

TECHNICAL SPECIFICATIONS FOR McGRATH LOT SITE IMPROVEMENTS



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Eric D. Batista

City Manager
City of Worcester

John Odell

Chief, Dept. of Sustainability & Resilience

Prepared by:

BSC Group
1 Mercantile Street
Worcester, MA 01608

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SECTION 02 41 13
SITE PREPARATION AND DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.
- B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:
 - 1. Protection of existing site features to remain.
 - 2. Protection of existing trees to remain.
 - 3. Clearing, grubbing, and removal of plant material.
 - 4. Removal and disposal of site features within limit of work.
 - 5. Removal and disposal of existing pavement.
 - 6. Dust control.
 - 7. Removal and stockpiling topsoil.
 - 8. Removal and re-setting of granite curb

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Project Special Conditions and Specifications
- B. Section 31 25 00 Erosion and Sedimentation Control
- C. Section 100 Earthwork (for extent of excavation and backfilling operations)

1.03 SUBMITTALS

- A. Not Applicable.

1.04 CODES AND STANDARDS

- A. The Contractor shall perform demolition and clearing work in accordance with applicable rules, regulations, codes and ordinances of The City of Worcester, State and Federal Authorities, and in accordance with the requirements of public utility corporations having jurisdiction over the work.

1.05 PROJECT CONDITIONS

- A. See Project Special Conditions and Specifications

1.06 EXISTING SERVICES

- A. See Project Special Conditions and Specifications.

1.07 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be stockpiled, relocated, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed by the Contractor from the site and disposed of in a legal manner.
- B. Historical items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, monuments, antiques, and other items of interest or value to the Owner, which may be encountered during site preparation, remain the Owner's property. The Contractor shall carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

1.08 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:
 - 1. The Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, supplementous latest edition.
 - 2. AASHTO: American Association of State Highway and Transportation Officials, latest edition.
 - 3. ASTM: American Society of Testing and Materials, latest edition.
 - 4. ADA: Americans with Disabilities Act, latest edition.
 - 5. ABB: Architectural Barriers Board, Commonwealth of Massachusetts Regulation 521 CMR, latest edition.
 - 6. City of Worcester Standard Specifications and Details for Public Works projects.

PART 2 - PRODUCTS

2.01 DUST CONTROL

- A. Acceptable materials for dust control use shall consist of the following or equivalent thereof:
 - 1. Potable water
 - 2. Calcium chloride
 - 3. Hydroseeding
 - 4. Motorized street sweeper
 - 5. Plastic covering
- B. The Contractor shall not use oil or similar penetrants.

PART 3 - EXECUTION

3.01 GENERAL

- A. See also Project Special Conditions and Specifications.
- B. Before commencing Site Preparation work, the Contractor shall meet with the Owner's representative in order to discuss the procedures to be utilized. The Contractor shall be held responsible for any damage to all vegetation designated to remain. The Owner's representative will be the sole judge as to damage inflicted.
 - 1. The Owner's representative shall make the final determination of action required regarding any and all items indicated for removal, stockpiling, disposal, adjustment and protection.
- C. The work shall be conducted with prime consideration given to the following:
 - 1. Compliance with governing laws and building codes.
 - 2. Safety, protection, and convenience of the public and workers.
 - 3. Erosion control (in accordance with Section 31 25 00 Erosion and Sedimentation Control)
 - 4. Minimization of dirt and dust proliferation.
 - 5. Neat and accurate cutting and trimming of elements to be partially removed subject to the Owner's representative's approval.
 - 6. Avoidance of any damage to existing vegetation to remain

3.02 PROTECTION OF EXISTING CONDITIONS

- A. The Contractor shall provide protections necessary to prevent damage to existing park features indicated to remain in place. In the event of damage, he/she shall immediately make all repairs and replacements necessary to the approval of the Owner's Representative at no additional cost to the Owner.
 - 1. The Contractor shall protect improvements on adjoining properties and on Owner's property.

3.03 PROTECTION OF EXISTING VEGETATION

- A. The Contractor shall protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of tree roots by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.
 - 1. The Contractor shall provide protection for roots over 1-1/2 inch in diameter that are cut during construction operations. He/she shall temporarily cover exposed roots with wet burlap to prevent roots from drying out, and cover with earth as soon as possible. The Contractor shall notify the Owner's representative immediately upon damage incurred during

the course of construction.

2. The Contractor shall repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to the Owner's representative. The Contractor shall employ a licensed arborist to repair damage to trees and shrubs.
3. Existing trees to be saved within or outside the limit of work line which have, in the opinion of the Owner's representative, become damaged, shall be assessed at \$300 per caliper inch and deducted from the Contract amount. Existing shrubs, vines, and groundcover indicated to be saved which have, in the opinion of the Owner's representative, become damaged, shall be replaced with plants of equal size by the Contractor.
 - a. All expenses of removal and replacement incurred shall be paid by the Contractor without additional cost to the Owner. The Contractor shall remove these plants according to the Specification requirements for removals, grub out and remove the stumps, and repair the ground surface.

3.04 DUST CONTROL

- A. The Contractor shall apply dust control materials to minimize raising dust from construction operations, and provide positive means to prevent air-borne dust from dispersing into the atmosphere. He/she shall maintain dust control at all times throughout the construction period. Control measures will be required in all areas as well as for stockpiles, temporary traffic ways, and all other areas where dust may develop.
- B. Dust control procedures shall be monitored by the Owners representative and shall be subject to on-site review by Authorities having jurisdiction.
- C. Site preparation and earthwork may be halted by the Owner's representative as deemed necessary should dust control procedures prove inadequate.
- D. The Contractor shall clean all soil and debris from wheels of all construction vehicles and cover earth loads prior to leaving the construction site.
- E. All streets, driveways, and sidewalks shall be swept daily or as required to prevent dust being a public nuisance.

3.05 CLEARING, GRUBBING, AND REMOVAL OF PLANT MATERIAL

- A. The Contractor shall accept the site as he/she finds it and shall remove and legally dispose off site all plants designated for removal and all debris, organic matter, and objectionable material which is not suitable at no additional cost to the Owner. No burning shall be allowed on site.
- B. Clearing and Grubbing: The Contractor shall clear site of all vegetation indicated to be removed by the Drawings as follows.
 1. The Contractor shall completely remove all stumps and roots to the following minimum depths:
 - a. Eighteen (18) inches below existing ground level for shrubs
 - b. Three (3) feet below existing ground level for trees.

2. The Contractor shall use only hand methods for grubbing inside drip line of trees indicated to remain.
3. The Contractor shall cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
4. Unless further excavation is required, the Contractor shall fill depressions caused by clearing and grubbing operations with Ordinary Borrow material.
 - a. The Contractor shall place borrow material in horizontal layers not exceeding six (6) inches loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.

3.06 TOPSOIL STRIPPING AND STOCKPILING

- A. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than four (4) inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over one (1) inch in diameter, and without weeds, roots, and other objectionable material.
 1. The Contractor shall strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
 - a. Topsoil excavation and stockpiling shall consist of disking and harrowing grassed areas at ninety (90) degrees to each prior operation, and removing topsoil from all areas of proposed work, screening it and storing in approved topsoil stockpiles to ensure organic matter decomposition.
 - b. Where existing trees are indicated to remain, the Contractor shall leave existing topsoil in place within drip lines to prevent damage to root system.
 2. The Contractor shall stockpile topsoil in storage piles in areas as directed by the Owner's representative. The Contractor shall construct storage piles to provide free drainage of surface water; cover storage piles to prevent erosion; and install coir logs around entire perimeter.
 3. The Contractor shall remove unsuitable or excessive topsoil and dispose of legally at no additional cost to the Owner.

3.07 REMOVAL OF EXISTING PAVEMENT

- A. See Project Special Conditions and Specifications.

3.08 REMOVALS (GENERAL)

- A. All items to be removed shall include, but are not limited to, those items as indicated on the Site Preparation Plan.
 1. The Contractor shall be responsible for storing items designated to be relocated, and shall also be responsible for preventing damage to or theft of stored items.

2. The Contractor shall be responsible for delivering all items designated to be salvaged to a designated area at the Public Works and Parks Department headquarters facility at Greenhill Park and/or as directed by the Owner's representative.
 3. All other removed items that are not to be stored for relocation or delivered to Owner shall be the property of the Contractor and shall be disposed of by the Contractor in a legal manner.
- B. The Contractor shall demolish and remove all items necessary, in their entirety, to complete the work as indicated on the Drawings. The Contractor shall use methods required to complete work within limitations of governing regulations and as follows:
1. Dispose of demolished items and materials promptly off site in a legal manner.
 - a. The Contractor shall not allow demolished materials to accumulate on-site.
 - b. Burning on Owner's property is not permitted.
 - c. On-site storage or sale of removed items is prohibited.
 2. The items to be removed shall include all associated footings, accessories, and hardware when applicable.

3.09 PATCHING AND REPAIRS

- A. The Contractor shall promptly patch and repair holes and damaged surfaces caused to adjacent areas by selective demolition and site preparation operations.

3.10 GENERAL CLEAN-UP

- A. The Contractor shall remove from the site all trash, litter, and debris and leave the site in a neat and orderly condition on a daily basis and to the satisfaction and approval of the Owner's representative.
- B. The Contractor shall provide street sweeping as directed by the Owner's representative.

END OF SECTION 02 41 13

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

- A. Provide all labor, equipment, materials and perform all operations necessary to complete all reinforced and plain concrete work, including form work, reinforcement, concrete mixing, placing, finishing and curing necessary to complete the work of this project as indicated within the drawings and specified herein which shall include but is not limited to the following:
 - 1. Footings for park furnishings, fencing, curbs, and similar items.
 - 2. Furnishing and installation of joint fillers and sealers.
- B. Related Work: The following sections contain requirements that relate to the section.
 - 1. Division 2 Section 31 00 00 "Earthwork" for excavation and backfilling operations.
 - 2. Division 2 Section 12 93 00 "Site Improvements".

1.03 QUALITY ASSURANCE

- A. Codes and Standards: Unless otherwise noted, or as modified by more stringent requirements specified herein, all plain and reinforced concrete work shall be performed in full compliance with applicable requirements of the most recent edition of the following codes and recommendations:
- B. American Concrete Institute (ACI)
 - 1. ACI 304 - Recommended Practice for Measuring, Mixing, Transportation and Placing Concrete.
 - 2. ACI 305 - Recommended Practice for Hot Weather Concreting.
 - 3. ACI 306 - Recommended Practice for Cold Weather Concreting.
 - 4. ACI 315 - Manual of Standard Practice for Detailing Concrete Structures.
 - 5. ACI 347 - Recommended Practice Concrete Formwork.
- C. American Society for Testing and Materials (ASTM): Listed Standards
 - 1. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
 - 2. ASTM A615 - Deformed and Plain Billet Steel for Concrete Reinforcement.
 - 3. ASTM C33 - Concrete Aggregates.
 - 4. ASTM C94 - Ready-Mix Concrete.
 - 5. ASTM C143 - Slump Test for Portland Cement Concrete.
 - 6. ASTM C150 - Portland Cement.
 - 7. ASTM C171 - Sheet Materials for Curing Concrete.
 - 8. ASTM C260 - Air Entraining Admixtures for Concrete.
 - 9. ASTM C309 - Liquid Compounds for Curing Concrete.

1.04 SUBMITTALS

MC GRATH LOT LANDSCAPE PREPARATIONS
WORCESTER, MASSACHUSETTS

- A. ~~Provide shop drawings for fabricating and placing reinforcing steel. Show all required information for cutting, bending and placing reinforcing bars, and show all accessories and support bars on placing drawings. Indicate suitable marks for placing bars. Not included~~
- B. Fabrication of any material or performing of any work prior to the final approval of the shop drawings will be entirely at the risk of the Contractor.
- C. The Contractor is responsible for furnishing and installing materials called for in Contract Documents, even though these materials may have been omitted from approved shop drawings.

1.05 TESTING, CONTROL AND INSPECTION

- A. The Contractor shall retain the services of a qualified testing agency, approved by the Owner, to test aggregate and to prepare mix design for each strength and type of concrete specified; and shall submit such mix designs and test results to the Owner for approval. The costs of all such preliminary services shall be borne by the Contractor. All other testing and inspection will be selected by the Owner and shall be paid directly by the Owner.
- B. A qualified testing agency for such other testing and inspection will be selected by the Owner and shall be paid directly by the Owner.
- C. Cooperate fully with the testing agencies work in taking and storing samples. Provide storage facilities for concrete cylinders at the site. Facilities must protect cylinders from effect of low or high temperatures.
- D. Accept as final results of tests made by the qualified professional testing organization engaged by the Owner.
- E. Testing required because of changes requested by the Contractor in materials, sources of materials, or mix proportions; and extra testing of concrete or materials because of failure to meet the Specification requirements are to be paid for by the Contractor.
- F. Advise the Testing Agency of intent to place concrete by notification at least twenty (24) hours prior to time of placement.
- G. All materials, measuring, mixing, transportation, placing and curing shall be subject to inspection by the Engineer or by the Testing Agency. However, such inspection, wherever conducted, shall not relieve the Contractor of his responsibility to furnish materials and workmanship in accordance with the Contract requirements, nor shall inspector's acceptance of material or workmanship prevent later rejection of same by the Owner or Engineer, if defects are discovered. Structural tests and inspections shall conform to Chapter 17 of the Massachusetts State Building Code, Sixth Edition.
- H. Contract requirements, nor shall acceptance of material or workmanship prevent later rejection of same by the Owner or Engineer if defects are discovered.

1.06 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with applicable provisions and recommendations of the following:
 - 1. Standard Specifications and Details: City of Worcester, Department of Public Works and Parks Engineering Division.
 - 2. Standard Specification: Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, supplemental specifications latest edition.

3. ASTM: American Society of Testing and Materials, latest edition.

PART 2 - PRODUCTS

2.01 CONCRETE

- A. Portland Concrete: ASTM C-150 Type II.
- B. Natural Aggregates:
1. Fine Aggregates for Concrete: Shall be natural sand consisting of clean, hard, durable, uncoated particles, conforming to ASTM C33. Organic content shall be determined according to ASTM C40, and supernatant liquid above test sample shall show color no darker than reference standard color solution prepared at same time. Allow no frozen or partially frozen aggregate in the mix.
 2. Coarse Aggregate for Concrete: For regular weight concrete use crushed stone or gravel from approved source conforming to ASTM C33. For lightweight concrete (115 pcf), use materials conforming to ASTM C330. Coarse aggregate shall not contain greater amounts of deleterious materials than specified in Table II, ASTM C33.
- C. Water: Shall be from approved source, potable, clean, and free of oils, salt, alkali, organic matter and other deleterious material.
- D. Admixtures:
1. Water Reducing Agent ASTM C494, Type A: WRDA by W.R. Grace Co. or equal approved by the Engineer. Water-reducing agent must be by same manufacturer as air-entraining agent.
 2. Air-entraining agent ASTM C260: Darex by W.R. Grace Co., or equal approved by the Engineer. Air-entraining agent must be by the same manufacturer as water-reducing agent.
- E. Concrete Reinforcement:
1. Reinforcing steel shall conform to ASTM Specification A-615 grade 60, deformed bars.
 2. Welded wire fabric shall conform to ASTM Specifications A-185. Supply in flat sheets.
 3. Bar supports, metal accessories and other devices necessary for proper assembly of concrete reinforcing shall be of standardized factory-made wire bar supports. Wire for tying shall be 18 gauge black annealed wire conforming to ASTM Specification A-82.
- F. Formwork:
1. Forms: Formwork material shall be exterior plyform Class 1, B-B or as approved by the Engineer, not less than 5/8 in. thick.
 2. Form Oil: Oil shall be of a non-staining type, specifically manufactured for concrete forms.
 3. Form Ties: Factory-fabricated, removable or snap back, of approved design. Wire shall be at least 1-1/2 in. back from surfaces.
 4. Design Criteria:
 - a. Design, construct, erect, support, brace, maintain and remove forms to comply with ACI

318 parts, 1, 2 and 3.

- b. Comply with ACI 347 for loads, lateral pressures and allowable stresses and include wind loads.
- G. Non-shrink Grout: Shall be Embeco 885" by Master Builders, SonogROUT by Sonneborn Building Products, Five Star Grout by U.S. Grout Corporation, or equal approved by the Engineer.
- H. Sleeves: Shall be standard weight steel pipe conforming to ASTM A53.
- I. Chemical surface sealer/hardener for concrete: Shall be Home Clear Seal by A.C. Horn Company, Kure-N-Seal by Sonneborn Building Products, Division of Contech, Inc. or approved equal chlorinated rubber base material at 22% solids. The material shall be applied both in accordance with the Manufacturers recommendations for a curing compound on the wet concrete and as a hardener on fully cured concrete just prior to the occupancy.
- J. Concrete curing membranes shall be:
 - 1. White polyethylene sheeting 4 mils thick, ASTM C171; or
 - 2. Waterproof paper, Sisalkraft Type, ASTM C171-69; or
 - 3. Liquid membrane curing compound of resin or latex bases liquid conforming to ASTM C309 Type I, Class A except for surfaces to be covered with other surfacing materials, the compound shall be compatible with the adhesive to be used.
- K. Joint Filler: Where used with caulking or sealants shall be non-extruding, self-expanding filler strips conforming to ASTM D1752, Type II, as manufactured by Celotex Corporation, W.R. Meadows, Inc. W.R. Grace Company, or equal approved by the Engineer. Where no sealant or caulking is required, strips may be non-extruding bituminous type in accordance with ASTM D1751.
- L. Control joints: For slab-on-grade construction shall be formed using Zip-Cap Control Joint Formers #832 as manufactured by Greenstreak Plastic Products Company, or approved equal. At construction joints provide keyed bulkheads plus Transverse Control Joint Formers #852 as manufactured by Greenstreak Plastic Products Company, or approved equal. 1/8" x 1 1/4" saw cut control joints with joint sealant May be used as an alternate to the above products.
- M. Liquid chemical hardener for concrete shall be Hornolith by A.C. Horn Company; Surfhard by Euclid Chemical Company, or approved equal zinc and/or magnesium silicofluoride with penetrating agent. The material shall be applied in accordance with the manufacturers written recommendations and shall be compatible with curing techniques.

2.02 CONCRETE MIXES FOR CAST-IN-PLACE CONCRETE

A. Strength, cement and water requirements

Design Comp. Str. fc	Min. Lab. Str. Testing Age <u>7 Days 28 Days</u>	Min. Cem.Fac. <u>Sacks/cu.yd.</u>	Maximum Net Water* <u>Gal/sack cem.</u>
4000 psi	3300 psi 4670 psi	6.5	5.5

* This is a total water in mix at time of placement, including free water of aggregates and liquid mixtures.

- B. Air-entraining and water-reducing agents shall be used in all concrete in strict accordance with the manufacturers printed instructions. Total air entrained in freshly-mixed concrete shall be 5.0% plus or

minus 1.0% of volume of concrete.

- C. Slump of concrete:
 - 1. Slabs-on-grade and footings: 3 inches +/- 1 inch.
 - 2. Other elements: 4 inches +/- 1 inch.
- D. Premix admixtures in solution form and dispense as recommended by the manufacturer. Include the water in the solution in the design water content of the mixtures.

PART 3 EXECUTION

3.01 STORAGE OF MATERIALS

- A. All materials shall be stored to prevent damage from the elements and other causes.
- B. Cement and aggregates shall be stored in such a manner as to prevent deterioration or intrusion of foreign mater. Any materials which have deteriorated, or which have been damaged, shall not be used for concrete.
- C. Store reinforcement steel on wood skids to prevent it from weather, oil, earth and damage from trucking or other construction operations. Reinforcement shall be free from loose mill scale, rust, form oil, concrete splatter and other extraneous coatings at the time it is embedded in the concrete.

3.02 FORMING FOR CAST-IN-PLACE CONCRETE

- A. Acceptable tolerance shall be as specified in ACI Standard 247, Recommended Practice for Concrete Formwork.
- B. Forms shall be constructed to conform to shapes, lines, and dimensions shown, plumb and straight, and shall be maintained sufficiently rigid to prevent deformation under load. Forms shall be sufficiently tight to prevent the leakage of grout. Securely brace and shore forms to prevent the leakage of grout. Securely brace and shore forms to prevent their displacement and to safely support the construction loads.
 - 1. Form and set all sleeves, box outs and passages as required for all existing and proposed utilities and as directed by the owner's representative.
- C. Treat forms with a form release agent applied according to the manufacturer instructions, by roller, brush or spray to produce a uniform thin film without bubbles or streaks. Apply the release agent in two coats for the first use of the form and in one coat for each additional use.
- D. ACI-301-89, Section 13.3- Forms, is also hereby made a part of this Specification.

3.03 MIXING PROCESS FOR CAST-IN-PLACE CONCRETE

- A. Ready-mixed concrete shall be mixed and transported in accordance with Specification for Ready-Mixed Concrete ASTM C94, Alt No. 3 and ACI STANDARD 304, Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

3.04 REINFORCING FOR CAST-IN-PLACE CONCRETE

A. ACI 301-89, Specification for Structural Concrete for Buildings, Chapter 5 - Reinforcement, is hereby made a part of this Section.

B. Reinforcement

1. Comply with ACI 318 standards for detail and method of placing reinforcement and supports.
2. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
3. Place, support, and secure reinforcement against displacement.
4. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
5. Place reinforcement to obtain proper coverage for concrete protection in accordance with A.C.I. standards.
6. Arrange, space, and securely tie bars and bar supports together with the specified tie wire.
7. Set wire ties so twisted ends are directed away from exposed concrete surfaces.
8. Install welded wire fabric in as long lengths as practicable, lapping adjoining pieces at least one full mesh.
9. Where lap splices are used, tie securely with specified wire to prevent displacement of splices during placement of concrete.
10. Accommodate placement of formed openings.
11. After reinforcement has been placed and tied together, notify the Engineer for inspection before pouring concrete.

3.05 JOINTS FOR CAST-IN-PLACE CONCRETE

- A. ACI 301-89, Specifications for Structural Concrete for Buildings, Sections 6.1, 6.2 and 6.3 are hereby made part of this Specification.
- B. Construction joints shall be formed with keyed bulkheads.
- C. Control joints shall be as shown on the drawings.
- D. Control joints shall be formed using Zip-Cap control joint (Model 832) and Transverse control joint (Model 852) by Greenstreak Plastic Products Company or approved equal. Installation shall be in strict accordance with the manufacturer recommendations. Note that reinforcing steel must have a gap at the joints. Saw cut control joints with joint sealant may be used as an alternative to Zip Cap and Transverse joint formers.

3.06 INSTALLING EMBEDDED ITEMS

- A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

3.07 PLACING OF CAST-IN-PLACE CONCRETE

- A. Do not place concrete until reinforcing steel, inserts, sleeves and other work to be built into the concrete have been inspected and approved by the Owners Representative and by all other trades concerned.
- B. In hot weather, all concreting shall be done in accordance with ACI 305, Recommended Practice for Hot Weather Concreting.
 - 1. When temperature rises above 70 degrees F., all surfaces of concrete shall be protected against rapid drying.
 - 2. Concrete delivered to the forms shall have a temperature of not over 90 degrees F.
 - 3. The temperature of the forms shall not be over 90 degrees F.
- C. In cold weather, all concreting shall be done in accordance with ACI 306, Recommended Practice for Cold Weather Concreting.
 - 1. When the average daily temperature falls below 40 degrees F., all surfaces of concrete shall be maintained at a temperature of at least 50 degrees F, and not over 90 degrees F, for seven (7) days.
 - 2. Concrete delivered to the forms shall be at least 60 degrees F., and not over 90 degrees F.
 - 3. The temperature of the forms shall be at least 40 degrees F.
 - 4. The Contractor shall maintain a record of temperature of the concrete at the most exposed surfaces of each placement at the beginning and at the end of each day of the curing period, which record shall be available to the Engineer.
- D. Conveying: Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent separation or loss of ingredients and in a manner which will assure that the required quality of the concrete is retained.
- E. Depositing: Delivery and placement of concrete shall be programmed so that time lapse between batching and placement shall not exceed 1-1/2 hours. Concrete shall not be allowed a free fall of over 4 feet. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing.
- F. Concrete shall be deposited continuously, in horizontal layers of such thickness (not deeper than 18 inches) that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. Placing shall be carried out at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened or which has been contaminated by foreign materials shall not be deposited.
- G. Concrete shall be compacted thoroughly by vibrating to produce a dense, homogeneous mass without voids or pockets. Vibrators should be placed in concrete so as to penetrate approximately 3 inches to 4 inches into the preceding lift so as to blend the two layers. Vibrating techniques must assure that, when the coarse aggregate reaches the form, it stops and the matrix fills the voids.
- H. Patching: Areas to be patched shall not exceed 1.5 square feet for each 1000 square feet of surface area. Patches shall match in every respect the color and texture of the surrounding surfaces. Mix formulation shall be determined by trial to obtain a color match when both the patch and surrounding concrete are cured and dry. After initial set, surfaces of patches shall be textured manually to obtain a match with the surrounding surfaces. All patching are subject to the Owner Representative final acceptance as to appearance and quality. At holes formed by withdrawal of ends of steel snap-ties,

wet and pack solid with patching mortar. Smooth out projections and fins with wet carborundum stones or power grinders. All voids, honeycombs and air pockets shall be patched.

- I. Concrete surfaces exposed to view and as directed by the Engineer in the finishing walls shall receive a smooth rubbed finish. Such elements include, but are not limited to, exposed portions of foundation walls and other exposed walls. Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than created by the rubbing process.

3.08 CURING AND PROTECTION

- A. Protect newly placed concrete against low and high temperature effects and against rapid loss of moisture. Moist cure all concrete for at least seven days at a temperature of at least 50 degrees F. by curing methods approved by the Engineer.
- B. For vertical or near-vertical surfaces, moist cure by keeping the form in contact with the concrete, or by other effective means approved by the Owners Representative. Intermittent wetting and drying does not provide acceptable curing.
- C. The contractor may submit for the approval of the Owners Representative alternative methods of curing non-exposed concrete surfaces. Approval of alternatives shall not relieve the Contractor of his responsibility for the proper curing of all concrete.
- D. In hot weather, be adequately prepared to protect the concrete from the adverse influence of heat before the placement of any concrete. Take special precautions to avoid cracking of the concrete from rapid drying during placement of concrete when air temperature exceeds 70 degrees F., partially when the work is exposed to direct sunlight.
 - 1. Cool forms by fog with water or by protecting them from the direct rays of the sun.
 - 2. If requested by the Contractor, deemed advisable by the Testing Engineer, and approved by the Owner Representative, a retardant may be used to delay the initial set of the mix.
- E. In cold weather, be adequately prepared to protect the concrete from the adverse influence of cold before placement of any concrete.
 - 1. When the average daily temperature falls below 50 degrees F., take special precautions to assure adequate strength gain of the concrete.
 - 2. When the average daily temperature falls below 40 degrees F., prepare concrete with heated materials such that the concrete delivered to the forms shall have a temperature of at least 60 degrees F., and not over 90 degrees F. Prewarm the forms to at least 40 degrees F., to prevent the rapid cooling of the concrete by their contact; keep forms free of all ice and snow. When heated materials are being used, combine the water with the aggregate in the mixer and keep the resulting temperature below 90 degrees F. before cement is added to the mix. Protect all concrete by the use of heated enclosures which must be sufficiently strong and windproof and within which adequate heaters are properly distributed to maintain all concrete at the required temperatures. Do not allow heaters to locally heat or dry the concrete and do maintain adequate fire precautions.

3.09 ACCEPTANCE

- A. When the tests on control specimens of concrete fall below the required strength, the Owners Representative shall have the right to require, at the Contractors expense, mix redesign, load tests and/or strengthening as directed and/or removal and replacement of those parts of the structure in which such concrete was used.

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WORCESTER, MASSACHUSETTS

3.10 CLEANING

- A. The exposed faces of the cast-in-place concrete shall be cleaned of all stains , water marks, and leaked fines.

END OF SECTION 03 30 00

**SECTION 31 23 10
EARTHWORK**

Part 1 - GENERAL

1.01 DESCRIPTION

- A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.
- B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:
 - 1. Excavation of all existing material for site improvements to the depth required in the plans and specifications to meet the required lines and grades.
 - 2. Providing, placing, and grading all specified compost chip and related growing media fill materials at locations specified herein and/or indicated within the Drawings.
 - 3. Providing, placing, and compacting all other specified fill materials at locations specified herein and/or indicated within the Drawings.
 - 4. Excavating, and re-handling all existing topsoil excavated within the construction site for reuse on-site.
 - 5. Compaction of all disturbed and undisturbed surfaces which are to receive new foundations, footings, slabs, and other load-bearing elements, to ensure against any weak areas in the substrate.
 - 6. Performing all operations and providing such equipment as necessary to maintain excavated areas and to avoid the disturbance of the subgrade.
 - 7. Installation of sheeting, shoring, and bracing; and protection of adjacent properties, streets utilities and structures as may be required due to the earthwork performed.
 - 8. Rough and fine grading.
 - 9. Dust control.
- C. The Contractor shall legally dispose off-site all the excess excavated material originating from the construction of this site.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions
- B. Section 02 41 13 Site Preparation and Demolition

1.03 DEFINITIONS

- A. Excavation consists of the removal of material encountered to sub-grade elevations and the reuse or disposal of materials excavated.
- B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Owner's representative. Unauthorized excavation, as well as remedial work directed by the Owner's representative, shall be at Contractor's expense.
 - 1. The Contractor shall backfill and compact unauthorized excavations with structural fill as specified for authorized excavations, unless otherwise directed by the Owner's representative.
- C. Additional Excavation consists of the removal of material as directed by the Owner's representative beyond the required subgrade that is determined as unsuitable. The Contractor shall continue excavation until suitable bearing materials are encountered. If unsuitable materials are removed that aren't indicated on the Drawings, the Contract Sum shall be adjusted by an appropriate Contract Modification. The following constitute unsuitable materials:
 - 1. Topsoil and loam (beneath areas to received pavement)
 - 2. All peat, organic soil, or soil containing sod, roots, or any other material subject to decomposition or decay.
 - 3. All soft, spongy or compressible soil, including, but not limited to, silt and loose fine sand.
 - 4. All buried building material, which may include but is not limited to the following:
 - a. Concrete rubble
 - b. Re-bars
 - c. Asphalt
 - d. Electrical materials and debris
 - e. Wood
 - f. Brick, block, tile (ceramic/quarry)
 - g. Pipe
 - h. Ashes
 - i. Metal pieces/parts
 - j. Insulation
- D. Sub-grade: The undisturbed earth or the compacted soil layer immediately below granular sub-base.
- E. Structure: Foundations, footings, slabs, or other man-made stationary features.
- C. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.04 SUBMITTALS (Not applicable)

1.05 QUALITY ASSURANCE

- A. Codes and Standards: The Contractor shall perform earthwork complying with all local and state regulations, laws, and ordinances and with requirements of authorities having jurisdiction.
- B. Testing and Inspection Service: The Contractor shall coordinate and submit all tests as specified herein.
 - 1. Owner's Responsibility: The Owner, at his option, shall employ a qualified geotechnical testing agency to verify that soils comply with specified requirements and to perform required field and laboratory testing for the following:
 - a. Field in-place density tests
 - b. Optimum moisture-maximum density curve for each type of soil encountered
 - c. Bearing tests
- C. Pre-Installation Conference: The Contractor shall conduct conference at Project site to comply with requirements of Special Conditions Section "Project Meetings".
 - 1. Before commencing earthwork, the Contractor shall meet with representatives of the governing authorities, Owner, Consultants, and other concerned entities. The Contractor shall review earthwork procedures and responsibilities including testing and inspection procedures and requirements. The Contractor shall notify participants at least three (3) working days prior to convening conference. The Contractor shall record discussions and agreements and furnish a copy to each participant.
- D. Experience: The Contractor or Sub-Contractor shall have a minimum of five (5) years of experience installing root zone mix based athletic fields of similar size and quality of this project.

1.06 PROJECT CONDITIONS

- A. The Contractor shall fully inform himself of existing conditions both surface and sub-surface before submitting his bid, and shall be fully responsible for carrying out all site work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. No claim for additional compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed. The Owner shall not be responsible for interpretations or conclusions drawn from data or interpretations by the Contractor.
 - 1. Test borings and other exploratory operations may be performed by Contractor, at the Contractors option; however, no change in the Contract Sum will be authorized for such additional exploration.
 - 2. The Contractor may assume that excavated material from on-site shall conform to the requirements specified as Ordinary Borrow and be approved for on-site construction where indicated on the Drawings or specified herein.
- B. Existing Utilities
 - 1. All locations of existing utilities shown on the plan have been developed from existing utility

records and/or above ground inspection of the site. Completeness or accuracy of locations or depth of underground utility or structures cannot be guaranteed. The Contractor shall verify the location and depth of all underground utilities or structures prior to the start of work.

2. Locate all existing underground utilities in areas of excavation work. Disconnect, seal and/or protect, as required, all existing utilities, including but not limited, to water, gas, sewerage, storm, electrical, and telephone in accordance with the regulations concerned. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
 - a. The Contractor shall be responsible for all on-site coordination with utility companies and public agencies and for obtaining all required permits and paying all required fees. In accordance with M.G.L., Chapter 82, Section 40, including amendments; the Contractor shall notify all utility companies and government agencies in writing prior to such excavation, (exclusive of Saturday, Sundays and Holidays). The Contractor shall also call "Dig Safe" at 1(888) 344-7233 no less than 72 hours prior to such excavation.
 - b. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, the Contractor shall consult utility owner immediately for directions. The Contractor shall cooperate with Owner and utility companies in keeping respective services and facilities in operation. The Contractor shall repair damaged utilities to satisfaction of utility owner.
 - c. The Contractor shall not interrupt existing utilities servicing facilities occupied by Owner or others, during occupied hours, except when permitted in writing by the Owner's representative and then only after acceptable temporary utility services have been provided.
 - d. The Contractor shall provide a minimum of forty-eight (48) hours notice to the Owner's representative, and receive a written notice to proceed, before interrupting any utility.
 - e. The Contractor shall place markers to indicate location of disconnected services. The Contractor shall also identify service lines and capping locations on Project Record Documents.

C. Use of Explosives: Use of explosives is not permitted.

D. Protection of Persons and Property:

1. The Contractor shall barricade open excavations occurring as part of this work and post with warning lights. He/she shall operate the warning lights as recommended by authorities having jurisdiction.
2. The Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
3. The Contractor shall perform excavation by hand within dripline of large trees to remain. He/she shall protect root systems from damage or dryout to the greatest extent possible. He/she shall maintain moist conditions for root system and cover exposed roots with moistened burlap.

- E. Adjoining Properties: No construction work, temporary or permanent, shall take place on adjoining properties. The Contractor shall be fully responsible for monitoring and maintaining that no construction activities trespass onto adjoining properties for the duration of the Contract.

1.07 BENCH MARKS, LINES, AND GRADES

- A. The Contractor shall engage a professional engineer or land surveyor, registered in the Commonwealth of Massachusetts, and submit the name, address and registration number of such persons to the Owner's representative for approval to perform the following work:
1. Furnish all stakes, pins, and grade markings, and lay out all lines and grade work, required to implement the work in accordance with Drawings.
 2. Establish permanent bench marks, maintain all established bounds and bench marks, and replace as directed any which are destroyed or disturbed.
 3. Establish all lines and vertical and horizontal alignment grades for the work and verify all locations, property lines, work lines, and other dimensioned points indicated on the Drawings for the existing site.
 4. Submit to the Owner's representative a written confirmation of locations of all lines, and any discrepancies between conditions and locations as they actually exist and those indicated on the Drawings. Such confirmation shall bear the engineer's or surveyor's registration stamp.
- B. The Contractor shall inform the Owner's representative when the general layout is completed and shall not begin excavation until the various alignments are approved. Any discrepancies encountered in field conditions shall be reported to the Owner's representative immediately.

1.08 WORK IN THE PUBLIC WAYS

- A. The Contractor shall notify the appropriate municipal officials at least seven (7) calendar days in advance of commencing any work in the public ways. The Contractor shall pay for and obtain all required permission and permits to perform this work. The Contractor shall perform all work in the public ways in a manner required by the municipal authorities.
- B. Should there be any conflict between requirements specified in the Contract Documents and those of the municipal authorities, the municipal requirements shall govern.
- C. The Contractor shall not close or obstruct any streets or sidewalks unless and until they have been discontinued by the appropriate municipal authority or unless and until the Contractor shall have first secured all necessary or other permits therefor. No materials whatsoever shall be placed or stored in the streets. The Contractor shall conduct all operations to interfere as little as possible with the use ordinarily made of roads, driveways, sidewalks, or other facilities near enough to the work to be affected thereby.
- D. The Contractor's attention is directed to the fact that the work on this project is to be performed in areas which are utilized by pedestrians as well as by vehicles. The Contractor shall be responsible for the installation of adequate precautions and other safety measures and controls deemed necessary by the authorities having jurisdiction, for the general public, and for his own personnel.

1. The Contractor shall without additional compensation be required to provide safe and convenient access during the execution of the work. Necessary areas for fire apparatus and other emergency vehicles shall be maintained at all times.

1.09 CODES AND STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:
 1. Standard Specifications and Details: City of Worcester, Public Works and Parks Department
 2. Standard Specification: Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, supplemental specifications latest edition.
 3. AASHTO: American Association of State Highway and Transportation Officials, latest edition.
 4. ASTM: American Society of Testing and Materials, latest edition.
 5. ADA: Americans with Disabilities Act, latest edition.
 6. ABB: Architectural Barriers Board, Commonwealth of Massachusetts Regulation Chapter 521 CMR, latest edition.

1.10 NOTIFICATION

- A. The Contractor shall notify the Owner in writing at least ten (10) days in advance of the time he intends furnishing Loam for sport field construction stating the location and amount of such deposit, the name and address of the supplier and also shall furnish such facilities, transportation and assistance as the Owner may require for collecting and forwarding samples.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

- A. Compacted Gravel Fill (See Special Conditions)
- B. Ordinary Borrow shall be well graded, natural inorganic soil, approved by the Owner's representative and meeting the following requirements:
 1. It shall be free of organic or other weak or compressible materials, of frozen materials, and of stones larger than six (6) inches maximum dimension.
 2. It shall be of such nature and character that it can be compacted to the specified densities.
 3. It shall be free from highly plastic clays, from all materials subject to decay, decomposition, or dissolution and from cinders or other material which will corrode piping or other metal.
 4. It shall have maximum dry density of not less than one hundred (100) pounds per cubic foot.

5. Material from excavation on the site may be used as ordinary fill if it meets the above requirements and is approved by the Owner's representative.
- C. Compost, Woody Compost, Leaf mulch compost. (Material provided by the Owner
- D. Excavated Materials: Material from on-site excavation may be utilized for Ordinary Borrow in locations indicated within the Drawings or specified herein if that material meets the specifications indicated within paragraph 2.1.E of this section. If sufficient suitable fill and backfill material is not available from excavations under the Contract, additional material, suitable for use, shall be brought to the site from other sources at no additional cost to the Owner.

2.02 GEOTEXTILE FABRIC

- A. Fabric shall be a non-woven polypropylene product with UV protection min. 6 oz./yd².

PART 3 - EXECUTION

3.01 PREPARATION

- A. The Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. The Contractor shall protect sub-grades and foundation soils against freezing temperatures or frost. He/she shall provide protective insulating materials as necessary.
- C. The Contractor shall provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. The Contractor shall provide tree protection as specified in Section 02 41 13 Site Preparation.

3.02 DUST CONTROL

- A. The Contractor shall refer to Section 02 41 13 Site Preparation for dust control requirements.

3.03 DEWATERING

- A. Upon entering the premises, the Contractor shall assume responsibility for site and subsurface drainage and maintain such drainage during the life of this Contract in a manner acceptable to the Owner's representative, at all times protecting and maintaining the existing conditions in adjacent areas. Presence of ground water in the soil shall not constitute a condition for which any increase may be made in the Contract Price.
- B. The Contractor shall prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding the project site and surrounding area.
- C. The Contractor shall protect subgrades and foundation soils from softening and damage by rain or free water accumulation.

- D. The Contractor shall legally remove by pumping, draining, or bailing all water which may accumulate or be found on the site within the Contract limits, where excavation and grading are to be done. The Contractor shall excavate and form all pump wells, sumps, dams, flumes, or other necessary works to keep excavations entirely clear of water. The Contractor shall protect newly-placed concrete and newly-constructed masonry from damage resulting from dewatering work, by the use of canvas, tarpaulins, or by such other sufficient method as the Owner's representative may approve. The Contractor shall maintain at all times upon the work sufficient and satisfactory pumping machinery, including standby equipment. The Contractor shall provide pump wells or well points and under drains as may be required, where needed to properly handle the water. The final approved trimming excavation shall not be done until the Owner's representative has approved the manner of dewatering. The Contractor shall maintain excavations free from water until all backfilling operations and new construction has been completed. The Contractor shall provide portable generator if temporary power is not available.
- E. The Contractor shall dispose of water from excavations in such a manner as will not (a) cause injury to persons, (b) endanger public health, (c) cause damage to public or private property, (d) cause damage to the work completed or in progress, and (e) cause any interference with the use of any area beyond the Limit Lines of this Contract.

3.04 EROSION CONTROL

- A. The Contractor shall install and maintain erosion control measures as indicated in Section 02 41 13 Site Preparation and shall do the following:
 - 1. Schedule the delivery and placement of fill materials, obtained from off-site sources, in a manner which will minimize the length of time such fill materials would be stored on site and subject to erosion.
 - 2. Limit new embankment slopes to three (3) horizontal to one (1) vertical, maximum unless indicated as steeper on plans.

3.05 FROST PROTECTION

- A. The Contractor shall not excavate to full indicated depth when freezing temperatures may be expected, unless footings or slabs can be poured immediately after the excavation has been completed. The Contractor shall protect the excavation from frost if placing of the concrete is delayed. Should protection fail, remove frozen materials and replace with concrete or gravel fill, as directed, at no cost to the Owner. Once footings or slabs are placed, protect same from frost.
- B. The Contractor shall keep the operations under this Contract clear and free of accumulations of snow as required to carry out the work.

3.06 SHEETING, SHORING AND BRACING AND PROTECTION

- A. The Contractor shall furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of the excavation and to prevent any movement of earth which could in any way diminish the width of the excavation below that necessary for proper construction, or otherwise injure or delay the work or endanger adjacent structure or personnel. If the Owner's representative is of the opinion that at any point sufficient or proper support has not been provided, he/she may order additional supports put in at the expense of the Contractor.

1. Prior to installation of sheeting, the Contractor and the Owner's representative shall notify and consult with adjacent residents who may be affected by vibrations caused by equipment installing the sheeting.
- B. Whenever possible, sheeting shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting will be driven. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled with sand and compacted.
- C. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing which the Owner's representative may direct him to leave in place at any time during the progress of the work, for the purpose for preventing injury to structure, personnel, utilities, or property at no additional cost. Timber or steel sheeting and bracing to be left in place shall be cut-off at least two feet below finish grade. This shall not constitute a waiver of the Contractor's responsibility to use his own judgment in where sheeting shall be left in place.
- D. All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger the construction or other structures. All voids left or caused by withdrawal of sheeting shall be immediately backfilled with approved material and compacted by ramming with tools especially adapted to that purpose, by watering, or otherwise as may be directed.
- E. The Contractor shall comply with local safety regulations or in the absence thereof, with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc.
 1. The Contractor shall submit sheeting and shoring design for review to the Owner's representative. The sheeting and shoring design shall be prepared by a professional engineer licensed in the Commonwealth of Massachusetts and in the employ of the Contractor.

3.07 EXCAVATION: GENERAL

- A. Classified Excavation: Excavation is classified and includes excavation to required sub-grade elevations indicated, regardless of character of materials and obstructions encountered. Excavation will be classified as earth excavation or rock excavation as follows:
 1. Earth Excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.
 - a. Intermittent drilling or ripping to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
 - b. All excavation shall be done with a backhoe whose bucket is equipped with a wedge plate across the teeth to provide a smooth bottom profile or equivalent equipment approved by the Owner's representative.
 2. Rock excavation in open excavations includes removal and disposal of materials and obstructions

encountered that 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 equivalent track-mounted loader, rated at not less than 210 HP flywheel power and developing minimum of 45,000-pound breakout force (measured in accordance with SAE J732).

3. Rock excavation for trenches includes removal and disposal of materials and obstructions encountered that cannot be excavated with a track-mounted power excavator, equivalent to Caterpillar Model No. 215C LC, and rated at not less than 115 HP flywheel power and 32,000-pound drawbar pull and equipped with a short stick and a 42-inch wide, short tip radius rock bucket rated at 0.81 cubic yard (heaped) capacity. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.
- B. Material, encountered in the excavation, to qualify as rock, must be two (2) cubic yards or more in undisturbed size in open excavation and in trenches. To be considered for classification as rock, material shall be any one of the following:
1. Rock, stone or shale (in original ledge) and all other material, including buried building foundations, which cannot be broken and removed by power excavation equipment and requires the use of drills.
 2. Boulders.
- C. When, during the progress of excavation, rock is encountered, uncover and expose the material, and notify the Owner's representative before proceeding further. Do not proceed with the excavation of material claimed as rock until the material has been classified by the Owner's representative. Failure on the part of the Contractor to uncover such material or notify the Owner's representative, and take cross-sections, will forfeit the Contractor's right-of-claim to any additional compensation or extension of time.
1. The Contractor shall employ qualified personnel, acceptable to the Owner's representative, to take cross-sections of rock three (3) feet on center before removal of same; and to provide computations of cross-sections.

3.08 STABILITY OF EXCAVATIONS

- A. Excavation of slopes shall be constructed to comply with all OSHA regulations and with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations. The Contractor shall notify the Massachusetts Department of Labor and Industries of the start of excavation work.

3.09 EXCAVATION FOR STRUCTURES

- A. The Contractor shall excavate to indicated elevations and dimensions as indicated within the Drawings within a tolerance of plus or minus 0.10 foot. He/she shall extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: The Contractor shall not disturb bottom of excavation. He/she shall excavate by hand to final grade just before placing concrete

reinforcement. He/she shall trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Mechanical or Electrical Appurtenances: The Contractor shall excavate to elevations and dimensions indicated on the Drawings within a tolerance of plus or minus 0.10 foot. He/she shall not disturb bottom of excavations intended for bearing surface.

3.10 EXCAVATION FOR WALKS AND PAVEMENTS

- A. The Contractor shall excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades, as indicated within the Drawings.

3.11 EXCAVATION FOR UTILITY TRENCHES

- A. The Contractor shall excavate trenches to indicated slopes, lines, depths, and below invert elevations as indicated in the Drawings.
- B. The Contractor shall excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. He/she shall excavate trench walls vertically from trench bottom to twelve (12) inches higher than top of pipe or conduit, unless otherwise indicated.
 1. Clearance: Twelve (12) inches each side of pipe or conduit.
- C. Trench Bottoms: The Contractor shall excavate and shape trench bottoms to receive bedding for pipes and conduit. He/she shall shape bedding to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. He/she shall remove stones and sharp objects to avoid point loading.
 1. Where rock is encountered, the Contractor shall excavate six (6") inches below required elevations and backfill with compacted gravel fill to required elevations.

3.12 APPROVAL OF SUBGRADE

- A. The Contractor shall maintain foundation excavations at least twelve (12) inches above design bearing level until final excavation immediately before footing construction, or placing fill. If footings will not be constructed within the same day as final excavation to subgrade level, a three (3) inch thick lean concrete mud slab shall be cast over the exposed bearing surface immediately after approval of the subgrade bearing surface by the geotechnical engineer.
- B. The Contractor shall notify the Owner's representative when excavations have reached required subgrade for inspection of conditions and approval to proceed with construction.
- C. If the Owner's representative determines that unforeseen unsuitable material is present, he/she may direct the Contractor to continue excavation until suitable bearing materials are encountered.
- D. The Contractor shall re-construct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner's representative, at no cost to the Owner.
- E. The Contractor shall not place fill material until the subgrade is approved by the Owner's

representative.

3.13 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation with structural fill material as directed by the Owner's representative. Flowable fill may be used to bring elevations to proper position when acceptable to the Owner's representative.
- B. Where indicated widths of utility trenches are exceeded, the Contractor shall provide stronger pipe, or special installation procedures, as required by Owner's representative at no additional cost to the Owner.

3.14 STORAGE OF SOIL MATERIALS

- A. The Contractor shall stockpile excavated materials approved as backfill materials, including acceptable borrow materials. He/she shall stockpile soil materials without intermixing. He/she shall place, grade, and shape stockpiles to drain surface water. He/she shall cover to prevent erosion and install siltation controls.
 - 1. The Contractor shall stockpile soil materials away from edge of excavations. He/she shall not store the materials within drip line of remaining trees.
 - 2. Intermixed stockpiles as determined and directed by the Owner's representative shall be re-tested by the Contractor for compliance to specified requirements or removed from site immediately, at no additional cost to the Owner.

3.15 PROOF COMPACTION

- A. The Contractor shall proof-compact the bottom of excavations or existing subgrade, as applicable. Proof compaction shall consist of making ten (10) passes with a ten ton vibratory roller or by a minimum of three (3) coverages from the rear wheel assembly of a fully loaded ten-wheel dump truck or by a minimum of three (3) coverages from the treads of a tractor dozer weighing at least 30,000 pounds and observing the subgrade for any soft or weaving areas.
 - 1. If, in the judgment of the Owner's representative, compaction of receiving surfaces is not required, or will disturb the natural soil, the subgrade compaction requirements will be waived.
- B. Prior to placing fill in trench areas, thoroughly compact the trench bottoms and fill all depressions to a smooth uniform surface.

3.16 PLACEMENT AND COMPACTION OF FILLS

- A. General: The Contractor shall backfill excavations as promptly as work permits, but not before completing the following:
 - 1. Acceptance by the Owner's representative of construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation.
- B. Coordinating drainage systems installation.

- C. Surveying locations of underground utilities for record documents.
 - 1. Testing, inspecting, and approval of underground utilities.
 - 2. Concrete formwork removal.
 - 3. Removal of trash and debris from excavation.
 - 4. Removal of temporary shoring and bracing, and sheeting.
 - 5. Removal of vegetation, topsoil, wet and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
- D. When sub-grade or existing ground surface to receive fill has a density less than that required for fill, the Contractor shall break up ground surface to depth required, pulverize, moisture-condition or aerate soil and re-compact to required density.
- E. The Contractor shall notify the Owner's representative when areas to receive fill are ready for inspection. All sub-grades to receive fill shall be compacted to a minimum ninety five (95) percent of maximum dry density beneath proposed foundations, slabs-on-grade, and paved parking areas and walkways. Unless otherwise noted within the Drawings or specified herein.
- F. The Contractor shall place approved fill materials in layers not exceeding six (6) inches compacted thickness and compact as specified below for various fill conditions.
- G. Placing Compacted Gravel Fill: The Contractor shall place Gravel Fill and compact to specified densities as indicated within the Drawings, and for all exterior site construction requiring filling and backfilling operations as a result of excavation operations and/or filling to required subgrades from existing grades.
- H. Placing Crushed Stone: The Contractor shall place Crushed Stone and compact to specified densities as indicated within the Drawings and/or specified herein.
- I. Placing Sand Borrow: The Contractor shall place Sand Borrow and compact to specified densities as indicated within the Drawings and specified herein.
- J. Placing Ordinary Borrow:
 - 1. Ordinary Borrow may be utilized, if approved by the Owner's representative, as fill and backfill material beneath pavements, structures, and lawn and planting areas.
 - 2. The Contractor shall place Ordinary Borrow and compact to specified densities as indicated within the Drawings and specified herein.
- K. Percentage of Maximum Dry Density Requirements: The Contractor shall compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557 and in place density in accordance with ASTM D 1556.
 - 1. Under structures and pavements, the Contractor shall compact the sub-grade and each layer of backfill or fill material at 95 percent maximum dry density.

2. Under walkways, the Contractor shall compact the subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
3. Under planting areas or unpaved areas, the Contractor shall compact the sub-grade and each layer of backfill or fill material at 90 percent maximum dry density.

3.17 UTILITY TRENCH BACKFILL

- A. The Contractor shall place bedding course on bearing surfaces and to fill unauthorized excavations. He/she shall shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits to spring line.
- B. The Contractor shall place concrete in backfill trenches that carry below or pass under footings and that are excavated within eighteen (18) inches of footings. He/she shall place concrete to level of bottom of footings.
- C. The Contractor shall provide 4-inch-thick concrete base slab support for piping or conduit less than 2'-6" below surface of roadways. After installation and testing, he/she shall completely encase piping or conduit in a minimum of four (4) inches of concrete before backfilling or placing roadway sub-base.
- D. The Contractor shall place and compact backfill material to a minimum height of twelve (12) inches over the utility pipe or conduit and as indicated within the Drawings.
 1. The Contractor shall carefully compact material and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- E. The Contractor shall coordinate backfilling with utilities testing.
- F. The Contractor shall fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- G. The Contractor shall place and compact final backfill of material to final sub-grade.
- H. The Contractor shall install warning tape directly above utilities, twelve (12) inches below finished grade, except six (6) inches below subgrade under pavements and slabs.

3.18 ROUGH GRADING

- A. General: The Contractor shall uniformly grade areas to a smooth surface, free from irregular surface changes. He/she shall comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. The Contractor shall provide a smooth transition between existing adjacent grades and new grades.
 2. The Contractor shall cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

- B. Site Grading: The Contractor shall slope grades to direct water away from buildings and to prevent ponding. He/she shall finish sub-grades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 0.10 foot.
2. Walks: Plus or minus 0.10 foot.
3. Pavements: Plus or minus 0.10 foot.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency Services: The Contractor shall allow testing agency to inspect and test each sub-grade and each fill or backfill layer. He/she shall not proceed until test results for previously completed work verify compliance with requirements.

1. The Contractor shall perform field in-place density tests according to ASTM D 1556 (sand cone method).
 - a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, the Contractor shall check the calibration curves furnished with the moisture gauges according to ASTM D 3017.
 - b. When field in-place density tests are performed using nuclear methods, the Contractor shall make calibration checks of both density and moisture gauges at beginning of work, on each different type of material encountered, and at intervals as directed by the Owner's representative.
2. Footing Sub-grade: At footing sub-grades, the Contractor shall perform at least one (1) test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing sub-grades may be based on a visual comparison of each sub-grade with related tested strata when acceptable to the Owner's representative.
3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, the Contractor shall perform at least one (1) field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.
4. Foundation Wall Backfill: In each compacted backfill layer, the Contractor shall perform at least one (1) field in-place density test for each 100 feet or less of wall length, but no fewer than two (2) tests along a wall face.
5. Trench Backfill: In each compacted initial and final backfill layer, the Contractor shall perform at least one (1) field in-place density test for each 100 feet or less of trench, but no fewer than two (2) tests.

- B. When testing agency reports that sub-grades, fills, or backfills are below specified density, the Contractor shall scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact and re-test until required density is obtained, at no additional cost to the Owner.

3.20 PROTECTION

- A. Protecting Graded Areas: The Contractor shall protect newly graded areas from traffic, freezing, and erosion. He/she shall keep these areas free of trash and debris.
- B. The Contractor shall repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or loosely compacted due to subsequent construction operations or weather conditions.
 - 1. The Contractor shall scarify or remove and replace material to depth directed by the Owner's representative; and shall re-shape and re-compact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, the Contractor shall remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
 - 1. The Contractor shall restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.
- D. All additional repairing, removing, and restoring work shall be completed at no additional cost to the Owner.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: The Contractor shall remove and legally dispose of surplus or excavated materials not required to complete construction, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 31 23 10

SECTION 31 23 19
DEWATERING AND DRAINAGE CONTROL

PART 1 GENERAL

1.01 DESCRIPTION

- A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.
- B. This Section specifies designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems and the requirements for control of surface water within the site.
- C. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:
 - 1. Control of surface water runoff to prevent flooding of excavations, trenches and adjacent properties, and the loosening and saturation of soils.
 - 2. Removal and disposal of subsurface water from excavations and trenches as required to lower and control water levels during construction.
 - 3. Provision of equipment and facilities to remove sediment and control the rates and volumes of disposal of surface and subsurface waters removed from the work areas.

1.02 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 02 41 13—Site Preparation and Demolition
 - 2. Section 31 23 19—Earthwork
 - 3. Section 31 25 00—Erosion and Sedimentation Control

1.03 DEWATERING SYSTEM REQUIREMENTS

- A. The Contractor shall design the dewatering systems to:
 - 1. Effectively reduce the hydrostatic pressure and lower the groundwater levels to a minimum of 2 feet below the bottom of excavations;
 - 2. Develop a substantially dry and stable subgrade for the proposed work;
 - 3. Prevent damage to adjacent properties, buildings, structures, utilities and other facilities;
 - 4. Ensure that, after 12 hours of initial pumping, no soil particles will be present in the discharge.
- B. The Contractor shall locate dewatering facilities where they will not interfere with utilities and construction work to be done by others.

- C. The Contractor shall modify dewatering equipment and procedures when operations threaten to cause damage to new or existing facilities.
- D. The Contractor shall be solely responsible for the proper design and execution methods for controlling surface and groundwater. Design review and/or field monitoring activities by the Owner or Engineer shall not relieve the Contractor of his responsibilities for the work specified herein.

1.04 SUBMITTALS

- A. Prior to installation of the dewatering system and at least two weeks prior to performing any excavation in areas that require dewatering, the Contractor shall submit working drawings and design data for review by the Owner's representative with the following information:
 - 1. The proposed types of dewatering system;
 - 2. Arrangement, location and depths of system components;
 - 3. Complete description of equipment and instrumentation to be used including installation, operation and maintenance procedures;
 - 4. Types and sizes of filters;
 - 5. Design calculations demonstrating adequacy of the proposed system and equipment; and provisions and methods of sediment removal and disposal of water.
- B. It is anticipated that the initial dewatering plan will have to be modified to suit the variable soil/water conditions encountered during construction. The Contractor shall modify the dewatering plan as often as necessary to meet the Specifications.

PART 2—PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. The Contractor shall furnish pumps, pipe, appliances, and equipment of capacity capable to keep the excavations free from water as necessary to complete the work as specified herein.
- B. The Contractor shall provide all necessary materials for environmental protection including construction fencing and erosion control barriers.

PART 3—EXECUTION

3.01 SURFACE WATER CONTROL

- A. The Contractor shall intercept and divert surface water runoff away from excavations through the use of dikes, curb walls, ditches, pipes, sumps or other approved means.
- B. The Contractor shall provide and maintain ditches of adequate size to collect and prevent surface and subsurface water seepage from entering the excavations. He/she shall divert the water to settling basins or other approved equipment required to reduce the amount of

fine particles before discharge into drainage pipes and natural watercourses. If a drainage system or watercourse becomes blocked due to dewatering operation, the Contractor, at no additional cost to the Owner, shall clean it.

3.02 DEWATERING EXCAVATIONS

- A. The Contractor shall accomplish dewatering in accordance with the means and methods submitted as required and approved by the Owner's representative. The Contractor shall keep the Owner's representative advised of any changes required to accommodate field conditions and, on completion of the dewatering system installation, revise and resubmit the information required to show the installed system.
- B. The Contractor shall perform dewatering operations to lower the groundwater level in excavations as required to provide a stable, dry subgrade for the prosecution of the proposed work.
- C. The Contractor shall maintain dewatering operations in a manner that prevents buildup of excessive hydrostatic pressure and damage to structures, and the subgrade.
- D. The Contractor shall not allow water to accumulate in excavations. He/she shall provide and maintain at all times ample means and devices to remove promptly, and to dispose of properly, all water entering excavations and to keep them dry until the proposed work is completed.
- E. If the Contractor's method of dewatering does not properly dewater the excavation as specified, then the Contractor shall install groundwater observation wells, as directed by the Owner's representative, and implement a revised dewatering plan that lowers the groundwater a minimum of 6 inches below the bottom of final excavation elevation, at no additional cost to the Owner.
- F. No pipe shall be laid in water. No masonry shall be laid in water, and no water shall be allowed to rise over concrete and brick masonry within 24 hours after being placed. Water shall not be allowed to rise over any concrete and masonry for four days. The Contractor shall constantly guard against the possibility of flotation of pipe or structures after installation. Backfill or other means shall be placed promptly to prevent this occurrence.
- G. Dewatering units used in the work shall be surrounded by suitable filter sand such that no fines shall be removed by pumping. Pumping shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.
- H. Dewatering flows shall be disposed of in an approved area. Sanitary sewer systems shall not be used to dispose of dewatering flows.

END OF SECTION 31 23 19

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.
- B. The work includes:
 - 1. Providing all temporary erosion control measures shown on the Drawings and as required by the Owner's representative during the life of the Contract to control soil erosion and water pollution.
 - 2. The installation and maintenance of erosion control barriers (wattles), catch basin filters, construction entrances, and other approved erosion control devices or methods.
 - 3. **For this project Erosion control includes catch basin protection and placement of woodchip berm perimeter erosion control (material provided by the city to be delivered and placed by the contractor)**
 - 4. **Related items included here are for reference if needed and may be requested by the city as additional services.**

1.02 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 02 41 13—Site Preparation and Demolition
 - 2. Section 31 23 10—Earthwork

1.03 SUBMITTALS

- A. Product Literature: Prior to ordering the below listed materials, the Contractor shall submit product literature to the Owner's representative for approval as follows. The Contractor shall not order materials until the Owner's representative's approval has been obtained.
 - 1. Erosion control barrier (wattle)
 - 2. Catch basin filter

1.04 REFERENCES

- A. Massachusetts Department of Transportation (MDOT), Standard Specification for Highways and Bridges, latest edition, hereinafter referred to as MDOTSSHB.

PART 2 – PRODUCTS

2.01 CATCH BASIN/INLET FILTERS

- A. The Contractor shall purchase, install, and maintain catch basin/inlet filters at the locations indicated within the Drawings for the provision of sediment control.
- B. Catch basin inlet filters shall be manufactured by either “Silt Sak” by Jennian, “Dandy Bag” by Dandy Products, “Drain Pac”, or approved equivalent.

2.02 EROSION CONTROL BARRIER

- A. Erosion control barrier shall be **(woodchip berm)** straw wattle, coir log, or approved equivalent.

2.03 TEMPORARY GRASSES FOR EROSION CONTROL

- A. ~~Quick growing grasses, such as wheat, rye, or oats, shall be in accordance with MDOTSSHB Section M6.03.1 Erosion Seed.~~ **Seed by others.**

2.04 SLOPE STABILIZATION

- A. Slope Stabilization: Erosion control netting/blanket shall jute mat made of unbleached, undyed, and loosely-twisted yarn. The unit yarn weight shall be from 0.90 to 1.50 lb/yd² (488 to 814 g/m²). A 48 in (1.2 m) width shall show between 76 and 80 wrappings, and a 36 in (900 mm) length shall show between 39 and 43 weftings. Woven mesh strips shall be at least 45 in (1.1 m) wide. Anchoring Staples shall be cold-drawn wire 14 gauge or wider in diameter, formed into a U shape from a wire 12 in or longer.

PART 3 - EXECUTION

3.01 EROSION CONTROL - GENERAL

- A. Erosion and sediment controls shall be in placed prior to any soil disturbing activities including, but not limited to, clearing and grubbing, earthwork, dewatering, and excavation work.
- B. All disturbed soils shall be stabilized, either permanently or temporarily, within two (2) weeks of disturbance.
- C. At a minimum, the Contractor shall comply with the following:
 - 1. Brush and stumps shall not be removed until no more than one (1) week prior to the start of pipe laying in that area or as directed by the Owner’s representative. The existing ground surface shall be disturbed as little as possible until no more than one (1) week prior to the start of pipe laying.

2. Drainage leaving the site shall flow to water courses in such a manner as to prevent erosion.
 3. Loaming and seeding or mulching shall take place as soon after laying of the pipe as practicable.
- D. Measures for control of erosion shall be adequate to assure that turbidity in the receiving water will not be increased more than ten (10) standard turbidity units (s.t.u.), or as otherwise required by the State or other controlling body, in waters used for public water supply or fish unless limits have been established for the particular water. In surface water used for other purposes, the turbidity shall not exceed twenty-five (25) s.t.u. unless otherwise permitted.
- E. When it becomes necessary, the Owner's representative will inform the Contractor of construction procedures and operations that jeopardize erosion control provisions. If these construction procedures and operations are not corrected promptly, the Owner's representative may suspend the performance of any or all construction until corrections have been made, and such suspension shall not be the basis of any claim by the Contractor for additional compensation from the Owner nor for an extension of time to complete the Work.
- F. The Owner's representative has the authority to order immediate, additional, temporary control measures to prevent contamination of adjacent streams or other watercourses, or other areas of water impoundment and damage by erosion.
- G. The Contractor shall construct all permanent erosion and sediment control features at the earliest practical time as outlined in the accepted schedule. Temporary erosion and sediment control measures shall be used to correct conditions that develop during construction which were unforeseen, but are needed prior to installation of permanent control features, or that are needed temporarily to control erosion or sedimentation which develops during construction operations.
- H. Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent erosion and sediment control features can follow immediately thereafter, if conditions permit; otherwise, temporary control measures will be required between successive construction stages.
- I. Failure by the Contractor to control erosion, pollution, and siltation shall be cause for the Owner to employ outside assistance to provide the necessary corrective measures. The cost of such assistance, including design costs, will be charged to the Contractor and appropriate deductions made to the Contractor's monthly progress payment request.
- J. The Contractor shall remove sediment from erosion control facilities as required, and as directed by the Owner's representative. The Contractor shall modify and improve erosion control facilities and replace deteriorated hay bales, coir logs, and other devices as required, and as directed by the Owner's representative.
- K. Temporary and permanent erosion and sedimentation control measures are shown on the Drawings. The Contractor shall strictly adhere to the provisions. Additionally,

temporary measures shall be constructed to accommodate field conditions that develop during construction.

3.02 CATCH BASIN FILTERS

- A. The catch basin filters shall be installed before any demolition and/or construction commences on site. They shall be maintained by removing the trapped sediment loads as needed or a minimum of once per week in such a manner as not to cause sediments and debris from entering the catch basin.
 - 1. The Contractor shall have on site at a minimum one (1) additional filter per catch basin for replacement purposes due to damage of the filter.
 - 2. The Contractor shall clean the existing catch basins/inlets of any debris, litter or sedimentation prior to the initial installation of any filter and shall be responsible for maintaining those catch basins/inlets clean for the duration of the contract or until directed otherwise by the Owner.

3.03 EROSION CONTROL BARRIERS

- A. Wattles or logs shall be installed in accordance with the Drawings.

3.04 SLOPE STABILIZATION

- A. Erosion control matting/blankets shall be installed in accordance with the Drawings, on slopes of 3:1 gradients and steeper that are required to be seeded.

3.05 MAINTENANCE AND CLEAN UP

- A. The Contractor shall inspect erosion control devices immediately after each storm event and at least daily during prolonged rainfall and maintain them in good operating condition for the life of the contract.
- B. The Contractor shall inspect the condition of erosion and sedimentation control devices after each rainstorm and during major storm events, and otherwise a minimum of twice monthly. The Contractor shall also remove silt build-up if greater than four (4) inches deep. Repairs shall be made as necessary and as directed by the Owner's representative.
- C. The Contractor shall also replace any damaged or deteriorated items, and keep erosion and sediment control devices securely anchored.
- D. The Contractor shall check temporary sedimentation control basins and swales periodically for sedimentation build-up and remove sedimentation as necessary to maintain specified profiles and dimensions.

3.06 REMOVAL OF EROSION CONTROL DEVICES

- A. Temporary soil erosion and sedimentation control devices shall be removed and adjacent areas outside the limits of grading restored upon completion of the work or when directed

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by the Owner's representative. Upon removal of the temporary controls, the site shall be restored to original condition in accordance with Section 32 92 19 – Seeding.

END OF SECTION 31 25 00

**SECTION 32 17 23
PAVEMENT MARKINGS**

PART 1—GENERAL

1.01 DESCRIPTION

- A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.
- B. This Section specifies requirements for removal of existing pavement markings and construction of new markings.
- C. The work includes:
 - 1. Removal of existing markings by approved methods
 - 2. Pavement surface preparation
 - 3. Furnishing and installing new pavement markings

1.02 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 31 00 00 - Earthwork

1.03 SITE CONDITIONS

- A. The Contractor shall cordon off areas where markings are being applied, but maintain access for vehicular and pedestrian traffic as required for other construction activities. Flagmen, barricades, drums, warning signs, warning lights and similar devices shall be used as required.

1.04 SUBMITTALS

- A. Submit material certificate to the Owners Representative, signed by the material producer and Contractor, certifying that materials comply with these specifications and have been approved for use by the Commonwealth of Massachusetts, Department of Highways and the City of Worcester Department of Public Works.

PART 2—PRODUCTS

2.01 MATERIALS

- A. Pavement markings shall conform to Section 860 of the current Commonwealth of Massachusetts Department of Highways Standard Specifications for Highways and Bridges and Manual of Uniform Traffic Control Devices, current edition.
- B. Pavement markings shall be white, non-reflectorized traffic paint.

PART 3—EXECUTION

3.01 PREPARATION

- A. The Contractor shall clean the pavement of dust, dirt, old pavement markings, concrete curing compounds and other foreign material which may be detrimental to the adhesion of the marking and painting material.

3.02 PAVEMENT MARKING REMOVAL

- A. Existing pavement markings that conflict with the proposed markings, and those shown on the Drawings, shall be removed. Pavement markings shall be removed before any change is made in the traffic pattern. Any excessive damage to the pavement caused by pavement marking removal shall be repaired by the Contractor by methods acceptable to the Owners Representative at no additional cost to the Owner.
- B. Approved methods include:
 - 1. Sand blasting using air or water.
 - 2. High pressure water.
 - 3. Steam or superheated water.
 - 4. Mechanical devices such as grinders, sanders, scrapers, scarifiers and wire brushers.
- C. Painting over a pavement marking line with asphaltic liquids or paints will not be permitted unless approved by the Owners Representative.
- D. Material deposited on the pavement from removal operations shall be removed as the work progresses. Accumulations of sand or other material which might interfere with drainage or could constitute a hazard to traffic will not be permitted.
- E. Where sand blasting is used for the removal of pavement markings and the removal operation is being performed within 10 feet of a lane occupied by traffic, the residue, including dust, shall be removed immediately as the marking removal progresses by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods approved by the Owners Representative.

3.03 PAVEMENT MARKING APPLICATION

- A. The material shall be applied to the pavement by equipment designed and manufactured specifically for the application of pavement markings.
- B. The Contractor shall employ the services of a Registered Land Surveyor to provide control for layout of pavement markings or as approved by the Owners Representative.

- C. Paint markings shall be applied at a minimum thickness of 15 ± 1 mil or as noted on manufacturers recommendations.
- D. Pavement markings shall be applied in accordance with the layout shown on the drawings. No paint shall be applied to new bituminous pavement until the top course has cured at least one week, and allow two weeks curing for newly installed bituminous concrete curbing.
- E. Where entire areas are to be cross-hatched, the striping shall conform to the cross-hatching shown on the Drawings.
- F. All markings shall be straight with sharp corners and clean edges. Directional arrows, cross hatching, lane divider stripes, stop lines, and lettering shall be painted white to the size, length, and spacing shown on the Drawings.
- G. All markings shall be applied in one coat with brush, spray, or marking machine over dry clean pavement surfaces, when the atmospheric temperature is at or above 40°F and when the weather is otherwise favorable in the opinion of the Owners Representative.
- H. Use only skilled workmen who are experienced and normally employed in the work of installing pavement markings. Supply all the necessary equipment and materials required for the work.
- I. The Contractor shall protect the buildings, walks, pavement, curbing, trees, shrubs, mulch and other site fixtures from over-spray of paint and damage from marking operations.
- J. Traffic shall not be permitted on the pavement until the paint is thoroughly dry.

END OF SECTION 32 17 23

SECTION 32 30 00
SITE IMPROVEMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.
- B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:
 - 1. Interpretive sign

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Project Special Conditions and Specifications

1.03 SUBMITTALS

- A. The Contractor shall prepare and submit Shop Drawings to the Owner's representative for approval prior to ordering the listed materials.
 - 1. Shop drawings shall show required sizes, dimensions, sections, profiles of units; the arrangement of and provision for jointing, anchoring, fastening, and support; and other necessary details.
 - 2. Shop drawings shall include large-scale details of any unique fabrication and setting requirements or any other specified areas seen as necessary or as directed by the Owner's representative.
 - 3. Each shop drawing shall reference the section and paragraph of the Specifications that requires the items included.
 - 4. The Contractor shall provide complete shop drawings for approval by the Owner's representative for all items listed below:
 - a. Interpretive sign
- B. The Contractor shall provide complete product literature and applicable color samples for approval by the Owner's representative prior to ordering the below listed materials:
 - a. Interpretive sign

1.05 QUALITY ASSURANCE

- A. Site improvement work shall be assigned to experienced and qualified subcontractors employing experienced workers who will work under the full-time supervision of a qualified

foreman with a minimum of five (5) years of experience on projects comparable to this project. The Contractor shall use an adequate number 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 the proper performance of the work in this Section. The Contractor shall demonstrate that he has successfully completed work of similar size and scope.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for timing the delivery of site improvement materials so as to minimize on-site storage time prior to installation. All stored materials shall be protected from weather, careless handling, and vandalism.
- B. The Contractor, sub-contractors, and suppliers are all individually required to furnish their own equipment necessary to get workers, material, and equipment from the point of delivery at the project site to the point of use or installation within the project site. All crane and rigging services required are the responsibility of each individual Contractor or trade.
- C. The Contractor shall deliver materials in original sealed containers marked with name of manufacturer and identification of contents. The Contractor shall store materials under waterproof covers on planking clear of ground and protect from handling damage, dirt, stain, water and wind.
- D. The Contractor shall take all necessary precautions to prevent all items from chipping, cracking, or other damage during the transportation of these materials to the project, unloading and storage on the site. The Contractor shall lift items with wide-belt type slings wherever possible; he/she shall not use wire rope or ropes containing tar or other substances which might cause staining. If required, he/she shall use wood rollers and provide cushion at end of wood slides. Damaged items will not be allowed to be installed and should any damaged items be found in constructed work, such items shall be removed immediately and replaced, and the Contractor shall assume all expenses incurred therefrom.
- E. Stored materials shall be adequately protected against moisture by one (1) stacking in such a manner as to allow a complete circulation of air under each stack, and two (2) covering each stack, top and sides with a waterproof paper or membrane. Coverings shall remain in place at all times, when not working from the particular stack.

1.07 EXAMINATION OF CONDITIONS

- A. The Contractor shall fully inform themselves of existing conditions of the site and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. The installer shall examine previous work, related work, and conditions under which this work is to be performed and notify the Contractor in writing of all deficiencies and conditions detrimental to the proper completion of this work. At the beginning of work, the installer shall accept substrates, subgrades, previous work, and conditions. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.
- B. The Contractor shall be solely responsible for judging the potential need for storing materials temporarily and/or re-handling items prior to final installation.

1.08 STANDARDS

- A. Except as modified by governing code and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:
1. AASHTO: American Association of State Highway and Transportation Officials, latest edition.
 2. ASTM: American Society for Testing and Materials, latest edition.
 3. ADA: Americans with Disabilities Act, latest edition.
 4. AAB: Architectural Access Board, Commonwealth of Massachusetts, Chapter 521 CMR, latest edition.
 5. ASTM C94 Ready-Mixed Concrete
 6. ASTM C1372 Segmental Retaining Wall Units

PART 2 - PRODUCTS

2.01 INTERPRETIVE SIGN

- A. Interpretive sign shall be aluminum double pedestal post style with CHPL composite panel, and anti graffiti coating Siloxane or approved equivalent. By www.izoneimaging.com or approved equal. Frame color black.

2.03 CONCRETE FOOTINGS

Concrete for footings shall comply the Project Special Conditions and Specifications, and section 03 30 00 Cast in place concrete.

PART 3 – EXECUTION

3.01 INTERPRETIVE SIGN

- A. See Project Special Conditions and Specifications.

3.03 CONCRETE FOOTINGS

- A. Concrete footing installation shall comply with requirements of the Project Special Conditions and Specifications.

END OF SECTION 32 30 00

SECTION 32 31 19
METAL PICKET FENCE (ADD-ALT-1)

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work under this Section consists of furnishing and installing steel picket fence with posts, sleeves and appurtenances as shown on the drawings and as specified herein including all labor, materials and equipment necessary to finish the work complete in place. The fence must meet the requirements of the commercial ornamental steel fence system of the Ameristar Aegis Plus (Majestic™) design or approved equal as manufactured by Master Halco 63 Manley St. W. Bridgewater, MA 02379 (800) 969-1669 or Anchor Fence, 1015 East Market Street Daly City, CA 94014(650) 757-2140 or other approved equal
- B. Instalation of metal picket fence and gates.

1.2 REFERENCE STANDARDS

- A. References herein to any technical society, organization, group or body are made in accordance with the following abbreviations:

ASTM American Society for Testing Materials AWS

American Welding Society

CPSC Consumer Product Safety Commission

1.3 SHOP DRAWINGS

- A. The Contractor shall submit complete manufacturer's shop drawings which shall include the horizontal layout and vertical alignment for the proposed installation to the Engineer for approval. Field verify all post sleeve spacing prior to fabrication. No material may be ordered prior to receiving written approval from the Owner's Representative.

PART II – MATERIALS

2.1 MANUFACTURER

- A. The metal fence system shall be Ameristar model Montage II, 2-Rail style 'Magestic' by

Ameristar Fence Products, Inc. in Tulsa, Oklahoma or McMaster or approved equal.

2.1 STEEL MEMBERS

- A. Posts shall be carbon steel structural tubing conforming to ASTM Designation A500.
 - 1. Material for fence pickets shall be 3/4" square x 14 Ga. tubing
 - 2. Sleeves for fence posts shall be 3" x 3" x 1/2" thickness steel square tube weighing 20.88 lbs./ft.
- B. Galvanizing:
 - 1. Hot-dip galvanize all items under this section in compliance with ASTM A 123, ASTM A 153, or ASTM A 386. Provide minimum 1.5 oz./ft.² zinc coating. Galvanize after fabrication.
 - 2. Following galvanizing, each item shall receive surface grinding to remove lumps, sags or spikes resulting from the galvanizing process. The finished surface following grinding shall be hand smooth and without irregularities. Take care not to damage the galvanized surface coating.
- C. Pickets, top and bottom rails and crossbars and hinge assemblies, called for on the drawings, shall conform to ASTM Designation A36.
- D. Bolts, nuts, washers and any other fasteners shall conform to ASTM Designation A307.
- E. Post caps shall be cast iron or steel in the sizes required, finished in conformance with all other fence elements. Caps shall be as manufactured by Julius Blum & Co., Inc., Carlstadt, New Jersey; Boundary Fence and Railing Systems, Inc. Richmond Hill New York; Monumental Iron Works, Inc., Baltimore, Maryland; or approved equal. All caps are to be coated with a minimum 3.0 mil thickness of liquid galvanizing compound by dipping and shall be securely affixed to the post top.

2.2 FINISH

- A. Cold galvanizing compound shall be a single component zinc rich compound yielding a dry film of at least 85% pure zinc. Galvanizing compound shall meet or exceed the requirements of Federal Specification MIL-P-21035, TT-P-641d primer for zinc rich compounds.
- B. Finish color coating shall be Color Galvanized Black.

2.3 CEMENT CONCRETE

- A. Cement concrete for footings and edgings shall conform to Project Special Conditions and Specifications.

PART III - EXECUTION

3.1 FENCE FABRICATION, GALVANIZING FINISHING AND ERECTION

- A. The fence sections shall be shop fabricated in strict conformance to the sizes and dimensions called for on the approved shop drawings and in accordance with these specifications, all as field verified by the Contractor.
- B. All welding shall be by arc welding process conforming to the latest AWS Specifications. All welds shall be as designated on the drawings, shall be ground smooth to a neat finish and shall be watertight with care to minimize locked-up stresses and distortion due to heat. All welds shall be made on bare, clean metal equal to "white" metal.
- C. After fabrications, all steel surfaces shall be thoroughly cleaned of all mill scale, rust, dirt, weld flux, weld splatter and other foreign matter by power wire brushing or sand blasting.
- D. Prime and finish all materials in accordance with industry requirements. Galvanizing shall provide a visually acceptable substrate for applied coatings, and be free of lumps, globules, or heavy deposits which will interfere with intended use or esthetic appearance of materials.
- E. Field erection of the fabricated fence sections shall be as called for on the drawings. Fence posts shall be set plumb in cement concrete footings which shall be mixed and placed in accordance with Project Special Conditions and Specifications. The fence rails shall be parallel to the top of wall and the fence posts and pickets shall be set plumb, when the fence is erected into its final position.
- F. Surfaces that are abraded or damaged during field erection or from which galvanizing compound has been damaged shall be thoroughly wire brushed and cleaned,

removing all loose and cracked coating, after which the surface shall be painted with two (2) coats of the approved cold galvanizing compound.

3.2 TOUCHUP PAINTING

- A. After erection, all rust spots, scratches or abrasions in the galvanized surface shall be repaired with finish surfacing treatments that are compatible with factory applied color galvanizing applications and satisfactory in all regards to the Engineer.

END OF SECTION 32 31 19

SECTION 33 10 00
WATER UTILITIES

PART 1 – GENERAL

- 1.0 RELATED DOCUMENTS: This section is only a portion of the Contract Documents. All of the Contract Documents, including Division 1 General Requirements, apply to this section.
- 1.1 SECTION INCLUDES
- A. This Section specifies requirements for the proposed water system pipe, fittings appurtenances and services.
 - B. The work includes:
 - 1. Furnishing and installing temporary hydrant meter, backflow prevention assembly, pressure-reducing valves and other related appurtenances.
 - 3. Disinfection and testing of the system.
- 1.2 COORDINATION WITH THE MUNICIPALITY:
- A. Work shall conform to Standard Specifications and Details: City of Worcester, Department of Public Works and Parks Engineering Division.
 - B. The Water Department shall be notified prior to starting construction of any portion of the water system.
 - B. The closing of valves necessary for making connections with the existing system will be done by the Water Department employees, assisted by the Contractor. Sufficient notice shall be given to the Water Department of planned connection. No allowance will be made for any delay in closing of valves. A 48-hour notice shall be given to residents or businesses affected by the shutdown, and shall be done by the Contractor under the direction of the Engineer. The Water Department may require the work to be done at night during the low use time period.
 - C. All work will conform with the Water Department standards.
- 1.3 STANDARDS
- A. ASTM D 2765 - Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics.
 - B. ASTM D 6394 - Specification for Sulfone Plastics (SP).
 - C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - D. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - E. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - F. ASTM F 876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

- G. ASTM F 877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
- H. ASTM F 1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Crosslinked Polyethylene (PEX) Tubing.
- I. American Water Works Association AWWA C904 Standard for Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2 in. Through 3 in., for Water Service.
- J. American National Standards Institute (ANSI)/National Sanitation Foundation (NSF)
- K. ANSI/NSF Standard 14 Plastics Piping System Components and Related Materials.
- L. ANSI/NSF Standard 61 Drinking Water System Components - Health Effects.
- M. ANSI/NSF Standard 359 Valves for Crosslinked Polyethylene (PEX) Water Distribution Tubing Systems.
- N. American National Standards Institute (ANSI)/Underwriters Laboratories, Inc. (UL)
- O. ANSI/UL 263 Standard for Safety for Fire Tests of Building Construction and Materials.
- P. ANSI/UL 2846 Standard for Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics.

1.3 SUBMITTALS:

- A. Shop Drawings:
 - 1. Submit Shop Drawings or descriptive literature, or both, showing dimensions, joints and other details of all materials to be furnished. Shop Drawings shall be submitted to the Engineer for approval prior to ordering materials.
- B. As-Built Drawings: Not Applicable.

1.4 DELIVERY, STORAGE AND HANDLING:

- A. Storage of pipe, fittings, valves, hydrants and other water line appurtenances on the site shall be in accordance with the manufacturer's recommendations, subject to the approval of the Engineer.
- B. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, fittings, valves, hydrants, and other water line appurtenances. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to pipe and fitting coatings shall be repaired as directed by the Engineer.
- C. Pipe, fittings, valves, hydrants and other water system appurtenances which are defective from any cause, including damage caused by handling, and determined by the Engineer as unrepairable, shall be unacceptable for installation and shall be replaced at no cost to the Owner.

- D. Pipe and all water system appurtenances that are damaged or disturbed through any cause prior to acceptance of the work shall be repaired, realigned or replaced as required by the Engineer at no additional cost to the Owner.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. The Drawings are diagrammatic only and are intended to indicate the extent, but not all details, of the system which shall be constructed. All materials are not shown; but the Contractor shall furnish and install all materials required for the complete system.

2.2 PIPE:

- A. PEX piping shall be PEX-a (Engel-Method Crosslinked Polyethylene) Piping: ASTM F 876 and F877 (CAN/CSA-B137.5)
- B. PEX-a Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
1. UNS No. C69300 Lead-free (LF) Brass.
 2. UNS No. C27453 Lead-free (LF) Brass.
 3. 20% glass-filled polysulfone as specified in ASTM D 6394.
 4. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D 6394.
 5. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D 6394.
 6. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D 6394.
 7. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".
- C. Copper piping shall be type "K" tubing.
- B. Couplings, if required, for existing to new service pipe connections shall have compression on the inlet and compression on the outlet.

PART 3 – EXECUTION

3.1 GENERAL:

- A. All water pipes, fittings, valves, hydrants and other appurtenances shall be installed at the locations as shown on the Drawings. The proposed location and vertical alignment may be altered to avoid conflicts with existing and proposed utilities, as approved by the Engineer.

3.2 LAYING PIPE AND FITTINGS:

- A. Pipe and fittings shall be installed in accordance with the requirements of ANSI/AWWA C600.
- B. Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a trench prepared and maintained. The type of materials to be used in bedding and backfilling and method of placement shall conform to the requirements of Section 31 2323.

- C. All pipes shall be clean before laying. When laying is stopped for any reason, the open ends of the pipe shall be closed by watertight plugs or other approved means. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe has been eliminated.

Fittings, in addition to those shown on the Drawings, shall be provided if required to avoid utility conflicts.

- D. When cutting of pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a push-on bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.
- E. Maximum allowable deflection for pipe laid without fittings shall not exceed the allowable amount established by the pipe manufacturer and shall not exceed those shown in AWWA C600.
- F. The pipe shall be laid with a minimum cover of 5 feet below finished grade.

3.3 JOINTING DUCTILE IRON PIPE:

- A. Push-on joints shall be made in strict accordance with the manufacturer's instructions. A rubber gasket shall be inserted in the groove of the bell end of the pipe and the joint surface cleaned and lubricated using the pipe manufacturer's suggested methods and materials. The plain end of the pipe to be laid shall be inserted in alignment with the bell of the pipe to which it is to be jointed and pushed home with a jack or by other means. After joining the pipe, a metal feeler gauge shall be used to make certain that the rubber gasket is correctly located and has not been twisted or otherwise displaced.

3.4 JOINTING MECHANICAL JOINT PIPE AND FITTINGS:

- A. Mechanical joints shall be made in strict accordance with the manufacturer's instructions. Mechanical joints shall be made by first cleaning the surfaces against which the gaskets will come in contact with a wire brush. The gasket, bell, and spigot shall be lubricated by washing with soapy water just prior to assembling the joint. After the nuts have been made up finger tight, the bottom nut, then top and then diametrically opposite nuts shall be progressively tightened. Bolts shall be tightened to the torques listed:

Bolt Size [Inches]	Range of Torque [Feet-Pounds]
5/8	45 - 60
3/4	75 - 90
1 inch	85 - 100

Under no conditions shall extension wrenches or a pipe over the handle of an ordinary ratchet wrench be used to secure greater leverage. After installation, a heavy bitumastic coating shall be applied to all bolts and nuts.

Restraining device shall be ductile iron and shall have dimensions such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA Z21.11 and ANSI/AWWA C153 latest revision.

3.5 POLYVINYL CHLORIDE INSTALLATION:

A. HANDLING AND CUTTING:

1. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, and scratching or marring surfaces.
2. Any fitting or pipe showing a crack or which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work site.
3. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used will be perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.
4. All cutting of pipe shall be done with a machine suitable for cutting PVC pipes. Cut ends shall be beveled when recommended by the pipe manufacturer.

B. PIPE AND FITTINGS:

1. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
2. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the complete work.
3. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or as required. Care shall be taken to ensure good alignment both horizontally and vertically.
4. In buried pipelines, each pipe shall have firm bearing along its entire length.
5. Alignment deflection at each joint shall not exceed the permissible deflection specified in the following table measured at 20 foot pipe lengths. Maximum permissible deflections for other pipe lengths shall be in proportion to such lengths.

Pipe Deflection Allowances
(From Tables 33 and 34 of UNI-BELL Handbook of PVC Pipe Design and Construction)

Maximum permissible deflection, inches	
Size of Pipe (inches)	Push-on-Joint
1-1/2	73
2	56
2 1/2	50
3	42
4	24
6	17
8	12
10	11
12	9

Permissible alignment deflection shall not be achieved by using mechanical means, but shall be accomplished manually by application of uniform forces along the pipe length.

6. Pipe shall be installed underground in a manner that will ensure that external loads will not subsequently cause a decrease of more than 5 percent in the vertical cross-section dimension (deflection). When installing the pipes, they shall be rotated 180N so that the upper quadrant of the pipe which was exposed to direct sunlight will not be backfilled upon.
7. At all times when pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary water-tight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.
8. Assembling of fittings with mechanical joint ends shall conform to AWWA C600, Section 9B and all amendments thereto.
9. If effective sealing of the mechanical joint is not attained at the maximum allowable torque, the joint shall be disassembled and thoroughly cleaned, then reassembled. Bolts shall not be overstressed to tighten a leaking joint. The correct torque as indicated by a torque wrench shall not exceed manufacturer's recommendations.
10. When PVC pipe is to be drilled and tapped, it shall be done in accordance with the manufacturer's recommendations. Only sharp cutting tools shall be used and the tool shall be lubricated during drilling to avoid a build-up of excess heat locally in the pipe. Saddles shall be used for all taps into the PVC water main.

3.6 CONCRETE THRUST BLOCKS:

- A. Where pipes change horizontal and vertical direction, at hydrants, tees and other fittings, and wherever abnormal thrust forces may be developed, the Contractor shall construct thrust and anchor blocks as detailed on the Drawings. They shall be concrete, of minimum dimensions as detailed on the drawings or of adequate additional size to suit actual conditions to withstand pressures anticipated, and shall be founded in undisturbed soil.
- B. Concrete for thrust blocks shall have a minimum 28 day's compressive strength of 3,000 psi.
- C. Fittings which do not use thrust blocks resting against natural occurring material with passive resistance pressure of 1,500 psf shall be installed with a restrained joint system as specified in Article 3.06.

3.7 RESTRAINED JOINTS:

- A. Pipe with restrained joints shall be installed at locations shown on the Drawings. Restrained joints shall be installed at bends, reducers, tees, valves, dead ends, and hydrants. The minimum length of pipe to be restrained on either side of the joint shall be as shown on the table below. The fittings of the new piping shall be for restrained joints, as marked on the Drawings.

Number of Joints to Restraint
on Either Side of Fitting

Fitting	Number of Joints to Restraint on Either Side of Fitting [Based on 18-Foot Pipe Length]
90 degree bend	3
45 degree bend	2
22-1/2 degree bend	2
Tee:	
Branch	3
Run	2

- B. No restraining is required in the direction of the existing pipe if only a short length of it is exposed in the trench for making a connection.
- C. Restrained joint assemblies for push-on pipe and fittings shall be made in strict accordance with the manufacturer's recommended installation procedures.
- D. Restrained joint assemblies for mechanical joint pipe shall be EBAA Iron Sales MEGALUG or approved equivalent.

3.8 WATER/SEWER SEPARATION:

When a sewer pipe crosses above or below a water pipe, the following procedures shall be utilized. The Contractor shall comply with these following procedures:

A. Relation to Water Mains:

1. *Horizontal Separation:* Whenever possible sewers shall be laid at a minimum at least 10 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:
 - a. It is laid in a separate trench, or if
 - b. It is laid in the same trench with the water mains located at one side on a bench of undistributed earth, and if
 - c. If either case the elevations of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.
2. *Vertical Separation:* Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

When it is impossible to obtain horizontal and/or vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical-joint cement lined ductile iron pipe or other equivalent based on water tightness and structural soundness. Both pipes shall be pressure tested by an approved method to assure water tightness or

both pipes shall be encased in concrete. When crossing an existing water main, the water main shall be encased in concrete per the Drawings.

3.9 GATE VALVES AND BOXES:

- A. Valves shall be set in firmly compacted and shaped soil. Where the soil in the trench subgrade is found to be soft, loose, freshly filled earth, unstable or unsuitable as a base, the unsuitable material shall be excavated to such additional depth and width as required. The excavated area shall be backfilled with gravel or crushed stone, compacted and shaped.
- B. Valve boxes shall be set centered and plumb over the operating nuts of all valves. The top of each valve box shall be set to finished grade with at least 10 inches of overlap remaining between the upper sections for vertical adjustment. Minimum overlap for lower, extension pieces shall be 4 inches.
- C. Boxes shall be adequately supported during backfilling to maintain vertical alignment.

3.10 TAPPING SLEEVES AND GATE VALVES:

- A. Installation shall be made under pressure and the flow of water through the existing pipe shall be maintained at all times. The diameter of the tap shall be a minimum of 1/4 inch less than the inside diameter of the branch line.
- B. The entire operation shall be conducted by workmen thoroughly experienced in the installation of tapping sleeves and valves, and under supervision of qualified personnel furnished by the manufacturer. The tapping machine shall be furnished by the Contractor.
- C. The Contractor shall determine the location of the existing pipe to be tapped to confirm that interference will not be encountered from existing utilities or a joint or a fitting. No tap shall be made closer than 3 feet from a pipe joint.
- D. Pipe upon which tapping sleeve is to be installed shall be thoroughly cleaned of all foreign matter with scraping tools and wire brushes to a minimum of six inches beyond each side of the sleeve. The cleaned area shall be washed with a hypochlorite solution. The interior of tapping valve shall also be washed with hypochlorite solution.
- E. Tapping sleeves and valves with boxes shall be set vertically and squarely centered on the pipe to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks shall be provided behind all tapping sleeves. the supporting earth around and under the valve and sleeve shall be compacted. After completing the tap, the valve shall be flushed to ensure that the valve set is clean.
- F. Before backfilling, all exposed portions of any bolts used to hold the two halves of the sleeve together shall be heavily coated with two coats of bituminous paint equivalent to Bitumastic No. 50, by Kopper Company, Inc.

3.11 HYDRANTS:

- A. Hydrants shall be installed at the locations and in conformance with the details shown on the drawings.

- B. Each hydrant shall be set vertically and be properly braced. Hydrants shall be installed with thrust blocks or restrained joints as specified in Articles 3.05 and 3.06. Care shall be taken to ensure that thrust block concrete does not plug the drain ports.

3.12 WATER SERVICES:

- A. Service Pipe: Care shall be exercised in placing and laying of services to prevent kinks or sharp bends and contact with sharp stones or ledge which would damage to the pipe. At least 6 inches of sand shall be placed adjacent to, under, and above the pipe, and no stone larger than 2 inches shall be placed over the pipe until the depth of backfill above the pipe is in excess of 1 foot.
- B. Corporation Stop: Taps to the pipe shall be threaded and shall be made at the horizontal diameter of the main. The tap shall be made by means of a tapping machine manufactured for this purpose and supplied by the Contractor. The tap and drill shall be kept sharp and shall have threads matching those of the stop. Corporation stop threads shall be coated with sealing compound and the stop screwed firmly into the water with the key upward and the inlet end projecting at least 1/8-inch beyond the inside face of the pipe. Corporation stop shall be left in the on open position after installation of the service pipe.
- C. Curb Stop and Curb Boxes shall be of a size equal to the size of the service pipe and shall be installed in the locations shown on the Drawings or as ordered by the Engineer. The boxes shall be set in a vertical position and flush with the proposed finish grade.
- D. Ductile Iron Service Pipe: Ductile iron service pipe connections to the water pipe shall be made with tee fittings or tapping sleeves. Engineer to review availability of tees, reducers, etc. in order to ensure feasibility of connection for lower size ductile iron services.

3.13 POLYETHYLENE ENCASEMENT:

- A. Installation of polyethylene encasement shall be in accordance with the recommended procedures contained in ANSI/AWWA C105.
- B. Care shall be taken during backfilling to prevent damage to polyethylene wrap. backfilling shall be in accordance with AWWA C600.

3.14 PRESSURE TESTING:

- A. Hydrostatic and leakage test shall be conducted in accordance with AWWA Standard C600, and as directed by the Engineer. Testing shall be conducted by a certified independent water testing company.
- B. Conduct pipe tests after concrete thrust blocks have cured to the required 3000 psi strength. Fill pipe 24 hours prior to testing, and apply test pressure to stabilize system. Use only potable water.
- C. Prior to pressure testing, the entire pipe section shall be flushed to remove any rocks or debris which may have inadvertently entered the pipe during construction.
- D. Once the pipe section has been filled at normal pressure and all entrapped air removed, the Contractor shall raise the pressure to 150 psi or two times the operating pressure (whichever is greater) by a special pressure pump, taking water from a small tank of proper dimensions

for satisfactorily measuring the rate of pumpage into the pipe. This pressure shall be maintained for a minimum of 2 hours, during which time the line shall be checked for leaks. Measured rate of water leakage shall not exceed the allowable leakage listed below.

Allowable leakage in gallons per hour, per 1,000 feet of exterior pipeline:

Test Pressure	Nominal Pipe Diameter [inches]					
	4	6	8	10	12	16
150 psi	0.36	0.55	0.74	0.92	1.10	1.47

Interior piping in vaults, buildings, etc. shall have zero leakage.

Should leakage exceed this rate, the Contractor shall immediately locate the leak or leaks and repair them. Pipe will be accepted only when leakage is zero, or less than the allowable amount. Approval does not absolve the Contractor from responsibility if leaks develop later within the period of warranty.

3.15 DISINFECTION:

- A. Before being placed in service, all new water pipe shall be chlorinated in accordance with ANSI/AWWA C651 Standard for Disinfecting Water Mains.
- B. The location of the chlorination and sampling points will be determined by the Engineer in the field. Taps for chlorination and sampling shall be installed by the Contractor. The Contractor shall uncover and backfill the taps as required.
- C. The pipe section being disinfected shall be flushed to remove discolored water and sediment from the pipe. a 25 mg/l chlorine solution in approved dosages shall be inserted through a tap at one end while water is being withdrawn at the other end of the pipe section. The chlorine concentration in the water in the pipe shall be maintained at a minimum 25 mg/l available chlorine during filling. To assure that this concentration is maintained, the chlorine residual shall be measured at regular intervals in accordance with procedures described in Standard Methods and AWWA M12, Simplified Procedure for Water Examination.
- D. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the pipe supplying the water. Chlorine application shall not cease until the entire pipe section is filled with chlorine solution. The chlorinated water shall be retained in the pipe for at least a twenty-four hour period. the treated water shall contain a chlorine residual throughout the length of the pipe section as indicated in AWWA C651.
- E. Following the chlorination period, all treated water shall be flushed from the pipe section and replaced with water from the distribution system. Prior to disposal of treated water the Contractor shall check with local authorities to determine if the discharge will cause damage to the receiving body or sewer and, if required, the Contractor shall neutralize the chlorinated water in accordance with Appendix B, AWWA C650. Bacteriological sampling and analysis of the replacement water may then be made by the Contractor in full accordance with AWWA Specification C651. A minimum of three samples shall be taken by the Contractor at locations directed by the Engineer along the length of water pipe being chlorinated and sent to a State approved private laboratory for analyses. The Contractor shall re-chlorine if

the samples show presence of coliform, and the pipe section shall not be placed in service until all of the repeat samples show no presence of coliform.

- F. Furnish two copies of a Certificate of Disinfection Report to the Engineer.
- G. The Contractor shall pay all costs for all testing, flushing, chlorinating; laboratory analyses, sampling, water supply and municipal charges.

END OF SECTION 33 10 00

SECTION 33 40 00
STORM DRAINAGE SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.
- B. This Section specifies requirements for the site storm drainage system.
- C. The work includes:
 - 1. Site storm drainage system.
 - 2. Adjustment of drainage structures.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 31 23 19 – Dewatering and Drainage Control
 - 2. Section 31 23 10 – Earthwork
 - 3. Project Special Conditions and Specifications (for Concrete)

1.03 SUBMITTALS

- A. Shop Drawings
 - 1. Materials list of items proposed for the work.
 - 2. ~~Not applicable Shop drawings or descriptive literature, or both, showing dimensions, joints, and other details of all materials proposed for the work. Shop drawings shall be submitted to the Owner's representative for approval prior to ordering material.~~
- B. As-Built Drawings Not applicable
 - 1. ~~The Contractor shall submit 5 hard copies, pdf copy, and AutoCAD file of As-Built Drawings upon completion and acceptance of work.~~
 - 2. ~~As-Built Drawings shall be complete and shall indicate the true measurements and locations, horizontal and vertical, of all new construction. As-Built Drawings shall also contain any additional information required by the municipality, and shall be stamped with the seal of a Licensed Land Surveyor and Licensed Professional Engineer.~~

1.04 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:
1. Standards and requirements of Worcester Public Works and Parks Department
 2. Standard Specification: Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, supplemental specifications latest edition.
 3. ASTM: American Society of Testing and Materials, latest edition.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All materials for storm drainage system shall be new and unused.

2.02 PIPE

- A. High Density Polyethylene Corrugated Pipe (HDPE): This specification applies to high density polyethylene corrugated pipe with an integrally formed smooth waterway. Nominal sizes for which this specification is acceptable are 4 - 60 inch diameters. Sizes 4 - 60 inch shall be either AASHTO Type 'S' or Type 'D' as follows. AASHTO Type 'S' (N-12) shall have a full circular cross-section, with an outer corrugated pipe wall and an essentially smooth inner wall (waterway). Corrugations for Type 'S' sizes 4 - 60 inch shall be annular (N-12). Sizes 42 - 60 inch designated as AASHTO Type 'D' (N-12HC) shall consist of an essentially smooth waterway braced circumferentially with circular ribs which are formed simultaneously with an essentially smooth outer wall. The 42 - 60 inch (N-12HC) sizes shall conform to AASHTO Type 'D' (which describes dual wall pipe with a smooth waterway). Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions, and markings found in AASHTO Designations M252, M294 and MP7. Pipe and fittings shall be made from virgin PE compounds which conform to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350.

The fittings shall not reduce or impair the overall integrity or function of the pipeline. Fittings may be either molded or fabricated. Common corrugated fittings include in-line joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes, and end caps. These fittings may be installed by various methods such as snap-on, bell and spigot, bell – bell, and wrap-around couplers. Couplers shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Only fittings supplied or recommended by the manufacturer shall be used. Where designated on the plans or project specifications, an elastomeric gasket meeting the requirements of ASTM F477 shall be supplied. Installation of the pipe specified above shall be in accordance with either AASHTO Section 30 or ASTM Recommended Practice

D2321 as described elsewhere in these specifications and as recommended by the manufacturer.

2.04 FLEXIBLE PIPE CONNECTIONS

- A. Flexible pipe connections to manholes shall be Lock Joint, Kor-n-Seal, A-Lok or approved equivalent and shall conform to the Worcester Department of Public Works and Parks standards.

PART 3 – EXECUTION

3.01 PIPE INSTALLATION

- A. As soon as the trench is excavated to the normal grade of the bottom of the trench, the Contractor shall immediately place the bedding material in the trench. The pipe shall be firmly bedded in the compacted bedding material accurately to the lines and grades shown on the Drawings.
- B. The Contractor shall install pipe, fittings, and accessories in accordance with manufacturer's instructions.
- C. The Contractor shall notch under pipe bells and joints where required to provide for uniform bearing under entire length of pipe.
- D. Excavation, backfilling, and compaction shall be as specified in Section 31 23 10.
- E. The Contractor shall maintain optimum moisture content of bedding material to attain required compaction density.

END OF SECTION 33 40 00