEEL EDGING

A. Metal Edging: Provide at tree pits and continuously at locations where paving does not abut a hard edge and as directed by the Engineer and as shown on the drawings. Steel edging to continue at 90 degree angle for minimum distance of 18" on one side around the corner at concrete pavement condition to insure adequate tie-in condition to prevent edge from moving upward and creating a trip hazard or maintenance hazard.

1. 3/16" thick by 4" high. Flange: 1.75", Minimum 8' lengths

2. Spikes: Galvanized spirals, 15" length, every 12"

3. Material: Galvanized Steel

4. Sections are to be L-shaped and notched to provide for smooth curves and crisp angles.

5. Finish: factory finish and paint.

6. Color: black

2.3 METAL BENCH WITH BACK

A. Manufacturer: DuMor Inc, 138 Industrial Circle, Mifflintown, PA 17059. Phone: 800-598-4018. Fax: 717-436-9839. Email: sales@dumor.com Website: www.dumor.com

B. Benches: DuMor Model 58 Series

1. Materials:

    a. Supports:

        1. End Supports shall be ASTM A48 Class 30 cast iron.

    b. Seat Assembly:

1. Seat straps shall be manufactured from 1/4" x 1 1/2" ASTM A36 carbon steel flat bar.

2. Support pipes shall be manufactured from 2" (2 3/8" OD)ASTM A513 schedule 40 steel tubing.

3. Pipe brace shall be manufactured from 3/4" (1 1/16" OD) ASTM A500 schedule 40 steel tubing.

c. Anchoring:

1. Stainless steel expansion anchors (1/2" x 3 3/4") provided.

C. Dimensions

1. Overall: 74 1/4" long x 27 9/16" deep x 31 11/16" high.

D. Finish:

1. Powder Coating:

a. All parts shall be processed through an 8-stage iron phosphorous wash system.

b. Parts shall be coated with a zinc-rich epoxy primer to an AVERAGE of 4-5 mils.

c. Parts shall be then finished with a top-coat of TGIC-polyester powder to an AVERAGE of 4-5 mils.

1. Color: Black

d. Powder shall be cured at the powder manufacturers specifications using combination of infrared and convection heat for approximately 20 minutes.

e. Finished parts shall comply with the following American Standard Test Method (ASTM) for coating and coating method: ASTM-D-523, ASTM-D-3363, ASTM-D-1737, ASTM-D-3359, ASTM-D-2794, ASTM-B-117 and ASTM-D-3451.

2.4 BICYCLE RACK TYPE 1

A. Bicycle Rack Ring and Post: Bike Hitch, as manufactured by Dero Bike Racks, Inc., 2657 32nd Avenue, South Minneapolis, MN, 55406. Phone: (888) 337-6729 Fax: (612) 331-2731. Website: www.dero.com

1. Material: Galvanized.
2. Mounting: In Ground mount per manufacturer's specifications.

3. Finish: Satin

2.5 BICYCLE RACK TYPE 2

A. Bicycle Rack Ring and Post: Bike Hitch, as manufactured by Dero Bike Racks, Inc., 2657 32nd Avenue, South Minneapolis, MN, 55406. Phone: (888) 337-6729 Fax: (612) 331-2731. Website: www.dero.com

1. Material: Stainless Steel 316L.
2. Mounting: In Ground mount per manufacturer's specifications.
3. Finish: Satin #4

2.6 TRASH AND RECYCLING RECEPTACLE

A. Trash Receptacle:

1. Manufacturer: Big Belly Solar, Inc. 50 Brook Road, Needham, MA 02494 Telephone: (781) 444-6002 www.bigbellysolar.com

2. Product: Bigbelly & Smartbelly HC5/SC5.5 Double Station with lifetime CLEAN remote fullness monitoring software.

3. Mounting: Surface mount per manufacturer's specifications.

4. Size: 50" height x 26" width x 26" depth (for each of two units), 50" height x 52" width x 26" depth (combined)

5. Finish and Color: City of Cambridge Standard

6. BigBelly (trash compactor) hopper should be gray in color, with the standard BigBelly logo.

10. BigBelly (trash compactor) must be equipped with the foot pedal

11. SmartBelly (recycler) single wide opening, with the blue "paper, bottle, and can recycling only" label.

2.7 WATER FILL STATION

A. Endura II Outdoor HydroBoost Bottle Filling Station, Bi-Level Pedestal, Non-Filtered, Non-Refrigerated, Bottle Filling Station – Item # 4420BF1U, as manufactured by Harsey Taylor, 1333 Butterfield Road, Suite 200 Downers Grove, IL 60515. Phone: (800) 476-4106. Website: www.harseytaylor.com

1. Special Features: 316 Stainless, Heavy Duty Vandal Resistant, Laminar flow

2. Finish: Black
3. Power: No Electrical required
4. Bubbler Style: Vandal Resistant
5. Chilling Capacity: Non-refrigerated

B. Provide Stop and Waste Valves in pavement adjacent to water fill station.

2.8 PLANTER – FREE STANDING – TYPE 1

A. Modern Rectangle Cast Stone Planter, manufactured by Planters Unlimited, www.plantersunlimited.com Tel: (888) 320-0626

B. Materials

1. Fiberstone
2. Provide pre-drilled drainage holes by factory per manufacturers recommendation
3. Provide pads on planter bottom

B. Size: 48”L x 24”W x 30”H

C. Color: Provide samples of the following colors for final selection: Iron, Ferric, Terron, Zinc

2.9 PLANTER – FREE STANDING – TYPE 2

A. Modern Rectangle Cast Stone Planter, manufactured by Planters Unlimited, www.plantersunlimited.com Tel: (888) 320-0626

B. Materials

1. Fiberstone
2. Provide pre-drilled drainage holes by factory per manufacturers recommendation
3. Provide pads on planter bottom

B. Size: 72”L x 24”W x 30”H

C. Color: Provide samples of the following colors for final selection: Iron, Ferric, Terron, Zinc

2.10 CHAIRS

A. Manufacturer: Landscape Forms, Inc., 7800 E. Michigan Ave, Kalamazoo, Michigan 49048. Phone: (800) 521-2546. Website www.landscapeforms.com. E-mail: specify@landscapeforms.com.

1. Model: ‘21’ Chair

a. Size: Backed.

1. Depth: 25-1/4 inches.

2. Height: 32-3/4 inches.
3. Seat Height: 18-1/2 inches.
4. With arms: 28-1/4" overall width

2. Material:

   a. Seat slats: 319 ASTM B26 or A413 ASTM B85 cast aluminum, attached to frame with Magni-coated ¼-20 x ½" flanged button head cap screws and washers.
   b. Legs and Frame: 1-inch O.D. by 0.065-inch wall cold rolled steel tube, with A1008 CR or A1011 HRPO commercial steel tabs welded on for bolting to seat slats.
   c. Stem Bumper: Clear vinyl
   d. Glide: non-marring 6/6 nylon

3. Custom D Rings: One (1) mounted to bottom of front left leg of each chair for cable attachment as per detail.

   a. Material to match legs and frame.

4. Recycled Content:

   a. Post-consumer content: 30%
   b. Pre-consumer content: 28%

5. Finish on Metal: Landscape Forms, Inc. "Pangard II".

   a. Primer: Rust inhibitor.

   b. Topcoat: Thermosetting polyester powdercoat. UV, chip, and flake resistant.

   c. Test Results: 'Pangard II'.
      1. Gloss Consistency, Garner 60 Degrees, ASTM D 523: Plus or minus 5 percent from standard.

      2. UV Resistance, Color and Gloss, ASTM G 155, Cycle 7: Delta E less than 2 at 2.0 mils and less than 20 percent loss.

      3. Cross-Hatch Adhesion, ASTM D 3359, Method B: 100 percent pass.

      4. Flexibility Test, Mandrel, ASTM D 522: 3 mm at 2 mils.

      5. Erichsen Cupping, ISO 1520: 8 mm.

      6. Impression Hardness, Buchholz, ISO 2815: 95.

      7. Impact Test, ASTM D 2794: 60 inch-pounds at 2.5 mils.

8. Pencil Hardness, ASTM D 3363: 2H minimum.

9. Corrosion Resistance, 1,500-Hour Test, ASTM B 117: Max undercutting 1 mm.

10. Humidity Resistance, 1,500-Hour Test, ASTM D 2247: Max blisters 1 mm.

d. Color: All chair colors are to be determined. Assume an equal distribution of 5 colors, three of which will be standard, with two being custom RAL colors.

1. Frame: TBD
2. Seat Panel: TBD

2.11 TABLES

A. Manufacturer: Landscape Forms, Inc., 7800 E. Michigan Ave, Kalamazoo, Michigan 49048. Phone: (800) 521-2546. Website www.landscapeforms.com. E-mail: specify@landscapeforms.com. Local Representative: Nadene Worth - Phone: (800) 430-6206 x 1325. Email: nadenew@landscapeforms.com

1. Model: Parc Centre Table

a. Size: Round

1. Diameter: 30".

2. Mounting:

a. Free-standing with factory installed adjustable levelers.

3. Custom D Rings: Four (4) mounted to top of table base for cable attachment as per detail.
1. Material to match legs and frame.

4. Material:

a. Table Top: Table tops are made from solid 5/16 steel plate welded to the table support.

b. Table Support: 2-1/2" outer diameter x 0.120" wall steel tubing. Base plate 17" outer diameter x 0.375" steel.

5. Recycled Content:

a. Post-consumer content: 58.9%
b. Pre-consumer content: 31.8%
c. Recyclable: 100%

6. Finishes: Finish on Carbon Steel: Landscape Forms, Inc. “Pangard II”.

a. Primer: Rust inhibitor.

b. Topcoat: Thermosetting polyester powdercoat. UV, chip, and flake resistant.

c. Test Results: ‘Panguard II’

1. Gloss, Garner 60 Degrees, ASTM D 523: Plus or minus 5.

2. UV Resistance, Color and Gloss, ASTM G 155, Cycle 7: Delta E less than 2 at 2.0 mils and less than 20 percent loss.

3. Cross-Hatch Adhesion, ASTM D 3359, Method B: 100 percent pass.

4. Flexibility Test, Mandrel, ASTM D 522: 3 mm at 2 mils.

5. Erichsen Cupping, ISO 1520: 8 mm.

6. Impression Hardness, Buchholz, ISO 2815: 95.

7. Impact Test, ASTM D 2794: 60 inches/pound at 2.5 mils.

8. Pencil Hardness, ASTM D 3363: 2H minimum.

9. Corrosion Resistance, 1,500-Hour Test, ASTM B 117: Max undercutting 1 mm.

10. Humidity Resistance, 1,500-Hour Test, ASTM D 2247: Max blisters 1 mm.

d. Color: Silver

2.12 PAVER GRATES – 8 FOOT, 6 FOOT AND 5 FOOT

A. Manufacturer: Ironsmith, 41-701 Corporate Way #3, Palm Desert, CA 92260 Tel (800) 338-4766 or approved equal.

B. Paver-Grate – 8 Foot: 8220-TGR 96” galvanized steel, in halves, with 24” round tree opening, for use with pavers.

C. Paver-Grate – 6 Foot: 6220-TGR 72” galvanized steel, in halves, with 24” round tree opening, for use with pavers.

D. Paver-Grate – 5 Foot: 5220-TGR 60” galvanized steel, in halves, with 24” round tree opening, for use with pavers.

E. Suspended paver type tree grates shall be manufactured from standard steel shapes to ASTM A36 and expanded metal grating 3# to ASTM A569/569M. If required, Tubing to ASTM A500. Units shall be manufactured true to design and all components shall fit together in a satisfactory manner. Grates are to be of uniform quality, flat and free from distortion.

F. Finish: Hot-dipped galvanized.

G. Grate: M2471Q METRO tree grate

1. 24" round in two sections – ¼" max slots for ADA Compliance
2. Material: 100% recycled gray iron
3. Opening: 14" tree opening
4. Finish: unfinished

2.13 SCULPTURAL SEATING FEATURES

A. Bench: Supercell Benches as manufactured by MD3 Contract Ltd., 412 Kelburn Rd. Suite 312 Deerfield, IL Phone: (847) 940.7072. website: https://www.md3contract.com/

1. Concrete bench colored in mass, acid etched and waterproofed. Registered and protected design by the Intellectual Property Office of the European Union.

B. Materials:

1. Concrete: High Quality concrete HA 30 B20 IIA

2. Cement: Portland cement (BLIIB-LL52.5-R) and GRIFFI cement (BLIIB-LL52.5-R).

3. Aggregates: Aggregates of marble, granite, with selected granulometry. With guarantees and certificates CEE and ISO9001: 2000 SIMO.

4. Water: drinking water, which does not contain impurities, silt or suspended organic components that can affect the quality of concrete such as structural concrete.

5. Reinforcing: steel welded with corrugated steel mesh B500 S (UNE3092)

C. Surface Finish:

1. Acid etching, leaving the aggregates on the surface, and waterproofed.

2. Anti-graffiti finish

D. Colors:

1. Small: 2 epoxy-polyurethane UV resistant system, glossy finish (color yellow).

2. Medium: 1 epoxy-polyurethane UV resistant system, glossy finish (color yellow).

E. Sizes:

1. Small: Supercell S: 90 x 60 x 43cm, 400kg.

2. Medium: Supercell L: 140 x 110 x 43cm, 800kg.

F. Mounting:

1. Sculptural seats placed on paving surface. No foundation or attachment required.

2.14 RELOCATED TUBMAN SQUARE SIGN

A. Existing Tubman Square Sign to be removed and protected.

B. Concrete footing and reinforcing as referenced herein below.

C. Compacted gravel as per Section 02210 – Earth Excavation, Backfill, Fill and Grading

2.15 AERATION GRATE

A. Manufacturer: GreenBlue Urban. Phone: (866) 282-2743. Email: Jeremy.bailey@greenblue.com

1. Type 1:

1. Model: RRARBV
   a. Medium-duty with Chevroned design pattern
   b. 4” x 4” Stainless Steel with aluminum inlet

2. Type 2:

1. Model: RootRain™ Precinct™
   a. Body: Cast aluminum
   b. Grate: Round Stainless Steel grate that meets ADA requirements

2.16 CARL BARRON MEMORIAL SIGN

A. Manufacturer: DCL Design Communications LTD 85 Bodwell St., Avon, MA 023227 Local Representative: Mike Vickers, Phone: (857) 284-5418. Email: mvickers@dclboston.com

OR EQUAL: If proposing an OR EQUAL manufacturer, the manufacturer must be approved by the Landscape Architect before submitting final bid proposal. If they are not approved before final bid deadline, then they will not be approved.

B. Products: Engineered and manufactured memorial sign

1. Material:

a. Stainless cladding

1. Frame: #316 marine grade alloy Stainless Steel passivated per ASTM A967 and AMS 2700 standards
2. Hardware: 18-8 Stainless Steel
3. Finish #4 brushed
4. Prior to fabricating, stainless face with copy is to be:
   i. Laser cut with holes for through-bolting of letters, top lines of copy, per computer generated "perfect" pattern
   ii. Same holes to be countersunk on back side for screws that secure letters, so that hardware is flush. Hardware is stainless steel at size designated.
   iii. Letters below header to be etched into stainless, and filled with dye, color TBD
   iv. Image to left of copy to be precision etched from pre-approved vector line art, and dye filled same color as letters

5. Post-production of artwork and laser cutting of primary panel, five other sides to be laser cut and brake-formed, or continuous welded to shape as shown and with proper clearance to slide over granite plinth with snug fit.
6. Primary panel to be protected during post-fabrication and finishing
7. Letters and plaque are precision stud mounted to stainless wrap. Prior to fabrication of wrap, all mounting holes must be precision laser cut through stainless steel
8. Welded corners to be ground smooth, to match radius of brake-formed corners
9. Refinish additional panels to match #4 finish of primary panel
10. Finished size to slide over granite plinth in "snug" fashion
11. To be affixed to granite in a tamper-proof manner, but able to be removed for potential repair or refinishing
12. Finish is per approved sample

b. Bronze Letters
   1. All applied letters are precision laser cut bronze, alloy C22000. Finish #8 mirror polish on letter face
   2. Large letters on primary side A of sign, "CARL BARRON PLAZA" are 3/8" thick, #8 mirror polish on letter face
   3. Bottom-tapped from back side, include 316 stainless studs project 1.5" from back of letters
   4. Granite is drilled to accept letter studs, set in place with epoxy, flush mount
   5. Header letters (approx 3/4") on side B of sign are 1/4" thick, precision laser cut bronze, alloy C22000, #8 mirror polish on letter face.
   6. Drilled and bottom tapped to accept 316 stainless machine screws
   7. Letters are affixed to stainless backer with counter-sunk screws from back side, including epoxy for permanent set
   8. All letters have an eased edge

c. Stainless Image and Copy Etching

1. Landscape Architect to provide high-resolution image. Fabricator to covert to high-contrast black and white vector artwork for use.
2. Image is to be chemically etched and filled into primary stainless panel, fill color TBD
3. Copy is etched and filled, same

4. Fabrication:

a. Shop fabricated

2.17 RODENT CONTROL GEOTEXTILE

A. Xcluder Geo stainless steel wool geotextile fabric as manufactured by Xcluder Rodent and Pest Defense, Global Material Technologies, Inc. 750 W Lake Cook Road, STE 480 Buffalo Grove, IL 60089. Phone 847.495.4700.

2.18 RELOCATED BENCH

A. Existing benches to be removed and protected. Refer to civil drawings.

B. Concrete footing and reinforcing as referenced herein below.

C. Compacted gravel as per Section 02300 - Earthwork

2.19 BOLLARD – OVER STRUCTURE

A. Steel shapes, plates and bars: AISI grade 316 Stainless Steel

B. Finish: Finish and Patina consistent with approved samples. Heavy Duty Media Blast to an approved surface finish, followed by application of a nitrate-based very dark warm patina slightly lightened with Scotchbrite to an approved patina, followed by the application of microcrystalline paste wax coating. Finish appearance and performance to be equal or better to Design Communications Ltd. Proprietary blackened stainless finish.

C. Fabrication:

1. Precision laser cut stainless pieces, including holes, bevels and other details per approved shop drawings
2. Continuous TIG weld using 316 filler rod per approved shops, in a manner to eliminate warpage
3. All seams to be completely filled with weld, and then ground smooth. No voids or imperfections.
4. Finish each unit with 120 grit dual action sanding of all surfaces, all corners eased at consistent radius to eliminate hazard
5. All tooling for working stainless must be completely clean, with no residue or usage on any other metal source of any type, including 304 stainless
6. Heavy Duty Media-blasting of each unit must have a completely contiguous, monolithic finish with no variations or imperfections
7. All surfaces to be properly passivated, as part of final finishing process

D. Hardware: AISI grade 316 Stainless Steel suitable for loading and mounting conditions.

1. Anchor bolt assemblies to include leveling nuts

2. Provided full scale, hardboard anchor bolt templates with drawings and instructions as needed, for others to direct embed into foundation.

3. The contractor is responsible for ensuring anchors are embedded correctly per specifications, and that bollards will mount at correct elevation, plumb, level and precise correct orientation to align with hardscape.

E. Spacers: Nylon spacers, sleeves or pads with hardness and grade suitable for loads and exterior exposure. Provide between dissimilar metals to separate from direct contact. Color: black.

2.20 MISCELLANEOUS METAL MATERIALS

A. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and for color match, strength, and compatibility in fabricated items.

B. Fasteners: Use fasteners of same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

C. Dissimilar Metals: When dissimilar metals abut one another, use neoprene washers or sleeves to create a separation between the surfaces.

2.21 MISCELLANEOUS METAL FABRICATION

A. Form metalwork to required shapes and sizes, lines and angles. Provide components in sizes and profiles indicated, but not less than required to comply with requirements indicated for structural purposes.

B. Drill and tap for required fasteners, unless otherwise indicated. Use concealed fasteners wherever possible.

C. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.

D. Remove mill scale, dirt, grease and other foreign matter prior to welding. Protect adjacent surfaces from damage due to weld sparks, spatter or tramp metal.

E. Comply with AWS for recommended practices in shop welding and brazing. Clamp members and alternate welds to prevent warping or misalignment. Provide welds and brazes behind finished surfaces without distortion or discoloration or exposed side. Fully weld continuously and ground flush and smooth connections in a uniform manner.

F. Clean exposed, welded and brazed joints of flux and dress exposed and contact surfaces.

G. Chip out and replace welding showing cracks, slag inclusion, lack of fusion, bad undercut and other defects ascertained by visual or other means of inspection.

H. Provide castings that are sound and free of warp, cracks, blow hoes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gatemarks, casting flash, and other casting marks unless part of the intended finish.

I. Finish exposed surfaces to smooth, sharp, well-defined lines and arrises.

J. Assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

2.22 FINISHES - GENERAL

A. Comply with MAAMM “Metal Finishes Manual” for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable temporary covering prior to shipment.

2.23 STAINLESS STEEL FINISHES

A. Finish designations with AISI conform with the system established by the American Iron and Steel Institute for designating finishes for stainless steel sheet.

B. Remove or blend tool and die marks and stretch lines into finish.

2.24 FASTENERS AND HARDWARE - GENERAL

A. Fasteners and hardware shall be that which is furnished by the manufacturer. If additional hardware is required, it shall comply to the following:

B. Fasteners and metal components shall be stainless steel AISI 304L.

C. Expansion Bolts shall be a minimum of 0.5inch diameter with minimum 3 inches embedment into concrete.

D. Structural Bolts shall be ASTM A325 for structural bolts, steel, heat treated, 120/105 ksi minimum tensile strength.

2.25 CONCRETE FOOTINGS FOR SITE FURNISHINGS

A. Cast-in-place concrete footings to be Class D air-entrained concrete conforming to requirements and applicable provisions of Section 900 of Standard Specifications and

SECTION 03300 – Site Cast-in-Place Concrete. Minimum 28-day compressive strength shall be 3,000 psi.

2.26 GRAVEL FILL BASE

A. Gravel Fill Base: as specified in Section 02210 – Earth Excavation, Backfill, Fill and Grading.

2.27 PUBLIC ART SCULPTURE CONCRETE FOOTING

A. Contractor shall construct concrete footing with helical piles for the sculpture as shown in the drawings. Location of footing shall be field verified with artist and coordinated with engineer.

2.28 PUBLIC ART SCULPTURE INSTALLATION ASSISTANCE

A. Contractor shall provide schedule and coordinate schedule for arrival of public art sculpture with the artist, Mark Reigelman. Note that design and fabrication of sculpture is not included in this contract.

B. Contractor shall coordinate and provide installation assistance to public artist, Mark Reigelman, for the off-loading and moving of metal art piece into the location shown on the plan.

C. Forklift and operator and additional labor shall be available to move metal sculpture off flatbed delivery truck and into position as directed by fabricator and artist.

PART 3 - EXECUTION

3.1 FIELD MEASUREMENTS

A. Verify dimensions and field measurements to ensure items are located and secured and function properly when installed. Details of proposed departures due to field conditions or other causes to be submitted to Engineer for approval.

3.2 INSTALLATION – GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete inserts, through-bolts, and other connectors. Manufacturer-provided hardware shall be used in all cases where it is furnished.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing site furnishing. Set site furnishings accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or similar construction.

D. Corrosion Protection: Coat concealed surfaces of metal that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

E. Site furnishings shall be erected as indicated on the Drawings, plumb, level, snug, and free from rocking. Make necessary shimming and final adjustments.

1. Shims shall be stainless steel sized so that they do not protrude beyond the base of the item so as to be visible in completed installation.

F. Protect furnishings from paint splatter, splashed concrete and other construction damage by wrapping and taping in place plastic sheeting or heavy kraft paper around all site furnishings until adjacent work is completed. Repair any damage to finish in a manner consistent with manufacturer's recommendations.

3.3 WOOD BENCH AT GRANITE SEAT WALL

A. Examination:

1. Examine areas to receive product.

2. Notify Engineer of conditions that would adversely affect installation or subsequent use.

3. Do not begin installation until unacceptable conditions are corrected.

B. Installation:

1. Install in accordance with manufacturer's instructions at locations indicated on the Drawings.

2. Install level.

3. Anchor securely in place.

C. Adjusting:

1. Finish Damage: Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Engineer.

2. Component Damage: Remove and replace damaged components that cannot be successfully repaired as determined by Engineer.

D. Cleaning:

1. Clean products promptly after installation in accordance with manufacturer's instructions.

2. Do not use harsh cleaning materials or methods that could damage finish.

E. Protection:

1. Protect installed product to ensure that, except for normal weathering, racks will be without damage or deterioration at time of Substantial Completion.

3.4 STEEL EDGING

A. Install steel landscape edging as per drawings and manufacturer's recommendations.

B. Provide and install steel landscape edging to the elevations and depth as indicated on the Drawings

3.5 METAL BENCH WITH BACK, BICYCLE RACK, TRASH AND RECYCLING RECEPTACLE

A. Coordinate and furnish anchorages and setting drawings, diagrams, templates, instructions and directions for installing items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the site.

B. Provide concrete foundations and install at proper elevation to allow paving to be installed over foundations. Install in accordance with manufacturer's recommendations and shown on Drawings. Grout anchorages and seal joint at pavement surface.

C. Install all items plumb and level.

C. Items shall be located as indicated on the Drawings.

D. Items shall be positioned in the required location and firmly secured to the pavement in accordance with manufacturer's recommendations.

3.6 WATER FILL STATION

A. Install in accordance with fabricator's recommendations and the following:

1. Contractor to stakeout the locations for drinking fountain for review and approval by the Engineer prior to installation.

2. Install water fill station and securely fasten to substrates.

3. Protect existing construction from damage.

4. Install work plumb, level and in proper alignment.

5. Provide work free from tool marks and blemishes.

6. Touch up damaged or abraded finishes. Replace sections which cannot be repaired.

7. Contractor responsible for timing the delivery of all items so as to minimize on-site storage time prior to installation. Stored materials and items must be protected from weather, careless handling and vandalism.

3.7 PLANTER – FREE STANDING

A. Install Planter plumb and level and per the drawings and as per manufacturer's recommendations.

3.8 CHAIRS

A. Install chairs in locations indicated on the drawings.

B. Install cable as per drawing details.

2. Attach cable to D-ring on bottom right leg of each chair with SS sleeve with 3 swages. Attach other end of each cable to one table base D-ring with SS sleeve with 3 swages.

3.9 TABLES

A. Install tables level and plumb with included levelers.

B. Install cable as per drawing details.

1. Attach cable to each table base D-ring with SS sleeve with 3 swages. Refer to 3.8 above for connection of other end of cable to D ring on leg of each chair.

3.10 PAVER GRATE

A. Install as per drawings and manufacturer's recommendations.

3.11 AERATION GRATE

A. Install as per drawings and manufacturer's recommendations.

3.12 RELOCATED TUBMAN SQUARE SIGN

A. Re-install Tubman Square sign plumb and level as per drawing and as specified herein.

1. Clean sign before and after installation.

3.13 CARL BARRON MEMORIAL SIGN

A. Foundation to be installed per stamped, engineered drawings
B. Granite to be set in place by experienced masonry contractor to ensure permanent installation
C. Stainless wrap to be set in place in shop, prior to granite installation
D. Primary Side A letters installed in shop

3.14 RODENT CONTROL GEOTEXTILE

A. Install rodent control geotextile as per drawings and manufacturer's recommendations.

B. Provide and rodent control geotextile to the elevations and depth as indicated on the Drawings

3.15 RELOCATED BENCH

A. Re-install Benches plumb and level as per drawing and as specified herein.

1. Clean bench before and after installation.

3.16 BOLLARD – OVER STRUCTURE

A. Install Bollards plumb and level as per drawing and as specified herein.

B. Provide concrete foundations, anchorage devices and fasteners for securing site furnishings items in place.

C. Shop fabricate bollards with openings and attachments to minimize cutting, drilling and other field adjustments.

D. Perform cutting, drilling and fitting to install site metalwork. Set products accurately in location, alignment, and elevation, plumb, level, and true, measured from established lines and levels.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.17 CONCRETE FOOTINGS FOR SITE FURNISHINGS

A. Concrete footings as specified in Section 03300 – Cast-in-Place Concrete.

3.18 PUBLIC ART INSTALLATION ASSISTANCE

A. Contractor shall coordinate and provide installation assistance to public artist for the off-loading and moving of metal art piece into the location shown on the plan.

B. Sculpture shall be installed plumb on the four footings provided by the contractor.

Contractor shall assist with mechanical fastening of sculpture to footings as per the contract drawings.

PART 4 - COMPENSATION

2990.1 WOOD BENCH AT GRANITE SEAT WALL LINEAR FOOT

2990.2 STEEL EDGING LINEAR FOOT

METHOD OF PAYMENT:
Measurement for Wood Bench at Granite Seat Wall – Tubman and Steel Edging shall be based on the Unit Linear Foot installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Wood Bench at Granite Seat Wall – Tubman and Steel Edging shall constitute full compensation for furnishing and installing each item complete in place, including anchoring hardware and fasteners, cleaning and touch-up painting, protecting the items from damage, and cutting and patching required to complete the installation as indicated and specified.

EXCLUSIONS:
The following item is not included for payment under this item: Granite Seat Wall -Tubman is included in Section 02995 - Site Stone.

2990.3	**METAL BENCH WITH BACK**	**EACH**
2990.4	**BICYCLE RACK – TYPE 1**	**EACH**
2990.5	**BICYCLE RACK – TYPE 2**	**EACH**
2990.6	**TRASH AND RECYCLING RECEPTACLE**	**EACH**
2990.7	**WATER FILL STATION**	**EACH**
2990.8	**PLANTER – FREE STANDING – TYPE 1**	**EACH**
2990.9	**PLANTER – FREE STANDING - TYPE 2**	**EACH**
2990.10	**CHAIRS**	**EACH**
2990.11	**TABLES**	**EACH**

2990.12	**PAVER TREE GRATE – 8 FOOT**	**EACH**
2990.13	**PAVER TREE GRATE – 6 FOOT**	**EACH**
2990.14	**PAVER TREE GRATE – 5 FOOT**	**EACH**
2990.15	**SCULPTURAL SEATING FEATURES (SMALL)**	**EACH**
2990.16	**SCULPTURAL SEATING FEATURES (MEDIUM)**	**EACH**
2990.17	**RELOCATED TUBMAN SQUARE SIGN**	**EACH**
2990.18	**AERATION GRATE**	**EACH**
2990.19	**CARL BARRON MEMORIAL SIGN**	**EACH**
2990.20	**RODENT CONTROL GEOTEXTILE**	**EACH**
2990.21	**RELOCATED BENCH**	**EACH**
2990.22	**BOLLARD – OVER STRUCTURE**	**EACH**

METHOD OF PAYMENT:
Measurement for Metal Bench with Back, Bicycle Rack Ring and Post, Trash and Recycling Receptacles, Benches, Water Fill Station, Planter- Free Standing – Type 1 and Type 2, Chairs, Tables, Paver Tree Grate, Frame and Anchoring Collar, Sculptural Seating Features (Small, Medium), Relocated Tubman Square Sign, Aeration Grate, Relocated Bench and Bollard – Over Structure shall be based on the Unit Each, installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Metal Bench with Back, Bicycle Rack Ring and Post, Trash and Recycling Receptacles, Benches, Water Fill Station, Planter- Free Standing - Type 1 and Type 2, Chairs, Tables, Paver Tree Grate, Frame and Anchoring Collar, Sculptural Seating Features (Small, Medium), Relocated Tubman Square Sign Aeration Grate, Relocated Bench and Bollard – Over Structure shall constitute full compensation for furnishing and installing each item complete in place, including concrete, gravel, anchoring hardware and fasteners, cleaning and touch-up painting, protecting the items from damage, and cutting and patching required to complete the installation as indicated and specified.

2990.18 CARL BARRON MEMORIAL SIGN EACH

METHOD OF PAYMENT:
Measurement for Carl Barron Memorial Sign shall be based on the Unit Each, installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Carl Barron Memorial Sign shall constitute full compensation for furnishing and installing each item complete in place, including concrete, anchoring hardware and fasteners, cleaning and touch-up

painting, protecting the items from damage, and cutting and patching required to complete the installation as indicated and specified. Granite block fabrication and delivery to sign fabricator will be paid for in Section 02995 - Site Stone.

EXCLUSIONS:
The following item is not included for payment under this item: Carl Barron Memorial Sign granite fabrication and delivery to signage fabricator. The granite is included in Section 02995 - Site Stone.

2990.19 RODENT CONTROL GEOTEXTILE SQUARE FOOT

METHOD OF PAYMENT:
Measurement for Rodent Control Geotextile shall be based on the Unit Square Foot, installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Rodent Control Geotextile shall constitute full compensation for furnishing and installing each item complete in place, including anchoring hardware and fasteners, cleaning, protecting items from damage, and cutting and patching required to complete the installation as indicated and specified.

Item 2990.81 PUBLIC ART INSTALLATION LUMP SUM

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on a lump sum of installed art assistance required for the coordination with the artist and the installation of the Ritsuko Art work as described herein and as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid as a lump sum item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to coordinate and provide assistance for public art installation.

END OF SECTION

SECTION 02995

SITE STONE

2995.1	**GRANITE COBBLE PAVERS – TYPE 1**	**SQUARE YARD**
2995.2	**GRANITE COBBLE PAVERS – TYPE 2**	**SQUARE YARD**
2995.3	**FLUSH GRANITE PAVING BAND – TUBMAN**	**LINEAR FOOT**
2995.4	**FLUSH GRANITE PAVING BAND – CARL BARRON**	**LINEAR FOOT**
2995.5	**GRANITE PLANTER CURB – STREETSCAPE**	**LINEAR FOOT**
2995.6	**GRANITE PLANTER CURB – PLAZA**	**LINEAR FOOT**
2995.7	**GRANITE SEAT WALL – TUBMAN**	**LINEAR FOOT**
2995.8	**REFURBISHED GRANITE PLANTER WALL**	**LINEAR FOOT**
2995.9	**RECONFIGURED GRANITE PLANTER WALL**	**LINEAR FOOT**
2995.10	**GRANITE SEATING STONE**	**EACH**
2995.11	**RELOCATED TUBMAN MONUMENT**	**EACH**
2995.12	**RELOCATED ALVIN THOMPSON MONUMENT**	**EACH**
2995.13	**CARL BARRON PLAZA MEMORIAL - GRANITE BLOCK**	**EACH**
2995.14	**SCULPTURAL GRANITE SEATING FEATURES (SMALL)**	**EACH**
2995.15	**SCULPTURAL GRANITE SEATING FEATURES (MEDIUM)**	**EACH**
2995.16	**SCULPTURAL GRANITE SEATING FEATURES (LARGE)**	**EACH**
2995.17	**FLUSH GRANITE PAVING BAND – CARL BARRON – ON STRUCTURE**	**LINEAR FOOT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for Site Stone including, but not limited to, the following:

1. Granite Cobble Pavers – Type 1
2. Granite Cobble Pavers – Type 2
3. Flush Granite Paving Band – Tubman
4. Flush Granite Paving Band – Carl Barron Plaza
5. Granite Planter Curb – Streetscape
6. Granite Planter Curb – Plaza
7. Granite Seating Stone
8. Refurbished Granite Planter Wall
9. Reconfigured Granite Planter Wall
10. Granite Seat Wall – Tubman
11. Relocated Tubman Monument
12. Relocated Alvin Thompson Monument
13. Carl Barron Plaza Memorial
14. Sculptural Granite Seating Features
15. Flush Granite Paving Band – Carl Barron Plaza – On Structure

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 02520 – Brick Pavers
3. Section 02780 – Precast Unit Pavers
4. Section 02990 – Site Furnishings
5. Section 03300 – Concrete

1.3 REFERENCES

A. Comply with applicable requirements of:

1. Commonwealth of Massachusetts, Standard Specifications for Highways and Bridges, Department of Public Works, latest edition.

2. ASTM: American Society for Testing and Materials

3. AASHTO: American Association of State Highway and Transportation Officials.

4. NBGQA: National Building Granite Quarries Association.

1.4 SUBMITTALS

A. Submittals: in accordance with Section 01300 – SUBMITTALS.

B. Identify by trade name and exact quarry source for each granite proposed for this project. Certify in writing that granite provided on job is from consecutive blocks from one quarry.

C. Submit laboratory data as required in 1.06 - Quality Assurance.

D. Product Data: submit manufacturer's specifications and installation instructions for:

1. Granite
2. Mortar materials.
3. Grout materials
4. Mortar coloring additive
5. Preformed Joint Filler
6. Silicon Sealant
7. Backer Rod
8. Granite

E. Shop Drawings: submit:

1. Layout and detailing of granite indicating sizes, dimensions, layout, finishes joint locations and types, concrete foundations and relationship to adjacent items. Drawings to show interface of granite components with concrete foundations including elevation changes in top of concrete and bottom of granite.

    a. Drawings shall indicate anchorage system, including steel support angles, anchors, cramps, dowels.

    b. Drawings shall indicate locations of inserts for stone anchors and supports which are to be built into concrete and masonry, and locations and dimensions of cut-outs, holes, openings, and other provisions required for the work of other trades.

    c. Anchorage shop drawings shall be designed by an engineer licensed to practice in the Commonwealth of Massachusetts. Provide signed and stamped shop drawings and calculations for review and approval.

2. Prepare drawings based on field verified dimensions.

F. Samples: submit prior to mock-up erection:

1. Granite:

    a. Granite Samples: four samples of each color type, 12-inch square x 1-inch thick samples for each color and finish. Samples shall be sufficient to show full range of color, characteristics, veining and finish to be expected in finished work. In the case of more variegated stones, color photos shall be submitted in addition to the number of samples to show the full range of color and markings to be expected.

b. Granite cobbles: four samples of Type 1 and four samples of Type 2.

1. Samples shall be sufficient to show full range of color, characteristics, veining and finish to be expected in finished work. In the case of more variegated stones, color photos shall be submitted in addition to the number of samples to show the full range of color and markings to be expected.

c. Flush Granite Paving Band – CB Plaza: four samples of granite equal to, or similar to, the adjacent MBTA station.

1. Samples shall be sufficient to show full range of color, characteristics, veining and finish to be expected in finished work. In the case of more variegated stones, color photos shall be submitted in addition to the number of samples to show the full range of color and markings to be expected.

d. Variation in Granite: variations in granite involving markings, inclusion characteristics, veining and grain deviations shall be kept to a minimum and shall not be more extensive than exhibited in the samples.

2. Mortar: four color samples of each type of mortar and color for each stone type and finish for pointing in 6-inch long by 1/2 inch wide samples strips of grout set in aluminum or plastic channels. Samples shall show full range of exposed color and texture to be expected in finished work.

3. Joint Sealant: color samples of each type and color of sealant for each stone type and finish. Sealant to include textured appearance.

G. Preliminary Test Reports:

1. Submit test reports for proposed stones prior to final stone selection. Preliminary test reports shall be indicative of the stone to be proposed for the project.

2. Testing of production stone is required in addition to preliminary test reports.

H. Certification

1. Submit a letter of certification from the stone fabricator, stating the material being furnished is the specified material and there are sufficient reserves available to supply the project and furnish replacements if needed.

2. Certification shall be based on independent testing laboratory tests made within last two years.

I. Material Test Reports: From a qualified independent testing agency, as follows:

1. Provide reports for each stone type.
2. For metal components.

J. Qualification Data: Submit qualification data as specified under Article, "Quality Assurance" for the following:

1. Installer
2. Fabricator

K. Cold-Weather Procedures: Detailed description of methods, materials, and equipment.

L. Shop and Erection Drawings: Provide shop drawings for fabrication, installation and erection of the entire scope of work. Provide setting drawings with each piece of stone numbered and located on Drawings. Provide plans, elevations and details of anchorages, connections and accessory items. Granite interface with supporting structure, masonry, glazing and other construction shall be detailed. Provide information on insert locations for work installed by others. Provide detailed information on locations where stone support system attaches to other structures. Mark and match mark each stone and clearly indicate each stone on details and erection drawings. Provide installation templates for anchor installation and other work installed by others.

1.5 QUALITY ASSURANCE

A. Source Limitations for Stone: Obtain each stone variety from a single quarry.

1. Make quarried blocks available for examination by Engineer.

B. Qualifications:

1. Installer Qualifications: Engage experienced installer that has at least ten years' experience and has completed stone installation similar in material, design, and extent to that indicated for the project. Stone veneer installer assumes undivided responsibility for work of this section including design, engineering, fabrication and installation of stone veneer system.

2. Fabricator Qualifications: Engage experienced fabricator that has at least ten years' experience and has completed stone fabrication similar in material, design, and extent to that indicated for the project and is equipped to provide quantities shown. Granite shall be fabricated by a firm approved by the Engineer.

C. Preconstruction Stone Testing: Engage an independent testing agency to perform the following testing for each stone variety:

1. Furnish test specimens that are representative of materials.
2. Physical Property Tests: ASTM standards specified for stone type.
3. Flexural Strength Tests: ASTM C 880
4. Independent testing agency to release data and test reports directly to Engineer.

D. Mockups: Provide mock-ups of the following:

1. Two joint grout samples in two select color ranges for each granite type set between 12" square granite samples.

2. Two sealant color samples in two select color ranges for each granite type set between 12” square granite samples.

E. Field Pre-Construction Testing:

1. Test each elastomeric sealant and joint substrate in accordance with the following, before beginning work of this section:

a. Install sealants in mockups using joint preparation methods determined by laboratory pre-construction testing.

b. Install field-test joints in location as approved by Engineer.

c. Test Method: Manufacturer's standard field adhesion test to verify joint preparation and primer required to obtain optimum adhesion of sealants to joint substrate.

d. When test indicates sealant adhesion failure, modify joint preparation, primer, or both and retest until joint passes sealant adhesion test.

1.6 DELIVERY, STORAGE AND HANDLING

A. Supplier to carefully pack and band stone for shipment. Following shipping, store stone on skids or pallets, covered with non-staining, waterproof membrane and protected from weather. Evenly place and stack skids to evenly distribute weight of stone materials and to prevent breakage, cracking, and damage to granite pieces. Store stone materials to allow air to circulate around granite material. Stone shall not be permitted to be in direct contact with ground during storage.

B. Handle, store, mix and apply setting materials in strict compliance with manufacturer's recommendations and instructions.

C. Damaged stone will be rejected and replaced with new materials at no additional cost to City.

D. Protect finished surfaces adjacent to paving work from soiling, staining, and other damage.

1.7 PROJECT CONDITIONS

A. Protect stone as follows:

1. At the end of each day’s work, cover stone with non-staining, waterproof covering. Protect partially finished work when not being worked on.

2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.

3. Protect base of walls using coverings spread on ground and over wall surface.

4. Protect sills, ledges, and other projections from mortar.

B. Weather: Perform cast-in-place concrete work when existing and forecasted weather conditions are within the limits established in Section 03300 – Concrete.

C. Cold-Weather Requirements for Exterior Stone Paving: Comply with ACI 530.1/ASCE 6/TMS 602.

1. Remove ice or snow formed on stone and concrete bed by carefully applying heat until top surface is dry to touch.

2. Remove stonework damaged by freezing conditions.

3. Perform the following construction procedures while work is progressing:

Mean Daily Air Temperature	Procedures
40° - 32°F.	Heat sand to produce mortar temperature between 40° and 120°F.
32° - 25°F.	Heat sand to produce mortar temperature between 40° and 120°F. Maintain temperature of mortar on boards above freezing.
25° - 20°F.	Heat sand to produce mortar temperature between 40° and 120°F. Maintain temperature of mortar on boards above freezing. Use wind breaks when wind is in excess of 15 mph.
20°F - below.	Heat sand to produce mortar temperature between 40° and 120°F. Provide enclosures and auxiliary heat to maintain air temperature above 32°F. Do not lay units which have a surface temperature below 20°F.

4. Do not use frozen materials or materials mixed or coated with ice or frost. Do not lower freezing point of mortar by use of admixtures or antifreeze agents, and do not use calcium chloride in mortar or grout.

5. Do not build on frozen work; remove and replace stonework damaged by heat or freezing.

6. Protect partially completed stonework against weather when work is not in progress.

D. Cold Weather Protection for Completed Stonework:

1. Perform the following construction procedures while work is progressing:

Mean Daily Air Temperatures	Procedures

40°- 32°F.	Protect stonework from rain or snow for at least 24 hours by covering with weather-resistant membrane.
32°- 25°F.	Completely cover stonework with weather-resistive membrane for at least 24 hours
25° - 20°F.	Completely cover stonework with insulating blankets or similar protection for at least 24 hours.
20°F. – below 0	Maintain stonework at temperature above 32°F. for 24 hours using enclosures and supplementary heat.

E. Hot-Weather Requirements for Exterior Stone Paving: ACI 530.1/ASCE 6/TMS 602.

F. Protection: Cover work at the end of each day and whenever work is not in progress. Extend cover down both sides of walls at least 24 inches and hold securely in place.

G. Staining: Prevent mortar from staining face of stone to be left exposed. Clean exposed stone surfaces immediately. Protect stone from splashed mud and other stains. Protect sills, ledges and projections from mortar droppings.

PART 2 - PRODUCTS

2.1 GRANITE

A. Comply with requirements of NBGQA for tolerance, color and finish qualities, unless indicated otherwise. Provide continuous blocks of granite to allow for fabrication of continuous matching units. Mark matched units to provide continuous sequence installation.

B. Certification of Specified Physical Characteristics:

1. Granite: ASTM C 615

2. Provide first quality granite, hard and durable, of uniform or similar color, grain, size and texture, free from seams, cracks and other imperfections, and having smooth splitting character.

a. Maximum allowable inclusion size is 3” in diameter.

3. Provide clean stone which shows no evidence of rust or iron particles.

4. Abrasion: 70.0 Ha.

C. Provide stone materials having characteristics and physical requirements defined by ASTM C119 and C615 and physical characteristics defined under ASTM C614 Table 1 according to the following ASTM test references:

1. Abrasion resistance of stone subject to foot traffic: ASTM C241.

2. Absorption 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.

D. Site Stone Type A: Granite to match existing granite cobbles.

1. Granite Cobble Pavers – Type 1 and Granite Cobble Pavers – Type 2:

a. Top, side and bottom finishes: Match existing granite cobbles.

b. Sizes:

1. Type 1: approximate sizes: length: 8-12”, width 4–4 ½”, depth 5-6”. Size to match existing.

2. Type 2: 4” x 4” x 4” to match existing.

c. Layout: Layout to match existing.

E. Site Stone Type B: Deer Isle Granite as supplied by Swenson Granite Works, 125 Newburyport Turnpike, Rowley, MA, 01969. Phone: (978) 948-3363.

1. Granite Planter Curb – Streetscape:

a. Top finish: Sawn and thermal finish, unless otherwise noted on the Drawings.

b. Sides finish: Split, unless otherwise noted on the Drawings. Finishes on exposed surfaces to extend 3" below finished grade.

c. Edges: eased with thermal finish, unless otherwise noted on the Drawings.

d. Unexposed surfaces: sawn finish on unexposed surfaces.

2. Granite Seating Stone:

a. Top finish: Sawn and thermal and washed finish, unless otherwise noted on the Drawings.

b. Side finish: Split face, unless otherwise noted on the Drawings. Finishes on exposed surfaces to extend 3" below finished grade.

c. Edges: eased with thermal finish, unless otherwise noted on the Drawings.

d. Unexposed surfaces: sawn finish on unexposed surfaces.

3. ASTM testing requirements:

a. Density: ASTM C97 - 162.70 pcf

b. Average Absorption: ASTM C97 - 0.25%

c. Average Compressive Strength: ASTM C170 - 26,756 psi

d. Average Modulus of Rupture: ASTM C99 - 1,920 psi

F. Site Stone Type C: Cold Spring Black as supplied by Cold Spring, 1 School Street, Manchester, MA, 01944.

1. Basis of Design: Cold Spring Black, quarried by Cold Springs Granite, 17482 Granite West Road, Cold Spring, MN, USA.

1. Bulk Density: ASTM C97.
2. Average Bulk Density: 178.5 pcf
4. Absorption: ASTM C97.
5. Average Absorption (%): 0.11%.
6. Compressive Strength: ASTM C170.
7. Average Compressive Strength (psi): 17,530 pounds per square inch.
8. Modulus of Rupture: ASTM C99
9. Average Modulus of Rupture (psi): 2,490 pounds per square inch.

2. Granite Planter Curb – Plaza, Granite Planter Curb – Tubman, Flush Granite Paving Band – Tubman, Flush Granite Paving Band – CB Plaza – On Structure, Granite Seat Wall – Tubman:

a. Exposed surfaces: Sawn and thermal and washed finish, unless otherwise noted on the Drawings. Finishes on exposed surfaces to extend 3" below finished grade.

b. Edges: eased with thermal finish, unless otherwise noted on the Drawings.

c. Unexposed surfaces: sawn finish on unexposed surfaces.

3. Sculptural Granite Seating Features

a. Exposed surfaces: 5 axis CNC milled and thermal and washed finish, unless otherwise noted on the Drawings. Finishes on exposed surfaces to extend 3" below finished grade.

b. Edges: eased with thermal finish, unless otherwise noted on the Drawings.

c. Unexposed surfaces: sawn finish on unexposed surfaces.

4. Carl Barron Plaza Memorial:

a. Sawn and thermal and washed finish, unless otherwise noted on the Drawings.

b. Finishes on exposed surfaces to extend 3" below finished grade.

c. Unexposed surfaces: sawn finish on unexposed surfaces.

5. ASTM testing requirements:

a. Density: ASTM C97 - 178.5 pcf

b. Average Absorption: ASTM C97 - 0.11%

c. Average Compressive Strength: ASTM C170 - 17,530 psi

d. Average Modulus of Rupture: ASTM C99 – 2,490 psi

G. Site Stone Type D: Granite to match existing granite on the adjacent MBTA headhouse. Contractor to determine granite type of adjacent MBTA headhouse and submit samples that show a match.

1. Flush Granite Paving Band – Carl Barron Plaza:

a. Top finish: Sawn and thermal and washed finish, unless otherwise noted on the Drawings.

b. Edges: eased with thermal finish, unless otherwise noted on the Drawings.

d. Unexposed surfaces: sawn finish on unexposed surfaces.

H. Appearance Criteria:

1. Color Criteria: Samples shall be sufficient to show full range of color for permissible range of variation in color provided by lightest and darkest color samples.

2. Variation in Graining Criteria: Samples shall be sufficient to show permissible variation in graining and pattern.

3. Markings, inclusion characteristics and veining criteria: Samples shall be sufficient to show permissible inclusions provided by a maximum size for inclusions, a maximum number of inclusions per piece and maximum number of inclusions for one face. Criteria for finish provided by samples.

4. Finishes criteria: Samples shall be sufficient to show full range of color for permissible range of finish variation.

5. Variation outside of established criteria:

a. In the case of more or less variegated color range, markings and inclusion characteristic stones, color photos shall be submitted in addition to the number of samples to show the full range of color to be expected.

b. Select color range involving markings, inclusion characteristics, veining and grain deviations from the standard quarried natural full stone range shall be

pre-determined by Engineer in a review of quarrier's standard quarried stone mock up photo that is kept on file. Final custom select color range, markings, inclusion characteristics, veining, grain and finishes shall be reviewed and determined first in a photo mock-up prior to final site mock-up. Final approval will be as selected and approved by Engineer.

2.3 STONE FABRICATION

A. Fabricate stone per requirements, as shown on Drawings, and as follows:

1. Granite Fabrication: Comply with NBGQA's "Specifications for Architectural Granite."

2. Fabricate stone to be straight, true, plumb, level and square and to sizes, shapes and profiles indicated on approved shop drawings. Cut and back-check stone for correct fit and clearance. Vertical joints: to be plumb.

B. Granite sculptural seating features: 5 axis CNC milled in accordance with shop drawings and approved samples. Fabricator to prepare 3d models of all walls and curbs in electronic Rhino file format to prepare shop drawings. Walls to be in strict adherence to the 3D model with a height and width dimensional tolerance of 1/16 in. No modifications to the forms will be accepted without prior approval.

C. Landscape Architect to provide design intent electronic files of Sculptural seating features in an electronic Rhino file format, but it is the fabricators responsibility to produce the final models used for production.

D. Arrises: Remove the sharp edge from arrises to slightly blunt edge and to reduce chipping of the finished edge.

E. Dress joints straight and at 90-degree angle to face. Shape beds to fit supports.

F. Anchor Provision: Cut and drill sink provisions and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone in place.

1. Allow room for expansion of the anchoring devices where necessary.

2. Where liners are required on the back of panels, secure by means of a mechanical anchors. Comply with referenced standards.

G. Finish exposed faces and edges of stone, except sawed reveals, to comply with requirements indicated for finish and to match final samples and mockups.

H. Joint Width: Cut stone to produce uniform joints 3/8 inch wide joint, unless otherwise indicated.

I. Provide chases, reveals, reglets, openings, and similar features as required to accommodate adjacent work.

J. Fabricate molded work, including washes and drips, to produce uniform stone shapes, with precisely formed arrises slightly eased, and matching profile at joints between units.

K. Grade and mark stone to achieve uniform appearance when installed. Inspect finished stone units at fabrication plant. Replace defective units.

L. Stone Fabrication Tolerances:

1. Stone thickness 2 inches or less: Plus or minus 1/16 inch of the nominal thickness.

2. Stone thicknesses greater than 2 inches: Plus 1/8 inch and minus 1/16 inch of the nominal thickness.

3. Stone thicknesses greater than 6 inches: Plus or minus 1/8 inch of the nominal thickness.

4. Overall face size: Plus or minus 1/16 inch in both height and width.

5. Out of square: Plus or minus 1/16 inch difference of diagonals.

2.4 POWER-WASHING, CLEANING, MODIFICATION AND RELOCATION OF EXISTING GRANITE COMPONANTS

A. The following existing granite items to be cleaned and power-washed, and repointed, in place:

1. Refurbished Granite Planter Wall

B. The following existing granite items to be relocated, re-installed, cleaned and power-washed:

1. Relocated Tubman Monument
2. Relocated Alvin Thompson Monument

C. The following existing granite item is to be disassembled, modified as per drawings, re-installed, cleaned and power-washed.

1. Reconfigured Granite Planter Wall

D. Granite cleaning products: Acceptable materials include mild soap and water, non-acid type cleaners and stiff fiber brushes. Wire brushes and caustic cleaners are unacceptable. Provide one of the following:

1. Sure Clean #600 Detergent manufactured by ProSoCo, Inc., Kansas City, KS
2. #101 Masonry Restorer/Cleaner manufactured by Diedrich Chemicals and Restoration Technologies, Inc, 300 A East Oak Street, Oak Creek, WI 53154.
3. Or approved equal.

E. Power-washing:

1. Use a low-pressure power washer with medium to low-pressure cleaning that ranges from 800 to as low as 100 psi.

F. Mortar mix: Mortar mix for repointing as specified in paragraph 2.8 MORTAR AND GROUT.

G. Modification to existing Granite: as specified in paragraph 2.3 STONE FABRICATION.

2.5 ANCHORS AND FASTENERS

A. Anchor Material: Stainless steel, ASTM A 666, Type 304

B. Dowels and Pins Material: Stainless steel, ASTM A 276, Type 304

C. Aluminum Anchor Material: Extruded aluminum, ASTM B 221, not less than strength and durability properties of Alloy 6063-T6.

D. Cast-in-Place Inserts Not In Contact with Stone: Steel or malleable iron adjustable inserts, with bolts, nuts, washers, and shims and as follows:

1. Finish: Hot-dip galvanized or mechanically zinc coated
2. Capacity: Sustain load equal to 4 times the required loads
3. Testing: ASTM E 488.

E. Post installed Anchor Bolts: Provide the following for installation into concrete and masonry:

1. Expansion anchors
2. Stainless Steel Bolts: ASTM F 593, Alloy Group 1 or 2.
3. Stainless Steel Nuts: ASTM F 594, Alloy Group 1 or 2.
4. Anchor Material: ASTM A 666 or ASTM A 276, Type 304 or 316.
5. Capacity:

a. Concrete: Sustain load equal to 4 times the required loads
b. Masonry: Sustain load equal to 6 times the required loads
c. Test: ASTM E 488.

F. Post installed Chemical Anchor Bolts:

1. Chemical anchors
2. Stainless Steel Bolts: ASTM F 593, Alloy Group 1 or 2.
3. Stainless Steel Nuts: ASTM F 594, Alloy Group 1 or 2.
4. Anchor Material: ASTM A 666 or ASTM A 276, Type 304 or 316.
5. Capacity:

a. Concrete: Sustain load equal to 4 times the required loads
b. Masonry: Sustain load equal to 6 times the required loads
c. Test: ASTM E 488.

G. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.

1. Stainless Steel Bolts: ASTM F 593, Alloy Group 1 or 2.
2. Stainless Steel Nuts: ASTM F 594, Alloy Group 1 or 2.
3. Threaded Fastener Anchor Material: ASTM A 666 or ASTM A 276, Type 304 or 316.

H. Provide stainless steel anchors including bolt, nut, flat and lock washer. Bolt designed to be inserted into routed slot in back of stone.

1. Provide Anchors manufactured by granite fabricator.
2. Diameter: Size anchors to comply with requirements, but not less than 3/16 inch

K. Anchors and Fasteners: Design selection of appropriate items by Contractor's engineer.

2.6 PRIMER PAINT

A. Shop Prime Paint: Zinc-rich primer, complying with SSPC-Paint 20 or SSPC-Paint 29.

B. Galvanizing Repair Paint: Zinc-content paint for repairing galvanized steel coating complying with SSPC-Paint 20.

2.7 STONE ACCESSORIES

A. Setting Shims: Plastic or vulcanized neoprene.

B. Setting Buttons: Resilient plastic buttons.

C. Concealed Sheet Metal Flashing: Stainless steel; refer to Division 7 Section "Sheet Metal Flashing and Trim."

D. Weep and Vent Tubes: Medium-density polyethylene tubing, 1/4-inch OD

E. Length: Required to extend from exterior face of stone to cavity behind.

2.8 SITE GRANITE MORTAR AND GROUT

A. Setting bed mortar mix for site granite:

1. Cement: conform to ASTM C 150, Type I or Type II, except Type III may be used for setting granite in cold weather.

a. Provide natural color or white cement as required to produce mortar color indicated.

2. Hydrated Lime: ASTM C 207, Type S.

3. Mortar aggregate: complying with ASTM C144, well graded, except for very thin joints (less than % inch) use gradation with 100% passing No. 16 sieve.

4. No calcium chloride or admixtures containing calcium chloride shall be used.

5. Mortar Proportions:

   a. 1 part white Portland cement, ¾ part lime, 4-3/4 to 5-1/4 parts bulked sand.

B. Mortar mix for pointing of joints:

1. Cement: conform to ASTM C 150, Type I or Type II, except Type III may be used for setting granite in cold weather.

   a. Provide natural color or white cement as required to produce mortar color indicated..

2. Hydrated Lime: ASTM C 207, Type S.

3. Mortar aggregate: complying with ASTM C144, well graded, except for very thin joints (less than % inch) use gradation with 100% passing No. 16 sieve

4. No calcium chloride or admixtures containing calcium chloride shall be used.

5. Mortar pigments: Natural and synthetic iron oxides. Use pigments with a record of satisfactory performance in mortar. Pigments shall contain no carbon black. Pigments shall have mineral oxide pigment and be certified by supplier to be resistant to alkali, Wit, and weather, and be of a chemical composition unaffected by cement and free of water and soluble salts. Color pigment shall not exceed 10% of Portland cement in mortar.

   a. Color: as selected by Engineer.

6. Mortar Proportions:

   a. 1-part white Portland cement, ¾ part lime, 4-3/4 to 5-1/4 parts bulked sand plus pigment as required to achieve approved color.

C. Grout for anchors: complying with ASTM C476 and with consistency appropriate to conditions so grout will completely fill spaces intended to receive grout. Grout shall be quality controlled hydraulic cement, quick setting, non-metallic grout.

2.9 EXPANSION JOINT FILLER

A. Flexible foam expansion joint filler in conformance to D 5249, Type 2, ASTM D 1752, Sections 5.1 through 5.4, with the compression requirement modified to 10 psi (7.03 g/mm²) minimum and 25 psi (17.58 g/mm²) maximum and as follows:

1. CERAMAR Flexible Foam Expansion Joint Filler manufactured by W.R. Meadows, Inc., Elgin, IL or approved equivalent product.

2.10 BACKER ROD

A. Continuous round rod of 100% closed cell polyethylene foam, complying with requirements of ASTM C-272.

2.11 SILICON SEALANT

A. Single Component Silicone: Low modulus, high performance, single component, self-leveling sealant, in conformance with ASTM C920, Standard Specification for Elastomeric Joint Sealants, and is classified as Type S (Single Component), Grade NS (Non-Sag), Class: 50 (+/- 50% joint movement); Uses NT, M, G, A and O; and be one of the following:

1. Spectrum 3 manufactured by Tremco Sealant/Weatherproofing Division of RPM International, Inc,
2. Pecora 301NS pavement sealant manufactured by Pecora Corporation, 165 Wambold Road, Harleysville, PA 19438 • 1-800-523-6688.
3. Sikasil-728 NS manufactured by Sika Corporation201 Polito Avenue, Lyndhurst, NJ 07071

B. Sealant to include textured appearance.

C. Color: to be selected by Engineer by review of on-site mockups.

2.12 EXPANSION DOWELS AND SLEEVES

A. Stainless steel bars, complying with ASTM A276, Type 304, with smooth end cuts. Provide bar in dimensions and size indicated on Drawings. Provide expansion caps with compatible waxed tube sleeve, which permit at least 1-inch movement.

2.13 PORTLAND CEMENT CONCRETE FOUNDATION

A. Concrete materials and products: as specified in Section 03300 – Cast-in-Place Concrete.

B. Portland Cement Paving Mix: Design mix to provide normal weight concrete complying with requirements of Section 03300 – Cast-in-Place Concrete for 4,000 psi compressive strength at 28 days, 3/4 aggregate, 610 pounds per cubic yard cement content and 5% to 7% air-entrained with 2" to 4" maximum slump.

2.14 GRAVEL BASE AND SUBBASE

A. Gravel Borrow: Section 02210 – Earth Excavation, Backfill, Fill and Grading.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of site granite with concrete walls and foundations, layout and installation of adjacent paving, other site improvements and building to ensure proper alignments.

B. Make corrections to subgrade and aggregate base course provided under Section 02210 – Earth Excavation, Backfill, Fill and Grading.

3.2 CONCRETE FOUNDATION INSTALLATION

A. Formwork: Set forms accurately to maintain specified tolerances. Remove loose material and clean forms immediately before concrete placement.

B. Reinforcing: provide reinforcing as required. Provide reinforcing in longest practical lengths. Unroll wire mesh for reinforcement flat before placing in concrete. Minimum concrete covering of 2" over wire mesh and reinforcing bars. Secure reinforcing against displacement during concrete placement.

C. Concrete: provide as specified in Section 03300 – Concrete for mixing, placing and curing concrete. Use vibrators to consolidate concrete and to prevent honeycombs.

3.3 INSPECTION

A. Installer shall examine substrates, supports and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions are corrected.

B. Verify measurements and dimensions coordinate installation of inserts for work and coordinate and schedule work with work of other trades. Give particular attention to location and size of cutouts required to accommodate other work or adjoining construction, in accordance with the reviewed Shop Drawings for such trade.

3.4 PREPARATION AND INSTALLATION

A. General Installation Requirements: comply with quarry/ fabricator's instruction and recommendations and instructions and recommendations of setting materials manufacturers, except where more restrictive requirements are specified in this section.

B. Anchors:

1. Securely fix in place supporting anchors and inserts and other items into concrete prior to waterproofing. Provide Location Drawings in sufficient time so to not delay job progress.

2. Build in anchors and attachments for stone in locations indicated on the Shop Drawings.

C. Individually set stonework:

1. Clean stone before setting by thorough scrubbing clean water and Tampico fiber brushes only.

2. Do not use granite with chips, cracks, voids, stains and other defects visible in finished work and structurally impair stone.

3. Set stone in strict compliance with approved Shop Drawings and Installation Drawings. Provide anchors, supports, fasteners and attachments. Shim and adjust stone true to lines and grades with accurately aligned joints of uniform width. Unless indicated otherwise, joints shall be 3/8 inch wide. Direct bearing contact between granite pieces shall be prohibited.

4. Follow manufacturer's instructions for mixing and applying mortar, pigment, grout and polymer additive according to manufacturer's instructions.

5. Set stone in full mortar or grout bed with setting buttons to prevent extrusion of mortar or grout and to control joint width. Before setting, back of granite pieces to be dampened and receive slurry of mortar or grout to ensure maximum contact with mortar or grout bed. Carefully bed pieces in full bed of mortar or grout and tap with rawhide mallet to full and solid bearing. Exercise particular care to equalize bed and joint openings and eliminate need for redressing of exposed surfaces.

6. For veneer wall construction, keep cavity behind stones clear and free of mortar and other obstructions to the downward and outward flow of water through weep holes, except where space between stone and back-up construction is to be fully grouted, place mortar stop and fill space completely with non-staining grout placed in small lifts. Rod each grout lift to eliminate voids and to consolidate grout. Avoid displacing stones from accurate position and alignment.

7. Keep exposed surfaces free from mortar and grout. Immediately remove mortar and grout smears with clean sponge and clean water before polymer modified mortar or grout sets.

8. Before joints and setting beds set, rake out joints 3/8-inch deep to allow space for both pointing mortar for mortar joints and sealant and backer rod for sealant joints.

9. Pointing of raked out stone joints shall be continuous operation in order to assure a consistent color for entire job. Point stone joints by placing pointing mortar in three layers with each of first and second layers filling approximately two thirds of joint depth and third layer remaining one third. Fully compact each layer and allow becoming thumbprint hard before applying next layer. Tool joints with a 1/2 inch round tool to produce a glassy hard concave joint free from drying cracks. During tooling of joints, enlarge voids or holes and completely fill with pointing mortar. No pointing shall be done in freezing weather nor in locations exposed to hot sun, unless properly protected.

10. Anchor stones to supporting construction with specified anchors, grouted and shimmed to maintain proper stone position and alignment.

11. Provide sealant joints wherever granite abuts dissimilar material and at locations noted in drawings and approved by Engineer. Extend joint filler full depth of joint and allow ½-inch minimum space at top for insertion of backer rod and sealant. Protect top edge of joint filler with metal cap or other temporary protection. Remove protection per manufacturer's recommendations.

D. Flashings: Coordinate stonework installation with flashing installation to ensure completely waterproof and weather-tight construction and assembly. Thoroughly inspect flashings before concealing and seal penetrations through flashings with bed of sealant.

E. Weep holes: provide fully open weep holes required to allow for a positive means of drainage.

3.5 CLEANING AND POWER-WASHING, MODIFICATION AND RELOCATION OF EXISTING GRANITE COMPONANTS

A. Cleaning and Power-washing:

a. Examine the granite to inspect for signs of cracking or flaking. If these areas are found put as little stress when cleaning the area as possible.

b. Place plastic tarps around the surrounding area to avoid damaging any nearby vegetation.

c. Add the cleaner to a few gallons of water in your bucket and apply to the entire area.

d. Using a non-metallic soft tip scrub brush or sponge brush the entire area, not just the visibly dirty areas.

e. Use a power washer with little to virtually no pressure to rinse the entire area carefully from a few inches away. It is not the pressure of the water that will clean the granite, it is the angle of the pressure washing tip that does all the work.

3.6 TOLERANCES

A. The following installed tolerances are allowable variations from locations and dimensions indicated by the Contract Documents and shall not be added to allowable tolerances indicated for other work.

1. Allowable Variation from True Plumb, Level, Line: +/- 1/8" in 10 feet, % inch in 40 feet.
2. Allowable Variation from True Plane of Adjacent Surfaces: + 1/16 inch

3.7 REPAIR, CLEANING AND PROTECTION

A. Remove and replace damaged work, providing new stone pieces to match as approved by Engineer. Make new joints to match so there is no evidence of replacement.

B. Clean exposed surfaces using clean water and soft Tampico brushes only, unless otherwise approved by Engineer. Do not change stone finish. Remove and replace work that cannot be successfully cleaned.

C. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean immediately before final inspection.

PART 4 – MEAUREMENT AND PAYMENT

2995.1	**GRANITE COBBLE PAVERS – TYPE 1**	**SQUARE YARD**
2995.2	**GRANITE COBBLE PAVERS – TYPE 2**	**SQUARE YARD**

METHOD OF MEASUREMENT:
Measurement for Payment for Granite Cobble Pavers – Type 1 and Granite Cobble Pavers – Type 2 shall be based on the Unit Square Yard, installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Granite Cobble Pavers – Type 1 and Granite Cobble Pavers – Type 2 shall be based on the Unit Square Yard. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, subbases, concrete, reinforcement, mortar, dowels and other incidental work and construction methods to complete the installation as indicated and specified.

2995.3	**FLUSH GRANITE PAVING BAND – TUBMAN**	**LINEAR FOOT**
2995.4	**FLUSH GRANITE PAVING BAND – CARL BARRON**	**LINEAR FOOT**
2995.5	**GRANITE PLANTER CURB – STREETSCAPE**	**LINEAR FOOT**
2995.6	**GRANITE PLANTER CURB – PLAZA**	**LINEAR FOOT**
2995.7	**GRANITE SEAT WALL – TUBMAN**	**LINEAR FOOT**
2995.17	**FLUSH GRANITE PAVING BAND – CARL BARRON – ON STRUCTURE**	**LINEAR FOOT**

MEASUREMENT AND PAYMENT

METHOD OF MEASUREMENT:
Measurement for Payment for flush granite paving band - Tubman, flush granite paving band – Carl

Barron, Flush Granite Paving Band – Carl Barron - On Structure, Granite Planter Curb – Streetscape, Granite Planter Curb – Plaza, and Granite Seat Wall – Tubman shall be based on the Unit Linear Foot, installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Flush Granite Paving Band - Tubman, Flush Granite Paving Band – Carl Barron, Flush Granite Paving Band – Carl Barron - On Structure, Granite Planter Curb – Streetscape, Granite Planter Curb – Plaza, and Granite Seat Wall – Tubman, shall be based on the unit Linear Foot. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, subbases, concrete, reinforcement, mortar, dowels and other incidental work and construction methods to complete the installation as indicated and specified.

EXCLUSIONS
The following items are not included for payment under this item and are included elsewhere: Wood Bench at Granite Seat Wall – Tubman is included in Section 02990 - Site Furnishings.

2995.8 REFURBISHED GRANITE PLANTER WALL LINEAR FOOT

MEASUREMENT AND PAYMENT

METHOD OF MEASUREMENT:
Measurement for Payment for refurbished granite planter wall shall be based on the Unit Linear Foot, installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for refurbished granite planter wall shall be based on the unit Linear Foot. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, cleaning and power-washing, mortar and other incidental work and construction methods to complete the installation as indicated and specified.

2995.9 RECONFIGURED GRANITE PLANTER WALL LINEAR FOOT

MEASUREMENT AND PAYMENT

METHOD OF MEASUREMENT:
Measurement for Payment for reconfigured granite planter wall shall be based on the Unit Linear Foot, installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for repurposed granite planter wall shall be based on the unit Linear Foot. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor for disassembly of existing wall, modification/re-fabrication, re-installation, cleaning and power-washing, equipment, materials, tools, subbases, concrete, reinforcement, mortar, dowels and other incidental work and construction methods to complete the installation as indicated and specified.

2995.10 GRANITE SEATING STONE EACH

METHOD OF MEASUREMENT:
Measurement for Payment for granite seating stone shall be based on the Unit Each, installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for granite seating stone shall be based on the unit Each. The unit price shall constitute full compensation for complete compliance with requirements of these items, including all labor, equipment, materials, tools, subbases, concrete, reinforcement, mortar, dowels and other incidental work and construction methods to complete the installation as indicated and specified.

2995.11 RELOCATED TUBMAN MONUMENT EACH

2995.12 RELOCATED ALVIN THOMPSON MONUMENT EACH

METHOD OF MEASUREMENT:
Measurement for Payment for relocated Tubman Monument and relocated Alvin Thompson Monument shall be based on the Unit Each, installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for relocated Tubman Monument and relocated Alvin Thompson Monument shall be based on the unit Each. The unit price shall constitute full compensation for complete compliance with requirements of these items, including all labor, equipment, materials, tools, subbases, concrete, reinforcement, mortar, dowels and other incidental work and construction methods to complete the installation as indicated and specified.

2995.13 CARL BARRON PLAZA MEMORIAL -GRANITE BLOCK EACH

METHOD OF MEASUREMENT:
Measurement for Payment for Carl Barron Plaza Memorial shall be based on the Unit Each, fabricated and delivered as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Carl Barron Plaza Memorial shall be based on the unit Each. The unit price shall constitute full compensation for complete compliance with requirements of these items, including all labor, equipment, materials, tools, and other incidental work and construction methods to fabricate the granite block for the Carl Barron Memorial Sign, protect and deliver the block to the signage fabricator for completion of the remainder of signage elements.

EXCLUSIONS
The following items are not included for payment under this item and are included elsewhere: furnishing and installing all other components of the Carl Barron Memorial Sign, aside from fabrication and delivery of granite block to the sign fabricator, is included in Section 02990 - Site Furnishings.

2995.14	**SCULPTURAL GRANITE SEATING FEATURE (SMALL)**	**EACH**
2995.15	**SCULPTURAL GRANITE SEATING FEATURE (MEDIUM)**	**EACH**
2995.16	**SCULPTURAL GRANITE SEATING FEATURE (LARGE)**	**EACH**

MEASUREMENT AND PAYMENT

METHOD OF MEASUREMENT:
Measurement for Payment for Sculptural Granite Seating Features small, medium and large shall be based on the Unit Each, fabricated and delivered as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Sculptural Granite Seating Features small, medium and large shall be based on the unit Each. The unit price shall constitute full compensation for complete compliance with requirements of these items, including all labor, equipment, materials, tools, subbases, concrete, reinforcement, mortar, dowels and other incidental work and construction methods to complete the installation as indicated and specified.

END OF SECTION

SECTION 03300

CONCRETE

3300.1	**CAST-IN-PLACE CONCRETE PIPE CONNECTION 12-INCH THROUGH 30-INCH DIAMETER (CAST-IN-PLACE FIELD CLOSURES)**	**EACH**
3300.2	**CONCRETE FOUNDATIONS FOR RIBBON AND TRANSIT SHELTERS**	**LS**
3300.3	**CONCRETE FOUNDATIONS FOR RITSUKO ART INSTALLATION**	**LS**

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing of cast-in-place concrete including formwork, reinforcement concrete, materials, mix design, placement procedures, and finishes.

2. Class A concrete is for reinforced concrete structures, including manhole bases, special structures, pipe collars, reinforced concrete fills, shelter and ribbon structure foundations, equipment pads, and similar items as applicable.

3. Class B concrete is for non-reinforced concrete including cradles, encasements, thrust blocks, plugs, and base for pavements and similar concrete whether reinforced or not.

B. Concrete for sidewalks is described in Section 02524 – CURBS, WALKS AND DRIVEWAYS.

1.2 RELATED TECHNICAL SECTIONS

A. Section 02456 – HELICAL PILES
B. Section 03315 – GROUT
C. Section 05700 – RIBBON STRUCTURE
D. Section 07160 – BITUMINOUS DAMPPROOFING
E. Section 10730 – TRANSIT SHELTERS

1.3 SUBMITTALS

A. Submit the following in accordance with section 01300 – SUBMITTALS:

1. Product Data: For each type of manufactured material and product indicated.

2. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

a. Indicate amounts of mix water to be withheld at plant for later addition at Project site. However, addition of water at project site shall be limited to maximum amount printed on the concrete delivery ticket. Absent this information, no water shall be permitted to be added at project site.

3. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

4. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

a. Cementitious materials and aggregates,

b. Form materials and form-release agents,

c. Steel reinforcement and reinforcement accessories,

d. Admixtures,

e. Waterstops,

f. Curing materials,

g. Bonding agents,

h. Adhesives,

i. Ready-mix concrete producer,

j. Repair materials,

5. Detailed cold-weather protection methods.

6. Qualifications of concrete installer, manufacturer, and testing agency as specified in this Section.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

D. Testing Agency Qualifications: Contractor shall employ a testing agency, acceptable to the Engineer and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 301, "Specification for Structural Concrete."

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, Light Pole Piers, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, ¾ inch by ¾ inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 2 inch to the plane of the exposed concrete surface.

2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing and for walls which are part of water containing tanks or structures.

2.2 STEEL REINFORCEMENT

A. Reinforcing Materials shall have a recycled content of 30% or greater and shall conform to the following standards:

1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

3. Plain-Steel Wire: ASTM A 1064, as drawn.

4. Plain-Steel Welded Wire Reinforcing: ASTM A 1064, fabricated from as-drawn steel wire into flat sheets.

5. Reinforcing shall be uncoated unless indicated otherwise on the Contract Drawings.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

B. Joint Dowel Bars: Plain-steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II.

B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Class: Severe weathering region, but not less than 3S.

2. Nominal Maximum Aggregate Size: 3/4 inch.

C. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

E. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

F. High Range Water Reducing Admixture: ASTM C494, Type F.

G. Crystalline Waterproofing Admixture: Xypex C-Series or approved equal.

2.6 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Ribbed.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Greenstreak.

b. Meadows: W. R. Meadows, Inc.

c. Vinylex Corporation.

B. Hydrophilic Waterstops: Manufactured as self-adhesive strips or caulk, for adhesive bonding to concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Earth Shield Type 23 by J.P. Specialties, Inc..

b. Hydrotite by Greenstreak.

c. Ultra Seal by Adeka Corporation.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. This product shall not be used as a substitution for curing compounds.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Volatile Organic Compounds (VOC) shall meet maximum emission limits of authorities having jurisdiction at project site.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Evaporation Retarder:

i. Eucobar; Euclid Chemical Co.

ii. E-Con; L&M Construction Chemicals, Inc.

iii. Confilm; BASF Construction Chemicals, LLC.

b. Clear, Waterborne, Membrane-Forming Curing Compound, 18 to 22 percent Solids:

i. Klear-Kote WBII 20 percent; Burke Chemicals.

ii. Dress & Seal WB; L&M Construction Chemicals, Inc.

iii. Vocomp-20; W. R. Meadows, Inc.

c. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:

i. Res-Cure; Atlas Tech Products.

ii. Lumiseal WB Plus; L&M Construction Chemicals, Inc.

iii. Vocomp-30; W. R. Meadows, Inc.

2.8 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

2. Fly ash and blast furnace slag shall not be used.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Concrete mixes shall be designed for the classes indicated below and in accordance with the requirements indicated.

Design Mix Schedule								
Class	Specified Compressive Strength (psi)	Minimum Cement Content (lb/cy)	*Maximum Water/ Cementitious Ratio	Admixture				Density and Aggregate Size
				% Air Entrainment	Corrosion Inhibitor (gal./cy)	Fiber Reinforcement (lb/cy)	Silica Fume (% wt. Cement)	
A	4,500	565	0.42	5+/-1	N/A	N/A	N/A	NW-3/4”
B	4,000	565	0.44	5+/-1	N/A	N/A	N/A	NW-3/4”

* Total water in mix at time of mixing, including free water in aggregates.

1. Mix Classifications: The design mix classes indicated above shall be used as indicated on the Drawings and as follows:

   Class A: Class A shall be used on all areas indicated on the drawings as follows: Structural (S Series) and Civil (C Series). Concrete shall be integral with high-range water reducer.

   Class B: Class B shall be used where ever low strength concrete fill is indicated.

2. Slump at point of placement shall be limited to 4”+/- 1”. With addition of high-range water reducer, slump at point of placement shall be limited to 7”+/- 2”.

3. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to City and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by the Engineer before using in work.

D. Admixtures: Subject to Engineer's approval, use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use crystalline waterproofing admixture where indicated in the drawing details and specifications. Bituminous damp-proofing shall not be used as an alternate unless approved by the ENGINEER on a case-by-case basis.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

2.12 COMPRESSIBLE MATERIAL

A compressible foam material is to be placed below the concrete walls of the transit shelters.

A. Compressible fill material shall be an expanded polystyrene (EPS) product.

B. The compressible material shall have a maximum compressive stress of 3 pounds per square inch.

PART 3 – EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch, for concrete surfaces exposed to view.

2. Class B, 1/4 inch, for other concrete surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete where indicated on Drawings.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50°F for 72 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained. When cold weather concrete requirements apply, formwork shall be left-in-place for a minimum of 7 days.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. At least 70% of 28-day design compressive strength.

2. Determine compressive strength of in-place concrete by testing representative field cured test specimens according to ACI 301.

3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

A. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain required concrete cover. Do not tack weld crossing reinforcing bars, unless indicated on the Drawings.

1. Shop- or field-weld reinforcement according to AWS D1.4, only where indicated on the Drawings.

2. Do not install reinforcement into previously placed concrete.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.

2. Form using bulkhead forms with keys, unless otherwise indicated. Leave-in-place bulkhead forms are prohibited.

3. Use a bonding agent at locations where indicated on Drawings, and where fresh concrete is placed against hardened concrete surfaces.

3.7 WATERSTOPS

A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

B. Hydrophilic Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable and in accordance with manufacturer’s typical installation details. Provide minimum depth of concrete cover per manufacturer written instructions.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved in writing by Engineer.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Limit drop height of concrete off of chute to 48-inches.

2. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

4. Concrete shall be carefully consolidated on each side of waterstop.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

6. Pulling of welded wire fabric through wet concrete from subgrade is prohibited.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. The finish of formed surfaces shall proceed concurrently with, or immediately after the repair of surface defects. The selection of finishes shall be as indicated in the table below.

Concrete Finishes (Formed Surfaces) Location	Finish
Footings, exterior walls, pile caps, portions of grade beams below grade and all other concrete not exposed to view	Rough-Formed Finish
Walls, portions of grade beams above grade, and all other concrete surfaces exposed to view. Surfaces to be coated or covered with waterproofing, dampproofing, plaster or paint	Smooth-Formed Finish

B. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

C. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

D. Smooth Rubbed Finish to Permanently Exposed Surfaces: Apply the following to smooth-formed finished concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

3.11 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.

   b. Continuous water-fog spray.

   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and

other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth

of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall employ qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Section.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete, plus one set for each additional 50 cu. yd. or fraction thereof.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40°F and below and when 80°F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

6. Cast and field cure one additional set of four standard cylinder specimens for each composite sample, when outside air temperature is below or expected to fall below 40°F that night. Also provide field cured cylinders to determine strength for form removal.

7. Compressive-Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days, two at 28 days, and one at 56 days.

C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

E. Test results shall be reported in writing to Engineer, City, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by

other methods as directed by Engineer. Petrographical analysis to determine water/cement ratio cement content, hydrated cement content, etc. shall be performed by the testing and inspection agency as directed by the Engineer when test results indicate requirements have not been met.

PART 4 – COMPENSATION

Item 3300.1 --- Cast-In-Place Concrete Pipe Connection 12-inch through 30-inch Diameter (Cast-In-Place Field Closures) - EA

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and leakage testing/inspection of Cast-In-Place Field Closures, complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: exposure and protection of existing underground infrastructure; waterseal/waterstop; reinforcement and doweling; formwork (with removal); Class A and B concrete, and admixtures; brick masonry; dampproofing; concrete testing; and all appurtenances and incidental work.

METHOD OF MEASUREMENT:
Payment for Cast-In-Place Field Closures shall be based on the Unit Price bid in the proposal. Measurement for payment shall be based on the actual numbers of Cast-In-Place Field Closures installed complete and functional as shown on the Contract Drawings or as directed by the City or Engineer.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: trenching (paid under installed pipe item); proposed pipe to be connected; disposal of material.

Item 3300.2 -- CONCRETE FOUNDATIONS FOR RIBBON AND TRANSIT SHELTERS - LS

METHOD OF PAYMENT
Measurement for Concrete Foundations for Ribbon and Transit Shelters shall be based on the unit Lump Sum, installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Lump Sum bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement and installation of the Concrete Foundations for Ribbon and Shelter Foundations, complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: exposure and protection of existing underground infrastructure; waterseal/waterstop; reinforcement and doweling; anchor bolts, formwork (with removal); Class A concrete, and admixtures; dampproofing; concrete testing; excavation, backfill and all appurtenances and incidental work. The Green St. Shelter slabs and pile caps are included in this pay item. The River St. Shelter and Magazine St. Shelter pedestals/columns, footings and

shaft foundations are included in this pay item. The Ribbon Structure spread footings and carry beam footings are included in this pay item.

EXCLUSIONS:
The concrete walls at the River St. Shelter and Magazine St. Shelter, between the pedestals is paid for under Item 10730.1 Shelter 1 -River St. Shelter and 10730.2 – Shelter 2 - Magazine St. Shelter. Helical piles used at the Green St. Shelter are paid for under 2456.2 Helical Piles.

Item 3300.3 --- CONCRETE FOUNDATIONS FOR RITSUKO ART INSTALLATION - LS

METHOD OF PAYMENT
Measurement for Concrete Foundations for Ritsuko Art Installation shall be based on the unit Lump Sum, installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Lump Sum bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement and installation of the Concrete Foundations for Ritsuko Art Installation, complete as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: exposure and protection of existing underground infrastructure; waterseal/waterstop; reinforcement and doweling; anchor bolts, formwork (with removal); Class A concrete, and admixtures; dampproofing; concrete testing; excavation, backfill and all appurtenances and incidental work.

EXCLUSIONS:
Helical piles used at Ritsuko Art Installation location(s) are paid for under 2456.2 Helical Piles.

-END OF SECTION 03300-

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SECTION 03315

GROUT

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, installing, and testing all materials for grout including formwork, materials, mix design, placement procedures, and finishes

2. The following types of grout shall be covered in this Section:

a. Cement Grout

b. Non-Shrink Grout: This type of grout is to be used wherever grout is shown in the Contract Documents, unless another type is specifically referenced.

c. Epoxy Grout

d. Topping Grout

1.2 RELATED TECHNICAL SECTIONS

A. Section 03300 – CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Submit certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of non-shrink and epoxy grout used in the work.

2. Certified testing lab reports for tests indicated herein.

3. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.

4. Certifications that grouts used on the project contain no chlorides or other chemicals that cause corrosion.

5. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. The current ICC-ES or IAPMO-UES report shall be submitted for all epoxy anchor grouts for adhesive anchors.

6. Manufacturer's certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.

7. Submit manufacturer's written warranty as indicated herein.

8. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grouts.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified

B. Field Tests:

1. Cement Grout and Topping Grout

a. Compressive strength of cement grout and topping grout shall be tested in accordance with the requirements of ASTM C 1107. The frequency of tests shall conform to the requirements of Section 03300 – CONCRETE.

2. Prepackaged Grout

a. Compression test specimens shall be taken during construction from the first placement of each type of grout, and for each different batch number of each type of grout thereafter. The specimens will be made by the City or its representative.

b. Compression tests and fabrication of specimens for non-shrink grout shall be performed as specified in ASTM C 109. A set of three specimens shall be made for testing at 24 hour, 28 days, and each additional time period as appropriate.

c. Compression tests and fabrication of specimens for epoxy grout shall be performed as specified in ASTM C 579, Method B. A set of three specimens shall be made for testing at 24 hours, and each earlier time period as appropriate.

3. All grout, already placed, which fails to meet the requirements of these specifications, is subject to removal and replacement at no cost to the City.

4. The cost of all laboratory and field tests on grout shall be borne by the Contractor, and the Contractor shall assist the City in obtaining specimens for testing. The Contractor shall supply all materials necessary for fabricating the test specimens.

C. Construction Tolerances: Construction tolerances shall be as specified in the Section 03300 – CONCRETE, except as modified herein and elsewhere in the Contract Documents.

PART 2 – PRODUCTS

2.1 CEMENT GROUT

A. Cement Grout: Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4500 psi.

B. Cement grout materials shall be as specified in Section 03300 – CONCRETE.

2.2 PREPACKAGED GROUTS

A. Non-Shrink Grout:

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.

2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi; shall have no shrinkage (0.0%) and a maximum 4.0% expansion in the plastic state when tested in accordance with ASTM C-827; and shall have no shrinkage (0.0%) and a maximum of 0.2% expansion in the hardened state when tested in accordance with ASTM C 1090.

3. Class B non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of ASTM C 1090.

4. Application:

a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified in the contract documents; except, for those applications for Class B non-shrink grout and epoxy grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.

b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100% solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all pre-measured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

2. Available Products: Subject to compliance with regulations, products that maybe incorporated into the work include, but not limited to, the following:

a. Five Star DP Epoxy Grout; Five Star Products,

b. Sikadur 42 Grout-Pak; Sika Corporation

c. Materflow 648 CP Plus; BASF

d. or equal.

3. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.

4. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75° F.

5. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 10,000 psi in seven days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0%) and a maximum 4.0% expansion when tested in accordance with ASTM C 827.

6. The epoxy grout shall exhibit a minimum effective bearing area of 95%. This shall be determined by a test consisting of filling a 2-inch diameter by 4-inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.

7. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95°F when tested with 75°F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30 x 10^{-6} inches/inch/degree F when tested according to ASTM C 531 or ASTM D 696.

8. Application: Epoxy grout shall be used for all other applications required in the Contract Documents, unless specified in drawings.

C. Epoxy Anchor Grout:

1. Epoxy anchor grout for use in concrete shall be certified for use in accordance with ICC-ES AC 308.

2. Epoxy anchor grout shall conform to ASTM C 881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete, Type IV, Class B & C, Grade 3 with the exception of gel time.

3. Heat deflection temperature per ASTM D 648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position shall be a minimum 120 degrees F.

4. Manufacturer shall certify that the epoxy anchor grout will maintain 100 percent of its capacity up to a short term temperature of 110 degrees F and 50 percent of its capacity up to a short term temperature of 150 degrees F.

5. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall

also come with a static mixer nozzle to thoroughly mix the hardener and resin together.

6. Epoxy anchor grout shall be capable of being used in submerged applications once cured.

7. Compressive strength per ASTM D 695 – Standard Test Method for Compressive Properties of Rigid Plastics shall be 10,000 psi minimum.

8. Whenever possible, overhead anchors subject to vibration, anchors in fire-resistive construction or high fire risk areas, and anchors subject to working or operating temperatures above 100 degrees F shall be cast-in-place anchors. Whenever cast-in-place anchors cannot be used in these applications, use cement based non-shrink grout and oversized holes.

9. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar unless otherwise noted on the Contract Documents. Embedment shall not exceed 67 percent of the member depth.

10. Epoxy anchor grout shall be **PE1000+ by Powers Fasteners; HIT-RE 500-SD** by **Hilti**, **SET-XP** by **Simpson Strong-Tie**, or equal.

2.3 TOPPING GROUT

A. Grout for topping of slabs shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and procedures specified for normal concrete in Section 03300 – CONCRETE shall apply except as noted otherwise herein.

B. Topping grout shall contain a minimum of 564 pound of cement per cubic yard with a maximum water cement ratio of 0.45.

C. Coarse aggregate shall be graded as follows:

US Standard Sieve Size	Percent By Weight Passing
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.

E. Strength: Minimum compressive strength of topping grout at the end of 28 days shall be 4000 psi.

2.4 CURING MATERIALS

A. Curing materials shall be as specified in Section 03300 – CONCRETE, for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application.

B. The slump for topping grout shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 – EXECUTION

3.1 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be as specified in Section 03300 – CONCRETE. The finish of the grout surface shall match that of the adjacent concrete.

B. The manufacturer of non-shrink grout and epoxy grout shall provide on-site technical assistance.

C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the Engineer.

3.2 GROUTING PROCEDURES

A. Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts

shall be done according to the instructions and recommendations of the manufacturer.

B. Base Plate Grouting:

1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a 1-inch thickness of grout or a thickness as shown on the drawings.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the City, alternate grouting methods shall be submitted for acceptance by the Engineer.

C. Topping Grout:

1. All mechanical, electrical, and finish work shall be completed prior to placement of topping. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.

2. The minimum thickness of grout topping shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45° with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3 ½ inches wide by 1 ½ inches deep.

3. The base slab shall be thoroughly cleaned and wetted prior to placing topping. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping shall be compacted by rolling or tamping, brought to established grade, and floated.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping has hardened sufficiently, it shall be steel troweled to a smooth surface

free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

3.3 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 03315

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SECTION 03410

PLANT-PRECAST STRUCTURAL CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing of underground precast concrete structures, complete and in place, within the limits and to the lines and grades indicated.

B. Refer to Section 02252 – MANHOLES for requirements relating to the following:

1. Jointing and gaskets,

2. Coatings,

3. Castings,

4. Masonry and building inverts,

5. Flexible manhole seals,

6. Installation regarding placing structure in trench, connecting pipes, building inverts, and backfilling,

7. Inspection and testing of completed structures.

1.2 RELATED TECHNICAL SECTION

A. Section 02140 – DEWATERING

B. Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

C. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

D. Section 02252 – MANHOLES

E. Section 02590 – BRICK MASONRY

F Section 03300 – CONCRETE

G. Section 03315 – GROUT

H. Section 07160 – BITUMINOUS DAMPPROOFING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Complete shop drawings which show details in accordance with ACI 315 and ACI 318 for all precast structural concrete units, cast iron frames and covers and appurtenances including:

a. Details of structures, joints and gaskets, construction details, tolerances, and other information as required by the City. Indicate member locations, plans, elevation, dimensions, shapes, cross sections, openings, and types of reinforcement, including special reinforcement.

b. Product Data: For each type of product indicated.

c. Design Mixes: For each concrete mix. Prior to commencing operations, including fabrications of the precast for any mock-up, a statement shall be submitted giving the nominal maximum aggregate size and proportions of all ingredients that will be used in the manufacture of concrete. The statement shall include test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory. A copy shall be submitted of concrete mix with each set of samples.

d. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.

e. Indicate locations and details of anchorage devices to be embedded in other construction.

2. Design drawings and calculations signed and sealed by a Professional Structural Engineer registered in the Commonwealth of Massachusetts to the Engineer.

3. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:

a. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

i. Concrete materials.

ii. Reinforcing materials.

iii. Admixtures.

4. Certificates of Compliance: Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.

5. Qualification Data: List of projects/orders completed in the last 5 years demonstrating capabilities and experience as specified in the Quality Control paragraph of this Section. Include project name and addresses, and other information specified.

6. Submit manufacturer's recommended installation procedures for informational purposes.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

1. Installer Qualifications: An experienced installer who has completed precast structural concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

2. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast structural concrete units similar to those indicated for this Project and with a record of successful in-service performance.

a. Assumes responsibility for engineering precast structural concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified Professional Engineer.

b. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of

precast structural concrete that are similar to those indicated for this Project in material, design, and extent.

c. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group C, Category C1.

d. Has sufficient production capacity to produce required units without delaying the Work.

3. Testing Agency Qualifications: An independent testing agency, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

4. Design Standards: Comply with ACI 318 and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."

5. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and camber and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products."

6. Product Options: Drawings indicate size, profiles, and dimensional requirements of precast concrete units and are based on the specific types of units indicated. Other fabricators' precast concrete units complying with requirements may be considered.

7. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."

B. City reserves right to inspect and test by independent services at manufacturer’s plant or elsewhere at his own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

1.6 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Dead Loads: 130 pcf soil load on roof.

2. Live Loads: AASHTO HS-20.

3. Lateral Earth Pressure; 90 psf/ft below ground level.

4. Internal Fluid Pressure: Based on unit weight of 63 pcf filled from invert to finished grade with no external soil pressure.

5. Traffic Surcharge:

   a. Vertical Load: 240 psf at the ground surface level.

   b. Lateral Load: 120 psf at the side of the wall applied over the full height of the wall.

6. Seismically induced earth pressure is not required by Geotechnical Design recommendations from Brierley Associates, LLC.

7. Maximum allowable bearing pressure at the bottom of foundation support shall be 2000 psf. Provide 12 inches of compacted crushed stone over the compacted bearing surface.

PART 2 – PRODUCTS

2.1 GENERAL

A. Each structure section shall be constructed with a bell-and-spigot or tongue-in-groove joint.

B. Structure flat tops shall be reinforced and not less than 8 inches thick. Manhole openings shall have a minimum inside diameter of 24 inches.

C. All exterior concrete surfaces shall be coated with bituminous dampproofing as per Section 07160 – BITUMINOUS DAMPPROOFING.

D. Jointing shall be O-ring gaskets or butyl rubber molding sealants. All joints shall be provided so as to be watertight under all conditions of service. The ends of base, riser, and top sections to be jointed using neoprene “O-ring” type joints shall be designed to enclose the gasket on four surfaces when the joint is in its final position.

E. Mortar for Brickwork shall be provided per Section 02590 – BRICK MASONRY.

F. Bricks shall be provided per Section 02560 – BRICK MASONRY.

G. Structure castings shall be provided per Section 02252 – MANHOLES.

2.2 MOLD MATERIALS

A. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes.

2.3 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

C. Steel Bar Mats: ASTM A 184, assembled with clips, as follows:

1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.

D. Plain-Steel Wire: ASTM A 82, as drawn.

E. Plain-Steel Welded Wire Fabric: ASTM A 85, fabricated from as-drawn steel wire into flat sheets.

F. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to CRSI's " PCI MNL 116, and as follows:

1. For uncoated reinforcement, use all-plastic CRSI Class 1 plastic-protected bar supports.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, of same type, brand, and source.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 4S.

C. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

D. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

E. Water-Reducing Admixture: ASTM C 494, Type A.

F. Retarding Admixture: ASTM C 494, Type B.

G. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

H. Ground Granulated Blast Furnace Slag: ASTM C 989, Grade 100 or better.

2.5 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36.

B. Carbon-Steel Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished; AWS D1.1, Type A or B, with arc shields.

C. Malleable Steel Castings: ASTM A 47.

D. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706.

E. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.

F. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

G. Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123, after fabrication.

1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94% zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

H. Welding Electrodes: Comply with AWS standards.

I. Accessories: Provide clips, hangers, plastic shims, and other accessories required to install precast structural concrete units.

2.6 STAINLESS-STEEL CONNECTION MATERIALS

A. Stainless-Steel Plate: ASTM A 666, Type 316L, of grade suitable for application.

B. Stainless-Steel Bolts and Studs: ASTM F 593, alloy 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.

C. Stainless-Steel Headed Studs: ASTM A 276.

2.7 CONCRETE MIXES

A. Prepare design mixes for each type of concrete required.

B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318.

D. Normal-Weight Concrete: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Specified Compressive Strength (28 Days): f'c 5,000 psi.

2. Maximum Water-Cementitious Materials Ratio: 0.440.

3. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows, with a tolerance of plus or minus 1-1/2 percent:

a. Air Content: 6% for 1-inch nominal maximum aggregate size.

b. Air Content: 6% for 3/4-inch nominal maximum aggregate size.

c. Air Content: 7% for 1/2-inch nominal maximum aggregate size.

E. Other Admixtures: Use water-reducing, high-range water-reducing, water-reducing and accelerating, or water-reducing and retarding admixtures according to manufacturer's written instructions.

F. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.8 FABRICATION

A. Formwork: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances.

1. Coat surfaces of forms with bond-breaking compound before reinforcement is placed. Provide commercial-formula, form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete

surfaces requiring bond or adhesion. Apply in compliance with manufacturer's written instructions.

B. Built-in Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless approved by Engineer.

C. Cast-in openings larger than 10 inches in diameter or 10 inches square according to Shop Drawings. Smaller holes may be field cut by trades requiring them, as approved by Engineer.

D. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.

2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.

3. Place reinforcement to obtain at least the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Mix concrete according to PCI MNL 116 and requirements in this Section. After concrete batching, no additional water may be added.

F. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 116 for measuring, mixing, transporting, and placing concrete.

G. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 116.

H. Comply with ACI 306.1 procedures for cold-weather concrete placement.

I. Comply with ACI 305R recommendations for hot-weather concrete placement.

J. Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint casting date on each precast concrete unit on a surface that will not show in finished structure.

K. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

L. Product Tolerances: Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product tolerances.

M. Finish formed surfaces of precast structural concrete as indicated for each type of unit, and as follows:

1. Standard Finish: Normal plant-run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls will be tolerated. Major or unsightly imperfections, honeycombs, or structural defects are not permitted.

N. Screed finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections.

1. Apply scratch finish to precast concrete units that will receive concrete fill after installation. After initial strikeoff, transversely scarify surface to provide ridges approximately 1/4 inch deep.

O. Repair of damaged epoxy coating, when required, shall be made with patching material conforming to ASTM A 775. Repair shall be in accordance with the material Manufacturer's recommendations.

2.9 SOURCE QUALITY CONTROL

A. Contractor will employ an independent testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.

1. Allow Contractor’s testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with City's testing agency and provide samples

of materials and concrete mixes as may be requested for additional testing and evaluation.

B. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements.

C. Strength of precast concrete units will be considered deficient if units fail to comply with PCI MNL 116 requirements, including the following:

1. Units fail to comply with compressive-strength test requirements.

2. Reinforcement of units do not comply with fabrication requirements.

3. Concrete curing and protection of units against extremes in temperature fail to comply with requirements.

4. Units are damaged during handling and erecting.

D. Testing: If there is evidence that the strength of precast concrete units may be deficient or may not comply with PCI MNL 16 requirements, Engineer may employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42.

1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer.

2. Cores will be tested in an air-dry condition per ACI 301 if units will be dry under service conditions.

3. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75% of the 28-day design compressive strength.

4. Test results will be made in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:

a. Project identification name and number.

b. Date when tests were performed.

c. Name of precast concrete fabricator.

d. Name of concrete testing agency.

e. Identification letter, name, and type of precast concrete unit or units represented by core tests; design compressive strength; type of break; compressive strength at break, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Dimensional Tolerances: Units with dimensions smaller or larger than required and not complying with tolerance limits may be subject to additional testing.

1. Precast concrete units with dimensions larger than required will be rejected if the appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units, as required, to comply with construction conditions.

G. Defective Work: Precast concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with qualified welders.

1. Protect precast concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.

2. Repair damaged metal surfaces by cleaning and applying a coat of galvanized repair paint to galvanized surfaces.

B. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless approved by Engineer.

C. Erection Tolerances: Install precast concrete units level, plumb, square, and true, without exceeding the recommended erection tolerances in PCI MNL 127, "Standards and Guidelines for the Erection of Precast Concrete Products".

D. Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at keyways, connections, and joints as follows:

1. Provide forms or other approved method to retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

3.3 FIELD QUALITY CONTROL

A. Testing: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Field welds and connections using high-strength bolts will be subject to tests and inspections.

C. Testing agency will report test results promptly and in writing to Contractor and Engineer.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.4 CLEANING

A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.

1. Wash and rinse according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.

3.5 PROTECTION

A. Adjacent surfaces shall be protected from damage during sealing and cleaning operations and against damage, disfiguration or discoloration from subsequent operations. Noncombustible shielding shall be used during welding operations.

PART 4 – COMPENSATION (NOT USED)

END OF SECTION

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SECTION 04200
STONE CLADDING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Stone Cladding at the bus shelters, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

1.2 RELATED SECTIONS

A. Section 03300 – CONCRETE

B. Section 03315 – GROUT

C. Section 07600 – FLASHING AND SHEET METAL

D. Section 10730 – TRANSIT SHELTERS

1.3 QUALITY ASSURANCE

A. Materials, Anchors and Installation Standards:
   1. Installer Qualifications: Engage experienced installer that has at least ten years' experience and has completed stone installation similar in material, design, and extent to that indicated for the project. Stone veneer installer assumes undivided responsibility for work of this section including design, engineering, fabrication and installation of stone veneer system.
   2. Fabricator Qualifications: Engage experienced fabricator that has at least ten years' experience and has completed stone fabrication similar in material, design, and extent to that indicated for the project and is equipped to provide quantities shown. Granite shall be fabricated by a firm approved by the Engineer.
   3. Provide Dimension Stone Cladding engineered to support dead, live, and lateral (wind or seismic) loads indicated.
      a. Design anchors and connection hardware for dead load, wind load and seismic load in accordance with applicable building codes.
      b. Required details defining method of fastening throughout system and attachments to supporting primary structure included in engineering requirement.
   4. Comply with provisions of ACI 530 and ACI 530.1, except where exceeded by requirements of the contract documents.

B. Mock Up Wall:
   1. Construct minimum 4 FT mock-up wall showing typical details, treatment and anchoring.
   2. Accepted mockup may remain part of building.

1.4 SUBMITTALS

A. Product Data:
   1. For each type of material and accessory.

B. Shop Drawings:
   1. Setting drawings.
   2. Indicate on shop drawings layout, pertinent dimensions, anchorages, and jointing methods.

C. Samples:
   1. Granite: Minimum 12 IN square samples of each color type.
      a. Color noted in section 2.2 below is base color. Final color to be selected by the City from the samples.

2. Mortar: four color samples of each type of mortar and color for each stone type and finish for pointing in 6-inch long by 1/2 inch wide samples strips of grout set in aluminum or plastic channels. Samples shall show full range of exposed color and texture to be expected in finished work.
3. Joint Sealant: color samples of each type and color of sealant for each stone type and finish. Sealant to include textured appearance.

D. Project Information:
1. Structural calculations for Cold Formed Metal Framing indicating design conforms to specified design criteria, sealed by the Specialty Structural Engineer.
a. Submit concurrent with Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Base:
1. Cold Spring Granite.

B. Optional:
1. _____.

C. Other manufacturers desiring approval comply with Section 01600.

2.2 MATERIALS

A. Granite Cladding and Sills:
1. Color:
a. Base: Cold Spring Charcoal Black
b. Final color to be selected by the owner from samples. Submit samples of (4) colors in a similar color family as the base color for final selection.
2. Opalescent, sound and free from defects which would materially impair strength, durability or appearance.
3. Uniform in texture, free from freak colorations.
4. Non-absorbent, free from reads, rifts, seams, spalls, chips and minerals which by weathering would tend to discolor, deteriorate, streak or stratify.
5. Polish finish exposed surfaces.
6. Thickness: 7/8 IN, or as indicated.

B. Mortars and grout: See Section 03315.

C. Anchors and fasteners:
1. Material for all anchor types: Type 316 Stainless Steel unless otherwise noted.
2. Anchors for general use:
a. Of sufficient length to anchor to backing.
b. Of sufficient size and configuration for support of stone and applicable superimposed loads.
3. Cramps:
a. 3/16 x 1 x 8 IN long after ends are turned up 1-1/2 IN.
b. Where doweling is required in addition to cramping, form cramps with dowel welded to underside of cramp.
4. Dowels: Size and length as required.
5. Spacing: Provide minimum of 2 anchors at top and bottom per stone wall panel, and minimum 2 anchors per sill stone.
6. Bolts, nuts, and washers: Stainless steel type 316.

D. Sealant: See Section 07920

E. Mortar:
1. Setting bed mortar mix for granite:

a. Cement: conform to ASTM C 150, Type I or Type II, except Type III may be used for setting granite in cold weather
    1) Provide natural color or white cement as required to produce mortar color indicated.
b. Hydrated Lime: ASTM C 207, Type S.
c. Mortar aggregate: complying with ASTM C144, well graded, except for very thin joints (less than % inch) use gradation with 100% passing No. 16 sieve.
d. No calcium chloride or admixtures containing calcium chloride shall be used.
e. Mortar Proportions:
    1) 1 part white Portland cement, ¾ part lime, 4-3/4 to 5-1/4 parts bulked sand.

2. Mortar mix for pointing of joints:
    a. Cement: conform to ASTM C 150, Type I or Type II, except Type III may be used for setting granite in cold weather.
        1) Provide natural color or white cement as required to produce mortar color indicated.
    b. Hydrated Lime: ASTM C 207, Type S.
    c. Mortar aggregate: complying with ASTM C144, well graded, except for very thin joints (less than % inch) use gradation with 100% passing No. 16 sieve
    d. No calcium chloride or admixtures containing calcium chloride shall be used.
    e. Mortar pigments: Natural and synthetic iron oxides. Use pigments with a record of satisfactory performance in mortar. Pigments shall contain no carbon black. Pigments shall have mineral oxide pigment and be certified by supplier to be resistant to alkali, Wit, and weather, and be of a chemical composition unaffected by cement and free of water and soluble salts. Color pigment shall not exceed 10% of Portland cement in mortar.
        1) Color: as selected by Engineer.
    f. Mortar Proportions:
        1) 1-part white Portland cement, ¾ part lime, 4-3/4 to 5-1/4 parts bulked sand plus pigment as required to achieve approved color.

F. Expansion Joint Filler:
1. Flexible foam expansion joint filler in conformance to D 5249, Type 2, ASTM D 1752, Sections 5.1 through 5.4, with the compression requirement modified to 10 psi (7.03 g/mm²) minimum and 25 psi (17.58 g/mm²) maximum and as follows:
    a. CERAMAR Flexible Foam Expansion Joint Filler manufactured by W.R. Meadows, Inc., Elgin, IL or approved equivalent product.

G. Backer Rod:
1. Continuous round rod of 100% closed cell polyethylene foam, complying with requirements of ASTM C-272.

2.3 FABRICATION

A. Make arises sharp and true with edges slightly eased.

B. Perform cutting, dressing, drilling, fitting, and other preparations of stone.
1. Include work as required to accommodate or fit work of other trades, such as cutting and fitting for pipes, conduits, structural work, etc.
2. Do not cut stone until shop drawings are approved.

C. Completely cut and finish before delivery to site except as necessary for fitting.

D. Cut accurately to shape and dimensions with joints as indicated.
1. Lay stone with 3/16 IN face joints.
2. Form exposed faces true and without wind.
3. Make beds and joints straight, at right angles to face.

E. Saw or dress backs parallel to wall face.
1. Where bonding occurs, arrange backs to fit lay of masonry backing.
2. Shape beds for stone resting on structural work to fit support.

3. Solidly back check stone coming in contact with structural steel or fireproofing.
4. Do not impair strength or stone bearing capacity.

F. Cut stone to set on its natural bed.

G. Cut holes and sinkages in stone for anchors, dowels or cramps specified or required to execute work properly.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify suitability of substrates to accept installation of stone work.

B. Start of installation constitutes acceptance of substrate conditions and responsibility for performance.

3.2 PREPARATION

A. Prior to setting, waterproof back of stone using non-staining material approved for use by manufacturer and satisfactory to Architect.

B. When ready for setting, clean stones, removing dirt or foreign matter from edges and surfaces.

C. Do not use wire brushes.

3.3 INSTALLATION

A. Erect stone in accordance with stone supplier's instructions and erection drawings.

B. Arrange stone pattern to provide a consistent joint width of 1/4 IN throughout.

C. Securely fix in place supporting anchors and inserts prior to installing setting bed.

D. Provide setting bed and pointing mortar in accordance with this section.

E. Place setting buttons and set stone in full mortar setting bed to support stone over full bearing surface and to establish joint dimensions.

F. Shore and maintain panel in position without movement for seven days after setting.

G. Fill dowel, clevis, and lifting holes with mortar.

H. Rake joints 5/8 to 3/4 IN and brush mortar joint clean to accommodate pointing mortar.

I. Fill Joints with pointing mortar.

J. Tool surface to a concave joint.

K. Install flashings of longest practical length, lap end joint minimum 6 IN and seal watertight to back-up.

3.4 TOLERANCES

A. Positioning of elements: Maximum 1/4 IN from true position.

B. Maximum variation from plan of wall: 1/4 IN in 10 FT; 1/2 IN in 50 FT.

C. Maximum variation between face planes of adjacent panels: 1/16 IN.

D. Maximum variation from plumb: 1/4 IN per story non-cumulative; 1/2 IN in any two stories.

E. Maximum variation from level coursing: 1/8 IN in 3 FT; in 1/4 IN in 10 FT; 1/2 IN maximum.

F. Maximum variation of joint thickness 1/8 IN in 3 FT or 1/4 the joint width, whichever is less.

3.5 PROTECTION AND CLEANING

A. Box and maintain projecting stone sills and stonework.

B. Just before project is completed, remove boxing and clean with fiber brushes, mild detergent and water.

C. Remove and replace units having stains which cannot be removed by cleaning.

D. Remove and replace units requiring patching or repairing.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZINE ST. SHELTER	(LS)

END OF SECTION

SECTION 05100

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, installing, and testing all structural steel and architecturally exposed structural steel.

1.2 RELATED TECHNICAL SECTIONS

A. Section 03300 – CONCRETE
B. Section 05700 – RIBBON STRUCTURE
C. Section 09900 – PAINTING
D. Section 10730 – TRANSIT SHELTERS

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Include embedment drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length and type of each weld.

4. Indicate type, size and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.

5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding Certificates: Certificate from AWS indicating certification in type of welding required for each welder and welding operator.

D. Welding Records and Data:

1. Before welding, submit the procedure which will be used for qualifying welders and welding procedures. For procedures other than those pre-qualified in accordance with AWS D1.1, submit a copy of procedure qualification test records.

2. Submit certified copy of qualification test records for each welder, welding operator, and tacker who will be employed in the work.

3. If field welding is permitted, submit descriptive data for field welding equipment.

4. Submit all NDE records (radiographs, ultrasonic, magnetic particle) and visual inspection reports upon completion or when otherwise requested by the Engineer.

E. Qualification Data: For installer, fabricator, professional engineer, testing agency, welding inspectors, NDE inspectors and galvanizer. Submit prior to starting work.

F. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.

2. Bolts, nuts, and washers including mechanical properties and chemical analysis.

3. Direct-tension indicators.

4. Tension-control, high-strength bolt-nut-washer assemblies.

5. Shear stud connectors.

6. Shop primers.

7. Non-shrink grout.

1.4 QUALITY CONTROL

A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is certified for: Steel Building Structures (STD); or Simple Steel Bridge Structures (SBD); or Major Steel Bridges (CBR) as applicable. Fabricator must be experienced in steel member rolling (bending) and provide examples of five similar projects including rolling of HSS members.

B. Galvanizer Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of five years experience in the successful application of galvanized coatings specified in this Section in the facility where the work is to be performed and who will apply the coatings within the same facility.

C. Installer Qualifications: A qualified installer with previous experience in installing structural steel.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"

F. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges"

2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2"

3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" and "Load and Resistance Factor Design Specification for Structural Steel Buildings"

4. AISC's "Specification for the Design of Steel Hollow Structural Sections"

5. AISC's "Specification for Allowable Stress Design of Single-Angle Members" and "Specification for Load and Resistance Factor Design of Single-Angle Members"

6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts"

G. Tests and Inspection

1. The Contractor will test and inspect high-strength bolted connections and welded connections and prepare test reports. Specialty tests shall be performed at no expense to the City by an independent testing laboratory approved by the Engineer. Costs of specialty tests shall be borne by the Contractor. Test reports shall be submitted to the Engineer for approval.

2. The Engineer reserves the right to inspect high-strength bolted connections and weld connections. Provide access to places where structural steel work is being fabricated or erected so that required inspection and testing can be accomplished at no change in Contract Price. At times, inspection may require moving or handling of steel to permit proper inspection. Notify Materials Testing Laboratory not less than 48 hours prior to start of fabrication.

3. The Engineer may inspect structural steel at the plant before shipment; however, the Engineer reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.

4. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements at the Contractor's expense. Perform additional tests, at no ex

pense to the City, as may be necessary to reconfirm any non-compliance of the original work, and as may be necessary to show compliance of corrected work.

5. Specialty Tests: Nondestructive examination of welds in accordance with provisions of AWS D1.1 and ASTM Standards noted shall be made in accordance with the following schedule:

   a. Radiographic Examination of Welds, per ASTM E94 and E142:

      1) Field, complete joint penetration groove welds:

         a) 1 out of 5 (20 percent) with thickness equal to or less than 3/4 inch.

         b) 100 percent with thickness greater than 3/4 inch.

      2) Shop, complete joint penetration groove welds:

         a) 1 out of 10 (10 percent) with thickness equal to or less than 3/4 inch.

         b) 1 out of 2 (50 percent) with thickness greater than 3/4 inch and equal to or less than 1-1/2 inches.

         c) 100 percent for thickness greater than 1-1/2 inches.

   b. Ultrasonic Examination, per ASTM E164: Complete joint penetration groove butt welds not accessible for radiographic examination shall be subjected to ultrasonic testing. The extent shall be the same as noted for radiographic examination. Ultrasonic examination shall be made 48 to 72 hours after welding at locations on weldments or welded joints subject to high restraint as indicated in order to check for lameller tearing. The exact location of the areas to be inspected shall be determined with the Engineer at the time of fabrication. This examination shall be made according to the following schedule unless conditions of tearing require a greater number of tests, as directed:

      1) 1 out of 10 (10 percent) for thickness equal to or less than 3/4 inch.

      2) 1 out of 5 (20 percent) for thickness greater than 3/4 inch and equal to or less than 1-1/4 inches.

      3) 1 out of 2 (50 percent) for thickness greater than 1-1/4 inches.

   c. Magnetic Particle Examination, per ASTM E709, field and shop:

1) 1 out of 5 (20 percent) of complete joint penetration groove welds of tee and corner joints.

2) 1 out of 10 (10 percent) of partial joint penetration groove and fillet welds.

d. Penetrant Examination, per ASTM E165: Shall be used for detecting discontinuities that are open to the surface use as appropriate.

6. Visual Examination: All welds whether otherwise examined or not shall be visually examined and faulty joints shall be marked for correction.

7. When any testing, examination or inspection reveals faulty welds, all joints of the same type shall be checked at no expense to the City until the integrity of the weld is assured before resuming examination.

8. After faulty welds have been corrected or repaired, they shall each be re-examined at no expense to the City in the manner specified for the original joint.

9. It is intended that inspections shall be performed to permit an orderly flow of completed material from the shop. Work with the Engineer to establish a schedule that will permit this.

10. Test result information shall be forwarded to the Engineer immediately after test results are available stating the acceptance or rejection of fabricated pieces in order that the repairs and re-inspection may be made as soon as possible.

H. Pre-Installation Conference: Contractor shall schedule a meeting to be attended by Contractor, Engineer, fabricator and galvanizer. Agenda shall include the following: Project schedule, source for each fabrication, coordination between fabricator and galvanizer and adjacent Work, finish of surfaces, application of coatings, submittals, and approvals.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Structural Steel:

1. Channels, Angles, M-Shapes, S-Shapes, W-Shapes: ASTM A36.

2. Plate and Bar: ASTM A36.

3. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

4. Steel Pipe: ASTM A 53, Type E or S, Grade B.

5. Medium-Strength Steel Castings: ASTM A 27, Grade 65-35 carbon steel.

6. High-Strength Steel Castings: ASTM A 148,Grade 80-50, carbon or alloy steel.

7. Welding Electrodes: Comply with AWS requirements.

B. Miscellaneous Materials:

1. Galvanizing Repair Paint: Coatings meeting requirements of ASTM A 780.

2. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.2 BOLTS, CONNECTIONS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

B. Finish: Hot-dip zinc coating, ASTM A 153, Class C.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish, mechanically deposited zinc coating, ASTM B 695, Class 50.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Anchor Rods: ASTM F 1554, grade as applicable, hot-dip zinc coating, ASTM A 153, Class C.

F. Threaded Rods: ASTM A 193, grade as applicable, hot-dip zinc coating, ASTM A 153, Class C.

G. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

H. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by the structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using the American Institute of Steel Construction's (AISC) "Manual of Steel Construction, Load and Resistance Factor Design", Volume 2, Part 9.

2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

PART 3 – EXECUTION

3.1 FABRICATION AND INSTILLATION REQUIREMENTS

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design".

1. Camber structural-steel members where indicated.

2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.

3. Mark and match-mark materials for field assembly.

4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.

1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.

2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

H. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches o.c., unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.

2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

1.1 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is certified for: Steel Building Structures (STD); or Simple Steel Bridge Structures (SBD); or Major Steel Bridges (CBR) as applicable

B. Galvanizer Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of five years experience in the successful application of galvanized coatings specified in this Section in the facility where the work is to be performed and who will apply the coatings within the same facility.

C. Installer Qualifications: A qualified installer with previous experience in installing structural steel.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"

E. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges"

2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2"

3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" and "Load and Resistance Factor Design Specification for Structural Steel Buildings"

4. AISC's "Specification for the Design of Steel Hollow Structural Sections"

5. AISC's "Specification for Allowable Stress Design of Single-Angle Members" and "Specification for Load and Resistance Factor Design of Single-Angle Members"

6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts"

F. Tests and Inspection

1. The Contractor will test and inspect high-strength bolted connections and welded connections and prepare test reports. Specialty tests shall be performed at no expense to the City by an independent testing laboratory approved by the Engineer. Costs of specialty tests shall be borne by the Contractor. Test reports shall be submitted to the Engineer for approval.

2. The Engineer reserves the right to inspect high-strength bolted connections and weld connections. Provide access to places where structural steel work is being fabricated or erected so that required inspection and testing can be accomplished at no change in Contract Price. At times, inspection may require moving or handling of steel to permit proper inspection. Notify Materials Testing Laboratory not less than 48 hours prior to start of fabrication.

3. The Engineer may inspect structural steel at the plant before shipment; however, the Engineer reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.

4. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements at the Contractor's expense. Perform additional tests, at no expense to the City, as may be necessary to reconfirm any non-compliance of the original work, and as may be necessary to show compliance of corrected work.

5. Specialty Tests: Nondestructive examination of welds in accordance with provisions of AWS D1.1 and ASTM Standards noted shall be made in accordance with the following schedule:

   a. Radiographic Examination of Welds, per ASTM E94 and E142:

      1) Field, complete joint penetration groove welds:

         a) 1 out of 5 (20 percent) with thickness equal to or less than 3/4 inch.
         b) 100 percent with thickness greater than 3/4 inch.

      2) Shop, complete joint penetration groove welds:

a) 1 out of 10 (10 percent) with thickness equal to or less than 3/4 inch.
b) 1 out of 2 (50 percent) with thickness greater than 3/4 inch and equal to or less than 1-1/2 inches.
c) 100 percent for thickness greater than 1-1/2 inches.

b. Ultrasonic Examination, per ASTM E164: Complete joint penetration groove butt welds not accessible for radiographic examination shall be subjected to ultrasonic testing. The extent shall be the same as noted for radiographic examination. Ultrasonic examination shall be made 48 to 72 hours after welding at locations on weldments or welded joints subject to high restraint as indicated in order to check for lameller tearing. The exact location of the areas to be inspected shall be determined with the Engineer at the time of fabrication. This examination shall be made according to the following schedule unless conditions of tearing require a greater number of tests, as directed:

1) 1 out of 10 (10 percent) for thickness equal to or less than 3/4 inch.
2) 1 out of 5 (20 percent) for thickness greater than 3/4 inch and equal to or less than 1-1/4 inches.
3) 1 out of 2 (50 percent) for thickness greater than 1-1/4 inches.

c. Magnetic Particle Examination, per ASTM E709, field and shop:

1) 1 out of 5 (20 percent) of complete joint penetration groove welds of tee and corner joints.
2) 1 out of 10 (10 percent) of partial joint penetration groove and fillet welds.

d. Penetrant Examination, per ASTM E165: Shall be used for detecting discontinuities that are open to the surface use as appropriate.

6. Visual Examination: All welds whether otherwise examined or not shall be visually examined and faulty joints shall be marked for correction.

7. When any testing, examination or inspection reveals faulty welds, all joints of the same type shall be checked at no expense to the City until the integrity of the weld is assured before resuming examination.

8. After faulty welds have been corrected or repaired, they shall each be re-examined at no expense to the City in the manner specified for the original joint.

9. It is intended that inspections shall be performed to permit an orderly flow of completed material from the shop. Work with the Engineer to establish a schedule that will permit this.

10. Test result information shall be forwarded to the Engineer immediately after test results are available stating the acceptance or rejection of fabricated pieces in order that the repairs and re-inspection may be made as soon as possible.

G. Pre-Installation Conference: Contractor shall schedule a meeting to be attended by Contractor, Engineer, fabricator and galvanizer. Agenda shall include the following: Project schedule, source for each fabrication, coordination between fabricator and galvanizer and adjacent Work, finish of surfaces, application of coatings, submittals, and approvals.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.3 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions and directions for installation.

PART 2 - **PRODUCTS**

2.1 STRUCTURAL-STEEL MATERIALS

A. Channels, Angles, M-Shapes, S-Shapes, W-Shapes: ASTM A 572, Grade 50.

B. Plate and Bar: ASTM A 572/A 572M, Grade 50.

C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

D. Steel Pipe: ASTM A 53, Type E or S, Grade B.

E. Medium-Strength Steel Castings: ASTM A 27, Grade 65-35 carbon steel.

F. High-Strength Steel Castings: ASTM A 148,Grade 80-50, carbon or alloy steel.

G. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating, ASTM A 153, Class C.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish, mechanically deposited zinc coating, ASTM B 695, Class 50.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

D. Anchor Rods: ASTM F 1554, grade as applicable, hot-dip zinc coating, ASTM A 153, Class C.

E. Threaded Rods: ASTM A 193, grade as applicable, hot-dip zinc coating, ASTM A 153, Class C.

F. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

G. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: Coatings meeting requirements of ASTM A 780.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design".

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.

1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.
2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

H. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches o.c., unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Complete welds in accordance with the Contract Drawings.

1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
3. Insufficient welds shall be rejected and corrected until required profiles are met.
4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
    a. Grind butt welds flush.
    b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
5. No skip welds will be permitted for steel connections to be coated.

2.6 STEEL PRIMERS AND FINISHES

A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for The Society for Protective Coatings (SSPC) surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 10/NACE No. 2, "Near White Metal Blast Cleaning"
2. Interiors (SSPC Zone 1A): SSPC-SP 6, "Commercial Blast Cleaning"
3. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, embedded in concrete or masonry, unless otherwise indicated. Extend priming of partially embedded members to a depth of 2 inches.
4. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel" for shop painting.
5. Comply with SSPC-PA 2, "Measurement of Dry Coating Thickness with magnetic Gages”

B. Zinc-Rich Primer: Urethane zinc rich primer compatible with topcoat Specified in Section 09900. Provide primer with a VOC content of 340 g/L (2.8 lb/gal.) or less per OTC ozone standards. Provide Tnemec Series 394 or Ameron 5105 or equal by DuPont or Carboline for exposed steel to be fireproofed, or Tnemec Series 901K97 Series or 90-97 or Ameron 68HS or equal by DuPont or Carboline for exposed steel to be finish painted at 3.0 mils DFT.

C. Primer for Exposed Steel to Receive Multi-Coat Shop-Applied Coating: Tnemec Series 901K97 or 90-97 urethane zinc rich primer at 3.0 to 3.5 mils DFT, topcoated in shop with Tnemec Series V73 Endura-Shield, or use Ameron Series 68HS Primer at 3.0 to 5.0 mils DFT topcoated in shop with Ameron's Amercoat 450H, or use or equal primers and finish coats from DuPont or Carboline.

D. Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards. The galvanizing bath shall contain high grade zinc and other earthly materials. Fill vent holes and grind smooth after galvanizing.

E. Hot-Dip Galvanizing And Factory-Applied Primer for Steel: Provide hot-dip galvanizing and factory-applied prime coat, certified OTC/VOC compliant less than 2.8 lbs/gal. and conforming to EPA and Commonwealth of Massachusetts requirements. Apply primer within 12 hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Blast cleaning of the surface is unacceptable for surface preparation. Primer shall have a minimum two year re-coat window for application of finish coat. Coatings must meet or exceed the following performance criteria:

1. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
2. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
3. Humidity Resistance: ASTM D 4585.
4. Salt Spray (Fog): ASTM B 117.

F. Hot-Dip Galvanizing and Factory-Applied Urethane Primer and Finish for Steel: Provide factory-applied architectural coating over primed hot-dip galvanized steel matching approved samples.

1. Primer coat shall be factory-applied polyamide epoxy primer. Apply primer within 12 hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.
2. Finish coat shall be factory-applied color-pigmented architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment

meeting applicable environmental regulations and as recommended by the finish coating manufacturer.

3. Coatings shall be certified OTC/VOC compliant and conform to applicable regulations and EPA standards.

4. Apply the galvanizing, primer and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.

5. Blast cleaning of the galvanized surface is not acceptable.

6. Primer shall meet or exceed the following performance criteria:

    a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
    b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
    c. Humidity Resistance: ASTM D 4585.
    d. Salt Spray (Fog): ASTM B 117.

7. Finish coat shall meet or exceed the following performance criteria:

    a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
    b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
    c. Graffiti Resistance: After drying for seven days, no staining from acrylic, epoxy, epoxy-ester and alkyd spray paints, ballpoint pen, crayons, magic marker, black shoe polish and lipstick.
    d. Weathering: ASTM D 1014, 45 degrees facing south.
    e. Surface Burning Characteristics: ASTM E 84
    f. QUV: ASTM G53, ES-40 bulbs, 4 hours light, 4 hours dark.
    g. Salt Spray (Fog): ASTM B 117.

8. Clearcoat over finish coat shall meet or exceed the following performance criteria:

    a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
    b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
    c. Graffiti Resistance: After drying for seven days, no staining from acrylic, epoxy, epoxy-ester and alkyd spray paints, ballpoint pen, crayons, magic marker, black shoe polish and lipstick.
    d. Weathering: ASTM D 1014, 45 degrees facing south; and ASTM D 4141C EMMAQUA-NTW.
    e. QUV: ASTM G53, ES-40 bulbs, 4 hours light, 4 hours dark.
    f. Salt Spray (Fog): ASTM B 117.
    g. Flexibility: ASTM D 522, Method B, cylindrical mandrel.
    h. Hardness: ASTM D 3363 (Pencil).

PART 3 - **EXECUTION**

3.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements. Elevations shall be verified by a surveyor licensed in the Commonwealth of Massachusetts.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges".

B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
3. Snug-tighten or pretension anchor rods as applicable after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges".

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint indicated on the Drawings.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

    a. Grind butt welds flush.

b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
c. Re-profile all steel surfaces (using needle guns or other profiling methods) that have been welded and ground smooth to assure proper adhesion of primers and topcoats.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts". When using bolted connections prime with “slip critical class B” primer as specified in this Section. All surfaces of bolted or bearing connections may be primed. When welding, hold back primer a minimum of 2 inches each side of weld.

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1. In addition to visual inspection, specialty tests will be performed in accordance with AWS D1.1 and at the frequency stated in Article 1.5.F.5

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

E. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

PART 4 - **MEASUREMENT AND PAYMENT**

4.1 MEASUREMENT

A. Structural steel associated with the Transit Shelters are paid under Items 10730.1 River St. Shelter, 10730.2 Magazine St. Shelter & 10730.3 Green St. Shelter. Transit shelters.

B. Structural steel associated with the Ribbon Structure are paid for under Item No. 5700.1 – Ribbon Structure.

4.2 PAYMENT

A. There is no separate payment.

END OF SECTION

SECTION 05500

MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following items.

1. All Work in this Section; refer to Schedule in Par. 2.1 and as indicated on the Drawings.

B. Items To Be Furnished Only: Furnish the following items for installation by the designated Sections

1. Section 03300 - CAST-IN-PLACE CONCRETE.
   a. Lintels, sleeves, anchors, inserts, plates, and similar items.

C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 05100 - STRUCTURAL STEEL; structural steel items.
2. Section 09900 – PAINTING
3. Section 10730 – TRANSIT SHELTERS

1.2 PERFORMANCE REQUIREMENTS

A. A. Structural Performance of Railings and Guardrails: Provide railings capable of withstanding the effects of gravity loads and Code required loads and stresses with limits and under conditions indicated.

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F ambient; 180 deg F material surfaces.

1.3 SUBMITTALS

A. Product Data: For paint products.

B. Samples: Two three by six inch samples of shop-applied finishes, in color selected by the Engineer.

C. Fabrication Samples: Prior to commencing the primary work of this Section, provide samples of materials and workmanship with final finishes as indicated below.

1. Sample of a typical canopy fascia section assembly, one foot in length, including an 8” length of canopy arm, attachment plates with 12” length of fascia beam, and 1/4 inch level fascia plate. Sample shall exhibit all welds and finishes as required in the same portion of the complete canopy.

D. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer licensed in the Commonwealth of Massachusetts responsible for their preparation.
4. Where fabrications are to receive sprayed-on fireproofing, include statement that primer is compatible with fireproofing proposed for use.

E. Certificates: Welder and weld procedure qualifications.

F. Qualifications for Inspection and Testing Agency and Contractor’s professional engineer indicating registration in the Commonwealth of Massachusetts.

G. Weld inspection reports.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel".
2. AWS D1.2, "Structural Welding Code--Aluminum".
3. AWS D1.3, "Structural Welding Code--Sheet Steel".
4. AWS D1.6, "Structural Welding Code--Stainless Steel".

B. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

C. Galvanizer Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of five years of experience in the successful application of galvanized coatings specified in this Section in the facility where the work is to be performed and who will apply the coatings within the same facility.

D. Pre-Installation Conference: Contractor shall schedule a meeting to be attended by Contractor, Engineer, fabricator, and galvanizer prior to starting Work. Agenda shall include the following: Project schedule, source for each fabrication, coordination between fabricator and galvanizer and adjacent Work, finish of surfaces, application of coatings, submittals, and approvals.

E. Inspection. Except as otherwise specified, only visual inspection of welds, materials, workmanship, finished products, and installation is required.

F. The engineering for all miscellaneous metals shall be delegated design engineered and stamped by registered engineer in the Commonwealth of Massachusetts to accommodate all related snow loads, wind loads and point loads as per Massachusetts State Building codes. Design layouts for miscellaneous metals are as shown on drawings.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings. Provide allowance for trimming and fitting at site.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 SCHEDULE

A. Station Items

	ITEM	MATERIAL	COATING/FINISH
1.	Bearing and Leveling Plates	Steel	Galvanized and Painted
2.	Plates and Angles	Steel	Galvanized and Painted
3.	Supports for Canopies	Steel	Galvanized and Painted
4.	Sheet Metal	Steel	Galvanized and Painted
5.	Electrical Conduits	Steel	Galvanized and Painted
6.	Gutters	Steel	Galvanized and Painted
7.	Drain Pipes, and Downspouts	Steel	Galvanized and Painted

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316L

C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L

D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Steel Tubing: ASTM A 500, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners. Provide stainless-steel fasteners for fastening stainless steel and aluminum. Select fasteners for type, grade, and class required.

B. Anchor Bolts: ASTM F 1554, Grade 36. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

C. Cast-in-Place Anchors in Concrete: Anchors shall be capable of sustaining, without failure, a load equal to four times the load imposed. Tests shall be as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

D. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488. Tests shall be conducted by a qualified independent testing agency.

1. Material for Anchors: Stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

E. Threaded Rods: Provide threaded rods of Type 316 stainless steel with stainless steel nuts, locknuts, and washers for the suspension of Variable Message Signs as shown in the drawings and in accordance with the Variable Message Sign Manufacturer's recommendations.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with The Society for Protective Coatings SSPC-Paint 20 or ASTM A780.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Provide neoprene pads to separate dissimilar metals.
   1. Material: Commercial Grade - 60A, 60 Durometer Black Neoprene
   2. Thickness: 1/16” unless otherwise noted.
   3. Length and width, refer to drawings.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts if units are installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

2.8 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.9 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.10 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

2.11 STEEL AND IRON FINISHES

A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Urethane Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning ".
2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush Off Blast Cleaning".
3. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, embedded in concrete or masonry, unless otherwise indicated. Extend priming of partially embedded members to a depth of 2 inches.
4. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel", for shop painting.
5. Comply with SSPC-PA 2, "Measurement of Dry Coating Thickness with magnetic Gages".

B. Zinc-Rich Primer: Urethane zinc rich primer compatible with topcoat Specified in Section 09900.

C. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards. The galvanizing bath shall contain high grade zinc and other earthly materials. Fill vent holes and grind smooth after galvanizing.

D. Hot-Dip Galvanizing And Factory-Applied Primer for Steel: Provide hot-dip galvanizing and factory-applied prime coat, certified OTC/VOC compliant less than 2.8 lbs/gal. and conforming to EPA and Commonwealth of Massachusetts requirements. Primer coat shall be factory applied polyamide epoxy primer compatible with topcoat specified in Section 09900. Apply primer within 12 hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Blast cleaning of the surface is unacceptable for surface preparation. Primer shall have a minimum two year re-coat window for application of finish coat. Coatings must meet or exceed the following performance criteria:

1. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
2. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
3. Humidity Resistance: ASTM D 4585.
4. Salt Spray (Fog): ASTM B 117.

E. Hot-Dip Galvanizing and Factory-Applied Primer and Epoxy Urethane Finish for Steel: Provide factory-applied architectural coatings as specified in Section 09900 over primed hot-dip galvanized steel and matching approved samples.

1. Primer coat shall be factory-applied polyamide epoxy primer. Apply primer within 12 hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.
2. Finish coats shall be factory-applied color-pigmented architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer.
3. Coatings shall be certified OTC/VOC compliant and conform to applicable regulations and EPA standards.

4. Apply the galvanizing, primer and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.
5. Blast cleaning of the galvanized surface is not acceptable.
6. Primer shall meet or exceed the following performance criteria:

    a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
    b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
    c. Humidity Resistance: ASTM D 4585.
    d. Salt Spray (Fog): ASTM B 117.

7. Finish coat shall meet or exceed the following performance criteria:

    a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
    b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
    c. Graffiti Resistance: After drying for seven days, no staining from acrylic, epoxy, epoxy-ester and alkyd spray paints, ballpoint pen, crayons, magic marker, black shoe polish, and lipstick.
    d. Weathering: ASTM D 1014, 45 degrees facing south.
    e. Surface Burning Characteristics: ASTM E 84
    f. QUV: ASTM G53, ES-40 bulbs, 4 hours light, 4 hours dark.
    g. Salt Spray (Fog): ASTM B 117.

8. Clearcoat over finish coat shall meet or exceed the following performance criteria:

    a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
    b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
    c. Graffiti Resistance: After drying for seven days, no staining from acrylic, epoxy, epoxy-ester and alkyd spray paints, ballpoint pen, crayons, magic marker, black shoe polish, and lipstick.
    d. Weathering: ASTM D 1014, 45 degrees facing south; and ASTM D 4141C EMMAQUA-NTW.
    e. QUV: ASTM G53, ES-40 bulbs, 4 hours light, 4 hours dark.
    f. Salt Spray (Fog): ASTM B 117.
    g. Flexibility: ASTM D 522, Method B, cylindrical mandrel.
    h. Hardness: ASTM D 3363 (Pencil).

2.12 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean. Remove all heat tint at welds and heat affected zones.

2.13 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturer's written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in this Section.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in this Section. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

E. Provide and install support tabs welded to downspout and drain leaders no more than 6'-0" on center or less than 2 per pipe segment or individual downspout assembly or as otherwise shown in the drawings. This shall include corresponding tabs with attachment hardware welded or otherwise secured to the structure to which downspouts and leaders shall be attached.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section

10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZING ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

SECTION 05700

RIBBON STRUCTURE

5700.1 RIBBON STRUCTURE LUMP SUM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including GENERAL AND SUPPLEMENTARY CONDITIONS and GENERAL REQUIREMENTS, apply to the work of this Section and are hereby made a part of the Section.

B. Examine all Drawings and other Sections of the Specifications for requirements therein affecting the work of this trade.

1.2 SCOPE OF WORK

A. This Section specifies administrative and procedural requirements for the Ribbon Structure including, but not limited to, the following:

1. Ribbon Structure including benches, platforms, bike lane separators and lighting
2. Public Art Application and Coordination

B. Related Sections include the following:

1. Section 02210 – Earth Excavation, Backfill, Fill and Grading
2. Section 03300 – Concrete
3. Section 02990 – Site Furnishings
4. Section 02780 – Precast Unit Pavers
5. Section 02901 – Planting Soils

1.3 REFERENCES

A. Comply with applicable requirements of the latest editions of the following:

1. Commonwealth of Massachusetts, MassDOT Standard Specifications and Supplements, latest edition, Boston, Massachusetts.
2. International Building Code
3. Massachusetts State Building Code – 780 CMR
4. AASHTO: American Association of State Highway and Transportation Officials.
5. ASTM Testing Standards:

a. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
b. ASTM D 522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
c. ASTM D 523 – Standard Test Method for Specular Gloss.
d. ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.

e. ASTM D 3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
f. ASTM D 3363 – Standard Test Method for Film Hardness by Pencil Test.
g. ASTM G 155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.
h. ASTM D 16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
i SSPC-SP 3 - Power Tool Cleaning Standard.
j. SSPC-SP 12 – High Pressure Water Jetting Standard.
k. SSPC-SP 16 – Brush-Off Blast Cleaning of Non-Ferrous Metals.4.

ISO Testing Standards:

a. ISO 1520 – Paints and Varnishes – Cupping Test.
b. ISO 2815 – Paints and Varnishes – Buchholz Indentation Test.

6. A.W.S. - American Welding Society.
7. N.A.C.E. - National Association of Corrosion Engineers.
8. N.A.A.M.M.- National Association of Architectural Metal Manufacturers.
9. S.S.P.C. - The Society for Protective Coatings (Steel Structures Painting Council).
10. AISC – American Institute for Steel Construction Manual

1.4 SUBMITTALS

A. Submittals: in accordance with Section 013300 – Submittals

B. Performance Criteria: Components to be designed and fabricated to accommodate the following minimum loading:

1. Live load: 300 pounds vertical on horizontal surfaces and 200 pounds horizontal on vertical surfaces. Concurrent static point loads assumed to be located anywhere along the surfaces to produce the highest stress. 20 pounds per square foot (psf) roof live load.
2. Wind load:
    a. Basic wind speed (3-second gust) = 130mph
    b. Exposure (all directions) = C
    c. Internal pressure coefficient= +-0.00
3. Snow load:
    a. Ground snow load (Pg) = 40 psf
    b. Flat Roof (Pf) = 34 psf
    c. Exposure Factor (Ce) = 1.0
    d. Importance Factor = 1.0
    e. Thermal Factor (Ct) = 1.2
4. Deflection: member length / 600
    a. Member length is the horizontal distance between any two vertical segments of ribbon
    b. Maximum deflection limit of ½”.
5. Load combinations from the Massachusetts State Building Code Section 1605.2

C. Design Calculations:

1. Design Calculations: submit a calculation package stamped by a Professional Engineer registered in the State of Massachusetts. At a minimum the calculation package should include the following:

a. Structural model input and results output
b. Design code checks for bending moments, shear, axial and torsional forces.
c. Splice and connection design calculations including bolted and welded connection types.
d. Anchorage calculations, including base plate design and anchor bolt design.
e. Displacement calculations.

Structural steel design shall be in accordance with AISC

2. Ribbon Foundation: The ribbon foundation has been designed based on the following factored loads:
   a.

Foundation	Fz kip	Fx kip	Fy kip	Mz kip-ft	Mx kip-ft	My kip-ft
1	-7.5	0.4	1.4	0	21.1	12.6
2	-7.5	0.6	0.5	0	10.0	36.7
3	-4.6	0.4	0.3	0	3.8	10.0
4	-4.8	0.5	0.4	0	12.3	18.9
5	-6.0	0.3	0.6	0	16.4	17.9
6	-5.7	0.4	0.7	0	23.5	12.5
7	-8.2	0.7	1.7	0	25.9	14.3
8	-8.6	0.8	1.5	0	16.9	39.3
9	-5.5	0.2	0.5	0	8.6	24.6
10	-5.0	0.2	0.4	0	6.9	26.9

      i. Where the x axis is along the length of the ribbon and the y axis is perpendicular to the ribbon.
   b. If loads exceed the design loads listed above, the contractor shall be responsible for the design of foundation for that particular foundation.
      i. The contractor shall submit a design calculation which evaluates the spread footing for bearing pressure, sliding, eccentricity limits, structural design in accordance with ACI-318. The calculation and details shall be stamped by a registered professional engineer licensed in the state of Massachusetts.

3. Erection procedure: The structure, or portions thereof, have been designed to rely on the completed configuration for lateral stability. Contractor shall submit an erection procedure which includes lifting configuration, stability calculations during erection, and temporary stress calculations during construction.

D. Product Data: submit manufacturer's specifications and installation instructions for:

1. Ribbon Structure including benches, platforms, bike lane separators and lighting.
2. Wood: within 30 days of award of Contract, submit written documentation indicating wood supplier has available the wood in the species, quantity and size(s) shown on the Drawings.
3. Polyester Powder Coating Finish System
4. RD-Monoguard Coating - include generic description, complete technical data, ASTM Performance Criteria as noted herein, surface preparation, and application instructions.

5. Hydrograff HP Finish Coat- include generic description, complete technical data, ASTM Performance Criteria as noted herein, surface preparation, and application instructions.

E. Shop Drawings: Submit shop drawings for the following components showing attachment methods, fabrication, casting and hardware and coordinating with other relevant and interfacing elements:

1. Ribbon Structure including benches, platforms, bike lane separators and lighting.

F. Samples: submit:

1. Material samples for approval by Engineer of the following:

a. Ribbon Structure bench and platform wood material and finish sample: four samples of 12" long x 3" wide typical wood section in natural finish and two samples with specified varnish finish.
b. Ribbon Structure carbon steel tubing with powder coated finish: four samples 6" square x material thickness
c. Ribbon Structure cladding with RD Monoguard Coating and Hydrograff HP Clear Gloss finish coat: four samples 6" square x material thickness

G. Mock-Ups: submit:

1. Mock-Up: Prepare mock-up of typical ribbon bench section, typical corner condition, and typical vertical section, including painted structural core, cladding, acrylic panels, perforated stainless panels, lighting and wood benches with bench back and armrest, using same materials, tools, equipment, and procedures expected for actual implementation. Obtain Engineer's approval of mock-ups. Retain mock-ups to establish intended standards by which fabrication will be judged.

2. Mock-Up: Prepare 4 foot x 4 foot mock-up for each coating system specified using same materials, tools, equipment, and procedures intended for actual surface preparation and application. Obtain Engineer's approval of mock-ups. Retain mock-ups to establish intended standards by which coating systems will be judged.

H. Certificates: submit material certificates signed by material producer and Contractor. Provide certifications stating materials comply with requirements.

I. Wood Certification, Chain of Custody Paperwork and Schedule of Acquisition, Acclimation and Fabrication:

1. Wood: submit Forest Stewardship Council Certification, certification numbers and complete chain of custody paperwork.
2. Wood: submit schedule identifying wood acquisition, acclimation and fabrication.

J. Warranty: 3 year warranty

1.5 QUALITY ASSURANCE

A. Work under this Section shall be performed by a firm which has at least ten (10) years' experience in work of the type and size required by this Section, workers experienced and familiar with required construction procedures and under full time supervision of a qualified supervisor and acceptable to the Engineer.

B. Metal finishing and patina work performed under this Section shall be performed by workers experienced and familiar with media blasting, application of patinas and microcrystalline wax including and under full time supervision of a qualified supervisor.

C. Wood work performed under this Section shall be performed by workers experienced and familiar with acquisition of sustainably grown tropical hardwoods including wood certification and Chain-of-Custody Paperwork, acclimation of wood, fabrication and sealing of end grain during fabrication including and under full time supervision of a qualified supervisor.

D. References: Supply three references for each proposed subcontractor for metal fabrication and wood work with bid including names and phone numbers of contact person(s).

E. Pre-application Meeting: Convene a pre-application meeting 2 weeks before start of application of coating systems. Require attendance of parties directly affecting work of this section, including Contractor, Engineer, applicator, artist and manufacturer's representative. Review the following:
   1. Schedule
   2. Environmental requirements.
   3. Protection of surfaces not scheduled to be coated.
   4. Surface preparation.
   5. Application.
   6. Disinfection.
   7. Repair.
   8. Field quality control.
   9. Cleaning.
   10. Protection of coating systems.
   11. One-year inspection.
   12. Coordination with other work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Wood elements of bench to be stored inside or outside until first section of wood bench has been installed on project site. Store wood bench sections in an outdoor environment so that all the wood shall weather at the same rate.

B. Other components may be stored inside or outside per Engineer's discretion.

C. Store components under cover, off ground and without risk of contamination of contact with other metals.

D. Protect finished surfaces and prevent distortion damage or contamination during handling and installation.

E. Coatings: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
   1. Coating or material name.
   2. Manufacturer.
   3. Color name and number.
   4. Batch or lot number.
   5. Date of manufacture.
   6. Mixing and thinning instructions.

F. Coatings Storage:
   1. Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions.
   2. Keep containers sealed until ready for use.
   3. Do not use materials beyond manufacturer's shelf life limits.

1.7 CUSTOM FABRICATED SITE METAL COORDINATION

A. Coordinate submittals, fabrication and installation of Ribbon Structure with fabrication and installation of structural concrete foundations, site electric and lighting.

1.8 ENVIRONMENTAL REQUIREMENTS FOR COATINGS

A. Weather:
   1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
   2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
   3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
   4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
   Wind: Do not spray coatings if wind velocity is above manufacturer's limit.

B. Dust and Contaminants:
   1. Schedule coating work to avoid excessive dust and airborne contaminants.
   2. Protect work and public access areas from excessive dust and airborne contaminants during coating application and curing.

PART 2 – MATERIALS

2.1 MANUFACTURED RIBBON STRUCTURE COMPONENTS

A. SF4001-001 Manufactured Ribbon Structure including benches, platforms, bike lane separator and lighting as manufactured by Landscape Forms, Inc., 7800 East Michigan Avenue, Kalamazoo, Michigan 49048.

B. Or approved equal.

2.2 MATERIALS

A. SF4001-001 – Manufactured ribbon structure including benches, platforms, and separator

   1. Inner Ribbon Frame: ASTM A-36 Carbon Steel, Bolts: A325 Type 1
   2. Inner Platform/Bench Topper Frame: ASTM A-36 Carbon Steel & ASTM A-500 Grade B structural Tubing
   3. Cladding: #6061 Aluminum
   4. Hardware: 18:8 Stainless Steel
   5. Lighting Perforation Panels, Backrest Support Bars, Separator Support Bars, Arm Rest Support Bars, Recessed Cover Panels at Platform and Bench Toppers , and plaques: #316 Stainless Steel
   5. Lighting: Q-tran LED strips and drivers
   6. Electronics: USB and GFCI Outlets
   7. Wood: Ipe

8. Acrylic Diffuser: #7328 White Acrylic

B. Recycled Content

1. Recycled Material Content: Minimum 65 percent.
2. Post-Consumer Material Content: Minimum 50 percent.
3. Pre-Consumer Material Content: Minimum 15 percent.
4. Recyclable: 100 percent.

C. Fabrication

1. Shop fabricated ribbon structure including benches, platforms, and separator

2.3 WOOD

A. Wood Components:

1. Wood: Clear, highest grade Ipe, FSC certified wood. Solid pieces, no laminated material/boards permitted. Wood fabrication from full timbers.

2. Wood Certifications: Wood certified by Forest Stewardship Council, Washington, DC.

3. Wood Timber Acclimation:

a. Acquire wood within 180 days of award of Contract and store wood protected from exposure to direct sunlight and in climate controlled environment to allow for additional drying time to acclimate and stabilize wood to proposed location temperatures and humidity levels.

b. To minimize end checking as timber acclimates, seal end grain immediately following cuts of wood timbers with a heavy coat of Anchorseal clear wax end sealer to slow down the release of moisture from the wood timbers and thereby reduce end checking.

4. Cutting and Drilling/ Sealing End Grain: Use carbide tipped saw blades and drill bits to ensure smooth cuts. Precut and predrill openings for attachments. Immediately

5. Fasteners and Hardware: AISI grade 316 Stainless Steel suitable for loading and mounting conditions. Engineered by Fabricator and reviewed by Owner's Representative for approval.

6. Wood to Metal Connections:

a. Shop drill holes through steel and wood to accommodate fasteners.

7. Wood Finish: as follows:

a. Varnish: Marine Spar Varnish as manufactured by System Three Resins Inc., P.O. Box 8448, Lacey WA, 98509; (800) 333-5514; support.systemthree.com, or approved equal. Local source: Joe's Paint Center, 451 Grand Ave., New Haven, CT 06513; (203) 562-5601.

b. Finish: Satin

2.4 METALS

A. Provide metals free from surface blemishes where exposed to view in the finished unit. Exposed to view surfaces exhibiting pitting, seam marks, roller marks, stains, discoloration, or other imperfections on finished units are not acceptable.

B. Form and fabricate metalwork to required shapes and sizes, lines and angles and modify to meet profiles and finishes. Provide components in sizes and profiles indicated, but not less than required to comply with requirements indicated for structural purposes.

C. Drill and tap for required fasteners, unless otherwise indicated. Use concealed tamperproof fasteners wherever possible.

D. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.

E. Remove mill scale, dirt, grease and other foreign matter prior to welding. Protect adjacent surfaces from damage due to weld sparks, spatter or tramp metal.

F. Comply with AWS for recommended practices in shop laser welding and brazing. Clamp members and alternate welds to prevent warping or misalignment. Provide welds and brazes behind finished surfaces without distortion or discoloration or exposed side. Fully weld continuously and ground flush and smooth connections in a uniform manner.

G. Clean exposed, welded and brazed joints of flux and dress exposed and contact surfaces.

H. Chip out and replace welding showing cracks, slag inclusion, lack of fusion, bad undercut and other defects ascertained by visual or other means of inspection.

I. Provide castings that are sound and free of warp, cracks, blow holes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash and other casting marks unless part of the intended finish.

J. Finish exposed surfaces to smooth, sharp, well-defined lines and arrises.

K. Assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

2.5 MISCELLANEOUS METAL MATERIALS

A. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and for color match, strength, and compatibility in fabricated items.

B. Fasteners: Use fasteners of same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

C. Dissimilar Metals: When dissimilar metals abut one another, use neoprene washers or sleeves to create a separation between the surfaces.

2.6 FINISHES – GENERAL

A. Comply with MAAMM “Metal Finishes Manual” for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable temporary covering prior to shipment.

2.7 STAINLESS STEEL FINISHES

A. Finish designations with AISI conform to the system established by the American Iron and Steel Institute for designating finishes for stainless steel sheet.

B. Remove or blend tool and die marks and stretch lines into finish.

C. All stainless steel surfaces to receive an electropolish bead blast (satin) finish producing a uniform, textured, polished finish, free of cross scratches.

2.8 PAINT FINISHES

A. Materials used shall be best grade products of their respective kinds. The Painting Schedule is based on products by the named manufacturers. These are specified to establish a standard of quality and kind of material desired. Provide these products, or equals as approved by Engineer.

B. Note: If substitutions are proposed, submit complete schedule showing materials specified and equivalent materials proposed as substitutes. Provide complete manufacturer's product data on proposed materials. Substitutes must be approved by Engineer before commitment for materials is made.

C. Provide these systems or comparable systems from specified manufacturers.

1. Finish on Non-exposed metal surfaces: Landscape Forms, Inc. “Pangard II”.

a. Primer: Rust inhibitor.
b. Topcoat: Thermosetting TGIC polyester powder coat. UV, chip, and flake resistant.
c. Test Results: “Pangard II”.
i. Gloss Consistency, Gardner 60 Degrees, ASTM D 523: Plus or minus 5 percent from standard.
ii. UV Resistance, Color and Gloss, ASTM G 155, Cycle 7: Delta E less than 2 at 2.0 mils and less than 20 percent loss.
iii. Cross-Hatch Adhesion, ASTM D 3359, Method B: 100 percent pass.
iv. Flexibility Test, Mandrel, ASTM D 522: 3 mm at 2 mils.
v. Erichsen Cupping, ISO 1520: 8 mm.
vi. Impression Hardness, Buchholz, ISO 2815: 95.
vii. Impact Test, ASTM D 2794: 60 inch-pounds at 2.5 mils.
viii. Pencil Hardness, ASTM D 3363: 2H minimum.
viiii Corrosion Resistance, 1,500-Hour Test, ASTM B 117: Max undercutting 1 mm.
x. Humidity Resistance, 1,500-Hour Test, ASTM D 2247: Max blisters 1 mm.
d. Color: Matte White for inner ribbon structure, black for inner bench and platform structures

2. Finish on exposed aluminum cladding:
   a. Manufacturer: RD Coatings Incorporated , Stratford, CT Represented by the Righter Group, Inc., Wilmington, MA. (800) 533-3003

   b. Coating Schedule:

      1st Coat: RD Coatings Monoguard, (color to be determined) applied to all surfaces scheduled for coating at 3.0-4.0 mils dft. (By Contractor)
      Stripe-Coat: RD Monoguard, applied at welds, corners, edges and any nut & bolt assemblies at 2.5-3.0 mils dft. (By Contractor)
      2nd Coat: RD Coatings Monoguard, (colors to be determined by artist) applied to all surfaces scheduled for coating at 3.0-4.0 mils dft. (By Artist)
      3rd Coat: RD Coatings Hydrograff, (clear coat4, clear gloss) applied to all surfaces scheduled for coating at 2.0-3.0 mils dft. (By Contractor)

D. Surface preparation guidelines for cast iron are as follows:

1. Solvent Cleaning: inspect and preclean surfaces with appropriate solvents to remove grease, oil and other soluble contaminants. The preferred method of precleaning is thorough scrubbing of the surface with stiff bristle brushes soaked in solvent. Prior to evaporation remove solvent by wiping with clean, lint-free cloth rags. Remove rag residue (if any) with dry, oil free compressed air.

2. Surface Profile: measure surface profile (anchor pattern) in accordance with ASTM D 4417, Method C (attached).

   a. If surface profile is less than 1.5 mils then proceed with brush-off blast cleaning in accordance with No. 3 below.
   b. If surface profile is 1.5 mils or greater then proceed with hand or power tool cleaning in accordance with No. 4 below.
   c. Note: Certain high film thickness coating systems (20 mils DFT and higher) will require a minimum profile greater than 1.5 mils. Check with our manufacturer of paint system for advice regarding high thickness systems.

3. Brush-Off Blast Cleaning: Remove loose annealing oxides, loose rust, dirt and other foreign matter by compressed air nozzle abrasive blast cleaning using a fine abrasive. Any dust or other contaminants remaining after blasting shall be removed with dry, oil free compressed air or by vacuum cleaning. Recheck surface profile prior to painting. A profile depth of at least 1.5 mils is required.

4. Hand or Power Tool Cleaning: Remove loose annealing oxides, loose rust, dirt and other foreign matter with the use of hand or power tools. Do not use cleaning tools that burnish or smooth the natural roughness (profile) of the cast iron surface. Any dust or other contaminants remaining after hand or power tool cleaning shall be removed with dry, oil free compressed air or by vacuum cleaning.

5. Protect from Moisture: The cleaned cast iron surfaces shall be protected from conditions of high humidity, rainfall and surface moisture. Surfaces must be dry, clean and at least 5 F. above the dew point during application of protective coatings.

D. Surface preparation guidelines for non-ferrous metals are as follows:

1. The substrate has to be free of all loosely adhered rust, degreased, dry, and free of dust. Prepare substrates by pressurized water cleaning using 4,000-5,000 psi pressure equipment with a “zero” degree oscillating tip (SSPC SP-12, WJ4). Remove any remaining loose and non-adhering substrate prior to coating. Contact your local RD Coatings representative for detailed information

2.9 PUBLIC ART APPLICATION AND COORDINATION

A. There will be an artist selection process facilitated by the City to select the preferred design for the Ribbon Structure paint application. This selection process is not included in this contract.

B. Within 30 days of award of Contract, the contractor shall submit written documentation indicating the proposed schedule for scope they are responsible for, which includes but is not limited to ribbon fabrication, delivery to storage facility, provisions for artist coating application, repackaging for delivery to site, and installation.

C. Contractor shall facilitate the artist coating application process and provide assistance to public artist by:

a. Securing a storage facility/lay down area (climate controlled in winter months and with appropriate ventilation) within 40 miles of project site, where artist can apply ribbon art.
b. Coordinate delivery and off-load all aluminum cladding to receive artist’s paint application at storage facility. Provide forklift, operator and labor as needed to move metal cladding off flatbed delivery truck and into position at storage facility as directed by fabricator and artist. All other components of ribbon structure to remain packed and secure until time of installation.
c. Upon delivery, the Contractor shall unpack and set up all cladding pieces in the correct sequence, mimicking final installed conditions. Each section of cladding shall be supported in an elevated manner, such that all visible surfaces of the cladding are visible and can be painted without obstruction.
d. Contractor to apply the first coat of RD Monogoard application.
e. After the 7 day cure time, the contractor shall allow time for artist to apply the second coat of RD Monoguard to the entire ribbon structure, which will be the design application. Contractor to supply all paint and supplies, in all colors to be determined during artists coordination process, and provide for transport of paint and supplies to and from the storage facility as required by the artist.
f. Contractor to apply Hydrograff HP finish coat for protection to entire ribbon structure.
g. Pack and protect all painted cladding for delivery to project site after required curing time (7 days). Confirm with paint vendor.
h. Install ribbon sculpture taking care not to scratch or damage art application in any way. Contractor to repair any damage per manufacturer’s recommendation.
i. Allow artist to make on-site touch-ups as required due to damage during transport. Contractor to re-coat touch ups with RD-Hydrograff HP Clear Gloss.

2.10 LIGHTING: LED STRIPS AND DRIVERS

A. Refer to Ribbon Construction Documents, electrical drawings and electrical specifications.

2.11 ELECTRONICS: USB AND GFCI OUTLETS

A. Refer to Ribbon Construction Documents, electrical drawings and electrical specifications.

2.12 EPOXY

A. Epoxy for setting anchor bolts/threaded rods and stone: Bonstone A-124/B-414x manufactured by Bonstone Materials Corporation, 5828 Northy 97th Street, Milwaukee, Wisconsin 53224, ph# 414.463.2580, or approved equivalent product.

2.13 GROUT

A. Grout for setting of items: pourable, quick setting, non-metallic and non-shrinking hydraulic cement grout such as "Por-Rok Cement" supplied by Waldo Bros., Roslindale, MA or approved equivalent product.

2.14 JOINT FILLER

A. Sponge rubber in conformance to AASHTO M-153-65, Type I, Fed. Spec. HH-F- 341F, Type II, Class A and ASTM D-1752-67, Type I and be one of the following:

1. Sealtight Sponge Rubber Expansion Joint Filler, manufactured by W.R. Meadows, Inc., Elgin, IL.
2. or approved equivalent product.

2.15 BACKER ROD

A. Continuous round rod of 100% closed cell polyethylene foam, complying with requirements of ASTM C-272.

2.16 JOINT SEALANT

A. Two or more part, self-leveling, polyurethane based elastomeric sealant, complying with ASTM C920, Fed. Spec. TT-S-00227E Type 1 Class A, having Shore A harness of not less than 40 $\pm$ 5 when tested according to ASTM D2240, cured modulus of elasticity at 100% elongation of not more than 150 psi when tested according to ASTM D412, and tear resistance of not less than 50 lbs./inch when tested according to ASTM D624, and be one of the following:

a. Pecora Urexpan NR-200
b. Tremco THC 900
c. Sika 1A, SL
d. or approved equivalent product.

B. Where joint surfaces contain bituminous materials, provide modified sealant compatible with bituminous materials encountered.

2.17 SHIMS, HARDWARE, ANCHOR BOLTS AND ATTACHMENTS

A. Stainless steel, type 316L

2.18 PORTLAND CEMENT CONCRETE MATERIALS AND PRODUCTS

A. Portland cement concrete materials and products: as specified in Section 033000 – Concrete

2.19 GRAVEL BORROW

A. Gravel Borrow: as specified in Section 02210 – Earth Excavation, Backfill, Fill and Grading

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages and setting drawings, diagrams, templates, instructions and directions for installing items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the site.

B. Examine areas and conditions under which coating systems are to be applied. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.2 INSTALLATION OF MANUFACTURED FABRICATED COMPONENTS

A. Manufactured Fabricated Components:

1. Ribbon Structure including benches, platforms, bike lane separator and lighting

B. Provide concrete foundations and maintenance strips, anchorage devices and fasteners for securing site furnishings items in place.

C. Perform cutting, drilling and fitting to install site metalwork. Set products accurately in location, alignment, and elevation, plumb, level, and true, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding and grinding are required for proper shop fitting and jointing of site metal items, restore finishes to eliminate evidence of corrective work.

E. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units.

F. Install concealed gaskets, joint filler, insulation, and flashings as work progresses.

G. Provide nylon spacers, sleeves or pads: provide between dissimilar metals to separate from direct contact.

H. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work to be performed at the same location.

I. Retain protective coverings intact and remove simultaneously from similarly finished items to preclude non-uniform oxidation and discoloration.

J. Field Welding: Comply with applicable AWS specifications for procedures of manual shielded metal-arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent surfaces.

K. Retouch and repair applied finish which is damaged by preparing and recoating with primer equal to shop or specified primer and refinished. Finished work shall have perfect surfaces when completed work is ready for inspection for substantial completion. Protect painted surfaces against damage until the date of substantial completion of work. The Engineer will conduct a final inspection, and areas which do not comply with the requirements of this specification shall be repaired or retouched by the Contractor at no additional cost to the City.

3.3 COATINGS APPLICATION

A. Protection of surfaces not scheduled to be coated

1. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.

2. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

B. Application

1. Apply coatings in accordance with manufacturer's instructions.

2. Mix and thin coatings in accordance with manufacturer’s instructions.

3. Keep containers closed when not in use to avoid contamination.

4. Do not use mixed coatings beyond pot life limits.

5. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer’s instructions.

6. Uniformly apply coatings at spreading rate required to achieve specified DFT.

7. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.

8. “Stripe-Coat” between primer and intermediate coat with one-brush coat at critical locations on steel such as welds, corners, nuts and bolts and edges using specified primer.

C. Application

1. Damaged Materials: Repair or replace damaged materials and surfaces not scheduled to be coated.

2. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.

3. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

D. Field Quality Control

1. Contractors Inspector's Services:
   a. Verify coatings and other materials are as specified.
   b. Verify surface preparation and application are as specified.
   c. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges.
   d. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
      i. Check for holidays on interior steel immersion surfaces using holiday detector.
   e. Report:
      i. Submit written reports describing inspections made and actions taken to correct nonconforming work.
      ii. Report nonconforming work not corrected.
      iii. Submit copies of report to Engineer and Contractor.

2. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems.

3.4 PROTECTION

A. Contractor to ensure components are wrapped with protective wrap prior to leaving Fabricator's facility and during any other periods of transport.

B. Protect finishes from damage during construction period with temporary protective coverings. Remove protective covering at the time of Substantial Completion.

3.5 TOUCH -UP AND REPAIR

A. For damaged to field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.

B. For factory-primed or factory-finished surfaces, touch-up finish in conformance with manufacturer's recommendations

C. Restore finishes damaged during installation and construction so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit; or provide new units

3.6 CLEANING

A. Clean work, removing excess dirt and foreign materials, restoring finishes, leaving work in condition acceptable to the Engineer.

B. Repair surface damage immediately following installation.

PART 4 - COMPENSATION

5700.1 RIBBON STRUCTURE LUMP SUM

METHOD OF PAYMENT
Measurement for Ribbon Structure shall be based on the unit Lump Sum, installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for the Ribbon Structure shall constitute full compensation for furnishing and installing the item complete in place, including lighting and electrical within the structure, anchoring hardware and fasteners, cleaning and touch-up painting, protecting the items from damage, and cutting and patching required to complete the installation as indicated and specified. Includes specified mock-ups, delivery of Ribbon Structure to storage facility, provisions for and facilitation of artist coating application, and repackaging for delivery to site, associated with the public art application. Payment also included reinforced concrete foundations and required excavation and earthwork.

EXCLUSIONS
The following items are not included for payment under this item: gravel borrow and concrete foundations are included for payment under Item 03300.2 – Concrete Foundations for Ribbon and Transit Shelters.

END OF SECTION

SECTION 07160

BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Cold applied, cut-back (asbestos-free) bituminous dampproofing applied to the following surfaces:

a. Apply damp proofing to exterior below grade surfaces of new concrete walls and slabs.

b. Exterior, below-grade surfaces of all new manholes and drain structures.

c. Exterior, below-grade surfaces of other concrete items specified.

B. Bituminous dampproofing can be factory applied, providing the application meets coating manufacturer's requirements. Additional field coatings must be applied, as directed by Engineer, to repair any coating imperfections, and chipped or damaged areas.

1.2 RELATED TECHNICAL SECTIONS

A. Section 02251 – MANHOLES

B. Section 03300 – CATCH BASINS

C. Section 03410 – PRE-CAST STRUCTURAL CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS

1. Product Data: For each type of product indicated.

2. For informational purposes only, submit recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

3. Material Certificates signed by manufacturers.

1.3 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.4 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

C. Allow a minimum of 48 hours for drying before backfilling, unless a greater drying period is recommended by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cold-Applied, Cut-Back (Solvent-Based) Bituminous Dampproofing shall be:

a. Karnak 83 AF by Karnak Corporation,

b. Sealmastic by Meadows, W. R., Inc.,

c. Waterban 50 by Lambert Corporation,

d. Or equal.

2.2 BITUMINOUS DAMPPROOFING (ASBESTOS-FREE)

A. Cold-Applied, Cut-Back (Solvent-Based) Bituminous Dampproofing:

1. Brush and Spray Coats: ASTM D 4479, Type I.

2. Trowel Coats: ASTM D 4586, Type I.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Begin dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

A. Comply with manufacturers' written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated and shall be applied to subsequent coat(s).

2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coat(s).

B. Apply dampproofing to all exterior below grade concrete surfaces.

1. For application on structures extending above grade, apply from finished-grade line down.

3.4 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. On all dampproofing applications: Apply two brush or spray coats at not less than 1.25 gallons/100 feet² for first coat and 1 gallons/100 feet² for second coat, or one trowel coat at not less than 4 gallons/100 feet².

3.5 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

PART 4 – COMPENSATION (NOT USED)

END OF SECTION 07160

SECTION 07210

THERMAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following.

1. Perimeter insulation under slabs-on-grade.
2. Perimeter wall insulation at Operator's Booth.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 03300 - CONCRETE: Concrete walls and slab-on-grades.
2. Section 09260 - GYPSUM BOARD ASSEMBLIES
3. Section 10730 – TRANSIT SHELTERS

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Showing locations and thicknesses of insulation to be installed.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Referenced Standards:
1. ASTM:
   a. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   b. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
   c. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
   d. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   e. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   f. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
   g. E136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 DEGC.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and enclosure of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 RIGID BOARD INSULATION EXTRUDED POLSTYRENE (XPS)

A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. DiversiFoam Products.
2. Dow Chemical Company.
3. Owens Corning.
4. Kingspan

B. Material Properties:
1. Minimum Compressive Strength:
   a. 25 PSI (type IV).
2. Minimum Surface Burning Characteristics per ASTM E84 and NFPA 268:
   a. Flame Spread: 25 or less.
   b. Smoke Developed: less than 450.
   c. No ignition from radiant heat source.
3. Water vapor permeance per ASTM E96:
   a. 1.50 perm maximum.
4. Water absorption per ASTM D2842:
   a. 0.3%, maximum.
5. Thermal resistance per ASTM C518:
   a. R-value of 5.0 per IN at 75 DEGF mean temperature.

2.2 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to materials, including removing projections capable of puncturing materials or of interfering with insulation attachment.

3.3 INSTALLATION GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

3.4 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be enclosed and protected by permanent construction immediately after installation.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section complete in place, all costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section complete in place, all costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)

END OF SECTION

SECTION 07220

CLOSED-CELL SPRAY FOAM INSULATION

1. GENERAL

1. SUMMARY

A. This section includes the following:

1. Closed-cell, medium-density spray polyurethane foam insulation.

B. Related Work in other Sections includes the following:

1. Section 05100 – Structural Steel.
2. Section 07411 – Preformed Metal Roof System.
3. Section 09546 – Linear Metal Ceiling.
4. Section 10730 – Transit Shelters

2. REFERENCES

A. ASTM International:

1. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
2. ASTM C1029 Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.
3. ASTM C1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
4. ASTM D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
5. ASTM D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics.
6. ASTM D1940 Method of Test for Porosity of Rigid Cellular Plastics.
7. ASTM D2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics.
8. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
9. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
10. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
11. ASTM E283 Standard Test Method for Determining Rate of Air Leakage.
12. ASTM E413 Classification for Rating Sound Insulation.
13. ASTM E2178 Standard Test Method for Air Permeance of Building Materials.
14. ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

B. NFPA

1. NFPA 285 Standard Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
2. NFPA 286 Standard Test Method of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

3. PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test methods indicated below or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

a. Surface Burning Characteristics (ASTM E84): 25 / 450.
b. Assembly Fire Resistance Rating (NFPA 285): Passes NFPA 285 as part of an approved assembly.
c. Combustion Characteristics (NFPA 286): Pass

B. Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 pounds per square foot) [0.02 liters per second per square meter at a pressure difference of 75 Pascals (0.02 L/(s·m²) @ 75 Pa)] when tested in accordance with ASTM E 2178 (unmodified). The water vapor permeance shall be determined in accordance with ASTM E 96 and shall be declared by the manufacturer.

C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.040 cubic feet per square foot per minute under a pressure differential of 0.3 in. water (1.57 pounds per square foot) [0.20 liters per second per square meter at a pressure difference of 75 Pascals (0.20 L/(s·m²) @ 75 Pa)] when tested in accordance with ASTM E 2357. Assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.

2. Assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.
3. Assembly air barrier material shall not displace adjacent materials in the assembly under full load.
4. Assembly shall be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.

4. SUBMITTALS

A. Submittals: Submit in accordance with Division 01 requirements.

B. Product Data: Submit manufacturer's product data, manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.

5. Submit letter from primary materials manufacturer indicating approval of products not manufactured by primary manufacturer.
6. Include statement that materials are compatible with adjacent materials proposed for use.
7. Submit letter from the sealant manufacturer indicating sealant adhesion to the air barrier material meet the requirements of the project.
8. Submit documentation from an approved independent testing laboratory certifying the air leakage rates of the air barrier membranes assembly, including primary membrane, primer, sealants and spray polyurethane foam building insulation have been tested to meet ASTM E 2357.

C. Samples: Submit clearly labeled samples, 4 inch by 4 inch (100 mm by 100 mm) minimum size of each material specified.

D. Shop Drawings: Submit shop drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated, how materials that cover the materials are secured with air-tight condition maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed.

1. Include VOC content of each material, and applicable legal limit in the jurisdiction of the project.
2. Include statement that materials are compatible with adjacent materials proposed for use.
3 Include recommended values for field adhesion test on each substrate.

G. Compatibility: Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

H. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).

I. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.

5. QUALITY ASSURANCE

Manufacturer Qualifications: Company specializing in manufacturing products and systems of this section with minimum ten years documented experience.

Building Assembly Testing: A copy of the ASTM E 2357 test report showing drawings which identify the materials and photos of the assemblies tested, and the following results reported: air infiltration and exfiltration through the assembly at 0.3 inches water (75 Pa) both before and after pressure cycling, for both specimen one and specimen two.

Single-Source Responsibility:

9. Obtain air/vapor barrier, flexible flashing and spray polyurethane foam building insulation materials from a single manufacturer regularly engaged in manufacturing the product.
10. Provide products which comply with all federal, state and local regulations controlling use of volatile organic compounds (VOCs).

Applicator Qualifications:

11. Certified to apply materials by material manufacturer.
12. Certified Installer or Master Installer by Spray Polyurethane Foam Alliance (SPFA PCP Certification).
13. Air Barrier Association of America (ABAA) certification.

6. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier spray foam manufacturer. Protect stored materials from direct sunlight.

C. Handle materials in accordance with manufacturer’s recommendations.

7. PROJECT CONDITIONS

A. Temperature: Install closed-cell, medium density spray polyurethane foam air barrier within range of ambient and substrate temperatures recommended by air barrier manufacturer. Do not apply air barrier to a damp or wet substrate.

B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.

C. Sequencing. Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.

D. Compatibility. Do not allow closed-cell, medium density spray polyurethane foam to come in contact with chemically incompatible materials.

E. Ultra-violet exposure. Do not expose the air barrier material to sunlight longer than as recommended by the manufacturer (if applicable).

8. WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard product warranty, for a minimum 1 year from date of Substantial Completion.

B. Manufacturer's Warranty: Provide manufacturer's limited product warranty, for a maximum of 10 years from date of Substantial Completion.

9. PRODUCTS

a. MANUFACTURERS

Medium Density Sprayed Polyurethane Foam Insulation (SPF):

1) Icynene, Inc
2) Master Builders Solutions
3) Certainteed
4) Demilec USA.
5) Henry Company
6) Johns Manville.
7) NCFI Polyurethanes

Thermal Barrier Coating:

8) International Fireproof Technology, Inc.
9) Covestro
10) Flameseal
11) No-Burn, Inc.

Approved Equals:

10. MATERIALS

Spray Polyurethane Foam (SPF) Insulation:

1) Closed-cell polyurethane foam insulation: Type II
2) Minimum density: 1.9 PSF
3) Closed cell content: 90%
4) Thermal resistance, aged: R-6 per IN at 75 DEGF
5) Maximum water vapor permeance: 1.0 Perm at 2 IN thickness
6) 4 IN-thick sample:
   a) Flame spread: Less than 25
   b) Smoke developed: Less than 450

7) Maximum installed permeance: 1.0 Perm.
8) Air leakage: Less than 0.0006 L/(s.m2) @ 75Pa, per ASTM E 2178
9) Tested to ASTM E 2357 for the air barrier assembly
10) Meet ICC AC377 standards
11) Accreditation and current full system listing by ABAA as found on www.airbarrier.org.
12) Base product: Proseal HFO by Icynene.

Thermal Coating:

1) Thermal Coating tested to prevent ignition and approved by manufacturer for use with insulation.
2) Installer is responsible for determining thermal coating requirements at each location.
3) Intumescent, UL listed or ICC tested for use with SPF.
4) Base product: DC 315 by International Fireproof Technology, Inc.
5) Minimum fire and heat protection of 15 minutes with an interface temperature not exceeding 250 DEGF.
6) Minimum bond to foam: 500 PSI.
7) Utilize Bonding Agent if required to attain specified bond properties.

11. ACCESSORIES

Primer: As required by insulation manufacturer base on substrate materials and conditions.

12. EXECUTION

EXAMINATION

A. Examine substrates, areas, and conditions under which the air barrier assembly will be installed, with Installer present, for compliance with requirements.
   1) Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
   2) Ensure that the following conditions are met:
   3) Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants
   4) Concrete surfaces are cured and dry, smooth without large voids or sharp protrusions.
   5) Masonry joints are reasonably flush, and all excess mortar sitting on masonry ties has been removed.
   6) Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
   7) Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
   8) Notify Architect in writing of anticipated problems using closed-cell, medium density spray polyurethane foam over substrate prior to proceeding.

SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

1. Ensure that penetrating work by other trades is in place and complete.
2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the closed-cell, medium density spray polyurethane foam.
3. Where there are release agents or other non-compatible coatings, wipe down metal surfaces to remove these release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the spray polyurethane foam.
4. Ensure veneer anchors are in place.

B. Protection from Spray Applied Materials:

1. Mask and cover adjacent areas to protect from overspray.
2. Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
3. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
4. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

INSTALLATION

A. Spray Polyurethane Foam Installation: Install materials in accordance with manufacturer's recommendations, ULC S 705.2 and the following:

1. Apply only after transition strip at foundation and wall intersection has been installed.
2. Installer shall use proper personal protective equipment (PPE) during the installation of material in accordance with US Government regulation 29 CFR 1910.134.
3. Warning signs shall be displayed and non-protected personnel shall be kept from the spray area in accordance with ULC S705.2.
4. Equipment used to spray polyurethane foam shall comply with ULC S 705.2 and the manufacturer’s recommendations for the specific type of application. Record equipment settings on the Daily Work Record as required by the ULC S 705.2 installation standard. Each proportioner unit shall supply only one spray gun.
5. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer or the ULC S 705.2 Installation standard.
6. Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings. Passes shall be not less than 1/2 inch (12 mm) and not greater than 3.5 inches (75 mm). An additional pass shall only be done after the first pass has had time to cool down.
7. Install within manufacturer’s tolerances, but not more than minus 1/4 inch (6 mm).
8. Do not install spray polyurethane foam within 3 inches (75 mm) of heat emitting devices such as light fixtures and chimneys.
9. Finished surface of foam insulation to be free of voids and embedded foreign objects.

10. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
11. Trim, as required, any excess thickness that would interfere with the application of cladding/covering system by other trades.
12. Clean and restore surfaces soiled or damaged by work of the section. Consult with section of work soiled before cleaning to ensure methods used will not damage the work.
13. Complete connections to other components and repair any gaps, holes or other damage using material which conforms to ULC S 710.1 (single component) or ULC S 711.1 (two components) and installed in accordance with ULC S 710.2 or ULC S 711.2 as applicable.

PROTECTING AND CLEANING

A. Protect material from damage during installation and the remainder of the construction period, according to manufacturer's written instructions.

   a. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the manufacturer.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.

13. MEASUREMENT AND PAYMENT

MEASUREMENT

Separate Measurement will not be made for the work of this Section complete in place, all costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

PAYMENT

Separate Payment will not be made for the work of this Section complete in place, all costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)

END OF SECTION

SECTION 07411

PREFORMED METAL ROOF SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies fabricating, furnishing and installing a leak-tight preformed (corrugated) metal roof system as indicated on the Contract Drawings and as specified herein, including, but not limited to, the following:

1. Mechanically attached preformed metal roof panel system at the Operators Booth, including fasteners, trim, fascia, rake, and closure pieces, with panels and connections fabricated for the design loads specified and spans and details shown in the Drawings.
2. All necessary fasteners and connections (except for structural steel indicated on the Drawings), sealers, sealants, flashings and counter-flashings as required to make the systems leak tight.

1.2 RELATED WORK

A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.

B. Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 05500 - MISCELLANEOUS METALS
2. Section 05100 - STRUCTURAL STEEL
3. Section 07920 - JOINT SEALANTS
4. Section 10730 – TRANSIT SHELTERS

1.3 STANDARDS

A. The following standards form a part of these Specifications.

B. American Society for Testing and Materials (ASTM):

1. ASTM E 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
2. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

C. American Iron and Steel Institute (AISI):

1. Specification for the Design of Cold-Formed Steel Structural Members.

D. American Institute of Steel Construction (AISC):

1. Code of Standard Practice.

E. American Society of Civil Engineers (ASCE):

1. ASCE-7, Minimum Design Loads for Buildings and Other Structures.

F. Federal Specifications (FS).

G. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1. Architectural Sheet Metal Manual.

1.4 SYSTEM PERFORMANCE

A. Design Wind Pressure: Roof system shall safely withstand Design Wind Pressure of 35 psf, and all loads prescribed by codes and authorities having jurisdiction. Loads shall be resisted in both positive and negative directions.

B. Design Live and Dead Load: Roof system shall safely withstand structural loading calculated in accordance with applicable building code, and as follows:

1. Roof system shall support a 250 lb. concentrated load distributed over a 4 inch square at the center of a panel at the maximum span used on the project without buckling the rib, permanent deflection or other perceptible damage.

C. Roof system shall be designed for a maximum deflection under positive loading of L/180.

D. Air infiltration of the roof system shall be limited to 0.06 CFM/ft2 at a positive pressure differential of 1.57 psf when tested in accordance with ASTM E 283.

E. There shall be no water penetration through the roof system when the roof system is tested per ASTM E 331 at a positive pressure differential of 6.24 psf or 20% of the design wind pressure whichever is greater. The test pressure need not exceed 12 psf.

F. Thermal Movement: Roof system shall permit thermal movement resulting from an ambient temperature range of 120ºF without leaking water.

1.5 QUALITY ASSURANCE

A. Subdivision of Work: Assign the complete canopy system to one manufacturer and one installer, including, but not limited to, panels, fasteners, ridge vents, caps, trims, and counter-trims.

B. Source: Provide roof systems that are the products of one manufacturer. Provide secondary materials that are acceptable to the manufacturer of the roof system.

1. Manufacturers Qualifications: The manufacturer shall have had a minimum of ten (10) years experience in the successful completion of projects employing similar materials, applications, and performance requirements.

C. Engineering: Provide the services of a Professional Engineer, registered in the Commonwealth of Massachusetts, to design, seal and certify that the work of this section meets or exceeds the performance requirements specified in this section.

D. Installer: The installer shall have a minimum of ten (10) years experience in the successful completion of projects of the type required by this Section, and shall be acceptable to the manufacturer of the roof system. The manufacturer shall certify that the installer is acceptable to the manufacturer.

E. Pre-installation Conference: A pre-installation conference shall be held to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

F. Field Leakage Test: Authority may employ an independent testing agency to make in-place field tests for water leakage and other performance criteria. Test will generally include a prolonged water spray test similar to AAMA 501.3, except water shall be applied for two minutes per lineal foot of joint being tested. Any uncontrolled leakage will be considered a failure.

1. Modify installation techniques as necessary to eliminate leaks. Make watertight all leaking areas.
2. At no additional cost to the Authority, provide all retesting and remedial work necessary because of failures found by testing.
3. Do not eliminate leaks through the application of sealants

1.6 WARRANTY

A. Roof System Warranty: Provide manufacturer's standard written warranty signed by manufacturer, installer and Contractor, agreeing to repair or replace work which exhibits defects in materials or workmanship. "Defects" is defined to include, but is not limited to, leakage of water, abnormal aging or deterioration, and failure to meet performance requirements.

1. Warranty Period: Twenty-five (25) years from date of Final Acceptance.

1.7 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Manufacturer's Qualifications: Submit a list of five (5) similar completed projects with addresses of the project location, architect, and owner.

C. Installer's Qualifications and Experience:

1. Submit a list of five (5) similar completed projects with metal roofing and canopy systems, with addresses of the project location, architect, and owner.
2. Certification that the installer is acceptable to the manufacturer.

D. Submit product data, test reports, and certifications in accordance with quality assurance and system performance requirements specified herein.

E. Submit panel shop drawings consisting of design and erection drawings, finish specifications, and other data necessary to clearly describe the design, materials, sizes, layouts, construction details, and erection. Submit small-scale layouts of panels and gutters and large-scale details of edge conditions, joints, fastener and sealant placement, flashings, penetrations, and special details. Distinction must be made between factory and field assembled work.

1. A Professional Engineer, registered in the Commonwealth of Massachusetts, shall sign and seal the shop drawings.
2. Do not begin fabrication without approved shop drawings.

F. Submit structural design calculations, in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members, for the canopy system. Show how the design load and other performance requirements have been satisfied.

1. A Professional Engineer, registered in the Commonwealth of Massachusetts, shall seal and certify the calculations.

G. Samples: Submit samples for initial selection, showing complete range of colors, textures and finishes available for each material exposed in the finish work. Base on the colors, textures and finishes selected by the Engineer, submit representative samples of each material exposed in the finish work, including the following, showing the range of color and finish variations expected:

1. Panel: Full panel width by 12 inches long.
2. Fasteners: Two (2) of each type with statement of intended use.
3. Closure: One (1) metal closure and one (1) foam closure as required.
4. Sealants: One (1) sample of each type with statement of intended use.
5. Expanded metal sheet infill: One (1) 12-inch x 12-inch panel with perimeter welded plates.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver to the site, preformed metal canopy system materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect against all possible damage. Sequence deliveries to avoid delays, but minimize on-site storage. All unacceptable materials shall be replaced at no additional cost to the Authority.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide roof system products of one of the following manufacturers that meet or exceed the specified requirements, or provide an Engineer-approved equal:

1. Centria.
2. Metecno-Morin.
3. Berridge.

2.2 ROOF SYSTEM PRODUCT

A. Preformed (corrugated), prefinished, galvanized steel roof panels:

1. Dimensions:
   a. 36 inches of coverage width.
   b. Rib crests 7.2" on center and 1.5" deep.
2. Material: Zinc coated (galvanized) steel conforming to ASTM A 653 SQ Grade 37 with G90 coating. Material shall be minimum 18 gauge with smooth surface texture. Finish coating shall be Kynar or Hynar based material.

B. Flashing and Trim: Fabricated in the same material, gauge, finish and color as the metal panels.

C. Finish: Galvanized with factory applied paint finish by the panel manufacturer.

1. All panels shall be painted on both interior and exterior surfaces with a 3 coat Kynar 500 or Hylar 5000 based polyvinylidene fluoride coating system. System shall consist of 0.8 mil urethane primer, 0.8 mil color coat and 0.8 mil clear top coat. The total dry film thickness of paint shall be 2.4 mils on both the interior and exterior surfaces of all roof panels.

2. Provide custom mixed colors matching Design Engineer's samples of 'Aged Copper' for the exterior side and 'Parchment White' for the interior side.

3. All exterior painted panels and flashings shall receive a factory applied plastic strippable coating for protection during shipping and handling.

D. Accessories:

1. Roof system fasteners shall be #14 minimum diameter, self-tapping, with hex head.
    a. Exposed fasteners shall be 300 series stainless steel with 5/8" bonded neoprene and stainless steel washers coated to match the exterior panel color.
    b. Concealed fasteners shall be 300 series stainless steel.
2. Closures shall be metal and foam as required. Foam shall be a pre-cut profile closure of closed cell foam. Metal closures shall be fabricated from the same material, gauge, finish, and color as the exterior metal panel. Metal ridge cap, ridge vent, flashing/drip edge, and end closures shall be fabricated in accordance with the manufacturer's recommendations.
3. Sealants:
    a. Hidden sealant at all side laps, end laps, and flashing details shall be gun grade non-curing butyl or polymeric non-skinning butyl tape to ensure weather tightness.
    b. Exposed sealant – provide Joint Sealant JS-2 as specified in Section 07920 – Sealants and Caulking.
4. Flashings, not including those associated with gutters, shall be factory-formed from the same type and gage of material as the roofing panels.
5. Lap Sealing: Vapor seal of the panels shall be created by applying manufacturer's recommended sealant at the side and end lap of metal roofing panels.

2.3 ROOF SYSTEM FABRICATION

A. Roof system components shall be fabricated in the factory for field assembly to the greatest extent possible. Avoid field cutting. Touch-up and repair factory applied finish damaged by field cutting.

PART 3 - EXECUTION

3.1 INSPECTING SUBSTRATE

A. Verify conditions as satisfactory to receive work.

B. Do not begin installation until all unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions.

3.2 ROOF SYSTEM INSTALLATION

A. Strictly comply with the manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this Section.

1. Remove all protective materials and labels from the canopy components as they are installed.
2. Install work to be truly straight and square.
3. Provide work as indicated on approved shop drawings.
4. Install work with uniform, tight, interlocking joints.
5. Provide trims, sealers, fillers and gaskets as necessary to make assembly weathertight and watertight.
6. Comply with the requirements of Section 07920 – Sealants and Caulking, including testing and compatibility.
7. Comply with SMACNA Architectural Sheet Metal Manual for installation of flashings and sheet metal work.
8. Metal filings caused by cutting and drilling shall be immediately removed from finished surfaces to prevent rusting and staining.

B. Coordinate work with other trades as required to ensure proper flashing and seals with adjoining construction.

3.3 TOUCH-UP AND REPAIR

A. Touchup with air dry coating material per Section 05041 - Hot Dip Galvanizing. Touch up factory applied finish with paint of the same manufacture and color of prefinished paint coating.

B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which the Engineer determines cannot be satisfactorily repaired.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section complete in place, all costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section complete in place, all costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)

END OF SECTION

SECTION 07600

FLASHING AND SHEET METAL

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Provide all labor, equipment, and materials to fabricate and install the following.

1. Edge strip and flashing.
2. Fascia and trim.
3. Counterflashings over bituminous base flashing.
4. Counterflashings for roof accessories.
5. Base flashing coverings.
6. Fascia and edge metal.
7. Lead flashing for bituminous membranes.
8. Other components.
9. Counterflashings at roof mounted equipment and vent stacks

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General Supplementary Conditions and Division 1 Specification Sections, Apply to this Section.

B. RELATED SECTIONS

Section 04200 – STONE CLADDING
Section 07411 – PREFORMED METAL ROOF SYSTEM
Section 07920 - SEALANTS
Section 08510 – STEEL WINDOWS
Section 10730 – TRANSIT SHELTERS

1.3 REFERENCES

ASTM A-446	Specification for steel sheet
ASTM B-209	Specification for aluminum sheet
ASTM B-221	Specification for aluminum extruded shape
FS QQ-L-201	Specification for Lead Sheet
ASTM A792	Steel Sheet, Aluminum-Zinc Alloy-Coated, by the Hot-Dip Process
ASTM B32	Solder Metal
ASTM B209	Aluminum and Alloy Sheet and Plate
ASTM B486	Paste Solder
ASTM D226	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D486	Asphalt Roof Cement, Asbestos-free
FS O-F-506	Flux, Soldering, Paste and Liquid
FM	Loss Prevention Data Sheet
NRCA	National Roofing Contractors Association - Roofing Manual
SMACNA	Architectural Sheet Metal Manual

1.4 SUBMITTALS

A. Submit under provisions of Section 01300 - Submittals.

B. Product Data: Provide manufacturer's specification data sheets for each product in accordance with Section 01300.

C. Provide approval letters from metal manufacturer for use of their metal within this particular roofing system type.

D. Submit two samples, 12 x 12 inch in size illustrating typical external corner, internal corner, valley, junction to vertical dissimilar surface, material and finish.

E. Shop Drawings

1. For manufactured and shop fabricated fascia, scuppers, and all other sheet metal fabrications.
2. Shop drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashing, terminations, and installation details.
3. Indicate type, gauge and finish of metal.

F. Certification

1. Submit roof manufacturer's certification that metal fasteners furnished are acceptable to roof manufacturer.
2. Submit roof manufacturer's certification that material furnished is acceptable to roofing manufacturer as a component of roofing system and is eligible for roof manufacturer's system warranty.
3. Submit certification that metal and fastening system furnished is Tested and Approved by Factory Mutual for 1-90 Wind Up-Lift Requirements.

G. Manufacturer's Product Data

1. Metal material characteristics and installation recommendations.
2. Submit color chart prior to material ordering and/or fabrication so that color selections can be made by the Engineer.

1.5 QUALITY CONTROL

A. Reference Standards

1. Comply with details and recommendations of SMACNA Manual for workmanship, methods of joining, anchorage, provisions for expansion, etc.
2. Factory Mutual Loss Prevention Data Sheet 1-49 windstorm resistance 1-90.

B. Contractor's Warranty

1. The Contractor shall provide the City with a notarized written warranty assuring that all sheet metal work including caulking and fasteners to be watertight and secure for a period of two years from the date of final acceptance of the building. Warranty shall include all materials and workmanship required to repair any leaks that develop, and make good any damage to other work or equipment caused by such leaks or the repairs thereof.

1.6 QUALIFICATIONS

A. Fabricator and Installer: Company specializing in sheet metal flashing work with 5 years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers or packages with labels intact and legible.

B. Stack pre-formed and pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials which may cause discoloration or staining.

PART 2 - PRODUCTS

2.1 APPROVED EQUIVALENT

A. Contractor must submit any product not specified for review and approval of the Architect prior to placing the order for product. The Architect will notify Contractor, in writing, of decision to accept or reject request.

2.2 MATERIALS

A. Miscellaneous Metals and Flashings at Preformed Metal Roof:

1. All installed metal to be fabricated in the same material, gauge, finish and color as adjacent preformed (corrugated) metal canopy panels and/or metal wall panels: zinc coated (galvanized) steel conforming to ASTM A 653 SQ Grade 37 with G90 coating. Material shall be minimum 18 gauge with smooth surface texture.

B. Miscellaneous Metals and Flashings at windows and masonry walls:

1. Material shall be type 316 stainless steel, unless otherwise noted, minimum 18 gauge with smooth surface texture

2.3 RELATED MATERIALS

A. Metal Primer: Zinc chromate type.

B. Plastic Cement: ASTM D 4586.

C. Sealant: Specified in Section 07920 or on drawings.

D. Lead: Meets Federal Specification QQ-L-201, Grade B, four pounds per square foot.

E. Solder: ANSI/ASTM B32; 95/05 type.

F. Flux: FS O-F-506.

G. Underlayment: ASTM D2178, No15 asphalt saturated roofing felt.

H. Slip Sheet: Rosin sized building paper.

I. Fasteners:

1. Corrosion resistant screw fastener as recommended by metal manufacturer. Finish exposed fasteners same as flashing metal.
2. Fastening shall conform to Factory Mutual 1-90 requirements or as stated on section details, whichever is more stringent.
3. Fasteners for stainless steel flashings shall be type 316 stainless steel.

J. Termination Bars:

1. Shall be aluminum unless otherwise recommended by membrane manufacturers.
2. Material shall be .125” x 1” (minimum) aluminum conforming to ASTM B-221, mill finish. Bar shall have caulk cup as required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect contact areas of dissimilar metals with heavy asphalt or other approved coating, specifically made to stop electrolytic action.

3.2 GENERAL

A. Install work watertight, without waves, warps, buckles, fastening stress, or distortion, allowing for expansion and contraction.

B. Fastening of metal to walls and wood blocking shall comply with SMACNA Architectural Sheet Metal Manual, Factory Mutual I-90 wind uplift specifications and/or manufacturer's recommendations whichever is of the highest standard.

C. All accessories or other items essential to the completeness of sheet metal installation, whether specifically indicated or not, shall be provided and of the same material as item to which applied.

D. Metal fascia and copings shall be secured to wood nailers at the bottom edge with a continuous cleat. Cleats shall be at least one gauge heavier than the metal it secures.

3.3 INSPECTION

A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets are in place, and nailing strips located.

B. Verify membrane termination and base flashings are in place, sealed, and secure.

C. Beginning of installation means acceptance of existing conditions.

D. Field measure site conditions prior to fabricating work.

3.4 SHOP FABRICATED SHEET METAL

A. Installing Contractor shall be responsible for determining if the sheet metal systems are in general conformance with respective roof, roof panel, and wall panel manufacturer recommendations.

B. Metal work shall be shop fabricated to configurations and forms in accordance with recognized sheet metal practices.

C. Hem exposed edges.

D. Angle bottom edges of exposed vertical surfaces to form drip.

E. All corners for sheet metal shall be lapped with adjoining pieces fastened and set in sealant.

F. Joints for fascia system, cap flashing, and surface-mount counterflashing shall be formed with a 1/4" opening between sections. The opening shall be covered by a cover plate or backed by an internal drainage plate formed to the profile of fascia piece. The cover plate shall be embedded in mastic, fastened through the opening between the sections and loose locked to the drip edges.

G. Install sheet metal to comply with Architectural Sheet Metal manual, Sheet Metal and Air Conditioning Contractor's National Associations, Inc.

3.5 FLASHING MEMBRANE INSTALLATION

A. METAL EDGE DETAIL

1. See details for scuppers. For manufactured edge metal, scuppers shall be factory fabricated.
2. Accessories: Joint covers, corners, supports, self –adhering strip flashing at joining, fastenings and other accessories shall be included.
3. Install continuous cleat fastened at 6" O.C.
4. Install new metal edge hooked to continuous cleat.
5. Prime metal edge at a rate of 100 square feet per gallon and allow to dry.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZINE ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following:

1. Joint sealants and fillers for interior and exterior applications.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 08801 - GLASS AND GLAZING: Glazing sealants.
2. Section 08450 – ALUMINUM FRAME GLAZED CANOPY SYSTEM
3. Section 08510 – STEEL WINDOWS
4. Section 10730 – TRANSIT SHELTERS

1.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Qualification Data: For Installer.

D. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in Part 1 "Quality Assurance" Article.

E. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Field Test Report Log: For each elastomeric sealant application.

G. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
3. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
4. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Engineer.
2. Conduct field tests for each application indicated below:

    a. Each type of elastomeric sealant and joint substrate indicated.
    b. Each type of nonelastomeric sealant and joint substrate indicated.

3. Notify Engineer seven days in advance of dates and times when test joints will be erected.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product

and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than or greater than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
5. When substrates have not cured sufficiently.

1.6 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

2.2 JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Elastomeric sealants shall be nonstaining to porous substrates. Provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Single-Component Neutral-Curing Silicone Sealant:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Corning Corporation; 790.
    b. GE Silicones; SilPruf LM SCS2700.
    c. Tremco; Spectrem 1.
    d. Pecora Corporation; 864.

2. Extent of Use: Joints in exterior vertical and soffit surfaces including sheet metal roofing, sheet metal siding, metal flashing, perimeter of door and window frames.

E. Multicomponent Pourable Urethane Sealant:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Bostik Findley; Chem-Calk 550.

b. Meadows, W. R., Inc.; POURTHANE.
c. Pecora Corporation; Urexpan NR-200.
d. Tremco; THC-901.

2. Extent of Use: Joints in exterior horizontal surfaces including joints between precast concrete segments and other adjacent materials.

2.3 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin). O (open-cell material). B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include concrete, masonry and unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following metal, glass, porcelain enamel and glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove excess material.
4. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
4. Install in uniform continuous ribbons without gaps or air pockets.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 REPAIR AND CLEANING

A. Remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

B. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZINE ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

Section 08450

ALUMINUM FRAME GLAZED CANOPY SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The design and manufacture of an aluminum framed canopy system, glazed with tempered safety laminated glass, or UV resistant monolithic polycarbonate glazing panels.

B. All anchors, brackets, and hardware attachments necessary to complete the specified assembly, when included within the project scope.

C. Weatherability and water-tightness performance as specified.

D. All flashings up to adjoining work are also required as part of the system and shall be included unless specifically noted as being supplied by others.

E. Installation of the system.

1.2 RELATED SECTIONS

A. Section 05100: Structural Steel
B. Section 05550: Miscellaneous Metals
C. Section 05100: Structural Steel
D. Section 07600: Flashing and Sheet Metal
E. Section 08801: Glass and Glazing

1.3 SYSTEM DESCRIPTION

A. Aluminum canopy frame glazed with flat tempered safety laminated glass, or UV resistant monolithic polycarbonate glazing panels.

B. Design Requirements:

1. Support structure, constructed of materials of adequate load bearing capacity and to maintain visual design concepts, and for attachment to and support of the specified system, supplied by other trades.
2. Glazing panels supplied in flat sheet sizes as needed to accommodate system framing.
3. Whenever possible, fasteners shall be concealed.
4. System shall be dry glazed.
5. Air permeable tape shall be applied to the top and bottom edges of the glazing panels.
6. Unrestricted thermal movement of the glazing panels shall be allowed to occur within the framing system without compromising its weathertightness.
7. The rabbet depth of all framing members shall, at a minimum, be based on a ¾” (.75”) engagement of the glazing panel, plus 1/8” (.125”) cutting tolerance, plus .005 x the glazing dimension (in inches) that affects that rabbet. For example, a glazing panel that

is 100” long will require a minimum rabbet depth of .75” + .125” + (.005 x 100”) = 1.375”.

C. Performance Requirements:

1. Air Infiltration: ASTM E-283: Air infiltration shall not exceed 0.03 cubic feet per minute per square foot of panel area when tested at a pressure of 12.0 psf.

2. Water Penetration: None when tested at a pressure of 12 psf in accordance with ASTM E-331.

3. Structural Performance: The system shall be capable of supporting the design loading for this project as listed below:
    a. Positive (downward) Wind Load: 8.07 psf
    b. Negative (uplift) Wind Load: -33.63 psf
    c. Snow Load (downward): 30.24 psf

4. Testing by a certified independent testing laboratory, in accordance with ASTM E-330, shall evidence this. In addition, the deflection of all framing members oriented normal to the glazing plane shall not exceed L/175.

1.4 SUBMITTALS

A. Product Data Sheets: Submit manufacturer's product data, including details of construction and installation, materials and finish, and installation instructions applicable to the configuration.

B. Shop Drawings:
1. Shall include Plans and/or elevations and details of the system and its installation. Flashing sealants and anchorage shall be clearly indicated.
2. Shall note gauges of brake metal, the finish on the framing, and any other information required to properly describe and install the system.

C. Samples: Submit manufacturer’s samples for each of the following:
1. Each type of glazing panel (6” x 6” minimum)
2. Each type of framing section (6” long minimum), showing finish, and color specified, including gaskets and fasteners.

D. Manufacturer’s Certification: Submit manufacturer’s certification that materials comply with specified requirements and are suitable for the intended application.

E. Manufacturer’s Project References: Submit a list of completed projects including project name and location, name of architect, and type of daylighting manufactured.

F. Warranty: Submit the manufacturer's standard warranty.

G. Test Reports:
1. *ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.*
2. *ASTM D 1929 – Standard Test Method for Determining Ignition Temperatures of Plastics.*
3. *ASTM E 1996 (Level D) – Standard Specification for Performance of Exterior*

Windows, Curtain Walls, Doors, and Impacted Protective Systems Impacted by Windborne Debris in Hurricanes. (Large Missile Impact Testing).

4. *ASTM E 1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.*
5. *ASTM D 2843 – Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.*
6. *ASTM D 1003 – Standard Test Method for Haze and Luminous Transmittance pf Transparent Plastics.*
7. *ASTM D 1925 - Standard Test Method for Yellowness Index of Plastics.*
8. *ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Wall by Uniform Static Air Pressure Difference.*

1.5 QUALITY ASSURANCE

A. Materials and Products shall be manufactured by a company continuously and regularly employed in the manufacture of glazing systems using cellular polycarbonate panel systems for a period of at least ten (10) years. Manufacturers shall provide a list of at least ten (10) projects having been in place for a minimum of five (5) years.

B. Erection shall be by the manufacturer, or an installer experienced in the erection of systems of the type specified.

C. The manufacturer shall be responsible for the configuration and fabrication of the complete system and will ensure that it fully meets all requirements of this specification.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the jobsite in the manufacturer's original and unopened containers and bearing labels as to the type of material and manufacturer's name. Delivered materials shall be identical to approved samples.

B. Store materials under cover in a dry, clean location, off the ground. Remove from the jobsite any materials that are damaged or otherwise not suitable for installation and replace with acceptable materials.

C. Protective coverings containing PVC shall not be used in contact with polycarbonate.

1.7 WARRANTY

A. Manufacturer Warranty: The Manufacturer shall provide a written warranty certifying that if within one (1) year from the shipment date of the system, the system experiences water leakage owing to defects in fabrication or materials, the Manufacturer will, in a timely manner, furnish (only) new components to replace all of those found to be defective.

   a. The above warranty does not apply in the cases of structural movement of the building(s), the negative air pressure inside the building(s), acts of God, alteration or abuse of the products, or unreasonable use.

b. The liability of the Warrantor shall be limited to the above and shall not include incidental or consequential damages of any kind.

c. The polycarbonate or glass glazing materials or any other materials or system (example… finishes on metals) furnished and warranted by others, shall be covered by only those warranties.

B. Polycarbonate Warranty: Provide written warranty from manufacturer agreeing to repair or replace work that has or develops defects in the polycarbonate panels. "Defects" is defined as abnormal aging or deterioration.

a. ***Warranty period for polycarbonate: [10]*** years from the date of shipment from the manufacturer against:
   i. Yellowing – The changes of yellowing index established in accordance with ASTM D 1925 standard should be less than 10 delta after 10 years, in relation to the original value.
   ii. Change in light transmission of no more than 6% per ASTM D-1003 in relation to the original value.
   iii. No delamination of panel affecting appearance, performance, or structural integrity of the cellular polycarbonate glazing panel.
   iv. No breakage due to direct effect from weather conditions and hail impact as defined by the manufacturer's written warranty submitted as part of section ***[1.4/F]*** in this specification.

C. Glass Warranty: See section 08801.

D. Finish Warranty: The framing finish applicator's warranty is specified below:

a. Anodized Finish: Ten (10) years from the date of application against chalking, fading, cracking, crazing, and blistering.

PART 2 PRODUCTS

2.1 MANUFACTURER AND PRODUCT

A. EXTECH/Exterior Technologies, Inc., 200 Bridge Street, Pittsburgh, PA 15223; Phone (800) 500-8083, Fax (800) 500-8012, website www.extechinc.com.
   a. Series #3300 Surface Mounted Canopy System.

B. Duo-Gard Industries Inc., 40442 Koppernick Road, Canton, Michigan 48187. Phone (734) 207-9700. Fax (734) 207-7995. Web Site: www.duo-gard.com.
   a. Series 3900 Sleekline Canopy System

C. DeaMor, 6210 S. 11th Street, Ridgefield, WA 98642; Phone (888) 284-6799, website http://www.deamor.com
   a. Skin System

D. Approved Equal

2.2 MATERIALS

A. Framing:

1. Shall be extruded aluminum of 6063-T5, 6005-T5, or 6105-T5 alloy and temper. All sections shall be formed true to detail and free from defects impairing appearance, strength, or durability.

B. Glazing Gaskets:

1. Shall be elastomeric, having low friction surfaces where they contact the glazing.

2. Shall be tested for chemical compatibility with the glazing, and test reports evidencing same shall be presented to the Architect.

C. Fasteners:

1. Where exposed, shall be stainless steel, 300 Series, with stainless steel backed neoprene washers.

2. Concealed fasteners they may be stainless or zinc-plated steel in accordance with ASTM Specifications A165-55 or A164-55.

3. Bolts, anchors and other fastening devices shall be as required for the strength of the connections and shall be suitable for conditions encountered. Washers shall be of the same metals as fasteners.

D. Flashing:

1. Minimum 0.040 thick Aluminum [painted finish: 3105-H14] [anodized finish: 5005-H34].

2. Factory formed to required profile(s) in 10-ft lengths, whenever practical, to allow for field trimming to suit as-built conditions.

3. The finish on this metal shall match as closely as possible that which is on the extruded aluminum framing members.

E. Glazing:

1. Tempered safety laminated glass: see section 08801.

2. Polycarbonate

A. Monolithic Polycarbonate:
   a. The solid polycarbonate panels shall be uniform in color.
   b. Solid panels shall consist of a polycarbonate resin with a permanent co-formulated ultraviolet (UV) protective additive.

c. Panels shall be 10mm (3/8”)
d. Panel width shall vary to suit the needs of the project.
e. Color (Panel): White
f. Light Transmission (LT %): 24% (minimum)
g. Flammability:
   i. Approved light transmitting plastic with CC1 classification per ASTM D-635 and IBC 2606.4.
   ii. Smoke density no greater than 75 per ASTM D2843.
   iii. Self-ignition temperature, per ASTM-1929 no less than 550 degrees Celsius.

F. Attachment:

1. System shall be fastened to substrate with fasteners that are designed and installed by the installer.

2. Fasteners to penetrate through one-piece perimeter extrusions, and through base extrusions of intermediate mullions.

3. Any shims or appurtenances required to facilitate system mounting and isolation shall be provided and installed by the installer.

2.3 FABRICATION AND WORKMANSHIP

A. Construct canopy(s) using extruded aluminum members.

B. Carefully and accurately design, fabricate and assemble work with proper provision for thermal contraction and expansion. Work shall conform to profiles and sections noted on the shop drawings. Work shall be assembled with joints in a neat and finished manner.

C. All framing members shall be factory fabricated and assembled to the greatest degree possible, including the following:

a. Cutting members to length.
b. Installation of glazing gaskets, to be glued within extruded gasket tracks.
c. Drilling straight and countersunk mounting holes, fastener access holes, and weep holes.
d. Fabricating miter joints with concealed joint reinforcements and joint gaskets.
e. Installation of non-metallic thermal isolation spacers.
f. Removal of extrusion portions to accommodate tight over-lapping joinery and connections, including coped ends, mid-span notches, etc.
g. Fabrication and installation of splice plates at jointed connections.

2.4 FINISHES

A. Exposed surfaces of the aluminum framing members shall be finished as follows:

1. Anodized Coatings:

a. Architectural Class I Color Anodized type AA-M10C22A44 electrolytically deposited complying with AAMA 611, 0.7 mil thick minimum
b. Color as noted on drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

A. All submitted opening sizes, dimensions, and tolerances are to be field verified by the installer unless otherwise stipulated.

B. Installer to examine site conditions to verify readiness. Notify general contractor or owner about any defects requiring correction, including but not limited to improperly sloping sill substrates and uneven planar substrates. Do not work until conditions are satisfactory.

3.2 INSTALLATION

A. Install components in strict accordance with manufacturer's instructions and approved shop drawings. Use proper fasteners and hardware for material attachments as specified.

B. Use methods of attachment to the structure which include provisions for thermal movement.

C. Glazing shall be installed in accordance with panel and system manufacturer's guidelines.

D. Remove all protective coverings on polycarbonate and glass panels during or immediately after installation.

E. Installation shall be performed by a company with ten (10) years of continuous experience in commercial construction.

F. Protect contact points between unprotected dissimilar metals (except stainless steel) using continuous separators of FRP, PVC tape (or approved equal)

3.3 CLEANING AND PROTECTION

A. During installation, protect exposed surfaces against the accumulation of paint, caulking, disfiguration, and damage.

B. Interior glazing surfaces shall be cleaned as the panels are being installed. The exterior shall be cleaned as each phase of the work is completed.

C. Follow panel manufacturer instructions when cleaning exposed panel surfaces. Clean polycarbonate or glass panels and frame at time of installation.

D. Follow panel manufacturer's guidelines when removing foreign substances from panel surfaces. Use only solvents that are deemed acceptable for use.

E. Before final acceptance, repair and/or replace any defective materials or work.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by a lump sum for all work necessary to complete in place Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZING ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

SECTION 08510

STEEL WINDOWS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following items.

1. Fixed steel window frames with factory applied finish for windscreens.
2. Fixed and sliding steel thermal window frames for the Operators Booth.
3. Thermal steel swing door.
4. All anchors, mullions, covers, and trim for steel doors and windows.
5. Factory applied finish.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 05100 – STRUCTURL STEEL; structural steel frame.
2. Section 07920 – JOINT SEALANTS; perimeter sealant and caulking.
3. Section 08801 – GLASS AND GLAZING; glazed lites.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, samples, test reports, manufacturer's warranty, and manufacturer's certificate of compliance.

B. Shop Drawings: In addition to requirements below, provide a schedule of window frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each window opening and door unit.
2. Details of windows and doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing.

C. Qualification Data: For Installer.

D. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

E. Samples:

1. For each type of window and frame system, submit a 6" long section with glazing beads.
2. Sample of muntin, showing welded intersections and glazing beads.
3. Color sample of finish.

F. Warranty: submit a sample of the manufacturer's warranty.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have not less than 10 years experience in the fabrication of heavy intermediate steel windows and doors and be a member of The Steel Window Institute (SWI).

B. Source Limitations: Obtain standard steel window and door frames through one source from a single manufacturer.

C. Installation of windows and doors shall be done by experienced window installers approved by the manufacturer.

D. Allowable tolerances: Size dimensions + 1/16 inch.

E. Source quality control:
1. Air infiltration test (windows)
   a. Products must be independently lab tested and meet or exceed ASTM E283.
   b. Maximum air infiltration 0.30 CFM/ SQFT with differential pressure across window unit of 1.57 / 6.24 PSF
2. Water penetration test (windows)
   a. Products must be independently lab tested and meet or exceed ASTM E331.
   b. No water penetration for 15 minutes when window is subjected to a rate of flow of 5 gal./hr/sq.ft with differential pressure across window unit of 4.50 PSF
   c. When weeps are required on fixed windows, ASTM E547 cyclic testing standard with differential pressure across window unit of 4.50 PSF shall be standard.
3. Field Testing
   a. Field testing criteria (when applicable) shall be in accordance with AAMA 502-08.
4. Structural test
   a. Meets or exceeds ASTM E330
5. Forced entry test
   a. Meets or exceeds ASTM F588
   b. Grade 40 @ 300 pounds
6. Thermal performance test:
   a. Products must be independently lab tested, listed and certified for U-value performance in accordance with NFRC-100.
   b. Products must be independently lab tested, listed and certified for solar heat gain coefficient in accordance with NFRC-200.
   c. Products must be independently lab tested, listed and certified for air infiltration in accordance with NFRC-400.
   d. Products must be independently lab tested, listed and certified for condensation resistance performance in accordance with NFRC-500.
7. Quality of factory applied paint finish system shall meet or exceed the following ASTM designations: ASTM D714- Paint Blistering Test, ASTM D4585 – Humidity Test, ASTM B117 – Salt Spray (Fog) Test, ASTM D1654 – Painted Products in Corrosive Environments, ASTM

G85 – Cyclic Fog/Dry Test (Prohesion), ASTM D5894 – Salt Fog/UV Painted Metal, ASTM D4541 – Pull off Strength of Coating Test.

8. Upon request, the window manufacturer shall provide a test report from a qualified independent U.S. testing laboratory regularly engaged in testing windows to verify that his products conform to these test requirements.
9. Pre-installation Conference: Prior to start of installation attend and conduct a Project site visit to ensure to compliance with requirements in Division 1.
10. Provide 10 year warranty against defect in material and manufacture.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver window frames and doors palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic. Provide additional protection to prevent damage to finish.

B. Store window frames and doors under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If wrappers on window frames become wet, remove cartons immediately. Provide minimum 1/4-inch space between each frame to permit air circulation.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

1.6 COORDINATION

A. Coordinate installation of anchorages for standard steel window frames and doors. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hope's Windows, Inc.
   a. Landmark 175 Series Fixed Steel Windows – true divided lite muntins:

b. Landmark 175 Series Steel Windows and doors with Thermal Evolution Technology;
c. Landmarks 175 Series Swinging Steel Doors with Thermal Evolution Technology

2. Or equivalent Engineer approved product by:
   a. Blis Nor-Am
   b. A & S Window Associates
   c. Optimum Window Manufacturing
   d. Torrance Steel Window Co.

2.2 MATERIALS

A. Steel Windows for windscreens shall be manufactured from solid hot rolled steel shapes.
   1. Profiles made from steel with flanges rolled integrally at the mill and bent to the required radius as indicated on the shop drawings.
   2. Perimeter frames and ventilator profiles shall have glazing rebates providing an unobstructed glazing surface of at least 5/8".
   3. Glazing rebate surfaces must be perpendicular to the web or stem of the profile. Applied glazing rebate extensions and rebate surfaces that are tapered will not be acceptable.
   4. Combined weight of frame and ventilator profiles shall be a minimum of 3.50 pounds per lineal foot. Frame profile alone shall not weigh less than 1.70 pounds per lineal foot.
   5. All steel profiles must be a minimum of 1-3/4″ in depth.
   6. The frame and ventilator profiles shall have integral grooves located in the exterior and interior bedding contacts for the reception of triple weatherstripping.

B. Thermal Steel Windows shall be manufactured from solid hot rolled steel shapes.
   1. Profiles made from steel with flanges rolled integrally at the mill and bent to the required radius as indicated on the shop drawings.
   2. Perimeter frames and ventilator profiles shall have glazing rebates providing an unobstructed glazing surface of at least 5/8".
   3. Glazing rebate surfaces must be perpendicular to the web or stem of the profile. Applied glazing rebate extensions and rebate surfaces that are tapered will not be acceptable.
   4. Combined weight of frame and ventilator composite profiles shall be a minimum of 4.10 pounds per lineal foot. Frame composite profile alone shall not weigh less than 2.10 pounds per lineal foot.
   5. All steel profiles must be a minimum of 1-3/4″ in depth.
   6. The solid hot-rolled steel ventilator profile shall have integral groove located at the exterior bedding contact for the reception of weatherstripping.
   7. The isolated composite frame shall provide two additional bedding contacts of weatherstripping to complete triple weatherstripping.

C. Steel doors shall be manufactured from solid hot-rolled steel profiles with thermal isolator.
   1. Profiles made from steel with flanges rolled integrally at the mill.
   2. Perimeter frames and ventilator profiles shall have glazing rebates providing an unobstructed glazing surface of at least 5/8".
   3. Glazing rebate surfaces must be perpendicular to the web or stem of the profile. Applied glazing rebate extensions and rebate surfaces that are tapered will not be acceptable.
   4. Combined weight of frame and door composite profiles shall be a minimum of 4.10 pounds per lineal foot. Frame composite profile alone shall not weigh less than 2.10 pounds per lineal foot.
   5. All steel profiles must be a minimum of 1-3/4″ in depth.
   6. The solid hot-rolled steel door profile shall have integral groove located at the exterior bedding contact for the reception of weatherstripping.
   7. Kick panels shall be of composite construction.

8. Lockbox and lock stile shall be of composite construction.
9. The isolated composite frame shall provide two additional bedding contacts of weatherstripping to complete triple weatherstripping.

D. Muntins:
   1. True Divided Lite muntins:
      a. Muntins shall be manufactured from solid hot-rolled steel. Size to be determined by design.
      b. Glazing rebate surfaces must be perpendicular to the stem of this profile. Rebate surfaces that are tapered will not be acceptable.
      c. 1-1/8" tee shall weigh 1.037 pounds per lineal foot.
      d. All steel muntin profiles must be a minimum of 1-1/4″ in depth.

E. Thermal isolators shall be composite material.

F. Glazing beads shall be composite or aluminum alloy 6063_T6 profile.

G. Weatherstripping shall be extruded vinyl, EPDM closed cell sponge, flexible silicone or polyethylene clad urethane foam.

H. Operable Hardware:
   1. Side sliding ventilators:
      a. Fastener: Brass or Bronze cam fastener.
      b. Pivots: High tensil aluminum pivot with stainless steel pin.
      c. Friction and limit device: Stainless steel with sliding brass shoe and screw adjusted friction.
   2. Door Hardware:
      a. Hinges / Pivots: AMC #905 Pivot, or approved equal.
      b. Door Trim Sets (to be selected from manufacturer standard options):
         1) Levers
         2) Escutcheon Trim
         3) Key Cylinder
         4) Thumbturn
      c. Locksets: Mortise lock
      d. Closer:
         1) Overhead surface mounted closer, with drop plate
      e. Threshold:
         1) ADA Compliant
         2) Stainless Steel
      f. Weatherstripping: Silicone
      g. Friction / Limit Device
         1) Friction Adjuster

I. All screws for hardware, trim, covers, anchoring, weather bars, water dams, screens, etc. shall be stainless steel.

J. Paint (factory finished by manufacturer)
   1. Cleaning.
   2. Pretreatment with Hot-Dip Galvanizing.
   3. Brush-Off Blast Cleaning.
   4. Epoxy Powder Primer.
   5. Polyester Powder Top Coat.

2.3 FABRICATION

A. Fabricate steel windows and doors in accordance with approved shop drawings.

B. Prior to fabrication, all hot rolled steel sections shall be cleaned by shot blasting.

C. Corners of frame and ventilator shall be mitered or coped then solidly welded. Exposed and contact surfaces shall be finished smooth flush with the adjacent surfaces. All interior and exterior rail bar and muntin joints shall be face welded and ground smooth.

D. Muntins:

1. True Divided Lite muntins shall be coped and welded to the perimeter frame. Muntin intersections shall be slotted, cross notched and welded. All interior and exterior muntin joints shall be face welded and ground smooth.

E. Glazing
1. All windows shall be designed for exterior glazing.
2. Provide replaceable continuous snap-in glazing beads to suit the glass as specified.
3. Glazing beads shall be cut and shop fitted to each glass lite prior to shipment.

2.4 STEEL FINISHES

A. Provide documentation of compliance with the following criteria for factory applied paint finish:
1. ASTM D714-02 Paint Blistering Test
2. ASTM D4585 Humidity Test
3. ASTM B117-03 Salt Spray (Fog) Test
4. ASTM D1654-05 Painted Products in Corrosive Environment
5. ASTM G85 Cyclic Fog/ Dry Test (Prohesion)
6. ASTM D5894-96 Salt Fog/ UV Painted Metal
7. ASTM D4541 Pull Off Strength of Coating Test

PART 3 - EXECUTION

3.1 EXAMINATION

A. Window and door openings shall conform to details, dimensions and tolerances shown on the window manufacturers approved shop drawings.

B. Conditions which may adversely affect the window or door installation must be corrected before installation commences.

3.2 INSTALLATION

A. Windows and doors specified under this section shall be installed by experienced personnel.

B. Install windows in openings in strict accordance with approved shop drawings.

1. Set units plumb, level and true to line, without warp or rack of frames.
2. Anchor units securely to surrounding construction with approved fasteners.
3. The exterior joints between the windows, trim and mullions shall be properly sealed watertight with an approved sealant and neatly pointed.

C. Attach ventilator hardware, as required, and adjust ventilators to operate smoothly free from twist and to be weather tight when closed.

D. Attach loose muntin grids per approved shop drawings, if applicable.

E. Glazing: Comply with installation requirements in Section 08801 – GLASS AND GLAZING and with window frame manufacturer's written instructions.

3.3 ADJUSTING AND CLEANING

A. Repair any abraded areas of the factory finish.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZING ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

SECTION 08801

GLASS AND GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following items.

1. Glass and glazing for the following products and applications:
   a. Tempered safety laminated glass panels at shelter canopies (GL-1).
   b. Tempered safety laminated glass panels at shelter windscreens (GL-3).
   c. Tempered safety laminated insulating tinted glass panels at Operators Booth (GL-4).
   d. Tempered safety laminated insulating glass at customer service window at Operators Booth (GL-5).

B. Related Work:

1. Section 08450 – ALUMINUM FRAME GLAZED CANOPY SYSTEM

2. Section 08510 – STEEL WINDOWS

3. Section 10730 – TRANSIT SHELTERS

1.2 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal uses that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

F. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and

cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size panels, but not less than thicknesses and in strengths (heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
    a. Specified Design Wind Loads: As required by Code.
    b. Specified Design Snow Loads for Sloped Glazing: As required by Code.
    c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
        1) Load Duration: 60 seconds minimum.
    d. Probability of Breakage for Sloped Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow action.
        1) Load Duration: 30 days minimum.
    e. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
        1) For monolithic-glass lites heat treated to resist wind loads.
        2) For laminated-glass lites.
        3) For insulating glass.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units with lites 6.0 mm thick and a nominal 1/2-inch-wide interspace.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
    a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
    b. Solar Heat Gain Coefficient: NFRC 200.
    c. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- square Samples for glass.

1. Each color of tinted float glass.
2. Each type of laminated glass with colored or translucent interlayer.
3. Insulating glass for each designation indicated. The final color selection for tinted insulated glass shall be selected from the samples. Submit a minimum of (3) similar colors for selection.
4. For each color (except black) of exposed glazing sealant indicated.

C. Glazing Schedule: Use same designations indicated on Drawings in preparing a schedule listing glass types and thicknesses for each size and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

E. Qualification Data: For installers, in accordance with Par. 1.5A.

F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Product Test Reports: For each of the following types of glazing products:

1. Tempered safety laminated glass.
2. Insulating glass.
3. Glazing sealants.
4. Glazing gaskets.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer with a minimum of three years experience who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance.

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, laminated glass and insulating glass.

C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in Part 1 "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

F. Hold Point - Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

G. Safety Glazing Products: Comply with testing requirements in 16 CFR 120 and ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

H. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001 "Sloped Glazing Guidelines."

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.8 WARRANTY

A. Manufacturer's Special Warranty for Glass Products: Manufacturer's standard form, made out to the Authority and signed by glass manufacturer agreeing to replace glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Ten years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to the Authority and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in Part 1 "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Viracon
2. PPG Industries
3. Guardian Industries
4. Oldcastle
5. Trulite
6. Approved Equal

2.2 GLAZING TYPES

A. Gl-1: Tempered safety laminated glass (sloped) for shelter canopies:
1. Configuration:
a. Outside / Top: ¼ inch tinted glass
b. Interlayer: 0.60 inch clear PVB

c. Inside / Bottom: ¼ inch glass with Low-E coating

2. Properties:
   a. Visible Light Transmittance (VLT): 70% minimum
   b. Visible Light Reflectance (VLR): 6%
   c. Solar Energy Transmittance: 38%
   d. U-Value (Winter): 0.67
   e. U-Value (Summer): 0.47
   f. Shading Coefficient: 0.57
   g. Relative Heat Gain: 120 Btu/(hrxsqft)
   h. Solar Heat Gain Coefficient (SHGC): 0.49

B. GL-3: Tempered safety laminated glass (vertical) for shelter windscreens:
1. Configuration:
   a. Outside / Top: ¼ inch clear glass
   b. Interlayer: 0.60 inch clear PVB
   c. Inside / Bottom: ¼ inch glass with Low-E coating
2. Properties:
   a. Visible Light Transmittance (VLT): 85%
   b. Visible Light Reflectance (VLR): 7%
   c. Solar Energy Transmittance: 56%
   d. U-Value (Winter): 0.61
   e. U-Value (Summer): 0.47
   f. Shading Coefficient: 0.73
   g. Relative Heat Gain: 153 Btu/(hrxsqft)
   h. Solar Heat Gain Coefficient (SHGC): 0.64

C. GL-4: Tempered safety laminated insulating tinted glass at Operators Booth
1. Configuration:
   a. Outside / Top: ¼ inch clear glass with bronze tinted coating on the #2 surface
   b. Interlayer: 0.60 inch clear PVB
   c. Inside / Bottom: ¼ inch clear glass
   d. Air Gap: 1/2 inch argon filled
   e. Inner-most lite: ¼ inch clear glass
2. Properties:
   a. Visible Light Transmittance (VLT): 73%
   b. Visible Light Reflectance (VLR): 15%
   c. Solar Energy Transmittance: 39%
   d. U-Value (Winter): 0.46
   e. U-Value (Summer): 0.47
   f. Shading Coefficient: 0.56
   g. Relative Heat Gain: 118 Btu/(hrxsqft)
   h. Solar Heat Gain Coefficient (SHGC): 0.49

D. GL-5: Tempered safety laminated insulating glass at customer service window at Operators Booth
   a. Outside / Top: ¼ inch clear glass
   b. Interlayer: 0.60 inch clear PVB
   c. Inside / Bottom: ¼ inch clear glass
   d. Air Gap: 1/2 inch argon filled
   e. Inner-most lite: ¼ inch clear glass
2. Properties:
   a. Visible Light Transmittance (VLT): 75%
   b. Visible Light Reflectance (VLR): 13%

c. Solar Energy Transmittance: 48%
d. U-Value (Winter): 0.44
e. U-Value (Summer): 0.46
f. Shading Coefficient: 0.68
g. Relative Heat Gain: 142 Btu/(hrxsqft)
h. Solar Heat Gain Coefficient (SHGC): 0.59

2.3 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Verify glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Engineer from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:

a. Dow Corning Corporation; 790.
b. GE Silicones; SilPruf LM SCS2700.
c. Tremco; Spectrem 1 (Basic).

2.4 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for project conditions.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze panels indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 - MAGAZINE ST SHELTER	(LS)
10730.3	SHELTER 3 - GREEN ST SHELTER	(LS)

END OF SECTION

SECTION 09260

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following items:

1. Interior gypsum wallboard.
2. Non-load-bearing steel framing.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 07210 – THERMAL INSULATION
2. Section 09546 – LINEAR METAL CEILING
3. Section 09900 – PAINTING
4. Section 10730 – TRANSIT SHELTERS

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. Sound Transmission Coefficient Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Hold Point - Mockups: Before beginning gypsum board installation, install mockups of at least 10 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

    a. Each level of gypsum board finish indicated for use in exposed locations.

b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and trim, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

B. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges with depth as required for span and loading and indicated on Drawings.

C. Furring Channels (Furring Members): 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.

D. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    b. Chicago Metallic Corporation; Drywall Furring System.
    c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), non-perforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

2.5 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. USG Corporation.
    b. G-P Gypsum.
    c. National Gypsum Company.

B. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard, regular-type and Type X gypsum board.

1. Core: Type X, thickness as indicated on the Contract Drawings.
2. Long Edges: Tapered.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. Expansion (control) joint.
    e. Curved-Edge Cornerbead: With notched or flexible flanges.
    f. F Reveal

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fry Reglet Corp.
    b. Gordon, Inc.
    c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Acoustical Sealant: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

   a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
   b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:

   a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
   b. Pecora Corp.; BA-98.
   c. Tremco, Inc.; Tremco Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754. Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within [1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

B. Z-Furring Members:

1. Erect insulation (specified in Section 07210 "Building Insulation") vertically and hold in place with Z-furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

3.6 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces, above ceilings and similar locations, except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to unsupported open edges of stud flanges first.

3.7 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:
1. On partitions/walls, apply gypsum panels to minimize end joints.
2. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.

3.8 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. Curved-Edge Cornerbead: Use at curved openings.
4. F Reveal: Use at base of panels to separate from the floor.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.9 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
4. Level 5: Where indicated on Drawings.

3.10 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or exhibit mold growth. Repair of damaged panels in place is not acceptable.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
3.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

B. PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)

END OF SECTION

SECTION 09546

LINEAR METAL CEILING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following items:

1. Non-perforated metal ceiling panels
2. Suspension systems
3. Accessories; provide other necessary items including devices for attachment overhead construction, secondary members, splines, splices, connecting clips, wall connectors, wall angles, and other devices required for a complete installation.
4. Supplemental support framing: Provide fully engineered secondary framing as required to meet code, conforming to layout shown in drawings, to support direct-hung metal ceilings suspension system.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 05100 – Structural Steel
2. Section 05500 – Miscellaneous Metals
3. Section 10730 – Transit Shelters
4. Section 16500 – Lighting

C. This Section covers the general requirements only for Acoustical Metal Ceilings as shown on the drawings. The supplying and installation of additional accessory features and other items not specifically mentioned herein, but which are necessary to make a complete installation, shall also be included or clarified accordingly.

D. Qualification Data:
1. Test Reports: Certified reports from independent agency substantiating structural compliance to windloads and other governing requirements.
2. Certificates:
   a. Data substantiating manufacturer and installer qualifications.
   b. Certified data attesting fire rated materials comply with specifications.
3. Manufacturer's Instructions: Detailed installation instructions and maintenance data.

1.2 DEFINITIONS

A. American Society for Testing and Materials (ASTM)

1. E 84 – "Standard Test Method for Surface Burning Characteristics of Building Materials"

2. E 488 – "Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements"

3. B 209 – "Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate"

4. C 423 – "Sound Absorption and Sound Absorption Coefficients by Reverberation Room Method"

5. E 580 – "Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint"

6. C 635 – "Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings"

7. C 636 – "Recommended Practice for Installation of Metal Ceiling Suspensions Systems for Acoustical and Lay-in Panels"

8. A 641 – "Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire"

9. A 653 – "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip process"

10. E 1264 – "Classification for Acoustical Ceiling Products"

11. E 1477 – "Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by use of Integrating-Sphere Reflectometers"

12. D 1044 – "Practice for Abrasion Resistance"

13. D 1002 – "Practice for Adhesion Resistance"

1.3 SUBMITTALS

B. Product Data: Manufacturer's published literature, including specifications.

C. LEED Submittal Data: Manufacturer's product data for each product specified in this section per ecoscorecard.com.

D. Product Certification: Manufacturer's certifications that products comply with specified requirements and governing codes including product data, laboratory test reports and research reports showing compliance with specified standards.

E. Shop Drawings: Submit shop drawings for reflected ceiling plans (RCP's), drawn to scale, and indicating penetrations and ceiling mounted items. Show the following details:

1. Reflected Ceiling Plan(s): Indicating metal ceiling layout, ceiling mounted items and penetrations.

2. Suspension System, Carrier and Component Layout.

3. Details of system assembly and connections to building components.

F. Samples for Verification: Full-size units (or as specified below) of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics. Submit samples for each type specified.

1. 11" square metal panel units.

2. 11" long samples of each exposed molding or trim.

3. 11" long samples of each suspension component.

1.4 QUALITY ASSURANCE

A. Manufacturer/Installer Qualifications:
   1. Provide metal ceiling system components produced by a single manufacturer with a minimum 5 years' experience in actual production of specified products and with resources to provide consistent quality in appearance and physical properties, without delaying the work.
   2. Provide suspension system components produced by a single manufacturer to provide compatible components for a complete metal ceiling system installation.
   3. Perform installations using a firm with installers having no less than 3 years of successful experience on projects of similar size and requirements.

B. Regulatory Requirements:
   1. Fire Rating: Class A complying with certified testing per ASTM E 84.
   2. Structural Criteria: Install and certify system to comply with structural and wind load requirements of governing codes.
   3. Installation Standard for Suspension System: Comply with ASTM C 636.

C. Mock-Up: Prior to beginning installation erect a mock-up section, where directed, using all system components.

D. Pre-installation Conference: Conduct a conference, prior to start of installation, to review system requirements, shop drawings, and all coordination needs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver system components in manufacturer's original unopened packages, clearly labeled.

B. Store components in fully enclosed dry space. Carefully place on skids, to prevent damage from moisture and other construction activities.

C. Handle components to prevent damage to surfaces and edges, and to prevent distortion and other physical damage.

1.6 SEQUENCING AND SCHEDULING

A. Begin system installations only after spaces are enclosed and weather-tight, and after all wet work and overhead work have been completed.

B. Prior to starting installations, allow materials to reach ambient room temperature and humidity intended to be maintained for occupancy.

1.7 WARRANTY

A. Provide specified manufacturer's warranty against defects in workmanship, discoloration, or other defect considered undesirable by the Engineer or City.

B. This warranty shall remain in effect for a minimum period of one (1) year from date of initial acceptance.

1.8 MAINTENANCE & EXTRA MATERIALS

A. Maintenance Instructions: Provide manufacturer's standard maintenance and cleaning instructions for finishes provided.

B. Extra Materials: Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Only typical system components are included with attic stock.

1. Acoustical Metal Ceiling Pan Units: Full-size units equal to two percent (2%) of amount installed.
2. Ceiling Suspension System Components: Quantity of each grid and exposed component equal to two percent (2%) of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Provide Box linear metal panel ceiling system manufactured by Hunter Douglas Ceilings & Walls exclusively from CertainTeed, Inc.; 5015 Oakbrook Parkway, Suite 100, Norcross, GA 30093. Tel: (800) 366-4327; www.CTSpecialtyCeilings.com or approved equal by ASI Architectural, Armstrong, USG, Rockfon.

B. Approved Equal

2.2 SYSTEM MATERIALS

A. Linear metal panel ceiling system for interior installations:

B. Panel Profile Type: Box 6, roll formed, 025" interior thick aluminum with square edges; 5-5/32" wide, 5/8" deep with 27/32" reveal to form a 6" module.
1. Panel length: Standard 12' (minimum 3' – maximum 16')

C. Linear Suspension System:
1. Carrier: Universal hat-shaped, .038" roll-formed aluminum section with hook-shaped tabs spaced to receive ceiling panels at 2" on-center and 27/32" apart. Support holes spaced 4" on-center. Finish: Factory-applied black enamel.
2. Hanger Wire: 12 gage galvanized carbon steel hanger wire.

3. Seismic/Wind Uplift Compression Struts: 1-1/2" (38 mm) deep, 16 Ga., cold-rolled steel "C" channels.

D. Non-Perforated

E. Panel Finish:
1. Paint; color to be selected by Engineer
a. Powder Coat

2.3 ACCESSORY MATERIALS

A. Panel End Caps: Formed, stamped, or milled end caps with matching finish

B. Panel Splice: Formed aluminum insert designed to snap-fit between ends of two ceiling panels. Finish: to match panel

C. Access Door: (2' x 2') aluminum access frame with hinges and retainer clip for downward-acting access panel to plenum space, as required.

D. Air Distribution Devices: Provide distribution devices that are independently suspended, adjustable from below finished ceiling, capable of being concealed behind (invisible to view) and fully integrated with ceiling system to allow no interruption of ceiling components.

E. Lighting Fixtures (Modular Type "M" or "MT" flange) and HVAC diffusers: Optional.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which acoustical metal panels attach or abut, with installer present, for compliance with requirements specified in this and other Sections that affect installation and anchorage, and other conditions affecting performance of metal panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

B. Measure each ceiling area and establish layout of acoustical metal pan units to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width units at borders, and comply with layout shown on reflected ceiling plans.

C. Survey substrate for wall attachment to assure squareness and proper elevation for wall panel installation.

3.3 INSTALLATION

A. General: Install acoustical metal pan ceilings, per manufacturers shop drawings provided, per manufacturer's written instructions and to comply with publications referenced below.
   1. ClSCA "Ceiling Systems Handbook"
   2. Standard for Ceiling Suspension System Installations - ASTM C 636
   3. Standard for Ceiling Suspension Systems Requiring Seismic Restraint - ASTM E 580
   4. IBC (International Building Code) Standard for Seismic Zone for local area

B. Suspend ceiling hangers from building's approved structural substrates and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produce hanger spacings that interfere with location of hangers at spacing required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Utilize supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
   4. Where used secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   5. Space hangers not more than 48" on-center, along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 12" from ends of each member. Supply supporting calculations from licensed Structural Engineer verifying hanger spacing meets all requirements, when spacing exceeds those recommended.
   6. Level grid to 1/8" in 10' from specified elevation(s), square and true.
   7. Adjust suspension system runners so they are square (within .5 degree from 90 degrees) and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

C. Secure bracing wires to ceiling suspension members and to supports acceptable to Engineer.. Suspend bracing from building's structural members and/or structural deck, as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs (unless directed otherwise).

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pan. Method of edge trim attachment and design of edge trims to be approved by Engineer.
   1. Screw attach moldings to substrate at intervals not more than 18" on-center and not more than 6" from ends, leveling with ceding suspension system to a tolerance of 1/8" in 10'. Miter corners accurately and connect securely.
   2. Do not use exposed fasteners, including pop rivets, on moldings and trim without prior written approval, or unless detailed otherwise.

E. Scribe and cut acoustical metal panel units for accurate fit at penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

F. Install acoustical metal panel units in coordination with suspension system. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.

3.4 ADJUST AND CLEAN

A. Adjust components to provide uniform tolerances.

B. Replace all ceiling panels that are scratched, dented or otherwise damaged.

C. Clean exposed surfaces with non-solvent, non-abrasive commercial type cleaner.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following items.

1. Field painting of exposed exterior items and surfaces.
2. Surface preparation for painting.

B. Work under this section shall be included paid for under Section 10730 – TRANSIT SHELTERS.

C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 03300 – CONCRETE: surface preparation of concrete.
2. Section 05100 - STRUCTURAL STEEL: Shop priming structural steel.
3. Section 05500 - MISCELLANEOUS METAL: Shop priming ferrous metal.
4. Section 08510 - STEEL WINDOWS: Factory priming steel doors and frames.
5. Section 09260 - GYPSUM BOARD ASSEMBLIES: Surface preparation of gypsum board.
6. Section 10730 – TRANSIT SHELTERS

Note, painting of the Ribbon Structure is not part of this section. That is covered under Section 05700.

1.2 DEFINITIONS AND EXTENT

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semi-gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

B. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Engineer will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include, but are not limited to the following factory-finished components:

    a. Architectural woodwork.
    b. Acoustical wall panels.
    c. Metal toilet enclosures.
    d. Metal lockers.
    e. Kitchen appliances.
    f. Elevator entrance doors and frames.
    g. Elevator equipment.
    h. Finished mechanical and electrical equipment.
    i. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

    a. Foundation spaces.
    b. Furred areas.
    c. Ceiling plenums.
    d. Utility tunnels.
    e. Pipe spaces.
    f. Duct shafts.
    g. Elevator shafts.

3. Finished metal surfaces include the following:

    a. Anodized aluminum.
    b. Stainless steel.
    c. Chromium plate.
    d. Copper and copper alloys.
    e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:

    a. Valve and damper operators.
    b. Linkages.
    c. Sensing devices.
    d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

A. Product Data: For each paint system indicated, include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
3. Submit two 8-inch by 12-inch Samples for each type of finish coating for Engineer's review of color and texture only.

C. Qualification Data: For Applicator.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. Mockups: Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in Painting and Decorating Contractors of America PDCA P5. Duplicate finish of approved sample Submittals.

1. Engineer will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.

   a. Wall Surfaces: Provide samples on at least 100 sq. ft.
   b. Small Areas and Items: Engineer will designate items or areas required.

2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.

a. After finishes are accepted, Engineer will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F and a maximum ambient temperature of 95 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.6 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Engineer about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats or tie-coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation to remove.

    a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
    b. Determine pH of surfaces using pH indicating papers and distilled water and perform moisture vapor transmission testing for concrete floors in accordance with ASTM F 1869 and moisture tests on concrete walls in accordance with ASTM D 4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method. For masonry walls, use a moisture meter approved by the coating manufacturer. Follow the selected and approved coating manufacturers recommendations for acceptable pH values, moisture vapor transmission values (in lbs. of moisture per 24 hours per 1,000 SF), and moisture meter values (for masonry). If these values are not acceptable, do not paint surfaces until moisture levels are acceptable or additional surface preparation has been performed and the pH values measured are acceptable
    c. Clean concrete floors to be painted with shot blast equipment.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

    a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
    b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
    c. If transparent finish is required, backprime with spar varnish.
    d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
    e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with The Society for Protective Coating's (SSPC) recommendations.

a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3, SSPC-SP 10/NACE No. 2

b. Treat existing painted surfaces with surface preparation methods recommended by coating manufacturer and in accordance with the coating schedule.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods. Use Oakite Cleaner LTS or equal for pretreatment of any non-primed galvanized metal before finish painting.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Blend material before application to produce a mixture of uniform density. Blend as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless or conventional spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Uninsulated metal piping.
2. Uninsulated plastic piping.
3. Pipe hangers and supports.
4. Tanks that do not have factory-applied final finishes.
5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

G. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.

2. Panelboards.
3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Engineer.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in Painting and Decorating Contractors of America PDCA P1.

3.6 PAINT SCHEDULE

A. Schedule: Provide products and number of coats specified. Use of manufacturer's proprietary product names to designate colors, materials, generic class, standard of quality and performance criteria and is not intended to imply that products named are required to be used to the exclusion of equivalent performing products of other manufacturers.

B. Coating Systems:

New Exterior Steel Polyurethane 3-Coat System:
Surface Preparation: SSPC-SP10 Near-White Blast Cleaning

System A	1.	Carboline Carbozinc 859 Primer
	2.	Carboline Carboguard 635 Epoxy
	3.	Carboline Carbothane 134HG Polyurethane
System B	1.	International Interzinc 52 Primer
	2.	International Intergard 345 Epoxy
	3.	International Interthane 990HS Polyurethane
System C	1.	PPG Amercoat 68HS Primer
	2.	PPG Amerlock 400 Epoxy
	3.	PPG Amercoat 450H Polyurethane
System D	1.	Sherwin Williams Zinc Clad IIIHS Primer
	2.	Sherwin Williams Macropoxy 646 Epoxy
	3.	Sherwin Williams Hi-Solids Polyurethane
System E	1.	Tnemec Series 90G-1K97 Primer
	2.	Tnemec Series 161 Epoxy
	3.	Tnemec Series 73 Endurashield Polyurethane

Or Approved Equal

New Exterior Galvanized Steel
Surface Preparation: SSPC-SP16 Brush-off Blast Cleaning of Galvanized Steel or Other Means as Required by Coatings Manufacturer

System A	1.	Carboline Carboguard 635 Epoxy
	2.	Carboline Carbothane 134HG Polyurethane
System B	1.	International Intergard 345 Epoxy
	2.	International Interthane 990HS Polyurethane
System C	1.	PPG Amerlock 400 Epoxy
	2.	PPG Amercoat 450H Polyurethane
System D	1.	Sherwin Williams Macropoxy 646 Epoxy
	2.	Sherwin Williams Hi-Solids Polyurethane

System E	1.	Tnemec Series 161 Epoxy
	2.	Tnemec Series 73 Endurashield Polyurethane

Or Approved Equal

New Exterior Aluminum
Surface Preparation: Prepare Surface as Required by Paint Manufacturer

System A	1.	Carboline Carboguard 635 Epoxy
	2.	Carboline Carbothane 134HG Polyurethane
System B	1.	International Intergard 345 Epoxy
	2.	International Interthane 990HS Polyurethane
System C	1.	PPG Amerlock 400 Epoxy
	2.	PPG Amercoat 450H Polyurethane
System D	1.	Sherwin Williams Macropoxy 646 Epoxy
	2.	Sherwin Williams Hi-Solids Polyurethane
System E	1.	Tnemec Series 161 Epoxy
	2.	Tnemec Series 73 Endurashield Polyurethane

Or Approved Equal

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZING ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

SECTION 10400

FIXED SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies all fixed signage as indicated on the Drawings and specified herein. The work of this section includes, but is not limited to, the fabrication and installation of the following:
   1. Station Identification and Wayfinding signs as indicated – vinyl on aluminum
   2. Maps – Line, RTL, Neighborhood, Bus Neighborhood– vinyl applied to shelter glazing
   3. Regulatory, Informational signage – Aluminum
   4. Bus berth signs – vinyl on aluminum
   5. Vinyl signs shall be furnished and installed by the contractor
   6. Sign frames and mounting accessories as indicated and required

B. Custom software to be used by the City of Cambridge Department for generating all custom sign content as digital files. No other method of creating graphic files or content is permitted.

C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
   1. Section 05500 – MISCELLANEOUS METALS
   2. Section 10426 – TACTILE /BRAILLE SIGNAGE
   3. Section 10730 – TRANSIT SHELTERS

D. Transportation: Deliver all signs and related elements, including frames and mounting hardware, to the job site.

E. Temporary: Provide fabrication, erection, and removal of any and all temporary safety barricades, temporary holding, retaining or storage structures necessary as described herein.

F. Permits: Obtain permits required by Local Authorities for installation of signs and frames.

G. Coordination between Architect and the City of Cambridge on signage Pre-Design meeting: Architect required to meet with City of Cambridge to discuss signage specs, process, and signage guidelines.

H. Pre-Construction meeting: The Engineer, Contractor, and signage/frame sub (same source for signage and framing to ensure quality) required to meet with City of Cambridge to discuss signage specs and schedules.

I. FIXED SIGNAGE SUBMITTAL PROCESS SUMMARY (Details found in 1.2 Submittals)

1. Submittals must include a dated transmittal form and be provided to Architect and the City of Cambridge for review.

2. Pre-Construction meeting with City of Cambridge Department, the Engineer, Contractor, and sign/framing fabricator:
   Review scope for signage and frames, submittal process, schedule, expected fabrication lead times, overall fabrication process and critical path to completion.

   PROOFING

3. The Contractor to provide for review:
   i. digital files foreach signage type.

4. Contractor provides to City of Cambridge:
   i. Sample: 15” x 15” part of station ID sign and map

   SHOP DRAWINGS

5. The Contractor to provide for review:
   i. 1/2" scale .png files of each sign to be used in shop drawings for placement only and are not for final fabrication.

6. Contractor provides to the City of Cambridge and Designer:
   i. Sign frame shop drawings of each sign frame for fabrication and installation to show required mounting holes, slots, clips, flanges, and other integral fastener components and accessory items.

   FABRICATION

7. Designer and Contractor coordinate fabrication of sign frames. Fabrication of signs cannot commence until sign shop drawings are approved by Designer and the City of Cambridge, and after sign frames are fabricated.

8. Contractor provides to Designer and the City of Cambridge:
   i. Complete field measurement schedule upon construction of all sign frames.
   ii. Notify the City of Cambridge, in writing, of any discrepancies between field measurement and digital sign files.
   iii. City of Cambridge will provide revised graphic files for any changes in sign sizes to fit frames. Major size discrepancies will require frames to be re-fabricated.
   iv. At no time is the contractor to alter digital artwork provided to fit frames.

9. 4. Contractor provides to City of Cambridge:
   i. Full-scale digital .eps files for each sign using final field measurements.

10. Contractor provides to the City of Cambridge:
    i. 100% scale digital of each sign, map, and mural elevation.

11. Contractor provides to the City of Cambridge:
    i. Notice to proceed on fabrication of PE signs, maps, and murals upon approval of samples and proofs.

1.2 SUBMITTALS

A. All submittals shall be provided to both the Architect and the City of Cambridge Department for review. Disposition and documentation management will be provided by the City of Cambridge Department.

B. Product Data: Manufacturer's product data, any limitations and recommendations for each material used, installation instructions, and manufacturer's certification (stating that materials comply with requirements) shall be provided for the Architect and City of Cambridge Department's review and approval.

C. City of Cambridge to provide digital graphic signage files for placement in construction drawings and for final fabrication, including for station ID, tactile braille, and aluminum signage. City of Cambridge team is the secondary reviewers to the Architect in reviewing signage-related construction submittals including graphic proofs and shop drawings.

D. Shop Drawings: Submit shop drawings for fabrication and installation of each sign assembly. This includes, but is not limited to; sign frames and associated sign panel drawings, plans and elevations, sign content elevations, and large-scale details of each sign frame and sign panel showing all required mounting holes, slots, clips, flanges, and other integral fastener components and accessory items. Provide date stamped digital copies of shop drawings for action by the Architect and City of Cambridge Department. After action, provide date stamped digital copies of shop drawings on which action has been taken to the Architect and City of Cambridge Department for record keeping.

E. Reuse of Existing Sign Frames: For reuse of existing sign frames at existing stations, verify rough opening of all dimensions and fill in on schedule column labeled "Verification". Advise the City of Cambridge Department of any discrepancies between design size and field-verified size. Final graphic export files will be based on verified sizes.

F. Sign Schedules: Submit complete sign schedule for each sign. Use same designations as indicated on the construction drawings. For signs scheduled to fit into existing frames, field verify dimensions of existing frames, noting clear openings and sign panel sizes in the sign schedule. Notify the City of Cambridge Department, in writing, of any size variances from the construction documents so that adjustments can be made to the final sign fabrication files.

G. Samples for Approval: Sample Submittals are in addition to quantities shown in sign schedule. They are record project samples to be kept on file at the City of Cambridge Department's office.
    1. Samples and Proofs: To be provided to the City of Cambridge Department within 30 business days from the City of Cambridge Department's submittal of digital artwork. All samples and proofs must be produced by the fabricator and submitted to the City of Cambridge Department by the contractor for approval.
    2. Fabricator proofs:
        a. For each sign assembly/content type listed on the signage schedule, provide digital proofs on all files and full size paper proofs on selected files as determined by the City

of Cambridge Department; Graphic artwork provided by the City of Cambridge Department.

b. Submit 3” x 4” samples of each color on all signage substrates specified.

c. For art and mural panels (if indicated), provide full size paper proofs; Graphic artwork provided by the City of Cambridge Department.

3. For station ID signage, art panels, maps, and murals provide 15” x 15” sample with flanges on all four sides of the sample (area of sign determined by City of Cambridge Department). Samples and proofs will be resubmitted until they meet quality standards outlined in the next section.

4. Provide samples and proofs to the Architectand City of Cambridge Department at no extra charge.

5. Approval is required from the Architectand City of Cambridge Department for all samples and proofs prior to final signage production.

6. Mock-ups: Provide a full-size mock-up in place of each type of sign, for locations as determined by the City of Cambridge Department, to verify selections made under sample submittals and to demonstrate aesthetic effects and quality of materials and execution. Build mock-ups to comply with the specified requirements, using materials indicated for final unit of Work.

   a. If the Architectand City of Cambridge Department determine mock-ups do not comply with requirements, provide new corrected sign(s) until mockups are approved.

   b. Approved mock-ups may become part of the completed work if undisturbed at time of substantial completion.

1.3 SUPPLIED GRAPHICS

A. Digital Graphics files: The City of Cambridge Department will prepare and supply all digital sign content to the contractor.

1. Elevation drawings of all signs at ½” = 1’ scale will be provided in raster format for contractor use in preparing shop drawings.

2. Full size sign layouts will be provided in vector format for direct fabrication from digital files.

3. The contractor is responsible for verifying that each sign frame and sign panel is coordinated with the dimensions and content of supplied digital sign files, and for fabricating and installing all signs based on the City of Cambridge Department’s supplied graphic layouts of signs, maps, historic interpretive (mural) panels and associated panels.

B. Formats: Digital files are provided in vector format (.EPS) for use in final fabrication of signs, and in raster format (.PNG) at ½” = 1’ scale for insertion in to shop drawings. Vector graphics do not contain editable fonts. Any typographic editing must be done by the City of Cambridge Department and returned to the contractor.

C. Colors: Match all spot colors using the Pantone Matching System (PMS) or as per file designation in the digital files and in compliance with the standard colors as identified in the City of Cambridge Signage Guidelines. Color samples, PMS color swatches, and proofs are to be provided to the City of Cambridge Department at no extra charge. Standard PMS Colors by Line:

Line	PMS Color
Bus (Yellow)	1235 C

1.4 PERFORMANCE REQUIREMENTS

1. Design Criteria: Design, fabricate, and install sign items to withstand normal exposure to weather, temperature variation, wind loads and building movement; provide units resistant to vandalism and theft.
2. Field Measurements: Check actual locations of construction - to which metal fabrications must fit - by accurate field measurements before fabrication; show recorded measurements on final shop drawings.
3. The drawings indicate minimum dimensions and thicknesses for components. Where performance requirements necessitate thickness of material to be increased or additional reinforcing to be added such revisions shall be made without changing the visible profiles of in-lay elements. Where changes cannot be made without changing visible profiles they shall be made only with approval by the City of Cambridge Department.
4. Thermal Movements: Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in engineering, fabricating, and installing signs to prevent buckling, opening of joints, over stressing of components and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
    a. Temperature Change (Range): 0 - 180 deg F ambient, material surfaces.
5. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 QUALITY ASSURANCE

A. MBTA Reference Standards: Comply with the MBTA Signage Guidelines V 03.2015.

B. Reference Standards: The work shall conform to the codes and standards of the following regulatory Agencies and Authorities as further cited herein:

1. ADAAG: Americans with Disabilities Act Accessibility Guidelines
2. ANSI: American National Standards Institute.
3. ASTM: American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 as published in "Compilation of ASTM Standards in Building Codes".
4. MAAB: Massachusetts Architectural Access Board.
5. Structural Code:
    a. Mass Building Code
    b. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals

C. Source: For each material type required for the work in this section, provide Single-Source Responsibility. This local Single-Source supplier will control coordination and installation of Frames and Fixed Signage. For each separate type of sign required, obtain signs from a single manufacturer. Inform the City of Cambridge Department of single-source supplier prior to submission of artwork.

D. Accessibility: The ADAAG and the MAAB regulations are pertinent to the design and installation of items covered under the work of this Section. When guidelines conflict, the guideline giving greater access shall be applicable.

E. Welding Standards: Comply with applicable provisions of the American Welding Society AWS D1.1 "Structural Welding Code".
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

F. Coating Applicator Qualifications: must be experienced in successfully applying specified coatings of the type indicated to specified materials, and equipped with the following:
   1. Application equipment required to apply a uniform coating as recommended by the coatings manufacturer.

G. Engineering and structural analysis for signs and new or reused frames, as well as necessary calculations, shall be prepared under the supervision of, and signed and sealed by, the Designer of Record. These calculations shall include gravity, wind, and seismic loading. The internal structure, dimensions and specifications for all items shall be indicated in the Contract drawings, and shall be indicated in the Contractor's shop drawings. The Architectshall engineer signs to a proper level to withstand abuses of their environment.

H. Coordination: The work in this section shall be completely coordinated with the work of other sections. Verify dimensions and work of other trades that adjoin materials of this section before the installation of items herein specified. Cooperate with such trades to assure the steady progress of all work under this contract.

I. Project Meetings: The signage contractor and related subcontractors shall be required to attend project meetings at the project site when required by the Architectand City of Cambridge Department.

J. Certification: Submit manufacturer's certification that materials furnished comply with requirements specified.

K. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of each sign installed to the City of Cambridge, including precautions for use of cleaning materials and solvents for paint removal, which could damage surfaces.

L. Warranty:
   1. Submit a written manufacturer's warranty for City of Cambridge acceptance, signed by the manufacturer, agreeing to repair or replace panels that fail during the specified warranty period. Failures include, but are not limited to, the following:
      a. Coating degradation.
      b. Chipping, chalking, fogging or discoloration.
      c. Fading.
      d. Structural failure.
      e. Delamination of applied graphics.
      f. Delaminating or degradation of applied anti-graffiti coatings.
   2. Warranty Period:
      a. Aluminum – 7 years
   3. The manufacturer's warranty is in addition to, and not a limitation of, other rights the City of Cambridge may have under the contract documents.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver and store work under this section in a manner to prevent the cracking or stress of components, and to prevent mechanical damage or damage from the elements.
   1. Station ID Signs: Store units at building site, under cover. Place units on minimum 4 in. high wood blocking. Do not use non-ventilating plastic or canvas shelters that could create humidity chambers. If package becomes wet, remove carton and crating immediately. Provide 1/4 in. spaces between stacked units to promote air circulation.

B. Deliver work under this section to site in ample time to avoid delay in job progress and at such times as to permit proper coordination of the various parts.

C. Installation of this work shall be scheduled to occur near time of substantial completion.

D. Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's written handling instructions for unloading components subject to damage. Inspect sign components for damage on delivery.
   1. Do not install damaged sign components.
   2. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is approved by the City of Cambridge; otherwise, remove and replace damaged sign components.

1.7 PROJECT CONDITIONS

A. Inspection of Site: The Contractor shall visit the site of the proposed work and become fully acquainted with existing conditions, and to become fully informed as to the facilities involved and the difficulties and restrictions attending the performance of the contract, prior to submitting a price quotation.

B. Substrates: Proceed with work of this section only when substrate construction and penetration work have been completed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Signs
   1. Acceptable Aluminum Sign Manufacturers: Provide products from manufacturers if they meet the requirements of the specifications following.

   2. Aluminum Grade: Alloy 6063-T5 aluminum sheet. Thicknesses as indicated on the sign schedule
      a. Surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner. Increase metal thickness or reinforce with concealed stiffeners or backing materials as required to produce surfaces without distortion, buckles, warp, or other surface deformations.

b. Unframed Single Sheet Panels: Provide unframed single sheet sign panels with edges mechanically and smoothly finished. The thickness of the aluminum sheeting shall be as shown on the plans or in these specifications.
c. Aluminum panels shall be free of buckles, warps, dents, cockles, burrs, and any other defects resulting from fabrication processes.
d. All possible fabrication including shearing, cutting and punching of holes shall be completed prior to pretreatment of the sheeting.

3. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
4. Continuously weld joints and seams unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.
5. Provide concealed sealing of joints to exclude water and provide corrosion protection, exclude sealing of joints where drainage of moisture will be inhibited - do not seal weep holes. Seal joints with specified sealers. For exposed sealers, provide color to match finish. Provide joint sealers tested for adhesion and compatibility with specified materials and finishes.
6. Mounting Method: Provide members with pins of length shown; for installation, weld to base plates or mechanically fasten where shown unless otherwise indicated. Provide turned pins and other anchorage provisions to resist vandalism and theft.
7. Silk screening imaging: Screen-printed graphics shall be produced directly from full-sized digital vector files, provided to the contractor as final approved graphics. Graphic files shall utilize digitally-prepared screens and shall be printed in accordance with accepted industry standards. No hand-cut screens will be accepted. All screen-printing shall be executed in such a manner that all edges and corners of letterforms are true and clean. Letterforms, color areas, or lines with rounded positive or negative corners, built-up edges, bleeding, spattering, etc. will not be accepted. All inks shall be applied evenly without pinholes, scratches, orange peeling, etc. All silk screening processes shall be approved by the City of Cambridge prior to fabrication.
8. Finishes:
   a. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
   a. The front and back surfaces of all aluminum panels shall be cleaned, deoxidized, and coated with a light, tightly adherent chromate conversion coating free of any powdery residue.
   b. Shop finish individual components prior to mechanical assembly.
   c. Color to match approved samples based on the City of Cambridge standard colors.
   d. Shop Painting of Panel Faces:
      1) Abrasive brush blasting preparation (SSPC-SP7) to a 100-mesh sandpaper texture.
      2) Finish Coats: Provide intermediate and finish coats of “Imron Elite" polyurethane enamel or approved equal to achieve the colors and matte finish selected by the City of Cambridge.
9. Anti-graffiti coating
   a. For signs scheduled to receive anti-graffiti coating, provide a high-durability, “permanent type” quality, matte finish, non-yellowing, and suitable for painted aluminum surfaces, as manufactured by one of the following companies, or approved equal:
      1) Monopole, Monochem Permashield Premium
      2) Dumond CPU 647 Graffiti Barrier Coat
      3) Adsil Microguard AD00

b. Apply anti-graffiti coatings in strict accordance with manufacturer's instructions
c. Warranty: 10 years

B. Vinyl Graphics
1. Acceptable Vinyl Graphics Sign Manufacturers: Provide products of one of the following manufacturers or approved equal if they meet the requirements of these specifications:
a. Design Communications, Ltd, Boston, MA
b. Eastern Sign Industries, Inc., Irvington, NJ
c. Signal Sign Co., Livingston, NJ
d. Signs + Decal Corp., Brooklyn, NY
e. Spectrum Signs Inc., Farmingdale, NY
2. Products
a. Vinyl graphics products shall be produced with 3M IJ180mC-10 print wrap film and 3M 8991 anti-graffiti vinyl overlay, or approved equal meeting the following requirements:
1) Thickness: Maximum 0.003 inch
2) Service Temperature: -50°F to +200°F
3) Vinyl Wrap Film Surface Finish: Luster
4) Anti-Graffiti Vinyl Overlay: Gloss
5) Vinyl wrap film shall be opaque or transparent. Anti-graffiti vinyl overlay shall be transparent.

C. Hardware and Frames
1. Supply sign frames and hardware as indicated on the drawings.
2. Structural steel materials, details and workmanship shall conform to the specifications of the latest edition of the A.I.S.C. Specifications for the Design, Fabrication, and Erection of Structural Steel Buildings. ASTM standards:
a. Extruded Bars and Shapes: ASTM B 221 (ASTM B 221M), 6063-T6.
b. Plate and Sheet: ASTM B 209 (ASTM B 209M), 6061-T6.
c. Die and Hand Forging: ASTM B 247 (ASTM B 247M), 6061-T6.
d. Castings: ASTM B 26/B 26M, A356-T6.
3. Anchors and Inserts: Use non-ferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. High strength bolts other than anchor bolts, nuts and washers shall conform to ASTM-A325. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
4. Tamper resistant fasteners to be stainless steel, 3/8" dia. button head Phillips socket pinhead.
5. Threaded studs shall be low carbon mild steel with a minimum yield strength of 50,000 PSI.
6. All hardware shall be as indicated on drawings: 316 stainless steel, or galvanized per ASTM-A153 requirements.
7. Where mechanical fasteners and hardware are required, they shall be of adequate thickness, length and construction to properly secure the sign unit. Any visible portion of any mounting device shall be finished to match adjacent sign surface, unless otherwise specified.
8. Non-metallic Washers: Provide rigid neoprene separators between fasteners and non-compatible materials being joined.
9. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AS

specifications, and as required for color match, strength, and compatibility in the fabricated items.

10. Unless directed otherwise by the City of Cambridge, sign frames shall be hot dip galvanized after fabrication and shop painted.
11. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, complying with DOD- P-21035 or SSPC-Paint 20.
12. Backing Materials: ½" cement board backing - Hardibacker 500 Board or equal, as indicated on the drawings.

D. Adhesives:
1. Where adhesive mounting techniques are specified, the Contractor shall use adhesives specifically designed for compatibility with the base materials and the desired adhesive strength. All adhesives shall be tested on site. All adhesives shall be indicated in the shop drawings.
2. Surfaces on which signage is to be installed using adhesive shall be free of grease, oil, or any other residue.
3. Foam tape shall be 1/32" thick, high-density open cell double coated polyurethane foam tape for applications indicated as manufactured by the 3M Co. or approved equal.
4. Very high bond (VHB) tape shall be double coated acrylic foam tape.

E. Sealant:
1. For joints indicated in the drawings, provide silicone sealant that meets or exceeds the industry specifications TT-S-230C Class A, ASTM C 920, Class 50, Type S, Grade NS as manufactured by one of the following companies, or approved equal:
   a. Tremco, Spectrem 1
   b. Pecora, 864NST
2. Install in strict accordance with manufacturer's instructions.
3. Surface Preparation: prepare joints in accordance with ASTM C 1193 and manufacturer's instructions. For good adhesion, the joint interface must be sound, clean and dry. Clean joint surfaces to remove dirt, dust, oils, wax, paints, and other contamination capable of affecting primer and sealant bond.
4. Joint-Sealant Backing:
   a. General: provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
   b. Elastomeric Tubing Sealant Backings: neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
   c. Bond-Breaker Tape: polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surface at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.
5. Color: match to frame color as closely as possible – use dark sealant with dark-colored frames and light sealant with light-colored (or galvanized) frames.

2.2 Fabrication

A. Aluminum Signs
   1. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
   2. Continuously weld joints and seams, unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.
   3. Provide concealed sealing of joints to exclude water and provide corrosion protection, exclude sealing of joints where drainage of moisture will be inhibited, and do not seal weep holes. Seal joints with specified sealers, and for exposed sealers, provide color to match finish. Provide joint sealers tested for adhesion and compatibility with specified materials and finishes.
   4. Mounting Method: Provide members with pins of length shown for installation weld to base plates or mechanically fasten where shown unless otherwise indicated. Provide turned pins and other anchorage provisions to resist vandalism and theft.

B. Adhered Vinyl Graphics
   1. Coordinate dimensions for vinyl graphics with exact supporting panel.
   2. Vinyl graphics to wrap all four return legs of backer panel.
      a. Where new backer panels are to be provided, vinyl graphics shall be installed in the shop.
      b. Where backer panels are existing, vinyl graphics can be done in the field. Extreme caution shall be taken to minimized exposed edges.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed, and notify the Contractor and the Designer of Record, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

B. Notification Point: The Architectand City of Cambridge Department will be given 72 hour notice to perform field inspection at the start of installation of signage. If work does not meet project requirements, contractor must remove and replace deficient work.

3.2 INSTALLATION/APPLICATION/ERECTION

A. All locations where signs, map, and murals are to be installed within new frames or retrofitted to existing frames must be field measured by contractor. This must be documented and sent to the City of Cambridge Department prior to final digital artwork submittal and fabrication of signage.

B. Strictly comply with approved shop drawings and manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.

C. Install work plumb, level, and in true plane and alignment. Provide signs and graphics where shown or scheduled using mounting methods indicated.

D. Protect adjacent or adjoining surfaces and work from damage during installation in this section.

E. Work shall be designed and anchored so that work will not be distorted nor the fasteners overstressed from expansion and contraction of metal or other materials as applicable.

3.3 TOLERANCES

A. The following installed tolerances are allowable variations from locations and dimensions indicated by the contract document and shall not be added to allowable tolerances indicated for other work:
   1. Allowable Variation from True Plumb, Level and Line: Plus or minus 1/32 inch from true position for signage smaller than 24 by 24 inches in size; plus or minus 1/16 inch from true position for signage 24 by 24 inches in size and larger.
   2. Allowable Variation from True Plane of Adjacent Surfaces: Plus or minus 1/16 inch.

3.4 CLEANING AND PROTECTION

A. Adjust work to present the best possible appearance. Touch-up damaged finishes and eliminate any evidence of repair. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully repaired or cleaned.

B. Provide temporary protection to ensure work is delivered without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

C. Manufacturer shall provide City of Cambridge Department with information on cleaning and maintenance recommendations for all signs.

D. Names, stamps and decals of manufacturers, installers or maintainers of signs shall not be visible in the finished work.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZING ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

SECTION 10426

TACTILE/BRAILLE SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies all ADA-required Tactile/Braille signage as indicated on the Drawings and specified herein.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
   1. Section 05500 – MISCELLANEOUS METALS
   2. Section 10400 – FIXED SIGNAGE
   3. Section 10730 – TRANSIT SHELTERS

C. Permits: Obtain permits as required by Local Authorities for installation of signs.

1.2 SUBMITTALS

A. Product Data: Manufacturer's product data, any limitations and recommendations for each material used, installation instructions, and manufacturer's certification (stating that materials comply with requirements) for the Engineer and the City of Cambridge's review and approval.

B. Approval Drawings: Provide dimensioned shop drawings of each individual sign, based on .eps files supplied by the City of Cambridge, along with a complete sign schedule utilizing the same designations as indicated on the City of Cambridge's drawings. The shop drawings must represent exactly what will be etched on each sign. No fabrication shall take place without approval of the shop drawings by the Engineer and City of Cambridge.

C. Provide four copies of shop drawings for action by the Engineer and City of Cambridge.

D. Samples for Approval:
   1. Provide one full-size, complete sample of a representative sign, etched, painted and finished, for approval by the Engineer and City of Cambridge.
   2. ADA compliance: Contractor shall complete the attached "ADA Tactile/Braille Metrics Check list" to assure that all metrics of sample sign are in compliance with ADA defined metrics.
   3. Approval of sample sign is required from the Engineer and City of Cambridge prior to final signage production.
   4. Sample will be resubmitted, if necessary, until it meets quality standards outlined in the next section.
   5. Once approved, the sample sign will be forwarded to the project site for installation (completed sample sign to be provided to the Engineer and City of Cambridge at no extra charge).

1.3 QUALITY ASSURANCE

A. Reference Standards: The work shall conform to the codes and standards of the following regulatory Agencies and Authorities as further cited herein:

1. ADA: Americans with Disabilities Act 2010 Standards
2. ANSI: American National Standards Institute.
3. ASTM: American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 as published in "Compilation of ASTM Standards in Building Codes".
4. MAAB: Massachusetts Architectural Access Board.

B. Performance Requirements
1. Painted Sign Finish shall comply with the following performance requirements:
   a. Weatherability: When tested in accordance with ASTM G 53, after 500 hours in Weatherometer (equivalent to approximately 3 years exterior exposure):
   b. Gloss retention not less than 88.0 determined in accordance with ASTM D 523 at a 60 degree angle.
   c. Color shall not change more than 1.68 units determined in accordance with STM D 2244 and measured with a Hunter Colorimeter, Model D25.
2. Durability: Sign finish shall not effect after repeated use of cleaners such as Graffiti Remover #1120 manufactured by Organics Corp., Lodi, NJ.

C. Source: For each type of material required for the work of this section, provide Single-Source Responsibility.

D. Accessibility: The ADA 2010 Standards and the MAAB regulations are pertinent to the design and installation of items covered under the work of this Section. When guidelines conflict, the guideline giving greater access shall be applicable.

E. Qualifications: The approved manufacturer shall have a minimum of 5 years of successful experience with similar work, and shall have a reputation for doing satisfactory work on time.

F. Coordination: The work in this Section shall be completely coordinated with the work of other Sections. Verify dimensions and work of other trades that adjoin materials of this Section before the installation of items herein specified. Cooperate with such trades to assure the steady progress of all work under this Contract.

G. Certification: Submit manufacturer's certification that materials furnished comply with requirements specified.

H. Maintenance Instructions: Submit manufacturer's instructions for maintenance of tactile/braille sign to the City of Cambridge, including precautions for use of cleaning materials and solvents.

I. Warranty:
1. Submit a written Manufacturer’s warranty for the City of Cambridge acceptance, signed by the manufacturer, agreeing to repair or replace panels that fail during the specified warranty period. Failures include, but are not limited to, the following:
   a. Coating degradation.
   b. Chipping, chalking, fogging or discoloration.
   c. Fading.
2. Warranty Period: 1 year from product ship date.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver and store work under this Section in a manner to prevent the cracking or stress of components, and to prevent mechanical damage or damage from the elements.

B. Deliver work under this Section to Site in ample time to avoid delay in job progress and at such times as to permit proper coordination of the various parts.

C. Installation of this work shall be scheduled to occur near time of Substantial Completion.

D. Inspect sign components for damage on delivery.
   1. Do not install damaged signs. Replace any damaged signs with new signs.

1.5 PROJECT CONDITIONS

A. Inspection of Site: The Contractor shall visit the site of the proposed work and become fully acquainted with existing conditions, and to become fully informed as to the facilities involved and the difficulties and restrictions attending the performance of the Contract, prior to submitting a price quotation.

B. Substrates: Proceed with work of this Section only when substrate construction and penetration work have been completed.

PART 2 - PRODUCTS

2.1 SUPPLIED GRAPHICS

A. The City of Cambridge will review all digital sign graphics (physical size, layout and content) in .eps format for etching. All graphic files are vector graphics, no font replacement is necessary.

2.2 MATERIALS

A. Zinc Signs
   1. 0.125” one-piece zinc plate, utilizing chemical etch process to produce raised characters in compliance with ADA and supplied graphics. Chamfer or ease all sides and corners to remove sharp edges.
   2. Acceptable Manufacturers: the following is a partial list of zinc signage manufacturers:
      a. Vivid Manufacturing
      b. Dixie Graphics
      c. Kroy Sign Systems
      d. Etchcraft Incorporated
      e. Advance Corporation
      f. ADA Signs
      g. ASI
      h. ASE Manufacturing

B. Attachments
   1. Mechanical:

a. Threaded inserts appropriate to substrate material – 4 per sign
b. Tamper resistant, ¼" diameter stainless steel Flat Head Phillips Pin-Head screws. Screws shall seat into countersunk holes such that when fully tightened the screw head is flush with sign background surface. Paint screws to match background paint color of sign
c. Non-metallic Washers: Provide rigid neoprene separators between fasteners and non-compatible materials being joined.

2. Adhesive:
a. Where adhesive mounting techniques are specified, very high bond (VHB) tape specifically designed for compatibility with the base materials and the desired adhesive strength shall be used. All adhesives shall be tested on site. All adhesives shall be indicated in the shop drawings.
b. Very high bond (VHB) tape shall be double coated acrylic foam tape as manufactured by the 3M Co., or approved equal.
c. Surfaces on which signage is to be installed using adhesive shall be free of grease, oil, or any other residue.

2.3 Fabrication

A. Zinc Signs:
1. Etching: Signs reverse-etched to create all tactile text, lines, arrows, and braille glyphs raised 1/32" high. Braille glyphs shall be standard rounded grade 2 Braille as rendered in the EPS files. Cross section angle of raised characters shall not exceed 45 degrees. Text and Braille shall be finished to provide smooth, non-pointed edges. Background surface shall be smooth texture.
2. Finishes:
a. Background - Mathews baked-on acrylic polyurethane enamel paint with eggshell/matte finish. Custom color shall be: Black.
b. Foreground - (Tactile lettering only) brushed natural zinc with U.V. resistant clear urethane topcoat.
c. Predrilled holes: Provide four ¼" counter sunk mounting holes, centered 3/8" from edges, only in corners of signs scheduled to be screw attached. All other signs to be provided without mounting holes.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to installation, the Installer shall examine substrates, supports, and conditions under which this work is to be performed, and notify the Contractor and the Engineer in writing of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

B. Notification Point: Engineer and the City of Cambridge will be given 72 hour notice to perform field inspection prior to the start of signage installation. The City of Cambridge shall conduct a detailed inspection of all tactile/braille signs to be installed prior to installation to assure compliance with the supplied drawings. A formal signoff by the City of Cambridge must be

executed prior to commencement of any installation. If work does not meet project requirements, contractor must replace deficient work.

3.2 INSTALLATION/APPLICATION/ERECTION

A. All locations where signs are to be installed new or retrofitted to existing frames must be field measured by contractor. This must be documented and sent to the Engineer and the City of Cambridge prior to final digital artwork submittal and fabrication of signage.

B. Strictly comply with approved shop drawings and manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this Section.

C. Install work plumb, level, and in true plane and alignment. Provide signs and graphics where shown or scheduled using mounting methods indicated.

D. Protect adjacent or adjoining surfaces and work from damage during installation in this Section.

E. Work shall be designed and anchored so that work will not be distorted nor the fasteners overstressed from expansion and contraction of metal or other materials as applicable.

F. The Tactile/Braille signs are small in size and shall be installed plumb and square. In the event that an adjacent material, such as a doorframe, is slightly out of plumb, the contractor shall install the Tactile/Braille sign parallel so as to minimize the visual conflict.

3.3 CLEANING AND PROTECTION

A. Adjust work to present the best possible appearance. Touch-up damaged finishes and eliminate any evidence of repair. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully repaired or cleaned.

B. Provide temporary protection to ensure work is delivered without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

C. Manufacturer shall provide Authority with information on cleaning and maintenance recommendations for all signs.

D. Names, stamps and decals of manufacturers, installers or maintainers of signs shall not be visible in the finished work.

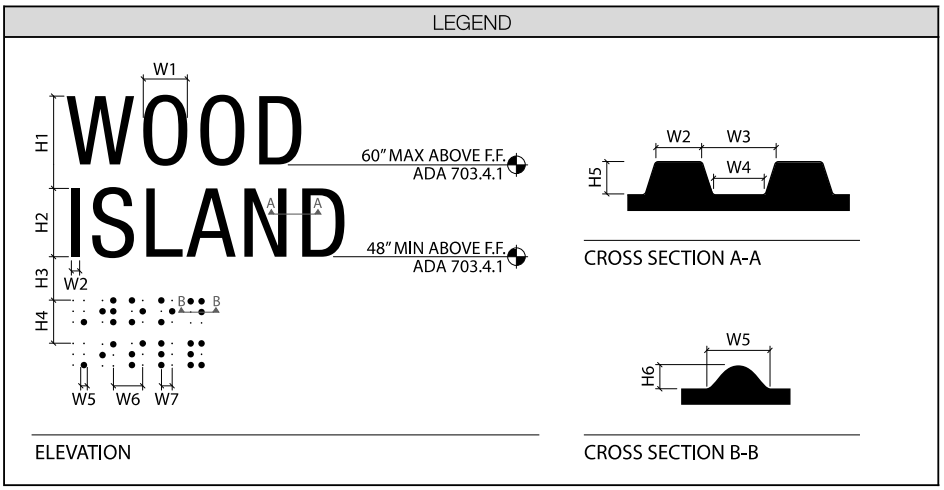
3.4 DA Compliance Checklist

A. Tactile/Braille signs must comply with the dimensional requirements of ADA 703.3 (2010). The following legend graphically illustrates each ADA 703.3 metric.

B. Once a mockup has been fabricated, and prior to submission for approval, the fabricator must complete the following check list to assure that the sample product is in complete compliance

with ADA metrics. Completed checklist must be submitted with sample sign for approval. Samples submitted without a completed checklist will be rejected.

C. Tactile metrics legend



D. ADA 703.2 and 703.3 Compliance Checklist

ADA 703.2 – Raised Characters						
Legend Symbol	ADA Reference	Description	ADA Values	ADA Values for 5/8" Text	Check by Contractor	Check by Designer
H5	703.2.1 Depth	Depth of character above background	≥ 1/32" (0.8 mm)	-		
-	703.2.2 Case	All Uppercase	Y/N	-		
-	703.2.3 Style	Sans serif, not italic, oblique, script, highly decorative, or of unusual forms	Y/N	-		
W1	703.2.4 Character Proportions	Width of uppercase “O” relative to height of uppercase "I" (H2)	0.55 ≤ W1/H2 ≤ 1.1	Min: 0.344" Max: 0.743"		
H2	703.2.5 Character Height	Height of uppercase “I”	0.625" ≤ H2 ≤ 2" 16 mm ≤ H2 ≤ 51 mm	0.625"		
W2	703.2.6 Stroke Thickness	Width of uppercase “I” relative to height of uppercase "I" (H2)	W2/H2 ≤ 0.15	≤ 0.094"		
W3	703.2.7 Character Spacing	Rectangular cross section or top of beveled cross section	0.125" ≤ W3 ≤ 4(W2) 3.2 mm ≤ W3 ≤ 4(W2)	Min: 0.125" Max: 0.376"		
W4	703.2.7 Character Spacing	Base of beveled cross section	0.0625" ≤ W4 ≤ 4(W2) 1.6 mm ≤ W4 ≤ 4(W2)	Min: 0.063" Max: 0.376"		
H1	703.2.8 Line Spacing	Distance between baselines of raised characters relative to height of uppercase "I" (H2)	1.35 ≤ H1/H2 ≤ 1.7	Min: 0.844" Max: 1.063"		

ADA 703.3 – Braille						
Legend Symbol	ADA Reference	Description	ADA Values	-	Check by Contractor	Check by Designer
-	703.3.1 Dimensions & Capitalization	Domed or rounded shape	Y/N			
-	703.3.1 Dimensions & Capitalization	Uppercase letters only before first word of sentences, proper nouns and names, individual letters of the alphabet, initials, acronyms	Y/N			
W5	703.3.1 Braille Dimensions	Dot base diameter	Min: 0.059" (1.5 mm) Max: 0.063" (1.6 mm)			
W7	703.3.1 Braille Dimensions	Distance between two dots in the same cell	Min: 0.090" (2.3 mm) Max: 0.100" (2.5 mm)			
W6	703.3.1 Braille Dimensions	Distance between corresponding dots in adjacent cells	Min: 0.241" (6.1 mm) Max: 0.300" (7.6 mm)			
H6	703.3.1 Braille Dimensions	Dot Height	Min: 0.025" (0.6 mm) Max: 0.037" (0.9 mm)			
H4	703.3.1 Braille Dimensions	Distance between corresponding dots from one cell directly below	Min: 0.395" (10 mm) Max: 0.400" (10.2 mm)			
-	703.3.2 Position	Braille below corresponding text. If multi-lined, below entire text.	Y/N			
H3	703.3.2 Position	Distance from Braille to tactile characters, raised borders, and decorative elements.	≥ 0.375" (9.5 mm)			

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZINE ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

SECTION 10730

TRANSIT SHELTERS

10730.1	**SHELTER 1 – RIVER ST. SHELTER**	**LS**
10730.2	**SHELTER 2 – MAGAZINE ST. SHELTER**	**LS**
10730.3	**SHELTER 3 – GREEN ST. SHELTER**	**LS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the following items.

1. All work necessary to complete in place the following transit shelters shall be included as part of this section:
   a. Shelter 1 - River Street Shelter
   b. Shelter 2 - Magazine Street Shelter
   c. Shelter 3 - Green Street Shelter

B. Work to be included and paid for under this section that is covered in other sections includes but is not limited to:

1. Section02456 – HELICAL PILES: pile supported foundation at Green Street Shelter
2. Section 03300 – CONCRETE: concrete work for the perimeter walls.
3. Section 03315 – GROUT: grout work related to the transit shelters.
4. Section 04200 – STONE CLADDING
5. Section 05100 – STRUCTURAL STEEL: structural steel work related to the transit shelters
6. Section 05500 – MISCELLANEOUS METALS: miscellaneous metal work related to the transit shelters.
7. Section 07210 – THERMAL INSULATION
8. Section 07220 – CLOSED CELL SPRAY FOAM INSULATION
9. Section 07600 – FLASHING AND SHEET METAL
10. Section 07920 – SEALANTS
11. Section07411 – PREFORMED METAL ROOF
12. Section 08450 – ALUMINUM FRAME GLAZED CANOPY SYSTEM
13. Section08510 – STEEL WINDOWS
14. Section 08801 – GLASS AND GLAZING
15. Section 09260 – GYPSUM WALL ASSEMBLIES
16. Section 09546 – LINEAR METAL CEILINGS
17. Section 09900 – PAINTING
18. Section 10400 – FIXED SIGNS
19. Section 10426 – TACTILE BRAILLE SIGNS
20. Section 12930 – SITE FURNISHINGS

21. Section 15600 – HEATING VENTILATION AND AIR CONDITIONING
22. Section 16880 – DIGITAL SIGNS

C. RELATED WORK: work that is related to the transit shelters, but is covered and paid for in other sections:

1. Shelter foundations, including helical piles.
   a. Section 03300 – CONCRETE.
   b. Section 02456 – HELICAL PILES

2. Shelter lighting and electrical work
   a. Section 16050 – BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK
   b. Section 16121 – INSULATED CONDUCTORS
   c. Section 16195 – ELECTRICAL IDENTIFICATION
   d. Section 16450 – GROUNDING
   e. Section 16471 – DISTRIBUTION AND BRANCH CIRCUIT PANELBOARDS

D. Public Wi-Fi Accommodations at Carl Barron Plaza: All three shelters should be provided a power connection that will have 2 strands, minimum, of fiber to each shelter. This connection will allow the City the ability to provide future internet access to these areas. The ruggedized mount or mounting area for the unit (to be installed by the City) must be on the northwest corner of shelter 1 on River Street, the northwest corner of shelter 2 on Magazine Street, and the southwest corner of shelter 3 on Green Street. This fixture should be mounted high enough so that people cannot reach it.

E. All work necessary to provide and install complete and accepted Transit Shelters that is not specifically covered in other sections shall be included in this section.

1.2 SUBMITTALS

A. Submittals for each respective item included in the construction of the Transit Shelters shall be in accordance with the requirements of each respective section of these specifications as listed above.

1.3 QUALITY ASSURANCE

A. Quality Assurance for each respective item included in the construction of the Transit Shelters shall be in accordance with the requirements of each respective section of these specifications as listed above.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Work for each respective item included in the construction of the Transit Shelters shall be in accordance with the requirements of each respective section of these specifications as listed above.

1.5 PROJECT CONDITIONS

A. Project conditions for the installation of each item included in the construction of the Transit Shelters shall be in accordance with the requirements of each respective section of these specifications as listed above.

1.6 WARRANTY

A. Warranties for each item included in the construction of the Transit Shelters shall be in accordance with the requirements of each respective section of these specifications as listed above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND MATERIALS

A. Manufacturers and material requirements for each item included in the construction of the Transit Shelters shall be in accordance with the requirements of each respective section of these specifications as listed above.

PART 3 - EXECUTION

3.1 GENERAL

A. The method of construction and fabrication of each respective item included in the construction of the Transit Shelters shall be accordance with the requirements of each respective section of these specifications as listed above.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for payment for each of the (3) Transit Shelters shall be Lump Sum based on the complete in place construction of each shelter. The foundations including reinforced concrete pedestals, columns and footings, as well as the corresponding anchorage is excluded from the Lump Sum payment and are covered under Item No. 03300.2 – Concrete Foundations for Ribbon and Transit Shelters. The concrete walls, between the foundation pedestals, are paid for under the (3) Transit Shelter Lump Sum items listed below.

4.2 PAYMENT

A. Payment shall be made for Transit Shelters at the Contract Unit Price LUMP SUM, complete in place for each of the (3) Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	LS
10730.2	SHELTER 2 – MAGAZINE ST. SHELTER	LS
10730.3	SHELTER 3 – GREEN ST. SHELTER	LS

END OF SECTION

SECTION 12360
SOLID SURFACE FABRICATIONS (SSF)

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Solid Surface Fabrications, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

1.2 RELATED WORK

A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.

B. Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 10730 – TRANSIT SHELTERS

1.3 QUALITY ASSURANCE

A. Applicable standards:
   1. International Association of Plumbing and Mechanical Officials (IAPMO)
      a. IAPMO Z124 Plastic Plumbing Fixtures.
   2. ASTM International:
   3. National Electrical Manufacturers Association (NEMA).
      a. NSF International.
         1) NSF/ANSI Standard 51 for food zone - all food types.
   4. Manufacturer's certification of fabricator and installer.

B. Installer Qualifications:
   1. Successfully installed at least five projects within the past four years, utilizing systems, materials and techniques as specified or required by product manufacturer.

C. Manufacturer Certification of Fabricator and Installer:
   1. Certified by manufacturer.
   2. Submit prior to Shop Drawings.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Show location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.
   2. Show full size details, edge details, thermoforming requirements, attachments, etc.
   3. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement.
   4. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacle and other items installed in surface.
   5. Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.

B. Product Data:
   1. Manufacturer's product data sheets, details and installation instructions for Solid Surface Fabrications, components and accessories.

C. Samples:
   1. For each SSF color selected:
      a. Minimum 6 IN x 6 IN sample in specified gloss.
      b. Cut sample and seam together for representation of inconspicuous seam.
      c. Indicate full range of color and pattern variation.
   2. Sealant colors for selection.
   3. Approved samples will be retained as a standard for work.

D. Project Information:
   1. Manufacturer's current certification of Fabricator and Installer prior to submittal of Shop Drawings.

E. Contract Closeout Information:
   1. Warranty.
   2. Maintenance data.

1.5 WARRANTY

A. Manufacturer's ten (10) year warranty including colorfastness and material defects.
   1. Warranty shall provide material and labor to repair or replace defective materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Solid Surface Fabrications (SSF):
   1. Base:
      a. Corian by DuPont.
   2. Optional:
      a. Avonite by Aristech Acrylics LLC.
      b. Hi-Macs by LG Decorative Surfaces.
      c. Wilsonart Solid Surface.

B. Sealant:
   1. Base:
      a. Color Rite.
   2. Optional:
      a. As approved by SSF manufacturer.

C. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Solid Surface Materials:
   1. Cast, non-porous, homogeneous, acrylic polymer composition with additional fire retardant fillers and pigments.
      a. Prime product may not be coated, laminated or of composite construction.
   2. Defects with depth less than 0.010 IN shall be considered superficial.
      a. Repair superficial damage by sanding and/or polishing.
      b. Components with more severe defects shall be rejected.
   3. Physical properties:

Minimum Physical Properties		
Property	Method	Value
Tensile Strength	ASTM D638	5500 PSI
Flexural Strength	ASTM D790	10 KSI
Hardness	Rockwell M Scale ASTM D785	Greater than 85
	Barcol Impressor ASTM D2583	55
Thermal Expansion	ASTM D696	1.8 x 10-5 IN/IN/DegF
Gloss (60 –degree Gardner)	IAPMO Z124	Matte = 5; Highly Polished = 75
Light Resistance	NEMA LD 3-2000 Method 3.3	No Effect (Xenon Arc)
Wear and Cleanability	IAPMO Z124	Pass
Stain Resistance	IAPMO Z124	Pass
Fungal Resistance	ASTM G21	Does not support growth
High Temperature Resistance	NEMA LD 3-2000 Method 3.6	No change
Boiling Water Resistance	NEMA LD 3-2000 Method 3.5	No visible change
Ball Impact Resistance; 1/2 LBS Ball	NEMA LD 3-2000 Method 3.5	36 IN drop 1/4 IN sheet
		144 IN drop 1/2 IN sheet
Water Absorption	ASTM D570	0.8% for 1/4 IN sheet
		0.6% for 1/2 IN sheet
Flammability	ASTM E84 and NFPA 255	Class I / Class A
Flame Spread Index		Less than 25
Smoked Developed Index		Less than 450

B. Backing materials (build down):
   1. Finished or exposed edges: SSF material.
      a. Profiles as indicated.
      b. Physical Properties, Based on 3/4 IN Thickness, ASTM D1037, Part A:
         1) Density: 48 LBS/FT3.
         2) Modulus of Rupture: 4,000 PSI.
         3) Screw Holding: Required to pull 1 IN #10 sheet metal screw:
            a) Face: 225 LBS.
            b) Edge: 200 LBS.
      c. Panel Thickness:
         1) As required for application, use a single thickness to achieve build down to cross sectional thickness.
   2. Backer Sheets for knee spaces:
      a. Plastic laminate in coordinating color
      b. Grade 20 (VGP)
      c. Apply to bottom side of backing material
   3. Backing materials adhesive:
      a. Construction grade adhesive recommended by SSF manufacturer for backing materials with VOC content no greater than 70 g/L.

C. Joint Adhesive:
   1. Manufacturer's standard one- or two-part adhesive as required for inconspicuous, non-porous joint with VOC content no greater than 80 g/L.

D. Sealant:
   1. Mildew resistant silicone sealant in colors matching components.
   2. Specifically formulated for applications indicated, including wet areas.
   3. Shore A Hardness: 25.

4. Compatible with SSF specified.
5. Compatible with gypsum wallboard, paint, laminates and other materials being sealed.
6. Sealant VOC content shall be no greater than 250g/L.
7. Colors:
    a. Colors to match specified SSF colors from no less than 400 standard color choices.
    b. Number of different colors required for project shall not be limited.
8. Base Products:
    a. At solid colored SSF: Color-Sil by Color Rite; 100% silicone.
    b. Where speckle colored SSF is specified: Poly-Sil by Color Rite; 100% silicone with suspended accent color particles.
    c. Architect to select final colors and locations during submittals phase.

E. Conductive Foil Tape:
1. Manufacturer's standard aluminum foil tape, with required thickness, for use with cutouts near heat sources.

F. Insulating Felt Tape:
1. Manufacturer's standard for use with conductive tape in insulating solid surface material from adjacent heat source.

2.3 SHOP FABRICATION

A. Shop Assembly
1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's instructions.
2. Form joints between components using color matched Joint Adhesive in an inconspicuous manner.
    a. Reinforce with 4 IN wide strip of SSF material.
3. Rout and finish component edges with clean, sharp returns.
    a. Rout cutouts, radii and contours to template.
    b. Smooth edges.
    c. Repair or reject defective and inaccurate work.
4. Fabricate coved splashes where indicated.
5. Reinforce inside corners, narrow pieces, cantilevered overhangs, and stress points against breakage by laminating an additional thickness of SSF on concealed face.
6. Laminate additional thicknesses of SSF and tool edge profiles indicated.
7. Uniformly finish completed pieces according to SSF schedule.

2.4 FABRICATIONS

A. SSF Window Sills:
1. Configurations detailed on Architectural Drawings.
2. Thickness: Minimum 5/8 IN (unless otherwise indicated).
3. Join multiple pieces with joint adhesive to create inconspicuous seam.
4. Edge Treatments: As indicated on the drawings.
5. Polish exposed faces.
6. SSF Color / Pattern / Finish: Per SSF Schedule.

B. SSF Desk Surface:
1. Configurations as indicated on the Contract Drawings.
2. Composite thickness of desk assemblies: 1-1/4 IN unless otherwise indicated.
    a. Nominal Thickness of SSF material: Minimum 1/2 IN unless otherwise indicated.
3. Radius exposed outside corners: Minimum 1-1/2 IN.
4. Join multiple pieces, where required, with Joint Adhesive to create inconspicuous seam.
5. Backer:
    a. Configure backing material as required for application:
    b. Ladder frame at SSF desk supported by base cabinets:
        1) Form ladders from approved backing material ripped into 3- 4 IN wide strips.
        2) Locate main runner strips (rails) along front and back edges of countertops.

a) Provide clearance for shrinkage and normal expansion and contraction.

3) Space front-to-back supports (stiles) to coordinate with wall bracket supports. Locate stiles over other wall brackets and supports.
4) Where supports exceed in 24 IN width: Include additional intermediate stiles so that maximum spacing does not exceed 24 IN.
5) Provide additional intermediate stiles at seams in SSF countertop material.
6) Join the stiles to rails using screwed or glued wooden biscuit seams, serrated dowels or rabbeted seams.
7) Overhangs: Configure backer material per SSF manufacturer's guidelines according to distance overhang projects past its support.

c. Desks which span between supports 30 IN and wider:
1) Fabricate backer from solid backing material (not stile and rail construction).
2) Extend one piece, solid backer material, across entire span. Extend load bearing edges not less than 4 IN over edge of supporting cabinets (or similar support).

d. Portions of desks schedule to support equipment:
1) Provide full backing for the entire countertop cross section for the full width of the equipment.
2) Extend 4 IN (min) beyond equipment width and as required for mounting.

6. Front overhang of Tops: 1-1/2 IN, unless otherwise indicated.
7. Edge Treatments: As indicated on the drawings.
8. Polish exposed faces.
9. SSF color / pattern / finish: Per SSF Schedule.

C. SSF Bench: as shown on the contract drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with fabricator present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. Verify measurements, dimensions and drawing details before proceeding.
2. Coordinate location of furring, nailers, blocking, grounds and similar supports for attached work.
3. Examine conditions under which work is to be installed.
4. Correct unsatisfactory conditions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Installation constitutes acceptance of responsibility for performance.

3.2 INSTALLATION

A. General:
1. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
2. Provide product in the largest pieces available.
3. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
a. Exposed joints/seams will not be allowed.
4. Reinforce field joints with SSF strips extending a minimum of 1 to 2 IN on either side of the seam with the strip being the same thickness as the top.
5. Cut and finish component edges with clean, sharp returns.
6. Rout radii and contours to template.
7. Anchor securely to base cabinets or other supports.
8. Align adjacent desk and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
9. Carefully dress joints smooth, remove surface scratches and clean entire surface.
10. Install desks with no more than 1/8 IN sag, bow or other variation from a straight line.

B. Window Stools (sills):
   1. Shim as required so that installed items are plumb, true and level.
   2. Install Window Sills full length of window, set securely into place using only concealed fasteners and approved adhesive.
   3. Adhere sills to substrate with dabs of a clear silicone sealant at 10 to 12 IN intervals.
   4. Where sills are abutted by walls at both ends: Allow 1/8 IN expansion gaps at both ends for every of 10 FT sill.
      a. Seal gaps with elastomeric sealant.
   5. Ease edges and sand smooth.

C. Desks:
   1. Install plumb, level, true and straight.
      a. Shim as necessary using concealed shims.
   2. Attach top securely to base unit or support brackets in accordance with manufacturer's instructions.
      a. Supply additional supports, spaced no more than 18 IN apart or as otherwise required for adequate strength.
      b. Ensure full contact with support brackets and backing for entire support length with mechanical fastening into backing material.
      c. Provide fasteners of appropriate length. Do not allow screws to penetrate into SSF material.
      d. Supply additional supports or solid backing as required for adequate strength.
   3. Where tops are abutted by walls at both ends:
      a. Include 1/8 IN expansion gaps at both ends for every of 10 FT desk.
      b. Seal gaps with elastomeric sealant.

3.3 CLEANING AND PROTECTION

A. Keep components clean during installation.

B. Protect finished surfaces from damage.

C. Remove adhesives, sealants and other stains.

D. Replace damaged work which cannot be repaired.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)

END OF SECTION

SECTION 12930

SITE FURNISHINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wood slat benches on concrete bases within shelters.
B. Freestanding wood slat benches located at the Green St Shelter.

1.2 REFERENCES

A. ASTM Testing Standards:
   1. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
   2. ASTM D 522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
   3. ASTM D 523 – Standard Test Method for Specular Gloss.
   4. ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
   5. ASTM D 2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
   6. ASTM D 3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
   7. ASTM D 3363 – Standard Test Method for Film Hardness by Pencil Test.
   8. ASTM G 155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.
B. ISO Testing Standards:
   1. ISO 1520 – Paints and Varnishes – Cupping Test.
   2. ISO 2815 – Paints and Varnishes – Buchholz Indentation Test.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data, storage and handling requirements and recommendations, installation methods and available colors, styles, patterns and textures.
B. Shop Drawings: Submit manufacturer's shop drawings, including plans and elevations, indicating overall dimensions.
C. Samples: Submit manufacturer's samples of materials, finishes, and colors.
D. Warranty: Manufacturer's standard warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer regularly engaged in manufacture of site furnishings for a minimum of 10 years.
B. Product Support: Products are supported with complete engineering drawings and design patents.
C. Facility Operator: Welders and machine operators are certified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area in accordance with manufacturer's instructions. Keep materials in manufacturer's original, unopened containers and packaging until installation.
C. Handling: Protect materials and finish during handling and installation to prevent damage.

1.6 WARRANTY

A. Warranty Information:
1. -Products will be free from defects in material and/or workmanship for a period of three years from the date of invoice.
2. -The warranty does not apply to damage resulting from accident, alteration, misuse, tampering, negligence, or abuse.

PART 2 PRODUCTS

2.1 MANUFACTURER AND PRODUCTS

A. Landscape Forms, Inc., 7800 E. Michigan Ave, Kalamazoo, Michigan 49048.
Phone: (800) 521-2546. Fax (269) 381-3455. Website www.landscapeforms.com
E-mail: specify@landscapeforms.com
a. Bench Style: Link
B. Columbia Coascade Company
C. Approved Equal

2.2 BENCHES

A. Provide custom benches in the style indicated above and as shown in the contract drawings.

B. Provide base, armrests, and backs as indicated in the contract drawings.

2.3 MATERIALS

A. Bench frame: 7 gauge (0.18") A1011 HRP&O commercial steel sheet, formed, with 3/8" carbon steel plate gussets, welded to two 1-3/4" dia x .120" wall HREW carbon steel tubes with 10 gauge (0.135") carbon steel sheet end caps. 3/8" HRP&O carbon steel sheet support attachment plates welded to tubes. Bolts to bench seat with 3/8-16 x ¾" socket button head cap screws and 3/8" washers, carbon steel with Magni-coat.
B. Metal leg: 0.25-inch carbon steel plate, formed, with 3/8" carbon steel plate gussets. Includes 2 nylon adjustable glides with 3/8-16 stainless steel threads. Bolts to bench seat with (4) each 3/8-16 x ¾" socket button head cap screws and 3/8" washers, carbon steel with Magni-coat.
C. Concrete block: Ultra high performance concrete. UV stable pigments are incorporated into the concrete mixture. Includes (4) 3/8-16 x 3-1/2" threaded rods, carbon steel with Magni-coat, to secure bench top to concrete block base. Base has 4 predrilled holes for accepting threaded rods. Includes (4) stainless steel adjustable glides for leveling.

Material:	**%**
Meldstone™ premix:	53.8%
Cement:	33.7%
Water:	11.8%
SP liquid:	0.5%
PVA fibers:	0.2%

Compressive strength after cure: minimum 18,000 psi (125 MPa)
Flexural strength after cure: minimum 2100 psi (14.5 MPa)

D. Top of wall mount: Includes (4) 3/8-16 x 3-1/2" threaded rods, carbon steel with Magni-coat, to secure bench top to concrete wall (wall/mounting structure provided by others).
E. Arm: 7 gauge (0.18") A1011 HRP&O commercial steel sheet, formed, with 7 gauge (0.18") A1011 HRP&O commercial steel sheet gussets. Bolts to bench seat with 3/8-16 x ¾" socket button head cap screws and 3/8" washers, carbon steel with Magni-coat. Bolts to bench back board with (2) #12 x ¾" Phillips pan head lag screws, stainless steel.
F. Piano key back support: 7 gauge (0.18") A1011 HRP&O commercial steel sheet, formed, with 3/8" carbon steel plate gussets, with formed 7 gauge (0.18") A1011 HRP&O commercial steel sheet backrest support channels, Bolts to bench seat with 3/8-16 x ¾" socket button head cap screws and 3/8" washers and 3/8-16 X 2-1/2" socket button head cap screws with hex nuts, carbon steel with Magni-coat.
G. Inline boards: eased edges
   1. Seat boards and bottom back board: 4-1/2" by 1-3/8" thick
   2. Back top board: 6-3/4" by 1-3/8" thick
H. Piano key boards: eased edges
   1. Straight seat boards and all back boards: 4-1/2" by 1-3/8" thick
   2. 96"R and 140"R seat boards: wedge shape 4-1/2" angled to 5-1/2" w by 1-3/8" thick
I. Wood:
   1. Wood: Clear, highest grade Ipe, FSC certified wood. Solid pieces, no laminated material/boards permitted. Wood fabrication from full timbers.
   2. Wood Certifications: Wood certified by Forest Stewardship Council, Washington, DC.
   3. Wood Timber Acclimation:
      a. Acquire wood within 180 days of award of Contract and store wood protected from exposure to direct sunlight and in climate controlled environment to allow for additional drying time to acclimate and stabilize wood to proposed location temperatures and humidity levels.
      b. To minimize end checking as timber acclimates, seal end grain immediately following cuts of wood timbers with a heavy coat of Anchorseal clear wax end sealer to slow down the release of moisture from the wood timbers and thereby reduce end checking.
   4. Cutting and Drilling/ Sealing End Grain: Use carbide tipped saw blades and drill bits to ensure smooth cuts. Precut and predrill openings for attachments. Immediately
   5. Fasteners and Hardware: AISI grade 316 Stainless Steel suitable for loading and mounting conditions. Engineered by Fabricator and reviewed by Owner's Representative for approval.

2.4 RECYCLED CONTENT

-Recyclable: 100 percent.

2.5 FINISHES

A. Finish on Metal:
   1. Primer: Rust inhibitor
   2. Topcoat: Thermosetting TGIC polyester powder coat. UV, chip, and flake resistant.
   3. Test Results: "Pangard II".
      a. Gloss Consistency, Gardner 60 Degrees, ASTM D 523: Plus or minus 5 percent from standard.
      b. UV Resistance, Color and Gloss, ASTM G 155, Cycle 7: Delta E less than 2 at 2.0 mils and less than 20 percent loss.
      c. Cross-Hatch Adhesion, ASTM D 3359, Method B: 100 percent pass.
      d. Flexibility Test, Mandrel, ASTM D 522: 3 mm at 2 mils.
      e. Erichsen Cupping, ISO 1520: 8 mm.
      f. Impression Hardness, Buchholz, ISO 2815: 95.
      g. Impact Test, ASTM D 2794: 60 inch-pounds at 2.5 mils.

h. Pencil Hardness, ASTM D 3363: 2H minimum.
i. Corrosion Resistance, 1,500-Hour Test, ASTM B 117: Max. undercutting 1 mm.
j. Humidity Resistance, 1,500-Hour Test, ASTM D 2247: Max. blisters 1 mm.

4. Color of bench frame: as indicated on the contract drawings
5. Color of arm: as indicated on the contract drawings
6. Color of support: as indicated on the contract drawings

C. Finish on Wood:
1. Wood for Exterior Use: Unfinished.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive product.
B. Notify Engineer of conditions that would adversely affect installation or subsequent use.
C. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

A. Install product in accordance with manufacturer's instructions at locations indicated on the Drawings.
B. Install product level.

3.3 ADJUSTING

A. Finish Damage: Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Engineer.
B. Component Damage: Remove and replace damaged components that cannot be successfully repaired as determined by Engineer.

3.4 CLEANING

A. Clean product promptly after installation in accordance with manufacturer's instructions.
B. Do not use harsh cleaning materials or methods that could damage finish.

3.5 PROTECTION

A. Protect installed product to ensure that, except for normal weathering, product will be without damage or deterioration at time of Substantial Completion.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZINE ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

SECTION 15600

HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies HVAC systems. Include all accessories and hardware necessary to install the HVAC systems specified here-in and in the Contract Drawings.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 16050 - BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK.

1.2 SUBMITTALS

A. Working Plans and Certificates

B. Shop Drawings

C. Operation and Maintenance manuals

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protection

1. Protect work, equipment and materials from dirt, water, chemical, or mechanical damage.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies

PART 2 - PRODUCTS

2.1 PACKAGED TERMINAL AIR CONDITIONER (PTAC)

A. Manufacturers
1. Frigidaire, 10200 David Taylor Drive, Charlotte, NC 28262
   Phone: 1.800.265.8352; website: https://www.frigidaire.com/
2. Amana Heating and Air Conditioning, 19001 Kermier Road, Waller, TX 77484
   Phone: 1.800.647.2982; website: https://www.amana-ptac.com/
3. GE Appliances,
   Phone: 1.888.231.2548; website: https://www.geappliances.com
4. Approved Equal

B. Product
1. Base Product:

a. GE Zoneline AZ65 Series Heat Pump with backup electric heat corrosion treated Packaged Terminal Air Conditioner.
   1) Voltage: 230 Volt
   2) Cooling: 11,800 BTUH
   3) Heating: 10,300 BTUH

2. Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation work shall include all receiving, storing, removing from storage, rigging, uncrating, setting, assembling and aligning necessary to prepare each item of equipment and its integral parts for normal continuous operation. Installation includes assembly and erection of equipment, specialties, controls, instruments and all other accessories furnished by the manufacturer with his equipment. Installation includes initial startup of all equipment, and initial operation of the complete heating, ventilating and air conditioning systems as indicated.

B. Furnish all necessary loading and hauling equipment, scaffolding, rigging, cranes, hoists, dunnage and such tools and instruments required to assemble, install, align, connect and make ready for operation all equipment, whether furnished by the Contractor or the Authority.

C. Install equipment per the manufacturer's recommendation and as indicated.

D. PACKAGED TERMINAL AIR CONDITIONER (PTAC)

1. Install the PTAC system complete and ready for operation, as indicated. Include operating and safety control wiring.

2. Install wall sleeve per manufacturer’s recommendations or as indicated on the Contract Drawings.

3.2 TESTS

A. Upon completion and prior to acceptance of the installation, test all systems as may be required by the Engineer to demonstrate satisfactory functional and operating efficiency. Operating tests shall cover a period of not less than six hours for each system, and all tests shall be conducted at such time as the Engineer may approve. Provide all instruments, facilities and labor required to properly conduct the tests. Electric power required will be furnished by the Authority. Balance air handing systems and provide three copies of the readings to the Engineer.

B. **MEASUREMENT AND PAYMENT**

2.7 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

2.7 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

2.7 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)

END OF SECTION

SECTION 16050

BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK

16050.03	3/4-Inch Flexible Metal Conduit (Single)	**LF**
16050.04	Concrete Junction Box	**EACH**
16050.05	Light Switch Including Outlet Box and Cover	**EACH**
16050.06	15A Receptacle Including Outlet Box and Cover	**EACH**
16050.07	USB Receptacle Including Outlet Box and Cover	**EACH**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies basic materials and methods for electrical work.

B. Related Work: Refer to Section 16450-Grounding, for proper installation of components identified in this section. The following items are not included in this Section and will be performed under the designated Sections:

1. Determine interfaces and coordinate electrical work with utility company or the City where power source is the City's.
2. Determine interfaces and coordinate with work completed, progressing, or to be performed under other sections of these Specifications or by other contractors. Make indicated connections to previously completed work. Where future connections to or extensions of the work are indicated, make safe and convenient provisions for such future connections and extensions.
3. Where indicated, take possession of, maintain, and operate as required any electrical plant and equipment left in place by others. Where indicated, leave temporary and interim electrical work, plant and equipment in place for maintenance and operation by others.

1.2 REFERENCES

A. Comply with applicable requirements of the following:

1. National Electrical Code
2. Massachusetts Electrical Code

1.3 SUBMITTALS

A. Submit shop drawings for review showing fabricated work being furnished and installed under these Specifications. Submit such drawings prior to fabrication and within ample time to prevent delays in the work.

B. Submit verified test results to the Engineer promptly upon completion of test.

C. Before installation of the wire and cable, submit the following information for each type and size of wire and cable for review:

1. Manufacturer of the wire and cable.
2. Number and size of strands composing each conductor.
3. Conductor insulation composition and thickness in mils.
4. Average overall diameter of finished wire and cable.
5. Minimum insulation resistance in megohms per 1000 feet at 20˚C ambient.
6. Jacket composition (if any) and thickness in mils.
7. Total number of conductors per cable.
8. Shield material (if any) and thickness.
9. Conductor resistance and reactance in ohms per 1000 feet at 20˚C ambient.
10. Conductor ampacity at 20˚C ambient.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Furnish all items of the materials, design, sizes, and ratings shown on the Contract Drawings and herein specified.

B. Furnish materials and equipment bearing evidence of UL listing where UL standards exist and such product listing is available.

C. Methods of fabrication, assembly and installation are optional unless otherwise specifically indicated.

D. Provide products that are free from defects impairing performance, durability, or appearance, and of the commercial quality best suited for the purpose shown on the Contract Drawings or specified herein.

E. Steel conduit and accessories specified to be zinc coated: Hot-dipped galvanized after fabrication in accordance with ASTM A286.

F. Conform to applicable requirements of Insulation Power Cable Engineers' Association (IPCEA).

2.2 RIGID GALVANIZED STEEL CONDUIT AND ACCESSORIES

A. Conduit, couplings, elbows, bends, and nipples: ANSI C80.1 and UL 6, with each length bearing manufacturer's stamp and UL label.

B. Method used to determine the thickness of zinc coating: The Referee Test included in the appendix to ANSI C80.1.

C. Fittings and Accessories:

1. Galvanized steel or malleable iron, ANSI C80.4.
2. Provide separable watertight hub fittings with a gasket, separate nylon insulated throat and a case hardened locknut.
3. Bushings: Nylon insulated metallic and grounding type.
4. Furnish conduit straps, clamps, and clamp backs made of galvanized malleable iron.

D. PVC Coated Conduit

1. NEMA Standard No. RN1, Coating Type A-40.
2. Thread protectors installed on both ends of conduit for shipment and handling, couplings packaged separately.

E. Almost without exception, in any below grade structures, the MBTA requires the use of RGS conduit.

F. All conduits penetrating floors and ceilings must have brass labels for ease of tracing circuits.

G. Buried conduits cannot have buried pull boxes.

2.3 LIQUID-TIGHT FLEXIBLE METALLIC CONDUIT AND FITTINGS

A. Furnish conduit consisting of a core of flexible galvanized steel with an extruded liquid-tight plastic or neoprene jacket overall. Jacket shall be moisture and oil-proof, capable of conforming to the minimum radius bends of flexible conduit without cracking.

B. Furnish conduits with a continuous copper bonding conductor spiral wound between the convolutions, as required by NEC, and as indicated.

C. Fittings: UL Standard 514, cadmium or zinc-coated.

2.4 PVC ELECTRICAL CONDUIT AND FITTINGS (ONLY FOR OUTDOOR USE)

A. Heavy wall, high impact strength, rigid PVC conforming to the requirements of EPC-40-PVC conduit of NEMA TC2 and fittings for EPC-40-PVC conduit of NEMA TC3.

B. UL listed in accordance with Article 347 of the NEC for underground and exposed use.

C. Flammability rated as self-extinguishing, and having the following minimum properties:

1. Tensile strength, ASTM D638 at 78˚F: 6,000 psi.
2. Flexural strength, ASTM D790: 11,000 psi.
3. Compressive strength, ASTM D695: 8,500 psi.
4. Hardness (Durometer D), ASTM D2240: 77.
5. Water absorption, percent maximum, in 24 hours at 72˚F. ASTM D570: 0.03.
6. Dielectric strength, volts per mil, ASTM D149: 1,100.
7. Thermal conductivity: 1.3 BTU per square foot per degree F per inch.

2.5 CONDUIT EXPANSION FITTINGS

A. Fabricate from material similar to the type of conduit with which they are to be used.

B. Include a factory installed packing ring, designed to prevent the entrance of moisture, and a pressure ring.

C. Also include a grounding ring or a grounding conductor for metallic expansion couplings.

2.6 INSERTS

A. Channel Inserts. Fabricate from not less than 12 gauge steel channel having an overall size of 1-1/2 by 1-1/2 or 1-5/8 by 1-5/8 inches with continuous 7/8 inch wide slot, in lengths as indicated. Galvanize after fabrication.

B. Channel Inserts for Embedding in Concrete

1. Fabricate from channels having a solid base.
2. Weld concrete anchors to the channel during fabrication and before coating.
3. Galvanize after fabrication
4. Provide assemblies with a minimum pull-out load rating of 4,500 pounds per linear foot uniformly distributed.
5. Furnish all channel inserts for installation embedded in concrete with the channel interior completely filled with styrofoam to prevent seepage of concrete into the channel during installation.

C. Channel Inserts for Surface Mounting

1. Fabricate from channel having 3/8 inch by 3-inch slots on 4-inch centers in the base.
2. Galvanize inserts for surface mounting on concrete surfaces or for installation in damp or wet areas.

D. Spot Inserts for Embedding in Concrete

1. Steel, galvanized after fabrication
2. Designed for a maximum loading of 800 pounds with safety factor of three.
3. Knockout openings to accommodate either square or rectangular nuts.

2.7 OUTLET, JUNCTION AND PULL BOXES

A. Conform to NEC Article 370. Electrical boxes shall conform to UL-50, "Standard for Electrical Cabinets and Boxes", and UL-514, "Standard for Electrical Outlet Boxes and Fittings".

B. Provide electrical boxes of the material, finish, type and size indicated and required for the location, kind of service, number of wires, and function. Boxes shall have mounting holes retapped for 10-24 machine screws.

C. Provide boxes complete with accessible covers designed for quick removal and suitable for the purpose for which they will be used, except that boxes in which or on which no devices or

fixtures are to be installed, shall be equipped with flat or raised blank covers as required. All ceiling fixture outlet boxes shall be equipped with 3/8-inch boltless fixture studs.

D. Boxes not over 100 cubic inches in size shall be cast. Boxes over 100 cubic inches in size shall conform to the requirements for cabinets.

E. Covers: Same thickness as boxes and secured in position by means of No. 10-24 stainless steel machine screws. Arrange covers to be readily and conveniently removed.

F. Coat junction boxes inside and outside to prevent oxidation. Where outlet boxes are used as junction boxes they shall be cast aluminum and not be smaller than 4 inches square by 1-1/2 inches deep. Provide such boxes with flat blank covers.

G. Outlet Boxes: Cast aluminum, not be smaller than 4 inches square by 2-1/8 inches deep.

H. Concealed Switch Boxes: Cast aluminum, not less than 4 inches square by 1-1/2 inches deep for two devices unless otherwise indicated. Provide covers with rectangular openings of proper size and shape. Furnish and install special boxes required to suit the kind of service and location requirements, as indicated, and as may be directed by the Engineer.

I. Cast metal boxes shall be of aluminum alloy, with compatible conduit fittings.

J. Boxes for exposed switches and receptacles: Cast metal, FS and FD Types.

K. Furnish brackets, supports, hangers, fittings, bonding jumpers and all other accessories required.

L. Provide neoprene gaskets 1/8 inch thick with boxes subjected to weather, and as directed by the Engineer.

M. Grounding. Provide each box to which a lighting fixture or receptacle is to be attached with a grounding terminal.

1. Grounding Terminal: Either a green-colored washer-in-head machine screw not smaller than No. 10-32 in a drilled and tapped hole in the back of the box, or a grounding bushing with green-colored machine screw terminal attached to one of the conduits.
2. Provide suitable grounding terminals in motor connection boxes.
3. Install grounding jumpers as specified in Section 16450 - GROUNDING.

N. Junction and pull boxes must be surface mounted and not buried.

2.8 WIRE AND CABLE (600 VOLT)

A. Conductors: Conform to the requirements of the NEC.

1. Feeder and Branch Circuit Conductors: Soft-drawn copper.
2. Control Circuits: Soft-drawn copper.
3. Conductor Sizes: Standard American Wire gauge sizes. Conductors No. 10 and smaller, solid copper; No. 8 and larger, stranded copper.
4. Minimum AWG sizes unless otherwise indicated:
   a. No. 12 for branch circuits.
   b. No. 14 for control wire and fixture wire

c. No. 16 for low voltage circuit and indication wire.

B. Wire and Cable 600 volts and Below Installed Raceways: Single conductor, NEC type XHHW, conforming to requirements of NEMA WC 7, or THWN.

C. Fixture Wire: Type AF single conductor, rated for 150˚C conductor temperature, 300 volts.

D. Color Coding of Conductors

1. Color code supply cables and branch circuit conductors throughout the secondary alternating current wiring system as follows:

Conductor	208/120 Volts
Phase A	Black
Phase B	Blue
Phase C	Red
Neutral	White
Ground	Green

2. Color code single-conductor wires as follows:
   a. 120/208 volt circuits, yellow with blue tracer.
3. Branch circuit phase conductors No. 10 and smaller and all neutral and equipment conductors: Solid color insulation or solid color coating.
4. Solid color coatings and tracers: A strongly adherent paint or dye not injurious to the insulation and which will not be obliterated by pulling into a conduit or raceway.
5. On-site coloring of ends of conductor may be permitted by the Engineer upon receipt of satisfactory evidence that the Contractor is unable to order color-coded wire and cable as specified. Provide certification from the cable manufacturer that the paint or dye proposed for field application is non-injurious to the insulation. Colored tape may be used to mark the ends of conductors in lieu of paint or dye.

E. Identification Tags

1. Provide waterproof identification tags of brass, aluminum, plastic, or pressure-sensitive moisture-resistant labels designed for fastening to cables, feeders, and power circuits in vaults, pull boxes, manholes, and switchboard rooms and at all terminations of cable or wire.
2. Stamp or print tags or labels to correspond with markings on the Contract Drawings or accepted Shop Drawings, or mark so that feeder, cable or conductor may be readily identified. Tags on conductors at switches, receptacles, motor control panels, wireways, and junction boxes shall bear the circuit number of the conductor as it appears in the circuit directory. Mark conductors in motor control panels with the terminal number.
3. If suspended type tags are provided, design tie tags with slip-free plastic cable lacing unit or design for attachment by nylon bundling straps.

F. Cable Supports and Fasteners: Design for use with channel inserts.

G. Conductor Bundling Straps

1. Formed from self-extinguishing nylon having a temperature range of minus 65˚F to plus 250˚F.
2. Equip each strap with a locking hub or head with a stainless steel locking barb on one end and a taper on the other end.
3. Make wire and cable ties for installation outdoors and in exposed locations of ultraviolet resistant nylon material.

H. Splice and Terminal Connectors

1. Design termination fittings for use with the cable furnished, NEMA Standard, and UL approved.
2. Termination and splice fittings for No. 10 and smaller conductors; Screw on, spring pressure-type copper connectors with nonflammable, self-extinguishing insulation of temperature rating equal to that of cable being connected. Terminals to provide a metal insulation grip on the conductor for stain relief.
3. Termination and splice fittings for No. 8 and larger conductors: Tool-applied compression connectors of material and design compatible with the conductors for which they are used.
4. Terminal connectors for conductors Size No. 4/0 and larger: Long-barrel, double compression type, and furnished with two bolting holes in the pad.

I. Insulating Material for Splices and Terminations

1. Of the type approved by the Engineer for the particular use, location and voltage, 3/4 inch nominal width.
2. Plastic electrical insulating tape for general use: Vinyl plastic with rubber-based pressure-sensitive adhesive. Pliable at temperature of minus 18˚C to 105˚C. When tested in accordance with ASTM D 3005, the tape shall have the following minimum properties:
   a. Thickness: 7 mils.
   b. Breaking Strength: 15 pounds per inch.
   c. Elongation: 200%.
   d. Dielectric Strength: 10,000 volts/mil
   e. Insulation Resistance (Direct method of electrolytic corrosion): 1,000,000 megohms.
3. Rubber electrical insulating tape for protective overwrapping: Silicone rubber with a silicone pressure-sensitive adhesive. When tested in accordance with ASTM D1000, the tape shall have the following minimum properties:
   a. Thickness; 15 mils.
   b. Tensile Strength: 11 pounds per inch.
   c. Elongation: 525%.
   d. Dielectric Strength: 13,000 volts
   e. Insulation Resistance (Indirect Method of Electrolytic corrosion): 1,000,000 megohms.
4. Arcproof Tape: Flexible, conformable organic fabric, coated one side with a flame-retardant flexible elastomer-self-extinguishing, with the following minimum properties:
   a. Thickness, ASTM D1000: 55 mils.
   b. Tensile strength, ASTM D1682; 50 pounds per inch.
   c. Thermal conductivity, ASTM D1518; 0.478 btu/hour/square foot/degrees F.
   d. Electrical Arc Resistance: Withstand 200 ampere arc for 40 seconds.
5. Mark each tape package to indicate shelf-life expiration date.

6. Glass Cloth Electrical Insulating Tape (for use with arcproof tape): Woven glass fabric; when tested in accordance with ASTM D1000, the tape shall have the following minimum properties:
   a. Thickness: 7 mils
   b. Breaking Strength: 170 pounds per inch.
   c. Elongation: 5%.
   d. Dielectric Breakdown: 2,500 volts.
   e. Insulation Resistance (Indirect Method of Electrolytic Corrosion): 5,000 megohms.

2.9 WIRING DEVICES

A. General. Wiring devices include switches, receptacles and special outlets installed in raceway or conduit boxes, complete with cover plates.

2.10 RECEPTACLES AND PLUGS

A. Configuration and requirements for connector and outlet receptacles; UL 498 and NEMA WD 1 for heavy duty general use type.

B. Receptacles: Fire-resistant nonabsorptive, hotmolded phenolic composition or equal bodies and bases with metal plaster ears integral with supporting member.

C. Type: Flush type, except where otherwise indicated.

1. Wall receptacles; Single or duplex as shown on the Contract Drawings.
2. Provide receptacles and plugs (caps) with light-colored terminal facilities for neutral connections, amber or brass colored for phase conductor connections, and green-colored hexagonal machine screws for the equipment grounding conductor or connections.
3. All contracts of the receptacles, including the grounding contract: Double grip bronze type with spring steel backup clips so that both sides of each male prong of the plug will be in firm contact.
4. Provide all receptacles with self-grounding clip or mounting strap screws.
5. Ground fault circuit interrupter duplex receptacles shall be 120 volt, 60 Hz, 15 ampere with built-in test, reset buttons, and ground fault tripped indication. They shall interrupt the circuit within 1/30th of a second on a 5 milliampere earth leakage current. They shall be designed for end of run installation or with provisions for feeding through to protect other outlets on the circuit. Maximum circuit capacity for the latter shall be 20 amperes. The receptacles shall be furnished with necessary wire connectors, clips, mounting scores and instruction.
6. Receptacles with integrated USB ports as shown on the contract drawings shall have 2-USB Type A and 2-USB Type C port minimum.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all items in their proper locations as shown on the Contract Drawings, rigid and secure, plumb and level, and in true alignment with related and adjoining work. Do not weld electrical materials for attachment or support.

B. Furnish anchor bolts and anchorage items as required, and field check to ensure proper alignment and location. Provide templates, layout drawings, and supervision at the job site to ensure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.

C. Install supporting members, fastenings, framing, hangers, bracing, brackets, straps, bolts and angles as required to set and connect rigidly the work.

D. Control erection tolerance requirements to not impair the strength, safety, serviceability, or appearance of the installations, as approved by the Engineer. Determine exact location of conduit. Route all conduit parallel to building lines.

E. The trade size, type and general routing and location of conduits, raceways, and boxes shall be as indicated.

F. Install exposed conduit so as to avoid conflicts with other work. Install horizontal raceway close to the ceiling or ceiling beams, and above water or other piping whenever possible.

G. Install individual conductors in conduits, raceways, cable trays, ducts, and trenches and multiple-conductor sheathed cables as shown on the Contract Drawings to complete the wiring systems.

H. Install switches, receptacles, special purpose outlets, and cover plates complete in a neat manner in accordance with the NEC and local electrical codes.

3.2 CONDUIT AND FITTINGS

A. Metallic Electrical Conduit

1. Install metallic conduit in accordance with the NEC and as indicated. Prevent concrete and other materials from obstructing the conduit. Pack all outlet, pull and junction boxes with paper prior to pouring concrete ends of embedded conduit. Do not use conduit smaller than 3/4-inch diameter.
2. Make all conduit bends in accordance with the NEC, with not more than 3 bends per run. Where more than 3 bends are required in a particular run, install pull boxes as required to facilitate pulling conductors.
3. Unless otherwise indicated, terminate metallic conduit installed for future extension with flush couplings set to finished floor level.
4. Provide metallic numbering tags indicting the conduit number on the end of conduit. Identify train control and communication conduit as indicated.

5. Properly support conduit to be embedded to maintain correct location and spacing during concreting operations. If necessary, provide suitable metal supports for this purpose.
6. Install conduit so that any moisture collecting in the conduit will be drained to the nearest outlet or pull box.
7. Whenever exposed or buried conduit passes through an expansion or contraction joint in the structure, install the conduit at right angles to the joint, and provide an approved conduit expansion joint at the joint. Paint the conduit with an approved bituminous compound for one foot on each side of the expansion couplings.
8. Provide expansion joints in conduit runs where required to compensate for thermal expansion.
9. Rod and swab embedded conduit after installation to remove foreign matter, which may have worked in at the joints. If obstructions are encountered which cannot be removed, or if any conditions exist which may result in damage to wires and cables pulled through the conduit, install new conduit at no additional expense to the Authority.
10. After the conduit has been rodded and swabbed, repack boxes and protect conduit ends to prevent any foreign material from entering the conduit.
11. Where metallic conduit is exposed to different temperatures, seal the conduit to prevent condensation and passage of air from one area to the other.
12. Use only conduits that are electrically and mechanically continuous and connect to the structure ground system. Secure continuous ground by bonding where required.
13. Apply conductive antisieze compound to the threads of threaded rigid conduit joints. Do not use compounds containing lead. Terminate the conduit in appropriate boxes at all motors, switches, outlets, and junction points.
14. When field cutting of conduit is required, thread and ream the conduit to remove any rough edges. Where a conduit enters a box or other fitting, provide a bushing to protect the wire from abrasion. Provide insulation type bushings and double locknuts on ends of rigid conduits terminating at steel boxes, panelboards, cabinets, motor starting equipment, and similar enclosures.
15. Support individual horizontal conduits not larger than 1-1/2 inches diameter by means of one-hole pipe straps with back spacers or individual pipe hangers.
16. Space conduits installed against concrete surfaces away from the surface by clamp backs or other approved means.
17. Support individual horizontal conduits larger than 1-1/2 inches diameter by individual pipe hangers.
18. In dry locations, spring steel fasteners, clips, or clamps specifically designed for supporting exposed single conduits may be used in lieu of pipe straps or pipe hangers.
19. Hanger rods used in connection with spring steel fasteners, clips, and clamps shall be either 1/4-inch diameter galvanized steel rods or, if concealed above a suspended ceiling, galvanized perforated steel strapping. Do not use wire for support of conduit.
20. Support parallel conduits at the same elevation on multiple conduit hangers or channel inserts. Secure each conduit to the pipe hanger or channel insert member by a U-bolt, one-hole strap, or other specially designed and approved fastener suitable for use with the pipe hangers or channel inserts.
21. Space supports not over 10 feet on centers for vertical conduits spanning open areas. Securely anchor conduit at each end and run so as not to interfere with the installation and operation of equipment at the location.
22. Support conduits and raceways above suspended ceilings from either the floor construction above or from the main ceiling support members, using the applicable method specified herein.

23. Install liquid-tight flexible metal conduit so that liquids tend to run off the surface and not drain toward fittings. Provide sufficient slack to reduce the effects of vibration. Running threads are not acceptable. Where necessary for connecting conduits, use right and left hand couplings.

B. Non-Metallic Electrical Conduit

1. Non-metallic electrical conduit includes polyvinyl chloride (PVC) and asbestos cement conduit.
2. Cap or plug the ends of embedded conduit to prevent concrete and other materials from obstructing the conduit.
3. Sandpaper joints in PVC conduit to remove all burrs, clean and dry the joints, and brush with a solvent cement acceptable to the manufacturer before installing.
4. Properly support conduits to maintain the correct location and spacing during concreting operations and, if necessary, provide suitable plastic supports and spacers for this purpose.
5. Wherever buried non-metallic conduit passes through an expansion or contraction joint, or where required to compensate for thermal expansion and contraction, provide a conduit expansion joint. Install the conduit to cross the joint at right angles. In areas of floating slabs, install horizontal runs of conduit beneath the floating slab. Conduit shall pass through the floating slab only where required to terminate in a vertical direction as shown on the Contract Drawings.

C. Pull Wires

1. Use nylon pull wires of tensile strength not less than 240 pounds in each conduit and duct, leave pull wires in ducts and conduit after cleaning.
2. No splices in pull wire will be allowed.
3. Leave ample slack length at each end of pull wire.

D. Filling of Openings. Wherever slots, sleeves, or other openings are provided in floors or walls for the passage of raceways, including bus ducts, fill such openings as follows:

1. Use fire-resistive filling material for openings similar to the material of the floor, wall or ceiling being penetrated, and finish to prevent passage of water, smoke, and fumes.
2. Where conduits passing through openings are exposed in finished rooms, use filling material that matches, and is flush with, the adjoining finished floor, ceiling or wall.

3.3 INSERTS

A. Channel Inserts. Install embedded channel inserts with the slotted face flush with the finished concrete surface.

B. Spot Inserts

1. Install with the insert face flush with the finished concrete surface, firmly embedded, with no evidence of movement.
2. Test selected inserts, as required by the Engineer, by suspension of 800 pounds of weight from the insert. If there is evidence of failure, replace the inserts in a manner satisfactory to the Engineer.

3.4 SURFACE METAL RACEWAYS

A. Securely ground surface metal raceways to outlet boxes or to backplates and fixtures by means of bolts, screws or other approved means and as specified in Section 16450 - GROUNDING.

B. Install surface metal raceways where indicated, in accordance with the NEC. Use fittings and accessories designed for the raceway.

3.5 OUTLET, JUNCTION AND PULL BOXES

A. Outlet Boxes

1. Unless otherwise indicated, flush mount outlet boxes with the front edges of the boxes or plaster covers attached thereto flush with the finished wall or ceiling.
2. Mount boxes so that the long axis of the devices will be vertical, unless otherwise indicated.
3. Locate conduit boxes and conduit box knockouts so as not to interfere with the reinforcing steel.
4. Unless otherwise specified, provide boxes in plastered walls and ceilings with plaster covers. Do not install these covers until the finish plaster line is determined for the particular location.
5. The mounting height indicated for a wall-mounted outlet box shall be construed to mean the height from the finished floor to the horizontal centerline of the cover plate.
6. Mount outlet boxes for switches and receptacles located on columns and pilasters so as not to interfere with installation of partitions.
7. Install boxes located near doors on the lock sides, even where the symbols appear on the hinge sides on the Contract Drawings, unless other locations are approved by the Engineer.

B. Junction and Pull Boxes

1. Install so that covers are readily accessible after completion of the installation.
2. Do not install boxes above suspended ceilings, except where the ceiling is of the removable type or where definite provisions are made for access to each box.

C. Boxes Set in Concrete

1. Adequately support boxes to prevent movement during placement of concrete.
2. Unused nailing holes or other holes in the side or bottom of the boxes will not be permitted.
3. After installation, clean boxes placed in concrete.

3.6 WIRING

A. General

1. Furnish wires and cables to the site in unbroken standard coils or reels, to which shall be attached a tag bearing the manufacturer's name, trade name of the wire, and the UL label for 600 volt wire and cable.
2. Provide all wiring complete as indicted. Provide ample slack wire for motor loops, service connections and extensions. In outlet or junction boxes provided for installation of equipment by others, tape ends of wires and install blank covers.
3. Do not bend cables during installation, either permanently or temporarily, to radii less than 12 times the outer diameters, except where conditions make the specified radius impracticable, and shorter radii are permitted by the NEC and NEMA Standard WC 7, Appendix N.
4. Neatly and securely bundle cable conductors located in branch circuit panelboards, cabinets, control boards, switchboards and motor control centers and pull boxes. Use nylon bundling straps.

B. Wire Pulling

1. Install wire and cable in conduit as indicated. Do not pull wiring into any conduit until conduits and outlets have been thoroughly cleaned and swabbed to remove water and debris. Do not use block or tackle or other mechanical means in pulling conductors smaller than No. 2 AWG in raceways.
2. Provide suitable installation equipment to prevent cutting and abrasion of conduits and wire during the pulling of feeders. Use lubricant and installation procedure as recommended by the cable manufacturer, and as approved by the Engineer.
3. Use masking or other means to prevent obliteration of cable identifications when solid color coating or colored tracers are used.
4. Pull together all cables to be installed in a single conduit.

C. Cable Supports. Install cable supports for vertical feeders in accordance with the NEC.

D. Splices and Terminations

1. Make wire and cable splices only in outlet, junction or pull boxes, or in equipment cabinets. Splices in conduit or raceway will not be permitted. Make splices by means of compression type connectors, and cover with tape to an insulation level equal to that of the cable.
2. Use positive type connector installation tools as recommended by the manufacturer.
3. Mechanical hand tools, with dies for each conductor size, recommended by the manufacturer, may be used on conductor sizes through No. 4/0.
4. For conductor sizes larger than No. 4/0, use hydraulic tools with hexagonal or circumferential installing dies for each conductor size, as recommended by the manufacturer.
5. For inspection purposes, clearly mark die numbers on the installed connectors.
6. Before installation, apply anti-corrosion electrical joint compound to conductors and terminal bolting pads.

PART 4 - COMPENSATION

Item 16050.03 - 3/4-Inch Flexible Metal Conduit (Single)

Item 16050.04 - Concrete Junction Box

Item 16050.05 - Light Switch Including Outlet Box and Cover

Item 16050.06 - 15A Receptacle Including Outlet Box and Cover

Item 16050.07 - USB Receptacle Including Outlet Box and Cover

METHOD OF MEASUREMENT:

Separate Measurement will not be made for the work of this Section. Work in this section shall be measured for all work necessary to complete in place the project lighting in accordance with section 10730.

BASIS OF PAYMENT:

Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price in accordance with section 10730. All costs, therefore, shall be included in the Contract for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to those items unit price.

PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZINE ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)

END OF SECTION

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SECTION 16135

ROADWAY LIGHTING INFRASTRUCTURE

16135.1	**2-INCH ELECTRICAL CONDUIT CONCRETE ENCASED (LIGHTING)**	**LINEAR FOOT**
16135.2	**4-INCH ELECTRICAL CONDUIT CONCRETE ENCASED (LIGHTING)**	**LINEAR FOOT**
16135.3	**ELECTRIC HANDHOLE (LIGHTING) – MUNICIPAL STANDARD**	**EACH**
16135.4	**LIGHT STANDARD FOUNDATION (STANDARD PRECAST)**	**EACH**
16135.5	**SHALLOW FOUNDATION (SHALLOW PRECAST)**	**EACH**
16135.6	**SELUX FOUNDATION (STANDARD PRECAST)**	**EACH**
16135.7	**GROUND ROD 8-FT LONG**	**EACH**
16135.8	**ACORN LUMINAIRE AND POLE**	**EACH**
16135.9	**PENDANT LUMINAIRE AND POLE (1 AND 2 HEAD)**	**EACH**
16135.10	**CONTEMPORARY LUMINAIRE AND POLE**	**EACH**
16135.11	**REMOVE AND STACK EXISTING STREET LIGHT**	**EACH**
16135.12	**REMOVE AND DISPOSE EXISTING STREET LIGHT**	**EACH**
16135.13	**REMOVE AND RELOCATE EXISTING STREET LIGHT**	**EACH**
16135.14	**WIRE TYPE 7 NO. 1/0 GENERAL PURPOSE**	**LINEAR FOOT**
16135.15	**WIRE TYPE 7 NO. 6 GENERAL PURPOSE**	**LINEAR FOOT**
16135.16	**WIRE TYPE 7 NO. 8 GENERAL PUROSE**	**LINEAR FOOT**
16135.17	**WIRE TYPE 7 NO. 10 GENERAL PURPOSE**	**LINEAR FOOT**
16135.18	**LIGHTING CONTROL EQUIPMENT**	**EACH**
16135.19	**TUBMAN UNDER BENCH LIGHTING**	**LINEAR FOOT**

PART 1 - GENERAL

1.1 Summary

A. Work includes the furnishing and installation of street lighting fixtures and poles, removal and relocation of existing street lights, light pole foundations, conduit, handholes, and wiring at locations indicated in the Contract Documents. Per City of Cambridge Standards, all conduits in sidewalks and roadways shall be concrete encased. Conduits in parks and conduits from handhole to pole base shall be direct buried. This work shall be performed in accordance with the Massachusetts Electrical Code and as required in the Contract Documents.

B. Work required to furnish and install handholes and light pole foundations for lighting shall be in accordance with Section 801 of the Mass DOT Standard Specifications and as required in the Contract Documents.

C. Work required to furnish and install ground rods and wiring shall conform to the requirements of Section 813 of the Mass DOT Standard Specifications and as required in the Contract Documents.

D. Conduits between lighting control enclosures or utility manhole to electric hand holes or lighting control enclosures shall be 2 inches, or as indicated on the drawings.

E. Conduits between hand holes and light bases, structures, or receptacles shall be 2 inches, or as indicated on the drawings.

PART 2 - PRODUCTS

2.1 Lighting Control Enclosure

A. Enclosure shall be aluminum, weatherproof traffic controller type cabinet, including a pull box base with a heavy-duty Neoprene gasket around the door opening. Lettering cast in the door shall read “Street Light Control Cabinet City of Cambridge”. Enclosure shall house the distribution panel, lighting contactor, electric meter, GFI receptacle, 2’ LED light at the top of the cabinet and other necessary equipment for a complete functioning lighting control system. The housing shall be furnished with a sheet of ¾” plywood, primed and painted, mounted against back wall and a permanently mounted grounding bus.

B. The street lighting enclosure shall remain unpainted unless otherwise directed.

C. Refer to Cambridge Electrical Department (CED) Street Lighting Specifications for further details.

2.2 Lighting Panelboard

A. Panelboard shall be 120/240-volt single-phase and shall have a minimum 10,000 ampere interrupting capacity, bolt on type, molded case circuit breakers in the quantities and sizes required. Panelboards shall be General Electric.

B. A three-phase service may be allowed with city approval.

C. The meter socket shall be mounted on the exterior of the enclosure and conduit to be the meter socket shall not enter the streetlight enclosure. Any exposed conduit shall be steel conduit.

D. Minimum service size shall be 200 amperes. 120/240 volt unless otherwise approved.

E. The streetlight enclosure shall have one 20 amp – GFI duplex receptacle and on P.C. porcelain lamp holder with 100-watt bulb.

F. Lighting shall be controlled by a single photocell installed at the nearest fixture to the streetlight control cabinet, as shown on the plans or as directed in the field. Photocell shall be considered incidental to 2.1

G. Lighting contactor shall be sized a minimum of 100 amperes. The contactor shall be manufactured by General Electric.

2.3 Electric Conduit

A. Rigid non-metallic conduit and fittings shall be high-quality polyvinyl chloride conduit (PVC). PVC conduit shall be heavy-wall Type 40, shall conform to industry standards and Commercial Standard CS207-60, shall be listed by Underwriters' Laboratories for direct burial underground use, and shall conform to or exceed all property requirements of UL651 and NEMA TC-2, 1970. All conduit shall be furnished with plain ends.

B. Concrete for encasement shall be 3,000 psi / 3/8 inch / 565 per MassDOT Standards.

2.4 Handholes

A. Handhole units for lighting shall be 13”W x 24”L x 18” D polymer concrete and shall otherwise meet the requirements of The City of Cambridge Electrical Department Specifications. Covers shall be clearly marked “LIGHTING”. Handholes shall be PG Style Quartzite as manufactured by Hubbell, or approved equivalent product.

B. Refer to CED Street Lighting Specifications for further details.

2.5 Light Foundations (Standard Precast)

A. Precast units shall meet the requirements of Mass DOT Standard Specifications Section M4.02.14, except concrete shall be 5,000 psi at 28 days.

B. Steel reinforcing bars shall be deformed bars rolled from new billet steel conforming to the requirements of ASTM A615, Grade 60.

C. The Contractor shall provide 2” rigid galvanized steel conduit to stub out of base.

D. Anchor bolts arrangement for installation of light pole shall be coordinated with light pole manufacturer. The City will not be responsible for delays or additional cost caused by any

mismatch between precast light base and light poles.

2.6 Light Standard Foundation (Cast in Place)

A. Concrete shall meet the requirements of MassDOT Standard Specifications section 901, and shall be 1 ½" aggregate with 565 cement with a minimum compressive strength at 28 days of 4,000 psi.

B. Steel reinforcing bars shall be deformed bars rolled from new billet steel conforming to the requirements of ASTM A615, Grade 60, epoxy coated.

C. The Contractor shall provide 2" rigid galvanized steel conduit to stub out of base.

2.7 Lamp Posts and Luminaires

A. Light poles, arms and luminaires shall match the City of Cambridge standards and specifications except as modified herein and on the drawings. Note that the type 2A ("Acorn") poles on this project have a smaller diameter base than the City Standard

B. Contractor shall furnish and install all lamp posts and luminaires as indicated and as specified on the drawings.

C. The Contractor shall also furnish an additional five (5) Type 2A poles for use as spares and shall deliver these to the Cambridge Electrical Department storage facility.

D. A weather resistant GFCI duplex receptacle shall be factory-installed on each roadway pole where indicated on the drawings. The duplex GFI receptacle shall be a ground fault circuit interrupting type, full gang size, polarized, duplex, parallel blade, U grounding slot, specification grade, rated at 20 amperes, 125 Vac and have screw terminals (use of push-in terminals is not acceptable). Receptacle cover plate shall be weatherproof in-use cover with NEMA 3R with cord in place spring-loaded cast aluminum cover door that meets current MEC standards. Receptacle shall be supplied from the factory with a quick-disconnect connector at the receptacle and shall have sufficient length of wire to reach 18" out of handhole in pole base (provided by Contractor).

2.8 Ground Rod

A. An 8 foot long, 3/4 inch copper-clad ground rod shall be provided for all light control enclosures, and handholes. The minimum size grounding conductor shall be No. 4 AWG with an approved type connection at each ground rod and light fixture foundation. All steel conduit where used shall be bonded. The grounding conductor shall be continuous and where connections are made, pressure connectors suitable for the purpose shall be used. The conductor shall provide connection between the associated handhole cover frame and the ground rod and between the handhole ground rod and the lighting pole foundation. This connection will be made with an exothermic weld.

2.9 Wiring

A. The minimum size wire from the circuit breaker to all hand holes shall be Three (3) 1/0 A.W.G. type THHN copper. 1 Black, 1 White, and 1 Red, 1/0 A.W.G. THHN copper. Green

for grounding conductor

B. The minimum size wire from the handholes to each light fixture luminaire, shall be two No. 10 A.W.G. type THHN copper for each service and one No. 10 A.W.G. type THHN copper for grounding. 1 Black, 1 White and 1 Green for grounding conductor

C. The minimum size wire from the handholes to each receptacle mounted at top of light pole, shall be two No. 10 A.W.G. type THHN copper for each service and one No. 10 A.W.G. type THHN copper for grounding. 1 Black, 1 White and 1 Green for grounding conductor

D. The minimum size grounding conductor from handhole or light fixture to ground rod shall be No. 4 AWG THHN copper with an approved type connection at each ground rod and light fixture.

E. Wires shall be continuous where practicable and where splices are made pressure connectors suitable for the purpose shall be used.

2.10 Lighting Control Equipment

A. The astronomic timer switch shall be rated 125 VAC, 1-pole, 20 Amp and be manufactured by Tork, paragon or equal

B. The photocell shall be rated 125 VAC, 20 Amp and be manufactured by Tork or equal.

PART 3 - EXECUTION

3.1 Electrical Conduit

A. The Perimeter of the paved area to be removed for conduit installation shall be sawcut.

B. The depth of excavation shall be sufficient to allow passing the conduit beneath curb as necessary and encasing the conduits as specified herein and as shown on the plans. Conduits shall have a minimum of thirty inches (30”) of cover in the public way. Any deviation from this requirement must be approved by the City of Cambridge Electrical Department and Engineer prior to installation.

C. A 6-inch wide magnetic marker tape shall be placed approximately 2-feet above underground conduit. This tape shall be colored and serve as a warning device to personnel who may be involved in future excavations that electrical cable is located below and should be avoided if possible. It will serve as a general warning that hand digging is required beyond this point in order that the rigid non-metallic conduit below the tape is not damaged or otherwise penetrated.

D. PVC conduit shall be jointed by means of solvent cement joints. Conduit shall be cut square and deburred. All surfaces shall be wiped clean and dry. Using a natural bristle brush of width about equal to conduit size, the Contractor shall apply a coat of cement to the outside of the conduit end. (Note: Cement should be flowed on and not brushed out). Conduit and coupling shall then be firmly pressed together and the fitting turned a quarter turn to distribute the cement

evenly. The time elapsed between applying the cement and completing the joint should not exceed 60 seconds. All conduit and fittings shall be watertight.

E. All conduits shall be free of foreign materials prior to the installation of conductors

F. A polypropylene or nylon pull rope shall be installed in all empty conduits.

G. Conduits shall be sealed after installation, prior to placing concrete encasement and installing conductors.

3.2 Handhole

A. In general, the locations of lighting handholes are shown diagrammatically on the drawings. In general, it is the intent that a lighting handhole with ground rod be located at or near each proposed light installation.

B. Handhole must be installed prior to the streetlight control cabinet for the service connection. No conductors other than the service entrance conductors shall be permitted in this handhole.

C. Each lighting installation shall be fused in the handhole associated with the fixtures. Fusing shall be provided by means of an in-line fuse holder, Tron HEB Series Single Pole Breakaway or approved equal, 5 ampere fuse. No fusing shall be allowed in the base of light poles.

3.3 Light Standard Foundation (Precast)

A. All foundations shall be installed at the location as shown on the plan except as approved deviations are required to meet field conditions. All locations must be approved by the Engineer prior to installation.

B. Contractor to coordinate with the City of Cambridge Electrical Department for type of anchor bolts to be used for securing the existing light poles to the precast foundations.

C. All foundations will be set plumb and true to grade.

D. The Contractor shall carefully mark the proposed location of the concrete foundation and then shall determine if any utilities or underground or overhead obstruction will prevent the installation at these locations. Similar marking shall be done for the conduit runs to the foundation. If such an obstruction is evident, the Contractor shall request permission from the Engineer to move or adjust the location of the foundation.

E. If no obstruction is apparent at the proposed foundation location, the Contractor shall make an excavation in order to install the foundation as detailed on the drawings, to be accomplished with hand digging. Mechanical excavating equipment may be used if approved by the Engineer. The Contractor must provide a compacted 6-inch cushion of gravel borrow under the foundation and shall backfill using acceptable excavated material or gravel borrow compacted in 6-inch layers around the foundation. A compaction of 95% for the backfill material of the excavation is required.

F. The backfill shall be thoroughly compacted by tamping with a pneumatic hammer equipped with a round dirt tamping pad with a minimum diameter of 6-inches driven by an air compressor with a minimum of 100 psi pressure.

G. The use of an impactor attachment on a standard backhoe with a dirt tamping pad may substitute for the pneumatic hammer with the permission of the Engineer. Use of a vibrator type compactor around pre-cast foundations or handholes is prohibited.

H. If the Contractor encounters no difficulty in the excavation and the soil conditions are suitable to support the foundation, the Contractor shall install the pre-cast concrete foundation. The top of the foundation must be level and installed as indicated on the detail plans. If difficulty is encountered in excavation due to underground obstructions, ledge, rock or when, in the opinion of the Engineer, the soil conditions require, the Contractor may install an approved precast short foundation or cast-in-place foundation with the approval of the Engineer.

I. Where foundations are placed adjacent to straight sections of roadway curb, the bolts and face of foundation shall be parallel with the face of the curb. When adjacent to curved curb, the bolts may be adjusted with the approval of the Engineer to allow proper placement of the pole when installed.

3.4 Lighting Standard Foundation (Cast in Place)

A. The top of the pedestal and foundation must be level and installed as indicated on the detail plans which will be provided by the Engineer prior to installation. If difficulty is encounter in the excavation due to underground obstructions, the Contractor shall submit a request for information detailing the obstruction encountered. A bond break shall be provided between the footing and adjacent materials.

3.5 Installation of Lighting Fixtures

A. Furnish and install a complete lighting system, including conduit, wire, outlet boxes, lighting fixtures with lamps, receptacles, and switches as required.

C. Where job conditions require locations different from those shown to avoid equipment, etc., such changes shall be made without additional cost to the Owner.

C. All fixtures shall be furnished complete with sockets, wiring, trims, hangers, frames, lamps, etc.

D. Install luminaires with the correct optical system orientation, socket position and inclination angle to meet the specified photometric requirements. Align luminaires vertical and perpendicular (or tangent) to the centerline of the street, install new lamps, and clean luminaire components of all construction dirt and dust and fingerprints prior to final completion.
Handle lighting fixtures carefully to prevent breakage, denting or scoring of fixtures' finishes. Do not install damaged lighting fixtures. Replace with undamaged units and return damaged units to equipment manufacturer. Install luminaire, fusing and wiring complete. Install a

wattage identification sticker inside the pole handhole. No other identifying numbers except the manufacturer's nameplate shall be installed on the poles or arms or luminaries.

F. Splices and junctions shall be made only in pole handholes and underground handhole junction boxes. Perform no more splices than needed. Do not splice or junction any wires that continue through a pole or junction box, in other words, those conductors without a termination to the adjacent pole. Use Junction box as a pulling point only. Cable pulled through poles or junction boxes shall be marked per the following paragraph and shall have sufficient loop to extend 18" beyond handhole or junction box lid for future maintenance but shall not be spliced. All splices in junction boxes shall be made waterproof by a UL listed heat shrink splice cover. All splices and junctions shall be considered incidental to the pay item.

G. Install a tie wrap type permanent wire marker on each and every pair of conductors passing through every junction box or pole handhole (bundle circuit pairs together). Mark controller number, circuit letter and pole number on each tie wrap and designate home runs as encountered. Install markers in each pole handhole.

3.6 3.5 Ground Rod

A. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

3.6 Wiring

A. The Contractor shall be required to furnish and install all materials, equipment and labor necessary to completely wire and operate the street lighting system. All materials and wiring procedures shall conform to the specifications contained herein and to the requirements and standard practices of the Section 800 and the following:

   All wire and connectors shall conform to the standards of the National Electrical Manufacturers Association or the Underwriters' Laboratories, Inc., whichever is applicable. All materials and workmanship shall conform to the requirements of the Mass Electrical Code, Standards of the American Society for Testing and Materials, and any local ordinances that may apply. Wherever any reference is made to the standards mentioned above, the reference should be construed to mean the standard that is in effect on the day the Notice to Proceed to the Contractor for the work is dated. Wire sizes shall be based on American Wire Gage (AWG), as applied to copper conductors.

B. Runs of wire and cable from the handholes to each light fixture shall be continuous with no splices except as required for branch connections. Splices, where required, shall be made in the handholes with compression type fittings suitable for the application. Shop drawings of the compression splice fittings shall be submitted for approval, by the Engineer, prior to any order being placed.

C. No wire shall be drawn into any conduit until all work that may cause damage to the wire is complete.

D. All wire terminals, taps and splices shall be made secure with connectors, splicing materials and methods as hereinafter specified.

E. All incoming wires and outgoing wires in lighting load centers, handholes and poles shall be banded as indicated on the contract drawings.

3.7 Grounding

A. Coatings and rust on conduits and grounding rods shall be removed at the location where the ground fittings are to be installed.

B. The bare copper conductor shall be connected to the continuous insulated bonding lead, which shall be identified with green plastic marking tape as noted in the specifications. Bonding leads for lighting fixtures on poles shall be an insulated #10 AWG, marked green, which shall be extended to the nearest handhole and interconnected to the bare copper ground wire in the handhole of gauge shown on the contract drawings and the pig tail conductor shall be connected to the ground rod. The ground wire shall also connect to the ground lug on the handhole frame and be bonded to the handhole cover.

C. A conductor with the same insulation of the power leads shall be installed in all conduits as a continuous bond wire. All bonding leads from fixtures, pole, control boxes, fittings and ground rods shall be connected to the continuous insulated bonding lead which shall be identified with green plastic marking tape as noted in the specifications.

D. All grounding shall conform to the applicable provisions of the National Electrical Code.

E. Field Tests

1. Upon the completion of each wiring system, and before any connection is made to operating equipment, the Contractor shall perform, in the presence of the Engineer, the following tests of each circuit to determine whether the installations are in acceptable working order.

    a. Tests for continuity

    b. Tests for ground

    c. Tests for insulation resistance (Megger Test) from circuit wires to ground, and between circuit wires.

2. Tests for ground shall be performed in accordance with the relevant provisions of Section 813 of the Standard Specifications. The entire electrical wiring system shall be tested for continuity, grounds, resistance to ground, insulation, shorts and opens. This shall be done by means of a megohm meter test.

3. After installation of the wiring system is complete with the required splices, the lamp ballast primary shall be disconnected, and each circuit shall be tested with a 1000 volt megger. Tests on each circuit shall be between each conductor. When the measured value is less than 200 megohms between two conductors, the Contractor shall locate the point

or points at fault, make proper corrections, and then demonstrate by further test the elimination of such faults.

4. These tests shall be performed in the presence of the Engineer.

5. The test results shall be submitted to the Engineer for review and approval. If any results are questionable or inconsistent, the Contractor shall repeat the tests and make any necessary corrections at the request of the Engineer. No wiring system will be accepted until these are satisfactorily performed and approved.

6. The Contractor shall furnish the Engineer with a report of the megohm-meter readings for a permanent project record.

7. All tests and any necessary repairs or replacements that are indicated by the Engineer to produce a fault-free system will be performed at the Contractor's expense.

F. Warranties

1. The Contractor shall provide a performance warranty for six months on the entire work performed under this contract including the performance of all equipment and components of the roadway lighting system specified. The performance warranty responsibility of the contractor shall commence after official acceptance by the city of Cambridge or the Engineer.

2. NOTE: The Contractor shall be completely responsible for all maintenance, repairs and replacement of damaged equipment during the functional test and throughout the performance warranty period.

3. If within 48 hours after notification by the Engineer of a malfunction, and the Contractor fails to make such repairs as necessary, the Engineer will undertake repairs of which all costs are to be SS-113 borne by the Contractor. The cost of any maintenance necessary, except electrical energy, shall be at the Contractor's expense and will be considered as included in the price paid for the contract item involved and no additional compensation will be allowed therefore.

3.7 Remove and Relocate Existing Street Light

A. Removal of existing street light, heads, poles and their accessories shall be done in a manner that will not damage the material.

B. Poles and bases shall be separated from one another without damage to either unit. The shaft shall be unscrewed from base.

C. Underground foundations, and other materials not reused shall be removed and properly disposed of.

D. Any damages to the street lights that are to remain operational shall be fully restored at no additional cost to the Owner.

E. Anchor bolt installation per manufacturer's recommendations

F. The Contractor shall exercise extreme caution when working near existing trees. The Contractor shall exercise extreme caution when removing and stacking the existing luminaires so as not to damage them.

3.8 Removal and Disposal of Existing Light Fixtures

A. The Contractor shall coordinate with City of Cambridge before starting any work. The work shall include disconnecting wiring, removing and stacking of luminaires at the Town's DPW Yard, removal and disposal of poles, foundations, conduit and hand holes no longer required for proposed installations, and repairing the disturbed area to match surrounding surfaces. In special case, the existing foundation and the like can be left in place, as approved by the Engineer. The Contractor shall exercise extreme caution when working near existing trees. The Contractor shall exercise extreme caution when removing and stacking the existing luminaires so as not to damage them.

PART 4 – COMPENSATION

Item 16135.1 2-Inch Electric Conduit Concrete Encased (Lighting)
Item 16135.2 4-Inch Electric Conduit Concrete Encased (Lighting)

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.1 and 16135.2 will be based on the linear foot of each individual conduit installed, regardless of the configuration (as an example, a two-conduit duct bank would be two times the length to capture both individual conduits) as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.1 through 16135.2 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, materials, equipment, and any other incidental costs necessary for the satisfactory completion of this work including but not limited to removal and disposal of the existing conduit within limits of trench; abandonment of existing conduit and wiring; saw cutting the roadway and/or sidewalk; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.), compaction and backfilling with suitable fill, furnish and install conduit, formwork and concrete for concrete encasement; and all other work not included for payment elsewhere.

No separate payment shall be made for marking tape, pull rope, concrete, or any incidental materials, but all costs in connection therewith shall be included in the Contract unit price per foot for these Items.

NOTES ON EXCLUSIONS:
Disposal of any excavated soil not suitable for re-use is not included for payment under this item and shall be paid for separately.

Item 16135.3 Electric Handhole (Lighting) – Municipal Standard

METHOD OF MEASUREMENT:
Item No. 16135.3 will be measured by the unit Each installed complete, which price and payment shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, excavation, backfill, compaction and construction methods.

BASIS OF PAYMENT:
Payment for work under these items shall constitute full compensation for sawcutting; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.), compaction and backfilling with suitable fill, furnish and install handhole and appurtenances; removal of existing handhole and conduit, and all other work not included for payment elsewhere.

NOTES ON EXCLUSIONS:
Disposal of any excavated soil not suitable for re-use is not included for payment under this item and shall be paid for separately.

Item 16135.4 Light Standard Foundation (Standard Precast)
Item 16135.5 Shallow Standard Foundation (Cast in Place)
Item 16135.6 Selux Foundation (Standard Precast)

METHOD OF MEASUREMENT: Item No. 16135.4 through 16135.6, will be measured by the unit Each installed complete, which price and payment shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, excavation, backfill, compaction and construction methods.

BASIS OF PAYMENT:
Payment for work under these items shall constitute full compensation for sawcutting; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.), compaction and backfilling with suitable fill, furnish and install precast foundation, and all other work not included for payment elsewhere.

NOTES ON EXCLUSIONS:
Disposal of any excavated soil not suitable for re-use is not included for payment under this item and shall be paid for separately.

Item 16135.7 Ground Rod – 8-FT Long

METHOD OF MEASUREMENT:
Measurement for payment for Item 16135.7 will be based on each ground rod installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.7 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including and all other work not included for payment elsewhere.

Item 16135.8 Acorn Luminaire and Pole
Item 16135.9 Pendant Luminaire and Pole (1 and 2 Head)
Item 16135.10 Contemporary Luminaire and Pole

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.8 through 16135.10 will be based on each Light assembly installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
This work shall be measured for payment for each Item, installed, wired and lamped in place, which price shall include all materials, labor, and equipment for a complete and accepted installation.

Note: The quantities shown on the Section 00300 "Form for General Bid" do not include the required spare Type 2A poles specified herein. These shall be considered incidental to the work of this Section and will not be measured or paid for separately.

Item 16135.11 Remove and Stack Existing Street Light
Item 16135.12 Remove and Dispose Existing Street Light
Item 16135.13 Remove and Relocate Existing Street Light
METHOD OF MEASUREMENT:
The Contractor shall coordinate with City of Cambridge before starting any work. The work shall include disconnecting wiring, removing and stacking of luminaires at the City's DPW Yard, removal and disposal of poles, foundations, conduit and hand holes no longer required for proposed installations, and repairing the disturbed area to match surrounding surfaces. In special case, the existing foundation and the like can be left in place, as approved by the Engineer.

BASIS OF PAYMENT:
Payment for work under this Item shall be at the Contract Unit Price bid per Each, which price shall constitute full compensation for the complete removal of existing streetlights, any charges for disconnection. Luminaires shall be removed and stacked. Poles and other items of the existing light system shall be removed and discarded.

Item 16135.14 Wire Type 7 No. 1/0 General Purpose
Item 16135.15 Wire Type 7 No. 6 General Purpose
Item 16135.16 Wire Type 7 No. 8 General Purpose
Item 16135.17 Wire Type 7 No. 10 General Purpose

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.13 through 16135.16 will be based on the linear foot of wiring installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.13 to 16135.16 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including installation of wire and cable runs; splices with compression type fittings; installation of circuit breakers; and all other work not included for payment elsewhere.

Item 16135.18 Lighting Control Equipment

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.17 will be based on the each control item installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.17 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including installation of wire and cable runs; splices with compression type fittings; installation of circuit breakers; and all other work not included for payment elsewhere.

Item 16135.19 Tubman Under Bench Lighting

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.18 will be based on linear feet of Ribbon Lighting installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
This work shall be measured for payment by linear feet of strip lighting installed, wired and lamped in place, which price shall include
all materials, labor, and equipment for a complete and accepted installation.

END OF SECTION 16135

SECTION 16195

ELECTRICAL IDENTIFICATION

16195.01	**CONDUIT TAGS**	**EA**
16195.02	**CABLE TAGS**	**EA**
16195.03	**EQUIPMENT IDENTIFICATION TAG**	**EA**

PART I - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies the furnishing and installing of nameplates and labels, wire and cable markers, and conduit markers. Engraved nameplates shall be designed, furnished and installed for every major piece of electrical equipment shown on the single-line diagrams. The single-line diagrams are shown on the Contract drawings.

B. Related requirements are included in, but not limited to, the following Sections.

1. Section 09900: PAINTING
2. Section 16010: GENERAL ELECTRICAL REQUIREMENTS
3. Section 16050: BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK

1.2 REFERENCES

A. National Fire Protection Association (NFPA)

1. NFPA No. 70 - National Electrical Code

1.3 SUBMITTALS

A. Submit in accordance with Section 01300, except as modified herein.

B. Product Data/Catalog Cuts

1. Nameplates and labels.
2. Wire and cable markers.
3. Conduit markers.

C. Certificates of Compliance

1. Nameplates and labels.
2. Wire and cable markers.

3. Conduit markers.

D. Manufacturer's Instructions

1. Delivery, handling, transportation, storage and protection.

2. Surface preparation, and application/installation of products.

3. Application conditions and limitations of use.

E. Engraved nameplate schedule shall be submitted for review and approval by the Engineer.

F. Submittals required for painting work shall be as specified in Section 09900.

1.4 DELIVERY, HANDLING, TRANSPORTATION, STORAGE AND PROTECTION

Delivery, handling, transportation, storage and protection shall be in accordance with the manufacturer's instructions, unless otherwise required by Division 1.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Conform to requirements of NFPA No. 70.

B. Provide products listed and classified by Underwriters Laboratories, or a testing firm acceptable to authorities having jurisdiction as suitable for purpose specified and indicated.

1. The Contractor shall submit certificates of compliance for products provided.

2. The Contractor shall provide the manufacturer's instructions indicating application conditions and limitations of use stipulated by the product testing agency.

2.2 NAMEPLATES AND LABELS FOR EQUIPMENT

A. Nameplates and Labels

1. Engraved three-layer laminated plastic, black letters on white background.

B. Locations

1. Electrical equipment including, but not limited to, each electrical distribution enclosure and control equipment enclosure, communication cabinets, transfer switches and panels.

C. Letter Sizes:

1. Use 1/4-inch letters for identifying individual equipment and loads.

2. Use 1/4-inch letters for identifying grouped equipment and loads.

3. Use 1/8-inch letters for identifying voltage, phase, and neutral.

2.3 WIRE MARKERS

A. Wire markers shall be manufactured by Panduit, Ideal, 3M, or approved equal.

1. Description: Cloth tape or tubing type wire markers.

2. Locations: Each conductor at panelboard, gutters, pull boxes, outlet and junction boxes and each load connection.

B. Legend

1. Power and lighting circuits: Branch circuit or feeder number indicated on the Drawings.

   a. Control circuits: Control wire number indicated on schematic and interconnection diagrams on the Drawings.

2. Power supervisory control and data acquisition (SCADA) system circuits:

   a. Circuits shown on the riser diagrams or schematic diagrams. The riser diagrams and schematic diagrams are shown on the Drawings.

2.4 CONDUIT MARKERS

A. Conduit markers shall be manufactured by Banded Labeling System, Brady USA, Inc., Panduit, or approved equal.

B. Location: Furnish markers for each conduit longer than 6 feet.

C. Spacing

1. Spacing shall be 20 feet on center, unless otherwise specified.

   a. Fire alarm conduits shall be marked every 10 feet.

   b. 13.8 kV system shall be marked for its entire length.

D. Color:

System Name	Color
1. 208 volt system	Blue
2. Fire alarm system	Red
3. Telephone system	Gray
4. Management information system	Purple
5. Passenger assistance system	Green
6. Public address system	White
7. Closed circuit television system	Black

E. Legend:

System Name	Legend
1. 208 volt system	208 V
2. Fire alarm system	FAS
3. Telephone system	TS
4. Management information system	MIS -
5. Passenger assistance system	PNRA
6. Public address system	PAS
7. Closed circuit television system	CCTV

2.5 PAINTED CONDUIT IDENTIFICATION

A. Conduit shall be painted for identification purposes. Paint system Identification Number shall be as specified Section 09900 - PAINTING

B. Paint colored band on each conduit longer than 6 feet.

C. Paint bands, 3 inches wide, 20 feet on center, unless otherwise specified.

1. Fire alarm conduits shall be painted every 10 feet.

D. Color

System Name	Color
1. 208 volt system	Blue
2. Fire alarm system	Red
3. Telephone system	Gray
4. Management information system	Purple
5. Passenger assistance system	Green
6. Public address system	White
7. Closed circuit television system	Black

2.6 UNDERGROUND WARNING TAPE

A. Underground warning tape shall be manufactured by Panduit, Ideal, Seton, or approved equal.

B. Description: Underground warning tape shall be 6 inch wide plastic tape, colored yellow with suitable warning legend describing: CAUTION - BURIED ELECTRICAL LINES BELOW.

PART 3 - EXECUTION

3.1 PREPARATION

Degrease and clean surfaces to receive nameplates, labels and markers, in accordance with the manufacturer's instructions.

3.2 APPLICATION INSTALLATION

A. Application/installation of products shall be in accordance with the manufacturer's instructions.

B. Nameplates and Labels

1. Install nameplates and labels parallel to equipment lines.

2. Secure nameplate to equipment front using screws.

3. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

C. Conduit Identification by Markers

1. Identify conduit using conduit markers.

    a. Apply conduit markers parallel to conduit runs.

D. Conduit Identification by Painting

1. Identify conduit, using paint. Paint shall be field applied.

    a. Painting, including surface preparation, shall be in accordance with Section 09900 - PAINTING

E. Identify underground conduits using underground warning tape. Install one tape per trench at 12 inches below finished grade.

PART 4 - COMPENSATION

Item 16195.01 - CONDUIT TAGS
Item 16195.02 - CABLE TAGS
Item 16195.03 - EQUIPMENT IDENTIFICATION TAG

METHOD OF MEASUREMENT:

Separate Measurement will not be made for the work of this Section. Work in this section shall be measured for all work necessary to complete in place the project lighting in accordance with sections 5700, 10730, and 16135.

BASIS OF PAYMENT:

Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price in accordance with sections 5700, 10730, and 16135. All costs, therefore, shall be included in the Contract for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to those items unit price.

PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
5700.1	RIBBON STRUCTURE	(LS)
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)
10730.2	SHELTER 2 – MAGAZINE ST. SHELTER	(LS)
10730.3	SHELTER 3 – GREEN ST. SHELTER	(LS)
16135.8	ACORN LUMINAIRE AND POLE	(EA)
16135.9	PENDANT LUMINAIRE AND POLE	(EA)
16135.10	CONTEMPORARY LIMINAIRE AND POLE	(EA)
16135.19	TUBMAN UNDER BENCH LIGHTING	(LF)

END OF SECTION

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SECTION 16880

DIGITAL SIGNS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish and install 55" LCD Screens with stainless steel frames and speakers at locations shown in the Contract Drawings.

B. Provide power required for the LCD screen and speakers to function properly.

1.2 RELATED SECTIONS

A. Section 10730 – TRANSIT SHELTERS

1.3 REFERENCES

A. National Electrical Manufactures Association (NEMA)

1. NEMA 3R – Enclosure Type

B. Code of Federal Regulations (CFR)

1. 42 U.S.C. 12181 - Americans with Disabilities Act of 1990 (Title III) (ADA)
2. Part 36, App. A ADA Accessibility Guidelines for Buildings and Facilities

C. Underwriters Laboratories

1. UL 1449 - Safety Standard for Surge Protective Devices

D. Video Electronics Standards Association

1. VESA – VESA Mounting Interface Standard

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Description and catalog cuts of proposed cabinets and racks to be furnished.

C. Shop drawings.

1.4 QUALITY ASSURANCE

A. The LCD screen submittals shall be reviewed and approved by the MBTA Customer Technology Group

B. MBTA Customer Technology Contacts:
   i. Karti Subramanian (ksubramanian@mbta.com)
   ii. General (customertechnology@mbta.com)

1.5 WARRANTY

A. LCD Screen Warranty: The manufacturer shall provide a written warranty for the LCD screen for a minimum of (5) years.
   i. If the manufacturer offers 24/7 on-site support, this shall be included with the purchase price. Otherwise, warranty shall include the best support offered by the manufacturer.

B. Audio Speaker Warranty: The manufacturer shall provide a written warranty for the audio speakers matching the warranty offered for the LCD screen.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND CONTACTS

A. LG-MRI (Bill Dunn; BDunn@mri-inc.net)

B. Samsung (Jeff Gropper; j.gropper@partner.samsung.com)

C. Daktronics (Michael Welsh; michael.welsh@daktronics.com)

D. GDS (Matteo Berti; m.berti@gds.com)

E. Peerless AV (Jeff Blankensop; jblankensop@peerless-av.com)

2.2 LCD SCREEN REQUIREMENTS

Orientation	Portrait
Resolution (min)	1920 x 1080 (1080 x 1920 in portrait orientation)
Aspect ratio	16:9 (9:16 in portrait orientation)
Screen size (diagonal)	55”
Brightness (min)	2000 cd/m2 (nits)
Power (max)	425 w
Weight (max)	175 lbs

Protection	Intrusion Protection: IP65 (IP66 preferred) Operating Temp: -30°C to 50°C Impact rating (e.g., IK10) not required but preferred
Connectivity	Verizon-compatible 4G cellular modem (MBTA will provide a Verizon SIM card)
Remote Capability	Secure remote health monitoring and diagnostics Secure ability to remotely reboot Secure ability to reset or edit operating parameters Secure read/write API access to all operating parameters
Content source	External media player running the latest version of Ubuntu (the MBTA will display real-time information via a browser in kiosk mode, so no additional software is required; the MBTA can provide a disk image for this media player upon request)

2.3 AUDIO REQUIREMENTS

A. Audio speakers shall be built into the enclosure.

Min SPL	70 dB
Protection	Intrusion Protection: IP65/NEMA 4X Operating Temp: -30°C to 50°C
Mounting	Side-facing, at or near the top of the enclosure
Content source (min)	Audio content and volume shall be programmable via the same media player as the screen
Content activation	Screens installed inside bus shelters shall not require push-button activation; the MBTA will program audio content to play automatically, on a timer. Screens installed outside bus shelters or in the public realm shall include an accessible push-button for audio activation.

2.4 MOUNTING REQUIREMENTS

A. LCD Screen Enclosure: All elements of the digital signage solution shall be enclosed within a single, vandalism-resistant enclosure.
   i. The LCD screen enclosure shall be coordinated between the screen manufacturer and the MBTA Customer Technology Group.
   ii. Enclosure Color: Black

B. Mounting Type: Free Standing

C. Mounting Material and Finish: Stainless Steel Type 316L

D. Mounting Details: As shown in the Contract Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

i. Install as indicated in conformance with manufacturer's directions for conditions of application.

ii. Exposed Conduit: Paint any exposed conduit to match color of canopy/ canopy structure

3.2 SOURCE QUALITY CONTROL

A. Factory Functional Testing:

1. Test each type of the Variable Message Sign (VMS) boards that will be installed in the field.
2. The tests shall include each type of video source that the VMS will be required to display.
3. Test input terminals and data interface for alarm input contact closure and to trigger local stored emergency messages.
4. Message Display Times.
5. Message Features: Scroll, flash, variable height.
6. Maximum viewing Angle.
7. Brightness and/or Contrast.
8. Document test results. To pass the test the VMS shall meet the requirements for the tested parameter listed in this section.

3.3 TESTING AND COMMISSIONING – GENERAL

A. Field Installation Testing – The Contractor shall test each component of the Variable Message Sign System. Testing to include all communications, control audio amplification and loudspeaker equipment, to ensure that the equipment is properly installed and that all functions and features are operating as specified and intended in the Contract. The Contractor shall provide RF test instruments and shall measure and record the received signal strength of the cellular data service provider's signal at the output of the Wireless Antenna. The Contractor shall locate and orient the Wireless Antenna to achieve the maximum signal strength and signal-to-noise ratio, sufficient for reliable operation of the Wireless Cellular Modem.

B. System Testing - The Contractor shall coordinate with the MBTA for integration of the SCR Passenger Information system into the MBTA's Systemwide Commuter Rail Passenger Information System. The Contractor shall, with the assistance of the MBTA or their contractor, functionally test the complete system. The Contractor shall provide necessary staffing to correct any deficiencies that are observed with the Contractor's portion of the system during the system testing period. The Contractor shall notify the MBTA 30 days in advance of the system test so that the MBTA can make necessary arrangements for their testing staff.

3.4 SPARE PARTS

A. One VMS and one LCD Display Sign.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Separate Measurement will not be made for the work of this Section. Work in this section shall be measured by lump sum for all work necessary to complete in place the Transit Shelters in accordance with section 10730.

4.2 PAYMENT

A. Separate Payment will not be made for the work of this Section, complete in place. Payment for work covered in this section shall be made at the Contract Unit Price Lump Sum in accordance with section 10730 – Transit Shelters. All costs, therefore, shall be included in the Contract Lump Sum Price for the work as indicated herein. All preparation and incidental work necessary to accomplish the installation will be considered incidental to the Lump Sum price.

4.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
10730.1	SHELTER 1 – RIVER ST. SHELTER	(LS)

END OF SECTION

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