

SECTION 02440**AUGER BORING****PART 1 GENERAL****1.01 SUMMARY**

- A. This Section specifies Auger Boring (“Jack and Bore”) as the trenchless method to install a minimum 48-in steel casing for containment of a 36-in RCP drain. The Contractor may elect to use pipe jacking as an alternate trenchless method. If proposed, the pipe jacking must meet the requirements specified herein.
- B. The minimum steel casing size shall be as shown on the Contract Drawings. The Contractor may elect to increase the size of the casing for its convenience, at no additional cost to the Authority, provided the minimum covers shown on the Contract Drawings are maintained.
- C. The work of this Section includes furnishing of all supervision, material, labor, tools, equipment and incidentals necessary to perform the work in accordance with these Specifications including but not limited to; installation, excavation, dewatering, backfilling, and removal of the launching and receiving pits (shafts); removal of penetrating obstructions; installation of casing including dewatering to control face, installation of RCP pipe and annular grout within casing; filling or grouting of voids between the natural ground and the casing pipe (contact grouting); soil and rock disposal; soil stabilization; utility relocation and/or support; backfill, site restoration; and cleanup.
- D. The utilities and pavements adjacent to and above the auger bore alignments are sensitive to loss of support. The capability to provide full support of the casing face is essential to prevent loss of ground which may result in ground settlement and damage to adjacent structures.
- E. The work shall meet all pertinent permit and OSHA requirements.
- F. The carrier pipe shall be installed to the line(s) and grade(s) shown on the Contract Drawings.
- G. Test borings have been completed by the Authority. The auger boring will encounter fill soils used to construct the existing ramp. The Contractor will be required to familiarize itself with the subsurface conditions depicted to provide and utilize methods and tooling suitable for the conditions depicted. Cobbles and boulders should be expected within the fill soils.
- H. The Contractor shall be responsible for groundwater control methods, subject to

submittal and review by the Authority.

- I. Conduct the work in compliance with local noise, parking, traffic, work hour and vibration restrictions.
- J. Retain the services of a professional engineer registered in the State of Massachusetts for submittal preparation.
- K. Do not impede or endanger the traffic on the ramp. Rescue shafts to remove obstructions will not be allowed.

1.02 RELATED SECTIONS

- A. Section 01300 – Submittals
- B. Section 01310 – Progress Schedules
- C. Section 02240 – Construction Dewatering and Groundwater Control
- D. Section 02311 – Support of Excavation
- E. Section 02495 – Geotechnical Instrumentation

1.03 CODES AND STANDARDS

- A. This section references the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
 - 1. ASCE MOP106 - Horizontal Auger Boring Projects, 2nd Edition.
 - 2. ASTM A 53, Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless.
 - 3. ASTM C39/C39M-21 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 4. ASTM A 106, Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - 5. ASTM A 139, Specification for Electric Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
 - 6. ASTM A 153, Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 7. ASTM A 307, Specification for Low Carbon Steel Externally and Internally Threaded Standard Fasteners.

8. ASTM 500, Specification for Cold-Formed Welded Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
9. ASTM A 569, Specification for Hot Rolled Carbon Steel Sheets and Strip, Commercial Quality.
10. ASTM S 252, Welded and Seamless Steel Pipe Piles.
11. AWS D1.1, Structural Welding Code.
12. MassDOT Utility Accommodation Policy on State Highway Right of Way, 2013, or most recent copy.

1.04 SUBMITTALS

- A. All submittals shall be due within 30 days from Notice to Proceed (NTP), unless otherwise noted.
- B. Qualifications Submittal – due upon Project award must include the following:
 1. Cover sheet.
 2. List date, company name, address, telephone/fax, contact for trenchless subcontractor.
 3. Summary Sheet Descriptions of three (3) relevant projects successfully completed by the trenchless subcontractor within the past three (3) years that meet or exceed all the following criteria:
 - a. Project installation of pipe by auger boring or pipe jacking, as proposed for this project.
 - 1) All projects having installed pipe diameter greater than or equal to 48 inches.
 - 2) Projects shall have been completed successfully below an active highway or railroad with a minimum Project Drive length of 150 feet from Launching Pit to Receiving Pit.
 - 3) Project subsurface conditions consisting of granular soils.
 4. Submit resumes of Key Personnel available for this project. Key Personnel shall meet the experience requirements as listed in Paragraph 1.07 of this Section and shall include the following personnel as a minimum:
 - a. Professional Engineer sealing submittals

- b. Superintendent over the auger boring operation
 - c. Auger boring machine operator.
- C. Shop drawings and Material Safety Data Sheets (MSDS, where appropriate) for all materials to be utilized by the auger boring process.
- D. Equipment Staging and Access Plan for auger bore launching and receiving pits demonstrating that all equipment and work will fit within the allocated access easements and established workspace and showing all access points for all construction equipment and personnel. Show location, horizontal and vertical dimensions of all equipment. The Contractor will be required to complete the Work within the allocated workspace limits shown on the Contract Drawings.
- E. Construction dewatering submittal as required by Section 02240 – Construction Dewatering and Groundwater Control.
- F. Construction Schedule. Provide a schedule for all auger bore work meeting requirements of Section 01310 – Progress Schedules, identifying all major construction activities as independent items. The schedule shall include, at a minimum, the following activities: instrumentation installation, mobilization, launching and receiving pit excavation and support, work pit bottom preparation, thrust block construction, dewatering system installation (as applicable), jacking equipment setup, auger bore advance, installation of the casing pipe, contact grouting, installation of the carrier pipe, casing annulus grouting, and work pit backfill. The schedule shall also include the work hours and workdays for each activity, and a written description of the construction activities. The schedule will be reviewed by the Authority and shall be updated and resubmitted by the Contractor weekly.
- G. Support of Excavation Submittal. Contractor's excavation support design shall meet the requirements of Section 02311 – Support of Excavation. Launching and receiving pits (shafts) required for the Contractor's operations shall be constructed along the casing alignment in accordance with the Contract Drawings. Pit ground support and groundwater control systems, including shoring and bracing shall be selected, designed, and stamped by the Contractor's Professional Engineer registered in the Commonwealth of Massachusetts in accordance with standard industry practices. Contractor's design shall be submitted in accordance with the following provisions:
 - 1. Launching and receiving pits for auger boring shall be suitably sized for auger bore operations, the Contractor's selected casing pipe length, and shall be capable of withstanding all temporary loads associated with jacking the casing and for groundwater control (as applicable) without excess ground movement, in addition to laterally supporting the surrounding ground and providing a stable bottom of the pit suitable for working conditions.

2. The pit bottom subgrades shall be stable, dry and suitable for the proposed work. Pit bottom-slabs may be constructed at the Contractor's discretion.
 3. All adjacent equipment and spoils surcharge loads and live loads shall be considered in work pit (shaft) support design.
 4. The selected pit excavation and support methods and ground stabilization measures shall be suitable for the anticipated ground conditions.
 5. Provide a detailed design of the auger bore entry through the earth support system which prevents slurry, water and soil from entering the excavation through the entry or exit portal.
 6. Work pit design shall consider special framing, bracing or shoring required around casing pipe "eyes" or other penetrations.
 7. Any voids or seepage paths around pits and adjoining pipe sections shall be immediately sealed upon detection. Method of sealing shall be described in submittal. If dewatering is installed, the design shall address prevention measures to ensure that the jacking lubrication injection fluids and slurry do not impact the dewatering system and that the dewatering system does not impact the slurry or lubrication system.
 8. The work pit design shall incorporate thrust blocks or suitable reaction structures needed for jacking equipment, as required for jacking associated with auger boring operations. The thrust block shall be capable of withstanding full jacking thrust with a factor of safety of 1.5 and sufficiently rigid to resist deformation or rotation that would create deviation of the application of axial thrust to the pipe when under full jacking loads
 9. The Contractor shall have sole responsibility for sizing the work pits. Make size adequate for construction of any permanent structures indicated on the Contract Drawings and to provide adequate room to meet the Contractor's operational requirements for auger boring construction and for backfill.
- H. Dewatering Submittal. Dewatering shall meet the requirements of Section 02240 – Construction Dewatering and Groundwater Control. Contractor to provide a dewatering plan for each pit and for the trenchless crossing for excavation face stability. Include dewatering method, anticipated pit dewatering rate and associated ground water drawdown curve. Provide dewatering induced settlement curve as well. Dewatering methods shall not adversely impact performance of tunneling equipment or process.
- I. Auger Bore Submittal. Contractor's Auger bore submittal shall include the following:

1. Product data, equipment and description of methods to be utilized in the auger bore process including but not limited to jacking system, water auger, lubricants, and cutting heads. Include the following:
 - a. Detailed description of the auger bore process, including sequence of work.
 - b. Manufacturer's specifications for the auger bore equipment, including the guidance system.
 - c. Capacity, number and configuration of jacks, and jack calibration details for jacking force reporting.
 - d. Details of cutterheads, drill casings. The casing must be capable of providing full ground support to the excavation face for the anticipated subsurface conditions without the need to change tooling during the Drive.
 - e. Method of lubrication.
 - f. Details of thrust block. Thrust block design shall be developed and sealed by a Professional Engineer registered in the State of Massachusetts.
 - g. Equipment layout sketch within and adjacent to the pits. Include equipment dimensions and offsets as appropriate.
 - h. Method of alignment monitoring and steering control.
 - i. Description of surveying methods to set guidance system positions and a description of procedures to check and reset or realign guidance system during construction to ensure that thrust block, entry seal, and jacking frame are installed on proper line and grade.
 - j. Details of spoils transfer, handling, storage, transport, and disposal equipment and procedures. Provide details of cuttings and drill fluid disposal location and related permits, including transport permits.
 - k. Method of face excavation, and method of penetrating or removing various types of potential obstructions such as boulders, stone blocks, timber, stumps, timber, debris, buried foundations, and other obstructing material.
 - l. Method of stabilizing face in the event unstable conditions are encountered, or prolonged shutdown is required.

J. Jacking Pipe Submittal

1. Provide calculations prepared and sealed by a Massachusetts Professional Engineer demonstrating that the selected steel casing pipes can withstand the jacking loads

and long-term external traffic, earth and hydrostatic load conditions. Steel casing pipe shall be jacked into place directly behind the drill/auger casing. Provide calculations demonstrating the anticipated jacking force for the auger bore installation is within the safe jacking force for the casing pipe, as provided by the pipe manufacturer. All loads shall be shown and described.

2. Calculations for the MassDOT crossing must demonstrate that the casing can withstand the live loads in accordance with a document entitled MassDOT Utility Accommodation Policy on State Highway Right of Way, 2013, or most recent copy.
 3. Provide shop drawings showing fabrication tolerances, pipe jointing method and details, and grout port locations. Include details of joint cushion materials.
 4. Provide location of pipe storage.
 5. Provide Manufacturer's certification sheet, stating pipe dimensions, and maximum jacking force for the pipe.
 6. Provide details of contact grouting port size and location.
- K. Contact Grouting Plan. Submit proposed means and methods, including maximum allowable injection pressure to be used, of filling the annulus around the casing pipe with grout (contact grouting). The materials, proportions to be used and the method of grouting shall be prepared and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts and submitted for approval before the start of work. Compressive strength shall be confirmed through laboratory testing as assigned by Contractor's Engineer. Submit the following:
1. Proposed grout mix design including additives;
 2. Proposed densities and viscosities;
 3. Initial set times of the grout;
 4. Proposed method, materials, plans and criteria of grouting operations;
 5. Maximum injection pressures;
 6. The 24-hour and 28-day minimum compressive strength along with laboratory test results confirming design strength; and
 7. Qualifications of grouting sub-contractor(s).
- L. Annular Space Grouting Plan. Submit proposed means and methods, including maximum allowable injection pressure to be used, of filling the annulus between the casing and RCP drain with grout. The materials, proportions to be used and the method

of grouting shall be prepared and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts and submitted for approval before the start of work. Compressive strength shall be confirmed through laboratory testing as assigned by Contractor's Engineer. Submit the following:

1. Proposed method, plans and criteria of grouting operations;
 2. Bulkhead design;
 3. Grout pump specifications;
 4. Pressure gauge calibration records;
 5. Tremie tube pipe specifications, orientation and lengths and discharge locations;
 6. Proposed grout mix design including 24-hr and 28-day compressive strength along with laboratory test results (cylinder strength testing) confirming design strength;
 7. Proposed densities and viscosities and plan for measuring and confirming in the field;
 8. Initial set times of the grout;
 9. Maximum injection pressures and buckling capacity of RCP drain. Include means of monitoring and controlling pressures. Maximum injection pressure shall not exceed unconstrained buckling of the pipe with a factor of safety of 1.5;
 10. Heat of hydration of grout mix and means of protecting pipe joints as applicable; and
 11. Methods for controlling RCP buoyancy and alignment during grouting including blocking or spacers.
- M. Ground Movement Monitoring Plan: The Contractor shall be responsible for installing, monitoring and reporting surface settlements and heave along the auger bore alignment in accordance with Section 02495 – Geotechnical Instrumentation. Prepare and submit a schedule and plan summarizing installation of surface monitoring points, which shall be installed and monitored in accordance with the specified requirements.
- N. Construction Progress Submittals: Submit the following to the Authority during construction within the specified time restrictions.
1. Submit results of startup inspection described under part 3.01.A.5.
 2. Maintain a daily activity log during jacking operations and any associated delays. The log shall be submitted to the Authority for record purposes on a daily basis,

within 24 hours of completion of shift. The information and activities to be logged and submitted shall include:

- a. Start and finish time of advancement of each casing section.
 - b. Total distance jacked at the end of each day.
 - c. Horizontal and vertical alignment deviation from design centerline of leading casing at not greater than four (4)-foot intervals.
 - d. Maximum jacking force exerted during the installation of each casing section, including pipe breakout peaks following periods of system shutdown.
 - e. Cutter head torque.
 - f. General description of each discernible ground condition mined.
 - g. Volume of lubrication used.
 - h. Details and perceived reasons for delays greater than one (1) hour other than normal breaks and shift changes.
 - i. Details of any unusual conditions or events.
 - j. Occurrence of obstructions.
3. Submit results of contact grouting, including the following:
- a. Start and finish dates and times;
 - b. Injection pressures used;
 - c. Results of compressive strength testing;
 - d. Results of field grout testing; and
 - e. Volume of grout used per grout port.
4. Submit results of annular space grouting, including the following:
- a. Start and finish dates and times;
 - b. Injection pressures used;
 - c. Results of laboratory testing;
 - d. Results of field grout testing; and

e. Volume of grout pumped.

5. Notifications

a. Provide written notice for the following:

- 1) Jacking pipe(s) failing to conform as specified herein;
- 2) Damaged jacking pipe(s); and
- 3) Damaged jacking pipe gasket(s).

- O. Line and Grade: Submit results of line and grade survey demonstrating that pits have been constructed to the necessary grades, and the auger boring equipment has been staged as required to install the casing and carrier pipe to the design line and grades shown on the Contract Drawings. Submit prior to commencement of auger boring operations.
- P. As-Built: Upon completion of all auger boring operations submit a complete as-built drawing of all information related to the casing and carrier pipe installation.

1.05 UTILITY CLEARANCE

- A. Contact Massachusetts Digsafe (Massachusetts 811) a minimum of 72 hours prior to any excavation or boring and obtain utility clearance for all construction work. This utility clearance permit shall remain active for the duration of the project.
- B. The existing utilities shown on the Contract Drawings are approximate. Locations and elevations of these utilities must be verified by the Contractor prior to construction. Maintain a minimum of three (3) feet of between the new casing pipe and any confirmed existing utility.
- C. Prior to excavation, verify by vacuum excavation or other non-destructive means the location of all utilities located which cross the auger bore path, or which pass within 25 feet of the bore path. Location of utilities shall be provided to the Authority prior to construction.

1.06 DEFINITIONS

- A. Auger Boring for this project is defined as the trenchless pipe installation method for directly installing the casing pipe by hydraulic or other jacking from a launch pit such that the casing pipe forms a continuous string in the ground. Materials at the face of the casing are removed by a rotating cutterhead connected to continuous flight augers, which transport the spoils back to the launch pit.
- B. Annular Grouting: Means of filling annular space between steel casing pipe and RCP

drain with grout.

- C. Jacking Pipe, Casing Pipe: The steel pipe (casing pipe) used to advance auger bore and specifically designed for loads due to jacking installation and long term ground, fluid, and live loads.
- D. Contact Grout: Grout injected into the theoretical space between the jacking pipe and the ground after the drive is completed.
- E. Jacking Frame: A structural component that houses the hydraulic cylinders used to propel the casing and augers. The jacking frame serves to distribute the thrust load to the pipeline and the reaction load to the shaft wall or thrust block.
- F. Jacking Shaft, Launching Shaft, Jacking Pit: Excavation from which trenchless technology equipment is launched and driven from.
- G. Laser: An optical system projecting a beam to a target to provide guidance reference for the excavation.
- H. Lubrication: A fluid, normally bentonite and/or polymers, used to reduce jacking loads on the jacking pipe.
- I. Principal Dimension: The largest of the three dimensions of an object.
- J. Penetration Seal: Seal maintained at the launch shaft to allow egress and ingress of casing and pipe, and limit inflow of soil and water.
- K. Receiving Shaft, Retrieval Shaft, Receiving Pit: Excavation into which the trenchless technology equipment is driven toward and recovered.
- L. Spoils: Earth, bedrock, and other materials excavated during auger boring.
- M. Water Jetting: Cleansing mechanism of the cutterhead where high-pressure water is sprayed from nozzles in the cutterhead to help remove cohesive soils.

1.07 QUALITY ASSURANCE

- A. All trenchless work shall be performed by an experienced contractor utilizing Key Personnel having the following minimum qualifications:
 - 1. Operator: Minimum five years of experience as auger bore operator and having completed at least three installations of similar length, size, diameter, pipe material, and subsurface conditions within the past five (5) years using the same method and similar equipment planned for this project.
 - 2. Superintendent: Minimum three (3) years of experience as a superintendent and

having a minimum of one (1) similar auger bore or pipe jacking project experience.

3. Professional Engineer: Registered in the State of Massachusetts and a minimum of five (5) years of experience providing design support in area of application associated with auger boring or pipe jacking projects including contact grouting and annulus grouting.
- B. No key personnel may be changed from the project without prior written approval of the Authority.
- C. The Contractor's surveyor responsible for line-and-grade control shall be a professional Land Surveyor licensed in the Commonwealth of Massachusetts who has prior experience in similar projects.
- D. The Authority shall have full access to the site prior to, during, and following all auger boring operations. Furnish necessary assistance and cooperation to aid the Authority in observations, measurements, data, and sample collection, including, but not limited to the following:
 1. Visual access to real-time operator control screens, gauges, and indicators.
 2. The Authority shall have full access to the launching and receiving pits prior to, during, and following all jacking operations. This shall include, but not be limited to, visual inspection of installed casing and pipes, launch and retrieval seals, and verification of line and grade. Provide safe access in accordance with all safety regulations.
 3. The Authority shall be allowed to collect spoil samples at a minimum of once per installed pipe section, or every 10 feet, whichever is more often, and at any time when changes in soil conditions or obstructions are apparent or suspected.
 4. The Authority shall be present during contact and annular (casing) grouting.

1.08 SAFETY

- A. The Contractor is solely responsible for safety on the job site. Methods of construction shall be such as to ensure the safety of the work and of anyone on site, including the public. Perform all work in accordance with all current applicable regulations and safety requirements of the federal, state, and local agencies.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Auger bore equipment and methods shall meet the following requirements:

1. Utilize a bore head shall having a maximum $\frac{3}{4}$ -inch radial overcut and designed to withstand all anticipated jacking forces and point loads from the soil and bedrock indicated by the test borings included in the Contract Documents.
2. Be equipped to allow efficient forward progress in the materials demonstrated on the boring logs, including cobbles and boulders while minimizing potential ground loss or heave.
3. Be equipped to facilitate safe and controlled excavation of the advancing face at all times and shall be so configured such that access to the face for the removal of obstructions is possible.
4. Utilize a spoil transportation system that has the capacity for removal of spoil in balance with excavation and drill casing advance. Spoil transportation and disposal, hoisting, lifting, safety and control equipment shall be compliant with applicable local codes and standards.
5. Soil removal methods shall incorporate use of temporary casing and augers such that the total system facilitates safe and controlled excavation of the advancing face at all times. Casing pipe shall be jacked into place directly behind the drill/auger casing following completion of the bore.
6. Provide a main jacking station at the launching/jacking pit capable of exerting uniform load to the pipe ring and at a speed commensurate with the speed of excavation advance. The jacking hydraulic circuit shall be set to relieve pressure at the maximum safe working capacity of the pipe as stated by the pipe manufacturer.
7. Inject bentonite slurry to lubricate the exterior of the casing pipe. Lubrication shall be injected through grout ports located immediately behind the overcut in the crown and springline. There shall be at least three grout fittings per casing pipe section. Equipment used to mix and pump the bentonite slurry shall be equipped with a pressure gauge located at the grout fitting. The gauge shall be certified by an approved testing laboratory within one (1) month prior to the beginning of slurry operations.

2.02 MATERIAL REQUIREMENTS

A. Steel Casing Pipe for Jacking

1. The steel pipe shall be seamless or continuously welded new steel pipe conforming to the requirements of ASTM A-36. Steel pipe shall be new pipe and have the equivalent strength of A-36 or greater.
2. Pipe Dimensions – Casing pipe shall have minimum wall thickness of 0.5-in, unless Contractor's jacking force calculations require thicker material.

3. Welded steel casing pipe shall be square cut with beveled ends for welding. Field joints shall be welded using complete joint penetration butt welds. Interlocking press-fit joint pipe (e.g., Permalok®) will be allowed provided it meets the installation and design requirements.
4. Finished pipe shall be straight.
5. The difference between major and minor outside pipe diameter shall not exceed one percent (1%).
6. All burrs at the ends of pipes shall be removed.
7. The welding of injurious defects in the pipe wall, provided their depth does not exceed one-third the wall thickness, will be permitted. Repairs of this nature shall be made by completely removing the defect, cleaning the cavity, and then welding.
8. The Contractor is responsible inspecting pipe and ensuring it meets the requirements of this Specification; however, the Authority reserves the right to inspect and reject the casing.
9. Each pipe section shall be marked with the manufacturer's distinguishing marking and pipe grade.
10. The casing pipe shall be provided with ports for injection of lubricant and for primary contact grouting, located as shown on the Contract Drawings. The ports shall be installed during the manufacturing of the pipe. No ports shall be added in the field. All ports shall be a minimum size to accommodate a threaded coupling for a minimum 1.0 in inside diameter hose. The ports shall be supplied with threaded grout port plugs. Refer to the Contract Drawings for required grout port spacing and locations.

B. Jacking Lubricants

1. Jacking lubricant design and maintenance to design parameters shall be the responsibility of the Contractor. The lubricants are anticipated to consist of bentonite slurry and compatible additives. Obtain and pre-treat the make-up water if required. Lubricants shall be a non-toxic slurry of bentonite and water. Additional additives, including polymers, shall be at the Contractor's discretion.
2. Lubricants shall be non-hazardous and suitable for landfill or similar disposal. Dispose of all excess bentonite slurry, cuttings, and shaft spoil after completion of the project at a legal off-site disposal area. Obtain all permits necessary for such disposal in accordance with Section 01060 – Permits and Regulatory Requirements and Section 02226 – Excavated Material Handling and Disposal.

- C. Contact Grout: Grout for annulus fill outside of the Casing Pipe shall be Portland Cement-based and delivered in bags or bulk. The contact grout shall consist of neat Portland cement and water. Grout shall have a minimum 24-hr compressive strength of 100psi and 28-day compressive strength of 500psi.
- D. Annular Grout: Grout for annulus fill inside of the Casing Pipe shall be Portland Cement-based and delivered in bags or bulk. The grout shall consist of neat Portland cement and water. Grout shall have a minimum 24-hr compressive strength of 100psi and 28-day compressive strength of 500psi. Cellular grout will be permitted provided it meets these strength requirements.
- E. Water: Water used for pipe lubricant or grout shall be clean, fresh and free from oil, organic matter or other deleterious matter and of neutral pH.

PART 3 EXECUTION

3.01 GENERAL

- A. Auger boring shall not begin until the following tasks have been completed:
 - 1. All required submittals have been provided, reviewed, and approved.
 - 2. Surface monitoring points have been installed and surveyed in accordance with the Ground Movement Monitoring Plan and Section 02495.
 - 3. Launching and receiving pit excavations and support systems have been completed in accordance with approved submittals. Locations and elevations of shafts shall have been surveyed to confirm that work can be completed in accordance with alignment and grade shown on Contract Drawings.
 - 4. The location, orientation and grade of the jacking frame and guide rails and entry/exit seals have been surveyed to ensure they are on the proper line and grade and to verify that they are properly supported. Special care shall be taken when setting the guide rails or jacking frame in the launching shaft to ensure stability and accuracy of the alignment and grade. Guide rails or jacking frame shall be securely attached to the concrete working slab (as applicable), with supplementary concrete or grout if necessary, to prevent movement or shifting during the work.
 - 5. A startup inspection of all mechanical and hydraulic systems associated with the auger boring operations has been completed. Prior to installation in the launch pit, the system shall be tested on the surface to ensure that the equipment is functioning properly. The Authority will be notified at least 72 hours prior to the startup inspection and a site inspector representing the Authority will be present during the startup inspection. Key machine performance data will be measured and recorded by the Contractor during this inspection, including cutterhead rotational

torque, functionality of main jacks, and other components. The records of the startup inspection will be submitted to the Authority within 24 hours of the completed inspection.

- B. Properly manage and dispose of groundwater inflows to the pits. Do not discharge groundwater inflows into storm sewers, sanitary sewers, drainage ditches, water bodies, or streets without an approved discharge permit. Follow all requirements of the approved discharge permit.
- C. If pits are located close to storm drainage channels, ditches, water mains, storm water or sanitary sewers or culverts, care must be taken to avoid washout or flooding of pits.
- D. Complete equipment staging and setup in accordance with the approved Equipment Staging Plan.
- E. Conduct all operations such that trucks and other vehicles do not interfere with traffic or create a mud or dust nuisance at the site. Promptly clean up, remove, and dispose of spoils.
- F. All work shall be done so as not to disturb roadways, pavements, water channels, adjacent structures, landscaped areas, or existing utilities. Any damage shall be immediately repaired to original or better condition and to the satisfaction of the Authority at no additional cost to the Authority.
- G. Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, operate with a full crew 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize stability.
- H. Establish and protect survey benchmarks as necessary prior to the start of construction.

3.02 LAUNCHING AND RECEIVING PITS

- A. Install launching and receiving pit soil support system in accordance with the approved submittals. Excavate shafts to the line and grade required for auger boring construction and for subsequent installation of the pipes and construction of appurtenances as applicable. Provide stable, dry working subgrades suitable for auger boring operations.
- B. Construct thrust blocks or reaction blocks in accordance with approved submittal.
- C. Provide ground water control as necessary and drainage from pits while work is in progress and until adjacent pipe joints have been properly sealed and the shaft is properly backfilled.
- D. Divert surface water runoff from the pit and protect the pits from infiltration or flooding by surface water, including discharge from any dewatering operation.

- E. Construct a suitable guardrail barrier around the periphery of the pits, meeting applicable State and Federal safety standards. Properly maintain the barrier throughout the period the pit remains open. Repair broken boards, supports, and structural members. In addition, provide suitable security barriers for each pit in which there is no construction activity or which is unattended by the Contractor's personnel.
- F. Whenever possible, minimize surface surcharge loads on pits from spoils piles, traffic, and stationary equipment.

3.03 AUGER BORING

- A. Provide at least 72 hours advance written notice to the Authority of the planned launch of the auger boring equipment. Immediately notify the Authority, in writing, when any problems are encountered with equipment or materials, or if the Contractor believes the conditions encountered are materially and significantly different than those represented within the Contract Documents. All work shall be done in the presence of the Authority unless the Authority grants prior written approval to perform such work in the Authority's absence.
- B. Auger boring shall be performed in a manner required to install casing pipe to allow installation of RCP drain as indicated on the Contract Drawings without damage to the casing or the drain by the tunneling equipment.
- C. The equipment and method of auger boring and excavation selected shall minimize settlement of pavements, utilities and structures above and adjacent to the jacking/bored alignment yet be capable of penetrating potential obstructions. Prevent the occurrence of voids outside the auger bored pipe that will endanger existing roads or structures. If voids occur, immediately fill them with cement grout. Contractor shall be entirely and solely responsible for damage to pavements and utilities resulting from auger boring operations, including traffic control costs.
- D. Contractor shall be responsible for type of auger boring equipment, cutterheads, excavation methods and other pertinent equipment and operations required for complete installations. Contractor shall be responsible for mobilizing on-site with a full range of drill tools for the anticipated subsurface conditions, based on the test boring logs and other subsurface data provided.
- E. Once the auger boring operation has begun, work continuously and diligently until the complete length of casing has been installed.
- F. Use a jacking ring to evenly distribute the jacking pressure around the wall of the jacked casing and carrier pipes.
- G. Have on site at all times equipment and materials needed for, dewatering, and auger boring operations in accordance with their work plan.

- H. Control groundwater as required to maintain a stable face.
- I. If used, provide and mix the required drill fluids/lubricants to suit the soil materials to be encountered. Drill lubricants shall be utilized and mixed in full accordance with the drilling fluid manufacturer's printed instructions.
- J. Make required connections to hydrants or bringing in water as necessary. Coordinate connections to existing fire hydrants in advance with the Town of Needham, which shall include necessary hoses, fittings, and a meter and backflow preventer assembly approved by the Town of Needham Water Department. Otherwise, water shall be brought to the site by the Contractor. Provide all items at no expense to the Authority. Connection shall include hydrant meter and an approved backflow prevention device.
- K. Use survey benchmarks to furnish and maintain all reference lines and grades for auger boring. Use these lines and grades to establish the exact location of the casing. The Contractor is fully responsible for the accuracy of the Work and the correction of it, as required. Install the jacking pipe shall be installed such that the carrier pipe meets the line and grade in accordance with the Contract Drawings.
- L. Record and report volume of excavated materials and cobble and boulder quantities removed from the hole to the Authority's designated representative.
- M. If the auger boring operations should encounter an object or condition that impedes the forward progress, notify the Authority immediately. Submit a plan to correct the condition, and remove, clear, or otherwise make it possible for the auger bore to advance past any and all objects or obstructions that impede forward progress. The safe jacking strengths of the pipe shall not be exceeded.
- N. The Contractor shall be capable of stabilizing face in the event of a work delay or shutdown.
- O. The annular space between the casing pipe and surrounding soil shall be completely filled with grout through casing ports in accordance with the Contact Grouting Plan immediately following casing pipe installation.
- P. Following completion of contact grouting, the casing pipe shall be cleaned of all deleterious materials, and the RCP pipe installed to the design line and grade within the casing. The contractor shall be responsible for use and placement of skids, blocking or spacers as appropriate to develop and maintain line and grade. Pipe supports shall not result in excessive load on pipe or pipe joints and shall not restrict placement of annular grout. The carrier pipe shall not be installed until approval of the casing pipe by the Authority.
- Q. If the RCP installation does not meet the specified tolerance in Section 02612 – Reinforced Concrete Pipe, correct the installation including any necessary redesign of

the pipeline or structures and acquisition of necessary easements. All corrective Work shall be performed by the Contractor at no additional cost to the Authority and without schedule extension, and is subject to the written approval of the Authority.

- R. The auger bore shall be considered a confined space. All operations within the auger bore casing and carrier pipe shall therefore comply with all applicable confined space access and safety requirements, including OSHA. Provide and maintain all training certificates and equipment necessary to pursue confined space work.
- S. Following installation of RCP drain, fill annulus between casing and carrier pipe with grout in accordance with the Annular Space Grouting Plan. Complete grouting through bulkheads using tremie tubes. The Authority shall witness all grouting. Ensure that the RCP drain pipe is not damaged during the grouting process.
- T. During auger boring operations, monitor and report ground movement in accordance with approved Ground Movement Monitoring Plan and Section 02495 – Geotechnical Instrumentation. All paved surfaces must be monitored per the approved Ground Movement Monitoring Plan for an additional one (1) month after completion of trenchless installation activities to verify the absence of settlement prior to acceptance.

**** END OF SECTION ****