INFRASTRUCTURE DEVELOPMENT AGREEMENT

(Wastewater Facilities)

THIS INFRASTRUCTURE DEVELOPMENT AGREEMENT (this "Agreement") is entered into as of the ____ day of February, 2021 (the "Effective Date"), by and between TOWN OF WAYLAND, acting by and through its Board of Selectmen (hereinafter "Seller"), a Massachusetts municipal corporation having an address of 41 Cochituate Road, Wayland, MA 01778, and ALTA RIVER'S EDGE, LLC, a Delaware limited liability company having its business address c/o Wood Partners, 91 Hartwell Avenue, Lexington, MA 02421, Attn: Jim Lambert (hereinafter "Buyer"). Each of Seller and Buyer are sometimes individually referred to herein as a "Party" and collectively as the "Parties".

RECITALS

A. Concurrently with the execution of this Agreement, Seller has conveyed to Buyer that certain property commonly known as 490 Boston Post Road in the Town of Wayland, Middlesex County, Commonwealth of Massachusetts, shown as "Lot A", "Lot C", and "Lot E" (the "Buyer's Property") on that certain plan entitled "ANR Subdivision Plan Assessors Map 22, Lot 3, Lot 6 & Lot 7 Boston Post Road Wayland, Massachusetts" prepared by WSP Transportation & Infrastructure, dated June 1, 2015, endorsed by the Wayland Planning Board on June 2, 2015, and recorded with the Middlesex South Registry of Deeds (the "Registry") as Plan No. 260 of 2017 (the "ANR Plan"). The acquisition of the Buyer's Property was consummated pursuant to a Land Disposition Agreement for the Sale and Redevelopment of Land between Seller and Buyer dated as of July 28, 2017 (as amended from time to time, most recently by a Twelfth Amendment dated on or about the date hereof (the "Twelfth Amendment"), the "LDA"). Capitalized Terms which are not otherwise defined herein shall have the meanings ascribed thereto in the LDA.

B. Buyer intends to construct a development of 218 multi-family apartment units on the Buyer's Property, together with required parking, landscaping, curb cuts, street openings and related amenities, all as more particularly provided in the plans and Approvals for the Buyer's Project (collectively, the "Buyer's Project").

C. Pursuant to the Twelfth Amendment, Seller has agreed, at its sole cost and expense, to design, permit and construct the Seller's WWTP Improvements (hereinafter defined) which are required to bring sanitary sewer service to Buyer's Project.

D. Prior to Seller agreeing to construct the Seller's WWTP Improvements, it was contemplated under the LDA that Buyer would permit and construct an on-site wastewater treatment facility, leaching field, and associated force mains, lines, pumps, equipment and facilities which would allow for the receipt, treatment and disposal or dispersion of sewerage effluent from the Buyer's Project on a private, self-contained basis (the "Buyer's Self-Contained WWTP Improvements").

E. The Seller's WWTP Improvements will, among other things, receive and treat wastewater effluent from Buyer's Project ("Buyer's Project Effluent") and return treated effluent from the Seller's Town Center wastewater treatment facility (the "Town Wastewater Treatment Plant") to the Buyer's Leaching Field (hereinafter defined); *provided, however*, that the Town shall in no event return treated effluent from the Town Wastewater Treatment Plant in quantities which exceed the amount that the leaching field is designed to receive ("Returned Effluent").

F. Buyer will be constructing the Buyer's Retained WWTP Improvements (hereinafter defined) on the Buyer's Property which will allow for the release and pumping of Buyer's Project Effluent into the Seller's WWTP Improvements at the point of connection with the Buyer's Retained

WWTP Improvements on the Buyer's Property and the receipt of Returned Effluent after being treated at the Town Wastewater Treatment Plant.

G. This Agreement is the Infrastructure Development Agreement contemplated by the Twelfth Amendment to the LDA and addresses, among other things, Seller's obligation to timely design, permit and construct the Seller's WWTP Improvements and Buyer's remedies in the event Seller fails to comply with such obligation.

NOW, THEREFORE, in consideration of the foregoing recitals, mutual covenants contained herein, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Seller and Buyer agree as follows:

1. Purpose/Definitions. The purpose of this Agreement is described in the Recitals and said Recitals are incorporated herein by reference. Additionally, the following capitalized terms used in this Agreement have the respective meanings assigned to them below:

"Applicable Legal Requirements" means, collectively, all laws, rules, statutes, ordinances, regulations and codes of any governmental or quasi-governmental body, authority, department or agency, including, but not limited to, the terms of all permits and other governmental approvals required to legally carry out and complete the work which is the subject of this Agreement or any portion thereof.

"Approvals and Contracts" shall have the meaning set forth in Section 5.2(d) hereof.

"Buyer's Construction Schedule" shall mean the construction schedule for the Buyer's Project attached hereto as Exhibit D, as the same may be updated from time to time by Buyer's Contractor. Notwithstanding anything in this Agreement to the contrary, in no event shall any modifications to Buyer's Construction Schedule be deemed to accelerate any Seller's WWTP Work Milestone Deadline.

"Buyer's Contractor" shall mean River's Edge Builders LLC, a Delaware limited liability company and Buyer's general contractor for Buyer's Project, any successor or assignee thereof, or any replacement general contractor retained by Buyer for Buyer's Project.

"Buyer's Increased Project Costs" shall mean additional or incremental increases in contractor general conditions costs and related fees and expenses which Buyer incurs as a result of (i) Seller's failure to cause Seller's WWTP Work Final Completion to occur by the Seller's WWTP Work Final Completion Milestone Deadline established therefor or (ii) otherwise on account of a Seller Event of Default, provided Buyer has not made the Buyer's Self-Contained WWTP Work Election on the terms hereof, in which case other remedies and provisions of this Agreement shall control.

"Buyer's Increased Project Costs Requisition" shall have the meaning assigned thereto in the WWTP Escrow Agreement.

"Buyer's Project Completion" means that (i) applicable Governmental Authorities have issued a certificate of occupancy (which may be a temporary certificate of occupancy) for the entirety of Buyer's Project or its functional equivalent permitting the lawful use of the Buyer's Project for its intended purpose; and (ii) Buyer's Project is otherwise "Complete" as provided in the LDA.

"Buyer's Project Delay" shall mean the number of days, as determined by Buyer's Contractor in its good faith and reasonable discretion with reasonable documentation in support thereof, and as reflected on Buyer's Construction Schedule, that Buyer's Project Initial T/C/O Date is actually delayed on account of a Seller Event of Default.

"Buyer's Project Delay LD Requisition" shall have the meaning assigned thereto in the WWTP Escrow Agreement.

"Buyer's Project Delay Liquidated Damages" shall mean $12,000 per day for every day of Buyer's Project Delay, which, if Buyer is entitled thereto pursuant to the provisions of this Agreement, are intended to compensate Buyer for any and all damages and losses which Buyer sustains or may sustain on account of a Buyer's Project Delay, specifically excluding Buyer's Increased Project Costs which, if applicable, shall be in addition to and not includable within Buyer's Project Delay Liquidated Damages (collectively, subject to such exclusion, "Anticipated Buyer Project Delay Losses"), including without limitation lost income and revenues from the leasing and operation of Buyer's Project (including impacts of seasonality on lease-up and stabilization of the Buyer's Project), additional interest and other carry costs and expenses associated with the Buyer's financing and otherwise in connection with the maintenance and operation of the Buyer's Project prior to Buyer's Project Completion (including insurance costs, taxes, utilities and other operational expenses), and the negative impact on investment returns for Buyer's capital partners. The Parties acknowledge and agree that the Anticipated Buyer Project Delay Losses are uncertain and difficult to estimate, and that therefore the Buyer's Project Delay Liquidated Damages constitute a reasonable pre-estimate and liquidation of such Anticipated Buyer Project Delay Losses and are not intended as a penalty, but as full liquidated damages associated with any Buyer's Project Delay.

"Buyer's Project Initial T/C/O Date" means the date upon which applicable Governmental Authorities issue (or plan to issue, as the case may be) the first temporary certificate of occupancy for Buyer's Project (or applicable portion thereof).

"Buyer's Project O/M Agreement" shall mean an agreement between the Seller (including its applicable divisions or departments, including the Wayland Wastewater Management District Commission (in any case, the "Wastewater Governing Authority")) and the Buyer which addresses the ongoing operation and maintenance of the Buyer's Retained WWTP Improvements, on terms mutually approved by the Wastewater Governing Authority and the Buyer.

"Buyer's Project O/M Fees" shall mean any and all annual user rates and fees charged or to be charged by the Seller and/or the Wastewater Governing Authority in connection with the ongoing operation and maintenance of the Buyer's Retained WWTP Improvements and the WWTP System in general as applied to the Buyer's Project, taking into account any credits, discounts, or offsets which Buyer may receive based on the construction of the Buyer's Retained WWTP Improvements or otherwise.

"Buyer's Retained WWTP Improvements" shall mean the following improvements to be constructed by Buyer on the Buyer's Property, as detailed or will be further detailed in Buyer's Retained WWTP Work Plans: (i) a force main, pumps, and related lines, fixtures and equipment which will carry and pump Buyer's Project Effluent to the point of connection with the Seller's WWTP Improvements at the property line for Buyer's Property; and (ii) a leaching field and related equipment and facilities (the "Buyer's Leaching Field") which will receive Returned Effluent from the Seller's WWTP Improvements after being treated at the Town Wastewater Treatment Plant.

"Buyer's Retained WWTP Work" shall mean the work to be performed by Buyer to install or construct the Buyer's Retained WWTP Improvements.

"Buyer's Retained WWTP Work Plans" shall mean the plans and specifications prepared by Buyer's architect or engineer for the Buyer's Retained WWTP Improvements.

"Buyer's Self-Contained WWTP Improvements" shall have the meaning set forth in the Recitals hereto, and as the same are more fully detailed in the plans, specifications, permits and other Approvals therefor.

"Buyer's Self-Contained WWTP Work" shall mean the work to be performed by Buyer to install or construct the Buyer's Self-Contained WWTP Improvements, if Buyer is entitled to and elects to install or construct same pursuant to the provisions of this Agreement by making the Buyer's Self-Contained WWTP Work Election.

"Buyer's Self-Contained WWTP Work Contractor" shall mean Ricciardi Bros., Inc. (the "Chosen WWTP Work Contractor"), or such other contractor which Buyer or Buyer's Contractor engages for the performance of the Buyer's Self-Contained WWTP Work, if applicable on the terms hereof, which shall be subject to Seller's prior written approval, not to be unreasonably withheld, conditioned or delayed.

"Buyer's Self-Contained WWTP Work Costs" shall mean any and all hard and soft costs and expenses incurred by Buyer in connection with the design, permitting and construction of the Buyer's Self-Contained WWTP Improvements should Buyer make the Buyer's Self-Contained WWTP Work Election, which shall include without limitation all costs, expenses and damages which, but for the Buyer's Self-Contained WWTP Work Deferral Period, Buyer would not have incurred had Buyer proceeded with the Buyer's Self-Contained WWTP Work from and after the Effective Date, including: (i) price escalations during the Buyer's Self-Contained WWTP Deferral Period; (ii) costs associated with Buyer's Self-Contained WWTP Work which the Buyer is forced to perform out-of-sequence relative to other components of Buyer's Project due to the Buyer's Self-Contained WWTP Work Deferral Period; (iii) contractor general conditions costs; (iv) increased costs associated with engagement of a Buyer's Self-Contained WWTP Contractor (including increased redesign costs and expenses) if the Chosen WTTP Work Contractor cannot accommodate Buyer's Construction Schedule and Buyer must engage another Buyer's Self-Contained WWTP Contractor; and (v) additional or incremental increases in contractor fees associated with any of the foregoing. In the event of a Buyer O/M Failure Event, Buyer shall use commercially reasonable efforts to provide its estimate of Buyer's Self-Contained WWTP Work Costs to Seller within ninety (90) days after the Permit Deadline.

"Buyer's Self-Contained WWTP Work Costs Requisition" shall have the meaning assigned thereto in the WWTP Escrow Agreement.

"Buyer's Self-Contained WWTP Work Costs Requisition Threshold" shall mean an amount equal to (A) $2,543,303 (i.e. the Original WWTP Work Estimate), less (B) the amount of Final On-Site WWTP Escrow Funds actually funded into the escrow which is the subject of the WWTP Escrow Agreement pursuant to the Twelfth Amendment and Section 4 hereof.

"Buyer's Self-Contained WWTP Work Deferral Period" shall mean the period commencing on the Effective Date and continuing until the date Buyer (i) makes a Buyer's Self-Contained WWTP Work Election, (ii) finalizes using all reasonable due diligence all relevant design and construction contracts associated therewith and obtain all required permits and approvals therefor, and (iii) is prepared to provide a notice to proceed to Buyer's Self-Contained WWTP Contractor for the performance of the Buyer's Self-Contained WWTP Work promptly after obtaining all permits and approvals therefor.

"Buyer's Self-Contained WWTP Work Election" shall have the meaning set forth in Section 5.2(a) hereof.

"Buyer's WWTP Damages" shall collectively mean, as applicable pursuant to the terms of this Agreement and the LDA, (i) Buyer's Project Delay Liquidated Damages, (ii) Buyer's Increased Project Costs, (iii) Buyer's Self-Contained WWTP Work Costs which exceed the Buyer's Self-Contained WWTP Work Costs Requisition Threshold, and (iv) Buyer's WWTP Self-Help Costs. Buyer's WWTP Damages (and each component comprising such damages in the foregoing clauses (i) through (iv)) shall specifically exclude any costs, expenses, damages, liabilities or losses incurred or sustained by Buyer which are attributable to delays caused by Buyer or its applicable agents, consultants, engineers, or contractors with respect to the development, design or construction of the Buyer's Project which are independent of and unrelated to Seller's performance of the Seller's WWTP Work.

"Buyer's WWTP Damages Requisition" shall have the meaning assigned thereto in the WWTP Escrow Agreement.

"Buyer's WWTP Self-Help Costs" shall have the meaning set forth in Section 5.2(d) hereof.

"Buyer's WWTP Self-Help Requisition" shall have the meaning assigned thereto in the WWTP Escrow Agreement.

"Construction Schedule" means each of Buyer's Construction Schedule and Seller's Construction Schedule, as applicable.

"Escrow Agent" shall have the meaning set forth in Section 4 hereof.

"Force Majeure Delay" shall mean a delay or stoppage of each of Seller's WWTP Work and the development of Buyer's Project (including the Buyer's Retained WWTP Work) caused by a state-imposed shutdown or statewide restrictions on the permitting and/or performance of construction activities. In no event shall a party's financial condition or inability to fund or obtain funding or financing constitute a Force Majeure Delay.

"Governmental Authorities" shall mean any and all governmental or quasi-governmental authorities with jurisdiction over the Seller's WWTP Work or any other applicable work which is the subject of this Agreement.

"Seller's Construction Schedule" means the construction schedule for the Seller's WWTP Work as provided on Exhibit B attached hereto, as the same may be updated by Seller's Work Contractor from time to time, and which updates shall be promptly delivered to Buyer.

"Seller's Groundwater Discharge Permit" shall mean the permit that Seller will require from Massachusetts Department of Environmental Protection ("DEP") to discharge Returned Effluent into the Buyer's Leaching Field.

"Seller's Work Contract" means the contract(s) entered into with the Seller's Work Contractor for the Seller's WWTP Work, as the same may be amended from time to time.

"Seller's Work Contractor" means the contractor(s) engaged by Seller to perform the Seller's WWTP Work.

"Seller's WWTP Escrow Release Requisition" shall have the meaning assigned thereto in the WWTP Escrow Agreement.

"Seller's WWTP Improvements" shall mean all utility lines, equipment, facilities, force mains, pumps, meters and related improvements which are required to effectively and legally receive, carry and treat Buyer's Project Effluent, to return Returned Effluent to the Buyer's Leaching Field and to otherwise bring and appropriately measure public sanitary sewer service to Buyer's Project (collectively, "Buyer's Project Wastewater Requirements"), as more fully (or will be more fully) detailed in the Seller's WWTP Work Plans, including without limitation: (i) certain alterations or modifications to the Town Wastewater Treatment Plant required to receive and treat effluent from Buyer's Project and return the Returned Effluent to Buyer's Leaching Field (the "Town WWTP Modifications"), and (ii) force mains, meters, pumps and related fixtures, equipment and improvements which will generally run along or in close proximity to U.S. Route 20, will carry (and appropriately measure) Buyer's Project Effluent from the boundary line of Buyer's Property at the point of connection with the Buyer's Retained WWTP Improvements to the Town Wastewater Treatment Plant and will carry (and appropriately measure) Returned Effluent from the Town Wastewater Treatment Plant once treated to Buyer's Leaching Field (the "Force Main Improvements"). For avoidance of doubt, the Town WWTP Modifications shall not include those elective upgrades which Seller may make to the Town Wastewater Treatment Plant that are not necessary to satisfy the Buyer's Project Wastewater Requirements.

"Seller's WWTP Work" (also referred to herein sometimes as the "Seller's Work") means the work to be performed by Seller to install or construct the Seller's WWTP Improvements as detailed in the Seller's WWTP Work Plans and Seller's WWTP Work Permits.

"Seller's WWTP Work 50% Completion" means, collectively, Seller's WWTP Work 50% Force Main Completion and Seller's WWTP Work 50% Town WWTP Modifications Completion.

"Seller's WWTP Work 50% Force Main Completion" means that 50% of the total linear feet of the force mains required to be installed as part of the Force Main Improvements, including 50% of those force mains which are to be located within Massachusetts DOT jurisdictional rights-of-way ("MA DOT ROWs") as part of Seller's WWTP Work (the "DOT Force Mains"), have been installed in accordance with the Seller's WWTP Work Plans, Seller's Work Permits and all Applicable Legal Requirements, as confirmed by receipt and delivery to Buyer of a certification by the Seller's architect or engineer of record and Seller's Work Contractor that such level of completion has been achieved, along with an updated version of Seller's Construction Schedule evidencing same.

"Seller's WWTP Work 50% Town WWTP Modifications Completion" means that 50% of the Town WWTP Modifications are completed in accordance with the Seller's WWTP Work Plans, Seller's Work Permits and all Applicable Legal Requirements, as confirmed by receipt and delivery to Buyer of a certification by the Seller's architect or engineer of record and Seller's Work Contractor that such level of completion has been achieved, along with an updated version of Seller's Construction Schedule evidencing same.

"Seller's WWTP Work Acceptance and Disposal Completion" shall mean that Seller's WWTP Improvements are completed to such a level that they can legally accept and dispose of Buyer's Project Effluent, all in accordance with the Seller's WWTP Work Plans, Seller's Work Permits and all Applicable Legal Requirements, as confirmed by receipt and delivery to Buyer of a certification by the Seller's architect or engineer of record and Seller's Work Contractor that such level of completion has been achieved.

"Seller's WWTP Work Final Completion" means that (i) all Seller's WWTP Improvements are fully completed in a lien-free manner in accordance with the Seller's WWTP Work Plans, Seller's WWTP Work Permits and all Applicable Legal Requirements, as confirmed by receipt and delivery to Buyer of a certification by the Seller's architect or engineer of record and Seller's Work Contractor that

such level of completion has been achieved; (ii) applicable Governmental Authorities have issued a certificate of completion respecting the Seller's WWTP Work or its functional equivalent permitting the lawful use of the Seller's WWTP Improvements for their intended purpose; (iii) the Seller's WWTP Improvements are otherwise fully functional and ready to receive, carry and treat all Buyer's Project Effluent and return the Returned Effluent to the Buyer's Project subject only to the completion of any unfinished Buyer's Retained WWTP Work; and (iv) subject to Buyer's compliance with Section 2(e) below, Seller shall have been issued a Seller's Groundwater Discharge Permit.

"Seller's WWTP Work Milestone" shall mean each of the following: (i) submission of all required applications, documents, requests or other filings for the Seller's WWTP Work Permits ("Seller's WWTP Permit Submissions"); (ii) (1) receipt of all Seller's WWTP Work Permits and (2) (y) a draft of Buyer's Project O/M Agreement shall have been provided to Buyer and (z) the consent of Seller's engineer for Seller's WWTP Work substantially in the form attached hereto as Exhibit C (or in such other form mutually agreed to by Seller, Buyer, and such engineer) shall have been provided to Buyer (collectively, clauses (y) and (z), the "Additional WWTP Documents"); (iii) the full execution and delivery of Seller's Work Contract by Seller and Seller's Work Contractor for the full scope of the Seller's WWTP Work, together with the issuance of a notice to proceed to Seller's Contractor (collectively, "Seller's Work Contract Execution"); (iv) Seller's WWTP Work 50% Completion; (v) Seller's WWTP Work Acceptance and Disposal Completion; and (vi) Seller's WWTP Work Final Completion.

"Seller's WWTP Work Milestone Achievement Evidence" shall be mean evidence in a written notification from Seller to Buyer (including all requisite supporting documentation therefor described in the definition of each applicable milestone) confirming that Seller has achieved a particular Seller's WWTP Work Milestone.

"Seller's WWTP Work Milestone Deadline" shall mean each of the following dates for each applicable Seller's WWTP Work Milestone:

February 15, 2021 – Seller's WWTP Permit Submissions
April 30, 2021 (the "Permit Deadline") - Receipt of all Seller's WWTP Work Permits (other than the Seller's Groundwater Discharge Permit) and Delivery of the Additional WWTP Documents
May 15, 2021 – Seller's Work Contract Execution
September 1, 2021 – Seller's WWTP Work 50% Completion
October 1, 2021 – Seller's WWTP Work Acceptance and Disposal Completion
January 15, 2022 – Seller's WWTP Work Final Completion

"Seller's WWTP Work Permits" shall mean all any and all permits, approvals, easements, licenses, right-of-way condemnation actions, and consents required from any applicable Governmental Authorities or any other third parties which are required in order to allow for the performance and completion of the Seller's WWTP Work and the effective operation of the WWTP System once completed, including without limitation (i) any and all permits or approvals required from or under the Massachusetts Department of Transportation and the Massachusetts Department of Environmental Protection; and (ii) any approvals, easements, or licenses required from third-party property owners in order to construct the Seller's WWTP Improvements.

"Seller's WWTP Work Plans" means the plans and specifications for the Seller's WWTP Work described in Exhibit A attached hereto and made a part hereof, as the same may be updated or advanced from time to time in accordance with this Agreement and are deemed to include the Final Plans once approved pursuant to the provisions hereof.

"WWTP Easement Agreement" shall mean the Grant of Easements (Wastewater Facilities) entered into between the Buyer and Seller on or about the date hereof which, among other things, includes a grant of certain easements by Buyer to Seller (and attendant covenants of Seller) for the ongoing operation and maintenance of the Buyer's Retained WWTP Improvements once completed.

"WWTP Escrow Agreement" shall have the meaning set forth in Section 4 hereof.

"WWTP Escrow Funds" shall have the meaning set forth in Section 4 hereof.

"WWTP System" shall mean, collectively, the Buyer's Retained WWTP Improvements and the Seller's WWTP Improvements.

2. CONSTRUCTION PLANNING, PERMITTING AND CONSTRUCTION OF THE SELLER'S WWTP IMPROVEMENTS.

(a) Preparation and Approval of Plans for Seller's WWTP Work.

i. 50% Plans. Attached as Exhibit A to this Agreement are 50% complete engineered working drawings for all of the Seller's WWTP Improvements (the "50% Plans"). Buyer shall grant or deny its approval of the 50% Plans, which shall not be unreasonably withheld, conditioned or delayed, by February 17, 2021. If Buyer fails to grant or deny its consent to the 50% Plans by February 17, 2021, it shall be deemed that Buyer has approved the 50% Plans. If Buyer withholds its consent to the 50% Plans, Buyer shall provide reasonably detailed comments setting out the specific reasons that Buyer has not approved (or is deemed to approved) the 50% Plans. This process shall continue until Buyer has approved the 50% Plans, except that Buyer shall only have five (5) business days to approve or withhold its consent to each submittal to Buyer of subsequent drafts of the 50% Plans following the initial submittal thereof, and failure of Buyer to timely approve or withhold its consent within such 5-business day period shall mean that the 50% Plans are deemed approved. Buyer's approval of the 50% Plans hereunder will in no event constitute a representation or warranty by Buyer as to the adequacy or sufficiency of such plans, or the improvements to which they relate, for any use, purpose or condition, but such approval shall constitute Buyer's confirmation that, among other things, the 50% Plans depict appropriate connections to and with the Buyer's Retained WWTP Improvements at the boundary line of Buyer's Property. During any period of time the Buyer is reviewing and commenting on the 50% Plans beyond the initial February 17, 2021 review period noted above, the period(s) of time of such review and commentary beyond the initial February 17, 2021 review period (until the 50% Plans are approved or deemed approved by Buyer) shall be added to Seller's WWTP Work Milestone Deadline with respect to Seller's WWTP Permit Submissions.

ii. Final Plans. Seller shall, at its sole cost and expense, cause complete engineered working drawings for all of the Seller's WWTP Improvements (the "Final Plans") to be prepared by March 1, 2021.

Seller shall submit the Final Plans to Buyer for its approval, which shall not be unreasonably withheld, conditioned or delayed so long as the Final Plans are materially consistent with the Seller's 50% Plans. Buyer shall grant or deny its approval of the Final Plans within three (3) business days after Buyer's receipt of same. If Buyer fails to grant or deny its consent to the Final Plans within such 3-business day period, it shall be deemed that Buyer has approved the Final Plans. If Buyer withholds its consent to the Final Plans, Buyer shall provide reasonably detailed comments setting out the specific reasons that Buyer has not approved (or is deemed to approved) the Final Plans. This process shall continue until Buyer has approved the Final Plans. Buyer's approval of the Final Plans hereunder will in no event constitute a representation or warranty by Buyer as to the adequacy or sufficiency of such plans, or the improvements to which they relate, for any use, purpose or condition, but such approval will merely be the consent of Buyer to such plans so that Buyer can confirm, among other things, appropriate connections to and with the Buyer's Retained WWTP Improvements at the boundary line of Buyer's Property; ***provided, however***, that if Seller constructs the Seller's WWTP Improvements in accordance with the Final Plans as approved by Buyer, the Buyer shall be precluded from later making a claim that the Seller's WWTP Improvements are not compatible for connection to and with the Buyer's Retained WWTP Improvements. Once the Final Plans are approved or deemed approved pursuant to the foregoing process, Seller will not modify such plans in a manner that would negatively impact the Buyer's Project or the Buyer's Retained WWTP Improvements (including the scope, timing or cost thereof) without again complying with the approval requirements set forth hereinabove with respect to any such proposed changes. During any period of time the Buyer is reviewing and commenting on the Final Plans beyond the initial 3-business day review period noted above, the period(s) of time of such review and commentary beyond the initial 3-business day period (until the Final Plans are approved or deemed approved by Buyer) shall be added to Seller's WWTP Work Milestone Deadline with respect to Seller's WWTP Permit Submissions.

(b) Permitting and Construction of Seller's WWTP Improvements. Once the Final Plans are approved or deemed approved pursuant to subsection (a) above, Seller will, at its sole cost and expense, diligently and expeditiously prepare all relevant Seller's WWTP Permit Submissions and otherwise pursue the procurement of all Seller's WWTP Work Permits. Upon receipt of all Seller's WWTP Work Permits, Seller shall, at its sole costs and expense, construct Seller's WWTP Improvements in compliance with all Applicable Legal Requirements, the Final Plans, the Seller's WWTP Work Permits and otherwise in a good and workmanlike manner employing new materials of good quality. Seller agrees to diligently prosecute the design, permitting, construction and completion of the Seller's WWTP Improvements, and without limiting the generality of the foregoing, agrees to cause all Seller's WWTP Work Milestones to be achieved by the applicable Seller's WWTP Work Milestones established therefor, subject to Section 8 hereof and any Gas Line Work Priority Stoppage (as hereinafter defined). Seller acknowledges and agrees that it shall be solely responsible for any and all costs associated with the design, permitting and construction of the WWTP Seller's Work Improvements, without any

compensation or remuneration due from Buyer, subject only to those Release Amounts which Seller may be entitled to receive pursuant to subsection (c) below. If, during the course of the performance of the Seller's WWTP Work, the company responsible for bringing gas service to the Buyer's Project, including applicable contractors engaged thereby, are prepared to begin installing gas lines and other infrastructure ("Gas Line Work") in MA DOT ROWs (including U.S. Route 20) to serve Buyer's Project and the Massachusetts Department of Transportation ("MassDOT") or any other applicable Governmental Authority will not allow applicable portions of the Seller's WWTP Work and the Gas Line Work to occur simultaneously within the MA DOT ROWs, the Gas Line Work will take priority over Seller's WWTP Work and Seller will cause Seller's Work Contractor to stop work in the applicable portions of the MA DOT ROWs while such Gas Line Work is being performed (a "Gas Line Work Priority Stoppage"). Upon the occurrence of any Gas Line Work Priority Stoppage, each of Seller's WWTP Work Milestone Deadlines (beginning with the Seller's WWTP Work Milestone Deadline of September 1, 2021) shall be delayed on a day-for-day basis for the duration of any Gas Line Work Priority Stoppage. Seller agrees to use reasonable efforts to coordinate its work plan for Seller's WWTP Work with MassDOT and such Gas Line Work company in an attempt to allow the Seller's WWTP Work and the Gas Line Work to occur contemporaneously so as to avoid a Gas Line Work Priority Stoppage, and Buyer agrees to use reasonable efforts to cause such Gas Line Work company to coordinate its work plan for the Gas Line Work with MassDOT and Seller accordingly.

(c) Release of WWTP Escrow Funds Upon Satisfaction of Certain Seller's WWTP Work Milestones. Provided that Buyer has not already made a Buyer's Self-Contained WWTP Work Election or exercised the Self-Help Remedy in accordance with the terms of this Agreement, Seller may deliver to Buyer and Escrow Agent a Seller's WWTP Escrow Release Requisition demanding the release of WWTP Escrow Funds in the following amounts (each, a "Release Amount"; collectively, the "Release Amounts") *after* achieving each of the following Seller's WWTP Work Milestones:

- $829,275 (the "Building Permit Fee"), upon Seller's receipt of all Seller's WWTP Work Permits (other than the Seller's Groundwater Discharge Permit);
- $905,725, upon Seller's WWTP Work 50% Completion; and
- The balance of the WWTP Escrow Funds

Notwithstanding the foregoing or anything herein to the contrary, subject to the last sentence of this Section 2, (w) upon the occurrence of a Seller Event of Default, no Release Amounts shall be disbursed from the WWTP Escrow Funds unless and until Seller's WWTP Work Final Completion occurs, at which time the remaining WWTP Escrow Funds will be released to Seller pursuant to a final Seller's WWTP Escrow Release Requisition, subject to the ensuing provisions of this Section 2, and the terms of the WWTP Escrow Agreement, (x) in the event Seller fails to achieve either Seller's WWTP Acceptance and Disposal Completion or Seller's WWTP Work Final Completion on or prior to the Seller's WWTP Work Milestone Deadlines established therefor, no Release Amounts shall be disbursed from the WWTP Escrow Funds until the Buyer's Project Initial T/C/O Date, so as to afford Buyer sufficient time to calculate any and all applicable Buyer's WWTP Damages and make requisition therefor under the WWTP Escrow Agreement as applicable, (y) if there are insufficient funds to satisfy any Release Amount(s) due to Buyer's exercise of remedies set forth in Section 5.2 below, the applicable Release Amount(s) shall be reduced accordingly so that it only equals the amount of WWTP Escrow Funds then remaining; and (z) if Buyer has made requisitions pursuant to the WWTP Escrow Agreement to draw down WWTP Escrow Funds to pay or reimburse Buyer for Buyer's Project Delay Liquidated Damages and/or Buyer's Increased Project Costs pursuant to Section 5(b-c) below and such draws are either (1) pending at the time of Seller's WWTP Escrow Release Requisition, or (2) requisitioned within five (5) business days after Seller's WWTP Escrow Release Requisition, Seller shall only be entitled to receive as Release Amount(s) that portion of the WWTP Escrow Funds which are not the subject of such Buyer requisition(s), and the applicable Release Amount(s) shall be reduced accordingly.

Notwithstanding the foregoing, the Building Permit Fee shall be released to Seller on the earlier to occur of (i) Seller's receipt of all Seller's WWTP Work Permits, and (ii) June 30, 2021.

(d) Buyer's Project O/M Fees and Buyer's Project O/M Agreement. Prior to the Permit Deadline, Buyer shall use commercially reasonable, good faith efforts to finalize the Buyer's Project O/M Fees and Buyer's Project O/M Agreement with the Wastewater Governing Authority on terms reasonably acceptable to Buyer. In the event that, despite its good faith efforts, Buyer is unable to reach an agreement with the Wastewater Governing Authority regarding the Buyer's Project O/M Fees by the Permit Deadline (a "Buyer O/M Failure Event"), Buyer shall have the right to make a Buyer's Self-Contained WWTP Work Election pursuant to Section 5.2(a) below, which election must be made, if at all, by the date which is 10 business days after the Permit Deadline. If Buyer fails to make such election within the foregoing 10-business day period, it will forfeit the right to make a Buyer's Self-Contained WWTP Work Election under this Section 2(d).

(e) Release of Permit for Buyer's Self-Contained WWTP Improvements. Buyer has obtained a groundwater discharge permit from DEP for Buyer's Self-Contained WWTP Improvements ("Buyer's Groundwater Discharge Permit"). DEP has informed Seller that DEP will issue Seller's Groundwater Discharge Permit only after Buyer releases Buyer's Groundwater Discharge Permit. Accordingly, at such time as DEP has indicated to Seller that it is prepared to issue to the Seller's Groundwater Discharge Permit, but in no event earlier than the date upon which Seller has achieved Seller's WWTP Work Acceptance and Disposal Completion, Seller may request that Buyer release the Buyer's Groundwater Discharge Permit to DEP (a "Discharge Permit Tender Request"), and promptly upon receipt of a timely-delivered Discharge Permit Tender Request, Buyer shall release to DEP (or as otherwise directed by DEP) Buyer's Groundwater Discharge Permit.

3. CONSTRUCTION REPRESENTATIVES. Seller appoints the following person(s) as Seller's representative ("Seller's Representative") to act for Seller in all matters covered by this Agreement, including the receipt of applicable notices hereunder:

Louise L.E. Miller, J.D.
Town Administrator
Town of Wayland
41 Cochituate Road
Wayland, MA 01778
O: (508) 358-3620
Email: lmiller@wayland.ma.us

Buyer appoints the following person(s) as Buyer's representative ("Buyer's Representative") to act for Buyer in all matters covered by this Agreement, including the receipt of applicable notices hereunder.

Jim Lambert
c/o WP East Acquisitions, L.L.C.
91 Hartwell Avenue
Lexington, MA 02421
Phone: 781.541.5822
Email: jim.lambert@woodpartners.com

All communications with respect to the matters covered by this Agreement are to be made to Seller's Representative or Buyer's Representative, as the case may be, in writing, in compliance with the notice provisions of the LDA (except that only Seller's Representative and Buyer's Representative are the only

parties that need be named in any applicable notification). Either party may change its representative and/or address under this Agreement at any time by written notice to the other party in compliance with the notice provisions of the LDA.

4. WWTP ESCROW AGREEMENT. Concurrently with the execution of this Agreement and the acquisition by Buyer of Buyer's Property, Buyer, Seller and First American Title Insurance Company ("Escrow Agent") are entering into an agreement entitled WWTP Escrow Agreement (the "WWTP Escrow Agreement") pursuant to which $[2,548,909.56] are being funded into escrow by Seller and Buyer (through a combination of Net Purchase Price proceeds and sources of funds outside of the Closing escrow) (collectively, the "WWTP Escrow Funds"), and such funds will be held and disbursed pursuant to this Agreement and the WWTP Escrow Agreement. At such time as Buyer deposits the Final On-Site WWTP Escrow Funds pursuant to Section 4(c)(ii) of the Twelfth Amendment, such funds shall become part of the WWTP Escrow Funds for all purposes under this Agreement and the WWTP Escrow Agreement.

5. SELLER DEFAULT; BUYER REMEDIES.

5.1 Seller Events of Default. Subject to Section 8 hereof, the occurrence of any one or more of the following shall constitute a "Seller Event of Default" under this Agreement:

(a) Seller or Seller's Work Contractor shall file any bankruptcy proceeding; or any proceeding under bankruptcy laws or other debtor-relief or similar laws shall be brought against Seller or Seller's Work Contractor and is not dismissed within 60 days after the filing thereof; or Seller or Seller's Work Contractor shall make an assignment for the benefit of creditors or file for any form of reorganization or arrangement under any bankruptcy law or other debtor-relief a similar law or proceeding;

(b) Once commenced, (1) any portion of the Seller's WWTP Work shall cease and not be resumed within 30 days thereafter; or (2) construction of the Seller's WWTP Work is abandoned;

(c) Seller falls behind schedule for completion of the Seller's WWTP Improvements by more than 30 days and does not, within 10 business days after receipt of notice from Buyer, deliver to Buyer a critical path recovery schedule updating Seller's Construction Schedule to reflect that Seller's WWTP Work Final Completion will still occur by the Seller's WWTP Milestone Deadline established therefor;

(d) Seller fails to deliver Seller's WWTP Work Milestone Achievement Evidence for any Seller's WWTP Work Milestone by the applicable Seller's WWTP Work Milestone Deadline established therefor. For avoidance of doubt, the Seller's WWTP Work Milestone will actually need to be satisfied or completed in order for a Seller's WWTP Work Milestone Achievement Evidence to be valid pursuant to the foregoing sentence.

5.2 Buyer Remedies. Upon a Seller Event of Default (or, in the case of a Buyer O/M Failure Event pursuant to Section 2(d) above as it concerns and is limited to a Buyer's Self-Contained WWTP Work Election), Buyer will have the following rights and remedies:

(a) Buyer's Self-Contained WWTP Work Election**.** Buyer shall have the right (but not the obligation), upon written notice to Seller, to elect to perform the Buyer's Self-Contained WWTP Work (the "Buyer's Self-Contained WWTP Work Election"). In the event the Buyer makes the Buyer's Self-Contained WWTP Work Election, (i) Seller will no longer be required to complete the Seller's WWTP

Improvements, (ii) Buyer shall construct the Buyer's Self-Contained WWTP Improvements in accordance with the plans, permits and other Approvals therefor and Applicable Legal Requirements, (iii) Buyer shall have the right to draw down on the WWTP Escrow Funds in order to pay for Buyer's Self-Contained WWTP Work Costs in excess of the Buyer's Self-Contained WWTP Work Costs Requisition Threshold as and when incurred pursuant to one or more Buyer's Self-Contained WWTP Work Costs Requisitions, and (iv) the WWTP Easement Agreement shall automatically terminate and be of no further force and effect, and Seller shall cooperate with Buyer in executing and recording any documentation necessary to terminate such WWTP Easement Agreement of record. Seller acknowledges and agrees that it will have no right to object to or disapprove any Buyer's Self-Contained WWTP Work Costs Requisition absent manifest error, so long as such requisition includes the Supporting Documentation required by the WWTP Escrow Agreement (and even then Seller's ability to object to the requisition will be as limited by the WWTP Escrow Agreement).

(b) Buyer's Project Delay Liquidated Damages. In the event of a Seller Event of Default with respect to Seller's failure to timely achieve the Seller's WWTP Work Milestone for Seller's WWTP Work Acceptance and Disposal Completion and such failure causes a Buyer's Project Delay with respect to delay of the issuance of a temporary certificate of occupancy for Buyer's Project by the Buyer's Project Initial T/C/O Date, Buyer will have the right to make a requisition on the WWTP Escrow Funds to pay or compensate Buyer for Buyer's Project Delay Liquidated Damages pursuant to a Buyer's Project Delay LD Requisition. At such time as the actual duration of Buyer's Project Delay is known based on when Buyer's Project Initial T/C/O Date actually occurs or is scheduled to occur, Buyer may make a Buyer's Project Delay LD Requisition within five (5) business days after the determination of such actual duration of Buyer's Project Delay.

(c) Buyer's Increased Project Costs. In the event of a Seller Event of Default which results in Buyer's Increased Project Costs, Buyer will have the right to draw down on the WWTP Escrow Funds to pay or compensate Buyer for Buyer's Increased Project Costs, as and when such Buyer's Increased Project Costs are finally determined, by making a Buyer's Project Increased Project Costs Requisition.

(d) Self-Help Remedy**.** Buyer shall have the right (but not the obligation) to assume control of all or a portion of the Seller's WWTP Work (the "Self-Help Remedy") upon at least 10 business days' written notice to Seller (a "Takeover Notice"). Upon issuance of a Takeover Notice, (i) Seller shall cease the performance of any Seller's WWTP Work so taken over, (ii) Buyer shall promptly and diligently prosecute and complete the Seller's WWTP Work, (iii) Buyer shall be entitled to draw down from the WWTP Escrow Funds under the WWTP Escrow Agreement pursuant to one or more Buyer's WWTP Self-Help Requisitions in accordance with the terms thereof to pay for all costs and expenses associated with the work taken over as if Buyer were Seller thereunder (collectively, "Buyer's WWTP Self-Help Costs"), (iv) [intentionally omitted]; and (v) to the extent deemed necessary by the applicable permit granting authority to complete the portion of the Seller's WWTP Work taken over, Seller hereby assigns to Buyer its interest under (A) any and all permits, licenses, variances, plans and approvals required in order to complete the work taken over and (B) any and all design, engineering, construction and development contracts related to same (collectively, "Approvals and Contracts"). Additionally, within five (5) business days after entering into Seller's Work Contract, to the extent such language is not included within the Seller's Work Contract itself, Seller will cause Seller's Work Contractor to deliver a consent document in a form reasonably agreed to by Buyer and Seller's Work Contractor which shall acknowledge Buyer's rights should it exercise the Self-Help Remedy hereunder. Seller hereby covenants that it shall, at any time and from time to time upon written request thereof, promptly execute and deliver to Buyer any new or confirmatory instruments and do and perform any other acts which Buyer may reasonably request in order to fully assign and transfer to and vest in Buyer, and protect Buyer's right, title and interest in and to each and all of the Approvals and Contracts intended to be transferred and assigned hereby. Additionally, if Buyer exercises the Self-Help Remedy, Buyer shall provide or cause

Buyer's Contractor (or, as the case may be, Seller's Work Contractor as engaged by Buyer) to provide to Seller, within a reasonable time after Seller's request for the same, all necessary documentation, in order to satisfy requirements imposed upon Seller by Seller's MassWorks's infrastructure funding grant for the Seller's WWTP Improvements so that Seller can continue to receive such funding under the terms of such grant ("Seller's Grant Funds"). Seller agrees to use commercially reasonable efforts to cause Seller's Work Contractor to provide all such necessary documentation with respect to Seller's Grant Funds, and Seller agrees that it shall be a requirement of Seller's Work Contract that Seller's Work Contractor provide such necessary documentation.

(e) Other Recourse; WWTP Escrow Funds Exhausted. Buyer may pursue any other rights and remedies at law or equity in connection with such Seller Event of Default; *provided, however*, that Buyer will first seek recourse pursuant to one or more of the remedies set forth above and through Buyer's WWTP Damages Requisitions made pursuant to the WWTP Escrow Agreement prior to resorting to this subsection (e). Without limiting the foregoing, to the extent the funds then remaining in the WWTP Escrow Agreement are not sufficient to pay for any Buyer's WWTP Damages, Buyer shall have the right to submit invoices to Seller for direct reimbursement, which shall be paid by Seller within 30 days of written demand therefor and if such amounts are not timely paid. Notwithstanding the foregoing, Seller's liability for Buyer's Project Delay Liquidated Damages shall be limited to an amount equal to (i) the WWTP Escrow Funds then being held in escrow at the time Buyer makes a Buyer's Project Delay LD Requisition, *plus* (ii) any amounts previously released to Seller as Released Amounts hereunder (excluding the Building Permit Fee).

(f) Cumulative Rights; No Election of Remedies. All rights, remedies, powers, and privileges conferred hereunder upon the Buyer will be cumulative. An exercise of one remedy by Buyer shall not be deemed an election of remedies by Buyer, and Buyer will have the right to pursue any and all other remedies available to it; *provided, however*, Buyer acknowledges and agrees that the exercise of one remedy may preclude the exercise of another, as certain remedies set forth above are mutually exclusive (e.g. Buyer cannot make a Buyer's Self-Contained WWTP Work Election and then exercise a Self-Help Remedy, as such remedies are mutually exclusive, but the Buyer may incur Buyer's Self-Contained WWTP Work Costs or Buyer's Increased Project Costs while also sustaining Buyer's Project Delay Liquidated Damages and pursue remedies with respect to same on a cumulative basis).

6. COUNTERPARTS; SEVERABILITY. This Agreement may be executed in multiple counterparts and on separate counterparts, each of which shall be deemed to be an original and all of which shall together constitute one and the same agreement. Electronic, facsimile or .pdf signatures shall have the same force and effect as original signatures. The parties hereto intend to be bound by the signatures on the electronic, facsimile or .pdf document, and hereby waive any defenses to the enforcement of the terms of this Agreement based on the use of an electronic, facsimile or .pdf signature. If any provisions of this Agreement or the application thereof to any person or circumstances shall, to any extent, be invalid or unenforceable, the remainder of this Agreement by the application of such provision or provisions to persons or circumstances other than those as to whom or which it is held invalid or unenforceable shall not be affected thereby, and every provision of this Agreement shall be valid and enforceable to the fullest extent permitted by law; provided, however, that if any of the provisions of this Agreement or the application thereof shall to any extent be invalid or unenforceable to one or more but not all of the parties, then this Agreement shall be valid and enforceable as to the other party or parties only to the extent that the same is equitable and consistent with the overall purposes of this Agreement.

7. ATTORNEYS' FEES. If any action is brought by a party to this Agreement against another party, relating to or arising out of this Agreement, the transaction described herein or the enforcement hereof, the prevailing party shall be entitled to recover from such party reasonable attorneys'

fees, costs and expenses incurred in connection with the prosecution or defense of such action. The provisions of this Section 7 shall survive the entry of any judgment, and shall not merge, or be deemed to have merged, into any judgment.

8. FORCE MAJEURE DELAY. The duties and obligations of Seller to observe or perform any of the terms or provisions of this Agreement shall be excused and extended for a period equal to the period of any Force Majeure Delay; ***provided, however***, the period for which Seller may claim a Force Majeure Delay hereunder shall only extend for the period of time that Buyer is also prohibited or restricted from performing work on Buyer's Project due to such Force Majeure Delay (the "Max FM Period"). Without limiting the foregoing, all Seller's WWTP Work Milestone Deadlines shall be extended for the duration of any Force Majeure Delay, subject to the Max FM Period. If Seller is invoking a Force Majeure Delay in order to extend any applicable deadlines hereunder, it must provide prompt notice to Buyer within 10 days after the commencement thereof and advise of its anticipated duration, and Seller shall take whatever reasonable steps are necessary to relieve the effect of such cause as rapidly as possible.

9. GOVERNING LAW; VENUE FOR LITIGATION. This Agreement shall be governed and construed in accordance with the laws of the Commonwealth of Massachusetts. Any litigation based on or arising out of this Agreement shall be brought exclusively in state or federal courts located in the Commonwealth of Massachusetts.

10. TIME. Time is of the essence of this Agreement.

11. AUTHORITY. Each Party certifies to the other that it authorized by all required corporate, limited liability company, partnership action or Board of Selectmen action, as applicable, to enter into this Agreement and the individual(s) signing this Agreement on behalf of such Party are each authorized to bind such Party. Buyer certifies to Seller that it is duly organized, validly existing and in good standing under the laws of its state of organization, and duly qualified to do business in the Commonwealth of Massachusetts.

12. ASSIGNMENT. No Party to this Agreement shall assign or in any manner sell or transfer any of its rights or interest in this Agreement without the prior written consent of the other Party, which consent may be withheld in the non-requesting Party's sole discretion; ***provided, however***: (i) that Buyer shall have the right in connection with any existing or future financing secured by Buyer's Property or Buyer's Project to assign for collateral purposes its interest hereunder to any lender(s) providing such financing, and the Seller hereby agrees to execute and deliver any consent or acknowledgment to any such collateral assignment on a commercially reasonable form; and (ii) Buyer, following the issuance of the initial temporary certificate of occupancy for Buyer's Project or otherwise in connection with a permitted assignment under the LDA, will have the right to assign this Agreement to successor(s) in title to the Buyer's Property and/or Buyer's Project.

13. NO WAIVER**.** Neither the failure of any Party to exercise any power or right given such Party hereunder or to insist upon strict compliance by any other Party with its obligations hereunder, nor any custom or practice of the parties at variance with the terms hereof, shall constitute a waiver of any Party's right to demand exact compliance with the terms hereof.

14. WAIVER OF RIGHT TO TRIAL BY JURY. EACH PARTY HERETO HEREBY KNOWINGLY, VOLUNTARILY AND INTENTIONALLY WAIVES THE RIGHT IT MAY HAVE TO A TRIAL BY JURY IN RESPECT OF ANY LITIGATION BASED HEREON OR ARISING OUT OF THIS AGREEMENT, THE TRANSACTIONS CONTEMPLATED HEREBY, AND ANY AGREEMENT CONTEMPLATED TO BE EXECUTED IN CONJUNCTION HEREWITH, OR

COURSE OF CONDUCT, COURSE OF DEALING, STATEMENTS (WHETHER VERBAL OR WRITTEN) OR ACTIONS OF ANY PARTY. THIS PROVISION IS A MATERIAL INDUCEMENT FOR SELLER AND BUYER ENTERING INTO THIS AGREEMENT.

[SIGNATURES ON FOLLOWING PAGE]

IN WITNESS WHEREOF, the undersigned Seller and Buyer have caused this Agreement to be duly executed by their duly authorized representatives as of the date hereof.

BUYER:

ALTA RIVER'S EDGE, LLC,
a Delaware limited liability company

By: Alta River's Edge Venture, LLC, a Delaware limited liability company, its sole member

By: WS River's Edge, LLC, a Delaware limited liability company, its Managing Member

By: WP Massachusetts, LLC, a Delaware limited liability company, its sole member and manager

By: _____
Name: Jim Lambert
Title: Vice President

SELLER:

TOWN OF WAYLAND,
By its Board of Selectmen

_____
Cherry C. Karlson, Chair

_____
David V. Watkins

_____
Thomas J. Fay

_____
Mary M. Antes

_____
Lea T. Anderson

EXHIBIT A

SELLER'S WWTP WORK PLANS

[SEE ATTACHED FOR 50% PLANS]

TOWN OF WAYLAND

BOSTON POST ROAD (ROUTE 20)
RIVER'S EDGE SEWER CONNECTION

DPW DIRECTOR

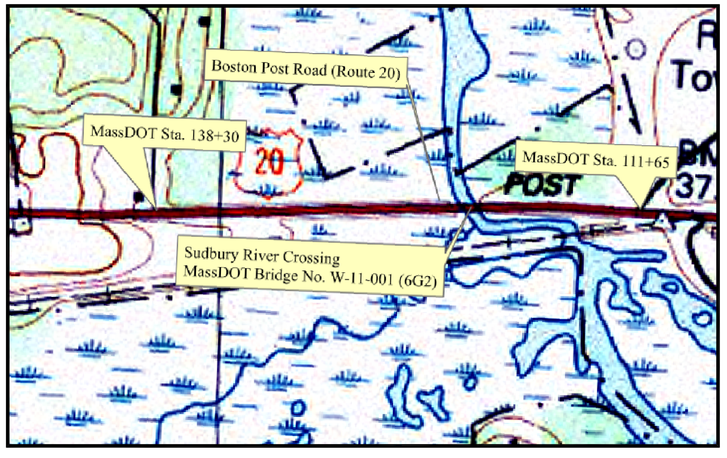
THOMAS HOLDER

TOWN ENGINEER

PAUL BRINKMAN, P.E.

WASTEWATER OPERATIONS MANAGER

RICHARD PEZZOLESI



LOCATION PLAN
NO SCALE

SHEET INDEX

JANUARY 2021

TATA & HOWARD

50% DRAFT JANUARY 2021

TATA & HOWARD, INC. • CONSULTING ENGINEERS • MARLBOROUGH, MA

P:\Wayland\6639 River's Edge Sewer Connection\CAD\Sheets\C\Cover.dwg ###### 1/25/2021 5:12 PM

GENERAL NOTES

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF THE TOWN OF WAYLAND. ALL EXCAVATION AND RESTORATION SHALL MEET TOWN SPECIFICATIONS.
2. THE ENGINEER MAY DIRECT THE CONTRACTOR TO VARY THE PROPOSED WORK DURING CONSTRUCTION TO MEET EXISTING CONDITIONS.
3. STATIONING ALONG THE LENGTH OF THE WATER MAIN IS INTENDED FOR GENERAL REFERENCE. WHERE PRECISE GROUND LOCATION IS REQUIRED, REFER TO ACTUAL FIELD MEASUREMENTS FOR ACTUAL DISTANCES FROM EXISTING GROUND FEATURES.
4. AREAS WITHIN THE 100–FOOT BUFFER ZONE OF A BORDERING VEGETATED WETLAND ARE SUBJECT TO AN ORDER OF CONDITIONS ISSUED BY THE WAYLAND CONSERVATION COMMISSION.
5. THE CONTRACTOR SHALL UTILIZE THE SOUTH LANDFILL LOCATED ON THE SOUTH SIDE OF BOSTON POST ROAD (NEAR MASSDOT STA. 11+30) FOR STAGING EQUIPMENT AND STOCKPILING MATERIALS. CONTRACTOR SHALL PROVIDE EROSION CONTROL MEASURES AROUND THE PERIMETER OF THE STAGING AREA. ANY ADDITIONAL STAGING AREAS SHALL BE ESTABLISHED OUTSIDE OF A 100–FOOT BUFFER ZONE OR 200–FOOT RIVERFRONT AREA. FOR THE STORAGE OF EQUIPMENT AND STOCKPILING OF MATERIALS, NO STORAGE OF GASOLINE, OIL OR OTHER FUEL OR HAZARDOUS MATERIALS IS PERMITTED WITHIN THE 100–FOOT BUFFERZONE OR 200–FOOT RIVERFRONT AREA. STAGING AREA LOCATIONS SHALL BE COORDINATED WITH AND APPROVED BY THE OWNER.
6. STOCKPILES SHALL BE LOCATED AS NEEDED, WITHIN THE LIMIT OF WORK, IN AREAS OF MINIMAL IMPACT.
7. THE CONTRACTOR SHALL TAKE ALL NECESSARY MEASURES AND SHALL PROVIDE ALL NECESSARY CONTINUOUS BARRIERS OF SUFFICIENT TYPE, SIZE AND STRENGTH TO PREVENT ACCESS TO ALL OPEN EXCAVATIONS AT THE COMPLETION OF EACH WORK DAY.
8. THE CONTRACTOR AT HIS EXPENSE SHALL BRACE UTILITY POLES IF REQUIRED, AND REPAIR ANY DAMAGE TO EXISTING SIDEWALKS, CURBS, PAVING, SHRUBS, TREES, STONE WALLS, LAWNS, ETC. ALL EXCAVATED MATERIALS SHALL BE RETURNED TO EQUAL OR BETTER THAN PRIOR CONDITION BY THE CONTRACTOR.
9. ALL EXISTING CONCRETE AND ASPHALT PAVEMENT SHALL BE SAW–CUT PRIOR TO EXCAVATION IN ORDER TO PROVIDE UNIFORM ASPHALT REPLACEMENT.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REPLACEMENT OF PAVEMENT MARKINGS, TRAFFIC SIGN LOOPS, STRIPING, ARROWS, CROSSWALKS, ETC.
11. ALL EXISTING CONCRETE STRUCTURES THAT REQUIRE CORING NEW INLET OR OUTLET PIPE PENETRATIONS SHALL HAVE A MECHANICAL LINK SEAL INSTALLED AT THE ANNULAR SURFACE BETWEEN THE PIPE OUTER DIAMETER AND THE CORING DIAMETER.
12. CONTRACTOR SHALL MAINTAIN PUBLIC ACCESS TO THE BOAT RAMP AT ALL TIMES AT APPROXIMATE MASSDOT STA. 115+50.

SURVEY NOTES

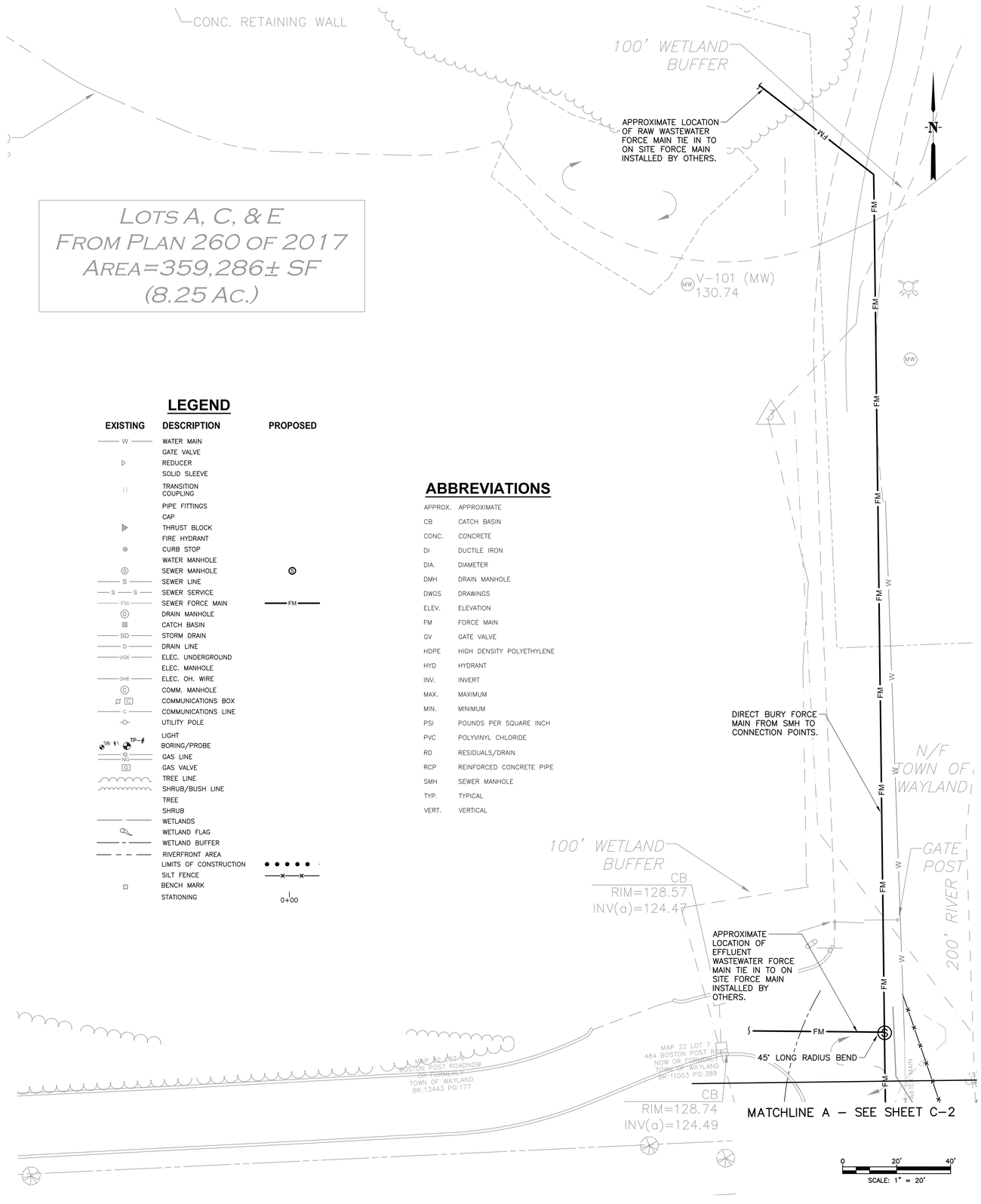
1. BASE PLANS AND PROPERTY LINE DETERMINATIONS WERE PREPARED BY WSP USA CORP., (155 MAIN DUNSTABLE ROAD, NASHUA, NH 03060)
2. DELINEATION OF BORDERING VEGETATED WETLANDS, AND EDGE OF BANK MEAN ANNUAL HIGH WATER WERE DETERMINED BY ECOTEC, INC (102 GROVE STREET, WORCESTER, MA 01605)
3. THE LOCATION OF THE EXISTING UTILITIES AS SHOWN ON THE PLANS ARE APPROXIMATE AND ARE INTENDED ONLY TO ADVISE THE CONTRACTOR OF THEIR PRESENCE. CALL "DIG SAFE" (1–888–344–7233) FOR FIELD LOCATIONS OF ALL EXISTING UTILITIES.
4. BENCH MARKS HAVE BEEN ESTABLISHED BY THE SURVEYOR PRIOR TO THE START OF CONSTRUCTION. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO MAINTAIN ALL BENCHMARKS THROUGHOUT CONSTRUCTION. ANY COST TO RE–ESTABLISH THESE ITEMS WILL BE AT NO COST TO THE OWNER.
5. AS APPROPRIATE, CONTRACTOR SHALL TAKE ALL NECESSARY MESASURES, INCLUDING HAND DIGGING, TO MAINTAIN THE INTEGRITY OF THE EXISTING UTILITIES.
6. HORIZONTAL DATUM REFERENCED THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM NAD83 AND THE VERTICAL DATUM REFERENCED THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

GEOTECHNICAL NOTES

1. BORINGS WERE DRILLED FOR PURPOSES OF DESIGN AND INDICATE SUBSURFACE CONDITIONS AT BORING LOCATION ONLY. SUBSURFACE CONDITIONS MAY VARY FROM THOSE SHOWN IN THE LOG.
2. BORING AND TEST PIT LOCATIONS ARE SHOWN ON THE PLANS AND BORING AND TEST PIT LOGS ARE IN THE GEOTECHNICAL DATA REPORT BOUND IN APPENDIX A OF THESE SPECIFICATIONS.
3. FOR EARTH EXCAVATION, BACKFILL, FILL AND GRADING, SEE SPECIFICATION 02221.
4. FOR DEWATERING SEE SPECIFICATION 02140.
5. FOR TEMPORARY EXCAVATION SUPPORT SYSTEM SEE SPECIFICATION 02160.
6. CONTRACTOR IS REQUIRED TO SUBMIT COMPACTION REPORTS AS SPECIFIED IN SPECIFICATION SECTION 02221. THE CONTRACTOR SHALL BE STRICTLY HELD TO COMPACTION STANDARDS AS REFERENCE IN THE CONTRACT DOCUMENTS. THE CONTRACTOR IS RESPONSIBLE FOR BACKFILLING, COMPACTING, AND STABILIZING ALL WORK DAILY.

EROSION & SEDIMENT CONTROL NOTES

1. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT A STORMWATER POLLUTION PREVENTION PLAN IN ACCORDANCE WITH THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM.
2. THE CONTRACTOR IS RESPONSIBLE FOR THE MAINTENANCE AND REPAIR OF ALL EROSION CONTROL DEVICES ON–SITE. ALL EROSION CONTROL DEVICES SHALL BE REGULARLY INSPECTED. ANY SEDIMENTS REMOVED FROM THE CONTROL DEVICES SHALL BE DISPOSED OF ON THE UPLAND SIDE OF THE EROSION CONTROL LINE. THE CONTRACTOR SHALL PLACE ADDITIONAL EROSION CONTROL, REGARDLESS OF IT BEING SHOWN ON THE CONTRACT DRAWINGS, AS NECESSARY TO PREVENT SOIL EROSION THROUGHOUT THE PROJECT DURATION. NO WORK SHALL OCCUR BEYOND THE EROSION CONTROL.
3. IN THE STAGING AREA, THE CONTRACTOR SHALL HAVE A STOCKPILE OF MATERIALS REQUIRED TO CONTROL EROSION ON–SITE TO BE USED TO SUPPLEMENT OR REPAIR EROSION CONTROL DEVICES. THESE MATERIALS SHALL INCLUDE, BUT ARE NOT LIMITED TO, HAY BALES, SILT FENCE AND CRUSHED STONE.
4. AT NO TIME SHALL SILT–LADEN WATER BE ALLOWED TO ENTER SENSITIVE AREAS (WETLANDS, OFF–SITE AREA AND DRAINAGE SYSTEMS). ANY RUNOFF FROM DISTURBED SURFACES SHALL BE DIRECTED THROUGH SETTLING BASINS AND EROSION CONTROL BARRIERS PRIOR TO ENTERING ANY SENSITIVE AREAS.
5. NO MATERIALS SHALL BE DISPOSED OF INTO ANY WETLANDS OR EXISTING OR PROPOSED DRAINAGE SYSTEMS. SILT SACKS SHALL BE USED IN ALL CATCH BASINS WITHIN PROJECT LIMITS TO MINIMIZE SILT DEPOSITS INTO DRAINAGE SYSTEM.
6. ANY REFUELING OF CONSTRUCTION VEHICLES AND EQUIPMENT SHALL TAKE PLACE OUTSIDE OF ANY 100–FOOT BUFFER ZONE TO ANY WETLANDS.
7. IF INTENSE RAINFALL IS ANTICIPATED, THE INSTALLATION OF SUPPLEMENTAL EROSION CONTROL DEVICES SHALL BE UTILIZED. ADDITIONAL TEMPORARY SETTLING BASINS ARE REQUIRED TO BE LOCATED WITHIN THE DISTRIBUTED AREA, TO MINIMIZE THE TRIBUTARY AREAS.



LEGEND

EXISTING	DESCRIPTION	PROPOSED
W	WATER MAIN	
	GATE VALVE	
	REDUCER	
	SOLID SLEEVE	
	TRANSITION COUPLING	
	PIPE FITTINGS	
	CAP	
	THRUST BLOCK	
	FIRE HYDRANT	
	CURB STOP	
	WATER MANHOLE	
S	SEWER MANHOLE	S
S	SEWER LINE	
S S	SEWER SERVICE	
FM	SEWER FORCE MAIN	FM
D	DRAIN MANHOLE	
	CATCH BASIN	
SD	STORM DRAIN	
D	DRAIN LINE	
UGE	ELEC. UNDERGROUND	
	ELEC. MANHOLE	
OHE	ELEC. OH. WIRE	
C	COMM. MANHOLE	
C	COMMUNICATIONS BOX	
C	COMMUNICATIONS LINE	
	UTILITY POLE	
	LIGHT	
TP–#	BORING/PROBE	
G NG	GAS LINE	
G	GAS VALVE	
	TREE LINE	
	SHRUB/BUSH LINE	
	TREE	
	SHRUB	
	WETLANDS	
	WETLAND FLAG	
	WETLAND BUFFER	
	RIVERFRONT AREA	
	LIMITS OF CONSTRUCTION	
	SILT FENCE	
	BENCH MARK	
	STATIONING	0+00

ABBREVIATIONS

APPROX.	APPROXIMATE
CB	CATCH BASIN
CONC.	CONCRETE
DI	DUCTILE IRON
DIA.	DIAMETER
DMH	DRAIN MANHOLE
DWGS	DRAWINGS
ELEV.	ELEVATION
FM	FORCE MAIN
GV	GATE VALVE
HDPE	HIGH DENSITY POLYETHYLENE
HYD	HYDRANT
INV.	INVERT
MAX.	MAXIMUM
MIN.	MINIMUM
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
RD	RESIDUALS/DRAIN
RCP	REINFORCED CONCRETE PIPE
SMH	SEWER MANHOLE
TYP.	TYPICAL
VERT.	VERTICAL

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

GENERAL NOTES
PROPOSED RIVER'S EDGE
DEVELOPMENT

Drawn By: CM | Designed By: MEC | Checked By: SJL | Approved By: JVH

Rev.	Date	Description

50% DRAFT SUBMITTAL
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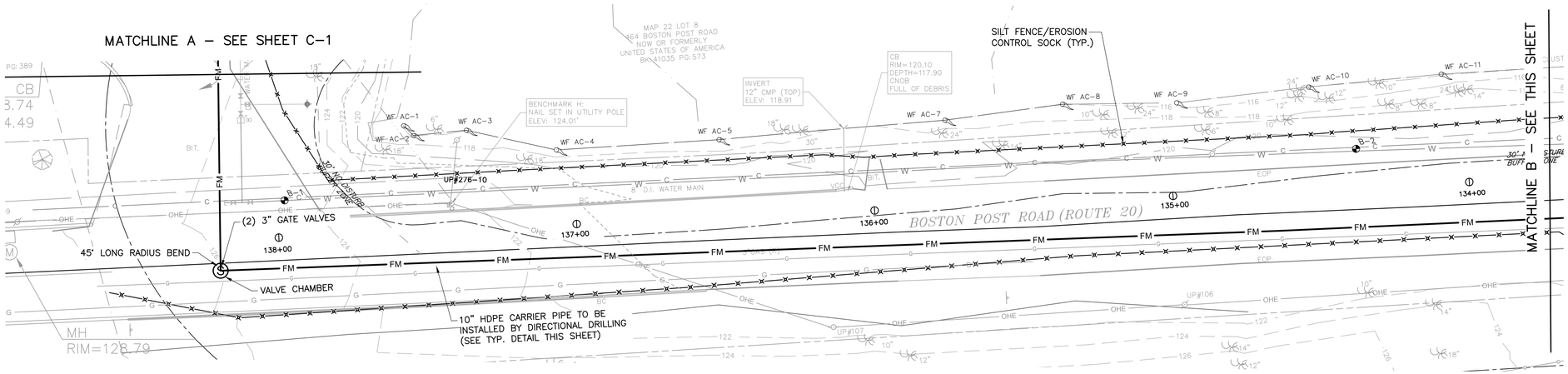
TATA & HOWARD

T&H NO.: 6639
DATE: JANUARY 2021
SCALE: AS NOTED

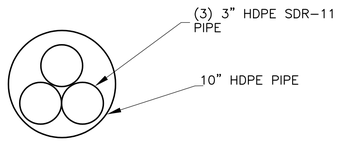
C-1



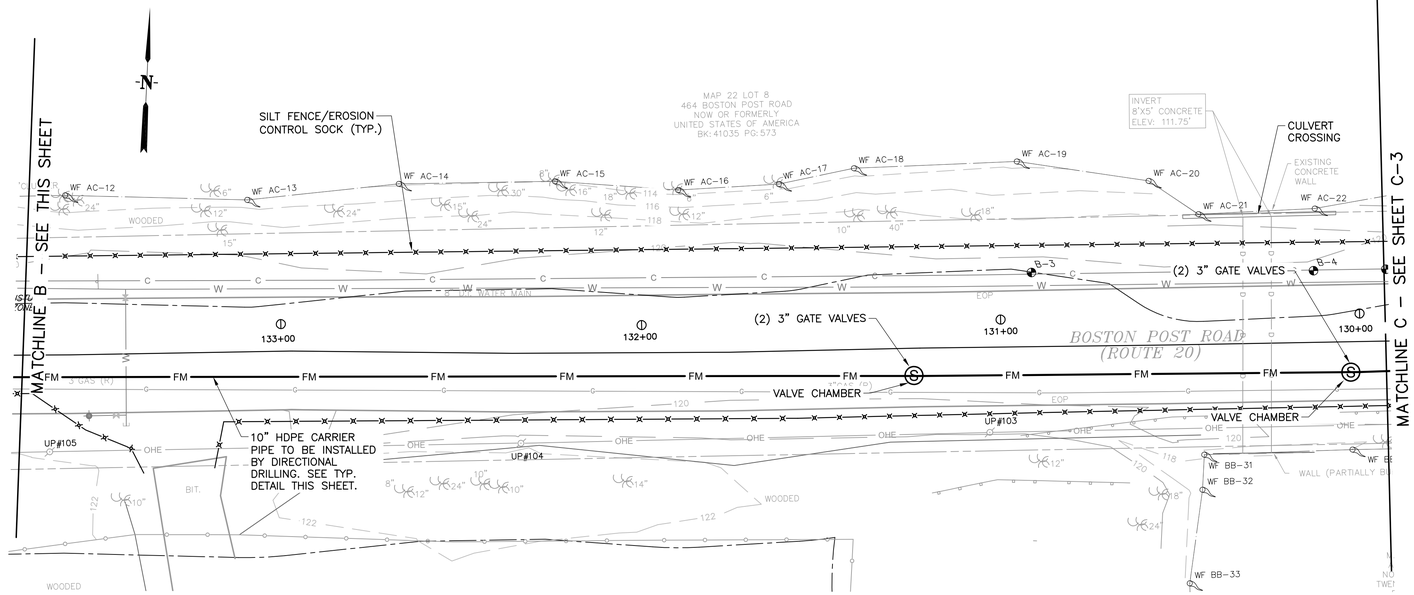
BOSTON POST ROAD MASSDOT STA. 138+30 TO MASSDOT STA. 133+74

0 20' 40'

SCALE: 1" = 20'



10" HDPE CARRIER PIPE DETAIL



BOSTON POST ROAD MASSDOT STA. 133+74 TO MASSDOT STA. 129+93

0 20' 40'

SCALE: 1" = 20'

NOTE: ACCESS PITS FOR HDD SHALL BE LOCATED AT THE LOCATIONS OF PROPOSED VALVE CHAMBERS UNLESS OTHERWISE AGREED UPON BY THE ENGINEER.

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

BOSTON POST ROAD
MASSDOT STA. 138+30 TO
MASSDOT STA. 129+93

Rev.	Date	Description

Drawn By: CM
Designed By: MEC
Checked By: SJL
Approved By: JVH

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T&H NO.: 6639
DATE: JANUARY 2021
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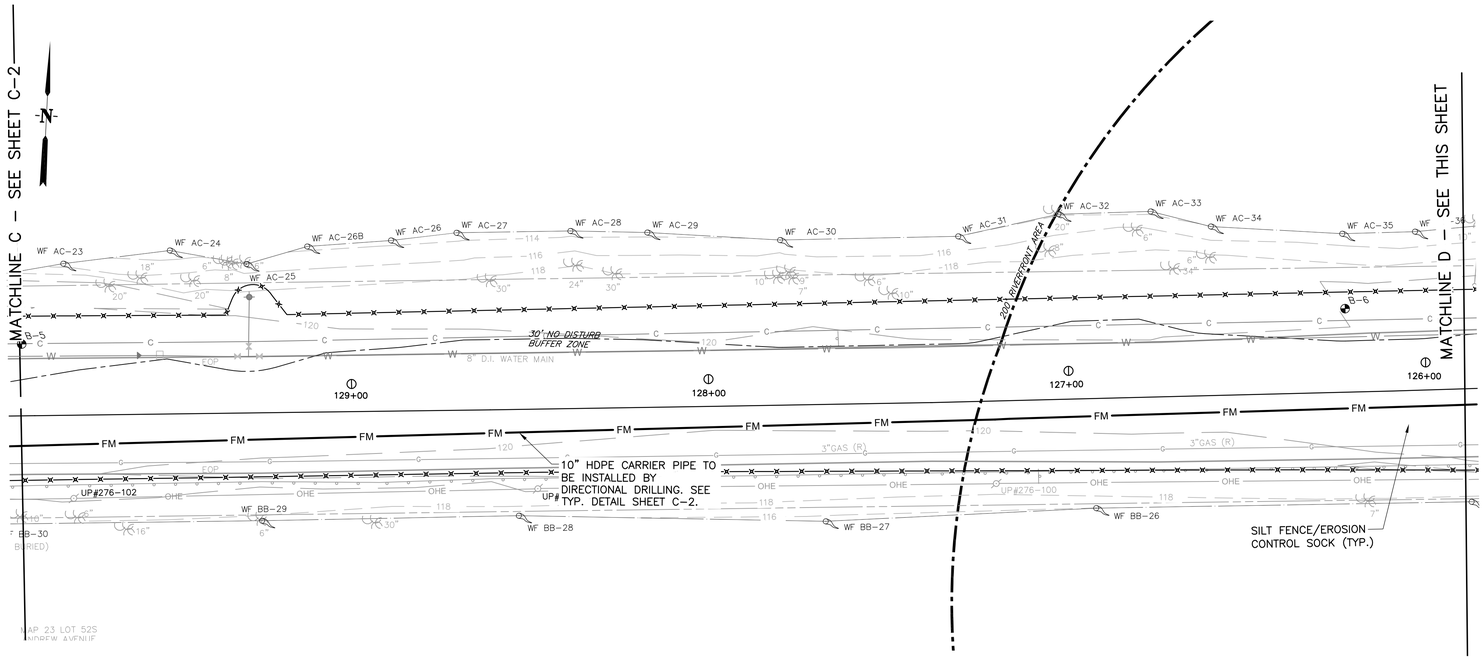
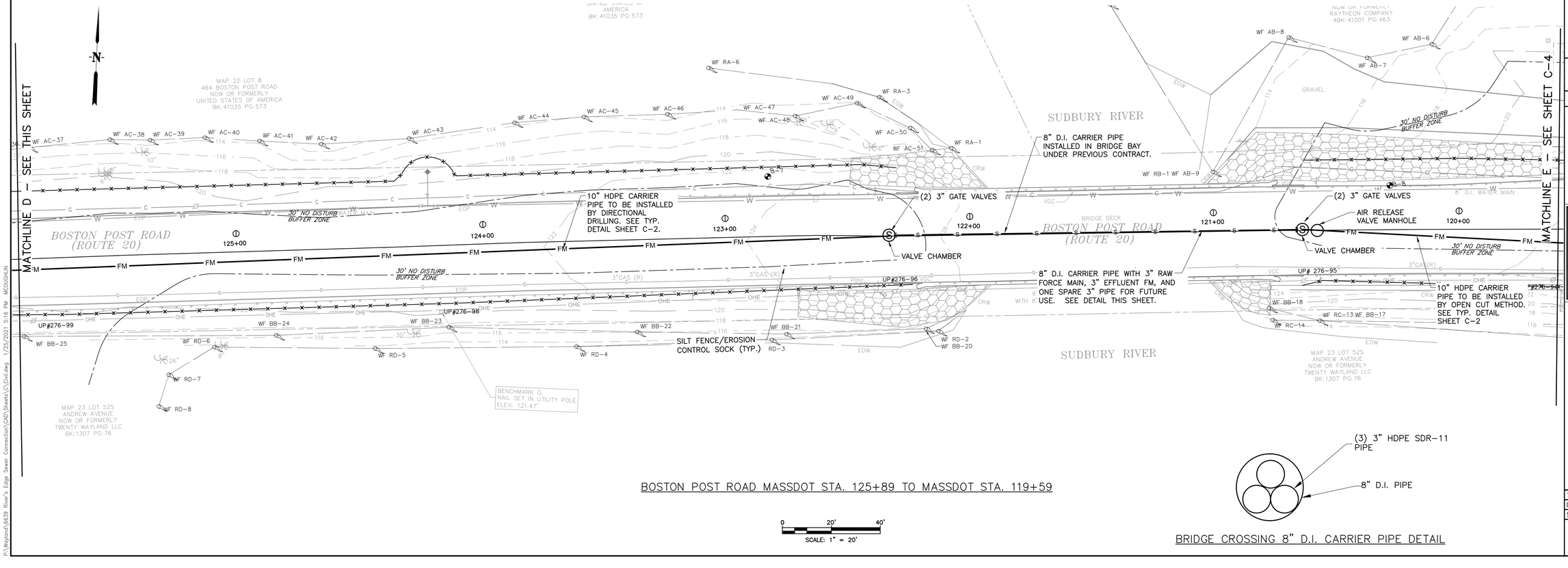
C-2



BOSTON POST ROAD MASSDOT STA. 129+93 TO MASSDOT STA. 125+89

0 20' 40'

SCALE: 1" = 20'



BOSTON POST ROAD MASSDOT STA. 125+89 TO MASSDOT STA. 119+59

0 20' 40'

SCALE: 1" = 20'

BRIDGE CROSSING 8" D.I. CARRIER PIPE DETAIL

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

BOSTON POST ROAD
MASSDOT STA. 129+93
TO MASSDOT STA. 119+59

Drawn By: CM | Designed By: MEC | Checked By: SJL | Approved By: JVH

Description | Date | Rev.

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TATA & HOWARD

T&H NO.: 6639
DATE: JANUARY 2021
SCALE: AS NOTED

C-3

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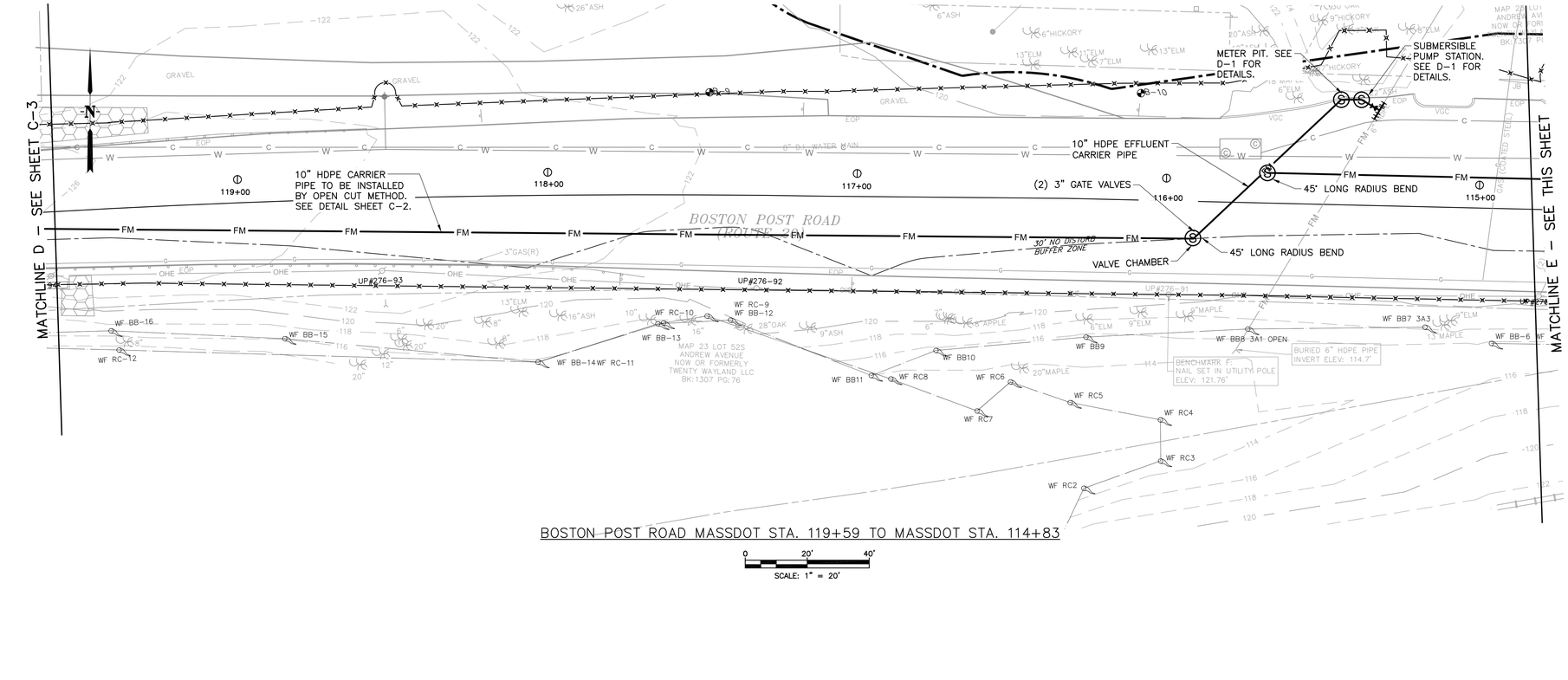
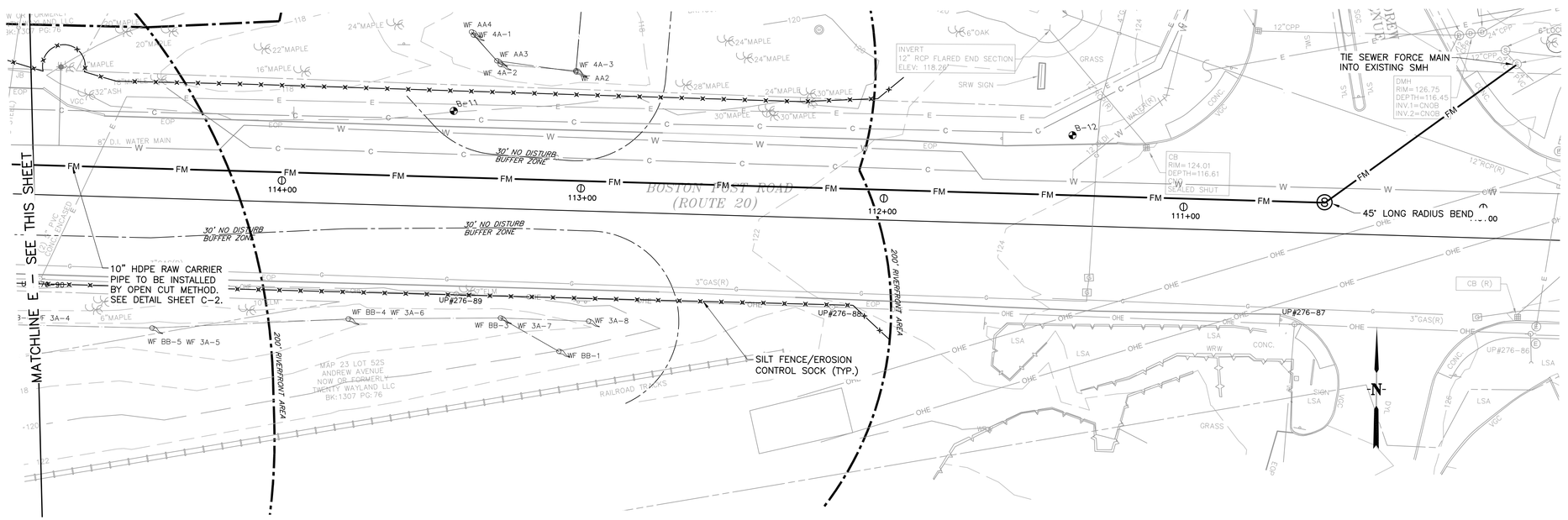


BOSTON POST ROAD MASSDOT STA. 119+59 TO MASSDOT STA. 114+83

SCALE: 1" = 20'



BOSTON POST ROAD MASSDOT STA. 114+83 TO MASSDOT STA. 110+91

SCALE: 1" = 20'

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

BOSTON POST ROAD
MASSDOT STA. 119+59 TO
MASSDOT STA. 110+91

Description	Date	Rev.

Drawn By: CM
Designed By: MEC
Checked By: SJL
Approved By: JVH

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TATA & HOWARD

T&H NO.: 6639
DATE: JANUARY 2021
SCALE: AS NOTED

C-4

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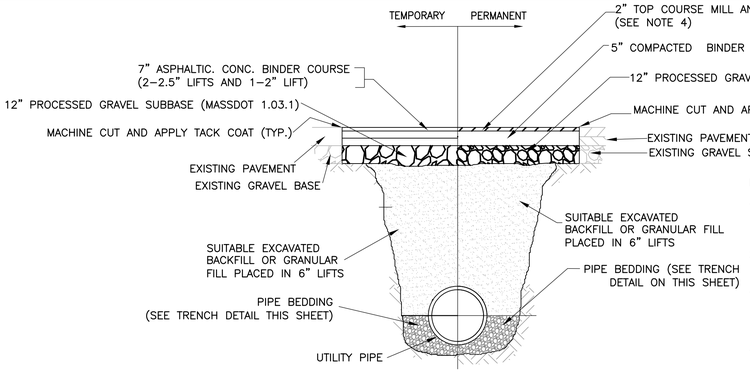
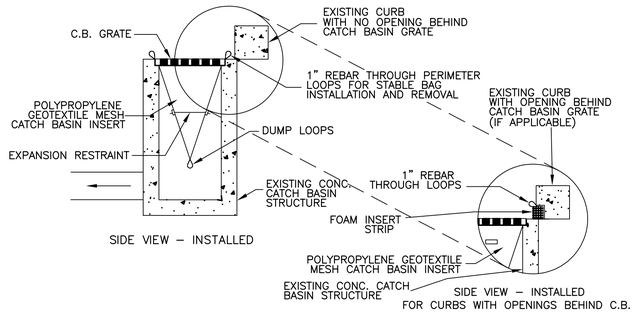


NOTES:

1. ALL PAVEMENT THICKNESSES AND PROCESSED GRAVEL SUBBASE THICKNESSES SHALL MATCH EXISTING, OR BE AS SPECIFIED ABOVE, WHICHEVER IS GREATER.
2. ALL PAVEMENT THICKNESSES AND PROCESSED GRAVEL SUBBASE THICKNESSES SHALL BE VERIFIED WITH THE OWNER.
3. SUITABLE EXCAVATED BACKFILL OR GRANULAR FILL, COMPACTED IN 6–INCH LIFTS, IS ACCEPTABLE WHERE THE TRENCHES ARE GREATER THAN 4–FEET IN DEPTH.
4. MILL AND OVERLAY SHALL BE FROM EDGE OF PAVEMENT (NORTH SIDE OF BOSTON POST ROAD) TO 12" BEYOND THE SOUTH SIDE OF THE TRENCH.
5. FOR HYDRANT TRENCH PAVEMENT REQUIREMENTS, SEE SPECIFICATION SECTION 02513, ASPHALTIC PAVEMENT.

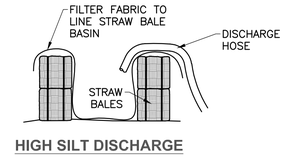
MASSDOT PAVEMENT DETAIL

SCALE: NONE



CATCH BASIN SILT FILTERING SYSTEM

SCALE: NONE

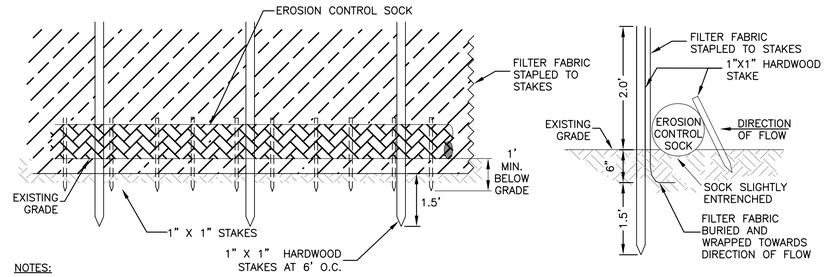


NOTES:

1. STRAW BALES SHALL BE STACKED 1 OR 2 ROWS HIGH AS REQUIRED TO MITIGATE THE FLOW.
2. THE BASIN SHALL BE SIZED TO FILTER THE FLOW BEING DISCHARGED TO THE BASIN.

SEDIMENTATION DISCHARGE CONTROL BASIN

SCALE: NONE

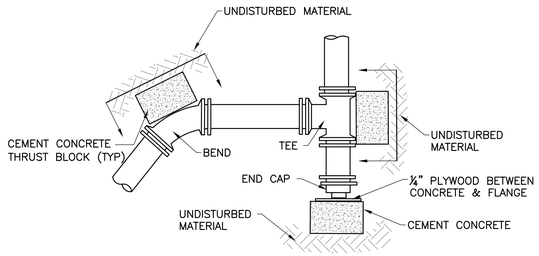


NOTES:

1. FINAL INSTALLATION TECHNIQUES SHALL BE AS RECOMMENDED BY THE MANUFACTURER AND AS DIRECTED BY THE ENGINEER.
2. EROSION CONTROL SOCK SHALL BE 8–INCHES IN DIAMETER AND FILLED WITH BIODEGRADABLE MATERIAL.

SILT FENCE/EROSION CONTROL SOCK

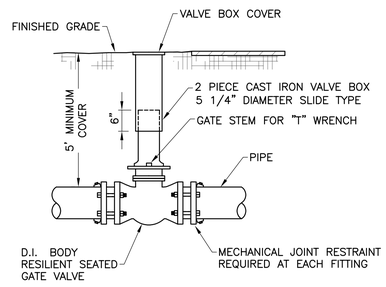
SCALE: NONE



PLAN

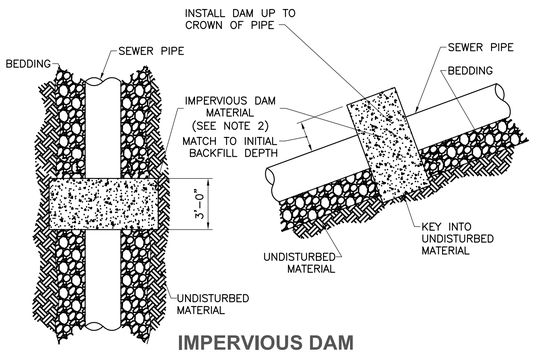
CONCRETE BACKING

SCALE: NONE



BURIED VALVE

SCALE: NONE

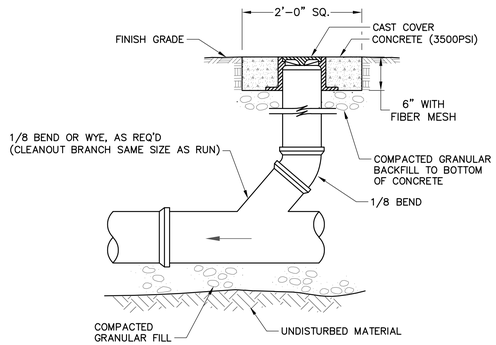


IMPERVIOUS DAM

SCALE: NONE

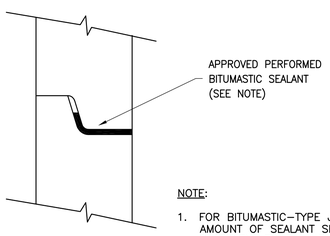
NOTE:

1. WHERE PIPE SLOPE EXCEED 8%, INSTALL IMPERVIOUS DAMS EVERY 100 FT AND WHERE REQUIRED BY ENGINEER.
2. REFER TO SPEC. SECTION 02221 FOR TYPE OF MATERIAL FOR THE IMPERVIOUS DAM.



CLEANOUT DETAIL

NOT TO SCALE



NOTE:

1. FOR BITUMASTIC–TYPE JOINTS, THE AMOUNT OF SEALANT SHALL BE SUFFICIENT TO FILL AT LEAST 75% OF THE JOINT CAVITY.

BITUMASTIC MANHOLE SEALANT/GASKET

SCALE: NONE

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

DETAIL SHEET I

Approved By: JVH
Checked By: SJL
Designed By: MEC
Drawn By: CM

No.	Description	Date

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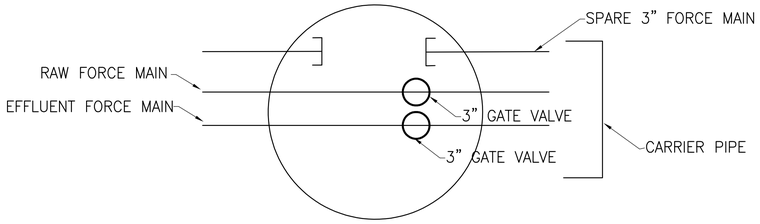
TATA & HOWARD

T&H NO.: 6639
DATE: JANUARY 2021
SCALE: AS NOTED

C-5

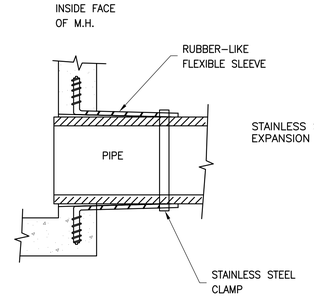


CARRIER PIPE VALVE CHAMBER SCHEMATIC

SCALE: NONE

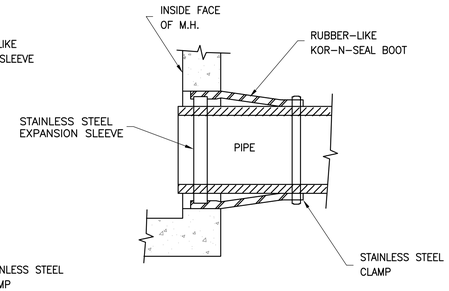
NOTES:

1. PIPES ROTATED FOR CLARITY.



LOCK-JOINT FLEXIBLE M.H. SLEEVE

(OR EQUAL)

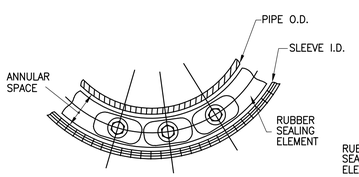


KOR-N-SEAL SLEEVE

(OR EQUAL)

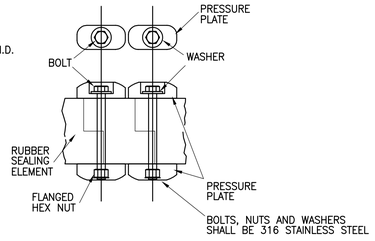
SLEEVE FOR MANHOLE WALL PENETRATION

SCALE: NONE



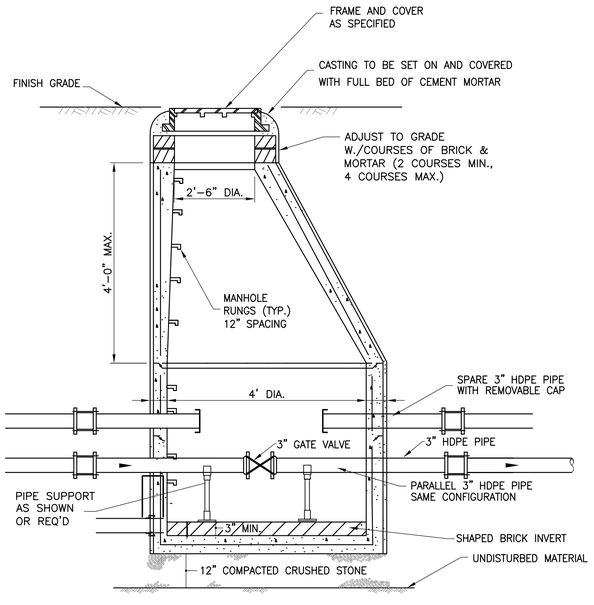
NOTE:

REFER TO LINK–SEAL CATALOGUE FOR DETAILS OF SIZES AND DIMENSIONS.



MECHANICAL LINK SEAL DETAIL

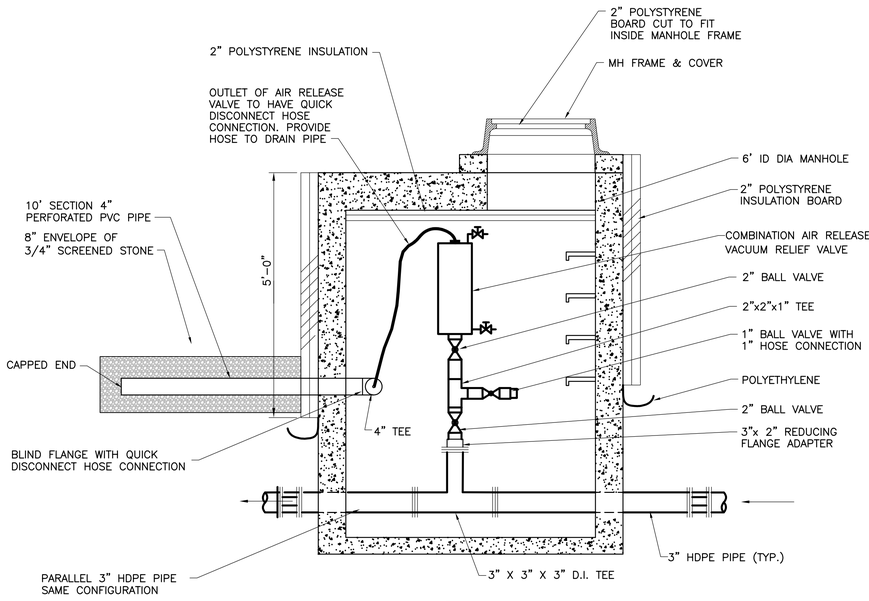
SCALE: NONE



SECTION

VALVE CHAMBER

SCALE: NONE



AIR RELEASE VALVE MANHOLE

SCALE: NONE

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

DETAIL SHEET II

Drawn By: KAT | Designed By: MEC | Checked By: SJL | Approved By: JAH

Rev.	Date	Description

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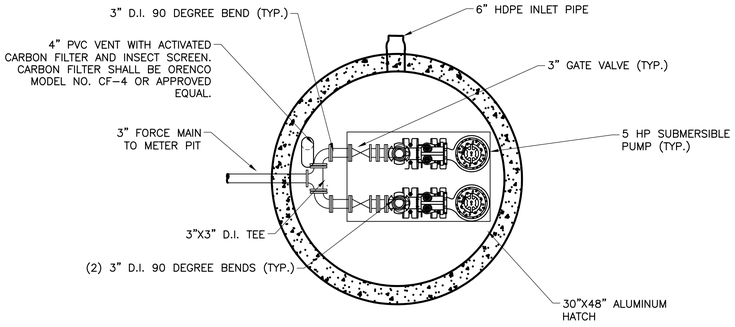
TATA & HOWARD

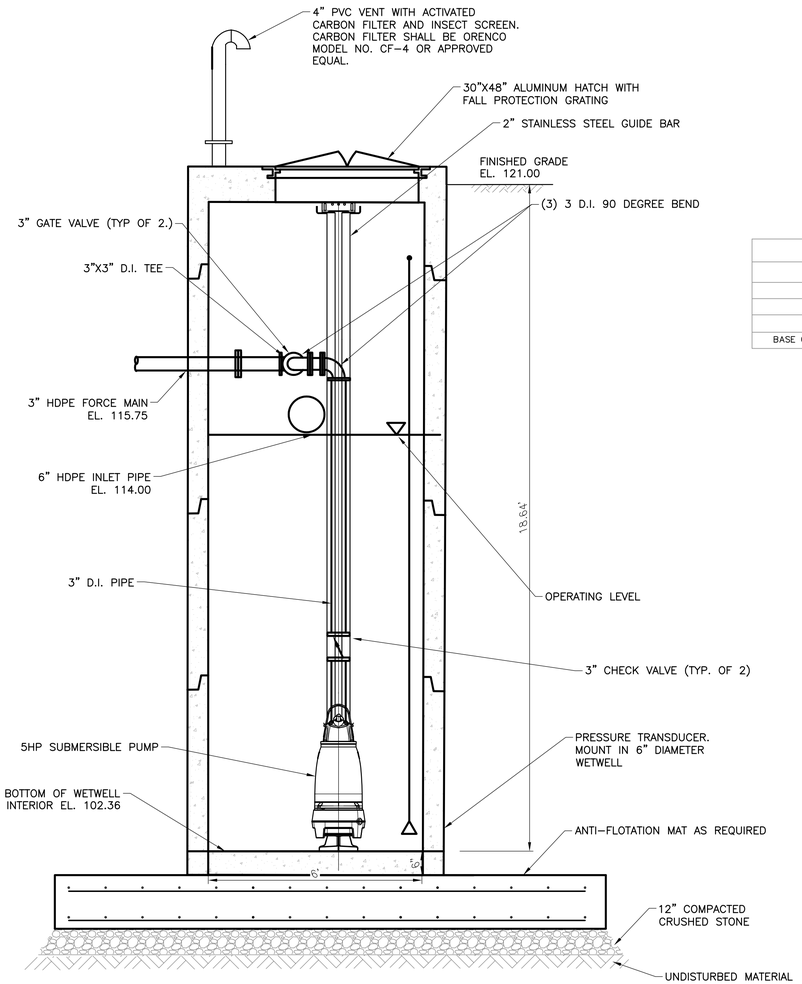
T&H NO.: 6639
DATE: JANUARY 2021
SCALE: AS NOTED

C-6



PROPOSED PUMP STATION PLAN VIEW

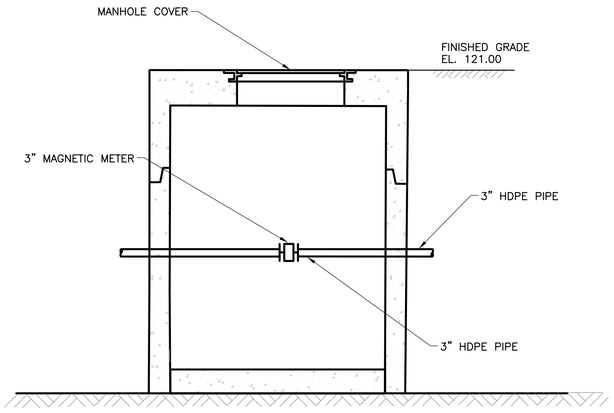
SCALE: 1/2" = 1'-0"



PROPOSED PUMP STATION PROFILE VIEW

SCALE: 1/2" = 1'-0"

WETWELL ELEVATIONS	
DESCRIPTION	ELEVATION (FT.)
FINISHED GRADE	121.00
INVERT OUT	115.75
INVERTS IN	114.00
BASE OF WETWELL – INTERIOR	102.36



PROPOSED METER PIT PROFILE VIEW

SCALE: 1/2" = 1'-0"

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

PROPOSED PIPING PLAN

Rev.	Date	Description

Designed By:MEC
Drawn By:CM
Checked By:SJL
Approved By:JVH

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TATA & HOWARD

T&H NO.: 6639
DATE: JANUARY 2021
SCALE: AS NOTED

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NOTES:

1. ALL TEMPORARY TRAFFIC CONTROL WORK SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) AND ALL REVISIONS, UNLESS SUPERCEDED BY THESE PLANS.
2. ALL SIGN LEGENDS, BORDERS, AND MOUNTING SHALL BE IN ACCORDANCE WITH THE MUTCD.
3. TEMPORARY CONSTRUCTION SIGNING AND ALL OTHER TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF ANY WORK.
4. TEMPORARY CONSTRUCTION SIGNING, BARRICADES, AND ALL OTHER NECESSARY WORK ZONE TRAFFIC CONTROL DEVICES SHALL BE REMOVED FROM THE HIGHWAY OR COVERED WHEN THEY ARE NOT REQUIRED FOR CONTROL OF TRAFFIC.
5. SIGNS AND SIGN SUPPORTS LOCATED ON OR NEAR THE TRAVELED WAY, CHANNELIZING DEVICES, BARRIERS, AND CRASH ATTENUATORS MUST PASS THE CRITERIA SET FORTH IN NCHRP REPORT 350, "RECOMMENDED PROCEDURES FOR THE SAFETY PERFORMANCE EVALUATION OF HIGHWAY FEATURES" AND/OR "MANUAL FOR ASSESSING SAFETY HARDWARE" (MASH).
6. CONTRACTORS SHALL NOTIFY EACH ABUTTER AT LEAST 24 HOURS IN ADVANCE OF THE START OF ANY WORK THAT WILL REQUIRE THE TEMPORARY CLOSURE OF ACCESS. SUCH AS CONDUIT INSTALLATION, EXISTING PAVEMENT EXCAVATION, TEMPORARY DRIVEWAY PAVEMENT PLACEMENT, AND SIMILAR OPERATIONS.
7. THE FIRST FIVE PLASTIC DRUMS OF A TAPER SHALL BE MOUNTED WITH TYPE A LIGHTS.
8. THE ADVISORY SPEED LIMIT, IF REQUIRED, SHALL BE DETERMINED BY THE ENGINEER.
9. DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
10. MAXIMUM SPACING OF TRAFFIC DEVICES IN A TAPER (DRUMS OR CONES) IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH.
11. MINIMUM LANE WIDTH IS TO BE 11 FEET (3.3m) UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF DRUMS OR MEDIAN BARRIER.
12. ALL SIGNS SHALL BE MOUNTED ON THEIR OWN STANDARD SIGN SUPPORTS.

LEGEND:

- REFLECTORIZED PLASTIC DRUM OR 36" CONE
- P/F POLICE/FLAGGER DETAIL
- TYPE III BARRICADE
- CHANGEABLE MESSAGE SIGN
- ARROW BOARD
- WORK ZONE
- DIRECTION OF TRAFFIC
- IMPACT ATTENUATOR
- MEDIAN BARRIER
- MEDIAN BARRIER WITH WARNING LIGHTS
- WORK VEHICLE
- TRUCK MOUNTED ATTENUATOR
- TRAFFIC OR PEDESTRIAN SIGNAL
- SIGN

THE IDEAL CAPACITY OF A MAJOR HIGHWAY IS GENERALLY CONSIDERED TO BE 1900 PASSENGER CARS PER HOUR PER LANE (PCPHPL). IN WORK ZONES ON A MULTI-LANE DIVIDED HIGHWAY, THE FOLLOWING VOLUME GUIDELINES HAVE BEEN SUGGESTED:

MEASURED AVERAGE WORK ZONE CAPACITIES

NUMBER OF LANES		NUMBER OF STUDIES	AVERAGE CAPACITY	
NORMAL (EXISTING)	OPEN (TO TRAFFIC)		VPH	VPHPL
3	1	7	1,170	1,170
2	1	8	1,340	1,340
5	2	8	2,740	1,370
4	2	4	2,960	1,480
6	2	6	4,580	1,430
4	3	4	4,580	1,520

Source: Dudek, C. Notes on Work Zone Capacity and Level of Service. Texas Transportation Institute, Texas A&M University, College Station, Texas (1984)

BY OBTAINING HOURLY TRAFFIC COUNTS FOR A PARTICULAR ROADWAY (WITH A MINIMUM OF A 48-HOUR AUTOMATIC TRAFFIC RECORDER (ATR) COUNT), THIS WILL HELP TO DETERMINE AT WHAT TIMES OF THE DAY OR NIGHT A CERTAIN NUMBER OF LANES MAY BE CLOSED.

massDOT Highway Division | Notes for Traffic Management | FIGURE GEN-1 GENERAL GUIDELINES

CONVENTIONAL ROADWAY– A STREET OR HIGHWAY OTHER THAN A LOW-VOLUME ROAD, EXPRESSWAY, OR FREEWAY.

EXPRESSWAY– A DIVIDED HIGHWAY WITH PARTIAL CONTROL OF ACCESS.

FREEWAY– A DIVIDED HIGHWAY WITH FULL CONTROL OF ACCESS.

LOW-VOLUME ROAD– A FACILITY LYING OUTSIDE OF BUILT-UP AREAS OF CITIES, TOWNS, AND COMMUNITIES, AND IT SHALL HAVE A TRAFFIC VOLUME OF LESS THAN 400 AADT. IT SHALL NOT BE A FREEWAY, EXPRESSWAY, INTERCHANGE RAMP, FREEWAY SERVICE ROAD OR A ROAD ON A DESIGNATED STATE HIGHWAY SYSTEM.

Source: MUTCD LATEST EDITION

TAPER LENGTH CRITERIA FOR TEMPORARY TRAFFIC CONTROL ZONES

TYPE OF TAPER	TAPER LENGTH (L)*
MERGING TAPER	AT LEAST L
SHIFTING TAPER	AT LEAST 0.5L
SHOULDER TAPER	AT LEAST 0.33L
ONE-LANE, TWO-WAY TRAFFIC TAPER	50 FT MIN.(15 m) 100 FT.(30 m) MAX.
DOWNSTREAM TAPER	50 FT MIN.(15 m) 100 FT MAX.(30 m) PER LANE

Source: Table 6C-3 MUTCD LATEST EDITION

FORMULAS FOR DETERMINING TAPER LENGTHS

SPEED LIMIT (S)	TAPER LENGTH (L) FEET
40 MPH OR LESS	$L = \frac{WS^2}{60}$
45 MPH OR MORE	$L = WS$

SPEED LIMIT (S)	TAPER LENGTH (L) Meters
60 KM/H OR LESS	$L = \frac{WS^2}{150}$
70 KM/H OR MORE	$L = \frac{WS}{1.6}$

WHERE: L = TAPER LENGTH IN FEET (METERS)

W = WIDTH OF OFFSET IN FEET (METERS)

S = POSTED SPEED LIMIT OR OFF-PEAK 85TH-PERCENTILE SPEED PRIOR TO WORK STARTING, OR THE ANTICIPATED OPERATING SPEED IN MPH (KM/H)

Source: Table 6C-4 MUTCD LATEST EDITION

massDOT Highway Division | Notes for Traffic Management | FIGURE GEN-3 NOTES ON WORK ZONE DISTANCES

SUGGESTED WORK ZONE WARNING SIGN SPACING

ROAD TYPE	DISTANCE BETWEEN SIGNS **		
	A	B	C
LOCAL OR LOW VOLUME ROADWAYS*	250 (100)	350 (100)	350 (100)
MOST OTHER ROADWAYS*	500 (150)	500 (150)	500 (150)
FREEWAYS AND EXPRESSWAYS*	1,000 (300)	1,500 (450)	2,640 (800)

* ROAD TYPE TO BE DETERMINED BY MASSDOT OFFICE OF TRANSPORTATION PLANNING.

** DISTANCES ARE SHOWN IN FEET (METERS). THE COLUMN HEADINGS A, B, AND C ARE THE DIMENSIONS SHOWN IN THE DETAILS' TYPICAL SETUP FIGURES. THE A DIMENSION IS THE DISTANCE FROM THE TRANSITION OR POINT OF RESTRICTION TO THE FIRST SIGN. THE B DIMENSION IS THE DISTANCE BETWEEN THE FIRST AND SECOND SIGNS. THE C DIMENSION IS THE DISTANCE BETWEEN THE SECOND AND THIRD SIGNS. (THE "THIRD" SIGN IS THE FIRST ONE TYPICALLY ENCOUNTERED BY A DRIVER APPROACHING A TEMPORARY TRAFFIC CONTROL (TTC) ZONE.)

THE "THIRD" SIGN ABOVE IS TYPICALLY REFERRED TO AS AN "ADVANCE WARNING" SIGN ON THE TTCP SETUPS. THOSE ADVANCE WARNING SIGNS ARE LOCATED PRIOR TO THE PROJECT LIMITS ON ALL APPROACHES (i.e. THE W20-1 SERIES (ROAD WORK XX FT) SIGNS), AND USUALLY REMAIN FOR THE DURATION OF THE PROJECT. ADDITIONAL SIGNS (i.e. "RIGHT LANE CLOSED 1 MILE" AND "LEFT LANE CLOSED 1 MILE") HAVE BEEN SHOWN IN SOME FIGURES AS EXAMPLES OF REINFORCEMENT SIGN PLACEMENT BUT ARE USED IN RARE OCCASIONS.

THE FIRST AND SECOND WARNING SIGNS ABOVE ARE REFERRED TO AS THE OPERATIONAL (DAY-TO-DAY) WORK ZONE SIGNS AND MAY BE MOVED DEPENDING ON WHERE THE SPECIFIC ROADWAY WORK FOR THAT DAY IS LOCATED.

R2-10a SIGNS SHALL BE PLACED BETWEEN THE SECOND AND THIRD SIGNS AS DESCRIBED ABOVE.

R2-10a, R2-10e, AND W20-1 SERIES SIGNS ARE TO BE INCLUDED ON ALL DETAILS/TYPICAL SETUPS.

Based on Table 6C-1 MUTCD LATEST EDITION

STOPPING SIGHT DISTANCE AS A FUNCTION OF SPEED

SPEED* (km/h)	DISTANCE (m)
30	35
40	50
50	65
60	85
70	105
80	130
90	160
100	185
110	220
120	250

SPEED* (mph)	DISTANCE (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

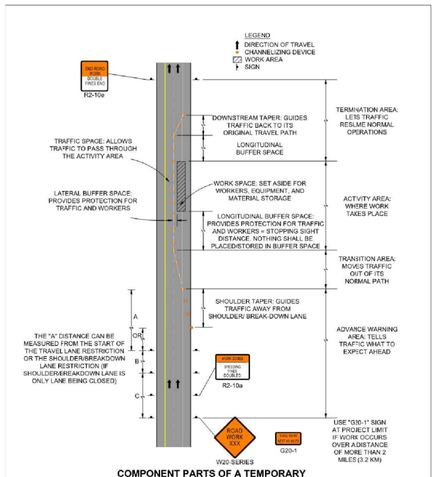
*POSTED SPEED, OFF-PEAK 85TH-PERCENTILE SPEED PRIOR TO WORK STARTING, OR THE ANTICIPATED OPERATING SPEED

THESE VALUES MAY BE USED TO DETERMINE THE LENGTH OF LONGITUDINAL BUFFER SPACES.

THE DISTANCES IN THE ABOVE CHART REPRESENT THE MINIMAL VALUES FOR BUFFER SPACING.

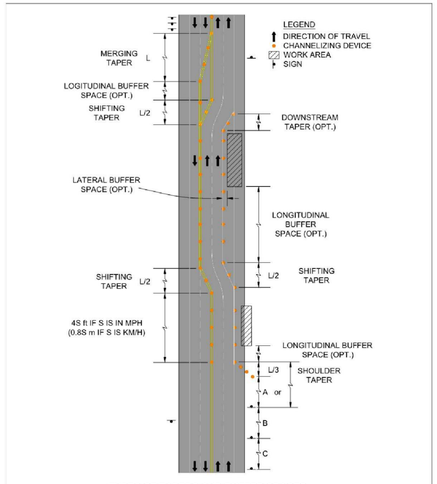
Source: Table 6C-2 MUTCD LATEST EDITION

massDOT Highway Division | Notes for Traffic Management | FIGURE GEN-2 NOTES ON WORK ZONE DISTANCES



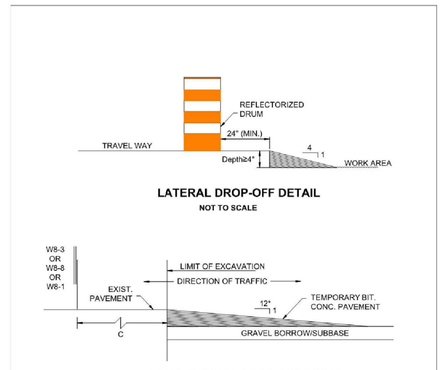
COMPONENT PARTS OF A TEMPORARY TRAFFIC CONTROL (TTC) ZONE

massDOT Highway Division | Standard Details and Drawings for the Development of Temporary Traffic Control Plans | FIGURE GEN-4 COMPONENT PARTS OF A TEMPORARY TRAFFIC CONTROL (TTC) ZONE NOT TO SCALE



TYPES OF TAPERS AND BUFFER SPACES

massDOT Highway Division | Standard Details and Drawings for the Development of Temporary Traffic Control Plans | FIGURE GEN-5 TYPES OF TAPERS AND BUFFER SPACES NOT TO SCALE



LATERAL DROP-OFF DETAIL

NOT TO SCALE

LONGITUDINAL DROP-OFF DETAIL

NOT TO SCALE

* - INCREASE SLOPE RATIO FOR HIGHER SPEEDS

LATERAL AND LONGITUDINAL DROP-OFF DETAILS

massDOT Highway Division | Standard Details and Drawings for the Development of Temporary Traffic Control Plans | FIGURE GEN-6 LATERAL AND LONGITUDINAL DROP-OFF DETAILS NOT TO SCALE

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

TRAFFIC MANAGEMENT PLAN
SHEET 1

Rev.	Date	Description

Drawn By: CM | Designed By: MEC | Checked By: JAH | Approved By: JAC

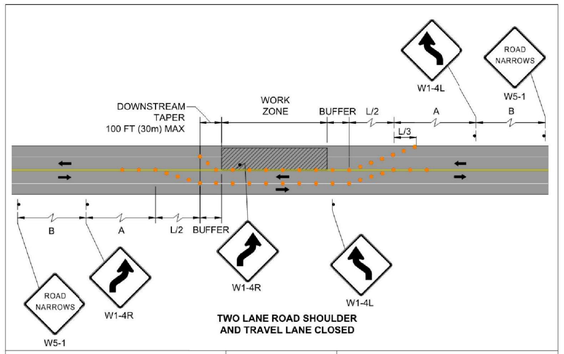
50% DRAFT SUBMITTAL
NOT FOR CONSTRUCTION

TATA & HOWARD

T&H NO.: 6639
DATE: JANUARY 2021
SCALE: AS NOTED

TR-1

P:\Wayland\6639 River's Edge Sewer Connection\CAD\Sheets\TR\TR-1 to TR-2.dwg 1/25/2021 6:02 PM MCOUGHLIN



TWO LANE ROAD SHOULDER AND TRAVEL LANE CLOSED

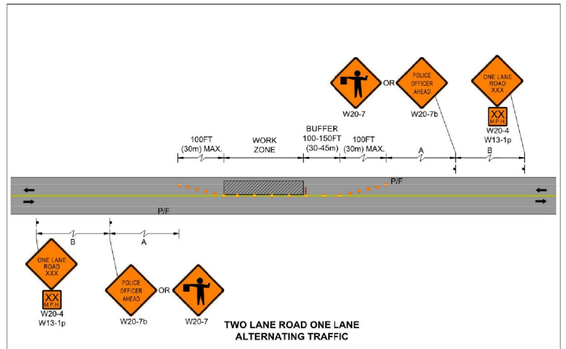
massDOT Massachusetts Department of Transportation Highway Division

Standard Details and Drawings for the Development of Temporary Traffic Control Plans

FIGURE TLR-2

TWO LANE ROAD SHOULDER AND TRAVEL LANE CLOSED

NOT TO SCALE



TWO LANE ROAD ONE LANE ALTERNATING TRAFFIC

massDOT Massachusetts Department of Transportation Highway Division

Standard Details and Drawings for the Development of Temporary Traffic Control Plans

FIGURE TLR-5

TWO LANE ROAD ONE LANE ALTERNATING TRAFFIC

NOT TO SCALE

TOWN OF WAYLAND
MASSACHUSETTS

RIVER'S EDGE SEWER CONNECTION

TRAFFIC MANAGEMENT PLAN SHEET II

Drawn By: CM | Designed By: MEC | Checked By: JHH | Approved By: JMC

Rev.	Date	Description

50% DRAFT SUBMITTAL NOT FOR CONSTRUCTION

TATA & HOWARD

T&H NO.: 6639
DATE: JANUARY 2021
SCALE: AS NOTED

TR-2

SECTION 02015

TEST PITS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide test pits where noted/shown on the Drawings or at locations requested by the Engineer.
   1. In general the work under this Section shall consist of the excavation of test pits or other miscellaneous excavations not specified for payment elsewhere, by the Contractor where it may be necessary to locate or examine soils, groundwater, drains, pipes, rock, public utilities, subsurface structures, or any other possible obstacle or condition.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02221 Earthwork for Sewer and Drainage Systems

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 COORDINATION WITH UTILITY OWNERS

A. The Contractor shall coordinate the excavation of all test pits with the respective utility owners having facilities in the vicinity of the location of test pits.
   1. All utilities shall be informed of the necessity of work under this Section and the Contractor shall give sufficient notice to the respective utility owners to afford reasonable time for coordination.
   2. If so desired by respective utility owners, all or part of the work under this Section may be accomplished by their crews and/or supervised by them.

3.02 EXCAVATION

A. Unless otherwise specified, the Contractor shall dig test pits as required by the Contract Documents, and the Contractor shall notify the Engineer of the results immediately and prior to the start of any underground installations within said test pit areas.
   1. The Owner/Utility Companies shall be notified well in advance of excavation so that they also may make the necessary measurements to locate all objects within test pits.

2. Excavation of test pits shall be accomplished by such means as are required to ensure that any underground utilities or structures that may be encountered are not damaged
3. It shall be the Contractor's responsibility for any damages incurred during the excavation operations. Any such damages shall be repaired by him (if permitted) to the satisfaction of the Responsible Agency at the Contractor's own expense. Where the repair and/or replacement must be done by the Responsible Agency, any and all costs thereof shall be borne by the Contractor.
4. The Contractor shall notify the Engineer and/or utility companies of any conflicts uncovered which may require design revisions, relocations and/or adjustment.
5. No work shall be started within these areas of conflict until so authorized by the Engineer.
6. Test pit excavation and backfill shall comply with the applicable provisions of Section 02221.
7. Hand excavation shall be performed where necessary to prevent damage to the existing utilities.

3.03 MEASUREMENT

A. The Contractor shall measure and record the size, configuration, horizontal and vertical location of all utilities, pipes or other obstacles uncovered in the various test pits dug under this Section.
   1. Size of test pits shall be as directed by the Engineer.

3.04 RESTORATION

A. Where an existing pavement has been removed for the test pit excavation, the surface shall be restored to grade. The top 12 inches shall be compacted gravel.
   1. In all other areas, the surface of test pit areas shall be restored to a condition equal to or better than original.

END OF SECTION

SECTION 02140

SITE DRAINAGE AND DEWATERING

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide drainage and dewatering as required by the Contract Documents.
   1. In general the Contractor shall furnish all materials, equipment, labor and incidentals necessary to provide dewatering and drainage control during construction.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 01567 Environmental Protection
   2. Section 02221 Earthwork for Sewer and Drainage Systems
   3. Section 02731 Plastic Sewer Pipe and Fittings

1.03 SUBMITTALS

A. None required.

PART 2 PRODUCTS

2.01 EROSION AND SEDIMENTATION CONTROL

A. Devices for erosion and sedimentation control for effluent of dewatering operations shall be as specified in Section 01567 Environmental Protection.

PART 3 EXECUTION

3.01 INSTALLATION

A. To insure proper conditions at all times during construction the Contractor shall provide and maintain ample means and devices with which to remove and dispose of all water entering trenches and other excavations.
   1. Means of water removal and disposal shall include but not be limited to wells, surface pumps, and/or well point systems, to the extent required to prevent "boils" or softening of the foundation soils.
   2. The Contractor shall pitch the ground around the excavation to prevent water from running into excavated areas and to prevent damage to other structures or work on adjacent property.

3. The Contractor shall remove immediately any surface or seepage water or water from sewers, drains, creeks, or other sources, which may accumulate during the excavation and construction work.

B. Excavations shall be kept dry until the structures, pipes and appurtenances, to be built or installed therein, have been completed and backfilled to such extent that they shall not float or otherwise be damaged by water in the excavation.
   1. In no event shall water rise to cause unbalanced pressure on the pipe or other structures. The Contractor shall prevent flotation of the pipe or structures.
   2. Pipe, masonry and concrete shall not be placed in water. Water shall not submerge new masonry or concrete within four (4) hours after placement.

C. Sufficient stand-by pumping equipment shall be installed and mounted for immediate use in case of emergencies. The Contractor shall be responsible for the adequacy of their dewatering equipment and system in controlling the water and for protection to adjacent public and private property from damage. Any damage to permanent work or existing property resulting from the failure of the Contractor to provide an adequate dewatering system shall be repaired by the Contractor at their expense.
   1. Wells, well points and pump sumps shall be installed with adequate filters to prevent loss of fine grained soils.

3.02 DISPOSAL OF DRAINAGE WATER

A. All water pumped or drained from the work shall be disposed of in such a manner as to not cause injury to public health, damage to public or private property, interference with other work or adverse impacts to adjacent wetlands.
   1. Effluent from dewatering operations shall not be discharged directly to wetlands or waterways and shall not be discharged to storm drain systems prior to being filtered through a siltation basin.
   2. Discharge shall be such that no erosion occurs. Erosion protection shall be as specified in Section 01567 Environmental Protection.

END OF SECTION

SECTION 02160

SUPPORT OF EXCAVATION

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide excavation support as required by the Contract Documents.
   1. In general this work shall consist of furnishing and placing timber and/or steel sheeting and shoring of the types and dimensions required for proper excavation support.

1.02 DEFINITIONS

A. Shoring shall mean the use of a steel trench box, steel sheeting, or timber sheeting braced as required.

B. Timber sheeting shall mean the use of tongue and groove wood sheeting or steel soldier beams with wood lagging braced as required.

C. Steel sheeting shall mean the use of steel sheet pilings with interlocking joints, braced by steel members as required.

1.03 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   1. Section 02221 Earthwork for Sewer and Drainage Systems
   2. Section 02731 Plastic Sewer Pipe and Fittings

B. As established in the General Conditions of the Contract, the Contractor is solely responsible for means and methods of construction and for the sequence and procedures to be used.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   1. The Contractor shall not perform excavations in unstable ground and shall employ a positive means of containing the unstable ground behind shoring, before excavation may proceed.

B. Employ a qualified Engineer, properly permitted to provide such services at the location of the work, to design the shoring system and to inspect and report on the quality of its construction.

C. Comply with all pertinent requirements of governmental agencies having jurisdiction.

1.05 STANDARDS

A. The following Standards form a part of this Specification as referenced:
   1. ASTM A328, Specification for Steel Sheet Piling
   2. Massachusetts DPW Standard Specifications, Section 950 Sheeting.
   3. Code of Federal Regulations (CFR), 29 CFR 1926, OSHA Standards - Excavation.

1.06 SUBMITTALS

A. Submit shoring design to Engineer for record purposes only.

PART 2 PRODUCTS

2.01 DESIGN

A. Design a shoring system which will safely and adequately prevent collapse of adjacent materials and which will permit construction of the Work to the arrangement shown on the Drawings.

B. All shoring systems shall be designed so as to support all vertical and lateral loads and other surcharge loads imposed on the system during construction, including earth pressures, utility loads and other surcharged loads in order to provide safe and expeditious construction of the permanent structures and prevent movement and/or damage to adjacent soil, buildings, structures and utilities.

C. Secure all needed approvals, including those of governmental agencies having jurisdiction and of adjacent property owners if required, at no additional cost to the Owner.

2.02 MATERIALS

A Material shall include, but not necessarily be limited to sheet piling, solder piles, lagging, bracing members such as wales, struts, shores and tieback anchors.

B. Lumber for timber sheeting and shoring:
   1. Shall be sound Spruce, Douglas Fir, white or yellow Lodgepole, Ponderosa pine, or western hemlock plank, planed on one side and either tongue and grooved or splined.

C. Steel sheeting:
   1. Shall be of approved section and quality, either new or secondhand, conforming to the requirements of ASTM A328.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Construct and install the shoring system in strict accordance with the design engineer's requirements.
   1. When using soldier piles and lagging, where boulders or cobbles are encountered, soldier piles shall be installed in pre-augered holes over the full depth as required to prevent misalignment and damage.
   2. Vibration monitoring during installation and extraction of braced excavation shall be provided wherever the excavation is within 100 feet of existing structures.

3.03 SHEETING LEFT IN PLACE

A. Sheeting left in place, for the purpose of preventing injury to structures, utilities or other property, shall be cut-off 3 feet below finished grade.
   1. The right of the Engineer to order sheeting left in place shall not be construed as creating any obligation on his part to issue such orders. His failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise growing out of a failure, on the part of the Contractor, to leave in place sufficient sheeting to prevent movement of the ground.

3.04 SHEETING REMOVED

A. All sheeting not left in place shall be carefully removed in such manner as to not endanger the construction or other structures, utilities, or property.
   1. All voids left or caused by withdrawal shall be immediately refilled with approved material, and compacted with tools especially adapted to that purpose.
   2. Vibratory extraction methods shall be used only when it can be demonstrated that settling of pipe and structures will not occur. If such settling occurs, it shall be corrected at the Contractor's expense.

3.05 TRENCH BOX OR SHIELD

A. Use of a trench box or shield shall not relieve the Contractor of any liability for damages to persons or property growing out of a failure of the Contractor to leave in place sufficient sheeting and bracing to prevent the caving or moving of the ground or disturbance of the completed work.
   1. Care shall be taken, when a trench box or shield is moved ahead, so as not to pull apart the joints of pipe already placed or leave voids around the pipe wall.
   2. At no time shall the portable box or shield be allowed to be positioned below the spring line of the pipe.

3. The width of the trench box or shield shall be such that a minimum 6 inch horizontal clearance is maintained between the pipe and shield at all times
4. If the pipe has moved, it shall be reset to the proper line and grade.
5. Any voids between the trench box or shield and the undisturbed trenchwall within the pipe zone (bottom of trench to top of cover material) shall be filled with crushed stone, bank run gravel, or approved material, immediately after the box or shield is positioned.

END OF SECTION

SECTION 02210

SITE GRADING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Excavate, backfill, compact, and grade work associated with the pump station and associated features to the elevations shown on the Drawings, as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02110 Clearing and Grubbing
   2. Section 02140 Site Drainage and Dewatering
   3. Section 02221 Earthwork for Sewers and Draints
   4. Section 01050 Field Engineering

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

PART 2 PRODUCTS

2.01 SOIL

A. Fill Material:
   1. The soil to be used for grading shall be obtained from the site cuts or a designated borrow area on the site.
   2. Do not permit rocks having a dimension greater than 8 inches in the upper 12 inches of fill or embankment.

2.02 TOPSOIL

A. Where shown on the Drawings or otherwise required, provide topsoil consisting of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and reasonably free from subsoils, roots, heavy or stiff clay, stones larger than 2 inches in greatest dimension, noxious weeds, sticks, brush, litter and other deleterious matter.

B. Obtain topsoil from sources within the project limits, or provide imported topsoil obtained from sources outside the project limits, or from both sources.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FINISH ELEVATIONS AND LINES

A. Comply with pertinent provisions of Section 01050, Field Engineering.

3.03 PROCEDURES

A. Utilities:
1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
2. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
3. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer.
4. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.

B. Protection of Persons and Property:
1. Barricade open holes and depressions occurring as part of this work, and post warning lights on property adjacent to or with public access.
2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.

C. Dewatering:
1. Remove all water, including rain water, encountered during trench and substructure work to an approved location by pumps, drains and other approved methods as specified in Section 02140.
2. Keep excavations and site construction area free from water.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

3.04 EXCAVATING

A. Perform excavating within the limits of the Work to the lines, grades, and elevations shown on the Drawings and specified herein.

B. Satisfactory Excavated Materials:
   1. Transport to, and place in, fill or embankment areas within the limits of the Work.

C. Excavate and backfill in a manner and sequence that will provide proper drainage at all times.

D. Ditches and Gutters:
   1. Cut accurately to the cross sections, grades and elevations shown.
   2. Maintain excavations free from detrimental quantities of leaves, sticks, trash and other debris until completion of the Work.
   3. Dispose of excavated materials as shown on the Drawings or directed by the Engineer.

E. Unauthorized Excavation:
   1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific instruction from the Engineer.

F. Ground Surface Preparation:
   1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from the ground surface prior to placement of fills.
   2. Plow, strip, or break up surfaces steeper than one vertical to four horizontal (1:4), so that fill material will bond with existing services.
   3. When existing ground surface has a density less than that specified under "compacting" for the particular area, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.
   4. At exposed soils in areas to be paved, scarify to a minimum depth of 6 inches, and recompact at a moisture content that will permit proper compaction as specified for fill.

3.05 GRADING

A. General:
   1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.
   2. Smooth the finished surfaces within specified tolerance.
   3. Compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points as existing grades.
   4. Where a change of slope is indicated on the Drawings, construct a rolled transition section have a minimum radius of approximately 8 feet, unless adjacent construction will not permit such a transition or if such a transition defeats positive control of drainage.

B. Grading Outside Building Lines:
   1. Grade areas adjacent to buildings to achieve drainage away from the structures, and to prevent ponding.
   2. Finish the surfaces to be free from irregular surface changes, and:

a. Shape the surface of areas scheduled to be under walks to line, grade and cross-section, with finished surface not more than 0.10 feet above or below the required subgrade elevation.
b. Shape the surface of areas scheduled to be under pavement to line, grade, and cross-section, with finished surface not more than 0.05 feet above or below the required subgrade elevation.

3.06 COMPACTING

A. Control soil compaction during construction to provide the minimum percentage of density specified for each area.

B. Provide not less than the following maximum density of soil material compacted at optimum moisture content for the actual density of each layer of soil material in place, and as approved by the soils engineer.
1. Structures:
a. Compact the top 8" of subgrade and each layer of fill material or backfill material to 95% of maximum density.
2. Lawn and unpaved areas:
a. Compact the top 8" of subgrade and each layer of fill material or backfill material to 85% of maximum density.
b. Compact the upper 12" of filled areas, or natural soils exposed by excavating, at 85% of maximum density.
3. Walks:
a. Compact the top 8" of subgrade and each layer of fill material or backfill material to 95% of maximum density.
4. Pavements:
a. Compact the top 8" of subgrade and each layer of fill material or backfill material to 95% of maximum density for cohesive soil material.

C. Moisture Control:
1. Where subgrade or layer of soil material must be moisture-conditioned before compacting, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compacting operations.
2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.
3. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by dicing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture-density relation tests approved by the Engineer.

3.07 FIELD QUALITY CONTROL

A. If, in the Engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing under the provisions of Section 02200, of these Specifications.

3.08 MAINTENANCE

A. Protection of Newly Graded Areas:

1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.

B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape and compact to the required density prior to further construction.

END OF SECTION

SECTION 02221

EARTHWORK FOR SEWERS AND DRAINS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Provide all earthwork as required by the Contract Documents.

B. In general the work of this Section shall include but not necessarily be limited to, excavation, trenching, filling, backfilling, compaction and grading for sewer and drain systems.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02160 Support of Excavation
   3. Section 02227 Rock Removal
   4. Section 02700 Precast Concrete Manholes
   5. Section 02731 Plastic Sewer Pipe and Fittings
   6. Section 02930 Loam and Seed
   7. Section 01013 Facility Interferance with Proposed Work
   8. Section 01300 Submittals
   9. Section 01567 Environmental Protection

1.03 SITE INVESTIGATION

A. The grades and other site information have been compiled by field surveys.
   1. The Contractor acknowledges that he has satisfied himself as to the nature and location of the work.
   2. Failure by the Contractor to acquaint himself with all available information concerning the site will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   1. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

1.05 PROTECTION OF PROPERTY AND UTILITIES

A. Extreme care shall be exercised to prevent damage to existing trees, shrubs, utilities, walls, sidewalks, fences and private property.

1. Any damage to these items as a result of work performed by the Contractor shall be repaired by the Contractor at his own expense.
2. Existing property boundary markers, control points and datum elevation markers or bench marks shall be preserved.
    a. All such items which are displaced or destroyed by the Contractor shall be replaced by a registered Engineer or Land Surveyor, as required, with all expenses paid by the Contractor.

B. Utility agencies shall be contacted and advised of proposed work prior to the start of work by the Contractor.
1. Notify Dig Safe.
2. Obtain information from the proper sources and authorities concerning locations of all utilities within the scope of this work.
3. If and when encountered, utilities shall be supported and protected, and the Engineer shall be notified. Ample time shall be allowed for entrance and taking such measures as may be required for the continuance of such services by the utility owner.
4. Rules and regulations governing the respective utilities shall be observed. The Contractor's responsibilities with respect to utility locations, protection, interferences and relocations shall be as further specified in Section 01013.

1.06 REFERENCE STANDARDS

A. The Contractor shall comply with the provisions of the following agencies as they apply to this project and as referenced:
1. Associated General Contractors of America, Inc. (AGCA) “Manual of Accident Prevention in Construction.”
2. Occupational Safety and Health Administration (OSHA), United States Department of Labor Requirements.
3. American National Standards Institute (ANSI) “Safety Requirements for Construction and Demolition.”
4. American Water Works Association Standards.

B. The following American Society for Testing and Materials (ASTM) standards form a part of this specification as referenced:
1. ASTM C33 Standard Specification for Concrete Aggregates
3. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
4. ASTM D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
5. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. The following Massachusetts Department of Transportation (MassDOT) Standard Specifications for a part of the specification as referenced:
1. Section M1 Soils and Borrow Materials
2. Section M2 Aggregates and Related Materials

1.07 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. Testing and Samples:
   1. Test reports on backfill materials, moisture density tests, in place density tests (ASTM D1557 and D6938).
   2. Representative backfill and bedding samples and gradation tests (ASTM D6913).
   3. Tests shall be in conformance with paragraph 3.15 compaction requirements and testing as specified herein.

1.08 TRAFFIC

A. While excavating and backfilling is in progress, traffic shall be maintained in a manner as specified in Section 01570 Traffic Regulation.

PART 2 PRODUCTS

2.01 GENERAL

A. Except as specified for pipe bedding, pipe cover, roadway subbase and refill for rock and unsuitable materials, backfill materials may be as follows:
   1. Suitable materials for trench backfill shall be the material excavated during the course of construction, but excluding debris, pieces of pavement, frozen materials, organic matter, silt, top soil, ledge excavation and rocks over six inches in largest dimension.
   2. Gradation of material shall be generally as specified for gravel borrow except that maximum size of stone shall be 6 inches.
   3. The suitability of existing material for use as backfill will be determined by the Engineer.
   4. All unsuitable materials shall be disposed of as per paragraph 3.17.A.

2.02 PIPE BEDDING AND COVER MATERIAL

A. Pipe Bedding and Pipe Cover Material (HDPE Pipe).
   1. Material for pipe bedding shall be screened gravel or crushed stone, ranging in size from 1/2 inch to 3/4 inch.

Sieve Size	Percent Passing by Weight
3/4 inch	90-100
1/2 inch	50-90
3/8 inch	20-40
No. 4	0-10
No. 8	0-5

2.03 CONCRETE SAND

A. Concrete sand shall meet ASTM C33 for fine aggregate.

2.04 STRUCTURAL FILL

A. Structural fill shall generally range from gavelly sand to gravel, free of organic material, trash, loam, ice, snow, frozen soil and other objectionable material, and shall conform to the following:

Sieve Size	Percent Passing by Weight
6 inch	100
No. 4	30-80
No. 40	5-35
No. 200	0-8

2.05 GRAVEL BORROW

A. Gravel borrow shall be a granular material, well graded from fine to coarse, with a maximum size of 3 inches, obtained from approved natural deposits and unprocessed except for the removal of unacceptable material and stones larger than the maximum size permitted.
   1. It shall not contain vegetation, masses of roots, or individual roots.
   2. It shall be substantially free from loam and other organic matter, clay, and other fine or harmful substances.
   3. Gravel borrow shall have the following gradation:

Sieve Size	Percent Passing by Weight
3 inch	95-100
1/2 inch	50-85
No. 4	40-75
No. 50	8-28
No. 200	0-10

2.06 PROCESSED GRAVEL FOR ROADWAY BASE

A. Shall meet the requirements of the Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges, latest edition, M1.03.1.

Sieve Size	Percent Passing by Weight
3 inch	100
1 1/2 inch	70-100
3/4 inch	50-85
No. 4	30-60
No. 200	0-10

2.07 CLAY/BENTONITE

A. Materials that will function as impervious barriers to water movement shall be a silty or clay soil material meeting the requirements of AASHTP M 145 for soil classification A2, A-6 and A-7 provided such materials do not have a Liquid Limit (LL) greater than 50.

PART 3 EXECUTION

3.01 TRENCH EXCAVATION

A. The Contractor shall make all excavation in earth and in rock, necessary or incidental to the proposed construction under the terms of this Contract and as herein specified or indicated on the Drawings.

1. All trench excavation shall be accomplished by open cut method.
2. All excavation shall be made in such manner and to such widths as will give ample room for properly installing, constructing and inspecting pipe lines and structures they are to contain.
3. The width of trenches shall be sufficient to allow thorough compacting of the refill adjacent to the lower quarters of the pipe. At pipe joints such additional width and depth shall be excavated as is necessary to give ample room for properly making and inspecting the pipe joint.
4. Bracing and support of all trench excavation shall meet all requirements of Local and State ordinances and OSHA regulations.
    a. Sheeting and bracing, or the use of a steel support box shall be used where required to maintain a safe working condition and provide protection from collapse of the trench walls.
5. During excavations, material determined by the Engineer to be suitable for backfilling, shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Unsuitable material shall be disposed of as specified in paragraph 3.18 and replaced as ordered by the Engineer with surplus suitable material and gravel borrow to the extent necessary.
6. Should conditions make it impractical or unsafe to stack material beside the trench, it shall be hauled and stored at a location provided by the Contractor. When required, it shall be re-handled and used in backfilling the trench. No additional compensation will be made for re-handling this material.
7. Pipe trenches shall be backfilled as soon as practical after the pipes have been laid, jointed and inspected by the Engineer. The extent of excavation open at any one time shall be no more than 50 linear feet of trench during working hours and no more than 20 linear feet during non-working hours. Under no circumstances shall more than 100 feet of trench be open at any one time.

3.02 EXCAVATION CLASSIFICATION

A. Earth excavation shall comprise all materials not classified as rock excavation and shall include clay, silt, sand, muck, gravel, hardpan, loose shale, pavement, pavement bases, loose stone in masses and boulders measuring less than one cubic yard in volume.

B. Rock: See Section 02227 - Rock Removal.

3.03 TRENCH EXCAVATION IN PAVED ROADWAYS

A. In excavating trenches in roadways having an improved pavement, the Contractor shall cut the pavement twice; once prior to excavation and again prior to permanent resurfacing.

1. The first cut may be made using a water cooled abrasive saw, pneumatic chisel or a wheel cutter attached to a front end loader.
2. The second and final cut shall be made with a water cooled abrasive saw.
3. In all cases a trial section shall be cut to indicate the performance of the equipment to be used.

4. Pavement removed shall not be mixed with other excavated materials, but shall be disposed of away from the site of the work before the remainder of the excavation is made.
5. Existing pavement and base course to remain shall be protected by the Contractor. All existing pavements and base courses which are to remain and have been damaged, shall be restored or replaced by Contractor to match existing pavements, base courses and grades, at no additional expense to the Owner.

3.04 UNSUITABLE MATERIAL

A. All pipes and structures are to be laid on a stable foundation. If material at grade is determined to be unsuitable by the Engineer, the Contractor shall excavate a further depth and/or width, and refill with an approved material. Refill material shall be structural fill or gravel borrow as determined by the Engineer.
   1. Where fine sand and silt are encountered at the bottom of the trench, it shall be the option of the Engineer to require a 6-inch compacted depth of concrete sand meeting ASTM C33 for fine aggregate to be installed beneath the pipe bedding to the full width of trench.
   2. Payment width limits shall be the same as specified for trench excavation, unless an additional width of trench is ordered by the Engineer.
   3. Any excavation in excess of the amount ordered by the Engineer shall be backfilled and compacted with an approved granular material, at the Contractors expense.

3.05 ROCK REMOVAL

A. See Specification Section 02227.

3.06 DEWATERING

A. See Specification Section 02140.

3.07 BACKFILLING AND COMPACTING

A. Backfill shall be placed in uniform layers. Each layer shall be thoroughly compacted by tamping or vibrating with mechanical compacting equipment.
   1. Care shall be taken to compact the backfill materials throughout the full width of the excavation and beneath all pipes and structures.
   2. The backfilling of trenches shall proceed as soon as the laying of the pipe(s) or installation of the structures will allow.
   3. Pipe bedding shall be required below and up to the springline of all pipe. Pipe bedding shall be placed to the full width of the trench and to a depth of 6 inches below the bottom of the pipe barrel as indicated on the Drawings
   4. Pipe bedding shall be placed 12 inches beyond the widths of a utility structure foundation (base) and to a depth of 6 inches below the foundation (base) or as indicated on the Drawings.
   5. After a pipe has been adjusted to correct line and grade, and bedded, the trench shall be filled to the centerline of the pipe with pipe bedding and compacted, except at the joint. After the joint has been inspected, that portion shall be filled in with pipe bedding and compacted. Material under and around the pipe shall be

carefully and thoroughly compacted and tamped with approved compacting equipment.

6. From the centerline of the pipe to a point 12 inches above the top of the pipe, the fill shall be pipe bedding.
7. Impervious dams of natural clay, or bentonite shall be installed in the pipe bedding, cover and below grade replacement material to a length of 12 inches and at maximum spacing of 300 feet to minimize flow of groundwater through the bedding.

B. Placement of Backfill Above the Pipe Bedding.

1. Above the pipe bedding, backfill shall be suitable material from the excavation or, if ordered by the Engineer, gravel borrow. This backfill shall be placed in layers 12 inches deep in loose measure, or greater at the discretion of the Engineer, and each layer shall be thoroughly compacted with mechanical tampers. This backfill shall be carried up to the bottom of materials specified to be placed for surfacing requirements.

C. Roadway Trench.

1. The following additions shall apply specifically to trenches within roadways:
   a. The top eighteen (18) inches of trench refill, roadway sub-base, shall be comprised of 6 inches of processed gravel and 12 inches of gravel borrow, placed, graded and compacted by the Contractor. This material shall be placed during the backfilling operation.
   b. The Contractor shall fine grade the surface, apply dust control treatment and maintain the surface in a condition which will allow safe vehicular traffic until resurfacing is placed.
   c. The length of unsurfaced trench shall not exceed 500 linear feet, and shall be maintained to the Owner's satisfaction, in a condition to allow safe vehicular traffic. If the trench is not maintained in a satisfactory condition, the allowable length of unsurfaced trench shall be reduced accordingly.

3.08 TRENCH SIZE

A. Trenches shall be excavated to the necessary width and depth for proper laying of pipe and placement of concrete and other materials and shall have vertical sides to 12 inches above the pipe. Above this point, sides shall be as near vertical as approved construction procedures and safety requirements permit.

1. Widths of trenches shall be as shown on the drawings.
2. The depth of trench shall be a minimum 6 inches below the pipe barrel, or as shown on the Drawings.

3.09 STRIPPING TOPSOIL

A. Topsoil shall be carefully stripped and separately stored to be used again for topsoiling and seeding on off-pavement areas within which excavations are to be made.

3.10 EXCAVATION NEAR EXISTING STRUCTURES AND UTILITIES

A. It is called to the attention of the Contractor that there are utilities and other underground pipes along the course of the work. Information shown on the Drawings as to the

location of said utilities and pipes is from the best available sources, but no guarantee is implied, nor is it to be assumed that such information is accurate or complete. Utility lines will be crossed in the course of the work.

B. The Contractor shall exercise special care during his operations to avoid injury to all such underground utilities and structures.
   1. When necessary, the Contractor shall cooperate with, and consult with representatives of the Owner and the utility companies in order to avoid damage to the structures.
   2. The Contractor shall arrange for or furnish and erect suitable supports and shoring or other means of protection where required to protect the utilities, all at no additional cost to the Owner.
   3. Hand methods of excavating shall be used around buried utilities and is included in the work to be done under this Contract, at no additional cost to the Owner.
   4. Interference between the proposed work and existing utilities, relocation of existing utilities, repair or damage to existing utilities, and protection and support of existing utilities during construction of the proposed work will be as specified in Section 01013.

3.11 PROTECTION OF PROPERTY

A. The Contractor shall, at his own expense, preserve and protect from injury all property either public or private along and adjacent to the line of work, and be responsible for and repair any and all damage and injury thereto, arising out of or in consequence of any act or omission of the Contractor.
   1. All existing pipes, culverts, poles, wires, fences, mailboxes, stone walls, curbs, bounds, etc., shall be temporarily removed, supported in place or otherwise protected from injury, and shall be restored to at least as good condition as that in which they were found immediately prior to the start of work.
   2. Lawns, shrubs, bushes, planting beds and decorative trees disturbed or damaged shall be restored to a condition equal to that found prior to the start of construction, either by temporary transplant or replacement in kind, except as otherwise indicated on the Drawings.

3.12 SAFETY AND ACCOMMODATION

A. The Contractor shall provide, at his own expense, suitable bridges over trenches where required for the accommodation and safety of the traveling public, and provide facilities for access to private driveways for vehicular use.
   1. He shall erect suitable barriers around the excavation to prevent accidents to the public and shall place and maintain during the night sufficient lights on or near the work.
   2. A space of twenty (20) feet shall be left so that free access may be had at all times to fire hydrants and proper precautions shall be taken so that the entrances to fire hydrants and fire stations shall not be blocked or obstructed.

3.13 DETOURS

A. It is the intent of this Contract to keep the roadways open to two way traffic at all times. In order to obtain permission for the closing of the roadway, the Contractor shall satisfy

the Owner, Police Chief and Fire Chief, that his operations will allow emergency access at all times.

1. See Section 01570, Traffic Regulations.

3.14 UNIFORMED POLICE OFFICERS

A. The Contractor shall make all arrangements with the Police Chief for the services of uniformed police officers.

1. If, in the opinion of the Police Chief or the Owner, uniformed police officers are required for protection of persons and control of traffic, the Contractor shall be responsible for making all arrangements for said uniformed police officers as may be required.

3.15 COMPACTION REQUIREMENTS AND TESTING

A. All backfill materials shall be thoroughly compacted by rolling, tamping or vibrating with approved mechanical or pneumatic compacting equipment so that pipe, structures, paving and other construction will not settle at the time of construction or in the future. The responsibility for thorough compaction is that of the Contractor irrespective of methods of backfill and depth of backfill layers placed.

B. All percentages of compaction specified herein shall be of the maximum dry density at the optimum moisture content as established ASTM D1557 and verified by ASTM D6938. When the term "thoroughly compacted" is used in these specifications, it shall mean compaction to at least 95% of the maximum density of the soils at optimum moisture content.

C. The following numbers and types of soil tests shall be made where directed by the Engineer. These tests shall be made by qualified personnel of an independent testing laboratory, acceptable to the Engineer and paid by the Contractor. Three copies of all test results shall be delivered to the Engineer.

1. Particle-Size analysis of Soils and Backfill Materials in accordance with ASTM D6913. A minimum of one satisfactory test from each material in the field shall be submitted to the Owner and Engineer in addition to the initial shop drawings confirming material compliance with the specifications.
2. Moisture-Density Relationship of soil in accordance with ASTM D1557, Method D. A minimum of one satisfactory test from each material in the field shall be submitted to the Owner and Engineer in addition to the initial shop drawings confirming material compliance with the specifications.
3. In-Place Density Tests of materials in accordance with ASTM D6938. Compaction tests will be taken at random on compaction layers below and at finished surfaces. Compaction testing frequency shall occur as outlined below, or as directed by the Engineer.
    a. Not less than one compaction test for every 300 linear feet.
    b. Not less than one compaction test for every 5,000 sq. ft. for each lift.
4. Failed tests shall be repeated at the Contractor's expense.

D. The Owner reserves the right to have additional compaction tests performed by an independent laboratory with testing costs borne by the Owner, except that failed tests shall be repeated at the Contractor's expense.

E. If any of the field density test results fail to met the density as specified herein for the earthwork involved, then the Contractor shall remove all of the earthwork in that portion of the work involved as determined by the Engineer, and shall replace it in accordance with these Specifications to the required density. After the work is replaced, additional field density tests will be made by an independent testing laboratory retained by the Owner, and the Contractor shall reimburse the Owner for all costs for such additional testing.

F. Compaction shall be to the following densities:

Fill and Backfill Location	Modified Proctor Density (Percent)
Under structures and pipes	95
Beside structure foundation walls	95
Top two feet under pavements	95
Under pavements below top two feet	95
Trenches through unpaved areas	90
In embankment	90

G. Puddling and jetting of the backfill shall not be permitted except in special cases approved by the Engineer.

3.16 TRENCH EXCAVATION IN FILL

A. Where the existing ground surface does not permit at least 4 feet of cover over the finished pipe, and where indicated on the Drawings, the Contractor shall place and compact suitable fill material to the depth necessary to provide the 4 foot minimum cover, including loam to a minimum top width of 6 feet, or as otherwise shown on the Drawings
   1. Minimum side slopes shall be two horizontal to one vertical.
   2. Fill material shall be from surplus suitable material or gravel borrow, and be clean, dry, and capable of satisfactory compaction, all as approved by the Engineer, and shall be placed in layers not exceeding 8 inches thick and compacted.
   3. The trench shall be excavated in the compacted fill and the remainder of the work shall be in accordance with other portions of these Specifications.

3.17 DISPOSAL OF SURPLUS AND UNSUITABLE EXCAVATED MATERIAL

A. All surplus excavated material and any material unsuitable for use shall be disposed of in disposal areas provided by the Contractor.
   1. It is the Contractor's responsibility to dispose of unsuitable excavated material in an approved manner.
   2. The Contractor shall not dispose of surplus materials on wetlands or other areas prohibited by the Corps of Engineers or the Commonwealth of Massachusetts Department of Environmental Protection, or any other local authority having jurisdiction.

3.18 DUST CONTROL

A. The Contractor shall perform dust control operations as specified in Section 01567.

3.19 CLEAN-UP

A. The Contractor shall remove all surplus materials (earth, pipe, fittings, storage and office trailers, barricades, etc.), from the construction site.
   1. All paved roadways affected by the construction shall have their full width swept clean (paved edge to paved edge) using methods which control the dust.
   2. Before the Contractor may proceed to another roadway, clean up of the previous roadway must be complete.

END OF SECTION

SECTION 02227

ROCK REMOVAL

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Remove all rock encountered while excavating for structures, roadways, or utility trenches as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02221 Earthwork for Drains and Sewer

1.03 DEFINITIONS

A. Rock excavation: Rock which requires explosives, wedging or impact hammer for its removal. Concrete shall be classified as rock.

B. Boulders, slabs or other single pieces of material encountered, which are less than one (1) cubic yard shall not be considered rock.

1.04 STANDARDS

A. All handling of explosives and blasting shall be in compliance with the pertinent sections of Commonwealth of Massachusetts Regulations (CMR) 13.00.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Comply with all pertinent requirements of governmental agencies having jurisdiction.

1.06 SUBMITTALS

A. Submit plans for proposed pre-blast survey (Record purposes only).

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 NOTIFICATION

A. When rock is encountered, it shall be uncovered and the Engineer notified.
   1. The Contractor shall provide the Engineer with cross sections of the rock surface or a profile of the rock where trenches are concerned.
   2. The Engineer shall be present when the cross sections or profiles are taken.
   3. The average end area method shall be used in computing the volumes wherever practicable.

3.02 LIMITS OF EXCAVATION IN ROCK

A. Excavation in rock shall be performed, so that no projection shall come within vertical planes twelve (12) inches outside of the structure being built or twelve (12) inches below the bottom of the structure base slab and footings.

B. In trenches, the rock shall be removed to the limits shown on the typical trench section.
   1. Where excavation is carried beyond the above determined limits, the additional space shall be refilled at the Contractor's expense with concrete or other specified materials.

3.03 BLASTING

A. Pre-Blast Survey: Prior to any blasting, the Contractor shall submit a pre-blast survey.
   1. The survey shall satisfy the insurance requirements of the Contractor and be acceptable to the Contractor's insurance carrier, as well as provide data to assess damages to personal property and real estate due to blasting operations.
   2. The survey shall be complete as warranted by the nature of the work.

B. Take all precautions necessary to warn and/or protect any individuals exposed to his operations. Such precautions shall include but not be restricted to the following:
   1. Present written certificate of insurance showing evidence that his insurance includes coverage for blasting operations, before doing any blasting work.
   2. Make necessary arrangements as may be required by the applicable Federal, State, County or Municipal codes, rules, regulations and laws, and shall be responsible for compliance.
   3. Obtain a permit from the local authorities to perform blasting operations.
      a. The Engineer shall be notified in writing that such permit has been obtained.
   4. Schedules for blasting shall be thoroughly coordinated with the proper authorities – Federal, State and Local.
      a. No blasting shall be done unless the Contractor has notified all concerned parties that he may blast.
      b. The Contractor shall also notify any commercial installation in the immediate area whose operations or instrumentation may be affected by blasting, at least twenty four (24) hours prior to blasting operations.
   5. Seismographic recordings shall be made of all blasting operations on the project by a qualified testing agency hired and coordinated by the Contractor.
      a. A copy of these recordings shall be made available to the Engineer.
   6. Blasting shall be performed by persons who are licensed to use explosives.

7. The Contractor shall keep an accurate record of each blast and submit a copy to the Engineer. The record shall show the date, time, exact stationing of the blast, the depth and number of drill holes, and kind and quantity of explosive used, and any other data required for a complete record.
8. The Contractor shall be fully responsible for damages caused by his blasting operations.
9. If rock below the limits of excavation is shattered by blasting, caused by holes drilled to deep, too heavy a charge of explosives or any other circumstance due to blasting, the shattered rock shall be removed and the void refilled with gravel borrow at the expense of the Contractor.
    a. Gravel borrow shall be as specified in Section 02221 Earthwork for Drains and Sewer.

3.04 DISPOSAL AND REPLACING OF ROCK

A. Remove and dispose of all pieces of rock which are not suitable for use in other parts of the Work.
    1. Rock disposed of by hauling away to spoil areas shall be replaced by surplus excavation obtained elsewhere on the site, insofar as it is available.

B. Fragments of rock approximately twenty five (25) pounds or less may be used in the fill areas of the site (roadway areas excluded).
    1. The Contractor shall place these pieces of rock in thin layers alternating them with layers of earth to be sure that all voids between the rock are completely filled with earth.
    2. If in the opinion of the Engineer the quantity is excessive, he may order the removal and disposal of the rock.

C. Be responsible for obtaining spoil locations and the removal of all excess rock from the site.

END OF SECTION

SECTION 02513

ASPHALTIC PAVEMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide asphaltic pavement and appurtenant items as required by the Contract Documents.
   1. In general the Contractor shall provide all labor, equipment, and materials, and perform all operations in connection with the installation of asphaltic pavement, berms, pavement markings, calcium chloride, final grade adjustments of valve boxes, manhole and catch basin castings, and preparation of the trench.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02221 Earthwork for Sewer and Drains

1.03 STANDARDS

A. All paving shall comply with the Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges, hereinafter called Standard Specifications, as referenced.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

PART 2 PRODUCTS

2.01 GRAVEL SUBBASE

A. Shall be as specified in Section 02221, Earthwork for Sewer and Drains.

2.02 ASPHALTIC PAVEMENT

A. Bottom and Top Course:
   1. Shall be Class I asphaltic pavement conforming to Sections 420, 460 and M3 of the Standard Specifications.

2.03 ASPHALT TACK COAT

A. Shall consist of either emulsified asphalt, grade RS-1 conforming to Section M3.03.1, or cutback asphalt, grade RC-70 or RC-250 conforming to Section M3.02.0 of the Standard Specifications.

2.04 PAVEMENT MARKING PAINT

A. Shall be High Heat Rapid Drying Traffic Marking Material conforming to Section M7.01.08 (White High Heat Rapid Drying Traffic Marking Material) and Section M7.01.09 (Yellow High Heat Rapid Drying Traffic Marking Material) of the Standard Specifications, as applicable.

B. Shall be Thermoplastic Reflectorized Pavement Markings conforming to Section M7.01.03 (White Thermoplastic Reflectorized Pavement Markings) and Section M7.01.04 (Yellow Thermoplastic Reflectorized Pavement Markings) of the Standard Specifications, as applicable.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FINAL PREPARATION OF SUBGRADES

A. Gravel Subbase:
   1. Minimum compacted depth shall be shown on details, of 12 inches as measured from the bottom of the pavement.
   2. Spread and compacted in layers not exceeding 6 inches in depth, compacted measurement.
   3. All layers shall be compacted to not less than 95 percent of the maximum dry density of the material as determined by the standard AASHTO Test Designation T99 Compaction Test Method C at optimum moisture content.

3.03 GENERAL

A. All asphaltic pavement thickness referred to in this Section shall be compacted thickness.

B. No asphaltic pavement shall be placed when the air temperature is below forty (40) degrees Fahrenheit, or when the material on which the mix is to be placed contains frost.

C. Maintain asphaltic pavment under this Contract during the guarantee period of one (1) year.
   1. Promptly refill and re-pave all areas which have settled or are otherwise unsatisfactory for traffic.

3.04 PLACEMENT OF ASPHALTIC CONCRETE PAVEMENT

A. Massachusetts Department of Transportation Temporary Pavement Requirements
   1. Place after underground facilities have been installed.
   2. Pavement shall be the type as specified in this Section except that "cold-mix" will be acceptable for repairs during seasonal closure of the asphalt concrete supplier.
   3. Within the MassDOT State Highway Layout (SHLO), the pavement profile shall consist of a compacted thickness of 7 inches of hot mix asphalt binder course Type I-1, placed in two 2.5-inch lifts and one 2-inch lift, as shown on the drawings.
   4. All trenches shall be backfilled and paved prior to the completion of work each day, and no trenches shall be left unpaved or plated in the road over the weekend in accordance with the MassDOT Permit. Millings may be allowed as temporary backfill on Sunday nights if asphalt plants are not opened, but millings shall be removed and temporary paving placed the following night.
   5. Asphalt shall be placed with a self propelled spreader.
   6. Compaction shall be accomplished with a self propelled roller, with a weight of approximately 285 pounds per inch of roller width.

B. Massachusetts Department of Transportation Permanent Paving Requirements
   1. Following the seasonal settling period, the Contractor shall, in preparation for permanent overlay in the MassDOT SHLO, mill the roadway from the nearest edge of road to 1-foot beyond the trench as required by the Drawings.
   2. The bottom 5-inches of temporary hot mix asphalt binder course Type I-1 paving shall be utilized as the base course of the permanent 2-inch mill and overlay permanent resurfacing with the MassDOT SHLO.
   3. After all loose and broken paving has been removed and replaced, the Contractor shall bring to subgrade, low or settled areas of temporary pavement and the existing pavement with a leveling course of asphaltic concrete.
   4. The surface of the remaining pavement shall be thoroughly patched, cleaned, and tack coated just prior to applying the overlay. Edges of the existing pavement shall be brushed clean and the specified tack coat applied. The surface receiving the top course shall be completely dry prior to the application of the tack coat.
   5. Tack coat shall be applied at the rate of 0.25 gallons per square yard. The contact surface of the curbing, castings and other structures shall be painted with the tack coat.
   6. All castings (frames and covers, valve boxes) shall be raised to finish grade before the top course is applied.
   7. The permanent pavement shall include a compacted 2-inch hot mix asphalt top course Type I-1 overlay.
   8. The equipment used for spreading and finishing shall be a mechanical self powered paver capable of spreading and finishing the mixture true to line, grade, width, and crown by means of fully automated controls for both longitudal and transverse slope.
   9. Compaction shall be accomplished with a self propelled roller with a weight of approximately 285 pounds per inch of roller width.

C. Sand Seal
   1. The but edges of all permanent resurfacing and overlays shall be sealed with a six (6) inch wide continuous strip of RS-1, completely covered with sand.

D. Infra-red Treatment

1. All trench resurfacing shall be blended with infra-red treatment.

3.05 CASTING ADJUSTMENTS

A. Where asphaltic pavement is to be applied, manhole and catch basin frames and valve boxes are to be adjusted to the grade of the new pavement.
   1. A neat line shall be cut in the pavement around the existing frames and valve boxes.
   2. The material; gravel, pavement and concrete collar (if applicable) shall be removed down to six (6) inches below the frame.
   3. The frame shall be freed from its existing grout bed and shimmed with steel shims of the appropriate thickness, at a minimum of four (4) alternate locations, so as to insure that the frame will not rock. The frame shall then be set into a full bed of grout, and a concrete collar placed around the frame, up to within two (2) inches of finish grade.
   4. The frame shall be protected from damage from traffic until the concrete has taken a firm set.

3.06 BERMS

A. Asphaltic Pavement Berms:
   1. Berms shall be class I asphaltic Type I-1.
   2. The mixture shall be placed and compacted with a machine acceptable and approved by the Engineer, for the type of berm required.
   3. Placing and forming of berms by hand shall not be allowed.

3.07 DUST CONTROL TREATMENT

A. Calcium chloride shall be applied only upon direction of the Engineer.
   1. The roadway shall be swept clean and calcium chloride spread at a uniform rate over the prepared gravel trench surface.

3.08 PAVEMENT MARKINGS

A. Pavement markings shall be applied as shown on the contract drawings or at locations directed by the Engineer.
   1. Pavements shall have been in place 48 hours prior to the application.
   2. The surface shall be prepared to accept the application in compliance with the paint manufacturer's requirements.
   3. Applied to a dry film thickness of fifteen (15) mils.
   4. The temperature of the pavement shall be between forty (40) degrees and one hundred twenty (120) degrees Fahrenheit.
   5. No thinners are to be used for the pavement markings.
   6. The equipment used for the application of pavement markings, shall be of standard commercial manufacturer. All other equipment and devices necessary for the application of pavement markings and protection thereof and for the protection of the traveling public, shall be as usually required for work of this type, and shall be furnished by the Contractor.
   7. Pavement markings shall be either a single continuous line or broken line, four (4) inches wide.
   8. If for any reason material is spilled or tracked on the pavement or any markings applied by the Contractor the Contractor shall remove such material.

a. The material shall be removed by a method that is not injurious to the roadway surface and is acceptable to the Engineer.
b. Clean the roadway surface and prepare the surface for a re-application of the pavement markings.

END OF SECTION

SECTION 02514

SIDEWALKS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: The work of this Section shall consist of furnishing all labor, materials and equipment required for installing sidewalks to conform to lines and grades shown on the Drawings.

B. Additional Work: The work in this Section shall consist of furnishing and installing all labor, materials and equipment required for install of either driveway or sidewalk transitions adjacent to or abutting concrete or bituminous sidewalks. In general, the Contractor shall match the material types and adjust cement or bituminous pavement for any changes in grade.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1. Section 02221 Earthwork for Sewer and Drainage Systems
2. Section 02513 Asphaltic Pavement
3. Section 02516 Remove and Reset Existing Curbing
4. Section 03300 Cast-In-Place Concrete

PART 2 PRODUCTS

2.01 CEMENT CONCRETE SIDEWALKS

A. Cement concrete for sidewalks shall conform to Class A cement concrete (3500 psi) as specified in Section 03300.

B. Curb ramps and driveway transitions shall conform to Class A concrete (3500 psi) as specified in Section 03300.

2.02 GRAVEL SUBBASE

A. Gravel subbase shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials.

B. Gradation requirements for gravel subbase shall be as specified in Section 02221 for structural fill.

2.03 BITUMINOUS CONCRETE SIDEWALKS

A. Bituminous concrete for bituminous sidewalks shall be as specified in Section 02513.

PART 3 EXECUTION

3.01 CEMENT CONCRETE SIDEWALKS

A. The subgrade for the sidewalks shall be shaped parallel to the proposed surface of the walks and shall be thoroughly compacted.

B. After the subgrade has been prepared, a foundation of gravel shall be placed upon it. After being compacted thoroughly, the foundation shall be at least 8 inches in thickness and parallel to the proposed surface of the walk. The gravel shall be compacted to not less than 95% of maximum density as defined in Section 02221.

C. Side forms and transverse forms for sidewalks shall be smooth, free from warp, of sufficient strength to resist springing out of shape, of a depth to conform to the thickness of the proposed walk.

D. The edge shall conform to the grade of the finished walk and shall have sufficient pitch to provide for surface drainage and shall not exceed 1/4 of an inch per foot.

E. The cement concrete sidewalks shall be placed in alternate slabs 24 feet in length except as otherwise ordered. The slabs for sidewalks shall be separated by transverse preformed expansion joint fillers 3/8 inch in thickness. Sidewalk and driveway expansion joints shall be 3/8" x 4" preformed ethylene vinyl acetate or closed cell polyethylene foam material.

F. Preformed expansion joint filler shall be placed adjacent to or around existing structures as directed.

G. The cement concrete shall be placed in such quantity that after being thoroughly consolidated in place it shall be 4 inches in depth. At driveways, the sidewalks shall be 6 inches in depth. After edging and jointing operations, the surface shall be floated with an aluminum or magnesium float. Immediately following floating, the surface shall be steel-troweled. If necessary, tooled joints and edges shall be rerun before and after troweling to maintain uniformity. After troweling, the surface shall be brushed by drawing a soft bristled push broom with a long handle over the surface of the cement concrete to produce a non-slip surface.

H. The surface of all cement concrete sidewalks shall be uniformly scored into block units of areas not more than 24 square feet. The depth of the scoring shall be at least one quarter of the thickness of the sidewalk.

I. The application of neat cement to surfaces in order to hasten hardening is prohibited.

J. The finishing of concrete surface shall be done by experienced and competent cement finishers. When completed the walks shall be kept moist and protected from traffic and weather for at least 3 days.

K. At driveways or street intersections the cement concrete shall be blended or tappered to cap the end of either concrete or granite curbing to form a smooth transition.

3.02 CURB RAMPS AND DRIVEWAYS

A. The subgrade for the sidewalks shall be shaped parallel to the proposed surface of the walks and shall be thoroughly compacted.

B. After the subgrade has been prepared, a foundation of gravel shall be placed upon it. After being compacted thoroughly, the foundation shall be at least 8 inches in thickness and parallel to the proposed surface of the walk.

C. Side forms and transverse forms for sidewalks shall be smooth, free from warp, of sufficient strength to resist springing out of shape, of a depth to conform to the thickness of the proposed walk.

D. The edge shall conform to the grade of the finished walk and shall have sufficient pitch to provide for surface drainage and shall not exceed 1/4 of an inch per foot.

E. The concrete ramps and driveway transitions shall be placed in alternate slabs 24 feet in length except as otherwise ordered. The slabs for sidewalks shall be separated by transverse preformed expansion joint fillers 3/8 inch in thickness. Ramps and driveway expansion joints shall be 3/8" x 4" preformed ethylene vinyl acetate or closed cell polyethylene foam material.

F. Handicap ramps and curb ramps at intersections shall be constructed in accordance with the Americans with Disabilities Act (ADA) Accessibility Guidelines (Jan 1998 edition) and in accordance with dimensions and minimum slopes presented in the design drawing(s) details.

G. Preformed expansion joint filler shall be placed adjacent to or around existing structures as directed.

H. The cement concrete in driveways shall be placed in such quantity that after being thoroughly consolidated in place it shall be 6 inches in depth. The cement concrete in sidewalk or curb ramps shall be 4 inches in depth except in conjunction with driveway areas. After edging and jointing operations, the surface shall be floated with an aluminum or magnesium float. Immediately following floating, the surface shall be steel-troweled. If necessary, tooled joints and edges shall be rerun before and after troweling to maintain uniformity. After troweling, the surface shall be brushed by drawing a soft bristled push broom with a long handle over the surface of the cement concrete to produce a non-slip surface.

I. At driveways, street intersections or sidewalk ramps the concrete shall be blended or tapered to cap the end of either concrete or granite curbing to form a smooth transition.

3.03 REMOVAL AND RELAYING OF EXISTING SIDEWALKS

A. The Contractor shall maintain access to all abutting business for the full duration of the Contract.

B. The Contractor shall remove and reset all existing castings in the sidewalk layout. If the existing castings are damaged as part of the Contractors sidewalk removal operations, the casting shall be replaced at the Contractor’s expense. The work shall include any

coordination required with public or privately owned utilities with equipment set in the sidewalk layout.

C. The Contractor shall make every effort to minimize damage to existing tree and root systems. In the case of excessive damage, which if determined by the OWNER will result in the death of the tree, the Contractor will be held fully responsible for replacement of the trees at no additional expense to the OWNER.

D. All existing curbs, bituminous sidewalks, brick sidewalks, concrete sidewalks, private or public walks, fences, stone walls and other similar items removed for the construction of the services, connections, water and/or storm drain lines shall be replaced in a manner equal or better than their original condition.

3.04 TRANSITIONS TO WALKWAYS AND DRIVEWAYS

A. The Contractor shall furnish and install a transition to the existing sidewalks and driveways to match the existing grades. The transition can vary from 6 inches to 3.0 feet wide depending on the location. The transition shall meet the Americans with Disabilities Act (ADA) requirements as specified herein under Item 3.02(F). The Contractor shall match the existing walk or driveway material type (i.e. cement concrete of asphaltic pavement). Any damage to the existing sidewalks or driveways, as a direct result of the Contractor's operations. shall be restored by the Contractor to the original conditions at no additional expense to the OWNER.

B. All costs related to replacement, furnishing, and installing the transitions shall not be measured for separate payment.

END OF SECTION

SECTION 02515

GRANITE CURBS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: The work of this Section shall consist of furnishing all labor, materials and equipment required for installing and setting curb(s), curb corners and edging on a gravel foundation, to conform with lines and grades shown on the Drawings.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02221 Earthwork for Sewer and Drainage Systems
   2. Section 02514 Concrete Sidewalks
   3. Section 03300 Cast-In-Place Concrete

PART 2 PRODUCTS

2.01 GRANITE CURBING

A. Granite curbing shall type VA-4 conforming to the requirements specified in Subsection M9.04.1 of the Massachusetts Highway Department Standard Specifications for Highways and Bridges.

B. All granite curb and edging shall be light gray in color, free from seams and other structural imperfections or flaws which would impair its structural integrity, and of a smooth splitting appearance.

C. Whenever curbing is sawed, all surfaces that are to be exposed shall be thoroughly cleaned and any iron rust or iron particles removed by sand blasting or other approved method and any saw mark in excess of 1/8 inch shall be removed.

2.02 CURB CORNERS (Bullnose Corners)

A. The granite for curb corners shall conform to M9.04.0 and shall have horizontal Beds. The curbs shall match the adjacent curbing in size, color and quality. The front arris lines shall extend through ¼ of a circle having a radius of 2 feet Type A curb corners. The back arris line shall be straight. The plane of back shall be normal to top.

2.03 GRANITE CURB INLETS (Throat Stone)

A. The granite curb inlets shall conform to Subsection M9.04.0 of the Mass Highway Department Standards. The curb inlets shall be horizontal bed with tops free from wind.

B. The curbing shall be sawn or peen hammered on top and the front face shall be straight split, free from drill holes.

C. The inlet curb shall be six (6) feet in length and 16-19 inches in depth. The curb shall be six (6) inches wide at the top and at least six inches wide at the bottom.

D. The mouth of the curb inlet shall be at least three (3) inches in depth and at least two (2) feet in length. The inlet curb shall be cut in the front face of the stone and the inlets shall match the adjacent curbing in color.

2.04 GRAVEL

A. Gravel shall conform to the requirements of Subsection M1.03.0 Type C of the Massachusetts Highway Department Standard Specifications for Highways and Bridges.

PART 3 EXECUTION

3.01 EXCAVATING TRENCH AND PREPARING FOUNDATION

A. The trench for the curb shall be excavated to a width of 18 inches. The subgrade of the trench shall be a depth below the proposed finished grade of the curb equal to 6 inches plus the depth of the curbstone. The trench for the curb corner shall extend 6 inches beyond the front and back of curb corner to the full depth of foundation.

B. The foundation for the curb shall consist of gravel spread upon the subgrade and after being thoroughly compacted by tamping shall be 6 inches in depth.

3.02 SETTING CURB AND EDGING

A. All spaces under the curb, curb corners or edging shall be filled with gravel thoroughly compacted so that the curb, curb corners or edging will be completely supported throughout their length.

3.03 FILLING ABOUT TRENCH

A. After the curb, curb corners, curb inlets and edging is set, the space between it and the wall of the trench shall be filled with gravel thoroughly tamped to the depth directed, care being taken not to affect the line or grade of the curb, curb corners, curb inlets and edging.

3.04 POINTING

A. The joints between curbstones or edging shall be carefully filled with cement mortar and neatly pointed on the top and front exposed portions. After pointing, the curbstones or edging shall be satisfactorily cleaned of all excess mortar that may have been forced out of the joints.

3.05 TRANSITION CURB FOR WHEELCHAIR RAMPS

A. Transitions from normal curb settings to wheelchair ramps shall be accomplished with transition curb. Transitions shall be of the same type of curb and similar to that abutting and, if on a curve, of the same radius.

END OF SECTION

SECTION 02516

REMOVE AND RESET EXISTING CURB

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: The work of this Section shall consist of removing the existing curb(s), edging, curb corners and curb inlets of every type and cross section and resetting them in accordance with these specifications and in conformity with the lines and grades shown on the Drawings.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02221 Earthwork for Sewer and Drainage Systems
   2. Section 02513 Asphaltic Pavement
   3. Section 02514 Concrete Sidewalks
   4. Section 03300 Cast-In-Place Concrete

PART 2 MATERIALS

2.01 CURBING

A. Curb, edging, curb inlets and curb corners shall consist of the same as is designated to be reset.

2.02 GRAVEL

A. Gravel shall conform to the requirements of Subsection M1.03.0 Type C of the Massachusetts Highway Department Standard Specifications for Highways and Bridges.

PART 3 EXECUTION

3.01 REMOVAL OF EXISTING CURB

A. A trench of sufficient width or depth shall be excavated so that the existing curb, edging, curb corners and curb inlets can be removed without damage.

B. The Contractor shall protect all curb or edging and keep it in satisfactory condition until the acceptance of the entire contract. The Contractor shall replace any existing curb, edging, curb corners and curb inlets that is to be reset, which is lost or damaged as a result of his operations, or because of his failure to store and protect it in a manner that would eliminate its loss or damage.

C. The length of any section of curb or edging, shall be altered by cutting in order to fit closures as necessary. The ends of all stones shall be square with the planes of the top and face so that when the stones are placed end-to-end as closely as possible no space shall show in the joint at the top and face of more than ¾ inch for the full width of the top and for 8 inches down on the face.

D. The Contractor shall accept and hold entire responsibility for the removal, handling, stacking at a convenient location for the Owner and the Contractor, and protection of all curbing and corners until final removal from the site or the resetting of the curb. Any curbing damaged through lack of protection or carelessness by the Contractor shall be replaced at the Contractors expense.

E. Any curb or curb corners not damaged through lack of protection or carelessness by the Contractor but deemed by the Engineer as unsatisfactory for relaying or stacking will be discarded. The Contractor is responsible for proper disposal of the granite without additional compensation. The OWNER reserves the right to claim the portions of the damage granite deemed useful.

3.02 EXCAVATING TRENCH AND PREPARING FOUNDATION

A. The trench for the curb shall be excavated to a width of 18 inches. The subgrade of the trench shall be a depth below the proposed finished grade of the curb equal to 6 inches plus the depth of the curbstone. The trench for the curb corner shall extend 6 inches beyond the front and back of curb corner to the full depth of foundation.

B. The foundation for the curb shall consist of gravel spread upon the subgrade and after being thoroughly compacted by tamping shall be 6 inches in depth.

3.03 SETTING CURB AND EDGING

A. All spaces under the curb, curb corners or edging shall be filled with gravel thoroughly compacted so that the curb, curb corners or edging will be completely supported throughout their length.

3.04 FILLING ABOUT TRENCH

A. After the curb, curb corners, curb inlets and edging is set, the space between it and the wall of the trench shall be filled with gravel thoroughly tamped to the depth directed, care being taken not to affect the line or grade of the curb, curb corners, curb inlets and edging.

3.05 POINTING

A. The joints between curbstones or edging shall be carefully filled with cement mortar and neatly pointed on the top and front exposed portions. After pointing, the curbstones or edging shall be satisfactorily cleaned of all excess mortar that may have been forced out of the joints.

3.06 TRANSITION CURB FOR WHEELCHAIR RAMPS

A. Transitions from normal curb settings to wheelchair ramps or driveways shall be accomplished with transition curb. Transitions shall be of the same type of curb and similar to that abutting and, if on a curve, of the same radius.

END OF SECTION

SECTION 02640

BURIED VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide buried valves, valve boxes, and valve accessories, as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02160 Support of Excavation
   3. Section 02221 Earthwork for Sewer and Drainage Systems
   4. Section 02731 Plastic Sewer Pipe and Fittings

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. An exploded view diagram with a materials list.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All of the types of valves and appurtenances shall be products of established firms who are experienced in the manufacture of the particular item to be furnished.
   1. All valves and their appurtenances shall be of domestic manufacture.

PART 2 PRODUCTS

2.01 VALVES

A. Gate Valves:

1. Meet or exceed the requirements of ANSI/AWWA C515.
2. Joints: Mechanical joint conforming to ANSI/AWWA C111/A21.11.
3. Ductile iron body.
4. Bronze stem.
5. Resilient sealed wedge type:
   a. Wedge: Fully encapsulated; no exposed iron.
6. Triple O-ring seal stuffing box.
7. Non rising stem.
8. Two (2) inch square operating nut.
9. Rated for 250 psi and tested to 500 psi.
10. Open: Counterclockwise (left).
11. All internal and external surfaces except rubber coatings shall be coated with fusion bonded epoxy to a minimum thickness of 8 mils:
    a. Coating shall be non-toxic, impart no taste to water and shall conform to AWWA C-550.

2.02 VALVE BOXES

A. Valve boxes shall be provided for each buried valve. They shall be:
1. Domestic manufacture.
2. Cast iron with a cast iron cover.
3. Cover shall have the word “SEWER” cast into the cover in raised letters.
4. Valve box barrel shall not be less than (5-¼) inches in diameter.
5. Shall be two (2) piece sliding type, providing a minimum overlap of six (6) inches.
6. The lower section shall enclose the operating nut and stuffing box/gear box of the valve and shall have a minimum diameter of 8 inches.
7. The box shall not transmit shock or stress to the valve.

PART 3 EXECUTION

3.01 HANDLING AND INSPECTION

A. Care shall be taken to prevent damage to valves, and appurtenances during handling and installation. All materials shall be carefully inspected for defects in workmanship and materials.

B. All operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves which do not operate easily or are otherwise defective shall be replaced at the Contractor's expense.

3.02 INSTALLATION

A. General:
1. Construction methods for the work under this Section shall conform to the applicable portions of Section 02611, Buried Ductile Iron Pipe and Fittings, details as shown on the Contract Drawings, manufacturer's recommended installation procedures, and procedures specified herein.

B. Valves and Appurtenances:

1. Generally, valves shall be set and aligned plumb, supported by a flat stone or solid concrete block, with the trench bottom being firmly compacted.
2. Valve boxes shall be set centered and plumb over the operating nuts of all, direct burial 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 future vertical adjustment. Minimum overlap for lower, extension pieces shall be 6 inches.
3. Valves, bolts and all other appurtenances shall be thoroughly cleaned and given a shop coat of asphaltum varnish.
4. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

END OF SECTION

SECTION 02651

DIRECTIONAL DRILLING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: The Contractor shall provide all labor, materials, tools and equipment that are necessary to perform the installation of the sewer line utilizing the directional drilling process, all as required by the Contract Documents.

B. Excavate and backfill access pits. Excavation includes, but is not limited to, pavement cutting and removal, topsoil stripping, excavating, rock excavation, filling and grading to obtain finish contours and elevations, and preparation of subgrade for structures.

C. This section contains guidelines and specifications applicable to the installation of pipelines using horizontal directional drilling (HDD). It includes minimum requirements for design, materials, and equipment used for the HDD for the substantially trenchless construction of pipelines. The section also includes materials, dimensions, and other pertinent properties of pipe and required accessories.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02160 Support of Excavation
   3. Section 02221 Earthwork for Sewer and Drainage Systems
   4. Section 02676 Testing Piping Systems

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All HDPE pipe and fittings shall be of domestic manufacture.

1.04 DESCRIPTION OF SYSTEM

A. Installation of pipelines shall be HDD where shown on the drawings, as approved by the Engineer. The bore path shall be designed by the drilling contractor to ensure that pipe joints do not deflect more than 50% of manufacturer’s recommended maximum deflection.

1.05 STANDARDS

A. The following American Society of Testing and Materials (ASTM) standards form a part of this specification as referenced:
   1. ASTM D3261- Butt Fusion Polyethylene Fittings for Polyethylene Plastic Pipe and Tubing.
   2. ASTM D3350- Polyethylene Plastic Pipe and Fittings Materials
   3. ASTM D790- Flexural Testing
   4. ASTM D638- Tensile Properties of Plastics

B. The following American Water Works Association (AWWA) standards form a part of this specification as referenced:
   1. AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. for Waterworks

1.06 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Plan outlining the procedure and schedule to be used in performance of the Work.
   2. Specifications on the directional drilling equipment that shall be used in the performance of the Work.
   3. Materials list of items proposed to be provided under this Section.
   4. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   5. Names of field personnel that will be working on the project. and their experience resumes.
   6. Submit Certificates of Compliance for pipe (SDR 11 HDPE).

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General
   1. Be of sufficient capacity to perform the bore and pullback of the pipe.
   2. Have a drilling fluid mixing and delivery system of sufficient capacity.
   3. Have a guidance system to accurately guide the boring operation.
   4. All of the equipment shall be in excellent and safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the equipment in working order for the duration of the project.

B. Directional Drilling Machine
   1. Shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head.

2. The hydraulic system shall be self-contained with sufficient pressure and volume to power the drilling operation.
3. Have a system to monitor and record maximum pullback pressures during the pullback operation.
4. The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.
5. Anchorage system to anchor drilling machine to the ground to resist thrust during operation.

2.02 APPURTENANT DRILLING EQUIPMENT

A. Mud Motors (If required)
1. Shall be of adequate power to turn the required drilling tools.

B. Drill Pipe
1. Shall be constructed of high quality 4130 seamless tubing, Grade D or better with threaded box and pins.
2. Tool joints shall be hardened to 32-36 RC.

C. Guidance System
1. Shall be of a proven type and shall be set up and operated by personnel trained and experienced with this system.

D. Pipe Rollers
1. Pipe rollers, if required, shall be sufficient size to fully support the weight of the pipe while being hydro-tested and during pullback operations

2.03 DRILLING FLUIDS (MUD) SYSTEM

A. Mixing System
1. A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, water and appropriate additives.
2. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing.
3. Drilling fluid reservoir tank shall be of adequate size for the application.
4. Shall continually agitate the drilling fluid during drilling operations.

B. Drilling Fluids
1. Composed of clean water and an appropriate additive.
   a. Water shall have a pH of 8.5 to 10.
   b. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal.
   c. The water and additives shall be mixed thoroughly and be absent of any clumps or clods.
2. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of the bore wall.
3. No hazardous additives shall be used.

C. Delivery System

1. The mud pumping system shall have adequate capacity and be capable of delivering the drilling fluid at a constant pressure.
2. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe.
3. Connections between the pump and drill pipe shall be relatively leak-free.
4. Drilling fluid spilled during drilling operations shall be contained and properly disposed of.
5. A berm, with a minimum height of 12-inches shall be erected and maintained around the drill rig, fluid mixing system and drilling fluid recycling system to prevent spills into the surrounding environment.

2.04 Pipe

A. Shall be manufactured in accordance with ANSI/AWWA C906 (latest revision), be high density polyethylene pressure pipe manufactured from materials conforming to PE Code designation PE 4710.

B. Pipe shall be 10-inch diameter SDR 11 HDPE with heat fused butt joints.

C. Tracer wire shall be #12 hard drawn copper conforming to ASTM B1 furnished with a plastic coating.

PART 3 EXECUTION

3.01 GENERAL

A. Excavation, backfill and compaction of access and test pits shall be in accordance with Section 02221.

B. Directional drilled pipe (SDR 11 HDPE) shall be installed to depths as required to permit the pipe to be laid at elevations indicated in the Contract Documents.
1. Directional drilled pipe shall be installed in one continuous pipe segment as shown on the Drawings.

C. The Contractor shall use electronic survey instrumentation to monitor and adjust the drill head.
1. The survey system shall measure the horizontal and vertical location of the drill head throughout the bore and provide readings at 5-foot intervals to allow for slope adjustment.
2. If magnetic interference affects the bearing sensors of the steering tool, the Contractor shall use appropriate methods to maintain the required slope and alignment.

D. An as-built sketch of the finished pilot hole shall be furnished for approval prior to pull-back of the pipe to be installed.

E. The pilot hole shall be reamed to a diameter, which is sufficiently sized in order to reduce forces applied to the pipe during pull back.

F. A swivel shall be installed between the molehead/reamer and the pipe connection to minimize torsional stress imposed on the pipe and allow the reamer to turn without rotating the pipe.

G. If pulling equipment is not capable of monitoring tensile forces imposed on the pipe, a weak link shall be installed between the pipe and the molehead/reamer in order not to exceed the safe tensile stress as prescribed by the manufacturer.

H. All pipe pulled through the pilot holes shall have 2 continuous tracer wires securely fixed to the pipe. If tracer wire does not traverse the entire length of pull back, the operation shall be repeated.

I. Because of the elastic properties of the pipe, main line and service connection pipe shall be relaxed for at least one overnight period in order to return to its original pre-pull length.

1. The pipe shall be installed past the exit tie-in point, according to manufacturer's recommendations, to accommodate thermal contraction as well as visoelastic stretch recovery in the pipe.

J. The leading edge of the pipe shall be examined for significant external damage after pull back.

1. If the pipe is deemed by the Engineer to have suffered significant damage, the damaged pipe shall be cut off and additional pipe pulled through the hole prior to the relaxation period.

K The Contractor shall be responsible for the containment and disposal of all drilling fluids or bentonite slurry.

1. The Contractor shall stockpile haybales at the drilling site to contain an inadvertent bentonite slurry return.
2. Any haybales used for containment of slurry shall be removed from the site and properly disposed of at the completion of the work.

L. The pull back shall be conducted in one continuous operation to limit the potential for binding of the pipe in the hole.

M. Sections of the SDR11 HDPE pipe shall be connected by heat fusion of the pipe butt ends in accordance with the manufacturer's recommendations.

1. Hand applied methods shall not be used.

N. The Contractor shall provide all appurtenances and make pipe connections as required to ensure a complete working system.

O. The access pit size shall be kept to a minimum.

3.02 PIPE TESTING AND DISINFECTION

A. The SDR11 HDPE pipe shall be tested in accordance with Section02676.

3.03 FINAL INSPECTION

A. Final inspection of the work shall include a visual inspection of each section of pipe by looking from the access pipe with the aid of reflected sunlight or illumination equipment.
   1. The pipe shall be true to both line and grade, shall shown no leaks, shall be free of cracks and from protruding joint materials and contain no deposits of sand, dirt or other material which will reduce the full cross-sectional area.
   2. Structural wall joints shall be tight.
   3. All finished work shall be neat in appearance and of high quality.
   4. The Contractor shall furnish laborers and illumination equipment to assist the Engineer in this inspection.

END OF SECTION

SECTION 02755

FINAL SEWER TESTING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included:
1. Final sewer testing work includes the performance of testing and inspecting each and every length of sewer pipe, pipe joints and each item of appurtenant construction.
2. Perform testing at a time acceptable to the Engineer, which may be during the construction operations, after completion of a substantial and convenient section of the work, or after the completion of all pipe laying operations.
3. Provide all labor, pumps, pipe, connections, gages, measuring devices and all other necessary apparatus to conduct tests.

B. Related Work Specified Elsewhere (When Applicable):
1. Excavation, backfill, dewatering, pipe, pipe fittings and manholes are specified in the appropriate Sections in this Division and/or Division 15.
2. Manhole testing is specified in Section 02700 – Precast Concrete Manholes.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.01 PERFORMANCE

A. General:
1. All sewers, manholes, and appurtenant work, in order to be eligible for acceptance by the Engineer, shall be subjected to tests that will determine the degree of watertightness and horizontal and vertical alignment.
2. Thoroughly clean and/or flush all sewer lines to be tested, in a manner and to the extent acceptable to the Engineer, prior to initiating test procedures.
3. Perform all tests and inspections in the presence of the Engineer and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes.
4. Perform testing by test patterns determined by or acceptable to the Engineer.
5. Remedial Work:
   a. Perform all work necessary to correct deficiencies discovered as a result of testing and/or inspections.
   b. Completely retest all portions of the original construction on which remedial work has been performed.
   c. Perform all remedial work and retesting in a manner and at a time acceptable to by the Engineer at no additional cost to the Owner.

B. Line Acceptance Tests (Gravity sewers with no active service connections):

1. Test all gravity sewer lines with no active service connections for leakage by conducting a low pressure air test.
2. Equipment:
   a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
   b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
   c. All air used shall pass through a single central panel.
   d. Connect 3 individual hoses:
      (l) From the control panel to the pneumatic plugs for inflation,
      (2) From the control panel to the sealed sewer line for introducing the low pressure air,
      (3) From the sealed sewer line to the control panel for continually monitoring the air pressure rise in the sealed line.
3. Testing Pneumatic Plugs:
   a. Seal test all pneumatic plugs prior to using them in the actual test.
   b. Lay one length of pipe on the ground and seal both ends with the pneumatic plugs to be tested.
   c. Pressurize the sealed pipe to 5 psig.
   d. The pneumatic plugs are acceptable if they remain in place without bracing.
4. Testing Sewer Pipeline:
   a. After the sewer pipe has been cleaned and the pneumatic plugs checked, place the plugs in the sewer line at each manhole and inflate them.
   b. Introduce low pressure air into the sealed sewer pipeline until the air pressure reaches 4 psig greater than the average groundwater pressure.
   c. Allow a minimum of 2 minutes for the air pressure to stabilize to a minimum of 3.5 psig greater than the groundwater pressure. Groundwater is assumed to be at ground surface unless the Contractor can prove by otherwise by test pitting.
   d. After the stabilization period, disconnect the air hose from the control panel to the air supply.
   e. The pipeline will be acceptable if the pressure decrease is not greater than l/2 psig in the time stated in the following table for the length of pipe being tested:

	Time (Min.) for Length of Pipe			
Pipe Diameter (inches)	0-100 ft	101-200 ft	201-300 ft	301-400 ft
4	2.0	2.0	2.0	2.0
6	3.0	3.0	3.0	3.0
8	4.0	4.0	4.0	5.0
10	5.0	5.0	6.0	8.0
12	5.5	5.5	8.5	11.5
15	7.0	8.5	13.0	17.0
18	8.5	12.0	19.0	25.0
21	10.0	17.5	26.0	35.0
24	11.5	23.0	34.0	45.5

Pipe Diameter (inches)	Time (Min.) for Length of Pipe 0-100 ft	101-200 ft	201-300 ft	301-400 ft
27 and larger.....	14.5	29	43.0	58.0

5. Test Results:
   a. If the installation fails the low pressure air test, determine the source of leakage.
   b. Repair or replace all defective materials and/or workmanship and repeat low pressure air test at no additional cost to the Owner.

C. Line Acceptance Tests (Gravity sewers with active services):
1. Test all new gravity sewer lines with active services by conducting a low-pressure air test on all joints using a packer after all services have been connected or capped at the property line and all trenches backfilled but before the surface course of permanent pavement is installed.
2. Equipment:
   a. Closed-circuit television system.
   b. Testing devices (packer):
      (1) Capable of isolating individual joints by creating a sealed void space around the joint being tested.
      (2) Constructed such that low pressure air can be admitted into the void area.
      (3) Shall contain a pressure gauge accurate to one tenth (0.1) psi in-line with the feed line to monitor the void pressure.
      (4) Capable of performing in sewer lines where flows do not exceed 1/4 of the pipe diameter without resorting to any method of flow control.
3. Testing Sewer Pipeline Joints:
   a. Test all joints except those with visible infiltration.
   b. Procedure:
      (1) Pull television camera through sewer line in front of the packer.
      (2) Position the packer on each joint to be tested.
      (3) Inflate the sleeves on each end of the packer.
      (4) Apply four (4.0) psi pressure above the existing hydrostatic pressure on the outside of the joint to the void area created around the inside perimeter of the joint.
      (5) Shut off the supply of air once the pressure has stabilized at the required amount.
      (6) Monitor the void pressure for thirty (30) seconds.
      (7) Repair the joint if the pressure drops more than one half (1/2) psi in the thirty (30) seconds.
   c. Water or chemical pressure testing may be used in lieu of air testing subject to review and approval by the Engineer.
   d. Re-clean and re-inspect all lines not approved by the Engineer at no additional cost to the Owner.
   e. Repairing of Joints:
      1. When a joint fails the pressure test, excavate and repair the failed joint. Repairing joints with chemical grout will not be permitted.
   f. The Engineer may request checking of the testing equipment for accuracy.
      1. Perform standard air test on a clean continuous section of pipe.

2. Repair the equipment if the void pressure drops.

g. Testing Operation Inspection:
   1. Reset each joint, as specified herein, prior to acceptance and final payment for joint testing. Retest all joints that fail until the test requirements are met.

h. The contractor will supply a black and white photograph of every joint that fails the pressure test.

D. Alignment Tests (Gravity Sewers):
   1. Perform tests for the correctness of horizontal and vertical alignment on each and every length of gravity sewer pipeline between manholes.
   2. Alignment tests to be conducted after all pipe has been installed and backfilled.
   3. The observation test shall be conducted after all upstream work has been completed and the pipeline cleaned of debris.
   4. Notify the Engineer at least 24 hours in advance of the proposed observation testing.
   5. Introduce water into the sewer lines to be tested from the upstream manhole prior to the observation test but no more than 24 hours in advance of the test.
   6. Beam a source of light, acceptable to the Engineer, through the pipeline from both ends and the Engineer will directly observe the light in the downstream, and/or upstream manhole of each test section.
   7. The length of pipe between manholes, diameter of pipe and amount of light observed in the manhole at the end of each pipe section will determine acceptance of the alignment test by the Engineer.
   8. The amount of vertical and horizontal deflection shall not be greater than the ASTM allowance and (manufacturer's recommendations) for the pipe being tested.
   9. No standing water shall be allowed. The presence of standing water shall be cause for rejection of that pipe (including manhole) section.
   10. Improper alignment will be corrected by re-excavation and resetting of pipe at no additional cost to the Owner.

E. Pipe Deflection: (Gravity Sewers)
   1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
   2. The Contractor shall wait a minimum of 30 days after completion of a section of sewer, including placement and compaction of backfill, before measuring the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.
   3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.

F. Television Inspection Tests (Gravity Sewers)
   4. No standing water shall be allowed. The presence of standing water may be cause for rejection of that pipe.

2. Any standing water, detectable leaks, improper joints or any other unacceptable feature detected by the television inspection will be corrected by re-excavation and resetting pipe at no additional cost to the Owner.

G. Inspection of Appurtenant Installations:
   1. Completely inspect, at a time determined by the Engineer, all manholes and inlets to ascertain their compliance with the Drawings and Specifications.
   2. Provide access to each manhole and inlet and check the following characteristics:
      a. Shape and finish of invert channels,
      b. Watertightness and finish of masonry structures,
      c. Location, type, and attachment of stops,
      d. Elevation and attachment of frames, covers, and openings,
      e. Pattern and machining of covers, and
      f. Drop connection arrangements.

H. Testing Pressure Sewers:
   1. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air, the Contractor shall make the necessary excavations backfilling and taps at such points and shall plug said holes after completion of the test.
   2. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
   3. Perform pressure and leakage test at 1-½ times the maximum system pressure or 100 psi which ever is greater (based on the elevation of the lowest point of the section under test and corrected to the gage location).
   4. While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. If the average leakage during a two-hour period exceeds a rate of 10 gallons per inch of diameter per 24 hours per mile of pipeline the section shall be considered as having failed the test. All joints within chambers and all flanged joints shall have no visible leakage.
   5. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

I. Manhole Leakage Testing:
   1. Refer to specification section 02700 Precast Concrete Manholes.

END OF SECTION

SECTION 02700

PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide precast concrete manholes as required by the Contract Documents.
   1. In general: Provide the precast concrete manholes.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02221 Earthwork for Drains and Sewer
   2. Section 02726 Covers/Grates and Frames
   3. Section 03600 Grout

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 PRODUCT HANDLING

A. Delivery, Storage and Handling:
   1. Deliver the work of this Section to the job site in such quantities and at such times as to assure the continuity of construction.
   2. Store units at the job site in a manner to prevent physical damage, and in a manner to keep markings visible.
   3. Lift and support the units only at designated lifting points or supporting points.

PART 2 PRODUCTS

2.01 DESIGN

A. Precast concrete manhole sections shall conform to:
   1. ASTM C478 Specification for Precast Reinforced Concrete Manhole Sections,
   2. PCI 116,
   3. CRSI “Manual of Standard Practice”,
   4. In the event of conflict between or among standards, the more stringent provision shall govern.

2.02 PRECAST CONCRETE SECTIONS

A. General:
   1. Wall thickness shall not be less than five (5) inches for a forty eight (48) inch diameter reinforced section, six (6) inches for a sixty (60) inch diameter reinforced section, seven (7) inches for a seventy two (72) inch diameter reinforced section and nine (9) inches for a ninety six (96) inch diameter reinforced section.
   2. All sections shall have tongue and groove joints.
   3. Concrete compressive strength shall be 5000 psi after 28 days.
   4. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of H-20 loading plus the weight of the soil above.
   5. Top sections of manholes shall be eccentric cones to provide a vertical wall from ground surface to manhole base, except that precast reinforced concrete slabs shall be used where cover over the top of the pipe is less than 5 feet.
   6. The inside clear diameter of the opening at the top of the cone or in the slab shall be 30 inches.
   7. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.
   8. Precast concrete bases shall be constructed and installed as shown on the Drawings. The thickness of the bottom slab of the precast bases shall not be less than the manhole barrel sections or top slab, whichever is greater.

2.03 JOINTS

A. Precast Sections:
   1. Tongue and groove joints of precast sections shall be sealed with an “O”-ring conforming to ASTM C443 or a flexible joint sealant such as Kent Seal No. 2 or an approved equal.

2.04 BRICK MASONRY

A. Bricks for leveling manhole frames inverts and tables shall comply with ASTM C62, Grade SW.

2.05 MORTAR

A. For use in brickwork:
   1. Composed of one (1) part Type II Portland Cement conforming to ASTM C150, to two (2) parts sand,
   2. For each bag of cement a small amount (not to exceed 10% by weight) of hydrated lime may be added. Lime shall conform with ASTM C207, Type N.

2.06 COVERS/GRATES AND FRAMES

A. Shall be furnished under Section 02726, Covers/Grates and Frames, and installed under the work of this Section.

2.07 MANHOLE STEPS

A. Manhole steps shall be aluminum alloy 6061 T6, extruded, safety-type, or 1/2 inch diameter, grade 60 steel reinforcing bar continuous throughout the step, bent to shape and encased in a co-polymer polypropylene plastic, with a tread design.
   1. Steps shall be fourteen (14) inches wide,
   2. Steps may be cast in place or inserted after casting,
   3. Steps shall be set at twelve (12) inches on center.

2.08 CONNECTIONS TO MANHOLES

A. Connection to the precast structures shall be accomplished by the following:
   1. “Kor-n’ Seal” joint with stainless steel clamp,
   2. “Lock-Joint Flexible Manhole Sleeve” shall be cast into the manhole base section. Strap shall be stainless steel.
   3. A fixed connection at the precast structure shall not be allowed.

2.09 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor, subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PRECAST INSTALLATION

A. Work shall be protected against flooding and flotation.
   1. Precast bases of the structure to be placed on a compacted six (6) inch layer of screened gravel.
   2. Precast barrel sections shall be set plumb with all sections in true alignment and joints sealed watertight.
   3. Grade at the top of the precast manhole shall be as such as to allow a maximum of twelve (12) inches of brickwork to bring the frame and cover to finish grade.

4. Grout all lifting holes with non-shrink grout.

3.03 MANHOLE PIPING CONNECTIONS

A. Shall be as stated in paragraph 2.08 of this Section.

3.04 BRICKWORK

A. Invert Table and Grade Adjustment:
   1. Brick for invert shall be laid on edge.
   2. Brick for table and grade adjustment shall be laid flat.
   3. Table shall be constructed to an elevation even with the top of the pipe.
   4. Table shall slope up from the pipe to the edge of the manhole.

3.05 COVERS/GRATES AND FRAMES

A. Shall be set in a full bed of mortar on the grade adjusting brick course.
   1. Shall be set to the finish grade.
   2. Frames and covers which are not on the same plane as the final grade shall be reset.
   3. Maximum height allowable for grade adjustment (between manhole and frame) shall be twelve (12) inches.

3.06 TESTING

A. Vacuum Test:
   1. Plug all openings with non-shrink grout and plug all pipes with suitable plugs.
   2. An initial vacuum of ten (10) inches Hg. shall be drawn.
   3. Test time shall be determined by the time required for the vacuum to drop from ten (10) inches Hg. to nine (9) inches Hg.
      a. Allowance test times are listed below.

Manhole Depth	Minimum Test Time
0 to 10 feet	1 minute
10 to 15 feet	1 1/4 minutes
15 to 25 feet	1 1/2 minutes

   4. Manholes which fail to meet the above minimum test times shall be repaired using methods approved by the Engineer.
   5. After the manhole has been repaired it shall be re-tested using the same vacuum test procedure. Following a second vacuum test failure, the manhole shall be repaired and tested using the water exfiltration method.

B. Exfiltration Test:
   1. All pipes and openings shall be suitably plugged and braced to prevent blowouts.
   2. Fill manhole to the top of the cone section or the opening in the flat top section if a cone section is not used.
   3. Seal all visible leaks.
   4. Allow a period of time for absorption by the concrete and refill as required.
   5. The test period shall be eight (8) hours.

6. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage determined on the basis of depth.
    a. The leakage for each manhole shall not exceed one (1) gallon per vertical foot for a twenty-four (24) hour period.
    b. If the manhole fails this requirement, and the leakage does not exceed three (3) gallons per vertical foot per day, repairs by approved methods may be made to bring the leakage within the allowable rate of one (1) gallon per foot per day.
    c. Leakage due to a defective section or joint or exceeding the three (3) gallon per vertical foot per day, shall be the cause for the rejection of the manhole.
    d. It shall be the Contractors responsibility to uncover the manhole as necessary and to disassemble, reconstruct or replace it. The manhole shall then be re-tested by the vacuum test or the water exfiltration test, at the discretion of the Engineer.
7. If the groundwater table is above the highest joint in the manhole, and if there is no leakage into the manhole, such a test can be used to evaluate the water-tightness of the manhole.

3.06 CLEANING

A. All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

SECTION 02726

COVERS/GRATES AND FRAMES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide Covers/Grates and Frames as required by the Contract Documents.

B. Aluminum hatches are specified in Section 08306 Aluminum Hatches.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02221 Earthwork for Drains and Sewer
   2. Section 02700 Precast Concrete Manholes
   3. Section 08306 Aluminum Hatches

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All castings shall be of domestic manufacture:
   1. Comply with ASTM A48 Gray Iron Castings.

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.
   1. Manufacturer's catalog cuts, specifications and other data to demonstrate compliance with the specified requirements.

PART 2 PRODUCTS

2.01 COVERS/GRATES AND FRAMES

A. Castings shall be manufactured in accordance with ASTM A48-83, Class 30B specifications with a minimum tensile strength of 30,000 psi.
   1. All frames covers and grates shall be of domestic manufacture.
   2. All frames, covers and grates, of the same pattern or catalog number, shall be interchangeable.

B. Manhole frames and covers in the roadway right of way shall have a 22-inch clear opening, and shall be manufactured by EJ Group, Inc., Neenah Foundry Co., or Campbell Foundry Co., or approved equal.

C. Manhole frames and covers which are to be installed off the roadway shall be medium duty frames and covers manufactured by EJ Group, Inc., or an approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. See Specification Section 02700, Precast Concrete Manholes for installation requirements.

END OF SECTION

SECTION 02731

PLASTIC SEWER PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Provide all the plastic sewer pipe and fittings as required by the Contract Documents.

B. In general the work of this Section shall include but not be necessarily limited to providing all plastic sewer pipe and fittings, joining materials, labor, tools, and equipment necessary to install the pipe and fittings as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02160 Support of Excavation
   2. Section 02227 Rock Removal
   3. Section 02221 Earthwork for Sewers and Drainage System

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications, installation procedures, and other data needed to prove compliance with the specified requirements;
   3. All pipe delivered to the jobsite shall be accompanied by test reports and notarized affidavits certifying that the pipe and fittings conform to the requirements of the Specifications.

1.04 ACCEPTABLE MANUFACTURERS.

A. The plastic sewer pipe and fittings shall each be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the pipe to be furnished. The pipe shall be designed, constructed, and delivered in accordance with the best practices and methods.

PART 2 PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

A. HDPE Carrier Pipe
   1. The high density polyethylene (HDPE) 10-inch carrier pipe shall be SDR 11 HDPE Ductile Iron Pipe Size (DIPS) and shall be manufacturered from a PE 4710 resin as specified by the Plastic Pipe Institute (PPI).
   2. Shall conform to AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 Inch through 65 Inch for Waterworks.

B. Sewer Force Mains
   1. The HDPE 3-inch sewer force mains shall be SDR 11 HDPE and shall be manufactured from a PE 4710 resin as specified by the PPI.
   2. Shall conform to AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ¾-Inch through 3-Inch, for Water Service.

2.03 FITTINGS

A. All fittings and accessories for the sewer pipe shall be as manufactured by the pipe supplier.
   1. Have bell and spigot configurations compatible with that of the pipe.
   2. Locked in rubber ring.

PART 3 EXECUTION

3.01 INSTALLATION

A. HDPE Pipe:
   1. Except as otherwise specified herein or shown on the Drawings, installation of HDPE pipe shall be in accordance with ASTM D2774, "Underground Installation of Thermoplastic Pressure Piping".

B. All trenching, backfilling, compacting and bedding and covering of the pipe shall be conducted in full accordance with the provisions of Section 02221, Earthwork For Sewers And Drains.

3.02 PIPE HANDLING

A. The Contractor shall arrange for the delivery of the pipe sections at approved locations in the vicinity of that portion of the line in which the pipe sections are to be laid. To this end, he shall do such work as is necessary for access and for delivery of the pipe.
   1. Pipes shall be stored in an approved, orderly manner so that there will be a minimum of rehandling from the storage area to the final position in the trench and so that there is a minimum obstruction and inconvenience to any kind of traffic.
   2. All pipe is to be loaded, unloaded and stockpiled in strict conformance with the manufacturer's recommendations.

3. Deliveries shall be scheduled so that the progress of the work is at no time delayed and also so that large quantities of pipe shall not be stored for excessive lengths of time.
4. Provide slings, straps and/or other approved devices to provide satisfactory support of the pipe when it is lifted.
5. Under no circumstances shall the pipe be dropped from trucks or into the trench.

3.03 CONTROL OF ALIGNMENT AND GRADE

A. The Contractor shall establish bench marks along the route of the pipeline at convenient intervals for his reference in checking the pipe and manhole inverts and other elevations throughout the project.

B. The Contractor shall use a laser beam for setting the pipe.
1. All units shall have equipment to control atmospheric conditions in the pipe that could affect the acceptable standard of construction.
2. The laser shall be operated by competent, trained personnel.
3. The Contractor shall establish center line and offset stakes at each manhole, plus one intermediate center line and offset stakes as a check point between manholes.
4. Laser aligning shall not be used to establish a continuous line in excess of 600 feet.

C. During construction, the Contractor shall provide the Engineer at his request, all reasonable and necessary materials, opportunities, and assistance for setting stakes and making measurements, taking quantities and checking location of the work.
1. Assistance shall include the furnishing of one or two men as needed at intermittent times.
2. The Contractor shall carefully preserve bench marks, reference points and stakes.
a. In cases of willful or careless destruction by his own men, he will be charged with the resulting expense and shall be responsible for any mistakes or delay that may be caused by their unnecessary loss or disturbance.

3.04 PREPARATION OF BED

A. As soon as the excavation is completed to the normal grade of the bottom of the trench, pipe bedding, shall be placed immediately in the trench and compacted.

B. The compacted bedding shall be shaped so that the bottom quadrant of the pipe shall rest firmly for the full length of the barrel. Suitable holes for bells or couplings shall be dug around the pipe joints to provide ample space for making tight joints.
1. The pipe shall be firmly bedded and covered to conform accurately to the lines and grades.

C. It shall be the Contractor's responsibility to control any water in the trench below the pipe invert and he shall place clay or other impermeable material in the bedding at intervals to prevent horizontal movement of the groundwater which might induce settling of the bed, or make it difficult to handle water in the trench.

3.05 LAYING PIPE

A. All pipe shall be laid with extreme care as to grade and alignment.
   1. Each pipe shall be laid so as to form a close joint with the next adjoining pipe and to bring the inverts continuously to the required grade.
   2. Each pipe length shall be inspected for excessive discoloration, blisters, pitting, cracks, holes, foreign inclusions, straightness and other injurious defects before lowering in place.
   3. In order to insure minimum amount of movement or disturbance, no more than two lengths of pipe may be laid before backfilling to a minimum of twelve inches over the pipe.
   4. Pipe shall be laid in the dry and at no time shall water in the trench be permitted to flow into the sewer pipe.
   5. Laying and jointing shall be in accordance with the manufacturer's instructions and appropriate ASTM Standards.
   6. The Contractor shall have on hand for each pipe-laying crew, the necessary tools, gauges, mechanical saws, mechanical bevelers, etc., necessary to install the pipe.
   7. The length of the incoming and outgoing pipe at manholes shall be a maximum of 2'-0".
      a. Measurements shall be made from the outside of the manhole wall.
      b. Shorter lengths of pipe shall be furnished as necessary to allow proper locations for wyes and manholes.
      c. In no case shall other than the specified joints be installed.
   8. Where pipe stubs are called for on the Drawings, for future connections or services, the stubs shall be closed on the exterior end of the stub with a gasketed HDPE pipe cap or plug of the same material as the pipe.
      a. Cap or plug shall be furnished by the pipe manufacturer.

3.06 WYES AND TEES

A. Installation
   1. At locations determined in the field, the Contractor shall provide six (6) inch branch, wyes or tees on the proposed sewer main for the property service connection.
   2. Watertight end caps shall be installed on the wye or tee branch until the service connection is installed.

B. Measurements
   1. No wyes or tees shall be backfilled before location measurements have been taken.
   2. The depth of cover from the road surface to the top of the fitting shall be recorded.
   3. The distance from the down stream manhole shall be recorded.

3.07 TESTING FOR GRAVITY SEWERS

A. Refer to Section 02767, Testing Piping Systems.

3.08. INFILTRATION

A. Sewer Pipe:
   1. Ground water infiltration rate shall not exceed 50 gallons, per inch of diameter, per mile, per 24 hours.

3.09 CLEANING

A. At the conclusion of the Work, the Contractor shall thoroughly clean all of the new pipelines by flushing with high pressure water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. Debris, cleaned from the lines, shall be removed from the lowest manhole.
   1. After the pipelines are cleaned, and if the groundwater level is above the pipe the Engineer will examine the pipe for leaks.
      a. If defective pipes or joints are discovered at this time, they shall be repaired at the Contractor's expense.

3.10 CONNECTIONS TO EXISTING SEWERS AND MANHOLES

A. The Contractor shall make all connections to the existing facilities as required by the Contract Documents.
   1. Provide all pipe, fittings, and appurtenances.
   2. Shall do all excavation and backfill as required.
   3. The pipe entrance to existing manholes shall be drill cored to the required diameter.
   4. Special attention shall be made to protect the existing sewers and structures.

END OF SECTION

SECTION 02930

LOAM AND SEED

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide loam and seed as required by the Contract Documents.
   1. Generally the Work consists of topsoiling, seeding and fertilizing all disturbed areas of the water main easements.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02015 Test Pits

   4. Section 02221 Earthwork for Sewers and Drains
   5. Section 01610 Product Handling

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   1. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

B. If the results of the hydraulic seeding operation (if utilized) are unsatisfactory, the method shall be abandoned and seeding shall be required by the sowing method.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

C. If hydroseeding application is to be used, a written description containing seed analysis, fertilizer and lime addition data is to be submitted for review of the Owner.

1.05 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01610.

B. Immediately remove from the site, materials which are not true to name, and do not comply with the specified requirements, and promptly replace with materials meeting the specified requirements.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Topsoil stripped from the site and stored, shall be approved before reuse.
   1. Topsoil from the site shall be treated to conform to the requirements for topsoil furnished from offsite sources.
   2. If the required quantity of suitable topsoil is not available from stripping of the site, or if it is not approved, topsoil from outside sources shall be furnished.
   3. Stockpiled topsoil used for this work shall be screened before being spread.
   4. Surplus topsoil not required to fulfill the requirements of the Contract shall be properly disposed of unless otherwise directed by the Owner.

2.02 TOPSOIL FURNISHED FROM OFFSITE SOURCES

A. Topsoil shall be fertile, friable, natural topsoil typical of the locality, and obtained from a well-drained site.
   1. It shall be without admixture of subsoil or slag.
   2. Shall be screened.
   3. Topsoil as delivered to the site shall have an acidity range of pH 5.0 to 6.5 and shall contain not less than 5% organic matter as determined by loss on ignition of moisture-free samples dried at 100 degrees Centigrade.
   4. If required, limestone shall be added to the topsoil to adjust the pH, so that it complies with the required limits.

B. Mechanical Analysis: Topsoil shall meet the following mechanical analysis

Size	% Passing	% Retained
1-1/4" screen	100	0
1/2" screen	97-100	0-3
No. 100 mesh sleeve	40-60	40-60

2.03 TREATING TOPSOIL WITH LIMESTONE OR ALUMINUM SULFATE

A. When the hydrogen-ion value is below the specified level, add ground limestone at the rate of 2-1/2 lbs. per cubic yard of topsoil to raise pH one full point.

B. The following table shows the amount of limestone needed for various soil reactions on the basis of 1,000 sq. ft. and on the basis of one (1) acre:

pH	pH Desired	Lbs. per 1000 sq. ft.	Tons per Acre
6.0	6.5	0-46	0-1
5.5	6.5	46-92	1-2
5.0	6.5	92-138	2-3

1. Limestone shall be raw, ground agricultural limestone containing not less than 90% calcium carbonate and shall be ground to such fineness that 50% will pass through a 100-mesh sieve and 90% will pass through a 20-mesh sieve.
2. When hydrogen-ion value is above specified level, add aluminum sulfate at the rate of 2-1/2 lbs. per cubic yard of topsoil to lower the pH one full point. Aluminum sulfate shall be unadulterated and delivered in containers with the name of the material, name of the manufacturer, and net weight of contents.

2.04 LIME

A. Lime shall be ground limestone containing not less than 85 percent calcium and magnesium carbonates.
1. Ground to such fineness that at least 50 percent will pass through a 100-mesh sieve and at least 90 percent shall pass through a 20-mesh sieve.

2.05 GRASS SEED (UPLANDS)

A. General: Provide grass seed which is:
1. Free from noxious weed seeds, and recleaned.
2. Grade A recent crop seed.
3. Treated with appropriate fungicide at time of mixing.
4. Delivered to the site in sealed containers with dealers guaranteed analysis.

B. Proportions by Weight (Level Areas):

1.	Chewing Fescue	60 percent.
2.	Red Top	10 percent.
3.	Annual Ryegrass	10 percent
4.	Kentucky Blue	20 percent.

C. Proportions by Weight (Slopes):

1.	Creeping Red Fescue	50 percent.
2.	Perennial Rye Grass	20 percent
3.	Red Clover	10 percent.
4.	Winter Rye	15 percent
5.	Ladino Clover	5 percent

D. Requirements:
1. Seed shall be furnished and delivered premixed in the proportions specified above.
2. All seed shall comply with State and Federal seed laws.

3. A certificate of compliance with the specifications shall be submitted by the manufacturer with the shipment of the seed. The certificate shall include the guaranteed percentage of purity, weed content and germination of the seed, net weight and date of shipment.
4. No seed shall be sown until the Contractor has submitted the above mentioned certificate to the Engineer.

2.06 GRASS SEED (WETLANDS)

A. Proportions by Weight

1.	Lurid Sedge	>10%
2.	Fowl Manna Grass	>10%
3.	Fringed Sedge	>10%
4.	Woolgrass	>10%
5.	Other Wetland Seeds	<60%

B. Germination Minimum

1.	Lurid Sedge	80%
2.	Fowl Manna Grass	80%
3.	Fringed Sedge	80%
4.	Wool Grass	80%
5.	Other Wetland Seeds	80%

C. Requirements:

1. Grass seed mixture for the compensatory storage areas shall be a fresh, clean, new crop seed. Seed may be mixed by an approved method on the site or may be mixed by the dealer. All seed shall comply with State and Federal seed laws. If the seed is mixed on the site, each variety shall be delivered in the original containers bearing the dealer's guaranteed analysis. If the seed is mixed by the dealer, the dealer's guaranteed statement of the composition of the mixture and the percentage of purity, weed content, net weight, and germination of each variety shall be provided. No seed shall be sown until contractor has submitted the guaranteed statement of the composition to the Engineer.
2. Seed shall be the commercial product of an approved reputable manufacturer and shall be certified to be not more than one (1) year old and shall be composed of the follwoign varieties, The seed mix shall be New England wetmix as manufactured by New England Wetland Plants Inc. Amherst, MA. or approved equal.
3. The application rate shall be one pound per 5,000 square feet. The seed shall be mechanical spread or broadcasted by hand works creating an even distribution. The seed mix shall be sown early spring or late fall for increased germination.

2.07 FERTILIZER

A. Fertilizer shall be furnished in containers plainly marked with the chemical analysis of the product and showing one of the following compositions by weight.

Constituent	10-6-4	8-6-4	7-7-7
Nitrogen	10% min.	8% min.	7% min.
Available Phosphoric Acid	6% min.	6% min.	7% min.
Water Soluble Potash	4% min.	4% min.	7% min.

1. Fertilizer shall be stored so that when used it will be dry and free flowing.

2.08 HYDRAULIC SPRAY MACHINE

A. Shall be designed specifically for seed dissemination.

B. Shall allow materials to be mixed with water in the machine and kept in an agitated state to keep materials uniformly suspended in the water.

C. Shall be designed to provide equal quantities of required materials over a particular spraying area.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 APPLICATION

A. Application of Topsoil
   1. Topsoil shall be applied to the prepared subgrade specified in Section 02210, Site Grading.
   2. Topsoil shall be spread to a compacted depth of:
      a. Four (4) inches for cross country areas.
      b. Areas to have topsoil applied to them shall be scarified or otherwise roughened, just prior to the application.

B. Seedbed Preparation
   1. Grade areas to be seeded to a smooth uniform grade.
   2. Roll, scarify, rake and level as necessary to obtain true, even surfaces
   3. Meet existing grades.
   4. All seeded areas shall slope to drain.
   5. All finish grades shall meet approval before grass seed is sown.

C. Application Rates of Limestone, Aluminum Sulfate, Fertilizer and Seed
   1. Limestone or Aluminum Sulfate shall be applied and thoroughly incorporated in the layer of loam or topsoil to adjust the acidity of the material.
   2. The rate of application of the limestone will be determined by the pH value.
   3. Fertilizer shall be applied at the rate of 20 pounds per 1000 square feet.

4. The seed mixture shall be sown at the rate of 5 pounds per 1000 square feet.

D. Fertilizing and Liming
1. Fertilizing and liming shall be done when the soil is in a moist condition and at least 24 hours before the sowing of the seed.
2. The fertilizer and lime shall be applied to the soil by means of a mechanical spreader or other approved method capable of maintaining a uniform rate of application.
3. Thoroughly harrowed, raked or otherwise mixed with the soil to a depth of not less than 2 inches.
4. The fertilizer and lime shall not be applied together.

E. Time of Seeding
1. The recommended seeding periods are from April 1 to June 1, and from August 15 to October 1.
2. The Contractor may choose to seed at other times but regardless of the time of seeding he shall be responsible for a full growth of grass.
3. When directed he shall re-fertilize and reseed areas on the project which do not develop a satisfactory growth of grass.
4. Re-fertilizing and reseeding shall be incidental to the original seeding item requirements.

3.03 SEEDING METHODS

A. Fertilizer, limestone, and mulch material, if required, and seed of the type specified may be placed by one of the following methods, provided an even distribution is obtained.

B. Dry Method
1. Power Equipment: Mechanical seeders, seed drills, landscape seeders, cultipacker seeders, fertilizer spreaders, or other approved mechanical seeding equipment or attachments may be used when seed, limestone, and fertilizer are to be applied in dry form.
2. Manual Equipment - On areas which are inaccessible to power equipment, permission may be given to use hand-operated mechanical equipment when the materials applied are in dry form. The use of hand shovels to spread the materials shall not be allowed.
3. When the dry method is used, limestone and fertilizer shall not be mixed together prior to their application, but shall be worked into the soil together to a depth of at least 2 inches.
4. At least 24 hours shall elapse between the time fertilizer is incorporated into the topsoil and seed is spread.
5. Areas covered with park seed shall be raked, and, rolled with a roller weighing not more than 100 pounds per foot of roller width to firm the soil but not to pack it. The rolling shall be done the same day as the seeding unless otherwise permitted.
6. Areas seeded in the spring after April 15 shall be covered with a 1 inch loose layer of clean wheat or oat straw. The straw shall be kept wet until a catch of grass is established. Loose straw shall be removed from the site.
7. Grass on slopes or banks may be established by another method subject to approval. Special care shall be exercised to prevent erosion or washouts.

C. Hydraulic Method

1. The application of grass seed, fertilizer, limestone, and a suitable mulch, if approved, may be accomplished through the use of an approved spraying machine.
2. The materials shall be mixed with water in the machine and kept in an agitated state in order for the materials to be uniformly suspended in the water.
3. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of limestone, fertilizer, and grass seed shall be equal to the required rates.
4. Prior to the start of work, the Engineer shall be furnished with a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder.
5. The hydraulic seeding and fertilizing machine shall be completely flushed and cleaned each day before seeding is started.
6. If the results of the spray operations are unsatisfactory, the Contractor shall be required to abandon this method and apply the materials in accordance with the dry method.
7. When the hydraulic method is used, compaction or rolling shall be required.

D. Side Slopes Application

1. Roadway side slopes shall be seeded utilizing a hydraulic (hydro-seed) application process, to place seed and fertilizer simultaneously.
2. A color agent shall also be within the hydraulic mix.
3. Care shall be taken during the application to prevent coverage of poles, trees, signs, and etc.

3.04 MAINTENANCE

A. The Contractor shall be responsible for the proper care of the seeded areas during the period when the grass is becoming established.

1. This period shall extend for two months after a successful uniform stand of grass is produced.
2. The Contractor shall reseed all areas as necessary to obtain a uniform stand of grass, free from bare spots.
3. Any seeded areas which fail to show a uniform stand of grass shall be reseeded until all areas are covered
4. Any and all additional seeding shall be at the Contractor's expense.
5. If necessary, barricades of brush or other materials and suitable signs shall be placed to protect the seeded areas.
6. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

3.05 GUARANTEE PERIOD

A. All seeded areas shall be guaranteed by the Contractor for not less than one (1) full year from the date of substantial completion.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 GENERAL

1.01 SCOPE

A. The work of this section includes all labor, materials, tools and equipment necessary for the construction, preparation, cleaning and later removal of all concrete formwork necessary for the proper completion of the Work.

1.02 SUBMITTALS

A. Shop drawings, brochures and samples shall be submitted for all items to be furnished in accordance with the provisions of Section 01300.

B. Submittals required under this section include, but are not limited to the following:
   1. Brochures and technical data:
      a. Form ties
      b. Form sealers and coatings, each type
   2. Samples
      a. Form ties

1.03 PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability or appearance.

1.04 TECHNICAL REQUIREMENTS

A. The design of concrete formwork is the Contractor's responsibility. The design and construction of forms shall conform to the American Concrete Institute's "Recommended Practice for Concrete Formwork" (ACI 347) as applicable except as modified by this specification.

PART 2 PRODUCTS

2.01 MATERIALS

A. Forms shall conform to the shape, lines and dimensions of the parts and members of concrete work as shown on the Drawings. Forms shall be substantial and sufficiently tight to prevent leakage of mortar or liquid. Furnish panels in largest practicable sizes to minimize number of joints.

B. Except as otherwise specified, forms shall be constructed of plywood conforming to U.S. Product Standard PS 1-74 Interior and Exterior Plyform as required.

C. Forms may be of metal or other approved materials. Steel forms or forms made of plastic faced plywood may be used if designed to equal in strength and deflection that specified for plywood except as otherwise specified herein.

D. Forms for round columns may be of fiber (paper), steel or plastic.

E. Form releasing agent shall be a non-grain raising and non-staining type that will not leave residual matter on surface of concrete or adversely affect proper bonding of subsequent application of other material applied to concrete surface. For water filtration facilities, form releasing agent shall be listed in the most recent version of the National Sanitation Foundation (NSF) product listing, of a type which will not contaminate potable water. This will include the entire facility.

F. Form Ties:
1. Provide factory-fabricated, adjustable length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
2. Provide ties so that portion remaining within concrete after removal of exterior parts is at least 1 inch from the outer concrete surface. Provide form ties which will not leave a hole larger than one inch in diameter in the concrete surface.
3. Provide tie cones at each end.
4. Ties for liquid containment structures shall have a neoprene waterstop, factory applied at the center of the tie.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. General:
1. Forms shall be straight and true, mortar tight and have sufficient strength to safely support construction loads without sagging or bowing.
2. Forms shall be braced, tied together and supported to maintain position and shape, and be of adequate strength to support, without deflection or distortion, the pressure and weight of the concrete, together with the movement of men and equipment.
3. Support spacings for the various thickness shall be such as to limit deflection, flexural strength and shear strength to 1/270 of the span for structural concrete and 1/360 of the span for architectural concrete. Bending stress and rolling shear stress shall be limited to 1930 and 80 psi respectively for Class I Plyform and 1330 and 72 psi respectively for Class II Plyform.

B. Tolerances: Tolerances shall be as given in Section 203.1 of ACI 347, "Recommended Practice for Concrete Formwork".

C. Form Alignment: Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the hardened concrete surface to obtain accurate alignment of the surface, prevent leakage of mortar and to prevent formation of fins, ridges or other noticeable defects.

D. Chamfered Edges:
1. All exposed edges of concrete shall have beveled strips to provide chamfers; sizes to conform to details on the drawings. If no size is specified on drawings, a 3/4 inch chamfer shall be used, unless otherwise directed by the Engineer.

2. Where masonry walls and partitions abut columns and beams, chamfer strip shall be omitted.
3. Grinding of chamfered corners will not be allowed.

E. Form Panel Joints:
1. Joints between form panels shall be tightly butted to prevent leakage of grout or fines and shall be strengthened with back-up framing to maintain contact faces of adjacent panels in the same plane.
2. Form gaskets or form tape shall be used at joinings or juncture of form panels to prevent leakage of fluids, grout or fines from concrete. Form gaskets or form tape shall be placed at the contact edge of the joint, but shall not project into the interior of the form. Where necessary, any projection shall be cut off prior to placement of the concrete. Form gaskets shall also be used between hardened concrete and form panels to prevent leakage of grout or fines from new concrete pours.
3. Form tape shall not be used in areas where concrete is to receive a brush sandblast finish.

F. Openings:
1. The Contractor shall form for and leave all openings in the concrete work where required for the installation of his own work and/or for the work of others. He shall carefully examine all drawings for the need of such openings and in failing to provide openings as shown on the drawings, he shall cut them at his own expense.
2. Except as otherwise noted or specified, all such openings shall be filled with concrete after the work to be installed therein has been completed.

G. Cleanouts and Access Panels:
1. Temporary openings shall be provided, where required, to facilitate cleaning and inspection prior to placing concrete. This is particularly required at the bottom of wall forms.
2. Shavings, chips and all refuse shall be removed and the forms shall be broom cleaned before any concrete is placed. Cleanout openings will not be permitted in exposed concrete without the Engineer's approval.

H. Form Releasing Agents:
1. New plyform may be used as furnished if inspection shows it to be satisfactorily oiled by the manufacturer. For reuse, forms for exposed surfaces of concrete shall be coated with a commercial form release agent or non-staining mineral oil which shall be applied before reinforcing steel is placed. After coating with a form releasing agent, surplus oil or coating on form surfaces and any oil on the reinforcing steel or other surfaces requiring a bond with the concrete shall be removed.
2. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling immediately before the placing of concrete, except that in freezing weather, oil shall be used.

3.02 INSTALLATION OF EMBEDDED ITEMS

A. General:

1. The Contractor shall notify all trades when construction is ready for the setting of anchor bolts, inserts, sleeves, and other built-in equipment, in order that such material shall be set at the proper time. Before placing concrete, care shall be taken to determine that all items to be embedded in concrete are accurately located, firmly secured in place and protected from damage or displacement until securely held by the concrete.
2. All items shall be thoroughly cleaned, free from rust, scale, dirt, grease or other coating. Any wood used for removable keys shall be thoroughly dampened before concrete is placed against the wood. The Contractor shall be responsible for any displacement of the items caused by his workmen.

B. Electrical conduit may be embedded in concrete according to the provisions of Article 6.3 of ACI 318 "Building Code Requirements for Reinforced Concrete", provided the following conditions are met:
1. Outside diameter of conduit shall not exceed 1/3 of concrete thickness.
2. Conduit shall not be placed closer than three diameters on center.
3. Conduit shall not be embedded in structural concrete slabs less than four inches thick.
4. A 1-1/2 inch minimum concrete cover shall be provided for conduits in structural concrete slabs.
5. Conduit shall not be located between bottom of reinforcing steel and bottom of concrete slab.
6. Conduit is generally not permitted in beams or girders.
7. Aluminum conduit shall not be embedded in concrete.

3.03 REMOVAL

A. Form Removal:
1. Forms shall be removed in a manner to insure complete safety of the structure. In no case shall supporting forms or shoring of slabs, beams, or other suspended members be removed until members have acquired sufficient strength to support safely their weight and the load thereon.
2. Care shall be taken to avoid spalling the concrete surface and to assure that newly unsupported portions of the structure are not subjected to heavy construction or material loading. Additional shores or reshores shall be provided, as required, to adequately support the members during the construction period.
3. All responsibility involved in the removal of forms, shores, and bracing shall rest with the Contractor, and he shall be solely responsible for accidents to persons and property of any nature.

B. All parts of removed forms reserved for reuse shall be inspected, cleaned and repaired. Any part or panel which has been dented, deformed or otherwise rendered unfit for reuse shall be removed from the site at once.

C. Tie-rod clamps to be entirely removed from the wall shall be loosened 24 hours after concrete is placed, and form ties may be removed at that time. Filling of form tie holes shall be as specified in Section 03345, Concrete Placing, Curing and Finishing.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE

A. The work of this Section includes all labor, materials, tools and equipment necessary for the fabrication, transportation and installation of all reinforcing steel necessary for the proper completion of the Work.

B. Provide all reinforcing steel for masonry reinforcing (seismic reinforcing), as shown on the Drawings.

1.02 SUBMITTALS

A. Shop drawings, brochures and samples shall be submitted for all items to be furnished in accordance with the provisions of Section 01300.

B. Submittals required under this section include, but are not limited to the following:
   1. Certified mill reports of reinforcing steel identifying chemical and physical analysis.
   2. Submit fully detailed shop drawings, conforming to the Manual of Standard Practice for Detailing Reinforced Concrete Structures, ACI 315 showing and including, but not limited to the following:
      a. Sizes and dimensions for fabrication and placing of reinforcing steel and bar supports.
      b. Bending schedules and diagrams.
      c. Splices and laps.
      d. Assembly diagrams.
      e. Reinforcing steel clearances.
      f. Class designation and details of bar supports.
      g. Pertinent concrete details with dimensions and elevations.
      h. Items furnished by mechanical trades or under other sections of the Specification to be cast in concrete where interference may occur.
      i. Reinforcement of concrete walls shall be shown on wall elevations with required sections, reinforcement of beams on beam elevations with required sections and reinforcement of floor and roof slabs on plan views with required sections.

1.03 PRODUCT HANDLING

A. Deliver reinforcement to project site in bundles bearing tags indicating size, length and identification mark. Each bundle, roll or individual bar shall be so labeled.

B. Classify and stack materials off the ground to prevent contamination and to facilitate subsequent inspection and handling.

1.04 TECHNICAL REQUIREMENTS

A. The concrete reinforcing work included in this contract has been designed in accordance with the American Concrete Institute's "Building Code Requirements for Reinforced Concrete" (ACI-318).

B. Reinforcing shall be performed in accordance with the applicable provisions of the building code of the state wherein the work is done and any local codes or ordinances having jurisdiction over the work.

C. In addition, the various ASTM, ACI, Department of Commerce, and Federal Specifications cited throughout this section are hereby included by reference.

PART 2 PRODUCTS

2.01 STEEL REINFORCEMENT

A. General: The term "steel reinforcement" shall include all bars, tendons, anchorage, hooks, stirrups, dowels, ties, tie-wire, chairs and spacers noted on the Drawings, and/or specified herein, and evidently required. The types and grades of reinforcing required are specified herein.

B. Materials:
   1. Reinforcing Bars: Shall be formed of new billet steel conforming to ASTM A615, Grade 60 except as otherwise noted.
   2. Welded Wire Fabric: Shall conform to ASTM A185 of the sizes indicated. For slabs, flat sheets only shall be used, and rolls will be unacceptable.
   3. Tie Wire:
      a. For Structural Concrete: FS QQ-W-461 annealed black, 16 gauge minimum.
   4. Bar Supports:
      a. Chairs, bolsters spacers and other devices to properly position reinforcing steel shall conform to "Bar Support Specifications" CRSI Manual of Standard Practice and shall be of adequate strength and approved design to prevent displacement of reinforcing and to prevent discoloration of concrete.
      b. Support devices shall be Class A, except where concrete surfaces are exposed to view, weather or moisture; support devices shall be Class C - Plastic Protected.
      c. For slabs on grade, supports shall be precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square and shall have compressive strength equal to that of the surrounding concrete.

C. Fabrication:
   1. Steel reinforcement shall be fabricated to the shapes, sizes and dimensions as shown on the drawings, details and schedules. All bending of bars and stirrups shall be in accordance with the requirements set forth in the Manual of Standard Practice of the Concrete Reinforcing Steel Institute. All steel shall be bent cold and shall not be bent or straightened in a manner that will injure the metal. Bars with kinks or bends not so detailed shall not be used.

2. Bends for stirrups and ties shall be made around a pin having a diameter not less than four times the minimum thickness of the bar but in all cases the diameter of bend shall be at least large enough to accommodate the supporting bar. Bends for other bars shall be made around a pin having a diameter not less than six times the minimum thickness of the bar, except that for bars larger than one inch the pin shall be not less than eight times the minimum thickness of the bar.

PART 3 EXECUTION

3.01 INSTALLATION

A. Reinforcing Bars:

1. Placing Reinforcement:
   a. Reinforcement shall be accurately placed in accordance with the drawings and adequately secured in proper position by concrete or metal chairs or spacers which will insure accuracy of position, both horizontally and vertically and will be sufficiently rigid to prevent displacement of the reinforcement during the placing and working of the concrete.
   b. Reinforcement steel shall be securely tied at intersections with tie wire or clips and shall be supported in a manner that will keep all metal away from exposed concrete surfaces.
2. Splices:
   a. All splices in the reinforcement shall be as shown on the drawings. The lapped ends of the bars shall be either separated sufficiently to allow the embedment of the entire surface of each bar in concrete, or connected as a single continuous bar to develop the full strength of the bar.
   b. Splicing shall not be made at the points of maximum stress, nor shall adjacent bars be spliced at the same points. Splices shall be staggered.
   c. When permitted by written approval of the Engineer, welding shall be in accordance with AWS 12.1.
3. All reinforcement in any one section shall be placed, supported and secured before the beginning of concrete operations. Unless otherwise indicated on the Drawings, the details of reinforcing steel, including bending, splicing and supporting shall conform to ACI Building Code 318 and Detailing Manual 315.

4. Steel Adjustment:
   a. Move within allowable tolerances to avoid interference with other reinforcing steel, conduits or embedded items.
   b. Do not move bars beyond allowable tolerances without approval of the Engineer.
   c. Do not heat bend or cut bars without approval of the Engineer.

B. Wire Fabric:

1. Install in longest practicable sheet.
2. Lap adjoining pieces one and one-half mesh minimum and wire securely together.
3. Offset end laps in adjacent widths to prevent continuous laps.

C. Cleaning: All reinforcement, when concrete is placed shall be entirely free from flaking rust, loose mill scale, grease, dirt or other coating which would destroy or reduce its bond with the concrete. Reinforcing shall be wire brushed before placing concrete if the Engineer deems it necessary.

D. Relation of Bars to Concrete Surfaces:
1. The minimum cover of concrete for all reinforcement shall conform to the dimensions shown on the Drawings, which indicate the clear distance from the edge of the reinforcement to the concrete surface.
2. Where not otherwise shown, the minimum coverage of the concrete in inches over the steel shall be as follows:

MEMBER	EXPOSED TO			
	Air	Weather & Air Over-Liquid	Earth & Liquid	Salt Water
Footing	--	--	3	4
Wall, Column or Beam	1-1/2	2	2(b)	3(b)
Slab and Joist Top	1-1/2(c)	2	2	3
Slab and Joist Bottom	3/4	2	2(b)	3(b)

a. Applicable to all cast in place concrete except as otherwise shown on the drawings.
b. Increase one inch when cast against earth.
c. Shall be 3/4 inch when membrane or wearing surface is used.

E. Observation of Reinforcing Steel:
1. Notify the Engineer at least 24 hours before placing concrete. All reinforcing within limits of one day's concrete placement must be tied in place and reviewed by the Engineer prior to placing concrete.

F. Protection During Concreting:
1. Keep reinforcing steel in proper position during concrete placement.
2. Dowels, other than at footings, projecting above or adjacent to exposed concrete surfaces shall be protected by means of a waterproof cover, a thin coating or neat cement slurry, or a coating of a zinc rich compound having 95 percent zinc in the dried film.

END OF SECTION

SECTION 03250

CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide concrete accessories as required by the Contract Documents.
   1. In general the work of this Section includes all labor, materials, tools and equipment necessary for furnishing and installing anchors and hardware as specified herein, as shown on the Drawings or as necessary for the proper completion of the work.

1.02 SUBMITTALS

A. Shop drawings, brochures and samples shall be submitted for all items to be furnished in accordance with the provisions of Section 01300.

B. Submittals required under this section include, but are not limited to the following:
   1. Brochures and technical data:
      a. Adhesive anchor systems

1.03 PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as not to degrade quality, or serviceability.

PART 2 PRODUCTS

2.01 ANCHORS

A. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.
   1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
   2. Exterior Use: Unless otherwise indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
   3. Reinforcing dowels shall be A615 Grade 60.

4. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:

   a. Hilti HAS threaded rods with HIT-HY 200 Safe Set System using Hilti Hollow Drill Bit System for anchorage to concrete, ICC ESR-3187.

   b. Hilti HIT-Z anchor rods with HIT-HY 200 Safe Set System for anchorage to concrete, ICC ESR-3187.

   c. Hilti HAS threaded rods with RE 500 SD Injection Adhesive Anchoring System for anchorage to concrete, ICC ESR-2322.

   d. Hilti HAS threaded rods with RE 500 Injection Adhesive Anchoring System for anchorage to concrete.

B. Capsule Anchors: Threaded steel rod, inserts and reinforcing dowels with 45 degree chisel point, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, and manufacturer's installation instructions. Type and size as indicated on Drawings.

1. Interior Use: Unless otherwise indicated on the Drawings, provide chisel-pointed carbon steel rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).

2. Exterior Use: Unless otherwise indicated on the Drawings, provide chisel-pointed stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

3. Reinforcing dowels shall be A615 Grade 60, with 45-degree chisel-points at embedded end.

4. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:

   a. Hilti HVA Adhesive System with HVU capsules.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE

A. The work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required for the concrete work and, where appropriate, applying or installing such materials for the various items of concrete work as shown on the Drawings, as specified herein, and evidently required.

B. Codes and Standards:
1. The concrete work included in this contract has been designed in accordance with the American Concrete Institute's "Building Code Requirements for Reinforced Concrete" (ACI 318).
2. The ACI Standards "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete" (ACI 211.1) and "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete" (ACI 304) are also hereby made a part of this specification insofar as they apply and do not conflict with the provisions of this specification or any local codes or ordinances having jurisdiction over the work. In addition, the various ASTM, ACI, Department of Commerce, and Federal Specifications cited throughout this section are hereby included by reference. Concrete work shall be performed in accordance with the applicable provisions of the building code of the state wherein the work is done.

C. Strength:
1. All concrete shall be designed to have a minimum 28 day compressive strength of 3,000 psi except as otherwise noted on the Drawings or specified herein.

D. Contractor may use a low shrinkage concrete mix with crack-reducing admixtures as recommended by the admixture manufacturer, if submitted and approved by the Engineer. If the alternate concrete mix is submitted for approval, and the Contractor requests greater spacing between construction joints, the Contractor shall redesign the construction joints and submit a drawing for approval stamped by a structural engineer licensed in the Commonwealth of Massachusetts, at no additional cost to the Owner.

1.02 SUBMITTALS

A. Shop drawings, brochures and samples shall be submitted for all items to be furnished in accordance with the provisions of Section 01300.

B. Submittals required under this section include, but are not limited to the following:
1. Certified mill reports of cement.
2. Fine and coarse aggregate data resulting from tests performed as specified in this section for all aggregates proposed for use.
3. Samples shall be submitted for at least the following items:
   a. Cement, each type, one vial.
4. Brochures and technical data for at least the following items:

a. Admixtures, each type.

5. Reports:
   a. Testing laboratory reports on all tests and design mixes for each different contemplated application to the Engineer for approval within 45 days after Notice to Proceed, or at least 14 days before initial placement of concrete, whichever date is earlier.
   b. Report shall include source of cement and aggregates.

1.03 PRODUCT HANDLING

A. It is intended that the major portion of the concrete be supplied from a commercial ready mix plant capable of meeting the following requirements for storage and handling of materials. Where no such plant exists within a reasonable distance from the site, and for small amounts of concrete which may be site mixed, the following requirements shall apply.

1. Cement shall be carefully stored immediately upon receipt. Cement in sacks shall be stored in a suitable weatherproof structure which shall be as airtight as practical to prevent the absorption of moisture. Sacks shall be stacked close together to reduce circulation of air but shall not be stacked against outside walls. The manner of storage shall permit easy access for inspection and identification of each shipment. Bulk cement shall be transferred to elevated airtight and weatherproof bins. At the time of use, all cement that has been in storage so long that there is doubt of its quality will be tested by standard mortar to determine its suitability for use, and such cement shall not be used without approval.
2. Aggregates shall be stored in a manner that will preclude the inclusion of foreign material. Aggregates of different sizes shall be stored in separate piles. Stockpiles of coarse aggregate shall be built in horizontal layers not exceeding four feet in depth to avoid segregation.

1.04 TESTING AND INSPECTION

A. General:

1. Concrete materials and operations shall be tested and inspected as the work progresses. Failure to detect any defective work or material shall not in any way preclude later rejection when such defect is discovered nor shall it obligate the Engineer for final acceptance.
2. The use of testing services shall in no way relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the contract documents.

B. Responsibilities and duties of General Contractor:

1. Ingredient Tests: Prior to making design mixes, the Testing Laboratory conforming to ASTM E329 and subject to the approval of the Engineer shall conduct the following tests in accordance with the procedures referred to in the applicable Reference Standards, cited herein, to assure conformance with the applicable Specifications.
   a. Cement: Specific gravity and brand name of cement.
   b. Aggregates: Sieve analysis, specific gravity, soundness, percentage of voids, absorption, potential reactivity, moisture content of fine and coarse aggregate, dry-rodded weight of coarse aggregate, and fineness modulus of fine aggregate.

2. Design Of Concrete Mixes:
   a. The testing laboratory shall recommend, as determined by trial mixes and strength curves, the design mixes to be used for each application of concrete that will produce concrete of specified strengths and finishes with slumps and workability to meet all placing conditions.
   b. Design mixes shall indicate water-cement ratio, cement factor, water content, admixture content, cement content, aggregate content, aggregate gradations, slump, air content and strength. Design mixes and related tests shall be in accordance with the procedures referred to in the applicable reference specifications cited herein.
   c. Reference Standards: Concrete mixes shall be designed in accordance with Article 3.9 of Chapter 3 of ACI 301 "Specifications for Structural Concrete Buildings" and references referred to therein.
   d. Water cement ratio shall not exceed 0.45.
   e. The maximum allowable net water content shall be 5.00 gallons per sack of cement and cement factor shall be at a minimum 6.50 sacks per cubic yard of concrete.
   f. Limit of Changes for Pumping: If the Contractor elects to convey concrete by pumping, the established job mix may not be altered by more than the following:

Cement	plus 20 pounds per cubic yard
Fine Aggregate	plus 50 pounds per cubic yard
Coarse Aggregate	minus 50 pounds per cubic yard

   g. Any conveying method requiring a greater increase in FA/CA ratio will not be approved.
3. Sampling of Concrete:
   a. Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C172.
   b. During the progress of the Work an independent testing agency acceptable to the Owner and Engineer shall be selected. The testing agency shall be accredited and qualified according to ASTM C1077 and ASTM E329. Testing work shall be paid for by the Contractor. The testing agency and its certified testing laboratory shall prepare test concrete cylinders. The Contractor shall assist the testing laboratory in completing concrete testing. One set of 4 cylinders each shall be taken for each 100 cubic yards, or fraction thereof, of each mixture design of concrete placed in any one day. When the total quantity of concrete with a given mixture design is less than 50 cubic yards, the strength tests may be waived by the Engineer if, in his judgement, adequate evidence of satisfactory strength is provided, such as strength test results for the same kind of concrete supplied on the same day and under comparable conditions to other work. Cylinders shall be delivered to the testing labs within 24 hours. One cylinder shall be tested at 7 days and two at 28 days. The fourth cylinder shall be saved for a 56-day break should the average of the 28-day results not achieve the specified strength. Two copies each of the test results shall be submitted to the Engineer directly by the laboratory for review. In any case where the strength of the cylinders fail to meet the criteria of ACI 318, Chapter 4, Section 4.7.2.3, the Engineer shall have the right to order the defective

concrete removed and proper concrete put in its place or to take such other action as they deem necessary to remedy the situation.

c. The concrete used shall have a maximum slump as herein specified unless otherwise directed by the Engineer. Slump shall be determined as per ASTM C143. Slump tests shall be taken by the testing lab for each set of cylinders taken.

d. Air Content: Test for air content shall be performed in accordance with ASTM C173 or ASTM C231. A minimum of one test per day shall be conducted.

4. Furnish necessary labor to assist the testing laboratory and the field observers in obtaining and handling samples at the project or other sources of materials.

5. Advise the Engineer and the field observers at least 24 hours in advance of placing concrete to allow for completion of quality tests and for the assignment of personnel.

6. Provide and maintain adequate facilities for safe storage and proper curing of concrete test specimens on the project site for the first 24 hours as required by ASTM C31, Article 7.2.

7. The Contractor, at no expense to the Owner, shall have the testing laboratory conduct additional tests on concrete ingredients and make new design mixes whenever the character or source of ingredients is changed or if the placed concrete fails to meet the specified strengths.

1.05 APPROVALS

A. Commencement of Work: Concrete work shall not begin until test results and design mixes have been approved by the Engineer.

B. Mix Variations: The Engineer reserves the right to vary in the field any previously approved design mix so as to compensate for field variables including but not limited to weather conditions, placing conditions, variations in size, gradation or characteristics of aggregate and end use of the concrete.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. General:

1. All concrete used in the work shall be composed of Portland Cement, fine and coarse aggregate, and admixtures as specified herein. Concrete for every part of the work shall be of a homogeneous structure which, when cured and hardened, will have the required strength and resistance to weathering.

2. The proportions of aggregate to cement for any concrete shall be such as to produce a mixture of the required strength which will work readily into the corners and angles of the forms and around reinforcement and that will produce finishes acceptable to the Engineer but without permitting the materials to segregate.

B. Cement: Cement shall meet the requirements of ASTM C150, Type II. Brands of cement shall be subject to the approval of the Engineer.

C. Aggregate:

1. All aggregates shall conform to the standard specifications for Concrete Aggregates, ASTM C33 as amended by the specification. Aggregates failing to meet these specifications but proved by special test or actual service to produce concrete of the required quality may be used under ACI 318, Section 3.3, where authorized by the Engineer.
2. Fine Aggregates:
   a. Fine aggregates shall consist of sand or screenings of gravel or crushed stone, well graded from fine to coarse; clean and free from soft particles, clay, loam or organic matter, with the volume removed by sedimentation not more than three percent. When tested in accordance with ASTM C40 for organic impurities, the color of the supernatant liquid above the test sample shall show not darker than organic plate No. 1.
   b. Fine aggregate shall conform to the following grading:

U.S. Standard Sieve Size	Percent Passing
3/8-inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

   c. Fine aggregate shall not have more than 45 percent retained between any two consecutive sieves of those listed above, and its fineness modulus shall not be less than 2.3 nor more than 3.1. If the fineness modulus varies by more than 0.20 from the value assumed in selecting proportions for concrete, the fine aggregate shall be rejected unless suitable adjustments are made in concrete proportions to compensate for the difference in grading.

3. Coarse Aggregates:
   a. Coarse aggregates shall consist of crushed stone or washed gravel having clean, hard, durable, uncoated particles, free from dust, dirt, or other deleterious substances; and free from thin, flat or elongated particles. The test for organic impurities specified for fine aggregate shall also apply to coarse aggregate. Maximum size shall be 3/4-inch for all concrete 8 inches and less in thickness. For heavier walls, footings and mass concrete, the maximum size may be increased to 1-1/2 inch, provided the space between the reinforcing bars therein is 1-1/3 greater than the maximum aggregate size.
   b. Coarse aggregate shall conform to the grading given in Table 2 of ASTM C33 for sizes No. 467, 57, 67, 7, and 8.

D. Water: Water shall be clean, fresh and free from oil, acid, salt, alkali, sewage, organic matter, and other deleterious substances.

E. Admixtures: Admixtures shall be used as follows. The use of products other than those named herein will be allowed only with the written approval of the Engineer.

1. Air Entraining Agent: The air entraining admixture shall be a chloride free, purified and modified salt of a sulfonated hydrocarbon resin in liquid form conforming to ASTM C260.
2. Water Reducing Agents: Except when otherwise ordered by the Engineer or noted elsewhere herein, all normal structural concrete shall have a water reducing agent added. The admixture shall be a salt of lignosulfonic acid in liquid form conforming to ASTM C494, Type A. The air entraining action of the water reducing agent shall be taken into account and the air entraining agent limited accordingly.
3. Water Reducing-Retarding Agents: When the ambient temperature rises above 70 degrees F., the water reducing agent shall be replaced in whole or in part with a water reducing-retarding agent conforming to ASTM C494, Type D. The admixture shall be used in such amounts as will produce concrete with a set time equal to that which it would have at 70 degrees F. without the retarder.
4. Set Accelerator: Where a set accelerator is allowed under the provisions of Section 03345 Concrete Placing, Curing, and Finishing, it shall be non-chloride conforming to ASTM C494, Type C and Type E.
5. Superplasticizer: Superplasticizing admixtures used to produce flowing concrete may be approved for use in concrete in any part of the structure. The dosage rate depends on the slump of the base concrete which should be kept constant and low (2-1/2 to 3 inches). Superplasticized concrete can lose slump in 60 to 90 minutes, or sooner if temperature is above 70 degrees F, therefore the admixture should be added to the mix at the project site if there is a probable combination of long concrete haul and warm temperature during placing operation. Otherwise the admixture should be added in accordance with the manufacturer's instruction.
6. Crack-Reducing Admixture: Crack-Reducing Admixtures may be used to reduce the magnitude of drying shrinkage, minimize the potential for cracking, and reduce joint spacing between concrete pours of large structures. Apply admixture at the dosage rate recommended by the manufacturer. Crack-Reducing Admixture shall be MasterLife CRA007 by Master Builders or approved equal.

F. Epoxy Grout: Epoxy grout shall conform to ASTM C881, Type III, Grade 2, Class C. Color shall be selected by the Engineer.

PART 3 EXECUTION

3.01 CONCRETE MIX

A. Proportions:
1. The work has been designed for concrete having a minimum compressive strength at 28 days as specified in this section.
2. The cement factor and water cement ratio shall be determined by consideration of the specified strength, the water reducing admixtures, the slump required for proper placement, air-entraining requirements, the available and maximum allowable aggregate size and its specific gravity and the amount of water carried on the aggregates.
3. The slumps and maximum sizes of aggregate for various types of construction, as well as the computation of trial mixes shall be as described in ACI 211.1 "Recommended Practice for Selected Proportions for Normal and Heavyweight Concrete".

B. Water Cement Ratio: The water cement ratio shall be as determined from the approved design mixes as specified in this section.

C. Water Content:
1. In calculating the total water content in any mix, the amount of water carried on the aggregate and the effect of admixtures shall be included. The water on the aggregate shall be determined periodically by test and the amount of free water on the aggregate subtracted from the water added to the mix.
2. In all cases the amount of water to be used shall be the minimum amount required to produce a plastic mixture of the strength specified and of the required density, uniformity and workability. The consistency of any mix shall be at that required for the specific placing conditions and methods of placement.

D. Concrete Slumps:
1. The Contractor must satisfy himself that he is capable of producing, with the following slumps, concrete of satisfactory quality and strength, that will produce the specified finishes, free of voids, honey-combing, or excessive air bubbles.
2. Execution of this contract signifies that the Contractor accepts full responsibility for the production of concrete of satisfactory quality, strength and finishes within the slump limitations specified. Slump shall be determined as per ASTM C143.

Types of Construction	Maximum (inches)	Minimum (inches)
Reinforced Footings and Mats	3	1
Substructure Walls	4	1
Slabs, Beams and Reinforced Walls	4	1

E. Air Entrainment:
1. All concrete, except interior concrete slabs subject to abrasion, shall be air entrained. Percent of air versus aggregate size shall be added as a part of the computed mixing water requirements, and be used strictly in accordance with the manufacturer's directions and these specifications to produce a total entrained air content, by volume, to be determined in accordance with the procedure given in ASTM C173, as follows:

Nominal Maximum Size Coarse Aggregate (inches)	Air Content By Volume (percent)
3/8	6 to 10
1/2	5 to 9
3/4	4 to 8
1	3.5 to 6.5
1-1/2	3 to 6

F. Ready Mixed Concrete: It is intended that the major portion of the concrete required for the work be ready mixed in an off site plant. Small amounts for miscellaneous purposes may be site mixed. All concrete produced in an off site plant shall be mixed and delivered in accordance with the requirements of the "Standard Specifications for Ready Mixed Concrete," ASTM C 94 and these specifications.

G. Mixing: Concrete shall be mixed and transported in accordance with the applicable provisions of the "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete" (ACI 304) of the American Concrete Institute and these Specifications.

END OF SECTION

SECTION 03315

MISCELLANEOUS CONCRETE PLACEMENTS

PART 1 GENERAL

1.01 SCOPE

A. The work of this section includes all labor, materials, tools and equipment necessary for the construction of concrete specialties as specified herein, as shown on the Drawings or as necessary for the proper completion of the work.

PART 2 PRODUCTS

2.01 EQUIPMENT FOUNDATIONS

A. All floor-mounted mechanical and electrical equipment shall be installed on concrete pads constructed of 4,000 psi concrete, whether or not specifically indicated on the drawings to be pad mounted.

2.02 GROUTING

A. General: Grouting is required for structural items and mechanical items. The materials to be used for mechanical items and base plates shall be as specified in Section 03345 Concrete Placing, Curing and Finishing.

2.03 CONCRETE FILLS

A. All concrete fills shall be 4,000 psi.

B. Thin Set Fills: Concrete fills two inches thick shall have a maximum size aggregate of 1/2-inch.

C. Thick Set Fills: Concrete fills greater than two inches thick shall be structural concrete as specified in Section 03300 Cast-In-Place Concrete.

2.04 DUCTBANKS

A. All underground electrical ductbanks shall be encased in concrete with materials as specified herein.

B. Cement, aggregate and all other concrete components shall be as specified herein except that aggregate size shall not exceed 3/8-inch. Concrete shall have a minimum compressive strength at 28 days of 2,500 psi.

C. Ductbanks shall be reinforced when crossing the backfill covering new pipe lines, roads, parking lots or any area subject to vehicular traffic. Beneath these areas, ductbanks shall be reinforced with a minimum of #5 @ 12” longitudinal and #4 @ 12” ties, extending 4 feet beyond area needing protection.

PART 3 EXECUTION

3.01 EQUIPMENT FOUNDATIONS

A. All equipment foundations shall be sized to suit equipment with reinforcement as shown on the equipment pad detail on the Drawings. Pads shall not be poured until all equipment sizes have been finalized.

B. All exposed surfaces shall be formed with smooth forms, all coarse aggregate spaded back from the forms so that all exposed surfaces shall have a smooth surface without excessive rubbing and shall be free from sandy streaks, coarse aggregate or stone pockets. All exposed surfaces shall have a smooth, even surface, with all exterior angles beveled and vertical surfaces coved to the floor.

C. The Contractor shall build in all anchor bolts, dowels, sleeves, and other built-in fittings as required for the equipment.

3.02 PITS, SUMPS AND TRENCHES

A. Care shall be required of the Contractor in the construction of all indicated pits, sumps and trenches to ensure provisions are made for all built-in or attached frames, embedded items, pipes and sleeves.

B. Waterstops shall be installed in all concrete joints as indicated.

C. Floors shall present a smooth evenly troweled surface, properly sloped to drains.

3.03 GROUTING

A. Surface Preparation:
1. The concrete surfaces shall be cleaned of all contamination and debris, chipping or roughening the surface if any laitance or poor concrete is in evidence.
2. Special care shall be taken with the grout in hot or cold weather to ensure proper setting and gain of strength. Aggravating conditions of placement are to be alleviated to an extent that the temperature of the grout up until time of set will be in about the range of 60 to 80 degrees F. Shields from the sun and hot winds shall be provided when required.
3. Following cleaning, the concrete shall be water-saturated for a period of six hours, the excess water then removed from the surface and non-absorbent edge forms erected.

B. Grouting of Equipment:
1. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets.
2. The grout may be poured in place, pressure grouted by gravity, or pumped. Whenever practical, grout shall be poured from one side only and made to flow across to the open side to avoid air-entrapment.

3.04 CONCRETE FILLS

A. Surface preparation for concrete fills shall conform to applicable portions of Section 03345 Concrete Placing, Curing and Finishing.

3.05 PADS AND BASES

A. All concrete work for the equipment pads shall be as specified herein and as detailed the Drawings. The Contractor shall be responsible for the excavation, installation of this concrete work, and backfill.

3.06 DUCTBANKS

A. Not less than three inches of concrete shall be between the outside of a duct and the earth. Not less than two inches of concrete shall be between adjacent ducts.

B. All duct line concrete pours shall be continuous between manholes or handholes and between manholes or handholes and structures.

C. Ductbanks shall be laid in trenches on mats of screened gravel not less than 6-inches thick and well graded.

D. Where duct lines pass through concrete walls, concrete envelopes shall be extended through and finished flush with inside surfaces. Watertight construction joints of an approved type shall be provided.

END OF SECTION

SECTION 03345

CONCRETE PLACING, CURING AND FINISHING

PART 1 GENERAL

1.01 SCOPE

A. The work of this section includes all labor, materials, tools and equipment necessary for the placing, curing and finishing of all cast-in-place concrete as shown on the Drawings, specified herein and evidently required to complete the work.

1.02 SUBMITTALS

A. Shop drawings, brochures and samples shall be submitted for all items to be furnished in accordance with the provisions of Section 01300.

B. Submittals required under this section shall include, but are not limited to the following:
   1. Manufacturer's Literature - including technical and installation information for:
      a. Cement Grout (Non-Shrink)
      b. Membrane Curing Compound
      c. Joint Sealant
      d. Concrete Sealer
      f. Epoxy Bonding Compound

1.03 ENVIRONMENTAL CONDITIONS

A. Protection:
   1. Fresh concrete shall be adequately protected from freezing, premature drying, heavy rains, flowing water and mechanical injury. Provisions shall be made for maintaining new concrete in a continuously moist condition for at least seven days after placement.

B. Cold Weather Requirement:
   1. When placing concrete in cold weather, the recommendations of the American Concrete Institute's Publication "Cold Weather Concreting" ACI-306R shall be followed insofar as the Engineer may direct. The use of set accelerators will be at his discretion except that no calcium chloride will be allowed. After the first frost of the winter and after the mean daily temperature at the site falls below 40 degrees F. for more than one day, concrete shall be protected from freezing for not less than the first 48 hours after is placed. In the spring, concrete shall be similarly protected until the mean daily temperature rises above 40 degrees F. for more than 3 consecutive days. When the mean daily temperature falls below 40 degrees F. for more than one day, concrete shall thereafter be placed at a temperature of between 50 and 55 degrees F. and maintained at that temperature for at least three days. During the next three days, it shall be protected from freezing.
   2. When it is necessary to heat the materials in order that the concrete when placed will have a temperature within the allowable range, water and aggregates shall be introduced into the mixer and the temperature allowed to stabilize before the

cement is added. If heating of aggregates is not practicable, the water may be heated to any temperature required to produce a water-aggregate temperature in the 60 degrees to 80 degrees F. range. Cement should never be added to a mix having a higher temperature due to the danger of producing a flash set. When aggregate heating is required and steam in pipes is not available, steam jets may be the only practicable method. With this method the amount of free water on the aggregate will vary considerably and the mixing water will have to be adjusted for each batch. In general, there is more danger in overheating water and aggregates, and producing mix temperatures on the high side of the allowable than there is in being on the low side.

3. Regardless of materials heating or the use of admixtures, protective measures shall be taken to maintain the temperature of freshly placed concrete as recommended by the ACI for the particular condition. Data on the duration of recommended protection, safe final removal of shores and forms, and the like appears in the ACI publication "Cold Weather Concreting" (ACI-306R).

4. The methods of protecting freshly placed concrete will be subject to the approval of the Engineer. In general, external heating will not be required during the first three days if measures are taken to retain the heat of hydration. Such measures shall be commercial batt insulation, insulating board, loose fill insulation, or other material approved by the Engineer. Canvas or plastic film shall be used to protect the insulations from precipitation. After three days, if heating is required to maintain the temperature of the concrete above freezing, it shall be provided as required. Exhaust steam is the best method, is fire safe, and does not dry the surface of the concrete. Airplane heaters, located outside the structure or enclosure and blowing hot air into it are acceptable but not preferred. Open fires and salamanders without proper ventilation will not be allowed due to the fire hazard and strong carbon dioxide atmosphere which is detrimental to freshly placed concrete.

C. Hot Weather Requirements:

1. For concrete placed during extremely warm weather, the aggregate shall be cooled by frequent spraying in such manner as to utilize the cooling effect of evaporation. Temperature of the concrete when placed shall not be more than 90 degrees F. If such a temperature cannot reasonably be maintained, the Engineer shall be notified in order to permit redesign of the mix at his direction to compensate for loss of strength resulting from higher mix temperatures. Newly placed concrete shall be protected from the direct rays of the sun and the forms and reinforcement, just prior to placing, shall be sprinkled with cold water.

2. During periods of excessively hot weather (90 degrees F., or above), ingredients in the concrete shall be cooled insofar as possible and cold mixing water shall be used to maintain the temperature of the concrete at permissible levels, all in accordance with the provisions of ACI 305R, "Hot Weather Concreting".

3. Temperature records shall be maintained giving air temperature, general weather conditions (calm, windy, clear, cloudy, etc.) and relative humidity. The record shall include checks on temperature of concrete as delivered and after placing in forms. Data shall be correlated with the progress of the work so that conditions surrounding the construction of any part of the structure can be ascertained. A copy of the weather data shall be included in the permanent records of the job. During excessively hot weather not more than one hour shall elapse between time of adding water to cement or cement to aggregate, and time of placing concrete.

1.04 EVALUATION OF CONCRETE

A. The Contractor shall comply with ACI 301, Chapter 17, Evaluation and Acceptance of Concrete.

B. Concrete test results and reports by the testing laboratory shall be the basis for evaluating concrete strength.

C. The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions:
   1. Low strength concrete as designated by ACI 301, Chapter 17.
   2. Reinforcing steel size, quantity, strength, position or arrangement at variance with the requirements of Section 03200, Concrete Reinforcement and/or the Drawings.
   3. Concrete which differs from the required dimensions or locations in such a manner as to reduce strength.
   4. Curing less than specified.
   5. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
   6. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
   7. Poor workmanship likely to result in deficient strength.

D. Where the strength of the structure is considered potentially deficient, core tests in accordance with ASTM C42 and/or load tests evaluated in accordance with ACI 318, Chapter 20 may be ordered by the Engineer. Should the Contractor elect to make core tests of questionable concrete, all expenses incidental thereto shall be paid by the Contractor. Should the Engineer direct that core tests be made, all costs will be paid for by the Owner if such tests prove the concrete to be satisfactory. If unsatisfactory, all costs including additional testing of replaced work shall be paid for by the Contractor.

E. Concrete work judged inadequate by results of core tests and/or load tests shall be removed and replaced if so directed by the Engineer at the Contractor's expense.

F. Water Tightness:
   1. The following concrete basins shall be tested for water tightness:
      a. Spent Washwater Wetwell.
      b. Clearwell.
   2. Testing Procedure:
      a. On completion of the tank, and prior to any specified backfill placement, the following test shall be applied individually to each basin to determine water tightness.
      b. Fill the tank with potable water to the maximum level and let it stand for at least 24 hours.
      c. Measure the drop in liquid level over the next 72 hours to determine the liquid volume loss for comparison with the allowable leakage. Evaporative losses shall be measured or calculated and deducted from the measured loss to determine net liquid loss (leakage). The net liquid loss for a period of 24 hours shall not exceed 0.1 of 1 percent of the tank capacity.

d. If the leakage exceeds the maximum allowable, the leakage test shall be extended to a total of five days. If at the end of five days average daily leakage does not exceed the maximum allowable, the test shall be considered satisfactory. If the net liquid loss exceeds the maximum allowable, leakage shall be considered excessive and the tank shall be repaired, and retested until leakage falls within the appropriate limit.

e. Damp spots on the exterior wall surface, or interior common walls, or measurable leakage of water at the wall base shall not be permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed in an acceptable manner. Leakage through the wall-base joint shall likewise be corrected.

PART 2 PRODUCTS

2.01 CEMENT GROUT

A. Grout shall be Embeco Pre-Mixed non-metallic non-shrink grout as made by Master Builders, Inc., Five Star Grout as made by U.S. Grout Company, Upcon Construction Grout as made by USM, Upco Chemical Division, or equal.

2.02 ROD STOCK

A. Shall be a closed cell polyethylene foam furnished in sizes one third greater in diameter than the joint.

2.03 JOINT SEALANT

A. Shall be a one component, polyurethane-base non-sag elastomeric sealant, Sikaflex-1A as manufactured by Sika Corporation or equal. Joint sealant shall be NSF approved for potable water contact.

2.04 CONCRETE SEALER

A. All interior concrete floors to be exposed upon completion of this work, and for which no other surface treatment is specified, shall have an application of Dekote as produced by A.C. Horn, Inc., or equal as made by Sonneborn or Euclid. The material shall be applied and cured in accordance with manufacturer's directions at the rate of 200 to 350 sq. ft. per gallon.

2.05 MEMBRANE CURING COMPOUND

A. May be used only on walls and slabs not subject to further treatment such as painting, chemical hardening, special topping or coatings. If used, it shall be Horncure 30D or 30C as manufactured by A.C. Horn, Inc. or equal as made by Sonneborn or Sika Corporation, and conforming to ASTM C309, Type 1 or 1D, Class B. Compound shall be applied uniformly by spray, leaving no pinholes or gaps, at a coverage rate not to exceed 200 square feet per gallon. The curing compound shall be applied after finishing operations are completed and surface moisture has disappeared. Any compound used must be of a type which will not contaminate potable water.

B. If forms are removed prior to eight days after placing the concrete, the uncovered surfaces shall be coated with the curing compound as specified herein.

2.06 CURING PAPER

A. Shall be used to cure floors which are to have applied toppings or chemical hardeners. Curing paper shall also be used in other areas to protect newly poured concrete floors from damage. Material shall conform to ASTM C171, for regular or white waterproof paper.

2.07 EPOXY BONDING COMPOUNDS

A. Shall be Uniweld as made by Permagile Industries, Inc., Sikadur 32 Hi-Mod as made by Sika Corporation, or equal.

2.08 BOND BREAKER

A. Shall be 15 pound asphalt saturated roofing felt.

PART 3 EXECUTION

3.01 CONCRETE PLACING

A. Placing:
1. Concrete shall be placed in accordance with the applicable provisions of the "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete" (ACI 304) of the American Concrete Institute and these specifications.
2. Concrete shall be handled from the mixer, or truck if ready-mixed concrete is used, to the place of final deposit as rapidly as practicable by methods which will prevent separation or loss of ingredients but in no case shall the time elapsed between the addition of the water to the cement or the cement to the aggregates and the placing of concrete in the forms exceed one and one-half (1-1/2) hours. In periods of excessive hot weather as previously defined in paragraph 1.04 C. of this section, this time shall be reduced to one hour.
3. The concrete shall be deposited in the forms as nearly as practicable in the final position to avoid rehandling and shall be so deposited as to maintain a homogeneous plastic surface approximately horizontal. Water shall be removed from all forms, trenches, and excavations and the work shall be kept dry while

the concrete is being placed. No water shall be thrown on or allowed to flow over or rise upon the concrete until it has had time to become thoroughly set.

4. The maximum free fall of any concrete shall be limited to three feet. Accumulation of concrete on the forms or reinforcement above level of the placement shall be avoided. Concrete that is partially hardened, or has been contaminated by foreign material or that has been retempered will not be permitted on this project. A concrete placement, once started, shall be carried on as a continuous operation until the placing of the section is completed.

B. Runways:

1. Runways shall be provided for wheeled concrete handling equipment. Such equipment shall not be wheeled over reinforcement nor shall runways be supported on reinforcement.

C. Chuting:

1. When concrete is conveyed in chutes, the equipment shall be of such size and design as to insure a continuous flow in the chute. The chute shall be of steel or be steel lined, and the different sections shall have the same slope throughout. Aluminum chutes will not be allowed. The slope shall be not flatter than 3 horizontal to 1 vertical or steeper than 2 horizontal to 1 vertical and, between these limits, the slope shall be that which will prevent segregation of ingredients. The end of the chute shall be provided with a baffle to prevent segregation of ingredients. If the end of the chute is more than three feet above the surface of the concrete in the forms, a spout shall be used. The spout shall be kept full of concrete and the lower end maintained as near to the surface of deposit as practical. The chute shall be thoroughly flushed with water before and after each run. The water used shall be discharged outside the forms.

D. Bonding:

1. After a section has been completed, any laitance on the temporary top surface of construction joints shall be removed and the surface raked immediately after the initial set has taken place. If removal of the laitance is delayed until the concrete has set, so that laitance cannot be removed by shovels or scrapers, the Contractor shall remove it by power chipping tools.
2. Before depositing concrete on or against concrete which has set, the surface of the set concrete shall be roughened, thoroughly cleaned with wire brushes, air blasted, and then saturated with water. The new concrete placed in contact with hardened or partially hardened concrete shall contain an excess of cement to secure bond. The surface of the hardened concrete shall be slushed with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its initial set. Where noted or where an unplanned interruption in a concrete placement has occurred, bonding shall be with epoxy bonding compound used in accordance with the material manufacturer's recommendations.

E. Compaction:

1. Concrete shall be placed in layers not exceeding 12 inches in depth, and each layer shall be compacted by mechanical internal-vibrating equipment supplemented by hand spading, rodding, and tamping as required.
2. Form vibrators will be considered only where internal vibration is impractical and will be allowed only with the written permission of the Engineer. When

allowed, the vibrator shall be placed so that motion is horizontal and vibration in any location shall not be continued to the extent that segregation occurs, but vibrators shall be relocated frequently. Vibrators shall not be used to transport concrete within the forms. Concrete shall be thoroughly worked around reinforcement, embedded fixtures and into the corners of the forms.

3. Compaction shall be in accordance with ACI 390, "Recommended Practice for Consolidation of Concrete" as modified by this specification.

3.02 CURING AND PROTECTION

A. Curing:

1. Shall be accomplished by the use of waterproof paper, curing compounds, "wet" methods (fog spray, damp sand or burlap) or other methods dependent upon the end used of the concrete. Provisions shall be made for maintaining new concrete in a continuously moist condition for a minimum of seven days.
2. The use of curing compound on surfaces to receive coating or bonded finished will not be allowed.

B. Concrete Slab Protection:

1. Finished concrete slabs shall be covered with curing paper as specified, laid with side joints lapped four inches and end joints lapped six inches. Paper shall be applied no sooner than 24 hours and not over 30 hours after finishing the slab and shall be left in place at least ten days. Joints shall be taped and paper shall be weighted to prevent displacement. Rips or tears appearing in the paper during the first seven days after a floor is completed shall be immediately patched. No traffic will be permitted until five days after pouring. From 5 to 15 days only light traffic will be permitted.
2. Where the use of wrenches and other heavy tools may be required, the Contractor shall provide additional protection as required.

3.03 DEFECTIVE CONCRETE

A. Concrete work not formed as shown on the drawings, out of alignment or level, or showing a defective surface, shall be removed and completely replaced if directed by the Engineer.

B. Slight imperfections in appearance of the structure may be patched as specified herein provided the permission of the Engineer is obtained prior to patching.

3.04 REPAIR OF SURFACE DEFECTS

A. General:

1. Immediately after the forms are removed, all form ties shall be cut off below surface of concrete, all fins and irregularities shall be removed and all defective areas, holes, honeycombs, cavities and irregularities cleaned and patched with a stiff mortar of the same composition as the mortar in the original concrete mix, all as specified herein. Exposed patchwork shall be rubbed where and as specified herein or otherwise treated to match adjacent surfaces.

B. Patching:

1. Defective areas for which patching is allowed shall be cleaned of all dust, dirt, grease, laitance, and loose or spalling concrete, and be given a brush applied coat of an epoxy bonding compound approved by the Engineer.
2. The compound shall be mixed as directed by the manufacturer. The patching mortar shall be freshly mixed and be composed of the same materials and proportions as were used for the original concrete, including the admixture, except that the coarse aggregate shall be omitted and fine aggregate substituted therefor. The placing of mortar shall begin immediately after the bonding compound is applied and shall be completed within the contact time. The bonding compound shall be sticky to the touch during placing of mortar. The patching shall be finished to match adjoining concrete, and cured and protected as specified for concrete. The manufacturer's directions and precautions shall be followed when using such compounds.

C. Filling Form Tie Holes:
1. Holes left by withdrawal of rods or by removal of end ties shall be filled solid with mortar, using epoxy bonding compound in the same manner as specified under "Patching" above. Holes passing entirely through the wall shall be filled using small tools that will pack the hole solidly with mortar. Excess mortar at the surface of the wall shall be struck off flush with a cloth.

D. Rubbed Finish:
1. Surfaces requiring remedial work which are to be exposed to view whether painted or not, shall have all projections and irregularities carefully removed and all cavities filled with stiff mortar of the same composition as the mortar in the concrete. The same brand and color of cement, and the same kind and color of aggregate shall be used for filling cavities as was used in the original concrete mix. The surface film of all such pointed surfaces shall be carefully removed before setting occurs. The preceding operations shall be done within 24 hours after removal of the forms. If, after patching and smoothing, surfaces do not present a smooth surface of even texture and appearance, then the following finish shall be repeated as many times as the Engineer deems necessary. The Engineer shall be the sole judge of the amount of rubbing required.
2. Immediately after the forms are removed, and necessary patching and smoothing is done, the surface shall be wetted with clean water, without applying any cement or other coating, and rubbed with a No. 16 carborundum brick or other abrasive of equal quality until even and smooth and of uniform appearance.
3. The final finish shall be obtained by a thorough rubbing with a No. 30 carborundum brick or other abrasive of equal quality.
4. After final rubbing is completed, the surface shall be thoroughly drenched and kept wet for a period of five days, unless otherwise directed. No rubbing will be permitted in cold or freezing weather, except in heated enclosures.

3.05 FINISH OF FORMED SURFACES

A. General:

1. All exposed interior and exterior concrete surfaces shall be finished as specified herein and shall have a smooth and even surface when completed. "Exposed concrete" shall be defined as submerged and non-submerged concrete exposed to view upon completion of the work whether or not a painted finish is specified.
2. Exterior concrete which will be covered by fill such as exterior faces of walls, spread footings, etc., shall have no treatment other than required for repairs as specified elsewhere in this section.

B. Grout Rubdown:

1. While the concrete is still damp, a thin coat of medium consistency neat cement slurry shall be applied to the concrete surface by means of bristle brushes to provide a bonding coat in the parent concrete. Before the slurry has dried or changed color, a dry (almost crumbly) grout comprising one volume cement, the same as used for the parent concrete, adjusted with white cement to match color where exposed, to 1-1/2 volumes of sand, shall be applied. This grout shall be applied by means of slightly damp pads of coarse burlap approximately 6 inch square used as a float. The grout shall be well scrubbed into the surface to provide a dense mortar.
2. The mortar shall be allowed partially to harden from one to two hours depending upon the weather. Work in direct hot sunlight shall be avoided, and if the air is hot and dry, the concrete shall be kept damp during this period with a fine fog spray.
3. When the grout has hardened sufficiently, all the grout that can be removed shall be removed with a trowel. Grout shall not be allowed to remain on the concrete too long since it will become difficult to remove.
4. The surface shall then be allowed to dry thoroughly and then be rubbed vigorously with clean, dry burlap to completely remove any dried grout. There should be no visible film of grout remaining after this rubbing.
5. The entire operation shall be completed in one working day. No grout shall be left on the concrete overnight. Sufficient time shall be allowed for the grout to dry after it has been cut with a trowel so that it can be wiped off clean with burlap.
6. On the day following, the concrete shall again be wiped clean with dry burlap to remove any inadvertent dust. At this time, the use of a piece of burlap containing old hardened mortar may be helpful since it will act as a mild abrasive. After this treatment no build-up film should remain on the parent surface. If however, such is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the parent concrete. Do not work up a lather.
7. After application of the surface grout, the surface shall be thoroughly washed down with stiff brushes and the concrete maintained in a continuously damp condition for at least three days above 50 degrees F. by the periodic application of a fine fog spray or by the use of a poultice of damp flannel covered with polyethylene taped to the concrete.

3.06 FINISHING OF RELATED UNFORMED SURFACES

A. Tops of exposed beams, walls, parapets and tops of similar unformed surfaces occurring adjacent to formed surfaces shall be struck off smooth and be hand steel troweled by cement masons assisted by a field party to continually verify and check correct lines and elevations, so as to produce a smooth hard level surface. Line and elevation shall be pre-established by means of preset wood screeds which shall be removed during the troweling operation.

B. After above troweling operations have been completed and after concrete has cured, the above troweled surface shall be dry honed to a smooth non-directional surface texture satisfactory to the Engineer.

3.07 CLEANING CONCRETE

A. Cleaning Concrete:
   1. The Engineer may require remedial action by the Contractor to remove blemishes, rust, stains, or discolorations from the exposed concrete. General cleaning shall be done with a non-etching cleaning agent used as per manufacturer's instructions. The cleaner shall be used on all surfaces to receive a painted finish.

B. In the event of a severe blemish or discoloration which cannot be removed with a non-etching agent, the Contractor shall notify the Engineer immediately and consider the following:

   1. A clean down with mild solution of detergent and water applied by scrubbing vigorously with soft bristle brushes, then flushing with water. Rust stains may be removed by applying a bleaching agent such as oxalic acid.
   2. Cleaning operation shall not begin until superstructure is entirely completed and then only where and as directed by the Engineer. Cleaning portions of building as work progresses is not permitted.
   3. Cleaning by other methods, bleaching, acid etching, sandblasting or any other procedure suggested by the Contractor and proven to be effective.

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install grout complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 1 of these Specifications.
   1. Section 02700 Precast Concrete Manholes
   2. Section 03250 Concrete Accessories
   3. Section 03300 Cast-in-Place Concrete

1.03 SUBMITTALS

A. Shop drawings and product data in accordance with Section 01300 showing materials of construction and details of mixing and installation for:
   1. Commercially manufactured non-shrink cementitious grout and underlayment grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations and conformity to the specified standards.
   2. Cement grout: The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures and the proposed mix of the grout.

B. Samples:
   1. Submit samples of commercially manufactured grout products when requested by Engineer.
   2. Submit aggregates proposed for use in mixes when requested by Engineer.

C. Laboratory Test Reports:
   1. Submit laboratory test data as required under Section 03300 for concrete to be used as concrete grout.

D. Qualifications:
   1. Grout manufacturers shall submit documentation that they have at least ten years experience in the production and use of the grouts which they propose to supply.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):
   1. ASTM C33 – Standard Specifications for Concrete Aggregates,
   2. ASTM C150 – Standard Specifications for Portland Cement,

3. ASTM C827 – Standard Test Methods for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures,
4. ASTM C1107 – Standard Specifications for Packaged Dry, Hydraulic – Cement Grout (Non-shrink).

B. U.S. Army Corps of Engineers Standard (CRD):
1. CRD-C 621 – Corps of Engineers Specification for Non-shrink Grout.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications:
1. Grout manufactures shall have a minimum of ten years experience in the production and use of grout proposed for the work.

B. Pre-installation Conference:
1. Well in advance of grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing, and curing procedures for each product proposed for use. Parties concerned with grouting, including Engineer, shall be notified of the meeting at least ten days prior to its scheduled date.

C. Services of Manufacturer's Representative:
1. A qualified field technician of the non-shrink grout manufacturer, specifically trained in the installation of the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of non-shrink grout and underlayment grout. Additional services shall also be provided, as required, to correct installation problems.

D. Field Testing:
1. All field testing and inspection services required shall be provided by Owner. Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc. for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.
2. The field testing of concrete grout shall be as specified for concrete in Section 03300.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.

B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to six months or the manufacturer's recommended storage time, whichever is less.

C. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to Owner.

1.07 DEFINITIONS

A. Non-shrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.

B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

C. Grout shall be applied where needed or at the discretion of the engineer.

2.02 MATERIALS

A. Non-shrink Cementitious Grout:
   1. Non-shrink cementitious grouts shall meet or exceed the requirements of ASTM C1107 Grades B or C and CRD-C 621. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water. Non-shrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
      a. General purpose non-shrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Euco NS by The Euclid Chemical Co.; NBEC Grout by Five Star Products, Inc. or equal.
      b. Flowable (Precision) non-shrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Five Star Grout by Five Star Products, Inc. or equal.

B. Cement Grout:
   1. Cement grout shall be a mixture of one part portland cement conforming to ASTM C150 types I, II, or III and one to two parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

C. Water:
   1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by Engineer.

B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints and free of all loose material or foreign matter which may effect the bond or performance of the grout.

C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oil less type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.

D. Remove all loose rust, oil or other deleterious substances which may affect the bond or performance of the grout from metal embedments or bottom of baseplates prior to the installation of the grout.

E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface, or other method acceptable to Engineer. Upon completion of the 24 hour period, visible water shall be removed from the surface prior to grouting.

F. Construct grout forms or other leak-proof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.

G. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.

H. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks, or other approved means. The shims, wedges, and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by Engineer. Grout voids created by the removal of shims, wedges and block.

3.02 INSTALLATION – GENERAL

A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and these specifications.

B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.

C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 degrees F and 90 degrees F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.

D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 degrees F and 90 degrees F range.

E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.

F. Inspect all existing underlying expansion, control and construction joints through the grout.

3.03 INSTALLATION – CEMENT GROUTS AND NON-SHRINK CEMENTITIOUS GROUTS

A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by Engineer.

B. Do not mix by hand. Mix in a mortar mixer (with moving blades). Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.

C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.

D. Provide forms where and as required. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement shall proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.

F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise ordered and approved by Engineer. Finish this surface with a wood float or brush finish.

G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding or other approved means. Provide sunshades as

necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

END OF SECTION

SECTION 08306
ALUMINUM FLOOR HATCHES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide floor hatches as required by the Contract Documents.
   1. In general provide aluminum and floor hatches for the wetwell at the River's Edge Effluent pump station shown on the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02700 Precast Concrete Manholes
   2. Section 03300 Cast in Place Concrete

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. For purposes of designating type and quality for work in this Section, Drawings and Specifications are based on floor hatches as manufactured by The Bilco Company, New Haven, CT.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Shop Drawings showing details of each frame type, details of openings, and details of construction, installation and anchorage.
   4. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.

C. The equipment to be furnished under this section shall be coordinated with all applicable structural and mechanical process drawings, including addenda.
   1. If no changes are required, provide a statement that no changes are required.
   2. If changes are required, furnish marked up drawings or statement detailing the modifications necessary for the equipment proposed.

Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
   1. If deviations and clarifications form the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 PRODUCT HANDLING

A. Deliver materials in manufacturer's original unopened and undamaged packages with labels legible and intact.
   1. Store materials in unopened packages in a manner to prevent damage from the environment and construction operations.
   2. Handle in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 ALUMINUM HATCHES

B. Floor hatch be type “JD-AL” (double door) as manufactured by the Bilco Co., New Haven, CT and shall have the following attributes:
   1. Shall have 1/4-inch aluminum diamond pattern plate to withstand a live load of 300 lbs. per square foot with a maximum deflection of 1/50th of the span.
   2. Channel frame shall be 1/4-inch aluminum with an anchor flange around the perimeter.
   3. Equipped with stainless steel hardware throughout.
   4. Automatically lock in the vertical position by means of a heavy hold-open arm with grip handle release.
   5. Cover shall pivot so that it does not protude into the channel frame.
   6. Channel frame shall have a 1-1/2 inch drainage coupling.
   7. Lock shall be of the slam lock design with removable key wrench.
      a. Latch release protected by a flush gasketed, removable screw plug.
      b. Frame and door shall be fabricated to include a recessed padock hasp covered by a flush hinged lid.
   8. Compression spring operators enclosed in telescopic tubes.
   9. EPDM gasket mechanically attached to the frame to reduce the amount of dirt and debris that may enter the channel frame.
   10. Size as shown on the Drawings.
   11. Add fall protection grating with hatch

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Access hatches to well shall be installed per manufacturer's installation instructions.

END OF SECTION

SECTION 11310

SUBMERSIBLE CENTRIFUGAL WASTEWATER PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. The work under this section shall consist of furnishing all equipment, materials and labor for the installation of the submersible centrifugal pumps, motors, and appurtenances, complete.

B. The pumps and motors shall be centrifugal end suction pumps with constant speed motors. Pumps shall be manufactured by ITT Flygt, KSB, Inc., Zoeller, Flowserve (Ingersoll Dresser), or approved equivalent.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1. Section 02700 Precast Concrete Manholes
2. Section 03250 Concrete Accessories
3. Section 03600 Grout
4. Section 13100 Instrumentation and Controls
5. Section 15100 Ductile Iron Pipe, Fittings, and Appurt.
6. Division 16 Electrical

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Shop Drawings: Include illustrations, dimensions, materials, performance and wiring diagrams, and certified factory pump curves.

C. Operating and Maintenance Manuals: Include manufacturer's instructions for equipment installation, start-up, operation, and maintenance, including parts lists for operation and maintenance manuals specified in Division 1.

D. Certified Performance Test Reports: Submit certified report performance test. Perform factory tests to certify that pumps meet the specified requirements for head and capacity, and meet or exceed all applicable National Hydraulic Institute standards.

1.04 SYSTEM DESCRIPTION

A. Pumping equipment shall comply with Section 2.01.

B. Equipment shall be suitable for pumping municipal wastewater and for service specified in Section 2.01

C. Equipment shall be suitable for continuous operation at maximum fluid temperature of 104ºF at all operating speeds specified and without external cooling fluid.

D. Adequately size motor hp so each pump is non-overloading throughout entire pump performance curve.

E. Design motor for up to 15 evenly spaced starts per hr for motors less than 125 hp and up to 10 evenly spaced starts per hr for motors 125 hp and larger.

F. Equipment shall be free from shock, vibration, cavitation, overheating, and noise while operating at specified conditions.

G. Equipment shall be capable of continuous operation without damage while operating under load and unsubmerged.

H. Design equipment for continuous submergence under water without loss of watertight integrity to depth of 65 ft.

I. Design equipment for removal and reinstallation of pumps without need to enter wet well and without removal of fasteners.

J. Design pump removal guide mechanism and permanently mounted discharge connection elbow so no part of pump bears on wet well structure.

K. Connection of pump to permanently mounted discharge elbow shall not leak.

L. Design equipment so parts readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store equipment on site according to manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Suitable for application specified:
   1. Pump Case: Cast iron, ASTM A48, minimum Class 30.
   2. Motor Housing: Cast iron, ASTM A48, minimum Class 30.
   3. Impeller: Cast iron, ASTM A48, minimum Class 30.
   4. Intermediate Housing: Cast iron, ASTM A48, minimum Class 30.
   5. Discharge Base Elbow: Cast iron, ASTM A48, minimum Class 30.
   6. Pump/motor Shaft:
      a. Shafts not directly exposed to pumped fluid or shafts provided with protective sleeve: Carbon steel, ASTM A576, minimum Grade 1035.
      b. Shafts directly exposed to pumped fluid: Stainless steel, ASTM A276, Type 420 or ASTM A182, Grade F XM-19.
   7. Shaft Sleeve: Stainless steel, ASTM A276, Type 420.
   8. Wear Ring; Case:

a. Pumps with motor nameplate less than 15 hp: Brass, nitrile rubber, or cast iron.
b. Pumps with motor nameplate 15 hp and larger: Cast iron, ASTM A48, minimum 200 Brinnel hardness.

9. Wear Ring; Impeller: Stainless steel, ASTM A276 - 400 Series, minimum 300 Brinnel hardness.
10. O-Rings: Nitrile or viton.
11. Fasteners: Stainless steel, ASTM A276, Type 316Ti.
12. Lower Seal Faces: Tungsten carbide vs. tungsten carbide or silicon carbide vs. silicon carbide.
13. Upper Seal Faces: Tungsten or silicon carbide vs. carbon (rotating seal ring) or tungsten carbide vs. tungsten carbide, or silicon carbide vs. silicon carbide.
14. Guide Rails and Brackets: Stainless steel, ASTM A276, Type 316.
15. Guide Cables and Brackets: Stainless steel, ASTM A276, Type 316.
16. Oil for all uses: Ecologically safe, paraffin based.
17. Power/control Cable: chloroprene rubber or neoprene.
18. Anchor Bolts: Stainless steel, ASTM A276, Type 316.
19. Cutter: 440 Stainless Steel

A. Each pump shall be designed for the conditions of service tabulated below:

Effluent to River's Edge Pump Station – 2 Pumps

1.	Design Capacity (gpm):	63
2.	Design TDH (ft):	77
3.	Shut Off Head (min) (ft):	110
4.	Solids Capacity (min) (in):	2
5.	Motor Speed (max) (rpm):	3600
6.	Motor Horsepower (max):	5
7.	System Voltage:	460
8.	Minimum Efficiency (%):	30%

2.02 PUMP FABRICATION

A. General:
1. Provide metal-to-metal contact between machined surfaces.
2. Machine and fit mating surfaces with O-rings where watertight sealing is required. Provide sealing by compression of O-rings without specific torque limits.
3. Do not use rectangular cross-sectioned gaskets, elliptical O-rings, grease, or secondary sealing compounds.
4. Any equipment installed in the wet well area shall meet Class 1, Division 1, Group C and D, to comply with the National Electric Code.

B. Impellers:
1. Non-clog or vortex type, capable of passing minimum spherical solid size specified.
2. Balance statically and dynamically.

C. Wear rings:
1. Provide case wear ring on all pumps. Pumps with motor nameplate 15 hp and smaller may be provided with wear ring plate as alternate to case wear ring. Plate shall be adjustable and have outward spiraling groove.

2. Provide impeller wear ring on pumps with motor nameplate 15 hp and larger. Impeller wear rings on pumps with motor nameplate horsepower less than 15 hp is optional.

D. Shaft and shaft sleeve:
1. Provide common pump/motor shaft. Pump shaft shall be extension of motor shaft. Pump shaft and motor shaft with connection coupling is not acceptable.
2. Provide shaft sleeve for carbon steel shafts that would otherwise be directly exposed to pumped fluid. Shaft sleeve is not required for stainless steel shaft.

E. Shaft seals:
1. Provide 2 totally independent mechanical shaft seals, installed in tandem, each with its own independent spring system.
2. Provide one stationary and 1 positively driven rotating seal ring for each seal.
3. Easily inspected and replaced.
4. Shall not require maintenance or adjustment.
5. Shall not depend on direction of rotation for sealing.
6. Shall not rely on pumped media for sealing.
7. At minimum, install upper seal in oil-filled chamber. Provide drain and inspection plug with positive anti-leak seal easily accessible external to pump.

F. Bearings:
1. Provide upper and lower bearings.
2. Single or double row to provide minimum B-10 life of 40,000 hrs at axial and radial loadings while operating at specified operating conditions.
3. Sealed/shielded-non-regreasable or open regreasable type. Provide re-lubrication ports with positive anti-leak plugs external to pump for open regreasable bearings.
4. Switch installed in separate leakage collection chamber to indicate seal leakage prior to penetration of lower bearing may be provided at pump manufacturer's option. Wire switch for connection to control panel. Switch, wiring and associated controls shall be provided at no cost to OWNER.

G. Motor:
1. Manufactures standard UL listed or labeled definite purpose motor.
2. 460-v, 3-ph, 60-Hz.
3. Environment as noted in Schedule 1.
4. Horsepower: As specified in Schedule 1.
5. Housed in air-filled, watertight casing.
6. Moisture resistant, minimum Class F insulation rated for 155ºC.
7. Embed 3 thermal switches in windings, 1 per phase, to provide high temperature shutdown protection. Wire switches in series for connection to control panel.
8. Provide leakage sensor to detect fluid in stator chamber and provide signal for motor shutdown. Wire sensor for connection to control panel.
9. Provide thermal switch and leakage sensor alarm relay panels for each pump supplied.

H. Cooling system:
   1. Provide motor cooling to comply with design and performance requirements and with sufficient surface area for ambient only cooling.

I. Power/control cable:
   1. Size in conformance with National Electric Code (NEC) standards. Provide sufficient length, and supports, to connect to junction box as shown on Electrical Drawings without splicing. Provide watertight cable entry seal to comply with design and performance requirements.

2.03 PUMP REMOVAL SYSTEM

A. Provide guide rail or guide cable system, and discharge base elbow. Provide anchor bolts and accessories for complete system. System shall comply with design and performance requirements and as specified.

B. Guide rail system: Provide 2 guide rails, upper and intermediate guide brackets for connecting rails to structure, and slide bracket for connecting pump to guide rails.

C. Discharge base elbow:
   1. Provide for automatic, leak-tight connection to pump discharge.
   2. ANSI B16.1 Class 125 flange for connection to piping.
   3. Provide for connection of guide rails or guide cables.

D. Anchor bolts: Comply with pump manufacturer's requirements.

2.04 CONTROL EQUIPMENT

A. Pump controls shall be provided by others under Division 13.

B. Constant speed motor starters shall be provided by others in Division 16.

2.05 COATING

A. Manufacturer is responsible for surface preparation, priming, and finish coating of ferrous metal components in plant prior to shipment.

2.06 SPARE PARTS

A. For each pump type furnished, provide one spare set of mechanical seals

PART 3 EXECUTION

3.01 INSTALLATION

A. Construct concrete base as required. Imbed anchor bolts. Set anchor bolts with pump manufacturer's templates.

B. Install all pump baseplates on a concrete pad as detailed in the drawings and anchor with bolts per the manufacturer's requirements. Grout baseplate to pad.

3.02 TESTING AND ADJUSTING

A. Retain the services of a factory-authorized service representative to inspect installation, supervise pre-start-up and final performance tests as specified in Section 01650, Facility Start-up.

B. During the tests, observe head, capacity, motor input, pump vibration, and general performance and fitness. Repair or replace defective equipment and repeat tests until satisfactory results are achieved.

C. Adjust or replace equipment to achieve indicated performance.

D. After 3 months of facility operation, a factory-authorized service representative shall return to check and readjust, if necessary, the pump alignments at no additional cost to the Owner.

3.03 DEMONSTRATION

A. Provide the services of a factory-authorized service representative for training of Owner's maintenance personnel in proper operation, servicing, and maintenance of equipment. Allow 4 hours for training. Conduct training separate from, and after the start-up tests.

END OF SECTION

SECTION 15060
PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide pipe hangers and supports as required by the Contract Documents.
   1. In general provide all hanging and supporting devices for hanging or supporting piping systems throughout the Work.
   2. The contractor shall be responsible for providing all piping supports required to conform with the requirements of this Section whether or not indicated on the drawings.
      a. Additional supports may be required to be provided by the contractor to restrain pipe movement noted during systems operations.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 1 of these Specifications.
   1. Section 15100 Ductile Iron Pipe, Fittings and Appurtenances

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Hangers and supports shall be of an approved standard design capable of supporting the load under all operating conditions.
   1. All hangers, supports, and appurtenance shall conform to the latest applicable requirements of ANSI 31.1.0.
   2. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10-foot of waterfilled pipe being supported.

C. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.
   1. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit certification stating that such requirements have been complied with.

D. Codes and Regulations:
   1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
   2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement shall govern.

E. The Contractor shall submit drawings and calculations stamped by a structural engineer registered in the State of Massachusetts detailing piping supports for all long runs of

piping that are not supported from the floor, and are not specifically called out in the support/spacing schedules included herein.

F. Coordinate the work of this Section with the work of other Sections.

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. Product Data:
1. Materials list of items proposed to be provided under this Section.
2. Manufacturer’s specifications and other data needed to prove compliance with the specified requirements.
3. Shop drawings and other data as required to indicate method of installing the pipe hangers and supports, except where such details are fully shown on the Drawings.

1.05 PRODUCT HANDLING

A. Handle in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. All of the equipment specified herein is intended to support the various types of pipe and piping systems.
1. The details shown on the drawings are intended to indicate the generally desired methods of support under normal conditions.
2. It shall be the responsibility of the Contractor to develop final details and any details associated with special conditions not already covered to meet the system conditions specified in the piping specifications.

B. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances and to support and secure the pipe in the intended position and alignment.
1. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe and personnel contact.
2. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05500 and shall be furnished and installed under this section.

C. Hangers and supports shall be spaced in accordance with ANSI B31.1 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified herein.

D. Where flexible couplings are required at equipment, tanks, etc. the opposite to the piece of equipment, tank, etc. shall be rigidly supported.

E. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping system.

F. All rods, clamps, hangers, inserts, anchor bolts, brackets, and components for interior pipe supports shall be furnished with galvanized finish, hot dipped or electro-galvanized coated, except where field welding is required.
   1. Interior clamps on plastic pipe shall be plastic coated.
   2. Supports for copper pipe shall be copper plated or shall have a 1/16-inch plastic coating.
   3. All rods, clamps, hangers, inserts, anchor bolts, brackets, and components for exterior pipe, submerged pipe and pipe within outdoor structures shall be Type 316 Stainless Steel.

G. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated load between supports.

H. All uninsulated non-metallic piping shall be protected from local stress concentration at each support point.
   1. Protection shall be provided by galvanized steel protection shields or other method as approved by the Engineer.
   2. Where pipes are bottom supported, 180 degrees arc shields shall be furnished.
   3. Where 360 degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference.
   4. Protection shields shall have an 18 gauge minimum thickness, not be less than 12-inch in length and be securely fastened to pipe with stainless steel or galvanized metal straps not less than ½-inch wide.

I. All insulated pipe shall be furnished with a rigid foam insulating saddle at each pipe support location.
   1. Provide galvanized protection shields as specified above at each location.

J. Where pipe hangers and supports come in contact with copper piping, provide protection from galvanic corrosion by; wrapping pipe with 1/16-inch thick neoprene sheet material and galvanized protection shield; isolators similar to ELCEN figure No. 228; or copper plated or PVC coated hangers and supports.

K. Pipe supports shall be provided as follows:
   1. Support spacing for steel and stainless steel piping two inch and smaller in diameter and copper tubing shall not exceed five feet.
   2. Supports for multiple PVC plastic piping shall be continuous wherever possible.
      a. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed three feet.
      b. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as the Electray Ladder by Husky/Burndy, the Globetray by the Metal Products Division of United States Gypsum, or approved equal.
         1) Ladder shall be of mild steel construction.
         2) Rung spacing shall be 12-inch.
         3) Tray width shall be approximately 6-inch for single rungs and 12-inch for double runs.
         4) Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc. required for a complete support system.
         5) Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners equal to Globe Model M-CAC; Husky/Burndy Model SCR; or approved equal.

6) Spacing between clamps shall not exceed 9-feet.
7) The cable trays shall provide continuous support along the length of the pipe.
8) Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

3. Pipe supports shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
4. Supports shall be provided at changes in direction and elsewhere as shown in the drawings or specified herein.
   a. No piping shall be supported from other piping unless specifically directed or authorized by the Engineer.
5. Pipe supports shall be provided to minimize lateral forces through valves, both sides of a split type couplings, and sleeve type couplings, and to minimize all pipe forces on pump housings.
   a. Pump housings shall not be utilized to support connecting pipes.
6. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.

L. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by Grinnell Co. Providence R.I.; Carpenter and Patterson, Inc Woburn MA; F & S Central Brooklyn NY; Elcen Metal Products Co. Franklin Park IL; Unistrut Northeast Cambridge MA; or approved equal.
1. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary in this specification.
2. Any item comparable in type, style, quality, design, and performance, shall be considered as equal.

M. Any required pipe supports for which the supports specified in this section are not applicable shall be fabricated or constructed from standard structural steel shapes, concrete, and anchor hardware similar to items previously specified herein and shall be subject to the approval of the Engineer.

N. Anchor bolts shall be equal to Kwik-Bolt as manufactured by the McCullock Industries Minneapolis MN; Wej-It manufactured by Wej-It Expansion Products Bloomfield CO; or approved equal.
1. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-inch behind the steel reinforcement.

2.02 SINGLE AND MULTIPLE PIPE SUPPORTS

A. Single pipes located in a horizontal plane close to the floor shall be supported by one of the methods specified herein or as shown on the drawings.

B. Pipes 3-inch in diameter and larger shall be supported by adjustable stanchions similar to F&S Figure 427, constructed of galvanized steel.
   1. Stanchions shall provide at least 4-inch adjustment and be flange mounted to floor.

C. Pipes less than 3-inch in diameter shall be held in positions by supports fabricated from steel C channel, welded post base similar to Unistrut figure P2072A and pipe clamps similar to Unistrut figure P1109 through P1126.
   1. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by horizontal member of sufficient load capacity to support pipe.
   2. Wherever possible, supports shall be fastened to nearby walls or other structural members to provide horizontal rigidity.
   3. More than one pipe may be supported from a common fabricated support.
   4. All supports unless specified otherwise shall be galvanized.

C. Where shown on the drawings, pipe shall be supported using concrete anchor posts.
   1. Pipe shall be securely fastened to concrete anchor posts using suitable metal straps as required and approved by the Engineer.

2.03 WALL SUPPORTED PIPES

A. Single or multiple pipes located adjacent to walls, columns or other structural members, whenever deemed necessary, shall be supported using welded steel wall brackets similar to Carpenter and Patterson Figures 69-78, 84, or 134; or C channel with steel brackets similar to Unistrut pipe clamps.
   1. All members shall be securely fastened to wall, column, etc. using double expansion shield or other method as approved by the Engineer.
   2. Additional wall bearing plates shall be provided where required.

B. Pipe shall be attached to supports using methods hereinbefore specified to meet the intent of this specification.

C. All supports shall be galvanized.

2.04 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut system as specified above, they shall be supported in one of the following methods.
   1. For pipes 1/4-inch to 2-inch in diameter, an extension hanger ring shall be provided with an extensions rod and hangers flange.
      a. The rod diameter shall be as recommended by the manufacturer for the type of pipe supported.
      b. The hanger ring shall be galvanized steel or PVC clad depending on the supported pipe.
      c. The hanger ring shall be equal to Carpenter & Patterson Figure 81 or 81 ct.
      d. The anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson 85.

2. For pipes equal to or greater than ½-inch in diameter extended pipe clamps similar to Carpenter and Patterson figure 26 may be used.
    a. The hanger shall be attached to concrete structures using double expansion shields, or to steel support members using welding lugs similar to Carpenter and Patterson figure 220.
3. Pipe riser clamps shall be used to support all vertical pipes extending through floor slabs.
    1. Riser clamps shall be galvanized steel similar to Carpenter and Patterson figure 126.
    2. Copper clad or PVC coated clamps shall be used on copper pipes.
    3. Insulation shall be removed from insulated pipes prior to installing riser clamps.
4. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding twelve (12) feet shall be supported by approved pipe collars, clamps, brackets or wall rests at all points required insure a rigid installation.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.

B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.

C. Finished iron or steel surfaces not galvanized or painted shall be properly protected to prevent rust and corrosion.

3.02 INSTALLATION

A. All pipes, horizontal and vertical, requiring rigid support shall be supported from the building structure by approved methods.
    1. Supports shall be provided at changes in direction and elsewhere as shown in the drawings and specified herein.
    2. No piping shall be supported from metal stairs, ladders and walkways unless specifically directed or authorized by the Engineer.

B. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement, and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces.
    1. Prior to installation, all pipe supports shall be approved by the Engineer.

C. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings.
    1. Pump housing shall not be utilized to support connecting pipes.

D. Inserts for pipe hangers and supports shall be installed on forms before concrete is placed.

1. Before setting these items, all drawings and figures shall be checked which have a direct bearing on the pipe location.
2. Responsibility for the proper location of pipe supports is included under this section.

E. Continuous metal inserts shall be embedded flush with the concrete surface.

3.03 TESTING

A. All pipe support systems shall be tested for compliance with the specifications.
1. After installation, each pipe support system shall be tested in conjunction with the respective piping pressure tests.
2. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired or augmented under this section to the satisfaction of the Engineer.

END OF SECTION

SECTION 15100
DUCTILE IRON PIPE, FITTINGS AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide all the interior ductile iron pipe, fittings and appurtenances as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   2. Section 15060 Pipe Hangers and Supports
   3. Section 15110 Valves and Appurtenances
   4. Section 15120 Piping Specialties

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All ductile iron pipe and fittings shall be of domestic manufacture.

C. Coordinate the work of this Section with the work of other related Sections.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Shop Drawings showing piping layouts, dimensions, location of supports and braces, and interfacing with piping and equipment furnished under other Sections of this Specification.

1.05 PRODUCT HANDLING

A. Comply with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 PIPE

A. Interior Use:
1. Have dimensional wall thickness in accordance with ANSI/AWWA C115/A21.15.
2. Pipe shall be ductile iron, Class 53, with a maximum working pressure of 250 psi.
3. Cement lined meeting the requirements of ANSI/AWWA C104/A21.4.
4. Thickness of cement lining:
   a. 1/8-inch for pipes 12-inches and smaller.
   b. 3/16-inch for pipe 14-inches and larger.
5. Exterior Coating
   a. All exposed piping not within tanks containing water shall be red primer.
   b. All exposed piping and fittings within tanks containing water whether submerged or not, shall be pre-finished at the factory before shipment.
      1) Exterior coating shall be a high solids, solvent free, epoxy incorporating ceramic pigment and amine cured epoxy formulated especially to coat the exterior of ductile iron pipe for aggressive atmospheres or liquids, applied at 20-25 mils.
      2) Coating shall be NSF 61 approved.
      3) Coating shall be Ceramawrap as manufactured by Induron Protective Coatings, or approved equal.
6. At the Contractor's option, exposed piping within tanks containing potable water may be furnished without cement lining, and coated inside and out with an NSF-approved fusion bonded epoxy, Skotchkote 134 or approved equal.

B. Pipe Flanges: Conform to ANSI/AWWA C115/A21.15.
1. Faced and drilled to American 125 Standard,
2. Long hubs.

2.02 FITTINGS

A. Interior Use:
1. Manufactured of ductile iron or gray iron, flanged joint design rated for 250 psi,
2. Meet or exceed the requirements of ANSI/AWWA C110/A21.10,
3. Tapping bosses on both sides of each branch and in the center of the fitting on both sides,
4. Interior and exterior coatings shall be as specified in paragraph 2.01,
5. Base bends and tees shall have machined and drilled bases.

2.03 GASKETS

A. Made from vulcanized styrene butadiene (SBR) rubber:
1. Shall meet ANSI/AWWA C111/A21.11,
2. Reclaimed rubber shall not be used.
3. Thickness: 1/8-inch.

2.04 FASTENERS

A. Bolts and Studs:
1. Shall conform to ASTM A307, Grade B.

B. Nuts:
   1. Shall conform to ASTM A563, Grade A, heavy hex.

2.05 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements to assure precise fit of the piping system.

3.03 COORDINATION

A. Coordinate the work of this Section with equipment suppliers to insure all dimensions and elevations are compatible.

3.04 INSTALLATION

A Interior Ductile Iron Pipe, Fittings and Appurtenances:
   1. During handling protect pipe and fittings from damage.
   2. Pipe and fittings cleaned out before assembly,
   3. Installed in accordance with the approved piping layout,
   4. Installed true to alignment and rigidly supported,
   5. Pipe, fittings and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain or loading being imposed upon the equipment.

B. All flange-mounted in-line instrumentation (i.e.: flow meters) shall be installed in a manner that will allow for removal/servicing. Unless specifically called out on the drawings, the Contractor my opt for either of the following jointing methods::
   1. Utilize a plain-end section of pipe with adaptor flange connected to the instrumentation device.
   2. Utilize a flexible sleeve and tie rods where flanges for connection of tie rod ends are no more than 3 feet apart.

C. Tapped Connections
   1. Tapped connections in pipe and fittings shall be made in such manner as to provide a watertight joint and adequate strength against pullout.
   2. All drilling and tapping of ductile iron pipe shall be done normal to the longitudinal axis of the pipe; fittings shall be drilled and tapped similarly, as appropriate.
   3. Drilling and tapping shall be done only by skilled mechanics.
   4. Tools shall be adapted to the work and in good condition so as to produce good, clean cut threads of the correct size, pitch, and taper.

3.05 TESTING

A. Pressure Piping Systems:
   1. Provide material and bracing required to isolate the piping system from equipment during the test.
   2. Test at a hydrostatic pressure of 150 psi for one (1) hour.
   3. Leaks shall be repaired under this Section and the test repeated.

END OF SECTION

SECTION 15110
VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide valves and appurtenances as required by the Contract Documents.

B. The items of this Section include but are not necessarily limited to:
   1. Gate Valves
   2. Check Valves
   3. Ball Valves
   4. Air and Combination Air/Vacuum Valves

C. Work Not Included:
1. Direct burial valves which are specified in Section 02640, Valves and Appurtenances.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 15100 Ductile Iron Pipe, Fittings and Appurtenances

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All of the types of valves and appurtenances shall be products of established firms who are experienced in the manufacture of the particular item to be furnished.
   1. All valves and their appurtenances shall be of domestic manufacture

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. Product Data:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer’s specifications catalog cuts, and other data needed to prove compliance with the specified requirements.

1.05 PRODUCT HANDLING

A. Handle in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General:
1. All valves and appurtenances shall be of the size shown on the Drawings and as far as possible all equipment of the same type shall be from one manufacturer.
2. All valves and appurtenances shall have the name of the manufacturer, flow directional arrows and the working pressure for which they are designed, cast in raised letters upon some appropriate part of the valve body.
3. All valves shall open counter clockwise. Operators shall have arrows cast thereon to indicate direction of rotation to operate the valve.
4. All iron valves shall have:
   a. An exterior coating of red oxide primer FDA approved for potable water use.
   b. An interior coating of an NSF/ANSI 61 certified fusion bonded epoxy.
      1) The interior of valves with seats that are bonded to the valve body, with the exception of disc edge, rubber seat and finished portions, shall be evenly coated with an NSF61 approved 2-part liquid epoxy. Minimum dry film thickness shall be 8 Mils minimum.
   c. All submerged valves shall have all wetted interior and exterior iron surfaces coated with an NSF 61 epoxy coating as specified above.

2.02 GATE VALVES

A. Less than Three (3) Inches:
1. Solid wedge,
2. Non-rising stem,
3. Union bonnet,
4. Bronze construction,
5. WOG rating: 300 psi.

B. Three (3) Inches and Larger (Resilient Seated):
1. Comply with ANSI/AWWA C515.
2. Flanges conform to ANSI B16.1, Class 125 cast iron flange.
3. Ductile iron body in compliance with ASTM A126, Class B.
4. Ductile iron waterway surfaces shall be epoxy coated at the factory.
   a. Coating shall be non-toxic, impart no taste to water and shall conform to AWWA C-550.
5. Bronze stem,
6. Resilient sealed wedge type:
   a. Wedge: Fully encapsulated; no exposed iron,
7. Triple O-ring seal stuffing box,
8. Non rising stem,
9. Handwheel operator.
10. Rated for 250 psi and tested to 500 psi,

C. Three (3) Inches and Smaller (Stainless Piping):
1. Solid wedge,
2. Non-rising stem,

3. Union bonnet,
4. 316L Stainless Steel construction,
5. WOG rating: 300 psi.

2.03 CHECK VALVES/FOOT VALVES

A. Check Valves (Silent Check)/Foot Valves:
1. Body: Cast iron with flanged ends conforming to ANSI Class 125.
2. Seat: Bronze,
3. Plug: Bronze,
4. Bushing Bronze,
5. Spring: Stainless Steel,
6. Globe style,
7. Drip tight seating at 150 psi.
8. Foot valve strainer shall be T302 stainless steel.

B. Swing Check Valves:
1. Conforming to AWWA C508
2. Body: Cast iron with flanged ends conforming to ANSI Class 125,
3. Seat: Bronze,
4. Disk: Resilient seat with cast iron holder and bronze plate,
5. Hinge pin Stainless steel,
6. Bearings Bronze,
7. Lever (None) (Lever and weight) (Lever and spring) (left (right)-side mounted),
8. Full port opening,
9. All working parts to be accessible from top.

C. Rubber Flapper Check Valves:
1. Body: Cast iron (ASTM A126) or ductile iron (ASTM A536) with flanged ends conforming to ANSI Class 125,
2. Seat: "O" ring, steel reinforced internally,
3. Flapper: Buna-N (70 Durometer) fully encapsulating the steel plate (ASTM A36),
4. 45-degree seating surface.
5. Full pipe size flow area requiring only 35-degree flapper travel.
6. All working parts to be accessible from top.
7. Bubble-tight shutoff at low pressures.

D. Check Valves (2 Inch and Smaller):
1. Bronze construction,
2. Disc. seat: Teflon,
3. "Y" pattern,
4. Horizontal swing,
5. WOG rating: 200 psi.

E. Check Valves (PVC/CPVC Piping):
1. Ball Type:
a. Type 1, Grade 1 PVC (cell classification 12454-B) or Type IV, Grade 1 CPVC (cell classification 23447-B), conforming to ASTM D1784.
b. True union with EPDM "O" rings.
c. Socket or flanged ends as required.
d. Rated for 150 psi working pressure at 75 degrees F.

2. Swing Check Type:
   a. Heavy-duty PVC/CPVC construction.
   b. EPDM seals.
   c. Dual drain plugs.
   d. Built-in O-ring flange seals
   e. Furnish PVC counterweight
3. Wafer-Style Swing Check Type:
   a. Heavy-duty PVC/CPVC construction.
   b. EPDM gasket and face seals.
   c. One-piece disc and shaft design.
   d. Contoured inlet port
   e. 316 stainless steel Spring
   e. Pressure Rated to 150PSI at 70F

2.04 BALL VALVES

A. Ball Valves (2-inches and Smaller):
   1. Metallic Piping (does not include stainless steel):
      a. Two piece bronze body,
      b. WOG pressure rating: 600 psi,
      c. Teflon seats and seals,
      d. Full port design,
      e. Adjustable packing gland,
      f. Screwed or soldered ends.
   2. Stainless Piping:
      a. All 316L stainless steel construction,
      b. Teflon seats, packing and “O” rings,
      c. Swing-out design,
      d. Full port design,
      e. Joint: As required,
      f. Locking stainless steel handle.

B. Plastic Piping:
   1. PVC Type 1, Grade 1, or CPVC Type IV, Grade 1.
   2. Comply with ASTM D1784
   3. Double entry true union with EPDM “O” rings.
   4. Teflon seats and EPDM packing.
   5. Socket or flanged ends, as required.
   6. Working pressure 150 psi at 75 degrees F.

2.05 AIR AND COMBINATION AIR/VACUUM RELIEF VALVES

A. The relief valves shall be shall be the equal of APCO Valve and Primer Corporation models indicated below for the various usages.

B. Air Release Valves (Model #50):
   1. Size: ½-inch
   2. Body: Cast iron
   3. Stem: Stainless Steel
   4. Float: Stainless Steel
   5. Seat: Buna-N

C. Combination Air and Vacuum Valves:

1.	Size:	To accommodate turbine pump capacity:
2.	Body:	Cast iron
3.	Baffle:	Delrin
4.	Float:	Stainless Steel
5.	Seat:	Buna-N
6.	Diffuser	Brass

D. Provide double acting throttling device on combination air and vacuum valves installed on vertical turbine pumps, which allows throttling of air out of the valve, full air flow back in to prevent vacuum and water column separation in the pump.

1.	Housing:	Malleable iron
2.	Adj. screw and nut	Stainless steel
3.	Spring	Stainless steel
4.	Plug	Teflon

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION

A. Coordinate the work of this Section with equipment suppliers, that the piping system shall be connected to, to insure that all dimensions and elevations are compatible.

B. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.03 VALVE INSTALLATION

A. The valves and appurtenances shall be installed at the locations shown on the Drawings.
   1. Valve operators shall be easily accessible and rigidly supported.
   2. After installation check valve operation. Valve shall operate smoothly through its entire operating range.
   3. Valve tags shall be installed on all valves with designations specifically labeled on the on the process or instrumentation drawings.

B. Swing and flapper-type check valves shall be installed horizontally, or vertically if direction of normal flow is upwards.

C. Air release valve assemblies shall be equipped with a line size ball valve for isolation.
   1. A copper drain line shall extend from the top of all air release valves to within 2 inches above a floor drain or drain channel.
   2. A ½-inch air release valve shall be installed on all high points of the process piping system where air can accumulate, whether or not indicated on the drawings, and as approved or directed by the Engineer. Air release valves are not required where other provisions for releasing air are indicated on the drawings.

D. Solenoid valves shall be installed with unions on both sides of the valve to facilitate removal.
   1. A line size ball valve shall be installed upstream of the union if necessary to facilitate solenoid valve removal without affecting water feed to branches off the common feed line.

END OF SECTION

SECTION 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide expansion joints, wall pipes, wall sleeves, filler rings, flexible mechanical pipe couplings, cam and groove couplings, and tapped connections for the piping systems all as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 15060 Ductile Iron Pipe, Fittings and Appurtenances

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Coordinate the work of this Section with the work of other Sections.

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. Product Data:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.05 PRODUCT HANDLING

A. Handle in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 EXPANSION JOINTS

A. Expansion joints shall be Redflex Type J-1 as manufactured by Red Valve Co. Inc., Carnegie, PA. The expansion joint shall have the following attributes:
   1. Redflex Model:

a. Type J-1 for “straight thru” joints.
b. Type J-10 for concentric reducers
c. Type J-11 for eccentric reducers

2. Size as shown on the Drawings,
3. Materials of construction: Buna-N,
4. Single “filled” arch, open configuration,
5. Flanges shall be 125 lb. conforming to ANSI Standards:
   a. Constructed integral with body.
6. Pressure rating: 140 lb standard, 190 lb high,
7. Retaining rings.

B. Control Units:
1. Gusset plate thickness: 1/2-inch,
2. Rod diameter: 5/8-inch,
3. Number of rods: 3,
4. Materials: Galvanized steel.

2.02 WALL PIPES

A. Ductile iron wall pipes shall have an integrally cast thrust collar as manufactured by American Cast Iron Pipe Co.
1. Wall pipe shall be used where indicated on the drawings, and shall conform to ANSI/AWWA C110/A21.10.
2. Ends of wall pipes shall be flanged or flange by mechanical joint. Flanges shall be of same class as that of pipe being connected.
3. The wall pipes shall be of the dimensions required with ends flush with both faces of the wall or as shown on the Drawings.
4. Ductile iron wall pipes shall be of approved type, dimension and wall thickness.
5. Ductile iron wall pipes shall be provided for all pipes passing through reinforced concrete walls.

B. At the Contractor’s option, if approved by the Engineer, wall sleeves for concrete floor and wall penetrations may be made by means of a sleeve capable of being bolted directly to the formwork to prevent misalignment.
1. Seal of the annular space between the carrier pipe and the sleeve shall be by means of a confined rubber gasket and capable of withstanding 350 psi.
2. Manufactured from Ductile Iron with an integrally cast waterstop of ½” minimum thickness and 2 ½” minimum height.
3. Shall be “Omni Sleeve” or an approved equal

2.03 WALL SLEEVES

A. The annular space created by the wall sleeve and the pipe shall be positively sealed with “Link Seal” manufactured by GPT Industries or an approved equal.
1. Seals shall be the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
2. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut.

a. After the seal assembles positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall opening.

3. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these two members.
4. All wall sleeves of which any portion is below main floor slab and penetrates an exterior wall, or where the wall sleeve penetrates a wall between a tank and an interior room shall have link seals on both the interior and exterior faces of the wall. All wall sleeves above this elevation shall have link seals on the interior wall only.
5. The Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing the seals.
   a. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a water-tight joint.
6. The Contractor shall familiarize himself with the installation of the seals through the manufacturer's instruction bulletin which illustrates the proper procedure for installing and tightening the seal to provide a water-tight pipe penetration.

2.04 FLEXIBLE MECHANICAL PIPE COUPLINGS

A. Flexible mechanical cast iron pipe couplings for jointing of plain ends of ductile iron pipe shall be suitable for a 200 psi water working pressure and shall be of the proper size and suitable for use on the piping on which it is installed.
   1. Couplings shall be of ductile iron construction and shall be provided with middle ring not less than 12-inches in length.
   2. Tee head alloy steel bolts with heavy hex nuts, molded rubber gaskets, follower rings and accessories as required for the complete installation.
   3. Where indicated, the coupling shall be provided with not less than two tie rods extended from flange connections on each side of the couplings.
   4. Follower rings shall be amply proportioned to take, without deformation, the strains imposed on the coupling by the installation.

2.05 FLANGE ADAPTERS

A. Ductile iron flange adapters as manufactured by Uni-Flange shall be provided where indicated on the drawings to allow for equipment removal, or approved by the Engineer for use in joining flanged piping with slight misalignment.
   1. Flange: Ductile iron, ASTM A536, Grade 65-45-12, drilled to ANSI B16.1 or ANSI B16.2.
   2. Gasket: SBR Buna-N
   3. Set Screw: AISI 4140 steel with break-away head

2.06 FILLER RINGS

A. Filler rings of the same materials, facing and drilling as the flanges they are used with shall be provided in flanged piping where necessary and approved for the proper fitting and layout of the piping.

2.07 CAM AND GROOVE FITTINGS

A. Cam and groove adapters for the chemical storage tanks fill lines shall be:
   1. Size: 2 inch.
   2. Material: Polypropylene.
   3. Style: Male adapter by male NPT.
   4. Interchange with all products produced to MIL-C-27487E.

B. Cam and groove dust cap shall:
   1. Size: 2 inch.
   2. Material: Polypropylene.
   3. Handles: Locking.
   4. Security chain: 12 inches long; stainless steel.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Expansion Joint: The expansion joints and appurtenances shall be installed at the locations shown on the Drawings.
   1. Misalignment of piping shall not exceed 1/8-inch.
   2. Install control unit per manufacturer’s requirements.

B. Wall Pipes
   1. The Contractor shall be responsible for having wall pipes readily available.
   2. Shall be tightly secured in the formwork at time of concrete placement.
   3. Thrust collars shall be located in the center of the wall in which the wall pipe is to be installed.

C. Wall Sleeves
   1. Securely anchor to formwork as required by the manufacturer.

END OF SECTION

EXHIBIT B

SELLER'S CONSTRUCTION SCHEDULE

Estimated Project Schedule
River's Edge Sewer Connection
Wayland, MA

Task	Deadline	Notes
Client Design Meeting	1/6/2021	
Submit 50% Design Package to Town	1/25/2021	50% Design to include plans, select specifications sections, and 50% cost estimate
Submit 90% Design Package to Town	2/23/2021	90% Design to include plans, all specifications, and 90% cost estimate
90% Comments back from Town	3/1/2021	
Plans and Specifications Available to Bidders	3/10/2021	Assume 2 week turn around time from 90% submittal to Town to incorporate edits and finalize.
Bid Opening	3/24/2021	2 week bid period

EXHIBIT C

FORM OF ENGINEER/ARCHITECT CONSENT

Engineer/Architect Consent

ARCHITECT'S/ENGINEER'S CONSENT, CERTIFICATE AND AGREEMENT

(LETTERHEAD OF ARCHITECTURAL/ENGINEERING FIRM)

_____, 2021

ALTA RIVER'S EDGE, LLC
c/o WP East Acquisitions, LLC
91 Hartwell Avenue
Lexington, Massachusetts 02421
Attention: Jim Lambert
Phone No.: (781) 541-5822
Email: Jim.Lambert@woodpartners.com

Re: Infrastructure Development Agreement ("**Agreement**") dated _____ by and among TOWN OF WAYLAND, acting by and through its Board of Selectmen (hereinafter "Seller"), a Massachusetts municipal corporation having an address of 41 Cochituate Road, Wayland, MA 01778, and ALTA RIVER'S EDGE, LLC, a Delaware limited liability company having its business address c/o Wood Partners, 91 Hartwell Avenue, Lexington, MA 02421, Attn: Jim Lambert (hereinafter "Buyer") for the completion of the Seller's WWTP Work (as defined in the Agreement, and also referred to herein as the "Project"), and [describe contract/agreement] dated ___, 202__ between Seller and [contractor] ("Contractor" or "we") regarding the Project (together with any assignments and amendments thereof, the "Contract") attached as **Exhibit "A"** hereto.

Ladies and Gentlemen:

We understand that the Contract and the plans and specifications for the Project (as may be amended from time to time and including all drawings and related papers, the "Plans") have been or will be collaterally assigned by Seller to Buyer in connection with the Agreement. In consideration of the Agreement and as an inducement thereto, we hereby (a) consent to such assignment and (b) agree that in the event (i) of a default by Seller under the terms of any of the Agreement or the Contract or any other circumstances thereunder whereby which it is reasonably likely that Seller will be in default under the terms of any of the Agreement or the Contract or (ii) we receive a copy of Buyer's Takeover Notice (as defined in the Agreement), (l) we shall, at Buyer's request, provide to Buyer the services as required of us under the Contract, provided that we are compensated as provided in the Contract for all such services rendered at Buyer's request, and (2) whether or not you request our continued services under the Contract, you shall be entitled to use the Plans in accordance with and as provided in the Contract in connection with the Project, without payment of additional fees or charges to us (provided that if we are due any amounts under the Contract for any services rendered in connection with changes to the initial Plans ("Plan Changes"), you shall not be entitled to use the Plan Changes until we are compensated therefor.

As the architectural or engineering firm responsible for performing the work regarding the Project described in the Contract, the undersigned is duly licensed and in good standing under the laws of the State in which the Project is located.

If Seller defaults in payment or performance of the Contract or if the Contract is terminated for any reason, the undersigned will give Buyer prompt written notice thereof and prior to exercising any remedy as a result thereof, will afford Buyer the same opportunity to cure such default to which Seller is entitled, but at least thirty (30) days in any event (it being acknowledged that Buyer shall have no obligation to cure any such default). Any notice of default or termination will be delivered by personal delivery, by nationally recognized overnight courier service or by certified mail, return receipt requested, to the address set forth above, and be effective upon receipt or when the attempted initial delivery is refused or cannot be made because of a change of address of which the sending party has not been notified. Any curative act done by Buyer shall be as effective as if done by Seller.

This letter shall bind and benefit Buyer and the undersigned and their respective heirs, successors and assigns, and shall be governed by the laws of the state where the Land is located. "Buyer" as used in this letter includes Buyer's successors or assigns, any receiver in possession of the Buyer's Property, any purchaser upon foreclosure of Buyer's Property, or any corporation or other nominee formed by or on Buyer's behalf. Time is of the essence of this letter agreement.

Sincerely,

[ARCHITECT'S/ENGINEERS SIGNATURE BLOCK]

By: _____
Name: _____
Title: _____

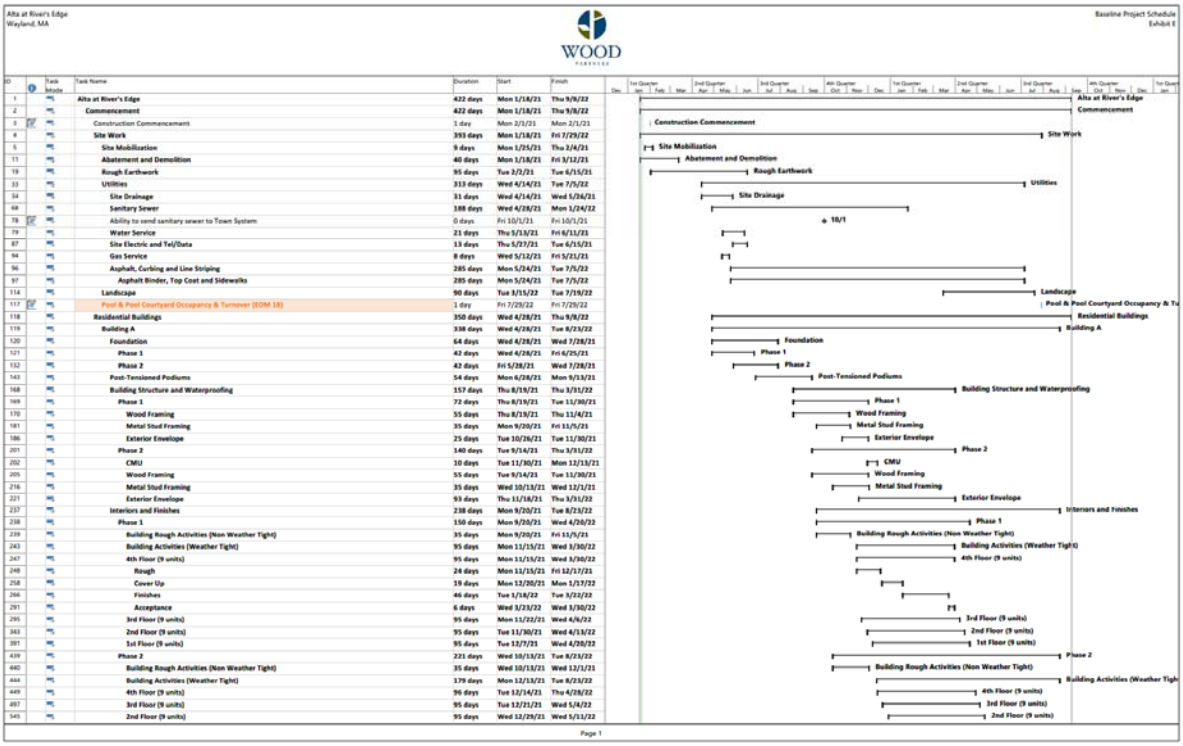
Exhibit “A”

CONTRACT

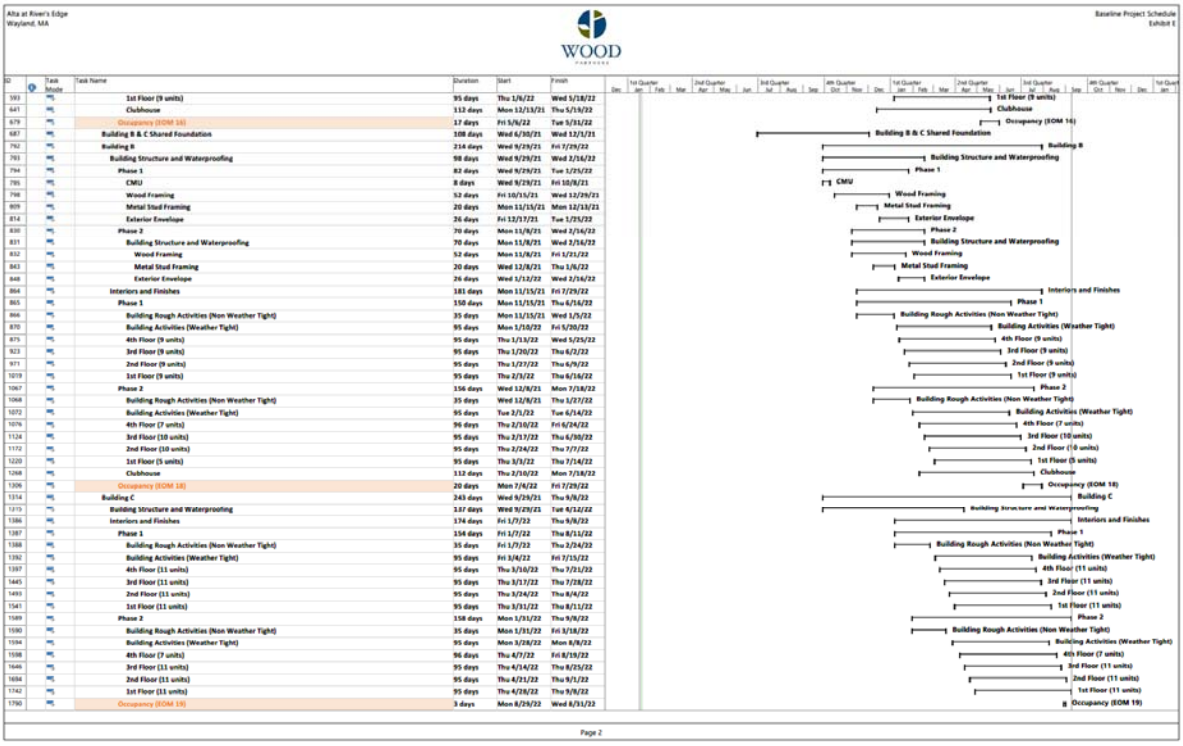
(Attach Contract, including assignments, amendments and supplements)

EXHIBIT D

BUYER'S CONSTRUCTION SCHEDULE



ID	Task Mode	Task Name	Duration	Start	Finish
1		Alta at River's Edge	422 days	Mon 1/18/21	Thu 9/8/22
2		Commencement	422 days	Mon 1/18/21	Thu 9/8/22
3		Construction Commencement	1 day	Mon 2/1/21	Mon 2/1/21
4		Site Work	393 days	Mon 1/18/21	Fri 7/29/22
5		Site Mobilization	9 days	Mon 1/25/21	Thu 2/4/21
11		Abatement and Demolition	40 days	Mon 1/18/21	Fri 3/12/21
19		Rough Earthwork	95 days	Tue 3/2/21	Tue 6/15/21
33		Utilities	313 days	Wed 4/14/21	Tue 7/5/22
34		Site Drainage	31 days	Wed 4/14/21	Wed 5/26/21
68		Sanitary Sewer	188 days	Wed 4/28/21	Mon 1/24/22
78		Ability to send sanitary sewer to Town System	0 days	Fri 10/1/21	Fri 10/1/21
79		Water Service	21 days	Thu 5/13/21	Fri 6/11/21
87		Site Electric and Tel/Data	13 days	Thu 5/27/21	Tue 6/15/21
94		Gas Service	8 days	Wed 5/12/21	Fri 5/21/21
96		Asphalt, Curbing and Line Striping	285 days	Mon 5/24/21	Tue 7/5/22
97		Asphalt Binder, Top Coat and Sidewalks	285 days	Mon 5/24/21	Tue 7/5/22
114		Landscape	90 days	Tue 3/15/22	Tue 7/19/22
117		Pool & Pool Courtyard Occupancy & Turnover (EOM 18)	1 day	Fri 7/29/22	Fri 7/29/22
118		Residential Buildings	350 days	Wed 4/28/21	Thu 9/8/22
119		Building A	338 days	Wed 4/28/21	Tue 8/23/22
120		Foundation	64 days	Wed 4/28/21	Wed 7/28/21
121		Phase 1	42 days	Wed 4/28/21	Fri 6/25/21
132		Phase 2	42 days	Fri 5/28/21	Wed 7/28/21
143		Post-Tensioned Podiums	54 days	Mon 6/28/21	Mon 9/13/21
168		Building Structure and Waterproofing	157 days	Thu 8/19/21	Thu 3/31/22
169		Phase 1	72 days	Thu 8/19/21	Tue 11/30/21
170		Wood Framing	55 days	Thu 8/19/21	Thu 11/4/21
181		Metal Stud Framing	35 days	Mon 9/20/21	Fri 11/5/21
186		Exterior Envelope	25 days	Tue 10/26/21	Tue 11/30/21
201		Phase 2	140 days	Tue 9/14/21	Thu 3/31/22
202		CMU	10 days	Tue 11/30/21	Mon 12/13/21
205		Wood Framing	55 days	Tue 9/14/21	Tue 11/30/21
216		Metal Stud Framing	35 days	Wed 10/13/21	Wed 12/1/21
221		Exterior Envelope	93 days	Thu 11/18/21	Thu 3/31/22
237		Interiors and Finishes	238 days	Mon 9/20/21	Tue 8/23/22
238		Phase 1	150 days	Mon 9/20/21	Wed 4/20/22
239		Building Rough Activities (Non Weather Tight)	35 days	Mon 9/20/21	Fri 11/5/21
243		Building Activities (Weather Tight)	95 days	Mon 11/15/21	Wed 3/30/22
247		4th Floor (9 units)	95 days	Mon 11/15/21	Wed 3/30/22
248		Rough	24 days	Mon 11/15/21	Fri 12/17/21
258		Cover Up	19 days	Mon 12/20/21	Mon 1/17/22
266		Finishes	46 days	Tue 1/18/22	Tue 3/22/22
291		Acceptance	6 days	Wed 3/23/22	Wed 3/30/22
295		3rd Floor (9 units)	95 days	Mon 11/22/21	Wed 4/6/22
343		2nd Floor (9 units)	95 days	Tue 11/30/21	Wed 4/13/22
391		1st Floor (9 units)	95 days	Tue 12/7/21	Wed 4/20/22
439		Phase 2	221 days	Wed 10/13/21	Tue 8/23/22
440		Building Rough Activities (Non Weather Tight)	35 days	Wed 10/13/21	Wed 12/1/21
444		Building Activities (Weather Tight)	179 days	Mon 12/13/21	Tue 8/23/22
449		4th Floor (9 units)	96 days	Tue 12/14/21	Thu 4/28/22
497		3rd Floor (9 units)	95 days	Tue 12/21/21	Wed 5/4/22
545		2nd Floor (9 units)	95 days	Wed 12/29/21	Wed 5/11/22


Alta at River's Edge
Wayland, MA
WOOD
Baseline Project Schedule
Exhibit E
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