

Dedham-Westwood Water District

Specifications for Developers

Revised June 30, 2008

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SECTION 01110

CONTROL OF WORK AND MATERIALS

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1. Hauling, Handling and Storage of Materials

- A. The Contractor shall, at his own expense, handle and haul all materials furnished by him and shall remove any of his surplus materials at the completion of the work.
- B. The Contractor shall provide suitable and adequate storage for equipment and materials furnished by him that are liable to injury and shall be responsible for any loss of or damage to any equipment or materials by theft, breakage, or otherwise.
- C. All excavated materials and equipment to be incorporated in the Work shall be placed so as not to injure any part of the Work or existing facilities and so that free access can be had at all times to all parts of the Work and to all public utility installations in the vicinity of the work. Materials and equipment shall be kept neatly piled and compactly stored in such location as will cause a minimum of inconvenience to public travel and adjoining owners, tenants and occupants.
- D. The Contractor shall be responsible for all damages to the work under construction during its progress and until final completion and acceptance even though partial payments have been made under the Contract.

2. Open Excavations

- A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe means for completely covering all open excavations and for accommodating travel when work is not in progress.
- B. Bridges provided for access to private property during construction shall be removed when no longer required.
- C. The length of open trench will be controlled by the particular surrounding conditions but shall always be confined to the limits prescribed by the Engineer.
- D. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, then special construction procedures shall be taken, such as limiting the length of trench and prohibiting stocking excavated material in the street.
- E. All street excavations shall be completely closed at the end of each work day. Backfilling or use of steel plates of adequate strength to carry traffic shall be used.

3. Maintenance of Traffic

- A. Unless permission to close the street is received in writing from the proper authority, all excavated materials and equipment shall be placed so that vehicular and pedestrian traffic may be maintained at all times.
- B. Should the Chief of Police deem it necessary, uniformed officers will be assigned to direct traffic. The Contractor shall make all arrangements in obtaining uniformed officers required.
- C. The Contractor shall at his own expense, as directed by the Police Traffic Control/Safety Officer, provide and erect acceptable barricades, barrier fences, traffic signs, and all other traffic devices not specifically covered in a bid item, to protect the work from traffic, pedestrians, and animals. He shall provide sufficient temporary lighting such as lanterns/flashers (electric battery operated) or other approved illuminated traffic signs and devices to afford adequate protection to the traveling public, at no additional cost to the Owner.
- D. The Contractor shall furnish all construction signs that are deemed necessary by and in accordance with Part VI of the Manual on Uniform Traffic Control Devices as published by the U.S. Department of Transportation. In addition, the Contractor may be required to furnish up to 128 square feet of additional special construction warning signs. Size and exact wording of signs shall be determined by the Engineer during construction.

- E. The intent of policing is to ensure public safety by direction of traffic. Police officers are not to serve as watchmen to protect the Contractor's equipment and materials.
- F. Nothing contained herein shall be construed as relieving the Contractor of any of his responsibilities for protection of persons and property under the terms of the Contract.

4. Care and Protection of Property

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

5. Protection and Relocation of Existing Structures and Utilities

- A. All existing buildings, utilities, pipes, poles, wires fences, curbing, property line markers and other structures which the Engineer decides must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the contractor. Should such property be damaged, it shall be restored by the Contractor, at no additional cost to the Owner.
- B. The Contractor shall determine the location of all underground structures and utilities (including existing water services, drain lines, electrical lines, and sewers). Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by Contractor.
- C. When fences interfere with the Contractor's operations, he shall remove and (unless otherwise specified) promptly restore them.
- D. On paved surfaces the Contractor shall not use or operate tractors, bulldozers, or other power-operated equipment with treads or wheels which are shaped so as to cut or otherwise damage such surfaces.
- E. All property damaged by the Contractor's operations shall be restored to a condition at least equal to that in which it was found immediately before work was begun. Suitable materials and methods shall be used for such restoration.
- F. Restoration of existing property and structures shall be carried out as promptly as practicable and shall not be left until the end of the construction period.

6. Maintenance of Flow

- A. The Contractor shall at his own cost, provide for the flow of sewers and drains interrupted during the progress of the work, and shall immediately cart away and dispose of all offensive matter. The entire procedure of maintaining existing flow

shall be fully discussed with the Engineer well in advance of the interruption of any flow.

- B. All existing drainage facilities including, but not limited to; brooks, streams, canals, channels, ditches, culverts, catch basins and drainage piping shall be adequately safeguarded so as not to impede drainage or to cause siltation of downstream areas in any manner whatsoever. If the Contractor damages or impairs any of the aforesaid drainage facilities, he shall repair the same within the same day.
- C. At the conclusion of the work, the Contractor shall remove all silt in drainage structures caused by his operations as described in Section 01740, CLEANING UP.

7. Rejected Materials and Defective Work

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

8. Sanitary Regulations

Sanitary conveniences for the use of all persons employed on the work, properly screened from public observation, shall be provided in sufficient numbers in such manner and at such locations as may be approved. The contents shall be removed and disposed of in a satisfactory manner as the occasion requires. The Contractor shall rigorously prohibit the committing of nuisances within, on or about the work. Any employees found violating these provisions shall be discharged and not again employed on the work without the written consent of the Engineer. The sanitary conveniences specified above shall be the obligation and responsibility of the Contractor.

9. Safety and Health Regulations

This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations (454 CMR 10.0 et. seq.)." Contractors shall be familiar with the requirements of these regulations.

10. Site Investigation

The Contractor acknowledges that he has satisfied himself as to the conditions existing at the site of the work, the type of equipment required to perform this work, the quality and quantity of the materials furnished insofar as this information is reasonably ascertainable from an inspection of the site, as well as from information presented by the drawings and specifications made a part of this contract. Any failure of the Contractor to acquaint himself with available information will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work. The Owner assumes no responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the Owner.

11. Hazardous Waste

Should the Contractor, while performing work under this contract, uncover hazardous materials, as defined in Massachusetts Hazardous Waste Regulations 310 CMR 30.00, he shall immediately notify the Engineer. The Contractor is not, and has no authority to act as, a handler, generator, operator or disposer of hazardous or toxic substances found or identified at the site, and the Owner shall undertake all such functions.

END OF SECTION

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SECTION 01575

WORK WITHIN THE WATER DISTRICT ZONE I AND II

1. Description
2. Notification
3. Implementation
4. Submittals
5. Refueling Areas
6. Protection of Water Resources
7. Construction in Wellhead Zone I and II Areas
8. Bathroom Facilities
9. Location of Storage / Staging Areas
10. Protection of Landscape
11. Discharge of Dewatering Operations
12. Dust Control

1. Description

- A. The work covered by this section of the specifications consists of furnishing all labor, materials, tools and equipment and performing all work required for the protection of the District's well sources and the prevention of environmental pollution during and as a result of construction operations within or near the Water District Zone I and II.

2. Notification

- A. The District will notify the Contractor in writing of any non-compliance with the foregoing provisions. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails to act promptly, the District may order stoppage of all or part of the work until satisfactory corrective action has been taken. No claim for an extension of time or for excess costs or damage incurred by the Contractor as a result of time lost due to any stop work orders shall be made unless it was later determined that the Contractor was in compliance.

3. Implementation

- A. Prior to commencement of work, the Contractor shall meet with representatives of the District to develop mutual understandings relative to compliance of the wellhead protection program.

4. Submittals

- A. The Contractor shall submit for formal approval by the District (or their consultant), four sets of details and literature fully describing the wellhead protection methods to be employed in carrying out construction activities within the Zone I and II before any construction activities will be allowed. The submittal shall include a site plan clearly noting the wellhead Zone I and II areas, the location of all wells, as well as all construction staging areas and equipment locations. The scale of this site plan shall be no smaller than 1 inch equals 40 feet.
5. Refueling Areas
 - A. Refueling activities within the Zone I will be prohibited. All refueling activities shall occur in the District approved designated area. All refueling shall occur on an impervious surface with containment zones set up during all construction. The refueling area shall contain emergency containment materials such as Speedi dry and absorbent pads in plentiful supply.
6. Protection of Water Resources
 - A. The Contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumens, calcium chloride, acids or other harmful materials. It is the Contractor's responsibility to comply with all applicable Federal, State, County and Municipal laws regarding pollution of rivers and streams.
 - B. The Contractor shall meet with representatives of the District monthly to review protection procedures of water resources.
7. Construction in Wellhead Zone I and II Areas
 - A. Insofar as possible, the Contractor shall make every effort to minimize disturbance within the wellhead Zone I and II areas.
 - B. All spills of lubricating oil, hydraulic fluids, fuels, and hazardous materials must be contained and cleaned up immediately. The Contractor shall have a Spill Prevention Countermeasure and Control Plan (SPCC) that includes the Best Management Practices (BMPs) required to respond to lubricating oil, hydraulic fluids, fuels, and hazardous material releases. All reporting of spills shall be completed in accordance with the Massachusetts Contingency Plan requirements.
 - C. Site Access and security for all work areas within the wellhead Zone I and II shall be maintained at all times by means of a chain link construction fence. This fence will be erected (and moved as necessary) in order to isolate the construction areas from direct public vehicle and pedestrian access.
8. Bathroom Facilities

A. No portable toilets will be located within the wellhead Zone I.

9. Location of Storage / Staging Areas

A. The location of the Contractor's storage / staging areas for equipment and/or materials shall be clearly shown on the site plan and shall require approval from the District.

B. Staging / Storage areas will not be allowed within the wellhead Zone I unless absolutely necessary and not without approval from the District.

C. No stockpiling of materials will be allowed within the Zone I.

D. The staging / storage areas shall contain all proper sediment control measures as outlined in the erosion and sediment control plans.

C. There shall be no storage of fuels, oils, and hazardous materials within the wellhead Zone I or II without approval from the District.

D. No blasting or concrete crushing operations will be allowed within the wellhead Zone I.

10. Protection of Landscape

A. The Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without written authority from the District. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorages unless specifically approved by the District. Excavating machinery and cranes shall be of suitable type and be operated with care to prevent injury to trees which are not to be removed, particularly overhanging branches and limbs. The Contractor shall, in any event, be responsible for any damage resulting from such use.

B. Branches, limbs, and roots shall not be cut except by permission of the District. All cutting shall be smoothly and neatly done without splitting or crushing. When there is unavoidable injury to branches, limbs and trunks of trees, the injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.

C. Where, in the opinion of the District, trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment or by his blasting or other operations, the District may direct the Contractor to adequately protect such trees by placing boards, planks, poles or fencing around them. Any trees or landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the expense of the Contractor.

D. Cultivated hedges, shrubs, and plants which could be injured by the Contractor's operations shall be protected by suitable means or shall be dug up, balled and temporarily replanted and maintained. After construction operations have been substantially completed, they shall be replanted in their original positions and cared for

until growth is re-established. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of a kind and quality at least equal to that existing at the start of the work.

11. Discharge of Dewatering Operations

- A. Any water that is pumped and discharged from the trench and/or excavation as part of the Contractor's water handling shall be filtered by an approved method prior to its discharge into a receiving water or drainage system.
- C. The pumped water shall be filtered through baled hay, a vegetative filter strip or a vegetated channel to trap sediment occurring as a result of the construction operations. The vegetated channel shall be constructed such that the discharge flow rate shall not exceed a velocity of more than 1 foot per second. Accumulated sediment shall be cleared from the channel periodically.

12. Dust Control

- A. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, to minimize creation and dispersion of dust. Calcium Chloride dust suppression chemicals shall not be used within the wellhead Zone I and II areas.

END OF SECTION

SECTION 02080

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the furnishing, handling, hauling, laying, jointing, testing and disinfecting of all ductile iron pipe, including fittings and appurtenant work as indicated on the drawings and as specified.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02513, INSULATION FOR PIPELINES
- C. Section 02514, HYDRANTS AND VALVES
- D. Section 02515, WATER SERVICE CONNECTIONS
- E. Section 02516, CONNECTIONS TO EXISTING WATER MAINS

1.03 QUALITY ASSURANCE:

- A. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. The Contractor shall furnish in duplicate to the Engineer sworn certificates of such tests.
- B. In addition, the Owner reserves the right to have any or all pipe, fittings and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

1.04 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Water Works Association (AWWA)

- | | | |
|------|------|--|
| AWWA | C104 | Cement-Mortar Lining for Ductile- Iron Pipe and Fittings for Water |
| AWWA | C105 | Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids. |

AWWA	C110	Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquids
AWWA	C111	Rubber Gasket Joints for Ductile- Iron and Gray-Iron Pressure Pipe and Fittings
AWWA	C150	Thickness Design of Ductile-Iron Pipe
AWWA	C151	Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids
AWWA	C153	Ductile-Iron Compact Fittings, 3 inches through 64 inches for Water Service.
AWWA	C600	Installation of Ductile-Iron Water Mains
AWWA	C651	Disinfecting Water Mains

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of all shop drawings shall be submitted to the Engineer for review.
- B. Shop drawings shall consist of manufacturer's scale drawings, cuts or catalogs including descriptive literature and complete characteristics and specifications, and code requirements. Shop drawings shall be submitted for the ductile iron pipe, type of joint, fittings, couplings, filling rings, restrained joints, and lining and coating in accordance with specifications.

PART 2 - PRODUCTS

2.01 PIPE:

- A. The Contractor shall use push-on joint type ductile iron pipe unless otherwise indicated on the plans or specified herein.
- B. All ductile iron pipe shall be designed in accordance with AWWA C150 and shall be manufactured in accordance with AWWA C151.
- C. Unless otherwise indicated or specified, ductile iron pipe shall be Thickness Class 52.

2.02 JOINTS:

- A. Joints for ductile iron pipe shall conform to AWWA C111.

- B. Pipe and fittings shall be furnished with approved joint restraining appurtenances as specified herein, or as indicated on the drawings, to keep the piping from pulling apart under pressure.

2.03 FITTINGS:

- A. Fittings shall conform to the requirements of AWWA C110 or C153 as appropriate and shall be of a pressure classification at least equal to that of the pipe with which they are used.
- B. The Contractor shall use ductile iron fittings. Cast-iron, Class 250 fittings may be substituted, upon approval of the Engineer, for ductile iron fittings.
- C. Unless otherwise indicated, fittings shall have all bell mechanical joint ends.

2.04 GASKETS, GLANDS, NUTS AND BOLTS:

- A. Gaskets, glands, nuts, bolts and accessories shall conform to AWWA C111 or C153 as appropriate.
- B. Gaskets shall be of plain tipped rubber, suitable for exposure to the liquid within the pipe.
- C. Glands shall be ductile or cast iron.
- D. Bolts and nuts shall be high strength alloy.

2.05 LINING AND COATING:

- A. The inside of pipe and fittings shall be given a cement lining and asphaltic seal coat in accordance with AWWA C104. The thickness of the lining shall be double that specified in AWWA C104.
- B. The outside of pipe and fittings shall be coated with the standard asphaltic coating specified under the appropriate AWWA Standard Specification for pipe and fittings.
- C. Machined surfaces shall be cleaned and coated with a suitable rust preventative coating at the shop immediately after being machined.

2.06 FLEXIBLE COUPLINGS:

- A. All sleeve-type couplings and accessories shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.
- B. Couplings shall be cast or ductile iron and shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

- C. Sleeve-type couplings shall be made by Dresser Mfg. Div., Bradford, PA; Smith-Blair, Inc., San Francisco, CA; Romac Industries Inc., Seattle, WA; Ford Meter Box Co., Wabash, IN; or be an approved equal.
- D. Couplings for buried pipe shall be Dresser 153; Smith-Blair Type 441 or 443; Romac Style 501; Ford Style FC1 or FC2; or approved equal.

2.07 JOINT RESTRAINTS:

- A. Where indicated or necessary to prevent joints or sleeve couplings from pulling apart under pressure, anchoring and joint restraint methods shall be utilized. Methods shall be restrained joint systems. The number of joints to be restrained shall be determined in accordance with Table 1, as shown on the construction plans or provided by the Engineer.
- B. Restrained joint system for standard mechanical joint or push on joint pipe shall be Megalug or Coverall by EBAA Iron Sales Inc., Eastland, TX; Fast-grip joint by American Cast Iron Pipe Company, Birmingham, AL; Field Lok 350 Gasket by United States Pipe and Foundry Company, Birmingham, AL; or approved equal. Methods that rely on the use of friction clamps and/or retainer glands with set screws alone are not acceptable.
- C. Restrained joint systems for non-standard or modified joints shall be Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, Birmingham, AL; TR-Flex Joint by United States Pipe and Foundry Company, Birmingham, AL; Super-Lock Joint by Clow Corporation, Bensenville, IL; Fastite Joint by Atlantic States Cast Iron Pipe Company, Philipsburg, NJ; Snap-Lok or Bolt-Lok by Griffin Pipe Products Company, Oak Brook, IL; or approved equal.
- D. Concrete thrust blocks may only be used for 6-inch, 8-inch, 10-inch, or 12-inch pipe where use of a joint restraint system is not feasible. Use of concrete thrust blocks shall be installed with the minimum bearing area (in square feet) against undisturbed material in accordance with the following:

Size of Main	90° Bends, Tees, Caps and Plugs	45° Bends and Wyes	22-1/2° Bends	11-1/4° Bends
6- & 8-inch	5	4	2	2
10- & 12-inch	12	9	5	2

- E. Tie rods may only be used for 6-inch, 8-inch, 10-inch, or 12-inch pipe where use of a joint restraint system is not feasible. Bolts shall have adequate length to allow nuts on both sides of the gland. Tie bolts shall have the same diameter as the tie rods and be in accordance with the following:

Pipe Size	Tie Rod	
	Number	Diameter
6	2	1/2"
8	2	3/4"
10	2	3/4"
12	4	3/4"

- F. Location of restrained joints shall be based on Table 1, as shown on the construction plans or provided by the Engineer. All joints that occur within the restrained length listed in Table 1, for the specific application, shall be restrained. For example, for a 90° bend, 8-inch unwrapped pipe, the restrained length required is 33 feet. Therefore, all joints within 33 feet of the 90° bend must be restrained.

Table 1 was derived from Thrust Restraint Design for Ductile Iron), published by Ductile Iron Pipe Research Association, based on the following assumptions:

Water Pressure (P)	=	150 psi
Cover	=	4.5 feet
Soil Type	=	Silt 1
Layering Condition	=	3

Restrained lengths for all bends less than 90° are based on the following factors times the 90° lengths: 45°-0.414, 22½°-0.199, 11 1/4 °-0.098.

If system conditions are significantly different from these assumptions, i.e. high-pressure zones, Table 1 should be modified by the Engineer.

2.08 POLYETHYLENE ENCASEMENT:

Where called for on the drawings, the pipe shall be encased in polyethylene conforming to AWWA C105.

PART 3 - EXECUTION

3.01 INSPECTION BEFORE INSTALLATION:

Pipes and fittings shall be subjected to a careful inspection just before being laid or installed.

3.02 HANDLING AND CUTTING:

- A. Any pipe or fitting which has a damaged lining, scratched or marred machine surface and/or abrasion of the pipe coating or lining shall be rejected and removed from the job-site.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used will be

perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.

- D. Except as otherwise approved, all cutting shall be done with a machine suitable for cutting ductile iron pipe. Hydraulic squeeze cutters are not acceptable for cutting ductile iron pipe. Travel type cutters or rotary type abrasive saws may be used. All cut ends shall be examined for possible cracks caused by cutting.
- E. Lined and coated pipe and fittings shall be assembled and installed with approved packing or gaskets of the type recommended by the pipe manufacturer for the particular lining used.

3.03 INSTALLATION:

A. DEPTH:

1. The pipe shall be installed with a minimum of 5'-0" of cover, unless specifically indicated otherwise on the plans or directed by the Engineer.
2. Where pipe is installed at less than the required cover, the Contractor shall furnish and install insulation in accordance with Section 02513, INSULATION FOR PIPELINES, or as directed by the Engineer.

B. PIPE AND FITTINGS:

1. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
2. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the complete work.
3. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or as required. Care shall be taken to ensure good alignment both horizontally and vertically.
4. In buried pipelines, each pipe shall have firm bearing along its entire length.
5. Castings to be encased in masonry shall be accurately set, with the bolt holes, if any, carefully aligned.
6. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign material.
7. Fittings shall not be used to clear beneath or above an existing structure or pipeline unless approved by the Engineer. The water main shall be brought to a depth sufficient to clear the structure or pipeline without the use of bends.

C. TEMPORARY PLUGS:

At all times when pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.

D. PUSH ON JOINTS:

1. Joining of push-on joint pipe shall conform to AWWA C600.
2. If effective sealing of the joint is not attained, the joint shall be disassembled, thoroughly cleaned, a new gasket inserted and joint reassembled.
3. Deflection of alignment at a joint shall not exceed the appropriate permissible deflection as specified in AWWA C600. The tables in AWWA C600 indicate the maximum permissible deflection for 18 and 20-foot pipe lengths. Maximum permissible deflections for other lengths shall be in proportion to such lengths.

E. MECHANICAL JOINTS:

1. Assembling of fittings with mechanical joint ends shall conform to AWWA C600.
2. If effective sealing of the joint is not attained at the maximum torque indicated in the above standard, the joint shall be disassembled and thoroughly cleaned, then reassembled. Bolts shall not be overstressed to tighten a leaking joint.
3. The deflection of alignment at a joint shall not exceed the appropriate permissible deflection as specified in the following table. These values indicate the maximum permissible deflection for 18-foot lengths. Maximum permissible deflections for other lengths shall be in proportion to such lengths.

Pipe Deflection Allowances
Maximum permissible deflection, inches

<u>Diameter of Pipe (inches)</u>	<u>Mechanical-Joint</u>
6	27
8-12	20
16	13.5
20	11
24	9

F. RESTRAINED JOINTS:

1. Joining of restrained joint piping shall conform to the manufacturer's recommendations.
2. If effective sealing of the joint is not attained, the joint shall be disassembled, thoroughly cleaned, a new gasket inserted and joint reassembled.
3. Deflection of alignment at a joint shall not exceed the appropriate permissible deflection recommended by the manufacturer.
4. All restraining appurtenances (and tie rods) shall be coated with an approved bituminous paint after assembly. The completed joint shall be inspected and the paint repaired/touched-up as necessary.

G. SLEEVE-TYPE COUPLINGS:

1. Pipe ends shall be cleaned thoroughly prior to installation. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferable by use of a torque wrench of the appropriate size and torque for the bolts. The correct torque as indicated by a torque wrench shall not exceed 90 foot-lb.

3.04 POLYETHYLENE ENCASUREMENT:

- A. The pipe to be encased shall be thoroughly cleaned of all soil and debris prior to installation of the polyethylene encasement. No soil or debris shall be allowed to enter the encasement during or after its installation.
- B. Polyethylene encasement shall be installed using Method A as described in AWWA C105, with the encasement joints coincident with pipe joints. Adhesive tape shall be used to secure the encasement.
- C. Minimum overlap of polyethylene encasement shall be 24-inches, 12 inches on each side of pipe joints.
- D. If required, two layers of polyethylene encasement shall be installed. The first layer shall be completely installed on and secured to the length of pipe before the second layer is installed.
- E. Tears, cuts and other damage shall be repaired with a piece of polyethylene covering secured with adhesive tape, when approved by the Engineer. Otherwise, the damaged length of polyethylene shall be replaced at the Contractor's expense.
- F. Care shall be taken when backfilling to avoid damage to the polyethylene encasement.

- G. Service and fitting connections shall be made by making an x-shaped cut in the polyethylene and folding back the cut film. Immediately following completion of the connection, the film shall be secured to the connection with adhesive tape and the cut area repaired. Service connections shall be wrapped with polyethylene encasement for a minimum of 3 feet from the point of connection to the encased pipe.
- H. At the junctions between wrapped and unwrapped pipe the polyethylene encasement shall be extended a minimum of 3 feet beyond the end of the pipe scheduled to be encased and the ends of the encasement securely taped so that no soil can enter the encasement.

3.05 TESTING:

- A. Prior to the pressure and leakage tests, the piping shall be thoroughly flushed clean of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to linings and coatings.
- B. The installed pipe shall be pressure tested and leakage tested in accordance with AWWA Standard C600.
- C. PRESSURE AND LEAKAGE TESTS:
 - 1. Unless otherwise approved, all pipelines shall be given a combined pressure and leakage tests between line valves. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gates, and other necessary equipment; and all labor required. The Owner or Engineer shall have the privilege of using his or her own gages.
 - 2. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when he desires.
 - 3. Unless it has already been done, the section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. The Contractor shall follow established procedures for filling the pipe and expelling trapped air to avoid exposing the piping system to water-hammer. If blowoffs are not available at high points for releasing air, the Contractor shall excavate as required and install the necessary taps. If the Contractor changes the grade of pipe installation, he will be responsible for locating the taps at the correct location in the system for testing. Taps shall be installed at the beginning and end of each disinfection run. After completion of the test, if so directed by the Engineer, he shall remove corporations used for testing; plug the holes and backfill as necessary.
 - 4. 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.

5. The pressure shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test corrected to the gage location) to a pressure in pounds per square inch numerically equal to the pressure rating of the pipe (150 psi, unless otherwise noted). If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour, the section shall be considered as having failed to pass the pressure test.
6. If the pressure test fails, the Contractor shall make a leakage test by metering the flow of water into the pipe while maintaining in the section being tested a pressure equal to the pressure rating of the pipe. If the average leakage during a two-hour period exceeds a rate of 11.6 gallons per inch of diameter per 24 hours per mile of pipeline, the section shall be considered as having failed the leakage test. For example, if 1,000 feet of 12-inch pipe is to be tested, the allowable leakage is 2.2 gallons over a 2-hour period, calculated as follows:

$$L = \frac{(11.6 \text{ gal}) \times (12'') \times (2 \text{ hr.}) \times (1000')}{(1'') \times (24 \text{ hr.}) \times (5280')} = 2.2 \text{ gal}$$

7. 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.

3.06 DISINFECTION AND FLUSHING:

- A. The Contractor shall disinfect the lines carrying potable water.
- B. The Contractor shall furnish all equipment and materials necessary to do the work of disinfecting, and shall perform the work in accordance with the procedure outlined in AWWA C651 and all amendments thereto.
- C. In general, the procedure of disinfecting the main shall be to apply the chlorine through a tap in one end of the section and bleed it off through a tap at the other end.
- D. The applied dosage shall be such as to produce a chlorine concentration of not less than 10 mg/l after a contact time of not less than 24 hours.
- E. During the disinfection period, care shall be exercised to prevent contamination of water in existing mains.
- F. Any temporary connection to the mains or other facilities required to accomplish the disinfection of the mains shall be at the Contractor's expense.
- G. After treatment, the main shall be flushed with clean water until the residual chlorine concentration is less than 0.2 mg/l.

- H. Before disposing of the water used in disinfecting and flushing water mains the Contractor shall thoroughly neutralize it through the application of a reducing agent, as referenced in AWWA C651.
- I. Bacteriological sampling and testing shall be done in accordance with AWWA C651 for each main and each branch. Sampling shall be accomplished with sterile bottles treated with sodium thiosulfate, as required by Standard Methods. No hose or fire hydrants shall be used in collection of samples. A corporation stop installed on the main, with a removable copper tube gooseneck assembly, is the recommended method.
- J. Bacteriological sampling and testing shall be conducted by a state certified laboratory certified for total and fecal coliform analyses of potable water.
- K. Testing shall be done by a laboratory approved by the Engineer, in accordance with Standard Methods, and shall show the absence of coliform organisms. A standard plate count may be required at the option of the Engineer.

END OF SECTION

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SECTION 02240

DEWATERING

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section specifies designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems as required to lower and control water levels and hydrostatic pressures during construction; disposing of pumped water; constructing, maintaining, observing and, except where indicated or required to remain in place, removing of equipment and instrumentation for control of the system.

1.02 RELATED WORK:

- A. Section 00890, PERMITS
- B. Section 01570, ENVIRONMENTAL PROTECTION
- C. Section 02300, EARTHWORK
- D. Section 02252, SUPPORT OF EXCAVATION

1.03 SYSTEM DESCRIPTION:

- A. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; preventing rupture or heaving of the bottom of any excavation; and disposing of pumped water.
- B. Normal dewatering is defined as using conventional pumps installed in open excavations, ditches, or sumps.

1.04 QUALITY ASSURANCE:

- A. The Contractor is responsible for the adequacy of the dewatering systems.
- B. The dewatering systems shall be capable of effectively reducing the hydrostatic pressure and lowering the groundwater levels to a minimum of 2 feet below excavation bottom, unless otherwise directed by the Engineer, so that all excavation bottoms are firm and dry.

- C. The dewatering system shall be capable of maintaining a dry and stable subgrade until the structures, pipes and appurtenances to be built therein have been completed to the extent that they will not be floated or otherwise damaged.
- D. The dewatering system and excavation support (see Section 02252, SUPPORT OF EXCAVATION) shall be designed so that lowering of the groundwater level outside the excavation does not adversely affect adjacent structures, utilities or wells.

1.05 SUBMITTALS

- A. Contractor shall submit six copies a plan indicating how they intend to control the discharge from any dewatering operations on the project, whether it is discharge of groundwater from excavations or Stormwater runoff during the life of the project.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 DEWATERING OPERATIONS:

- A. All water pumped or drained from the work shall be disposed of in a manner which will not result in undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, structures and utilities. Suitable temporary pipes, flumes or channels shall be provided for water that may flow along or across the site of the work. All disposal of pumped water shall conform to the provisions of Section 01570 ENVIRONMENTAL PROTECTION and Section 00890 PERMITS.
- B. Dewatering facilities shall be located where they will not interfere with utilities and construction work to be done by others.
- C. Dewatering procedures to be used shall be as described below:
 - 1. Crushed stone shall encapsulate the suction end of the pump to aid in minimizing the amount of silt discharged.
 - 2. For dewatering operations with relatively minor flows, pump discharges shall be directed into haybale sedimentation traps lined with filter fabric. Water is to be filtered through the haybales and filter fabric prior to being allowed to seep out into its natural water course.
 - 3. For dewatering operations with larger flows, pump discharges shall be into a steel dewatering basin. Steel baffle plates shall in used to slow water velocities to increase the contact time and allow adequate settlement of sediment prior to discharge into waterways.
 - 4. Where indicated on the contract drawings or in conditions of excess silt suspended in the discharge water, silt control bags are to be utilized in catchbasins.

- D. The Contractor shall be responsible for repair of any damage caused by his dewatering operations, at no cost to the Owner.

END OF SECTION

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SECTION 02252

SUPPORT OF EXCAVATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers wood sheeting and bracing for support of excavations. The requirements of this section shall also apply, as appropriate, to other methods of excavation support and underpinning which the Contractor elects to use to complete the work.
- B. The Contractor shall furnish and place timber sheeting of the kinds and dimensions required, complying with these specifications, where indicated on the drawings or ordered by the Engineer.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK.
- B. Section 02240, DEWATERING.

1.03 QUALITY ASSURANCE:

- A. This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations (454 CMR 10.0 et seq.) Contractors shall be familiar with the requirements of these regulations.
- B. The excavation support system shall be of sufficient strength and be provided with adequate bracing to support all loads to which it will be subjected. The excavation support system shall be designed to prevent any movement of earth that would diminish the width of the excavation or damage or endanger adjacent structures.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Timber sheeting shall be sound spruce, pine, or hemlock, planed on one side and either tongue and grooved or splined. Timber sheeting shall not be less than nominal 2 inches thick.

- B. Timber and steel used for bracing shall be of such size and strength as required in the excavation support design. Timber or steel used for bracing shall be new or undamaged used material which does not contain splices, cutouts, patches, or other alterations which would impair its integrity or strength.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Work shall not be started until all materials and equipment necessary for their construction are either on the site of the work or satisfactorily available for immediate use as required.
- B. The sheeting shall be securely and satisfactorily braced to withstand all pressures to which it may be subjected and be sufficiently tight to minimize lowering of the groundwater level outside the excavation, as required in Section 02240, DEWATERING.
- C. The sheeting shall be driven by approved means to the design elevation. No sheeting may be left so as to create a possible hazard to safety of the public or a hindrance to traffic of any kind.
- D. If boulders or very dense soils are encountered, making it impractical to drive a section to the desired depth, the section shall, as directed, be cut off.
- E. The sheeting shall be left in place where indicated on the drawings or ordered by the Engineer in writing. At all other locations, the sheeting may be left in place or salvaged at the option of the Contractor. Steel or wood sheeting permanently left in place shall be cut off at a depth of not less than two feet below finish grade unless otherwise directed.
- F. All cut-off will become the property of the Contractor and shall be removed by him from the site.
- G. Responsibility for the satisfactory construction and maintenance of the excavation support system, complete in place, shall rest with the Contractor. Any work done, including incidental construction, which is not acceptable for the intended purpose shall be either repaired or removed and reconstructed by the Contractor at his expense.
- H. The Contractor shall be solely responsible for repairing all damage associated with installation, performance, and removal of the excavation support system.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall make excavations of normal depth in earth for trenches and structures, shall backfill and compact such excavations to the extent necessary, shall furnish the necessary material and construct embankments and fills, and shall make miscellaneous earth excavations and do miscellaneous grading.

1.02 RELATED WORK:

- A. Section 01110, CONTROL OF WORK AND MATERIALS
- B. Section 02240, DEWATERING
- C. Section 02324, ROCK EXCAVATION AND DISPOSAL
- D. Section 02252, SUPPORT OF EXCAVATION
- E. Section 02745, PAVING
- F. Section 02920, LOAMING AND SEEDING

1.03 REFERENCES:

American Society for Testing and Materials (ASTM)

ASTM	C131	Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM	C136	Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM	C330	Specification for Lightweight Aggregate for Structural Concrete.
ASTM	D1556	Test Method for Density of Soil in Place by the Sand Cone Method.
ASTM	D1557	Test Methods for Moisture-density Relations of Soils and Soil Aggregate Mixtures Using Ten-pound (10 Lb.) Hammer and Eighteen-inch (18") Drop.
ASTM	D2922	Test Methods for Density of Soil and Soil-aggregate in Place by Nuclear Methods (Shallow Depth).

Commonwealth of Massachusetts Highway Department Standard Specification for Highways and Bridges.

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Samples of all materials proposed for the project shall be submitted to the Engineer for review. Size of the samples shall be as approved by the Engineer.

1.05 PROTECTION OF EXISTING PROPERTY:

- A. The work shall be executed in such manner as to prevent any damage to facilities at the site and adjacent property and existing improvements, such as but not limited to streets, curbs, paving, service utility lines, structures, monuments, bench marks, observation wells, and other public or private property. Protect existing improvements from damage caused by settlement, lateral movements, undermining, washout and other hazards created by earthwork operations.
- B. In case of any damage or injury caused in the performance of the work, the Contractor shall, at its own expense, make good such damage or injury to the satisfaction of, and without cost to, the Owner. Existing roads, sidewalks, and curbs damaged during the project work shall be repaired or replaced to at least the condition that existed at the start of operations. The Contractor shall replace, at his own cost, existing benchmarks, observation wells, monuments, and other reference points which are disturbed or destroyed.
- C. Buried drainage structures and pipes, observation wells and piezometers, including those which project less than eighteen inches (18") above grade, which are subject to damage from construction equipment shall be clearly marked to indicate the hazard. Markers shall indicate limits of danger areas, by means which will be clearly visible to operators of trucks and other construction equipment, and shall be maintained at all times until completion of project.

1.06 DRAINAGE:

- A. The Contractor shall provide, at its own expense, adequate drainage facilities to complete all work items in an acceptable manner. Drainage shall be done in a manner so that runoff will not adversely affect construction procedures nor cause excessive disturbance of underlying natural ground or abutting properties.

1.07 FROST PROTECTION AND SNOW REMOVAL:

- A. The Contractor shall, at its own expense, keep earthwork operations clear and free of accumulations of snow as required to carry out the work.

- B. The Contractor shall protect the subgrade beneath new structures and pipes from frost penetration when freezing temperatures are expected.

PART 2 - PRODUCTS

2.01 MATERIAL:

A. GRAVEL BORROW:

Gravel Borrow shall satisfy the requirements listed in MHD Specification Section M1.03.0, Type b.

B. CRUSHED STONE:

Crushed stone shall satisfy the requirements listed in MHD Specification Section M2.01.

C. SAND BORROW:

Sand Borrow shall satisfy the requirements listed in MHD Specification Section M1.04.0.

D. PEASTONE:

Peastone shall be smooth, hard, naturally occurring, rounded stone meeting the following gradation requirements:

Passing 5/8 inch square sieve opening	-	100%
Passing No. 8 sieve opening	-	0%

E. BACKFILL MATERIALS:

1. Class B Backfill:

Class B backfill shall be granular, well graded friable soil; free of rubbish, ice, snow, tree stumps, roots, clay and organic matter; with 30 percent or less passing the No. 200 sieve; no stone greater than two-third (2/3) loose lift thickness, or six inches, whichever is smaller.

2. Select Backfill:

Select backfill shall be granular, well graded friable soil, free of rubbish, ice, snow, tree stumps, roots, clay and organic matter, and other deleterious or organic material; graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
3"	100
No. 10	30-95
No. 40	10-70
No. 200	0-10

F. STATE HIGHWAY TRENCH BACKFILL:

When required by Permit, Controlled Density Fill (CDF) shall be used to backfill trenches. The CDF shall satisfy the requirements listed in MHD Specification Section M4.08.0.

G. LIGHTWEIGHT FILL:

1. Lightweight Fill shall be rotary kiln expanded shale meeting all the requirements of ASTM C330. Particles shall be tough, durable, non-corrosive and have the following properties:

Delivered Gradation:

<u>Sieve Size</u>	<u>% Retained</u>
1"	0
3/4"	0 to 20
#4	85 to 100

- b. The dry loose unit weight shall be less than 55 PCF.
- c. The Contractor shall submit verification of a compacted density of less than 70 PCF. Density shall be verified by testing in accordance with Standard AASHTO Test Designation T99.
- d. The maximum soundness loss when tested with five cycles of magnesium sulphate shall be ten percent in accordance with ASTM C131.
- e. Moisture content shall be determined by the Engineer.
- f. Provide manufacturer's certificate stating materials provided comply with the standards specified.

H. SPECIAL PIPE BEDDING MATERIAL

1. The special pipe bedding material shall consist of a filter cloth installed on the trench bottom before backfilling with crushed stone as specified and as shown on the contract drawings.

2. The filter cloth shall be composed of needle punch, stapled fibers thermally bonded together to form a sheet.
3. The filter cloths shall possess the following minimum properties:

Grab strength:	120 lbs	ASTM D 4632.
Elongation:	50%	ASTM D 4632
Burst Strength:	240 psi	ASTM D 3786
Puncture Strength:	65 lbs.	ASTM D 4833
Trapezoid Tear:	40 lbs.	ASTM D 4533
Equivalent opening size:	No. 70 sieve	ASTM D 4751
Permittivity (sec ⁻¹)	1.8	ASTM D 4491
Flow Rate (gal/min/ft ²)	135	ASTM D-4491
4. The filter cloth shall be Mirafi 140N by Mirafi, Inc. Charlotte, NC; Foss-65 by Foss Manufacturing Co., Haverhill, MA; Supac 4NP, Phillips Fibers Corp., Greenville, SC or approved equal.

PART 3 - EXECUTION

3.01 DISTURBANCE OF EXCAVATED AND FILLED AREAS DURING CONSTRUCTION:

- A. Contractor shall take the necessary steps to avoid disturbance of subgrade during excavation and filling operations, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials, dewatering and other acceptable control measures.
- B. All excavated or filled areas disturbed during construction, all loose or saturated soil, and other areas that will not meet compaction requirements as specified herein shall be removed and replaced with a minimum 12-inch layer of compacted crushed stone wrapped all around in non-woven filter fabric. Costs of removal and replacement shall be borne by the Contractor.
- C. The Contractor shall place a minimum of 12-inch layer of special bedding materials and crushed stone wrapped in filter fabric over the natural underlying soil to stabilize areas which may become disturbed as a result of rain, surface water runoff or groundwater seepage pressures, all at no additional cost to the Owner. The Contractor also has the option of drying materials in-place and compacting to specified densities.

3.02 EXCAVATION:

A. GENERAL:

1. The Contractor shall perform all work of any nature and description required to accomplish the work as shown on the Drawings and as specified.

2. Excavations, unless otherwise required by the Engineer, shall be carried only to the depths and limits shown on the Drawings. If unauthorized excavation is carried out below required subgrade and/or beyond minimum lateral limits shown on Drawings, it shall be backfilled with gravel borrow and compacted at the Contractor's expense as specified below, except as otherwise indicated. Excavations shall be kept in dry and good conditions at all times, and all voids shall be filled to the satisfaction of the Engineer.
3. In all excavation areas, the Contractor shall strip the surficial topsoil layer and underlying subsoil layer separate from underlying soils. In paved areas, the Contractor shall first cut pavement as specified in paragraph 3.02 B.1 of this specification, strip pavement and pavement subbase separately from underlying soils. All excavated materials shall be stockpiled separately from each other within the limits of work.
4. The Contractor shall follow a construction procedure, which permits visual identification of stable natural ground. Where groundwater is encountered, the size of the open excavation shall be limited to that which can be handled by the Contractor's chosen method of dewatering and which will allow visual observation of the bottom and backfill in the dry.
5. The Contractor shall excavate unsuitable materials to stable natural ground where encountered at proposed excavation subgrade, as directed by the Engineer. Unsuitable material includes topsoil, loam, peat, other organic materials, snow, ice, and trash. Unless specified elsewhere or otherwise directed by the Engineer, areas where unsuitable materials have been excavated to stable ground shall be backfilled with compacted special bedding materials or crushed stone wrapped all around in non-woven filter fabric.

B. TRENCHES:

1. Prior to excavation, trenches in pavement shall have the traveled way surface cut in a straight line by a concrete saw or equivalent method, to the full depth of pavement. Excavation shall only be between these cuts. Excavation support shall be provided as required to avoid undermining of pavement. Cutting operations shall not be done by ripping equipment.
2. The Contractor shall satisfy all dewatering requirements specified in Section 02240 DEWATERING, before performing trench excavations.
3. Trenches shall be excavated to such depths as will permit the pipe to be laid at the elevations, slopes, and depths of cover indicated on the Drawings. Trench widths shall be as shown on the Drawings or as specified.

4. Where pipe is to be laid in bedding material, the trench may be excavated by machinery to, or just below, the designated subgrade provided that the material remaining in the bottom of the trench is not disturbed.
5. If pipe is to be laid in embankments or other recently filled areas, the fill material shall first be placed to a height of at least 12-inches above the top of the pipe before excavation.
6. Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed.
7. If, in the opinion of the Engineer, the subgrade, during trench excavation, has been disturbed as a result of rain, surface water runoff or groundwater seepage pressures, the Contractor shall remove such disturbed subgrade to a minimum of 12 inches and replace with crushed stone wrapped in filter fabric. Cost of removal and replacement shall be borne by the Contractor.

C. BUILDING AND FOUNDATION EXCAVATION:

1. Excavations shall not be wider than required to set, brace, and remove forms for concrete, or perform other necessary work.
2. After the excavation has been made, and before forms are set for footings, mats, slabs, or other structures, and before reinforcing is placed, all loose or disturbed material shall be removed from the subgrade. The bearing surface shall then be compacted to meet the requirements of this specification.
3. If, in the opinion of the Engineer, the existing material at subgrade elevation is unsuitable for structural support, the Contractor shall excavate and dispose of the unsuitable material to the required width and depth as directed by the Engineer. If, in the opinion of the Engineer, filter fabric is required; the Contractor shall place filter fabric, approved by the Engineer, as per manufacturer's recommendations. Crushed stone shall then be placed in lifts and compacted to required densities. Backfill shall be placed to the bottom of the proposed excavation.

D. EXCAVATION NEAR EXISTING STRUCTURES:

1. Attention is directed to the fact that there are pipes, manholes, drains, and other utilities in certain locations. An attempt has been made to locate all utilities on the drawings, but the completeness or accuracy of the given information is not guaranteed.
2. As the excavation approaches pipes, conduits, or other underground structures, digging by machinery shall be discontinued and excavation shall be done by means of hand tools, as required. Such manual excavation, when incidental to normal

excavation, shall be included in the work to be done under items involving normal excavation.

3. Where determination of the exact location of a pipe or other underground structure is necessary for properly performing the work, the Contractor shall excavate test pits to determine the locations.

3.03 BACKFILL PLACEMENT AND COMPACTION:

A. GENERAL:

1. Prior to backfilling, the Contractor shall compact the exposed natural subgrade to the densities as specified herein.
2. After approval of subgrade by the Engineer, the Contractor shall backfill areas to required contours and elevations with specified materials.
3. The Contractor shall place and compact materials to the specified density in continuous horizontal layers. The degree of compaction shall be based on maximum dry density as determined by ASTM Test D1557, Method C. The minimum degree of compaction for fill placed shall be as follows:

<u>Location</u>	<u>Percent of Maximum Density</u>
Below pipe centerline	95
Above pipe centerline	92
Below pavement (upper 3 ft.)	95
Embankments	95
Below pipe in embankments	95
Adjacent to structures	92
Below structures	95

4. The Engineer reserves the right to test backfill for conformance to the specifications and Contractor shall assist as required to obtain the information. Compaction testing will be performed by the Engineer or by an inspection laboratory designated by the Engineer, engaged and paid for by the Owner. If test results indicate work does not conform to specification requirements, the Contractor shall remove or correct the defective Work by recompacting where appropriate or replacing as necessary and approved by the Engineer, to bring the work into compliance, at no additional cost to the Owner. All backfilled materials under structures and buildings shall be field tested for compliance with the requirements of this specification.
5. Where horizontal layers meet a rising slope, the Contractor shall key each layer by benching into the slope.

6. If the material removed from the excavation is suitable for backfill with the exception that it contains stones larger than permitted, the Contractor has the option to remove the oversized stones and use the material for backfill or to provide replacement backfill at no additional cost to the Owner.
7. The Contractor shall remove loam and topsoil, loose vegetation, stumps, large roots, etc., from areas upon which embankments will be built or areas where material will be placed for grading. The subgrade shall be shaped as indicated on the Drawings and shall be prepared by forking, furrowing, or plowing so that the first layer of the fill material placed on the subgrade will be well bonded to the subgrade.
8. Where called for on the Drawings, Lightweight Fill shall be placed and compacted as recommended by the manufacturer. The exact number of passes shall be approved by the Engineer to insure stability of the layer. As soon as the compaction of each layer has been completed, the next layer shall then be placed. The Contractor shall take all necessary precautions during construction activities in operations on or adjacent to the Lightweight Fill to insure that the material is not over-compacted. Construction equipment, other than for compaction, shall not operate on the exposed Lightweight Fill. The top surface of the Lightweight Fill lying directly below the gravel course shall be chinked by additional rolling of the Lightweight Fill to prevent infiltration of fines.

B. TRENCHES:

1. Bedding as detailed and specified shall be furnished and installed beneath the pipeline prior to placement of the pipeline. A minimum bedding thickness shall be maintained between the pipe and undisturbed material, as shown on the Drawings.
2. As soon as practicable after pipes have been laid, backfilling shall be started.
3. Unless otherwise indicated on the Drawings, select backfill shall be placed by hand shovel in 6-inch thick lifts up to a minimum level of 12-inches above the top of pipe. This area of backfill is considered the zone around the pipe and shall be thoroughly compacted before the remainder of the trench is backfilled. Compaction of each lift in the zone around the pipe shall be done by use of power-driven tampers weighing at least 20 pounds or by vibratory compactors. Care shall be taken that material close to the bank, as well as in all other portions of the trench, is thoroughly compacted to densities required.
4. Class B backfill shall be placed from the top of the select backfill to the specified material at grade (loam, pavement subbase, etc.). Fill compaction shall meet the density requirements of this specification.

5. Water Jetting:
 - a. Water jetting may be used when the backfill material contains less than 10 percent passing the number 200 sieve, but shall be used only if approved by the Engineer.
 - b. Contractor shall submit a detailed plan describing the procedures he intends to use for water jetting to the Engineer for approval prior to any water jetting taking place.
 - c. Compaction of backfill placed by water jetting shall conform to the requirements of this specification.
6. If the materials above the trench bottom are unsuitable for backfill, the Contractor shall furnish and place backfill materials meeting the requirements for trench backfill, as shown on the drawings or specified herein.
7. Should the Engineer order crushed stone for utility supports or for other purposes, the Contractor shall furnish and install the crushed stone as directed.
8. In shoulders of streets and road, the top 12-inch layer of trench backfill shall consist of processed gravel for sub-base, satisfying the requirements listed in MHD standard specification M1.03.1.
9. Trenches in state highways shall be backfilled with Controlled Density Fill, in accordance with the state highway permit included in Section 00890, PERMITS.

C. BACKFILLING UNDER BUILDINGS AND FOUNDATIONS:

Material to be used as structural fill under structures shall be special bedding material or gravel borrow, as shown on the Drawings or as directed by the Engineer. Where gravel borrow fill is required to support proposed footings, walls, slabs, and other structures, the material shall be placed in a manner accepted by the Engineer. Compaction of each lift shall meet the density requirements of this specification.

D. BACKFILLING ADJACENT TO STRUCTURES:

1. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads to which they will be subjected. Excavated material approved by the Engineer may be used in backfilling around structures. Backfill material shall be thoroughly compacted to meet the requirements of this specification.
2. Contractor shall use extra care when compacting adjacent to pipes and drainage structures. Backfill and compaction shall proceed along sides of drainage structures

so that the difference in top of fill level on any side of the structure shall not exceed two feet (2') at any stage of construction.

3. Where backfill is to be placed on only one side of a structural wall, only hand-operated roller or plate compactors shall be used within a lateral distance of five feet (5') of the wall for walls less than fifteen feet (15') high and within ten feet (10') of the wall for walls more than fifteen feet (15') high.

3.04 DISPOSAL OF SURPLUS MATERIALS:

- A. No excavated material shall be removed from the site of the work or disposed of by the Contractor unless approved by the Engineer.
- B. Surplus excavated materials, which are acceptable to the Engineer, shall be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill. Upon written approval of the Engineer, surplus excavated materials shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes as indicated by the Owner, within its jurisdictional limits; all at no additional cost to the Owner.
- C. Surplus excavated material not needed as specified above shall be hauled away and disposed of by the Contractor at no additional cost to the Owner, at appropriate locations, and in accordance with arrangements made by him. Disposal of all rubble shall be in accordance with all applicable local, state and federal regulations.

END OF SECTION

SECTION 02324

ROCK EXCAVATION AND DISPOSAL

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall excavate rock, if encountered, to the lines and grades indicated on the drawings or as directed, shall dispose of the excavated material, and shall furnish the required material as specified in Section 02300 EARTHWORK for backfill in place of the excavated rock.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02252, SUPPORT OF EXCAVATION

1.03 DEFINITIONS:

- A. The word "rock," wherever used as the name of the excavated material or material to be excavated, shall mean only boulders and pieces of concrete or masonry exceeding one cubic yard* in volume, or solid ledge rock which, in the opinion of the Engineer, requires for its removal, drilling and blasting, wedging, sledging, barring, or breaking up with a power-operated tool. No soft or disintegrated rock which can be removed by normal earth excavation methods, no loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere, and no rock exterior to the maximum limits of measurement allowed, which may fall into the excavation, will be measured or allowed as "rock."
- B. The word "earth," wherever used as the name of an excavated material, or material to be excavated shall mean all kinds of material other than rock as above defined.

1.04 QUALITY ASSURANCE:

- A. The Contractor shall conform to all municipal ordinances and state and federal laws relating to the transportation, storage, handling, and use of explosives. In the event that any of the above mentioned laws, ordinances, or regulations require a licensed blaster to perform or supervise the work of blasting, said licensed blaster shall, at all times, have his license on the work site and shall permit examination thereof by the Engineer or other officials having jurisdiction.
- B. The Contractor shall procure all permits required for blasting.

1.05 SUBMITTALS:

- A. At least two weeks before beginning blasting operations, the Contractor shall submit to the Engineer for record the following data:
 - 1. Name of Contractor or Subcontractor responsible for blasting and monitoring operations and license number.
 - 2. Name, affiliation, and license number of the person or persons who will be directly responsible for designing each blast, supervising the loading of the shot, and firing it.
- B. Copies of all permits required for blasting.
- C. Results of pre-blast survey.
- D. When blasting is in progress, daily reports on blasting operations and blast monitoring results.

1.06 DELIVERY/STORAGE AND HANDLING:

Delivery, storage and handling of explosives shall conform to all federal, state and local regulations and permits.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 PREPARATION/PRE-BLAST SURVEY

If required, the pre-blast survey shall be conducted in accordance with state regulations and/or local permit requirements.

3.02 EXCAVATION:

- A. The Contractor shall excavate rock to the lines and grades indicated on the drawings or as directed by the Engineer. The excavated rock shall be removed and disposed of by the Contractor as specified for surplus excavated materials under Section 02300, EARTHWORK.
- B. Work damaged by blasting shall be repaired or replaced at the Contractor's expense.
- C. If rock is excavated beyond the limits of payment indicated on the drawings, specified, or authorized in writing by the Engineer, the excess excavation, whether resulting from overbreakage or other causes, shall be backfilled, by and at the expense of the Contractor, as specified below:

1. In pipe trenches, excess excavation shall be filled with the required material and compacted in the same manner as specified for the material in the zone around the pipe under Section 02300 EARTHWORK.
2. In excavations for structures, excess excavation in the rock beneath foundations shall be filled with concrete which shall have a minimum 28-day compressive strength of 3000 psi. Other excess excavation shall be filled with Class B backfill compacted to a minimum of 92 percent density (ASTM D1557 Method C) as specified under Section 02300, EARTHWORK.
3. If the rock below normal depth is shattered due to drilling or blasting operations of the Contractor, and the Engineer considers such shattered rock to be unfit for foundations, the shattered rock shall be removed and the excavation shall be backfilled with concrete as required, except that in pipe trenches crushed stone may be used for backfill, if approved. All such removal and backfilling shall be done by and at the expense of the Contractor.

D. When directed by the Engineer, the Contractor shall remove all dirt and loose rock from designated areas and shall clean the surface of the rock thoroughly to determine whether seams or other defects exist.

E. When concrete is to be placed on rock, the rock shall be free of all vegetation, dirt, sand, clay, boulders, scale, excessively cracked rock, loose fragments, water, ice, snow, and other objectionable substances.

3.03 VIBRATION AND AIR BLAST MONITORING:

A. The Contractor shall measure air blast and vibration levels of blasting operations to assure compliance with all applicable regulations and local permits.

B. Records of each day's air blast and vibration measurements shall be submitted to the Engineer in writing no later than the start of the next day's work. Records shall include, as a minimum:

- Identification of instrument
- Name of observer
- Name of interpreter
- Distance and direction of recording station from the area of detonation
- Date and exact time of reading
- Type of ground at recording station

- Peak particle velocity for all components as well as resultant for all frequencies of vibrations
- Duration of motion with a velocity in excess of one thousandth of an inch per second
- A copy of the photographic record of seismograph readings
- Peak air blast level.

3.04 BLASTING RECORDS:

The Contractor shall prepare and submit to the Engineer daily blast reports, including logs of each blast. Reports shall be submitted to the Engineer no later than the start of the next day's work. However, during each day of blasting, the Contractor shall review and shall provide access for the Engineer to review the data from that day's blasting. Reports after each blast shall include at least the following information for each blast:

- Date, time, and location of blast
- Permit number and expiration date
- Amount and type of explosives used by weight and number of cartridges
- Total number of delays used and number of holes used for each delay
- On a diagram of the blast pattern, indicate total number and depth of holes, maximum charge per delay, maximum charge per hole, and corresponding delay number
- An evaluation of the blast indicating areas of significant overbreak, unusual results, and any recommended adjustments for the next blast.

3.05 POST BLASTING INSPECTIONS:

The Contractor shall examine any properties, structures, and conditions where complaints of damage have been received or damage claims have been filed. Advance notice shall be given to all interested parties so that the parties may be present during the final examination. Records of the final examination shall be signed and distributed to the owner of the property, the head of the local fire department, and the Engineer.

END OF SECTION

SECTION 02513

INSULATION FOR PIPELINES

PART 1 - GENERAL

1.01 WORK INCLUDED:

This Section covers the furnishing of all material, accessories, labor, and equipment necessary to insulate the pipelines where shown on the drawings and where so directed by the Engineer.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02080, DUCTILE IRON PIPE AND FITTINGS

1.03 REFERENCES:

- A. The following standards form a part of this specification as referenced:

American Society for Testing and Materials (ASTM)

ASTM C552 Specification for Cellular Glass Block and Pipe Thermal Insulation

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Six sets of manufacturer's literature of the materials of this section and installation instructions for the products being provided for the project shall be submitted to the Engineer for review.
- B. A sample of the insulation shall be submitted to the Engineer.

PART 2 - PRODUCTS

2.01 INSULATION: DIRECT BURIED PIPE

- A. Insulation shall be cellular glass type. The insulation shall be a cellular glass product that is made specifically for thermal insulation of piping and is compatible with the piping material. Insulation shall be a minimum of 2-inches thick, unless otherwise shown on the drawings.
- B. Insulation shall be composed of all glass sealed cells having no binders or fillers. The completed product shall be rigid and impermeable, with an ultimate compressive

strength of at least 100 psi. The thermal conductivity of the cellular glass shall be no higher than 0.40 BTU/(hr)(sq. ft.)(EF/in).

- C. The cellular glass insulation shall comply with all requirements of ASTM C552. The cellular glass shall be fabricated in half sections whenever possible.
- D. Bands for securing the insulation to the pipe shall be 0.5 inches wide by 0.020 inches thick made of stainless steel.
- E. The jacketing for the insulation shall be one of the following methods:
 - 1. A 125 mil (3mm) thick, heat sealed high polymer asphaltic membrane with an integral glass scrim and integral 1 mil (.02mm) aluminum foil and a thin Mylar film on the surface, equal to Pittwrap Jacketing as manufactured by Pittsburgh Corning or equal.
 - 2. Mastic - asphalt cutback mastic, equal to Pittcote 300 Finish, as manufactured by Pittsburgh Corning or equal.
 - 3. Reinforcing fabric - an open mesh polyester fabric with a 6 x 5.5 mesh/inch configuration, equal to PC Fabric 79, as manufactured by Pittsburgh Corning or equal.
- F. The insulation shall be "Foamglass" with jacketing as manufactured by Pittsburgh Corning Corporation, Pittsburgh, PA, or an approved equal. A minimum of 6" layer of fine sand shall surround the insulated pipe before rock free backfill is used in the trench.
- C. The Foamglass and jacketing shall be installed per the manufacturer instructions included in the approved shop drawings.
- G. Tees, valves, and bends shall be covered with form fitting factory made sections.

2.02 INSULATION: ABOVE GROUND PIPING

- A. Insulation shall be cellular glass type. The insulation shall be a cellular glass product that is made specifically for thermal insulation of piping and is compatible with the piping material. Insulation shall be a minimum of 2-inches thick, unless otherwise shown on the drawings.
- B. Insulation shall be composed of all glass sealed cells having no binders or fillers. The completed product shall be rigid and impermeable, with an ultimate compressive strength of at least 100 psi. The thermal conductivity of the cellular glass shall be no higher than 0.40 BTU/(hr)(sq. ft.)(EF/in).
- D. The cellular glass insulation shall comply with all requirements of ASTM C552. The cellular glass shall be fabricated in half sections whenever possible.
- E. The jacketing for the insulation shall be one of the following methods:
 - 1. Fiber reinforced tape - 3/4" wide - Scotch #898 by 3M corp. or equal.

2. Sealant - Pittseal 444 by Pittsburgh Corning or equal.
 3. Vapor Retarder Mastic - Pittcote 300 by Pittsburgh Corning or equal.
 4. Weather Barrier Mastic - Pittcote 404 by Pittsburgh Corning or equal.
 5. Reinforcing Fabric - PC Fabric 79 by Pittsburgh Corning or equal.
 6. Metal Jacketing - 0.016" smooth aluminum jacket.
 7. Metal Bands - 0.5" X 0.020" stainless steel bands with matching seals.
 8. Vapor Retarder Laminate (This can be either shop or field applied)
 9. Bore coating - Hydrocal B-11 gypsum cement by U.S. Gypsum Corp of equal.
- F. The insulation shall be "Foamglass" with jacketing as manufactured by Pittsburgh Corning Corporation, Pittsburgh, PA, or an approved equal.
- G. The Foamglass and jacketing shall be installed per the manufacturer instructions included in the approved shop drawings.
- H. Tees, valves, and bends shall be covered with form fitting factory made sections.

2.03 INSULATION: INDOOR APPLICATIONS

- A. Insulation shall be cellular glass type. The insulation shall be a cellular glass product that is made specifically for thermal insulation of piping and is compatible with the piping material. Insulation shall be a minimum of ? inches thick, unless otherwise shown on the drawings.
- B. Insulation shall be composed of all glass sealed cells having no binders or fillers. The completed product shall be rigid and impermeable, with an ultimate compressive strength of at least 100 psi. The thermal conductivity of the cellular glass shall be no higher than 0.40 BTU/(hr)(sq. ft.)(EF/in).
- I. The cellular glass insulation shall comply with all requirements of ASTM C552. The cellular glass shall be fabricated in half sections whenever possible.
- J. Tees, valves, and bends shall be covered with form fitting factory made sections.
- K. The jacketing for the insulation shall be one of the following methods:
1. Fiber reinforced tape - 3/4" wide - Scotch #898 by 3M corp. or equal.
 2. Sealant - Pittseal 444 by Pittsburgh Corning or equal.
 3. Vapor Retarder Mastic - Pittcote 300 by Pittsburgh Corning or equal.
 4. Weather Barrier Mastic - Pittcote 404 by Pittsburgh Corning or equal.
 5. Reinforcing Fabric - PC Fabric 79 by Pittsburgh Corning or equal.
 6. Metal Jacketing - 0.016" smooth aluminum jacket.
 7. Metal Bands - 0.5" X 0.020" stainless steel bands with matching seals.
 8. Vapor Retarder Laminate (This can be either shop or field applied)
 9. Bore coating - Hydrocal B-11 gypsum cement by U.S. Gypsum Corp of equal.
- L. The insulation shall be "Foamglass" with jacketing as manufactured by Pittsburgh Corning Corporation, Pittsburgh, PA, or an approved equal.

- M. The Foamglass and jacketing shall be installed per the manufacturer instructions included in the approved shop drawings.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Cellular glass shall not be applied to the piping until the piping has been wiped clean and supported so that there is adequate space to apply the full thickness of insulation and the covering completely around the pipe. The Contractor must obtain the Engineer's approval before the installation begins.
- B. Cellular glass insulation and jacketing shall be applied in accordance with the manufacturers installation procedures included in the approved shop drawings.
- C. There shall be at least three 0.50-inch wide stainless steel bands secured around each joint and these bands shall be placed not over 9 inches on center on straight sections of pipe.
- D. Tees, valves, and bends shall be covered with form fitting factory made sections.
- E. All testing of the piping system, such as hydrostatic, x-ray or other such testing, shall be accomplished prior to application of insulation.

END OF SECTION

SECTION 02514

HYDRANTS AND VALVES

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section covers the furnishing and installation of all outside hydrants, valves and appurtenances as indicated on the drawings and as specified herein.
- B. Pipe and couplings shall be specified under the appropriate pipe sections.

1.02 RELATED WORK:

- A. Section 02300, EARTHWORK
- B. Section 02080, DUCTILE IRON PIPE AND FITTINGS
- C. Section 02516, CONNECTIONS TO EXISTING WATER MAINS

1.03 REFERENCES:

- A. The following standards form a part of this specification:

American Society for Testing and Materials (ASTM)

ASTM	A48	Gray Iron Castings
ASTM	A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM	A536	Ductile Iron Castings
ASTM	B62	Composition Bronze or Ounce Metal Castings
ASTM	D429	Test Method for Rubber Property Adhesion to Rigid Substrate.

American Water Works Association (AWWA)

AWWA	C500	Gate Valves, 3 through 48 inch NPS, For Water and Sewerage Systems
AWWA	C502	Dry-Barrel Fire Hydrants

AWWA	C504	Rubber-Seated Butterfly Valves
AWWA	C515	Resilient-Seated Gate Valves, 3-through 12-inch NPS, for Water and Sewerage Systems
AWWA	C550	Protective Interior Coatings for Valves and Hydrants
		Federal Specifications (FS)
FS	TT-V-51F	Varnish, Asphalt

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Shop drawings shall be submitted for the hydrants, valves and appurtenances indicating type of joint, and lining and coating, etc., in accordance with the specifications.
- B. Shop drawings shall consist of manufacturer's scale drawings, cuts or catalogs including descriptive literature and complete characteristics and specifications, and code requirements.
- C. Refer to Paragraph 3.01.A for Affidavit of Compliance required to be submitted.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Valves shall open right (clockwise).
- B. Hydrants shall open left (counterclockwise).

2.02 HYDRANTS:

- A. Hydrants shall conform to the requirements of AWWA C502. They shall be equipped with a 4-1/2-inch main valve and 6-inch mechanical joint inlet.
- B. Hydrants shall have one 4-1/2-inch pumper and two 2-1/2- inch hose connections. Threads shall be Dedham standard thread.
- C. Hydrant operating and nozzle cap nuts shall be of pentagonal shape and measure one and one half inches from flat to point. The height of the nut shall not be less than one inch.
- D. All internal operating parts including main valve, main valve seat, drain valve mechanism, operating rod, etc., shall be removable without excavating.

- E. Main valve seats shall be made of brass or bronze, and shall screw into a seat ring or sub-seat, which shall also be made of brass or bronze.
- F. Hydrants shall be traffic models with frangible bolts or breakaway couplings. Details of hydrant design shall meet the requirements of the Owner.
- G. For purposes of standardization, hydrants shall be Mueller "Super Centurion 250," Model A-421 as manufactured by Mueller Co., Decatur, IL; Darling B-50-B, B-62-B, B-84-B as manufactured by American Darling Valve and Manufacturing Co., Birmingham, AL; or FireFlo - Model F-06 as manufactured by United, Middletown, RI.

2.03 HYDRANT PAINT:

- A. Hydrants shall be thoroughly cleaned and given two shop or field coats of paint in accordance with AWWA C502 and the instructions of the paint manufacturer. Paint color shall be the standard hydrant color of the Owner as follows:
 - 1. Barrel - Blue
 - 2. Bonnet - Reflective White
 - 3. Nozzle Caps - OSHA White
- B. If the hydrants are delivered with the Owner's standard color, they shall be given one matching field coat of an alkyd gloss enamel. If the hydrants are not delivered with the Owner's standard color, they shall be given two coats of an alkyd gloss enamel, colors as indicated above.
- C. Hydrant paint shall be as manufactured by PPG Industries, Pittsburgh, PA; Tnemec Company, Inc., Kansas City, MO; or Minnesota Mining and Manufacturing Co. (3M), St. Paul, MN; or approval equal.
- D. Alkyd gloss enamel shall be Series 54-300 by PPG, or 2H-Tneme by Tnemec; or approved equal. Reflective paint shall be Scotchlite #7211 by 3M.

2.04 RESILIENT SEAT GATE VALVES:

- A. Resilient seat, wedge type gate valves shall be manufactured to meet all applicable requirements of AWWA C515. All valves shall be bubble-tight at 200 psi water working pressure, tested in both directions.
- B. Valve bodies shall be of ductile iron and shall have non-rising threaded bronze stems acting through a bronze stem nut. Opening nuts shall be 2 inches square and shall open as specified above. All buried valves shall have mechanical joint ends.
- C. Valve wedges shall be of ductile iron with resilient seating surfaces permanently bonded to the wedges in strict accordance with ASTM D429 or attached to the face of the wedges

with stainless steel screws. Each valve shall have a smooth, unobstructed water way free from sediment pockets.

- D. Valves shall have low friction, torque-reduction thrust bearings. All O-rings and gaskets shall be removable without taking the valves out of service.
- E. A non-toxic epoxy coating which is safe for potable water shall be applied to exterior and interior valve surfaces.
- F. Valves for horizontal applications shall have Delrin wedge covers, and be specifically designed for horizontal installation.
- G. Resilient seat gate valves shall be as manufactured by Clow Valve Co., Oskaloosa, IA; Mueller Co., Decatur, IL; American Valve and Hydrant; Birmingham, AL; Waterous Co., S. St. Paul, MN; or United, Middletown, RI.
- H. Post indicating valve assemblies shall have a post and indicator as an integral part of the resilient seated gate valve assembly. The unit shall be provided with a detachable crank which OPENS the valve in a counterclockwise direction. Shafts shall be Type 304 stainless steel. Post indicators and valves shall be UL listed, FM approved. Post indicators and valves shall be as manufactured by Pratt, Clow or approved equal."

2.05 TAPPING SLEEVES AND VALVES:

- A. Tapping sleeves and valves shall consist of a split cast iron or ductile iron sleeve tee with mechanical joint ends on the main and a flange on the branch. Tapping-type gate valves shall have one flange and one mechanical joint end. The valves shall conform to the requirements hereinbefore specified for gate valves and shall be furnished with a 2-inch square operating nut. The Contractor shall be responsible for verifying the outside diameter of the pipe to be tapped.
- B. Oversized valves shall be provided as required to permit the use of full size cutters. Before backfilling, all exposed portions of bolts used to hold the two halves of the sleeve together shall be heavily coated with two coats of bituminous paint comparable to Inertol No. 66, Special Heavy. Sleeves shall be of cast iron furnished with rubber gaskets. Gaskets shall cover the entire area of flange surfaces.
- C. Tapping sleeves and valves shall be as manufactured by Clow Valve Co., Oskaloosa, IA; Mueller Co., Decatur, IL; American Value and Hydrant, Birmingham, AL; or approved equal.

2.06 BUTTERFLY VALVES:

- A. Buried butterfly valves shall be Class 150B, iron body, rubber seated, with mechanical joint ends. Butterfly valves shall conform to AWWA C504, except as otherwise specified

herein. Butterfly valves shall have valve seats designed to provide bubble-tight shutoff at 150 psi upstream and downstream.

- B. Butterfly valve designs utilizing continuous lining on the internal body surfaces and extending over the flanges, will NOT be acceptable. Valve disks shall seat at an angle of 90 degrees to the axis of the pipe.
- C. Valve seats shall be of molded natural rubber, BUNA-NM or EPDM. Rubber seats may be attached to the body or the disk. If the seat is attached to the disk, the seat ring on the body shall be of stainless steel.
- D. Seats mounted on the disk shall be securely clamped to the disk. All clamps, retaining rings, and their fasteners shall be Series 300 stainless steel.
- E. The valve disk shall be of either ductile iron conforming to ASTM A536 or Type 304 stainless steel.
- F. The valve shaft shall be Type 300 stainless steel or carbon steel with stainless steel joints. The valve disk and shaft connection shall be by means of mechanically secured taper pins extending through the disk and shaft. Taper pins, lockwashers and nuts shall be 18-8 stainless steel. The shaft seals shall be designed for the use of standard chevron type packing or standard O-ring seals.
- G. The manual operation mechanism shall be firm fixed to the valve body. The operator shall be permanently lubricated, and totally enclosed with a cast iron case, and the nut for buried valves shall turn in the direction specified above to open. The operator for buried valves shall be suitable for submersion. The operator shall have adjustable threaded collars at each end of the stroke.
- H. Butterfly valves shall be as manufactured by Mueller Co., Decatur, IL; Clow Valve Co., Oskaloosa, IA; Keystone Valves USA, Houston, TX; Henry Pratt Company, Aurora, IL; or approved equal and shall conform to the above specifications.

2.07 DAMPENED SWING CHECK VALVES:

- A. Provide swing check valves with weighted arm plus an externally mounted air cushion cylinder APCO Series 6000 as manufactured by Valve and Primer Corporation, Inc.
- B. The dampened swing check valves shall be flanged with cast iron body, bronze seat ring and continuous stainless steel shaft connected to an external lever and weight and bronze air cushion cylinder.
- C. Valves shall be full ported and prevent reverse flow when the inlet pressure becomes less than the downstream pressure, and shall be tight seated.

- D. The disc shall be cast iron, utilizing a double clevis hinge connected to a ductile iron disc arm. The disc arm assembly shall be suspended from the stainless steel shaft.
- E. The air cushion cylinder shall be constructed of corrosion resistant material and the piston shall be totally enclosed within the cylinder (not open at one end). The cushion cylinder assembly shall be externally attached to the right side of the valve body looking downstream and be adjustable to cushion the closure of the valve. Cushioning shall be by air trapped in the cushion cylinder, which shall be fitted with a one-way adjustable control check valve to cushion disc contact to the seat at the shut-off point.

2.09 INSERTION VALVES:

- A. Insertion valves shall consist of a ductile iron or ASTM A-36 steel fusion bonded epoxy coated to 10-12 mils in accordance with AWWA C-213. The valves shall conform to the requirements herein specified for gate valves and shall be furnished with a 2-inch square operating nut. The contractor shall be responsible for verifying the outside diameter of the pipe where the valve will be inserted.
- B. Before backfilling, all exposed portions of bolts used to hold the two halves of the sleeve together shall be heavily coated with two coats of bituminous paint comparable to Inertol No. 66, Special Heavy. Sleeves shall be furnished with a rubber gasket that fits 360 degrees around the pipe at each end.
- C. Insertion valves shall be as manufactured by Hydra-Stop, Inc., Blue Island, IL; Romac Industries, Inc, Seattle, Washington; or approved equal.

2.10 VALVE BOXES AND EXTENSIONS:

- A. Valve boxes shall be manufactured in North America. The minimum outside diameter of the boxes shall be 5½-inches and the lengths shall be as necessary to suit the ground elevation and the depth of each valve operator, regardless of the depth of cover.
- B. When there is more than 6 feet of cover, valve operators shall have non-rising extension stems which raise the operating nut to a depth of approximately 4 feet below grade. The extension stem shall have a centering support ring at the upper end. The lower socket shall be tapped with a set screw into the valve nut to prevent the extension stem from lifting off the valve nut.
- C. Each valve shall be provided with a box which has a close fitting 7-1/4-inch diameter cover and is substantially dirt-tight. The top of the cover shall be flush with the top of the box rim. The word "WATER" shall be cast in the top of the cover.
- D. Valve boxes shall be of cast iron and of the adjustable sliding, heavy pattern type. They shall be so designed and constructed as to prevent direct transmission of traffic loads to the pipe or valve. The upper or sliding section of the box shall be provided with a flange on the top of the section (not on the bottom) having sufficient bearing area to prevent undue

settlement. The lower section of the box shall be designed to enclose the operating nut and stuffing box of the valve and to rest on the backfill. The boxes shall be adjustable through at least 6 inches vertically without reduction of lap between sections to less than 8 inches.

PART 3 - EXECUTION

3.01 AFFIDAVIT OF COMPLIANCE

- A. The manufacturer shall furnish as part of the shop drawing submittal the ENGINEER with an affidavit stating that valve(s), hydrants conform to the applicable requirements of the applicable AWWA Standard and the ENGINEER's specifications, and that all tests specified therein have been performed and all test requirements have been met and the test date.
- B. A copy of the Affidavit of Compliance shall be delivered to the construction site attached to each valve and/or hydrant furnished. The Affidavit shall be attached to the valve or hydrant inside a waterproof pouch.
- C. Any valve or hydrant received without the required affidavit shall be removed from the project and replaced at no expense to the Owner.
- D. All materials shall be certified "NEW". No reconditioned or repaired materials are permitted. Any reconditioned or repaired materials furnished or installed shall be removed and replaced with new materials at no expense to the Owner.

3.02 INSTALLATION:

- A. All valves shall be carefully installed and supported in their respective positions free from distortion and strain. Care shall be taken to prevent damage or injury to the valves and appurtenances during handling and installation.
- B. All material shall be carefully inspected for defects in workmanship and all debris and foreign material cleaned out of valve openings and seats. All mechanisms shall be operated to check for proper functioning, and all nuts and bolts checked for tightness.
- C. Valves and other equipment that do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.
- D. Hydrants shall be set plumb. Earth fill shall be carefully tamped around the hydrants to a distance of 4 feet on all sides of the hydrant, or to the undisturbed trench face, if less than 4 feet. Hydrants and connecting pipe shall have at least the same depth of cover as the distributing main. Hydrants shall be set upon a layer of stone or a slab of concrete not less than 4 inches thick and 15 inches square. The side of the hydrant opposite the pipe connection shall be firmly wedged against the vertical face of the trench with a concrete thrust block, as indicated on the drawings.

- E. Broken stone shall be placed around the base of the hydrant at the location of the drain hole, and backfill around the hydrant shall be thoroughly compacted to the grade line in a satisfactory manner. Hydrants shall have the interiors cleaned of all foreign matter before installation, and shall be inspected in both the open and closed positions.
- F. The body of the hydrant shall be of sufficient length to allow the hydrant to be set at the proper elevation, as shown on the drawings. Extensions shall be furnished and installed at the Contractor's expense, when required for greater depths.
- F. Valve boxes shall be set plumb, flush with the ground or paved surface, and centered directly over the operating nut of the valves. Earth fill shall be carefully tamped around the valve boxes to a distance of 4 feet on all sides of the boxes or to the undisturbed trench face, if less than 4 feet.
- G. Valves shall be operational and accessible at all times during construction and warranty period. The Contractor shall verify proper operation of all valves in the presence of the Engineer and/or Owner following completion of the project and prior to the acceptance of substantial completion.

END OF SECTION

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SECTION 02515

SERVICE CONNECTIONS

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers the furnishing and installation of new water service connections and the repair, replacement, and/or transfer of existing water service connections as shown on the drawings, as specified herein, and as directed by the Engineer.

1.02 RELATED WORK:

- A. Section 02745, PAVING
- B. Section 02080, DUCTILE IRON PIPE AND FITTINGS

1.03 REFERENCES:

- A. The following standards form a part of this specification:

American Society for Testing and Materials (ASTM)

ASTM B88 Seamless Copper Water Tube

ASTM D2737 Polyethylene (PE) Plastic Tubing

American Water Works Association (AWWA)

AWWA C800 Underground Valves and Fittings

AWWA C651 Standard for Disinfecting Water Mains

AWWA C901 Polyethylene Pressure Pipe, Tubing, and Fittings, 1/2-inch through 3-inch for Water Service

Federal Specifications (FS)

FS WW-T-799C Tube, Copper, Seamless

1.04 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF THE GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Six sets of manufacturer's literature of the materials of this section for review.

PART 2 - PRODUCTS

2.01 SERVICE PIPING:

- A. Piping for buried copper water services shall be continuous Type K annealed seamless copper water tubing conforming to ASTM B88 Standard Specification for Seamless Copper Water Tube or U.S. Federal Specification WW-T-799C for Tube, Copper, Seamless. Tubing shall be 1-inch diameter unless otherwise indicated.
- B. Couplings, if required, for existing to new service pipe connections shall have compression connections on the inlet and compression connections on the outlet.

2.02 CORPORATION STOPS:

- A. Corporation stops shall be of bronze. The inlet shall have AWWA taper thread (CC) connections and the outlet shall have compression connections.
- B. Service clamps shall be installed with all corporation stops 2 inches and larger in size and with all corporation stops installed in PVC pipe. Clamps shall be all bronze, ductile iron or stainless steel, double strap, AWWA taper thread (CC) with O-ring seal.
- C. Corporation stops shall be Mueller Ori-Corp by Mueller Co., Decatur, IL; or approved equal.

2.03 CURB STOPS:

- A. Curb stops shall be of brass. The inlet and the outlet shall have compression or flared connections.
- B. Curb stops shall be Oriseal III by Mueller Co., Decatur, IL; or approved equal.

2.04 CURB BOXES:

- A. The cast iron box shall be the sliding Buffalo type with arch pattern. Minimum inside diameter of the upper section shall be 1-1/2-inch for 3/4-inch and 1-inch curb stops and 2-inch for 1-1/2-inch and 2-inch curb stops.
- B. Boxes shall be equipped with 30-inch stationary extension rods with pinned connections to the curb stop.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Where new water mains are being installed and existing water services are to be transferred to the new main, the Contractor shall discontinue the existing water services by shutting down the corporation stop at the old water main, unless specifically directed otherwise. The Contractor shall take special care to minimize the interruption of existing water service.
- B. The Contractor shall tap a new corporation stop, cut the existing service piping and connect the new service piping to the old service piping using an approved coupling at a point between the main and the existing curb stop and box.
- C. Where transfers are to be made and the existing curb stop and box cannot be utilized or a new curb stop and box is required, the Contractor shall connect the new service piping to the existing service piping using an approved coupling approximately 12 inches from the curb stop on the building side of the stop.
- D. Where transfers are being made and the existing service is of lead, galvanized steel, or iron, the service shall be replaced to the curb stop and box unless otherwise directed. If required, the curb stop and box shall be replaced as specified above.
- E. Curb stops and boxes shall be set plumb, flush with the ground or paved surface, and centered with the box located directly over the stop. The box shall be set on a concrete block or flat stone. Earth fill shall be carefully tamped around the boxes to a distance of 4 feet on all sides of the box or to the undisturbed face of the trench, if less than 4 feet.
- F. Curb stops shall be operational and accessible at all times during construction and warranty period. The Contractor shall verify the proper operation of all curb stops in the presence of the Engineer and/or Owner following completion of the project and prior to the acceptance of substantial completion.
- G. All services shall be installed at 5 feet 0 inches of cover unless otherwise directed by the Engineer.
- H. Service connections shall be tested and disinfected in accordance with AWWA standards.

END OF SECTION

SECTION 02516

CONNECTIONS TO EXISTING WATER MAINS

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section covers connections to existing water mains, complete.
- B. The Contractor shall furnish all pipe, fittings, valves, tapping machines, if required, and appurtenances. The Contractor shall do all excavation and backfill as required.

1.02 RELATED WORK:

- A. Section 02080, DUCTILE IRON PIPE AND FITTINGS.
- B. Section 02514, HYDRANTS AND VALVES. (Tapping sleeves and valves specified)

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 CONTRACTOR OPERATIONS:

- A. The Contractor shall make all connections to the existing mains as indicated on the drawings and as herein specified.
- B. The Contractor shall develop a program for the construction and putting into service of the new work subject to the approval of the Engineer. All work involving cutting into and connecting to the existing work shall be planned so as to interfere with operation of the existing facilities for the shortest possible time and when the demands on the system best permit such interference even to the extent of working outside of normal working hours to meet these requirements.
- C. The Contractor shall have all possible preparatory work done prior to making the connection and shall provide all labor, tools, material, and equipment required to do the work in one continuous operation.
- D. The Contractor shall have no claim for additional compensation, by reason of delay or inconvenience, for adapting his operations to the needs of the Owner's water supply. No damages shall be claimed by the Contractor for delays in dewatering pipelines nor shall any damages be claimed because of water leaking through closed valves after dewatering is completed.

- E. Under no circumstances shall any customers be without water for a period of more than 4 hours without prior approval of the Owner. Should it appear that any customer will be without water for more than 4 hours, the Contractor shall install temporary water service as specified in Section 02511, TEMPORARY WATER SERVICE where directed by the Engineer.
- F. Existing pipeline that is not to be abandoned but is damaged by the Contractor during the work shall be replaced by him at his own expense in a manner approved by the Engineer.

3.02 TAPPING CONNECTION TO EXISTING MAINS:

- A. Tapping connections to the existing mains, where indicated on the drawings, shall be made with service pressure in the main, using tapping sleeves and valves and a suitable tapping machine.
- B. Other connections to existing mains shall be made with the main out of service, unless otherwise directed by the Engineer. Such connections will not require tapping sleeves and valves but connections as indicated on the drawings.

END OF SECTION

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SECTION 02745

PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED:

The Contractor shall furnish all labor, materials and equipment and shall replace the pavements as indicated on the drawings and as herein specified.

1.02 RELATED WORK:

- A. Section 01562, DUST CONTROL
- B. Section 02300, EARTHWORK

1.03 SYSTEM DESCRIPTION:

A. GENERAL

The types of pavement systems to be utilized on this project are as follows:

TYPE 1. PERMANENT TRENCH PAVEMENT
TYPE 2. CURB TO CURB OVERLAY

B. TYPE 1. PERMANENT TRENCH PAVEMENT

Areas shall be paved with temporary trench binder course pavement, 2 inches thick, as soon as practicable after installation of individual pipe line segments. Temporary pavement shall be maintained a minimum of 90 days prior to installation of permanent trench binder course pavement, 2 inches thick and permanent trench top course pavement, 1-1/2 inches thick. This may require that the temporary pavement be maintained until the following year, at which time the permanent pavement shall be installed. Permanent trench binder course and trench top course pavement shall be installed only with the approval of the Engineer.

C. TYPE 2. CURB TO CURB OVERLAY

Areas shall be paved with permanent trench binder course pavement, 2-inches thick, in lieu of temporary pavement. Permanent trench binder course pavement shall be installed flush with the existing pavement and maintained until such time as the permanent curb to curb top course pavement, 1-1/2 inches thick, is installed. The permanent curb to curb top course pavement shall not be installed until the following year or, at a minimum, until the trench binder pavement has been in place not less than 90 days, as approved by the Engineer.

1.04 REFERENCES

The following standards form a part of these specifications and indicate the minimum standards required:

American Society for Testing and Materials (ASTM)

ASTM D1557 Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 Pound Rammer and 18-Inch Drop

Commonwealth of Massachusetts Highway Department Standard Specification for Highway and Bridges (MHD)

MHD 405 Gravel Base Course

MHD 420 Class I Bituminous Concrete Base Course, Type I-1

MHD 460 Class I Bituminous Concrete Pavement

MHD 476 Cement Concrete Pavement

MHD 860 Reflectorized Pavement Markings

Federal Specifications

SS-S-164 Sealing Compound, Hot Poured Type, for Joints in Concrete

SS-S-1401C Sealants, Joint, Non-Jet-Fuel-Resistant, Hot Applied, for Portland Cement and Asphalt Concrete Pavement

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

Six sets of complete job mix formula shall be submitted to the Engineer at least two weeks before any of the work of this section is to begin.

PART 2 - PRODUCTS

2.01 STATE HIGHWAY TRENCH REPAIR:

- A. See the state highway permit in Section 00890, PERMITS, for trench repair detail and Section 02300, EARTHWORK, for Controlled Density Fill mix information. The CDF shall satisfy the requirements listed in MHD Specification Section M4.08.0 FOR MHD Permits.

- B. The concrete slab for state highways shall consist of Class F, Type III Hi-Early strength, air-entrained cement concrete, as shown in MHD 476. Reinforcing steel shall be as called for in MHD 476, sized and located as shown on the drawings.

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 02300, EARTHWORK for Gravel Borrow.

2.03 BITUMINOUS CONCRETE PAVEMENT:

- A. Bituminous concrete pavements shall consist of Class I Bituminous Concrete, Type I-1.
- B. Bituminous concrete mixtures shall be within the composition limits of base courses, binder courses, top courses and surface treatment, in accordance with MHD M3.11.03, with constituents that conform to Table A, below.

TABLE A

PERCENT BY WEIGHT PASSING SIEVE DESIGNATION

Standard Sieves (in.)	Base Course	Binder Course	Top Course	Surface Treat.	Low Permeability Pavement	
					Dense Binder Course	Dense Top Course
2 in	100					
1 in	55-80	100			100	
¾ in		80-100			80-100	
5/8 in			100			
½ in	40-65	55-75	95-100		65-80	100
3/8 in			80-100	100		80-100
No.4	20-45	28-50	50-76	80-100	48-65	55-80
No.8	15-33	20-38	37-54	64-85	37-51	48-63
No.16			26-40	46-68		36-49
No.30	8-17	8-22	17-29	26-50	17-30	24-38
No.50	4-12	5-15	10-21	13-31	10-22	14-27
No.100*			5-16	7-17	6-18	6-18
No.200	0-4	0-5	2-7	3-8	0-6	4-8
Bitumen	4-5	4.5-5.5	5.5-7.0	7-8	5-6	7-8

* Percentages shown for aggregate sizes are stated as proportional percentages of total aggregate for the mix.

Unless authorized by the Engineer, no Job-Mix Formula will be approved which specifies:

Less than 4% passing No. 200 for Top Course.

Less than 6% bitumen for Top Course.

- C. The joint sealant shall be a hot poured rubberized emulsified asphalt sealant meeting the requirements of Federal Specifications SS-S-1401 or SS-S-164.
- D. The tack coat shall be an asphalt emulsion, RS-1 if required, conforming to MHD Section M3.03.0.

2.04 SEAL COAT:

- A. Seal coats shall be within the composition limits for protective seal coat emulsion in accordance with MHD M3.03.3.
- B. Silica sand when blended with seal coat emulsion shall be No. 30 silica sand.

2.05 PAVEMENT MARKINGS:

- A. Pavement markings shall conform to the requirements of MHD 860.
- B. The mixture of the marking material shall be within the composition limits for reflectorized pavement markings as described in the MHD Specifications as follows:
 - 1. Thermoplastic reflectorized pavement markings - M7.01.03/04.
 - 2. Fast drying traffic paint - M7.01.10/11.
 - 3. Fast drying white and yellow water-borne traffic paints - M7.01.23/24.

PART 3 - EXECUTION

3.01 GENERAL:

Paving courses required for the project shall be as shown on the drawings and as specified herein. Pavement thicknesses specified are measured in compacted inches. If a pavement course thickness exceeds 2-1/2 compacted inches, the course shall be installed in multiple lifts with each lift not exceeding 2-1/2 compacted inches in thickness.

3.02 STATE HIGHWAY TRENCH REPAIR:

Contractor shall construct and repair trenches in state highways in accordance with the state highway permit. Trench shall be backfilled with Controlled Density Fill or with earth, as stipulated in the permit and in Section 02300.

3.03 GRAVEL SUBBASE:

- A. The gravel subbase to be placed under pavement shall consist of 12-inches of gravel evenly spread and thoroughly compacted.
- B. The gravel shall be spread in layers not more than 4-inches thick, compacted measure. All layers shall be compacted to not less than 95 percent of the maximum dry density of the material as determined by ASTM D1557 Method C at optimum moisture content.

3.04 TEMPORARY BITUMINOUS PAVEMENT:

- A. Where specified and directed by the Engineer and after placement of the gravel subbase, the Contractor shall place temporary bituminous pavement above the trench, between the edges of the existing pavement. It shall consist of Class I Bituminous Concrete Pavement, Type I-1, 2-inches thick, in accordance with MHD 460.
- B. The temporary pavement shall be repaired as necessary to maintain the surface of the pavement until replaced by permanent pavement. When so directed by the Engineer, the Contractor shall remove the temporary pavement and install or regrade the subbase for installation of permanent pavement.

3.05 PERMANENT BITUMINOUS PAVEMENT:

- A. The bituminous paving mixture, equipment, methods of mixing and placing, and the precautions to be observed as to weather, condition of base, etc., shall be in accordance with MHD 460.
- B. BASE COURSE AND BINDER COURSE PAVEMENT:
 - 1. Immediately prior to installing the base and/or (**dense**) binder course, the trimmed edges shall be made stable and unyielding, free of loose or broken pieces and all edges shall be thoroughly broomed clean. Contact surfaces of trench sides, curbs, manholes, catch basins, or other appurtenant structures in the pavement shall be painted thoroughly with a uniform coating of asphalt emulsion (tack coat), just before any mixture is placed against them.
 - 2. The (**dense**) binder course shall be repaired as necessary to maintain the surface of the pavement until placement of the permanent overlay. If required, the Contractor shall place a leveling course before placing the permanent overlay.
- C. TOP COURSE OR SURFACE TREATMENT PAVEMENT (PERMANENT OVERLAY):
 - 1. (**Dense**) top course or surface treatment shall be placed over the trench or full width as shown on the drawings or as specified.

2. Prior to placement of the (**dense**) top course or surface treatment, the entire surface over which the top course or surface treatment is to be placed shall be broom cleaned and tack coated.
3. (**Dense**) top course or surface treatment pavement placed over trenches may be feathered to meet existing paved surfaces, if approved by the Engineer.
4. Prior to placing full width (**dense**) top course or surface treatment pavements, keyways shall be cut in all intersecting streets.

3.06 COLD PLANING

- A. The Contractor shall remove bituminous concrete pavement by use of an approved "cold planer" equipment to a depth sufficient to apply an overlay of 2 inches of bituminous concrete pavement. Existing pavement shall be removed to a depth of 2 inches at the road centerline and 3 inches at the curb line.
- B. The equipment shall be capable of accurately and automatically establishing profile grades along each edge of the machine by referencing from the existing pavement by means of a ski or matching shoe from an independent grade control and shall have an automatic system for controlling cross slope at a given rate.
- C. The machine shall be equipped with an integral loading means to immediately remove material being cut from the surface of the roadway and discharge cuttings into a truck, all in one operation. All planing machinery shall be equipped with dust-control devices to prevent any dust produced in the cutting operation from escaping into the air.
- D. The bituminous surfaces being planed and profiled shall be removed to a depth, width, grade and cross section directed by the Engineer. Loose material resulting from the operation shall be the property of the Owner unless otherwise directed by the Engineer.
- E. The planed surface shall provide a smooth riding surface free from severe gouges, continuous grooves, ridges, oil film and other imperfections of workmanship and shall have a uniform surface appearance exclusive of broken or cracked underlying pavement.
- F. All existing pavement around castings shall be removed with hand cold planing equipment or by the use of hand tools if necessary. Any castings damaged or disturbed shall be removed and replaced as directed by the Engineer, at the Contractor's expense.

3.08 PAVEMENT PLACEMENT:

- A. Unless otherwise permitted by the Engineer for particular conditions, only machine methods of placing the pavement shall be used. The equipment for spreading and finishing shall be mechanical, self-powered pavers, capable of spreading and finishing the mixture true to line, grade, width and crown. The mixtures shall be placed and compacted only at such times as to permit proper inspection and checking by the Engineer.

- B. After the paving mixtures have been properly spread, initial and intermediate compaction shall be obtained by the use of steel wheel rollers having a weight of not less than 240 pounds per inch width of tread.
- C. Final rolling of the top course or surface treatment pavement shall be performed by a steel wheel roller weighing not less than 285 pounds per inch width of tread at a mix temperature and time sufficient to allow for final smoothing of the surface and thorough compaction.
- D. Immediately after placement of top course or surface treatment pavement, all joints between the existing and new top course or surface treatment pavements shall be sealed with hot poured rubberized asphalt sealant meeting the requirements of Federal Specification SS-S-1401 or SS-S-164.
- E. Where there is no backing for the edges of the curb-to-curb pavement, the Contractor shall provide a gravel transition. The gravel transition shall be installed immediately after the pavement is placed, shall be feathered and extend a minimum of 18 inches, and shall be compacted using the same equipment as for pavement compaction. The gravel shall be uniformly graded material with a maximum size of 3/8 to 1/2 inch.
- F. When directed by the Engineer, the Contractor shall furnish and install additional paving to provide satisfactory transition for driveways and walkways impacted by a new curb-to-curb pavement installation. The transition installation will be considered incidental to the curb-to-curb pavement installation.

3.09 ADDITIONAL PAVING:

- A. If the Engineer determines that the existing bituminous concrete pavement on local streets is thicker than the permanent pavement specified herein, the Contractor may be required to install additional Type I-1 bituminous concrete to obtain the depth of the existing pavement.
- B. If for the installation of full width paving, the Engineer determines that the existing road surface requires additional leveling pavement, then the Contractor shall install additional Type I-1 bituminous concrete to bring the section to proper line and cross section. Additional paving required to restore the proper line and cross section of binder course installed by the Contractor which has become rough and uneven shall be furnished and installed at the expense of the Contractor.

3.10 PARKING LOTS AND DRIVEWAYS:

- A. Pavement shall consist of a 2-inch binder course and a 1-1/2-inch top course on a 12-inch gravel sub-base. All thicknesses are compacted thicknesses.

- B. Adjacent concrete work, slate work, sidewalks, structures, etc., shall be protected from stain and damage during the entire operation. Damaged or stained areas shall be replaced or repaired to equal their original condition.
- C. All joints between binder and top course shall be staggered a minimum of 6-inches.
- D. After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened sufficiently to prevent distortion and loss of fines, and in no case in less than 6 hours.
- E. Smoothness of all areas of the finished surface shall not vary more than 1/4-inch when tested with a 16 foot straight-edge, applied both parallel to and at right angles to the centerline of the paved area. At building entrances, curbs, and other locations where an essentially flush transition is required, pavement elevation tolerance shall not exceed plus or minus 1/8-inch. Irregularities exceeding these amounts, or which retain water on the surface, shall be corrected by removing the defective work and replacing or repairing it to the satisfaction of the Engineer.
- F. The surface area to be seal coated, as shown on the drawings, shall be swept and air cleaned. The first coat shall be applied with eight (8) pounds of #30 silica sand blended with each gallon of emulsion applied at a rate of 0.15 gallons per square yard. The second coat shall be a straight sealer applied at the rate of 0.1 gallons per square yard.
- G. Parking lot line painting shall be in accordance with Section 09900, PAINTING.

3.11 RAISING AND ADJUSTING CASTINGS:

- A. In areas of permanent top course paving, existing municipally-owned catch basin and manhole castings and valve boxes shall be raised to the proper grade where directed by the Engineer.
- B. Castings owned by private utilities shall be raised by their own forces. The Contractor shall be responsible for coordinating this work.
- C. The method of adjusting these castings shall be as follows: Cut around catch basin or manhole castings a minimum of 8-inches from casting. Excavate and if required rebuild up to 12-inches of masonry below the bottom of the casting. Backfill with suitable material and compact to bottom of casting. Place high, early strength cement or bituminous concrete collar, as directed, to approximately 1½-inches below the raised casting grade. Masonry work shall conform to Section 02631, PRECAST MANHOLES AND CATCH BASINS.
- D. In some areas, raising of castings may not be required. Where directed by the Engineer, castings not to be raised shall have at least 12-inches of bituminous concrete pavement chipped and removed around the casting. New bituminous concrete pavement shall be placed and compacted around such castings to approximately 1-1/2-inches below the top of the casting. The overlay course shall then be sloped down to the level of the casting.

- E. The method of raising valve boxes shall be as follows: Cut around valve box a minimum of 8-inches from valve box. Excavate as required and raise the valve box. Pour high early strength cement or bituminous concrete collar, as directed, to approximately 1-1/2-inches below the top of the valve box.
- F. Castings which need to be raised or adjusted to complete permanent curb to curb paving shall be done immediately prior to paving.

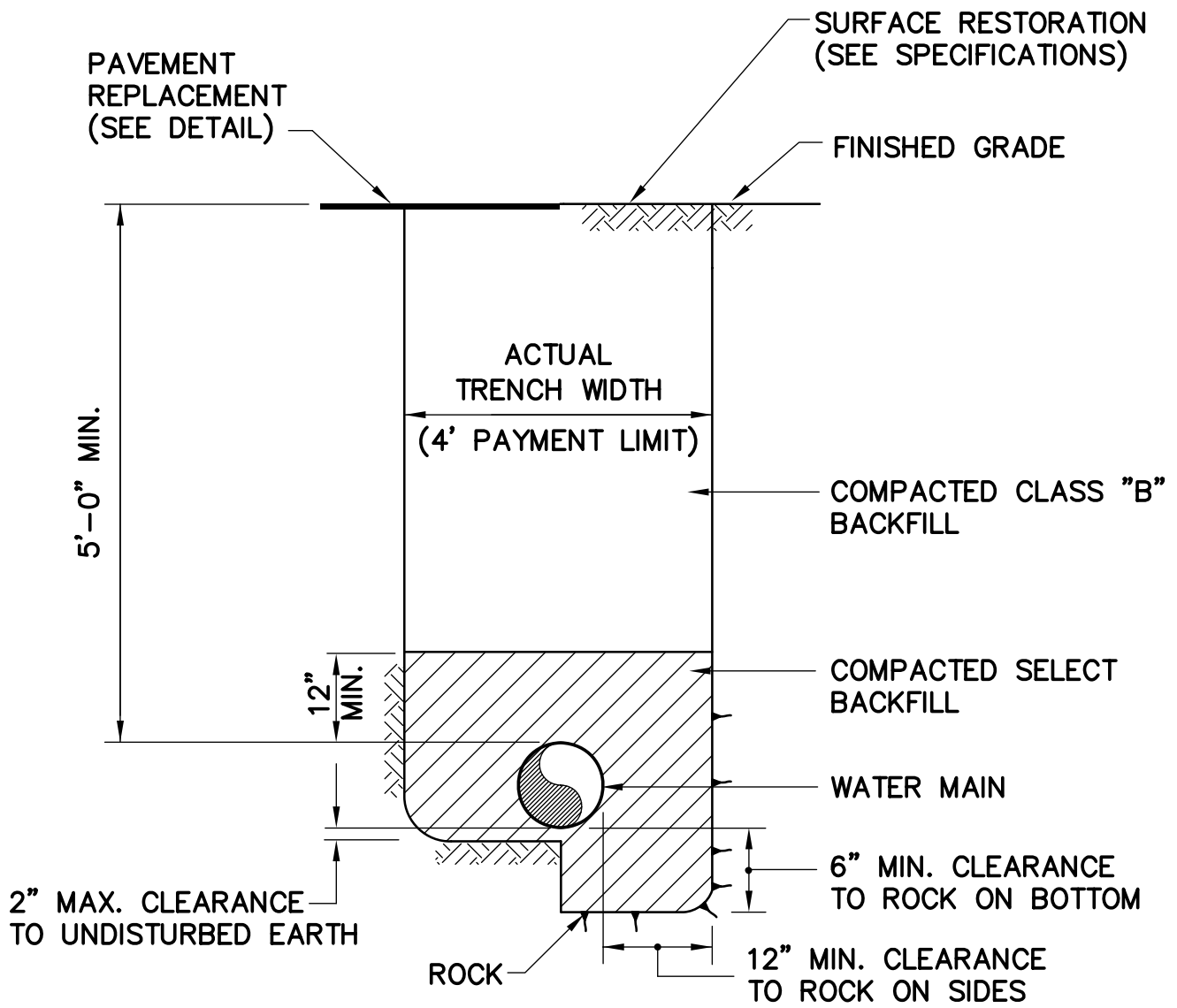
3.12 PAVEMENT MARKINGS:

- A. The Contractor shall replace all pavement markings removed or covered-over in carrying out the work, and as directed by the Engineer, no sooner than 48 hours after completion of permanent pavement. The markings shall be 4-inches wide, white or yellow, single or double lines as required.
- B. When directed by the Engineer, the Contractor shall provide temporary markings at no additional cost to the Owner.

3.13 PAVEMENT REPAIR:

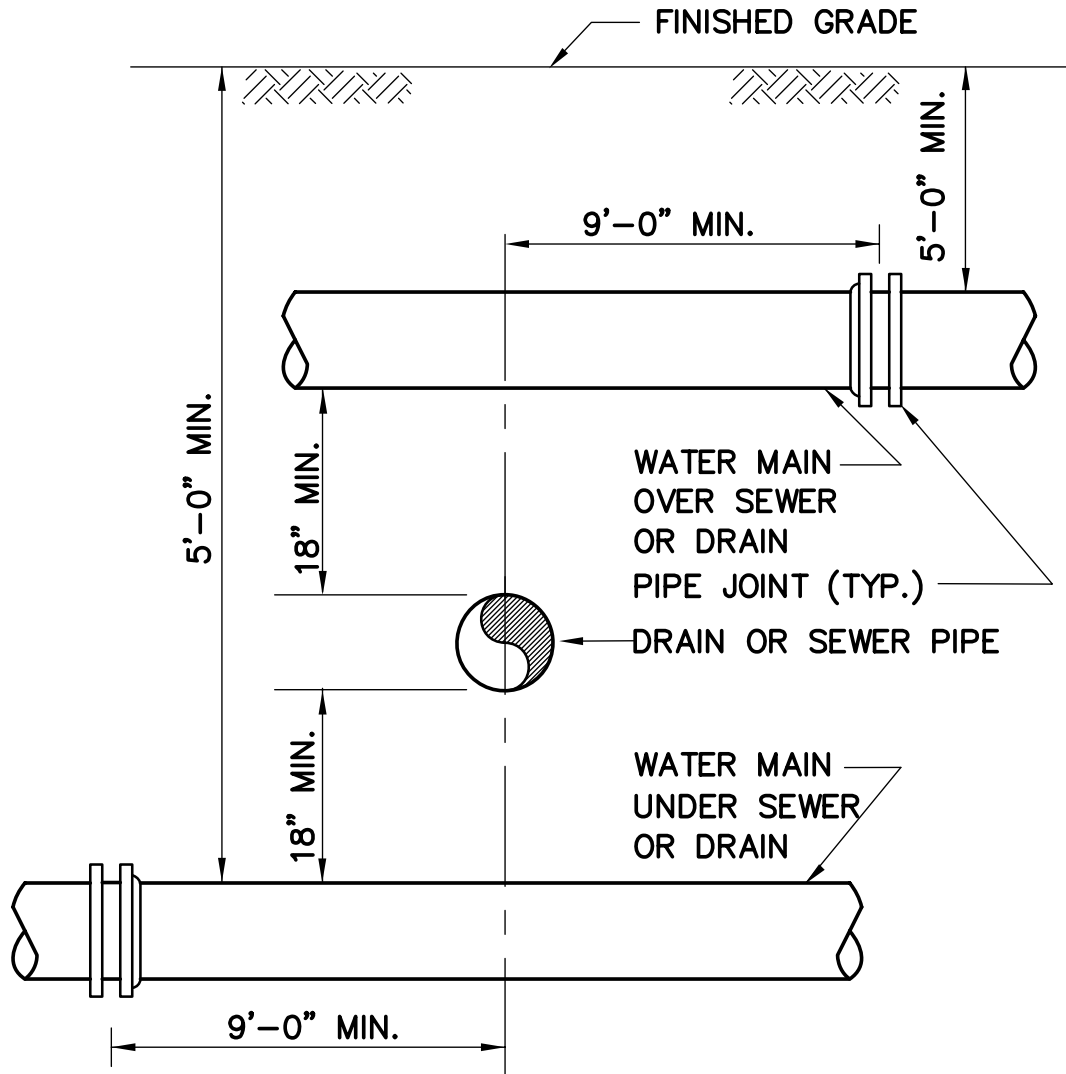
- A. If required in the contract or if permanent pavement becomes rough or uneven, permanent pavement patches and trenches shall be repaired and brought to grade utilizing "infrared" paving methods following completion of the construction.
- B. The Contractor performing the work shall use care to avoid overheating the pavement being repaired.
- C. Pavement repair shall extend a minimum of 6-inches beyond all edges of the pavement patch to assure adequate bonding at the pavement joints.

END OF SECTION



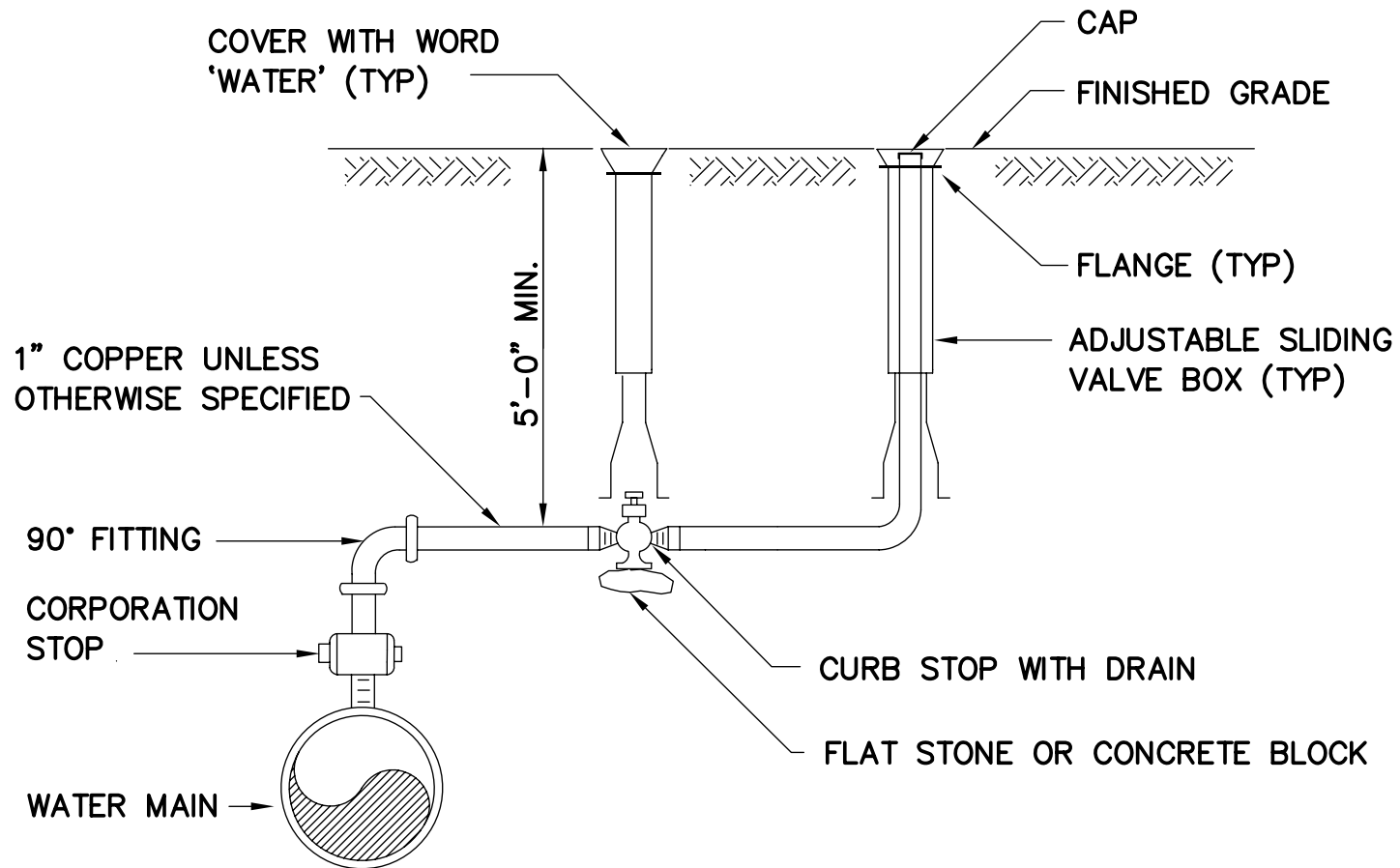
WATER MAIN TRENCH DETAIL

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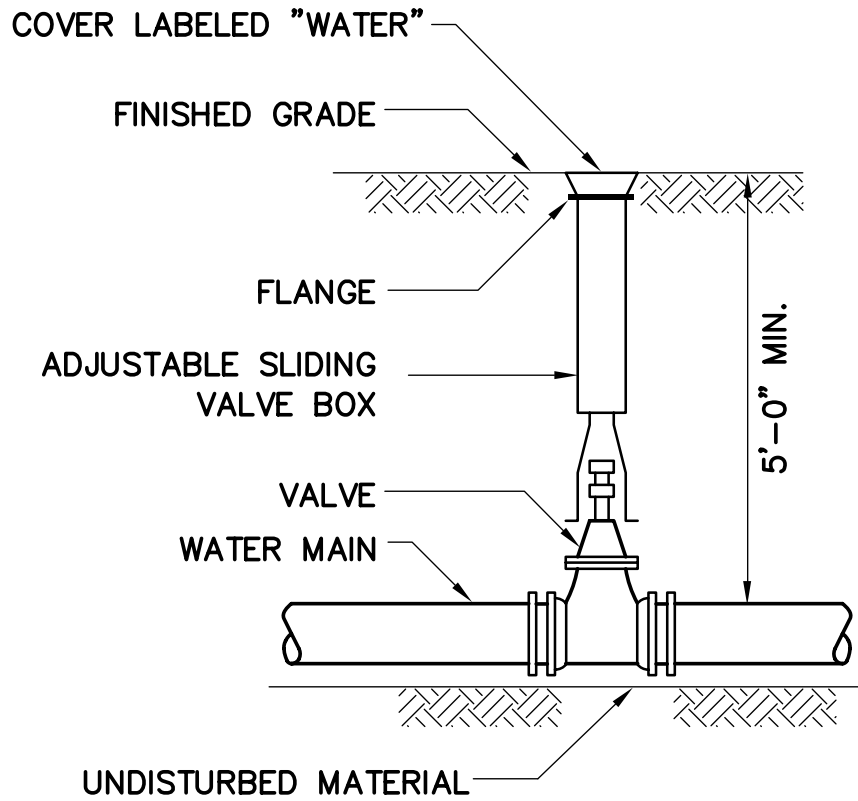


SEWER OR DRAIN CROSSING DETAIL

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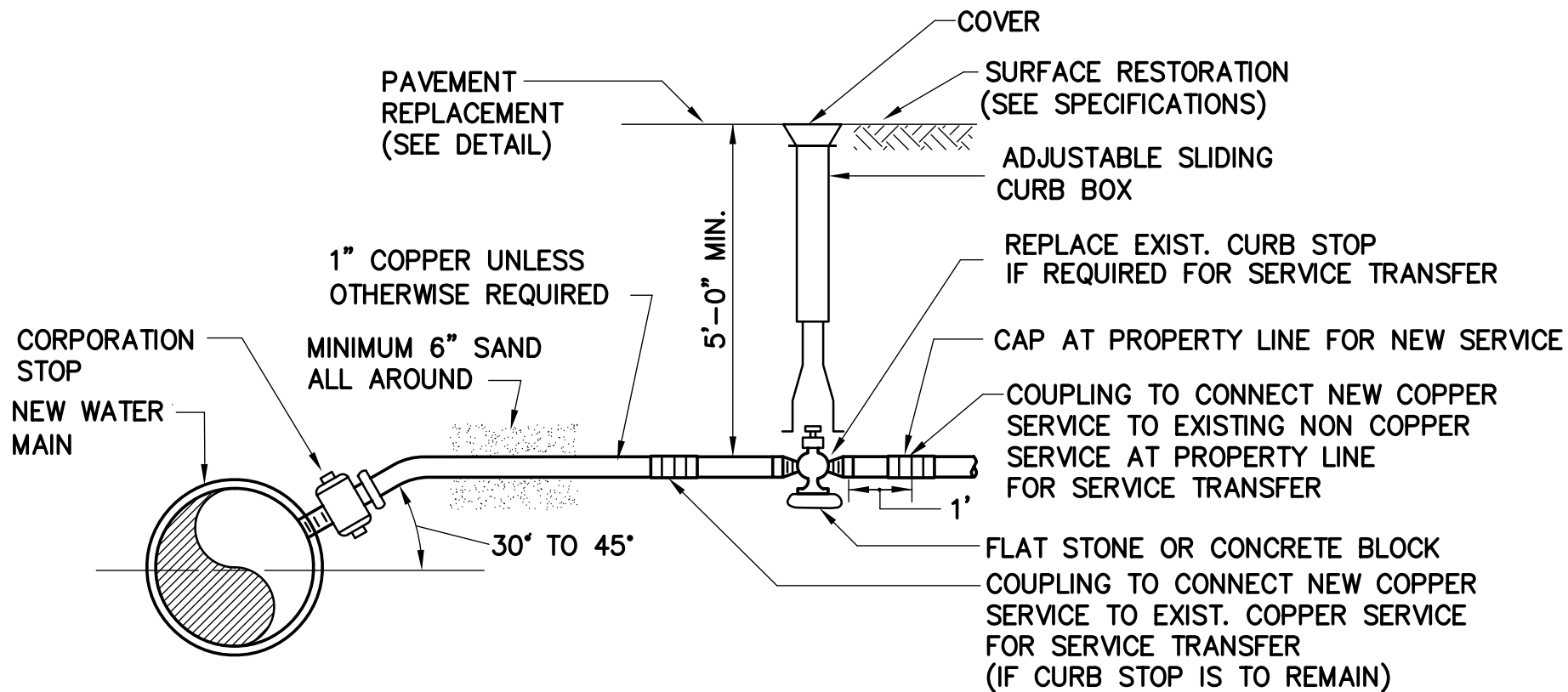


CURB STOP BLOWOFF DETAIL
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VALVE AND BOX DETAIL

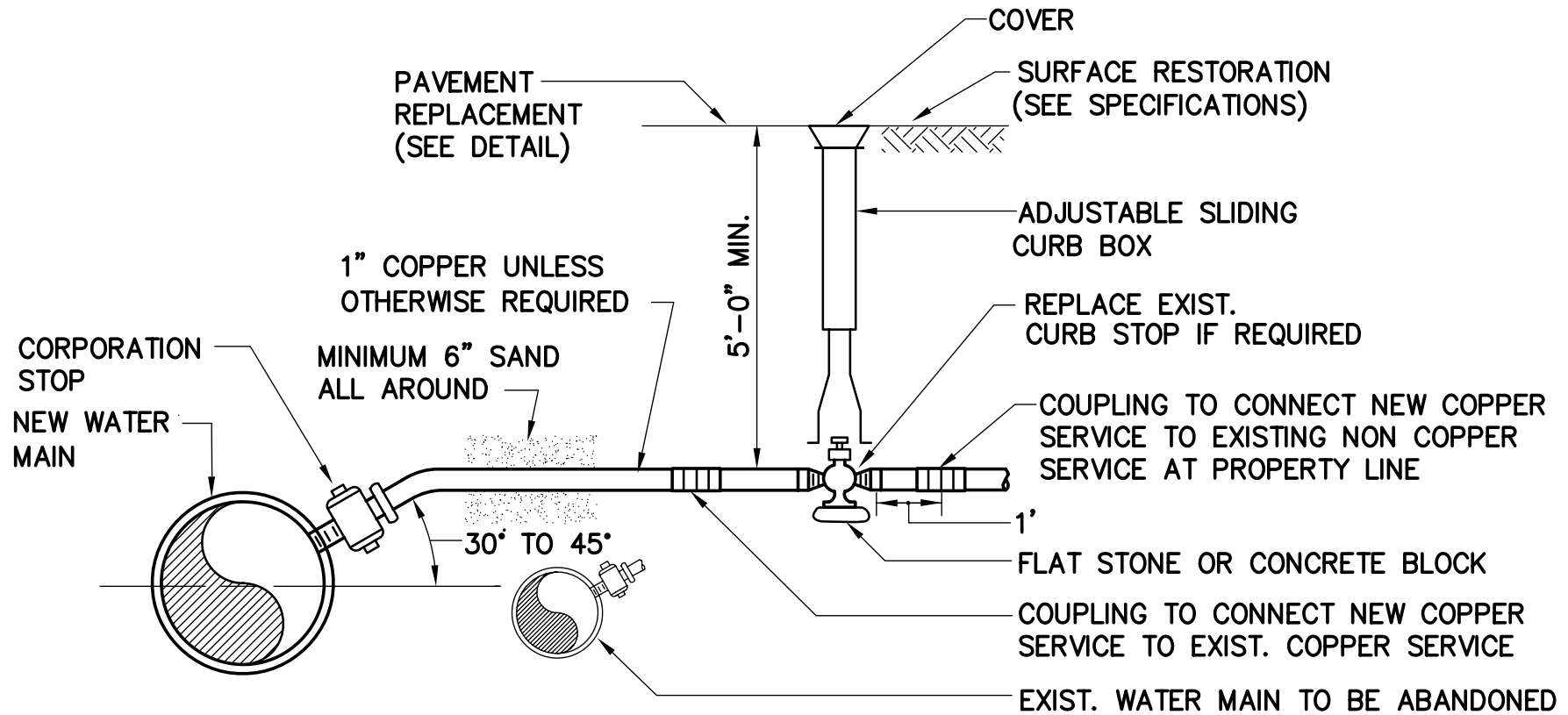
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NOTE: PROVIDE SADDLE FOR ALL AC AND PVC MAINS AND ALL 2" OR LARGER STOPS

WATER SERVICE DETAIL

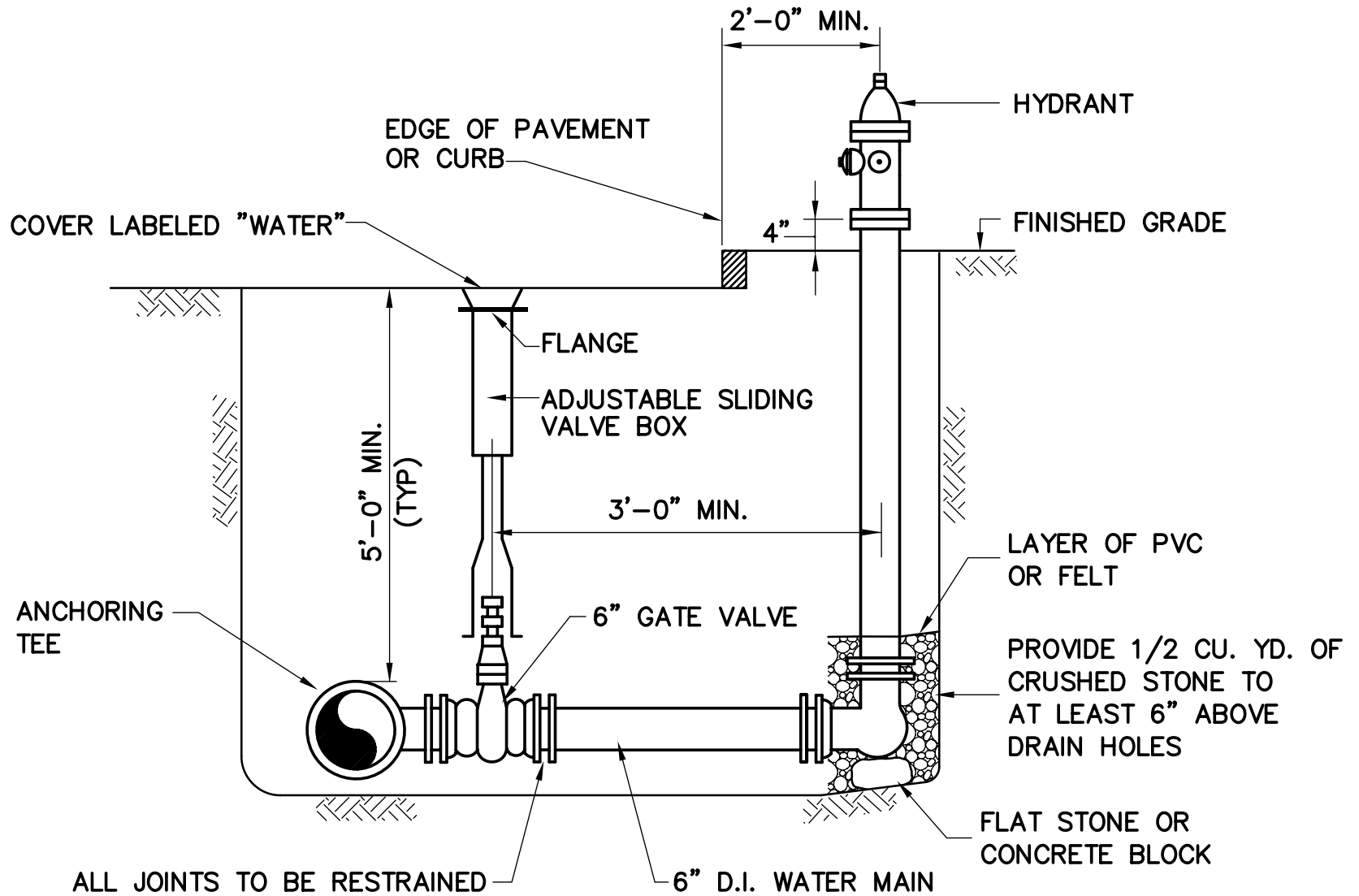
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NOTE: PROVIDE SADDLE FOR ALL AC AND PVC MAINS AND ALL 2" STOPS

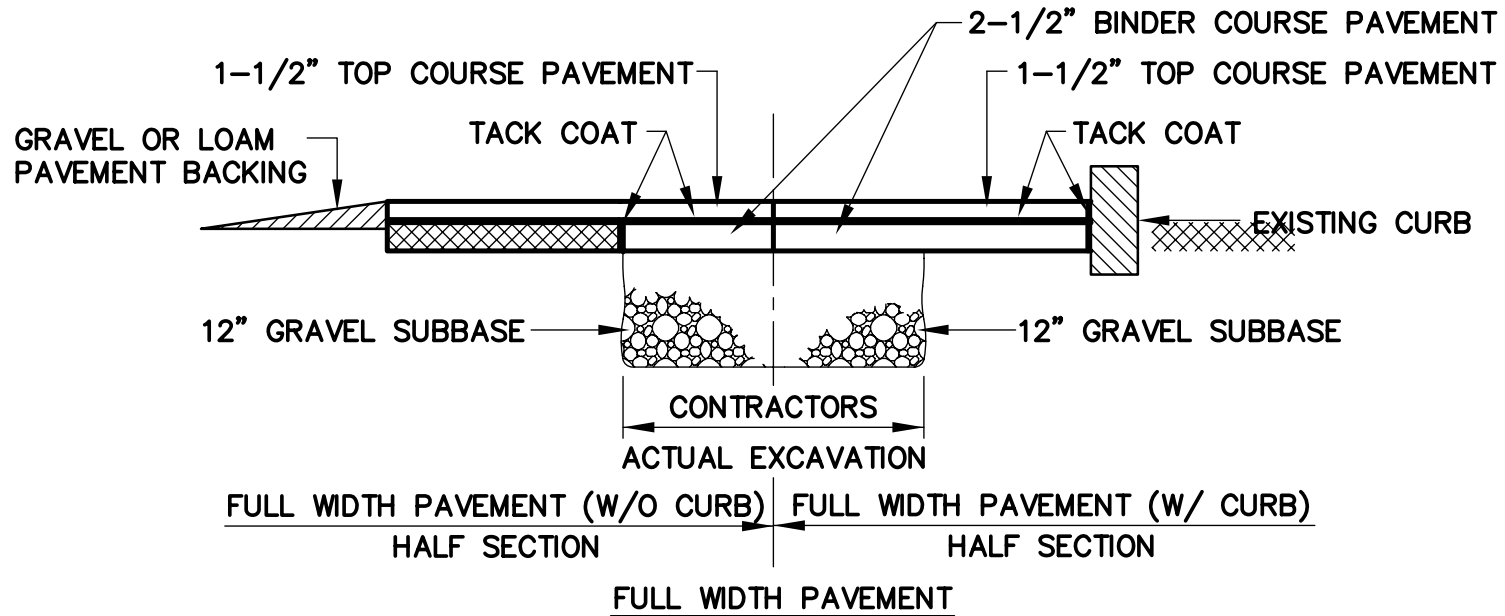
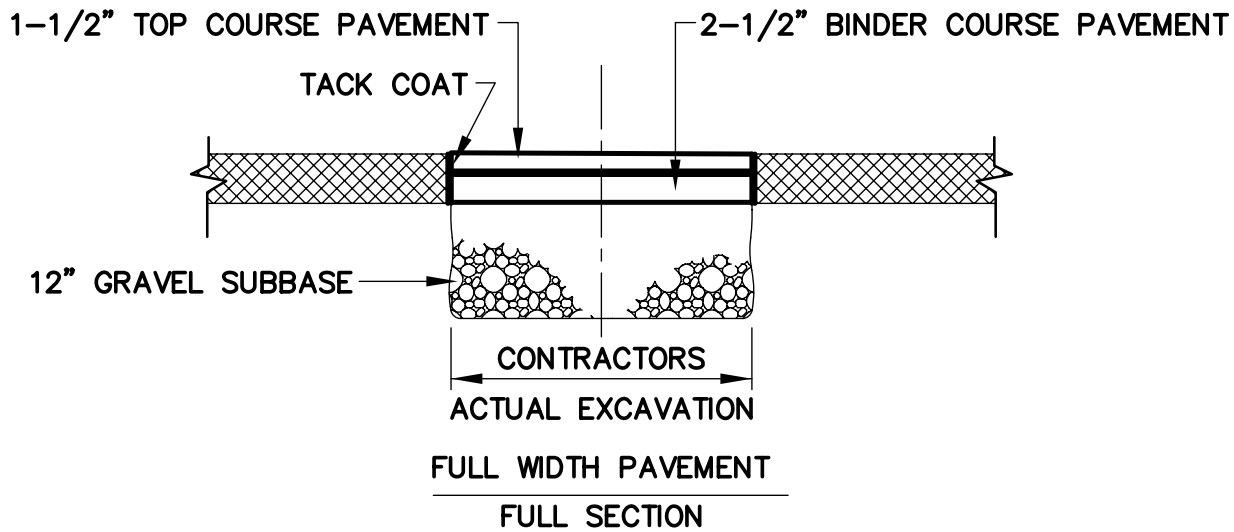
WATER SERVICE TRANSFER DETAIL

N.T.S.



HYDRANT AND VALVE DETAIL

N.T.S.



PAVEMENT REPLACEMENT DETAILS

N.T.S.

TABLE 1

REQUIRED LENGTH OF RESTRAINED JOINTS FROM FITTINGS (FEET)

PIPE SIZE	90° BEND	45° BEND OR WYE BRANCH	22 1/2° BEND	11 1/4° BEND	PLUG OR CAP	TEE (BRANCH)
6"	25 (30.5)	10.5 (12.5)	5 (6)	2.5 (3)	43 (64)	34 (51)
8"	33 (40)	13.5 (16.5)	6.5 (8)	3 (4)	55 (82)	47 (70)
10"	40 (48.5)	16.5 (20)	8 (9.5)	4 (5)	67 (100)	58 (87)
12"	47 (56.5)	19.5 (23.5)	9.5 (11.5)	4.5 (5.5)	79 (118)	70 (105)
16"	59.5 (72)	24.5 (30)	12 (14.5)	6 (7)	101 (152)	92 (139)
20"	72 (86.5)	30 (36)	14.5 (17)	7 (8.5)	123 (184)	114 (171)
24"	84 (100)	35 (41)	16.5 (20)	8 (10)	144 (216)	134 (202)
30"	100 (120)	41 (50)	20 (24)	10 (12)	174 (261)	165 (247)

NOTES:

1. RESTRAINED LENGTHS LISTED IN PARENTHESES ARE FOR PIPE WRAPPED IN POLYETHYLENE. THE OTHER ASSOCIATED LENGTHS ARE FOR PLAIN UNWRAPPED DUCTILE IRON PIPE.
2. THE CONTRACTOR SHALL USE THIS TABLE IN CONJUNCTION WITH THE APPROPRIATE PIPE SPECIFICATION SECTION.
3. TABLE BASED ON 150 PSI TEST PRESSURE.