

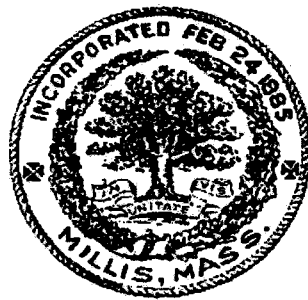
# **WATER MAIN CONSTRUCTION GUIDELINES**

Governing Water Work

in

**THE TOWN OF  
MILLIS, MASSACHUSETTS**

EFFECTIVE JULY 2007



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## SECTION 1 AUTHORITY

The Board of Selectmen of the town of Millis, Massachusetts has adopted these guidelines governing the design and construction of the water mains within the Town.

## SECTION 2 GENERAL

### A. DEFINITIONS

For the purpose of the guidelines, the following shall have the meaning hereunder assigned to them:

**Applicant:** The person who applies for the approval of a proposed water main extension or connection. An applicant must be the owner of record who is requesting the extension or connection. An agent or his assigns may act for an owner provided that written evidence of such fact is submitted. A list of the stockholders and officers and a certified copy of the corporation resolution conferring authority to execute and deliver documents binding upon the corporation shall be submitted by every corporate applicant.

**Department:** Department of Public Works

**Final Plan:** A final plan of the proposed water system delineating existing information, utilities and proposed water mains. Plan shall be drawn in ink on polyester film (4 mil mylar, double matte) and prints thereof.

**Profile:** A complete and accurate representation of the finished vertical profile of proposed water mains to be constructed, drawn on plan/profile polyester film and prints thereof; on the plan portion, there shall be a plan of the water system with stationing corresponding to the stationing on the profile.

**Record As-**

**Built Plan:** A plan/profile, drawn on polyester film with prints thereof, showing the actual location and elevation of all improvements installed and stamped by a Massachusetts Registered Professional Engineer.

### B. SUBMISSION OF CONSTRUCTION DRAWINGS & SPECIFICATIONS

All requests for water main extension/connections shall be filed with the appropriate application forms and required documentation in the Department's office where required in these guidelines.

To be complete and properly submitted, each application must have all the required documentation and the required filing fee. The Department is empowered to reject, or return any application he deems to be non-conforming to the requirements, and shall specify those reasons, in writing, to the applicant.

Plans which have been properly submitted will be reviewed by the Town Consultant.

### C. FEE SCHEDULE

Permit Fee (See Appendix B)

## SECTION 3 PROCEDURE FOR APPROVAL OF WATER MAINS

### A. SUBMITTALS

Any person who desires approval of a water main extension shall submit five copies of the following to the Department.

- a) The original water main plan drawing will only be needed if and when actual signing of the plan takes place.
- b) Application Form
- c) Filing Fee as retainer for consultant to review and comment on documents.

#### **B. PLANS AND SPECIFICATION CONTENTS**

The water main plans shall be prepared by a registered professional engineer and shall be clearly and legibly drawn in black ink upon mylar. The plan shall be at a scale of 1"=40', 1"=4' vertical or other such scale may be acceptable to show details clearly and adequately. Sheet sizes shall be 24"x36". The water main plans shall contain the following:

- a) A title stating the date, scale, bench mark; name and address of owner, engineer; name of project, if any; names of streets.
  - 1. **Water Mains:** An applicant shall show the size and location of the existing water facilities which the proposed system will tie into and shall put them on Preliminary and Definitive Plans, and show that the existing system will support the new addition to the system. Where adjacent property is not sub-divided provision shall be made for proper projection of the system by continuing appropriate water mains to the exterior boundaries of the subdivisions at such size and grade that may be deemed necessary by the Director of Public Works. Water lines and related equipment shall be constructed to serve all lots on each street in the subdivision, whether or not there is a building thereon. In some instances an applicant will be required to bring a water main to the property line of abutting lots of a subdivision. Before a new development is approved, the Department of Public Works may ask to have the existing water mains in the area flow tested and perform needed repairs and to upgrade the existing system.
- b) **Geographical Features**
  - 1. **Topography and Elevations:** Existing or proposed streets and all streams or water surfaces shall be clearly shown. Contour lines at suitable intervals should be included.
  - 2. **Streams:** The direction of flow in all streams, and high and low water elevations of all water surfaces shall be shown.
  - 3. **Boundaries:** The boundary lines of the municipality and the water district or area to be supplied shall be shown.
- c) Location and ownership of abutting property.
- d) Location and character of all rights of way, or other easements existing or proposed.
- e) Location of all permanent monuments properly identified as to whether existing or proposed.
- f) Location of existing and proposed utilities which are in the proximity of the water mains.

- g) Details showing water main trench, valves, hydrants, concrete encasement, services, etc.
- h) Location of streets and water mains. All known existing structures and their material construction above and below ground which might interfere with the proposed construction, particularly sewer mains, gas mains, storm drains, etc.
- i) Where unusual site conditions require additional details where the applicant is proposing a unique construction solution or where the consultant or DPW requests additional information, details shall be submitted by the applicant.
- j) Complete technical specifications for the construction of water mains, booster water pumping stations, and all appurtenances, shall accompany the plans. The specifications accompanying construction drawings shall include, but not be limited to, all construction information not shown on the drawings which is necessary to inform the builder in detail of the design requirements as to the quality of materials, workmanship and fabrication of the project. They shall also include: the type, size, strength, operating characteristics and rating of equipment; the complete requirements for all mechanical and electrical apparatus, wiring, and meters; laboratory fixtures and equipment; operating tools; construction materials, special filter materials such as stone, sand or gravel; installation specifications for water mains; miscellaneous appurtenances; chemicals when used; instructions for testing materials and equipment as necessary to meet design standards; and operating tests for the completed works and component units.
- k) Calculations showing water pressure in the project area and on the top floor of each structure.

#### C. REVIEW BY TOWN WATER CONSULTANT

The consultant shall review the plans submitted and comment on their completeness and acceptability to the Town. The consultant shall recommend acceptance to the Town once in conformance with design and construction standards. Review is based upon all standards herein and DEP guidelines, American Water Works Association (AWWA) Standards, American National Standard Institute (ANSI), State and Federal guidelines, Town water ordinance. In instances where various regulations contain conflicting requirements, the most stringent requirements shall be met. In addition to these standards, the most recent edition of the following rules and guidelines shall be adhered to:

- a) "Guidelines for Public Water Systems", Commonwealth of Massachusetts, Department of Environmental Protection, Division of Water Supply.
- b) "Massachusetts Plumbing Code", Commonwealth of Massachusetts, Board of Examiners of Plumbers and Gas Fitters.
- c) "State Sanitary Code, Article I and II", Commonwealth of Massachusetts, Department of Public Health.
- d) "Drinking Water Regulations: 310CMR Section 22", Commonwealth of Massachusetts, Department of Environmental Protection.
- e) "National Fire Code", National Fire Protection Association.

#### D. APPROVAL

The consultant may give approval with or without modifications. Such approval does not constitute approval from the Town but does facilitate the procedure in securing final approval of the Town.

### SECTION 4 DESIGN STANDARDS

#### A. DESIGN GUIDELINES

##### a) WATER MAINS

Minimum Size:	Public water main shall be a minimum of eight inches in diameter.
Depth of Cover:	In general, water mains shall be designed with a minimum depth of cover of five feet unless approved. Insulation shall be provided for water mains that cannot be placed with a minimum depth of cover of four feet to prevent freezing.
Materials:	All materials shall be new and in accordance with Section 4 "Construction Specifications".
Bedding:	Trench specifications shall be as specified in Section 4 "Standard Specifications and in Appendix A "Standard Details"
Intersection Valves:	Every intersection shall be valved "three ways" if a tee is used and "four ways" if a cross is used at intersections with other water mains.
Line Valves:	A maximum spacing of seven hundred feet shall be maintained between line and intersection valves.
Hydrants:	A maximum spacing of five hundred feet between new and existing fire hydrants shall be maintained. Hydrants shall be equipped with a six inch shut off valve with anchor tee and shall be self draining in the closed position.
Restraints:	All line and branch valves, fittings and hydrants (all mechanical joints) shall be mechanically restrained in addition to the placement of concrete thrust blocks as required in Section 4 "Standard Specifications"
Water Main Looping:	Looping of all water mains is required to avoid "dead ends" whenever practical.
Separation of Sewers:	Whenever possible, a minimum ten foot horizontal separation shall be maintained from sewers. When conditions prevent the minimum ten foot horizontal separation, the water main may be laid closer to the sewer in a separate trench on undisturbed earth if a minimum eighteen inch vertical separation between sewer and water

is maintained. Whenever it is impossible to maintain the minimum vertical and horizontal separations, the water mains shall be encased in concrete according to the standard details in Appendix A.

**Separation of  
Other Buried Utilities:**

A minimum three foot horizontal separation shall be maintained from any other buried utility (gas, electric, telephone, cable, fire, etc.). When conditions prevent the minimum three foot horizontal separation, the water main may be laid closer to the other buried utility in a separate trench on undisturbed earth if an eighteen inch minimum vertical separation between the other buried utility and water is maintained. Whenever it is impossible to maintain the minimum vertical and horizontal separations, the water main shall be encased in concrete according to the standard details in Appendix A.

**Testing:**

All water mains shall be tested and chlorinated according to Section 4 "Construction Specifications".

**b. WATER SERVICES**

**Minimum Size:**

Public water service shall be a minimum of one inch in diameter.

**Depth of Cover:**

In general, water services shall be designed with a minimum depth of cover of five feet unless approved. Insulation shall be provided for water services that cannot be placed with a minimum depth of cover of four feet to prevent freezing.

**Materials:**

All materials shall be new and in accordance with Section 4 "Construction Specifications".

**Bedding:**

Trench specifications shall be the same as the water mains.

**Taps:**

On new water mains, water service line shall not be tapped until the written results of the pressure and disinfection tests on the water main and have been received and approved.

**Separation of  
Sewers:**

There must be at least a 10 foot horizontal separation between water service pipes and sewer service pipes.

**Inspection:**

DPW personnel will inspect the service lines and approval will not be made if a water permit is not on file in the Public Works office.

**c. FIRE SERVICE**

**Design and Construction:**

Fire protection services shall be designed and constructed according to the preceding guidelines for water mains and services, Section 4 "Construction Specifications" and the latest edition of



the Massachusetts Plumbing Code, National Fire Code and Town fire codes.

Location:

Fire services shall be laid in a separate trench from all other utilities. Connections shall be at 90 degrees to public water mains.

Restrictions:

Water supplied through a fire service is for fire protection only. A fire service shall not be connected with a water service and shall be separately metered.

**B. EASEMENTS**

Easements for municipal water mains outside of the street layout shall be provided where necessary. Easements shall be at least 20 feet wide and centered on lot lines where practical.

## C. CONSTRUCTION SPECIFICATIONS

### 1. DUCTILE IRON PIPE AND FITTINGS

#### PART 1 MATERIALS

- 1.01 DUCTILE IRON PIPE AND FITTINGS
- 1.02 PUSH-ON JOINTS
- 1.03 MECHANICAL JOINTS
- 1.04 FLANGED JOINTS
- 1.05 PIPE MARKING

#### PART 2 EXECUTION OF WORK

- 2.01 HANDLING AND CUTTING PIPE
- 2.02 INSTALLING PUSH-ON JOINT PIPE AND FITTINGS
- 2.03 DEFLECTION OF PIPE
- 2.04 INSTALLING MECHANICAL JOINT PIPE AND FITTINGS
- 2.05 CONNECTIONS TO EXISTING WATER MAINS
- 2.06 REMOVAL / ABANDONMENT OF EXISTING WATER MAINS

#### PART 1 MATERIALS

##### 1.01 DUCTILE IRON PIPE & FITTINGS

- A. The Ductile Iron pipe shall be designed in accordance with AWWA C150 and shall be manufactured in accordance with AWWA C151. The Ductile Iron pipe shall conform to the ANSI A21.50, A21.51 Specifications for Ductile Iron Pipe. The grade of iron, from which pipe is made, shall be 60-42-10, having 60,000 psi minimum tensile strength, 42,000 psi minimum yield strength, and 10% minimum elongation.

PIPE SIZE	Thickness (inches)	Thickness Class	Rated Working Pressure
6"	0.31	52	350
8"	0.33	52	350
10"	0.35	52	350
12"	0.37	52	350
16"	0.34	50	350
16"	0.40	52	350

- B. Pipe fittings shall conform in all respects to ANSI 21.10 and 21.11 (AWWA C110 and C111) and shall be mechanical joint. Compact fittings 3 inches through 16 inches shall conform to ANSI/AWWA C153/A21.53 and shall be mechanical joint. Compact fittings larger than 16 inches shall not be used. All fittings shall be restrained with retainer glands or bolted restrainers ("Mega-lug" or equal).
- C. Pipe shall be of the push-on type, mechanical joint or flanged.
- D. All pipe and fittings shall be supplied with silicon bronze serrated wedges.
- E. All pipe and fittings shall be furnished with a cement lining on the inside of the pipe. The lining shall be twice the thickness as specified in ANSI A21.4 (AWWA C104). Cement lining shall be double thickness. The cement lining shall be given a seal coat of asphalt material. Asphalt seal coat shall not impart taste or odor, or toxic or carcinogenic compounds to the water contained therein. Asphalt seal coat shall be a product acceptable to the U.S. E.P.A. for use in potable water and shall be so listed in the most current E.P.A. summary of approved products. The asphalt seal coat shall

be applied and cured in strict conformance with the coating manufacturer's cautions and instructions. The seal coat shall be applied by the pipe manufacturer or supplier, under controlled factory conditions. Field application is strictly prohibited.

- F. All ductile iron pipes for buried service shall be furnished with a minimum of 1 mil thick bituminous coating on the outside of the pipe.
- G. Fittings shall be ductile iron, with mechanical joint ends. All fittings shall be cement lined and coated inside and out, as specified hereinbefore for ductile iron pipe. Branch of tees for hydrants or stubs shall be mechanical joint anchoring tees.
- H. All fittings shall be Class 350 and all fittings shall conform to the weights and dimensions shown in the latest edition of the CIPRA Handbook of Ductile Iron Pipe and Cast Iron Pipe.
- I. When required, flanged fittings shall be furnished and installed. Fittings shall be ductile iron and shall have Class 125 drilled flanges and shall conform in every respect to the applicable requirements of AWWA C115 and ANSI B16.1.
- J. Retainer glands or bolted restrainers ("Mega-lug" or equal) with double heat treated set screws and break away nuts shall be furnished for all fittings, valves, hydrants, caps and plugs.
- K. Joint accessories shall consist of high strength ductile iron glands ("Mega-lug" or equal), rubber gaskets, tee head or hex head bolts and nuts. Nuts and bolts shall be made of low alloy steel or stainless steel. Where corrosive soils and/or saltwater conditions exist, bolts and set screws shall be tightened in accordance with the manufacturer's recommendations.

#### 1.02 PUSH-ON JOINTS

- A. Push-on joints shall meet all the requirements of ANSI A21.11 and shall consist of a single continuous, molded, rubber ring gasket ("Tyton" or equal); a bell socket cast integrally with the pipe or fitting; and a plain end. The configuration shall be such that when the plain end is inserted into the pipe fitting socket, the gasket shall be compressed radially to form a positive seal. The gasket and annular space shall be so designed and shaped that the gasket is locked in place after the plain end is inserted into the fitting socket.
- B. Push-on joints shall have the same pressure rating as the pipe or fitting of which they are a part.
- C. Gaskets for push-on joints shall be vulcanized natural or synthetic rubber. All gaskets shall be free of porous areas, foreign material and visible defects.

#### 1.03 MECHANICAL JOINTS

- A. Mechanical joints shall meet all the requirements of ANSI A21.11 and consist of: a bell socket cast integrally with the pipe or fitting and provided with an exterior flange having bolt holes and a socket with annular recess; a plain end; a continuous molded, rubber ring gasket and; a follower with bolt holes, tee head bolts and hexagonal nuts and break away restraining wedge bolts..
- B. Mechanical joints shall have the same pressure rating as the pipe or fitting of which they are a part.

C. Glands for mechanical joints shall be cast or ductile iron and be stamped with the manufacturer's identification, nominal size and material type. Glands shall be capable of restraining the joint and be "Mega-lug" or equal. Glands shall receive a bituminous coating at the shop.

D. Rubber gaskets for mechanical joints shall be natural or synthetic vulcanized rubber, free of porous areas, foreign materials and visible defects.

#### 1.04 FLANGED JOINTS

A. Flanged joints shall meet all the requirements of ANSI A21.15 and ANSI A21.10 and shall consist of two threaded flanges; flange gasket and; bolts with square or hexagonal shaped heads and hexagonal nuts.

B. Threaded flanges shall be individually fitted and machine tightened on the threaded pipe by manufacturer. Threaded flanges shall not be installed in the field. Flange faces shall be machined.

C. Pipe furnished with flanges at each end shall have the bolt holes aligned.

D. Flange gaskets shall be ring or full face rubber and be 1/8 inch thick.

#### 1.05 PIPE MARKING

A. The weight, class or nominal thickness and casting period shall be shown on each piece of pipe. The manufacturer's mark, year of fabrication and the letters "DI" or the word "Ductile" shall be cast or stamped on in letters and numerals not less than 1/2 inch in height.

### PART 2 EXECUTION OF WORK

#### 2.01 HANDLING AND CUTTING PIPE

A. Care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe or lining, scratching or marring machined surfaces and abrasion of the pipe coating or lining.

B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

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 portion, if so approved, may be cut off by before the pipe is laid so that the pipe used may 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.

#### 2.02 INSTALLING PUSH-ON JOINT PIPE AND FITTINGS

A. Prior to assembling, the bell and plain end shall be cleaned of all foreign matter. Push-on joints shall be made up by first inserting the gasket into the groove of the bell and applying a thin film of special non-toxic gasket lubricant safe for potable water supplies, supplied by the pipe manufacturer, uniformly over the inner surface of the gasket which will be in contact with the spigot end of the pipe. The end of the plain pipe shall be chamfered to facilitate assembly. The end shall be inserted into the

gasket and then forced passed it until it seats against the bottom of the socket. Bedding and backfill requirements shall be as shown on the hereinafter.

#### 2.03 DEFLECTION OF PIPE

- A. When laying ductile iron pipe, the deflection at the joints for sizes 3" through 12" shall not exceed 5 degrees or 21 inches for a 20 foot length of pipe.
- B. When laying ductile iron pipe, the deflection at the joints for sizes 14" through 64" shall not exceed 3 degrees or 12 inches for a 20 foot length of pipe.

#### 2.04 INSTALLING MECHANICAL JOINT PIPE AND FITTINGS

- A. Prior to assembling mechanical joints the bell and plain end shall be cleaned of all foreign matter and then brushed with non-toxic gasket lubricant supplied by the pipe manufacturer. With the follower gland and gasket on the plain end, seat the plain end into the bell and press the gasket evenly and firmly into the bell. Move the follower gland into position for bolting and insert all nuts and bolts and make finger tight. The follower gland shall be tightened evenly using a torque wrench on opposite bolts until all are made up. Bedding and backfill requirements shall be as shown on the Contract drawings. All nuts and bolts shall be given a bituminous coating after bolts are tightened. All fittings shall be rodded to the other fittings or a restraining gland placed on the pipe.

#### 2.05 CONNECTIONS TO EXISTING WATER MAINS

- A. At least forty-eight (48) hours prior to connecting to any existing water main, the Contractor shall notify the Water Department. At no time shall the Contractor operate any existing system valve or hydrant. All such operations shall be performed by Water Department Personnel. Prior to connecting or disconnecting any fire sprinkler service line, the Contractor shall notify the Fire Department, Water Department and a responsible party at the building(s) being serviced by the line.
- B. Make all cuts into the existing water pipes, and install the required sleeves, tees, couplings, adaptors, reducers, pipe nipples, jointing materials, and other fittings which may be required and make all joints watertight.
- C. The cutting, removal, plugging, and bracing of parts of the existing water mains made necessary by this work, and the shutdown of the existing water system and subsequent pumping, hand excavating and time that may be required by the Owner to notify customers of discontinuation of water service, time required to effect tight closures of existing valves or any other work done shall be considered as an obligation of the Contractor to complete the work.
- D. The work shall be coordinated with the Water Department and connections that may be required shall be made at times and in a manner to cause as little interference in water service within the existing system as practicable

#### 2.06 REMOVAL / ABANDONMENT OF EXISTING WATER MAINS

- A. All existing water mains and appurtenances to be replaced shall be physically removed and disposed of by the Contractor.
- B. Sections of existing water main that are permitted to be abandoned in-place shall have open ends plugged with concrete or brick and mortar to prevent the entrance of soil into the pipe after backfilling.

## 2. PIPING SPECIALTIES

### PART 1 MATERIALS

- 1.01 CONCRETE FOR THRUST BLOCKS
- 1.02 GATE VALVES
- 1.03 VALVE BOXES
- 1.04 BUTTERFLY VALVES
- 1.05 "DRESSER" COUPLINGS
- 1.06 INSERTION VALVES
- 1.07 TAPPING SLEEVES AND VALVES
- 1.08 WATER SERVICES
- 1.09 HYDRANTS

### PART 2 EXECUTION

#### 2.01 INSTALLATION

### PART 1 MATERIALS

#### 1.01 CONCRETE FOR THRUSTS BLOCKS

1. Concrete for thrust blocks shall have a minimum compressive strength of 3,000 psi and shall conform to the contract drawings.

#### 1.02 GATE VALVES

1. All gate valves shall be manufactured in full compliance with the content and intent of this specification. Gate valves shall be iron body, resilient wedge type with 8 mil epoxy coating inside and out, with two inch operating nut. Valves shall have mechanical joint hubs. Gate valves shall conform in every respect to AWWA C509. Valves shall be designed for 200 psi working and 300 psi test pressure. Valves shall open "Right" in the direction as in use by the Water Department.
2. Valves shall also conform to the specifications of the AWWA as to size of stem, pitch of thread, etc. The gasket seating area shall be fully machined to fixed dimensions and tolerances as per AWWA specifications. All valves shall be provided with "O" rings. The design of the valve is under pressure in a fully open position. Cartridge O-ring type gate valves, if accepted, shall be furnished with a spare cartridge for each valve furnished.
3. The surface of all valves shall be coated with a minimum 8 mil epoxy coating inside and out, on a rust-free casting, prior to shipment. Body ring shall be free of any epoxy coating.
4. Gate Valves shall be used for sizes 3" through 12" unless otherwise approved.
5. Gate valves shall be manufactured by Clow Valve Co., Oskaloosa, IA; Mueller Co., Decatur, IL; American Valve and Hydrant; Birmingham, AL; Waterous Co., S. St. Paul, MN; or approved equal.

1.03

VALVE BOXES

1. Valve boxes shall be provided for each buried valve. They shall be cast iron, of heavy pattern, sliding adjustable type and provided with cast cover. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve. Boxes shall have barrel of not less than 5 ¼-inch diameter and be of the sliding adjustable type with a lap of least 6 inches when in the most extended position. Covers shall have the word "WATER" cast into them.
2. Valve boxes shall be provided for each gate valve installed for buried service. Valves shall open "RIGHT" in the direction as those in use by the Water Department. Direction arrows shall be on the valve covers.

1.04

BUTTERFLY VALVES

Butterfly Valves and operators shall conform to the requirements of AWWA C504 and with the specific requirements and exceptions to AWWA C504 which follow:

1. Manual operator shall be submersible, worm gear type (Philadelphia Gear or equal) rack and pinion traveling nut type on lead screw type suitable for buried service.
2. All operators shall have positive adjustable stops to prevent over-traveling of the disc in the open or closed positions.
3. Operators shall be equipped with two inch square operating nuts, fully gasketed and lubricated for buried service.
4. Gearing shall be totally enclosed, air tight and permanently sealed.
5. Butterfly Valves greater than 12" shall have a minimum rated working pressure of 150 psi.
6. The exterior of all valves shall be coated with a minimum of three applications of an approved bituminous solution over a rust free casting prior to shipment. Body rings shall be free of bitumen or defect.
7. Valve interiors shall have a 100 percent solid heat cured or fusion bonded epoxy coating system in accordance with AWWA C550.
8. The location and arrangement of the operator shall be as shown on the plans. The operator shall be designed to hold the valve disc on any intermediate position between fully opened and fully closed without creeping or fluttering. It shall be furnished with a device such as an input shaft lock device to hold the valve in a fixed position for an extended period of time. Valve operating mechanism shall be capable of transmitting sufficient torque to open and close each valve under the most adverse operating conditions. In addition, valves and their operators shall be satisfactory for application involving valve operation after long periods of inactivity. Valve operation shall be through a precision made, high quality, totally enclosed; factory greased and sealed worm gear reducer. Primary gearing shall consist of self-locking worm gear constructed of high tensile bronze and a worm polished or traveling nut designed according to AWWA specification C-504-74, Section 11.3. The valve operator shall be so sized that a maximum input force will be necessary to develop the required operating torque. When additional gearing is required to reduce the input force to the operator, it shall consist of a combination of

helical or spur gearing in the first or input stage with a self-locking worm gear unit as described above in the final or output stage. The gearing of the valve operating mechanism shall be such that the operating nut shall turn clockwise to open the valve. All gear operators shall be designed to transmit twice the required torque without permanent damage to the gear teeth. The valve shaft at the connection to the operator shall have built-in adjustable mechanical stops to prevent over-travel of the disc. These stops shall be fully enclosed and integral with the worm gear housing. Each operator shall be equipped with a large mechanical position indicator which is positively coupled to the valve shaft. The manual operators shall contain a 2 inch square operating nut.

9. Operators shall be watertight for buried service with extension shafts in enclosed, sealed housing and valve boxes at grade.
10. Butterfly Valves shall be used for sizes 14" through 64" unless otherwise approved.
11. Butterfly valves shall be manufactured by DeZurik BAW, Sartell, MN or approved equal.

#### 1.05 SOLID SLEEVE AND "DRESSER" COUPLINGS

1. Solid Sleeve and "Dresser" couplings shall be mechanical joint with ductile iron glands or approved adapter gland.
2. Ductile iron Solid Sleeve and "Dresser" couplings shall conform to AWWA Specification C-110. Solid sleeves, plugs and caps shall also be ductile iron and conform to AWWA Specification C-110.

#### 1.06 INSERTION VALVE

1. Insertion valves shall be first quality, free from all imperfections and defects. The sleeve shall be made of ASTM A-36 steel, epoxy coated to 10-12 mils.
2. Insertion valves shall be "Quik Valve" as manufactured by Romac Industries of Seattle, Washington or approved equal.

#### 1.07 TAPPING SLEEVES AND VALVES

1. Tapping sleeves and valves shall conform to AWWA specifications for tapping sleeves and valves. Tapping sleeves shall be mechanical joint, two part castings, flanged on the vertical centerline, and come complete with all joint accessories. The surface area of each flange shall be thoroughly machined, and the sleeve flanges shall be fitted with gaskets. Each gasket shall cover the entire surface area of each joint for the full length of the sleeve. Bolts used to assemble the sleeves shall pass directly through each flange and through each gasket. Bolts shall be properly spaced to insure uniform gasket pressure and compression.
2. Sleeve outlets shall have counter bored flanges to insure proper centering of the tapping valve. All tapping valves shall be flanged by mechanical joint. Tapping valves shall conform to the aforementioned specifications for gate valves.



3. Tapping sleeves and valves shall be manufactured by Clow Valve CO., Oskaloosa, IA; Mueller Co., Decatur, IL; American Valve and Hydrant, Birmingham, AL; or approved equal.

1.08

WATER SERVICES

1. Piping for buried water services shall be continuous Type K annealed seamless copper water tubing conforming to ASTM B88 Standard Specification for Seamless Copper Water Tube. Minimum tubing size shall 1" diameter unless otherwise approved.
2. Service Boxes: The cast iron service box shall be 2 ½" "Buffalo" style, two piece curb box and lid with brass pentagonal nut. Minimum diameter of the upper section shall be 4" inch for 1-inch through 2-inch curb stops.
3. Service boxes shall be tar coated and adjustable to accommodate bury depths from five feet to six feet.
4. Required Brass Goods shall include Corporation Stops, Curb Stops, Misc. Couplings and Fittings. Fittings shall be sufficiently heavy to meet all service conditions without springing or leaking and be clean and free from roughness both inside and out. All fittings shall have a minimum rated working pressure of 300 psi. Waterways shall be smooth, full size and free from obstruction. All threads shall be cut sharp, clean and true.
5. Nuts shall be of commercial bronze containing not less than 89 percent copper and finished on both sides to true faces. Adjusting nuts shall also come to a true facing against the bottom of the bronze washer and proper adjustment shall be made to assure easy turning and freedom from leakage. Adjusting nuts shall be properly locked to the stop to avoid change in position in operation of stop.
6. All corporations and curb stops shall be solid (except for waterway). Bronze in all plugs shall be of composition harder than that of the body such as ingot No. 245 Navy M metal containing not less than 87 percent copper. All plugs shall be properly lubricated and upon assembly bronze washers are to come to a true facing completely around bottom of curb cock body.
7. All corporation and curb stops shall be subjected to a sustained hydraulic test pressure of 200 pounds and tested in both the open and closed position.
8. All brass goods shall be individually wrapped to protect threads during shipment.
9. The inlet of corporation stop shall have AWWA taper thread (CC) connections and the outlet shall have compression connections. The corporations shall be "Ball Valve" Type and have a minimum rated working pressure of 300 psi.
10. The inlet and outlet of curb stop shall have compression connections. The Curb Stops shall be "Ball Valve" Type, "no draining" and have a minimum rated working pressure of 300 psi.
12. All compression connections shall be equipped with a split clamp/stainless steel screw locking device that tightens to the copper tubing.

13. Corporation and curb cocks shall open "RIGHT" as those in use by the Water Department, and manufactured by Ford Meter Box Co., Inc., Wabash, IN; Red Head Manufacturing Co., Lincoln, RI; Mueller Co., Decatur, IL; Hayes of Zurn Industries, Inc., Gastonia, NC; or approved equal.

#### 1.09

#### HYDRANTS

1. Hydrants shall be American Darling Model B-84. The Millis Water Department has standardized this make and model hydrant. No substitution will be allowed.
2. Hydrants shall have a 6 inch mechanical joint inlet, 5 ¼ inch valve opening and shall open right or counter-clockwise. The hydrant barrel shall have two 2 ½ inch hose outlets and one 4 ½ inch pumper outlet with National Standard Threads. Operating nuts shall be standard pentagon. Hydrants shall be supplied with drain ports. Hydrant barrel extensions when required shall be repainted in the field to the Town's standards prior to acceptance.
3. 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 as specified by the Water Department.
4. If the hydrants are delivered with the Owner's standard color, they shall be given one matching field coat of alkyd gloss enamel. If the hydrants are not delivered with the Owner's standard color, they shall be given two coats of alkyd gloss enamel.
5. Hydrant paint shall be as manufactured by Sherwin-Williams, Cleveland, OH; Tnemec Company, Inc., Kansas City, MO; or Minnesota Mining and Manufacturing Co. (3M), St. Paul, MN; or approved equal.

### PART 3 EXECUTION

#### 3.01

#### INSTALLATION

- A. Buried valves and boxes shall be set with the stem plumbed vertical and box vertically centered over operating nut. Valves shall be set on a firm foundation and supported and anchored as shown on the Standard Details. Select excavated material shall be placed and tamped under and at the sides of the valve. Valve box shall be supported during backfilling and maintained in vertical alignment with the top flush with finish grade.
- B. All bolts and nuts shall be heavily coated with two coats of bituminous paint comparable to Inertol No. 66 Special Heavy.
- C. Pipe upon which a tapping sleeve is to be installed shall be thoroughly cleaned of all foreign matter with scraping tools and wire brushed, a minimum of six (6) inches each side of the sleeve. Sleeve bolts shall be alternately tightened from the extreme end on one side to the extreme of the opposite side with approved torque wrenches until all are securely tightened. Take care to ensure that the tapping machine is kept in leveled horizontal position and securely supported so as not to transmit any additional weight to the tapping valve.
- D. Service Connections: Connect all services to the new main as specified herein. Services shall be connected after the new main has been pressure tested, chlorinated

and approved for service and the work shall result in a minimum disruption of service to the consumer. Make only "wet taps" into the new mains and install corporation cocks, copper tubing, new curb stops, new service boxes, fittings, etc., and make all joints water tight. The Contractor shall connect the new copper tubing to the existing service pipe using an approved coupling approximately 12 inches from the new curb stop on the building side of the stop. Where transfers are being made and the existing service is lead or iron, the service shall be replaced to the limit of the Town right of way. All services shall be installed with 5 feet cover unless otherwise directed by the Engineer.

- E. Water mains shall be tapped in accordance with the manufacturer's latest published recommendations, i.e., depth of tap, number of threads exposed, allowable sizes, etc., and the Contractor shall adhere strictly to these recommendations. The Contractor shall be held responsible for all subsequent leaks or failure of the taps for one year from the date of final acceptance and he shall make all necessary repairs that may be required during this period.
- F. Thrust blocks shall be installed at all fittings, bends, tees, caps and hydrants subject to movement by line surge or internal pipe stresses. Thrust blocks shall be placed in addition to mechanical restraints ("Mega lug" or equal). Concrete thrust blocks shall be constructed according to the standard details in appendix A.

### 3. WATER DISTRIBUTION SYSTEM DISINFECTION AND TESTING

<u>PART 1</u>	<u>EXECUTION OF WORK</u>
1.01	FLUSHING POTABLE WATER LINES
1.02	TESTING
1.03	DISINFECTION
1.04	ACCEPTANCE

#### PART 1 EXECUTION OF WORK

##### 1.01 FLUSHING POTABLE WATER LINES

- A. Prior to testing and disinfecting water lines, the Contractor shall thoroughly flush all water lines with potable water. Potable water shall be supplied by the Owner. The Contractor shall furnish all equipment necessary including ancillary pumping equipment, taps, temporary piping, etc., to provide a minimum of 2.5 FPS scouring velocity in the mains being flushed for a duration of at least 15 minutes.
- B. The Contractor with the assistance of the D.P.W. shall fill water mains as slowly as practicable so as not to cause dirty water and serious pressure drops within the existing system.
- C. Air shall be vented from the mains during the filling process and temporary or permanent blow-offs shall be made on the mains where directed.
- D. After the water mains have been filled, controlling gate valves shall be closed and the new mains kept isolated from the existing system.
- E. Water mains shall be filled at least 1 day before testing to allow for absorption.

##### 1.02 TESTING

- A. Testing and chlorinating of the pipelines shall closely follow pipe laying work. Pipelines shall be tested approximately every 2000 feet, or distances slightly greater or less, as approved by the Engineer or DPW, unless otherwise noted, as the pipeline is installed. Should the pipelines fail to be tested and chlorinated as specified, the pipe laying work shall be suspended until the testing and chlorinating is done.
- B. The completed pipelines shall be pressure tested in the presence of the engineer or DPW. The method of testing shall be approved by the engineer or DPW and in general shall consist of applying a constant hydrostatic pressure of 150 pounds per square inch to the new mains or 1½ times the normal static pressure whichever is greater. This test shall be conducted for two continuous 15 minute periods. After the first 15 minute period, the pressure in the mains shall be dropped to the normal working pressure of the system, and then built back up to the required test pressure.
- C. The leakage test may be conducted independently of the pressure test. The allowable liquid lost shall not exceed the amount shown on the following table. The leakage test shall be conducted for one hour per mile of pipe but not less than ½ hour per test. The leakage shall be recorded to one-tenth of gallon accuracy by means of a test meter or where allowed by the engineer or DPW permission will be given to measure the drawdown in the test barrel. If the leakage is more than that specified above or in the table that follows, leak or leaks shall be located and the necessary repairs made so that the leakage will not exceed the amount specified. The

Contractor shall employ qualified personnel throughout the test procedure. All records and charts shall become the property of the DPW.

#### NOMINAL PIPE DIAMETER (INCHES)

#### AVG TEST PRESSURE

(PSI)	6	8	10	12	16	20	24
Ductile, Gray Cast Iron and PVC Mains <u>Allowable Leakage per 1000 ft.</u>							
250	0.71	0.95	1.19	1.42	1.90	2.37	2.85
200	0.64	0.85	1.06	1.28	1.70	2.12	2.55
150	0.55	0.74	0.92	1.10	1.47	1.84	2.21
100	0.45	0.60	0.75	0.90	1.20	1.50	1.80

\*Leakage allowable based on gallons per hour per 1000 feet of Main.

- D. The contractor shall at his own expense make any taps and furnish all necessary caps, plugs, etc., as required in conjunction with testing a portion of the main between gate valves. The contractor shall also furnish a test pump, gauges, and any other equipment required in conjunction with carrying on the hydrostatic tests. The contractor shall at all times protect the new water mains and the existing water mains against the entrance of polluting material.

#### 1.03 DISINFECTION

- A. Before being placed in service, all new water pipe-lines shall be chlorinated in accordance with AWWA C900, "Standard Procedure for Disinfecting Water Mains". The procedure shall be discussed with the Engineer or DPW before doing the work and shall be approved.
- B. The location of the chlorination and sampling points will be determined by the Engineer or DPW in the field. Taps for chlorination and sampling shall be uncovered and backfilled by the Contractor as required.
- C. The general procedure for chlorination shall be to first flush all dirty or discolored water from the lines, and then introduce chlorine in approved dosages through a tap at one end, while water is being withdrawn at the other end of the line. The chlorine solution shall remain in the pipeline for about 24 hours.
- D. Following the chlorination period, all treated water shall be flushed from the lines at their extremities, and replaced with water from the distribution system. Bacteriological sampling and analysis of the replacement water shall then be made by the Engineer or DPW in full accordance with the AWWA Manual C601. The Contractor will be required to rechlorinate, if necessary, and the line shall not be placed in service until the requirements of the State Public Health Department are met.
- E. Upon completion of disinfection, the water main shall be thoroughly flushed with potable water supplied by the Town until the chlorine concentration within the main is less than 0.5 ppm.
- F. The Contractor shall engage the services of an independent testing laboratory, certified to perform the necessary testing, to obtain samples from the disinfected main and perform bacteriological tests. The results of the bacteriological tests shall

be compared with the maximum contaminate levels set forth in the Primary Drinking Water Standards. Where these levels are exceeded the disinfection process shall be repeated as directed by the Engineer or DPW.

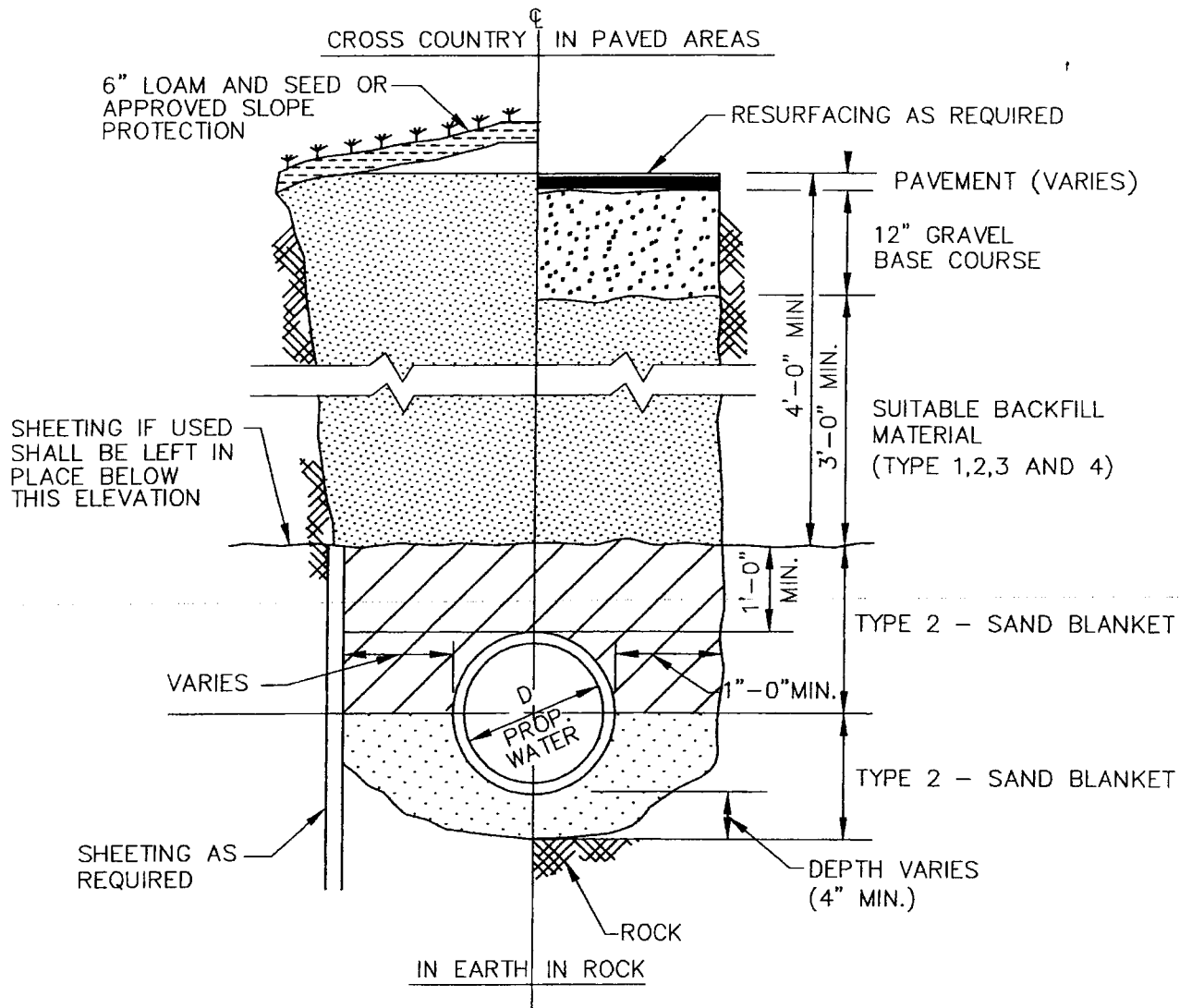
1.04

ACCEPTANCE

- A. The DPW reserves the right to accept the water mains in sections after the satisfactory tests have been made and approved and to make full use of any part or parts of the system.
- B. The Contractor shall be held responsible, for one (1) year from the date accepted by the Engineer and the Town, to rectify any leaks, errors, or other poor workmanship which may be discovered and shall make any necessary repairs, alternations or adjustments as may be required to properly complete the work.

APPENDIX A

CONSTRUCTION DETAILS



TYPICAL TRENCH DETAIL  
NOT TO SCALE



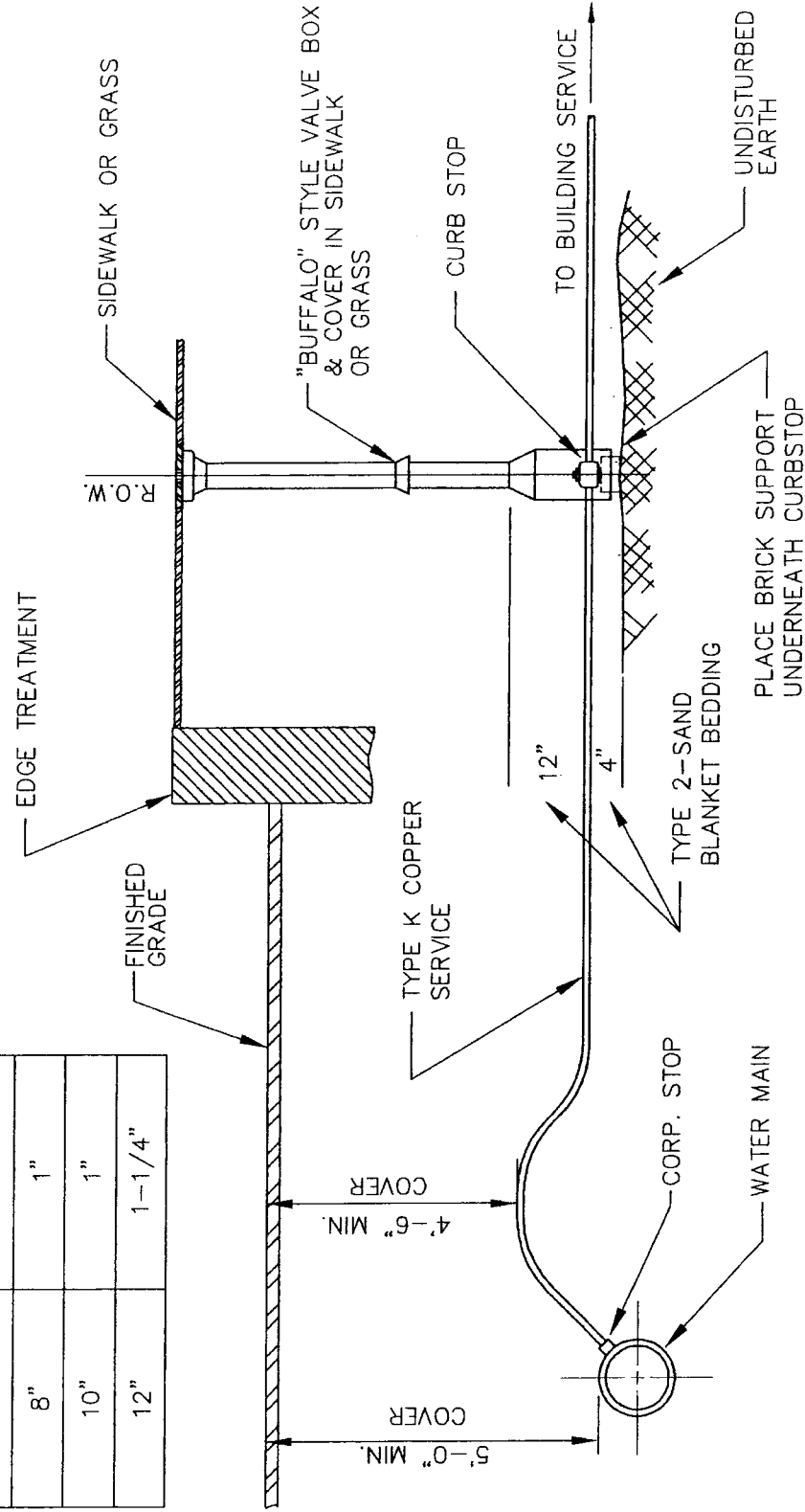
# DUCTILE IRON PIPE

## MAXIMUM SIZE

### TAPPED CONNECTION \*

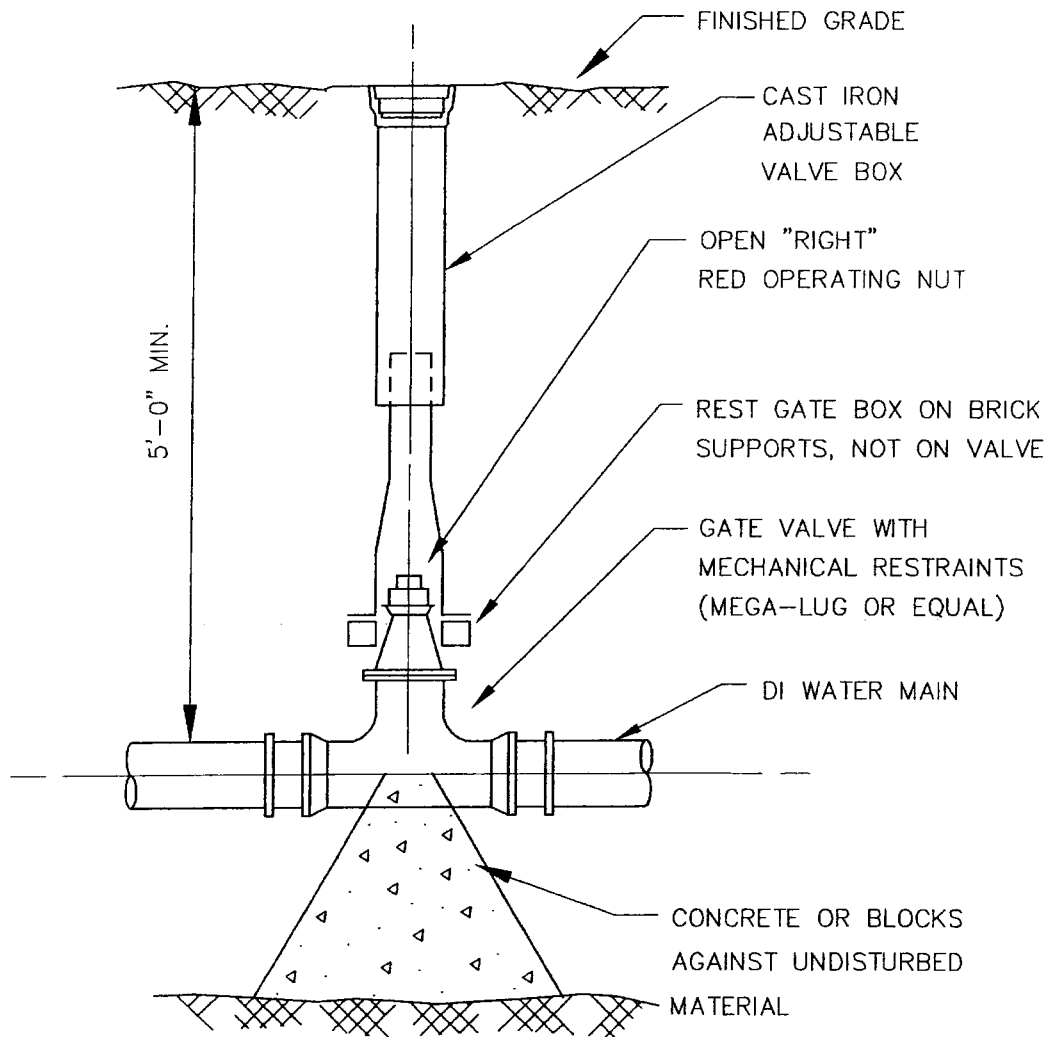
WATER MAIN DIAMETER	MAXIMUM TAP DIAMETER
3"	3/4"
4"	3/4"
6"	1"
8"	1"
10"	1"
12"	1-1/4"

\* WHERE THE SIZE OF THE CONNECTION EXCEEDS THAT GIVEN IN THE TABLE A BOSS SHALL BE PROVIDED OR THE TAP SHALL BE MADE BY MEANS OF MULTIPLE CORP. STOPS AND BRANCH FITTINGS, TAPPED TEE, OR TAPPED SADDLE. TAPPING SADDLES SHALL BE USED FOR ALL SIZES OF AC AND PVC WATER MAINS



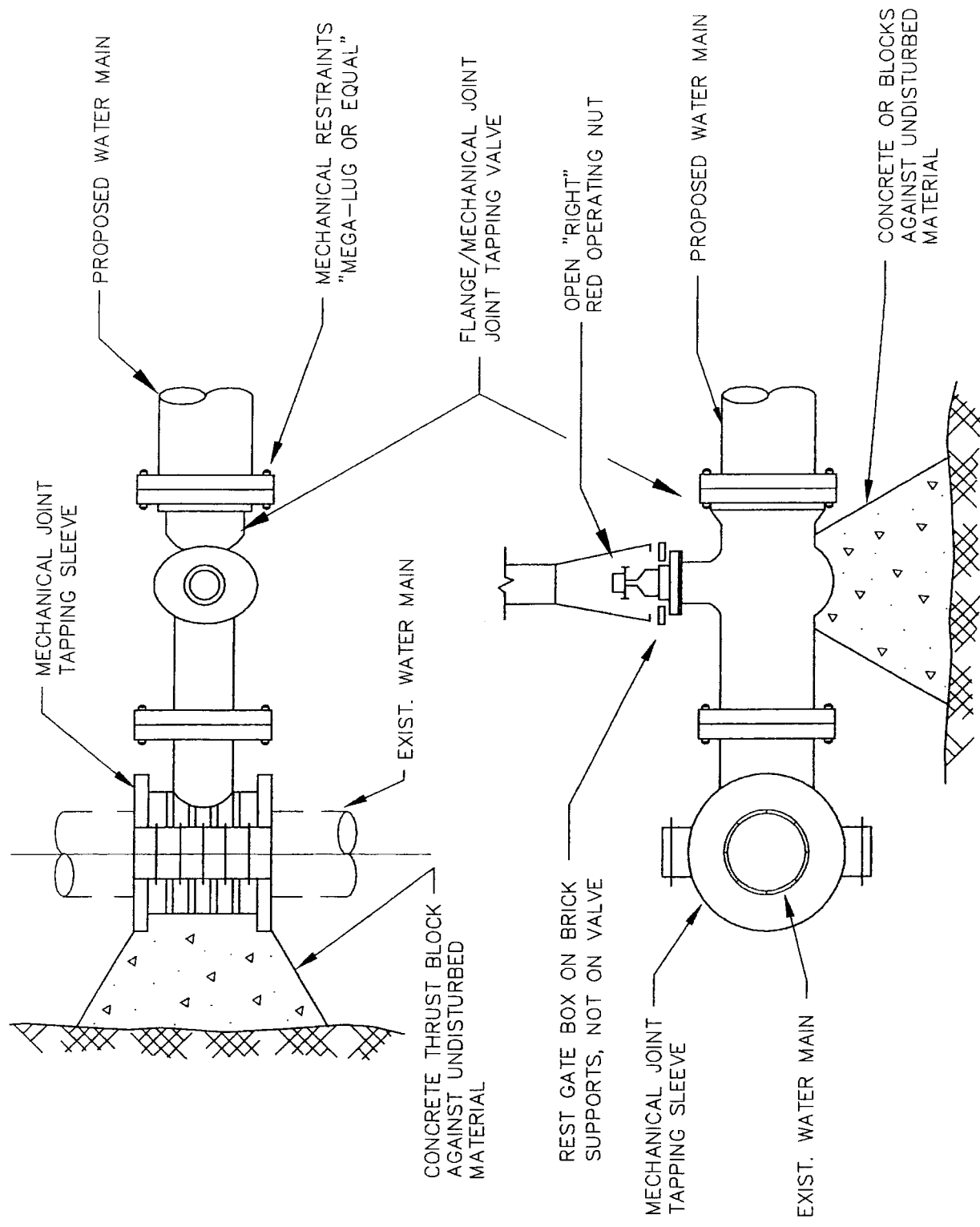
## COPPER SERVICE CONNECTION

NOT TO SCALE



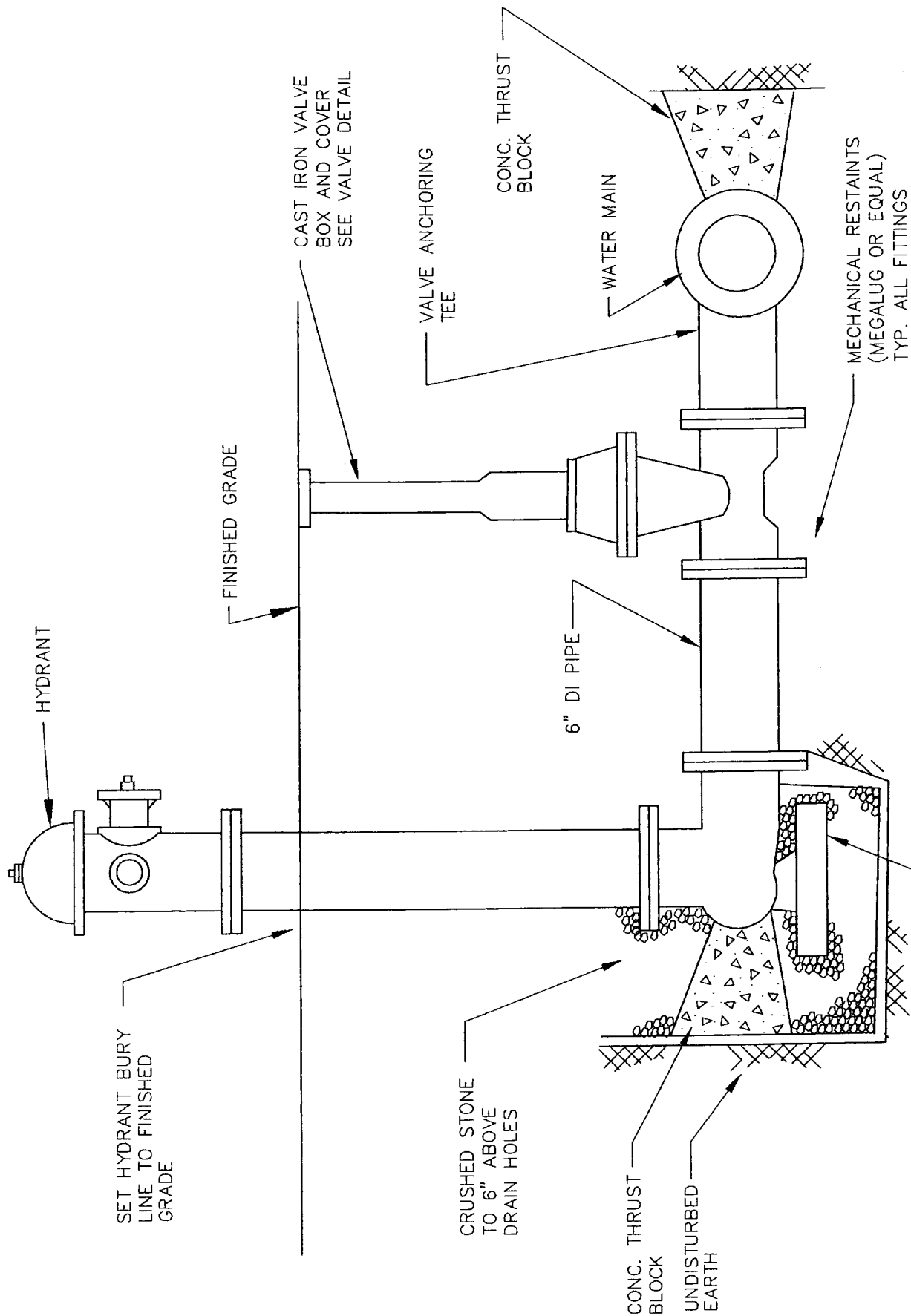
## WATER GATE DETAIL

NOT TO SCALE

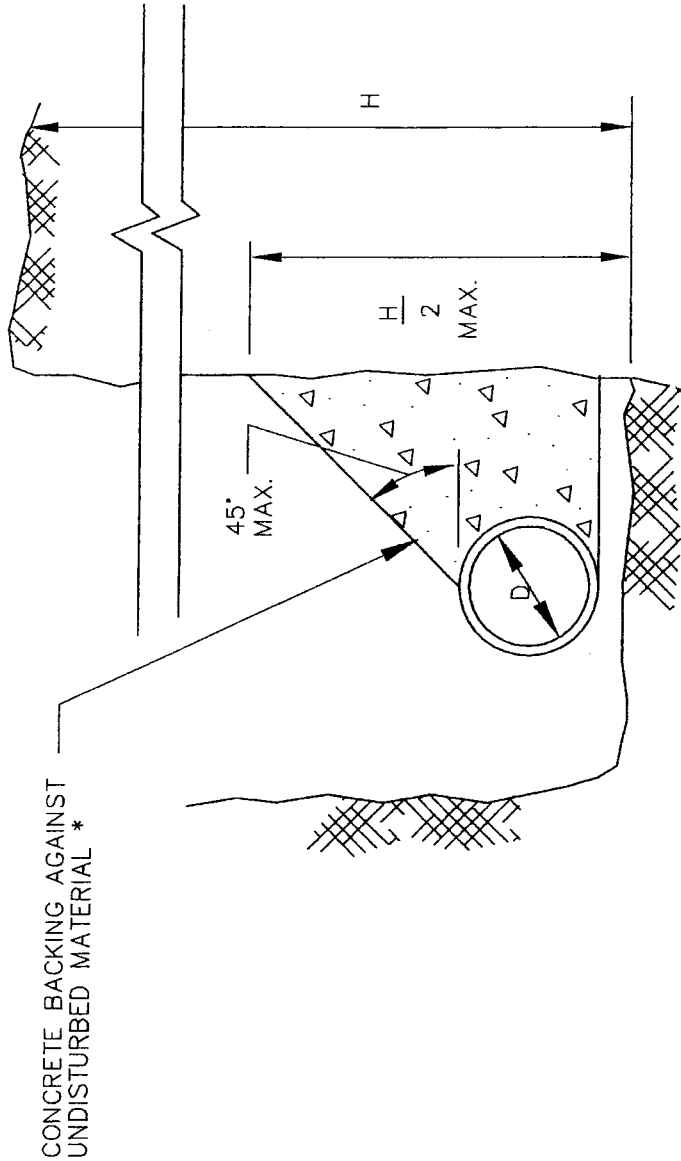


TYPICAL TAPPING SLEEVE AND VALVE

NOT TO SCALE

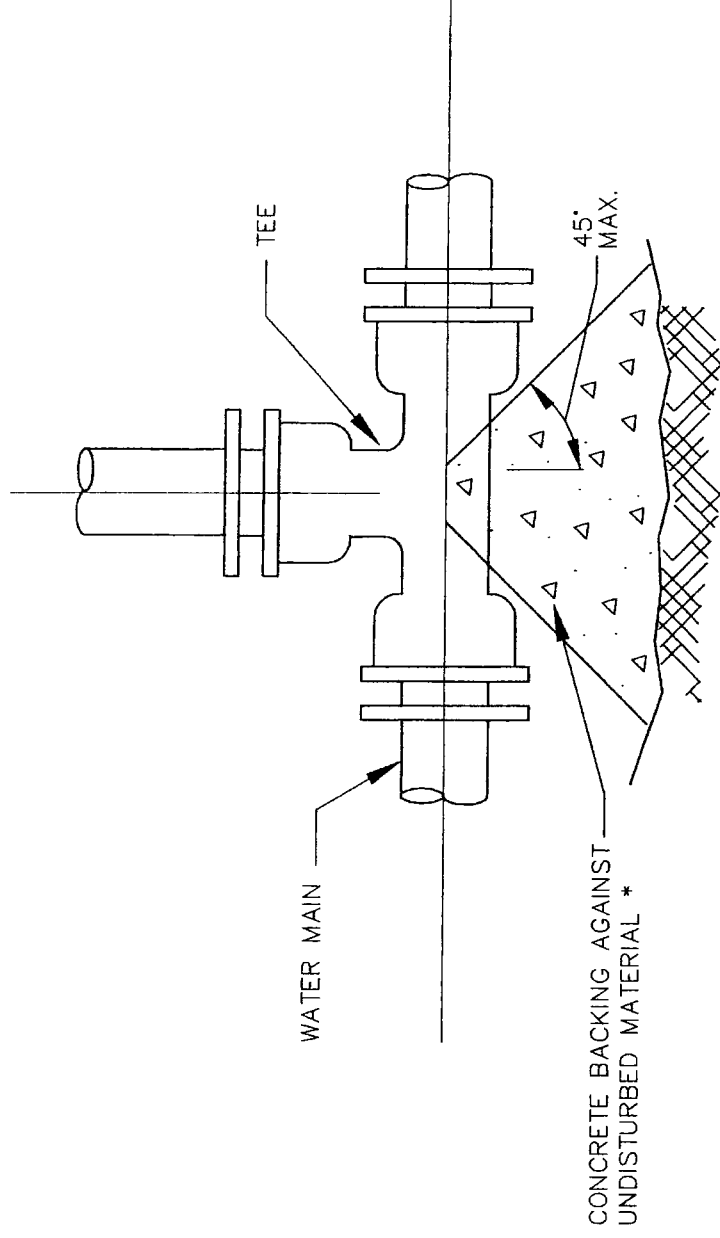


HYDRANT DETAIL  
NOT TO SCALE



\* SEE TABLE ON THRUST BLOCK BEARING AREAS  
FOR THE AREA OF CONCRETE REQUIRED.

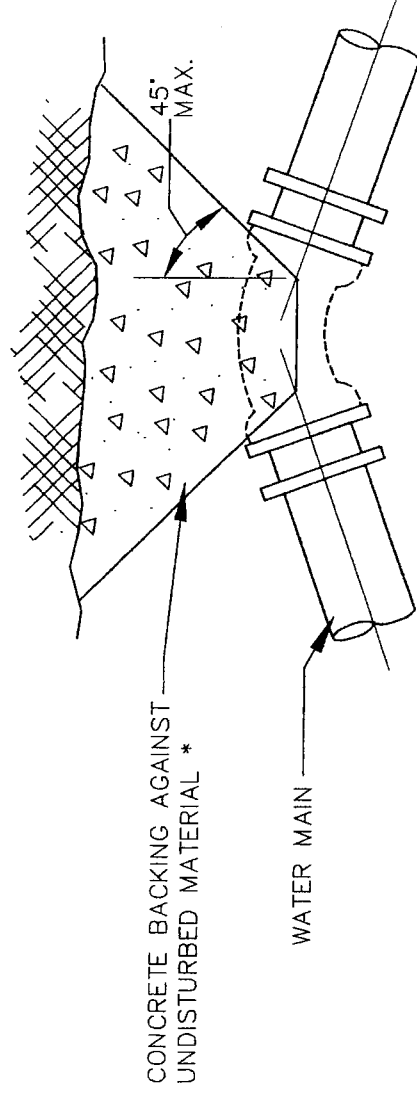
TYPICAL WATER MAIN THRUST BLOCK  
SECTION DETAILS  
NOT TO SCALE



\* SEE TABLE ON THRUST BLOCK BEARING AREAS  
FOR THE AREA OF CONCRETE REQUIRED.

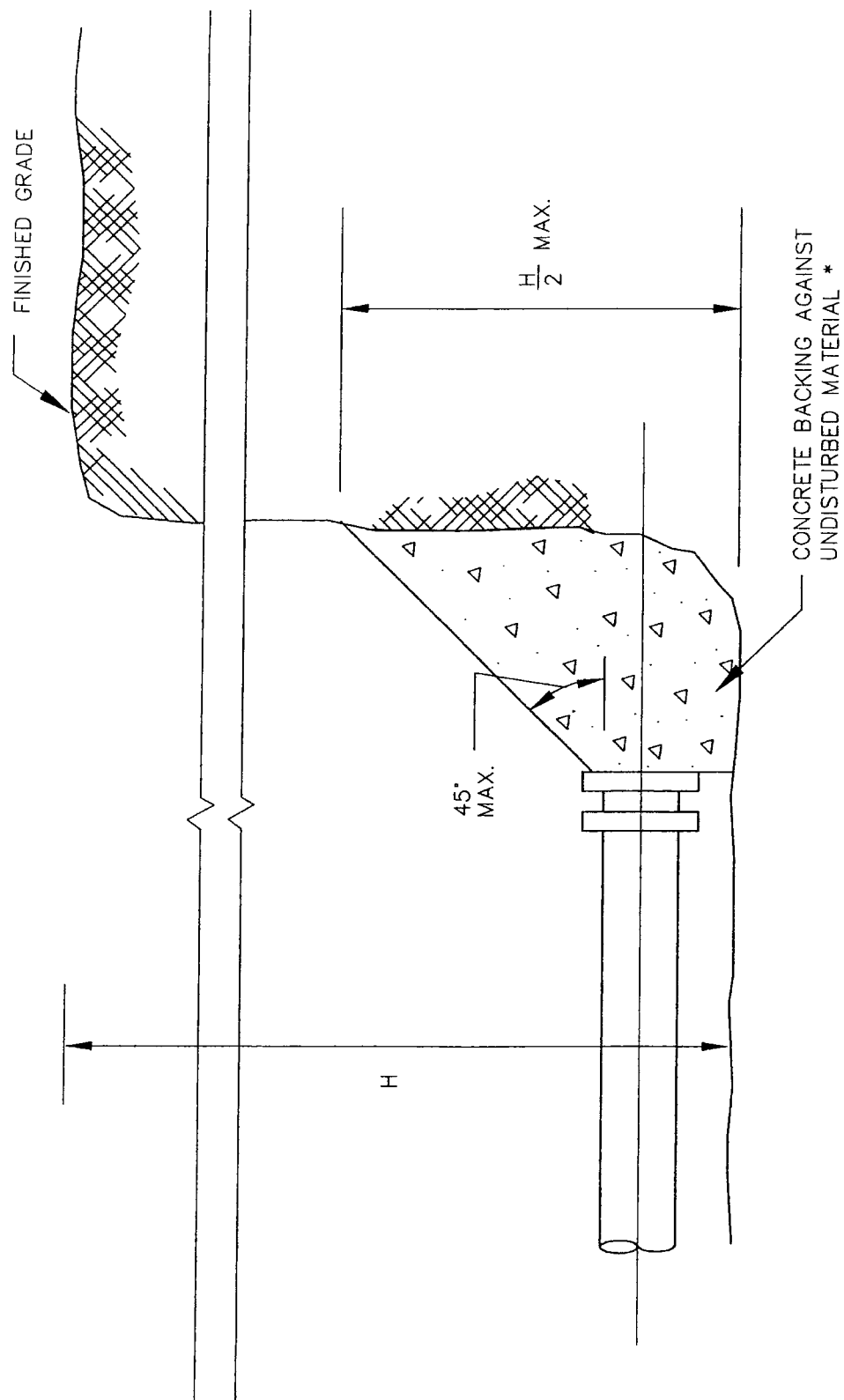
## TYPICAL WATER MAIN TEE THRUST BLOCK DETAILS

NOT TO SCALE



\* SEE TABLE ON THRUST BLOCK BEARING AREAS  
FOR THE AREA OF CONCRETE REQUIRED.

TYPICAL WATER MAIN BEND  
THRUST BLOCK DETAILS  
NOT TO SCALE



\* SEE TABLE ON THRUST BLOCK BEARING AREAS  
FOR THE AREA OF CONCRETE REQUIRED.

## TYPICAL WATER MAIN PLUG

NOT TO SCALE



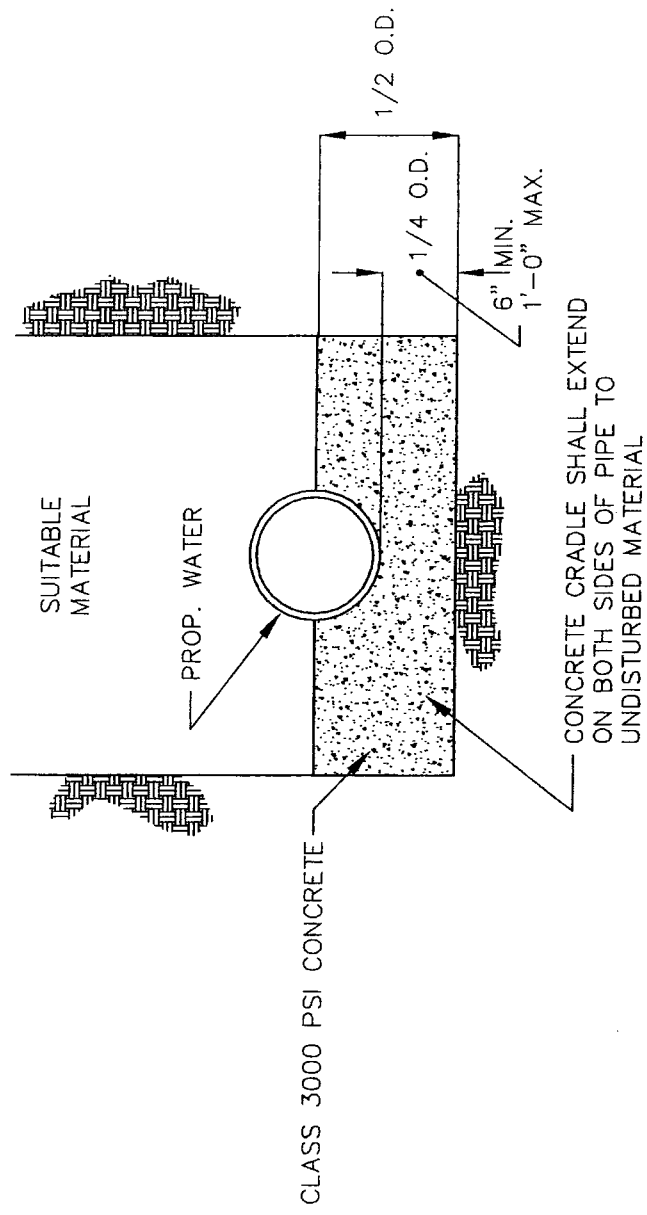
# THRUST BLOCK BEARING AREAS FOR WATER PIPE

TABLE OF BEARING AREAS IN SQ. FT. AGAINST UNDISTURBED MATERIAL FOR WATER MAIN FITTINGS*			
SIZE OF MAIN (IN.)	90° BEND	TEES AND PLUGS	45° BEND
6	4	2.5	2
8	6	4	3
12	12	9	7
16	21	16	12

\* TYPE OF SOIL IS MEDIUM CLAYEY, 6 OR MORE BLOWS PER FOOT, OR LOOSE GRANULAR, 9 OR MORE BLOWS PER FOOT. SOIL CONDITIONS OTHER THAN THOSE GIVEN WILL REQUIRE LARGER BEARING AREAS.

## NOTES:

1. FOR FITTINGS WITH LESS THAN 45° DEFLECTION, USE BEARING AREAS FOR 45° BEND.
2. BEARING AREAS BASED ON HORIZONTAL PASSIVE SOIL PRESSURE OF 2000 P.S.F. AND INTERNAL WATER PRESSURE OF 150 P.S.I.G. JOINTS SHALL NOT BE ENCASED IN CONCRETE. BEARING AREAS MAY BE DIREGARDED FOR TRENCHES IN ROCK WHERE THE TOP OF THE ROCK FACE IS AT OR ABOVE THE CROWN OF THE PIPE. HOWEVER, CONCRETE BACKING SHALL BE PLACED BETWEEN THE PIPE AND THE ROCK FACE.
3. THE CONTRACTOR SHALL SUBMIT 2 WEEKS IN ADVANCE OF PLACEMENT, WORKING DRAWINGS FOR EACH THRUST BLOCK TO THE ENGINEER FOR APPROVAL PRIOR TO INSTALLATION.

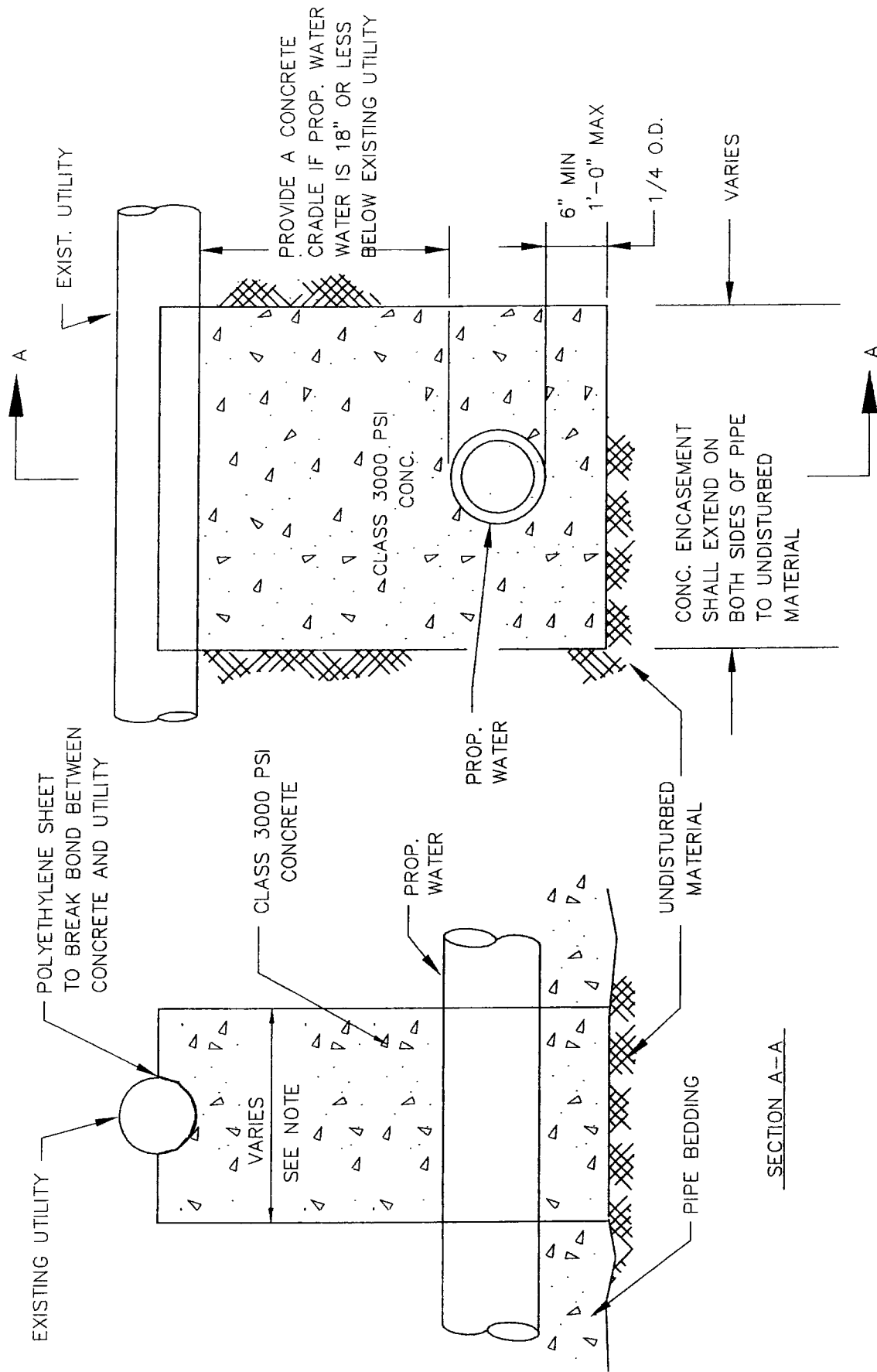


## CONCRETE CRADLE

NOT TO SCALE

### NOTES:

1. CONCRETE CRADLE OR ENCASEMENT SHALL TERMINATE AT PIPE JOINTS.
2. PIPE SHALL BE BRACED TO PREVENT MOVEMENT WHILE CONCRETE IS POURED.

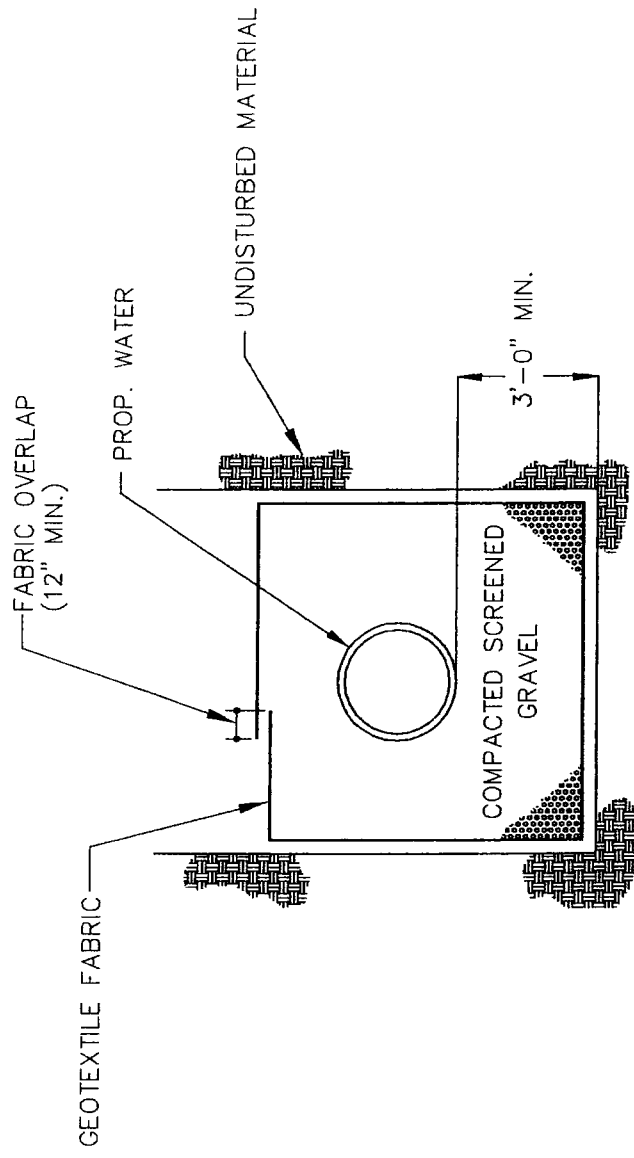


NOTE:  
 CONCRETE CRADLE SHALL EXTEND A MINIMUM OF 5'  
 BEYOND EITHER SIDE OF EXISTING UTILITY AND SHALL  
 TERMINATE AT PIPE JOINTS ONLY.

# CONCRETE UTILITY SUPPORT DETAIL

NOT TO SCALE

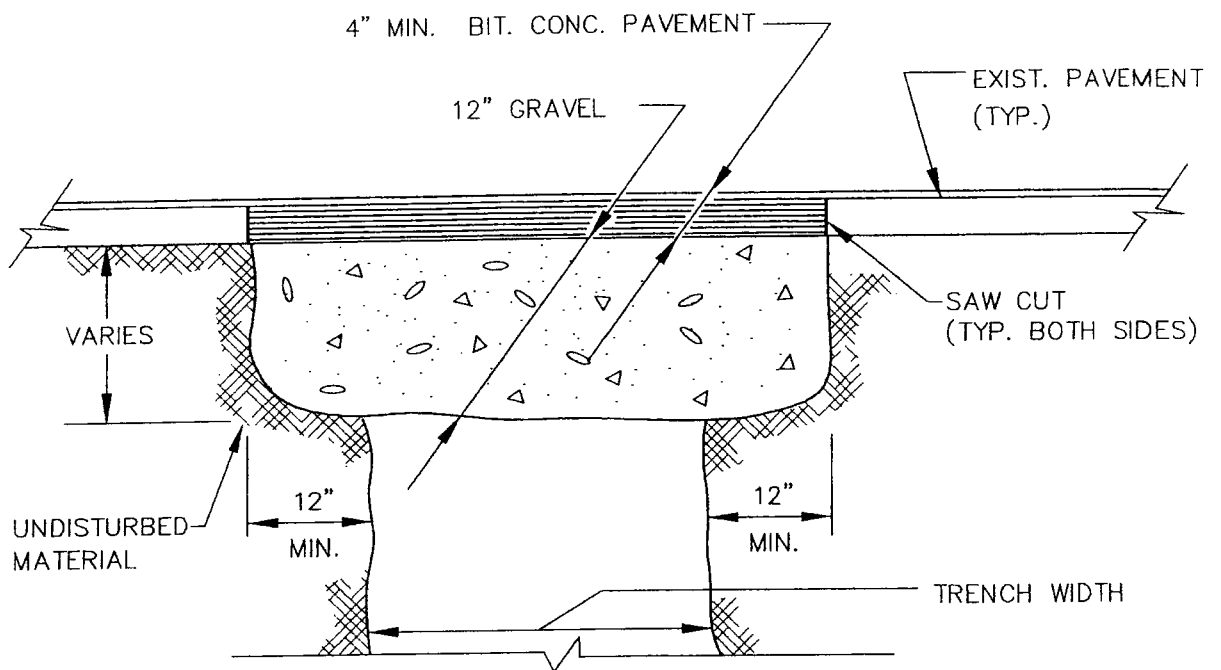
SECTION A-A



NOTE:  
 PLACEMENT OF GEOTEXTILE FABRIC SHALL EXTEND 5'  
 ON EITHER SIDE OF POOR SUBGRADE CONDITIONS.

## TRENCH EXCAVATION WITH UNSUITABLE SOIL CONDITIONS

NOT TO SCALE



## TRENCH PAVEMENT DETAIL

NOT TO SCALE

APPENDIX B

APPLICATION FORM

**TOWN OF MILLIS, MASSACHUSETTS**  
**WATER MAIN EXTENSION APPLICATION**

NAME OF  
APPLICANT: \_\_\_\_\_

LOCATION: \_\_\_\_\_

**WATER AGREEMENT**

The undersigned applicant hereby requests approval of its proposal to construct a water which shall eventually become a public sewer and herewith submits to the Town for its review, recommendation and approval, the design drawings and specifications of the proposed water. The undersigned applicant understands, covenants and agrees that the Board may, in its sole discretion, submit the said design information to its independent professional engineering firm for a review and recommendations, and that the undersigned applicant shall be required to pay the full cost of any such engineering review without any surcharges or add-ons by the Town and that the said payment shall be made by the applicant directly to the engineering firm. Fees listed below shall be charged for in-house review of plans and field inspections during construction. The Town shall not approve, disapprove or otherwise act on the said application until said payment has actually been made.

\_\_\_\_\_  
Applicant Signature

\_\_\_\_\_  
Date

Proposed # Gallons per Day Discharge \_\_\_\_\_

WATER:

L.F. \_\_\_\_\_ No. # Valves \_\_\_\_\_ No. # Services \_\_\_\_\_

\_\_\_\_\_ \$1000 Deposit Fee (For Town's Consulting Engineers)

\_\_\_\_\_ Extension Fee \$1000

\_\_\_\_\_ \$1750 per water service (paid at time of building permit application)

Classification: Residential Extension \_\_\_\_\_

Commercial Extension \_\_\_\_\_

Industrial Extension \_\_\_\_\_

# TOWN OF MILLIS, MA WATER CONNECTION APPLICATION

( ) Residential

( ) Commercial

Single Family \_\_\_\_\_

Type of Use: \_\_\_\_\_

Multi-Family \_\_\_\_\_

Number of Families \_\_\_\_\_

Apartment Building \_\_\_\_\_

Number of Apartments \_\_\_\_\_

Toilets: Tank type \_\_\_\_\_ Flushometer \_\_\_\_\_ Swimming Pool: \_\_\_\_\_

Number of Bathrooms: \_\_\_\_\_ Tub Style \_\_\_\_\_ Shower Stall \_\_\_\_\_ Sinks: \_\_\_\_\_ Outside Silcock: \_\_\_\_\_

Irrigation System: \_\_\_\_\_ Water Cooled Refrigeration: \_\_\_\_\_ Air Conditioning: \_\_\_\_\_ Fire System: \_\_\_\_\_

Address: \_\_\_\_\_

Owner: (Name and Mailing Address) \_\_\_\_\_

Meter Serial #: \_\_\_\_\_

Encoder Serial #: \_\_\_\_\_

Reading: \_\_\_\_\_

Tel. No.: \_\_\_\_\_

Drainlayer Performing work: \_\_\_\_\_

Address/Telephone: \_\_\_\_\_

## CONDITIONS

- 1) Application must be accompanied by plans and specifications for proposed building connection.
- 2) Accept and abide by all Water Regulations of the Town of Millis, and of all other pertinent ordinances or regulations that may be adopted in the future.
- 3) Notification to D.P.W. 24 hours in advance of installation to allow for scheduling of inspection prior to any backfilling.

Homeowner agrees to comply with all conditions and regulations set forth by Town of Millis.

The undersigned or any successor hereby makes application for water to be furnished by the Town of Millis, Department of Public Works, for use at the above premises and agrees to take and use the same and to pay for all the water and service supplied to the said premises, at the rate now fixed, or which may be hereafter fixed by the Town of Millis, Department of Public Works, as bills are rendered therefore, as measured by meter, until written notice is given by the subscriber to the Town of Millis, Department of Public Works, at its office to discontinue service and subscriber hereby expressly agrees to and this application is made subject to, all and singular, the terms and provisions of the By-Laws and Regulations of the Town of Millis and of the Department of Public Works now in effect or thereafter adopted for the management, operation and protection of the Department of Public Works of the Town of Millis. Subscriber hereby agrees to be held responsible for the payment of all bills rendered for water and service at the above described premises UNTIL WRITTEN NOTICE BE GIVEN TO THE TOWN OF MILLIS, DEPARTMENT OF PUBLIC WORKS for the cancellation of this contract, this application to become a contract only upon acceptance of the same by the Town of Millis, Department of Public Works.

\_\_\_\_\_  
Applicant

\_\_\_\_\_  
Date

## APPROVALS

**Millis Department of Public Works**

**Millis Town Administrator**

James McKay, Assistant Director

\_\_\_\_\_  
Date

Charles Aspinwall, Director

\_\_\_\_\_  
Date

Entrance Fee: \$1,750.00

( ) Paid

Meter and Encoder Fee: \$250.00

( ) Paid



APPENDIX C  
RELATED SECTIONS

## SECTION 02200

### EARTHWORK

#### PART 1 GENERAL

- 1.01 SCOPE OF WORK
- 1.02 RELATED WORK SPECIFIED ELSEWHERE
- 1.03 SITE INFORMATION
- 1.04 PROTECTION OF EXISTING CONDITIONS

#### PART 2 MATERIALS - NOT APPLICABLE

#### PART 3 EXECUTION OF WORK

- 3.01 DESCRIPTION
- 3.02 OPEN EXCAVATION
- 3.03 SEPARATION OF SURFACE MATERIALS
- 3.04 EXCAVATED MATERIAL
- 3.05 DRAINAGE
- 3.06 STRUCTURE EXCAVATION
- 3.07 SLABS ON GRADE
- 3.08 TRENCH EXCAVATION
- 3.09 TRENCH EXCAVATION IN FILL
- 3.10 TRENCH LIMITS
- 3.11 EARTH EXCAVATION BELOW NORMAL GRADE
- 3.12 EXCAVATION NEAR EXISTING STRUCTURES
- 3.13 RELOCATION AND REPLACEMENT OF EXISTING STRUCTURES
- 3.14 CARE AND RESTORATION OF PROPERTY
- 3.15 DUST CONTROL
- 3.16 BACKFILLING - GENERAL
- 3.17 BACKFILLING AROUND STRUCTURES
- 3.18 BACKFILLING IN OPEN TRENCH
- 3.19 MATERIAL FOR FILLING AND EMBANKMENTS
- 3.20 GRADING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. The Contractor shall make all excavation of normal depth in earth for sites, structures, roads, and trenches in whatever substance encountered, and shall place and compact backfill to the dimensions and levels shown on the plans or as required by the Engineer. The Contractor shall provide all labor, material, equipment, supervision and incidentals to execute the work in strict accordance with these specifications and applicable drawings. Work under this section includes, but is not necessarily limited to, stripping and stockpiling of suitable topsoil, excavation of all materials encountered, trenching, sheeting, shoring, dewatering, blasting, maintenance of excavation, backfill, fill, providing borrow, compaction, and grading. Layout shall be done by the Contractor.
- B. The Contractor is advised that lines and grades, as shown on plans and profiles, are subject to change. Although it is the intention to adhere to that which is shown on the plans, the Engineer reserves the right to make changes in lines and grades of utilities and locations of manholes when such changes may be necessary or advantageous.
- C. The Contractor's particular attention is directed to the related sections of the specifications. Specific information is provided for stockpiling material on-site or off-site

and disposal of unsuitable material. Special requirements applicable to excavation to remove soft material, site preparation settlement, and timing of construction are identified.

- D. In open trenching on State, County, or local highways and railroad properties, the Contractor shall be governed by the conditions, restrictions and regulations made by the appropriate body. All such regulations shall be in addition to those set forth in these specifications.
- E. Any excavation, dewatering, sheeting, and bracing shall be carried out in such a manner as to eliminate any possibility of undermining or disturbing the foundations of any existing structures or any work previously completed under this Contract, or as specified herein.
- F. The Contractor shall fill or backfill all excavations as indicated on the Contract Drawings and as specified herein, but is advised that some of the excavated material may not be suitable as backfill material.

#### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. SECTION 02224 - FILL AND BACKFILL MATERIALS
- B. SECTION 02250 - COMPACTION CONTROL AND TESTING
- C. SECTION 02575 - PAVING REPAIR AND REPLACEMENT

#### 1.03 SITE INFORMATION

- A. Existing grades and other site information shown on the applicable Contract Drawings are approximate and have been compiled by field surveys. The Owner does not guarantee that grades shown will not vary from the actual site conditions. The Contractor must make his own field investigations to determine all conditions affecting the work to be done and materials needed and make his bid in sole reliance thereon.

#### 1.04 PROTECTION OF EXISTING CONDITIONS

- A. General: Extreme care shall be exercised to avoid existing trees, shrubs, facilities, utilities, fences, and private property that are to remain and all necessary precautions taken to preclude damage to these items. Any damage to these items as a result of work performed by the Contractor shall be repaired by the Contractor at his own expense.
- B. Utility agencies shall be contacted and advised of proposed work prior to the start of actual excavation. The Contractor shall obtain information from the proper sources and authorities concerning locations of all utilities within the scope of this work, in order that there will be no damage done to such utilities.
- C. If and when encountered, utilities shall be supported and protected, and the Engineer shall be notified. Entrance, opportunity, and ample time shall be allowed for such measures as may be required for the continuance of utility services. Utilities to be abandoned within excavation areas shall be removed, plugged, or capped by the Contractor as directed by the Engineer. Permanent existing utilities near the excavation and/or construction work shall be properly protected during construction work, and any damage to such permanent utilities shall be repaired by the Contractor without expense to the Owner or Engineer.
- D. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs. No separate item is provided for service supports and the Contractor must cover supports in the unit prices bid for the roadway construction.

- E. The Contractor shall not be compensated for any additional work involved whenever a utility or underground structure is so encountered within the work limits.
- F. The Contractor shall not be compensated for any additional work involved if the utilities or underground structures cross the trench line transversely above or below the proposed work.
- G. Rules and regulations governing the respective utilities shall be observed. Active utilities shall be adequately protected from damage, and shall not be removed or relocated except as indicated or directed.
- H. All existing pipes, poles, wires, fences, curbing, and other structures which, in the opinion of the Engineer, must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from injury by the Contractor, and in case of injury, the Contractor shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. The Contractor shall at his own expense replace, repair, or restore the affected facilities to their original condition or shall reimburse the owner of said facilities for such expenses as the owner may accrue. When the owners do not wish to make the repairs themselves, all damage shall be repaired by the Contractor, or, if not promptly done by him, the Engineer may have the repairs made at the expense of the Contractor.
- I. Survey markers: Any existing property boundary markers, City bounds, control points, and datum elevations markers or bench marks to be removed and replaced as shown on the Contract Drawings or directed by the Engineer shall be removed and replaced by the Contractor with all expenses for such replacement paid for by the Contractor.
- J. The Contractor shall provide and maintain barricades, signs, lights, etc., required for the protection of personnel, materials and property. Barricades, etc., shall conform with all codes and regulations, and shall be lighted at night with lanterns, and reflectorized paint as directed or required for safety, and shall be removed upon completion of the Contract.

**PART 2 MATERIALS - NOT APPLICABLE**

**PART 3 EXECUTION OF WORK**

**3.01 DESCRIPTION**

- A. The Contractor shall make excavations in such manner and to such width as will give suitable room for building the structures or for constructing the roadways but complying with the limits shown on the Contract Drawings. The Contractor shall furnish and place all sheeting, bracing, and supports; shall do all pumping and draining and any other work necessary for dewatering and shall render the bottom of the excavation firm and dry and in all respects acceptable.
- B. In no case, except as provided for in Part 3.10 titled "Trench Limits", shall the earth be plowed, scraped, or dug by machinery so near to the finished grade as to result in disturbance of material below said grade. The last of the material to be excavated shall be removed with pick and shovel just before placing pipe, masonry, or other structures.
- C. All excavations shall be braced with steel sheeting or steel excavation boxes as specified in the related specifications or as shown on the Contract Drawings.

**3.02 OPEN EXCAVATION**

- A. All excavation, except as otherwise specified or permitted, shall be open cut. The length of trench open at any one time will be controlled by the Engineer. The Contractor shall

not have more than three hundred (300) feet of trench open at any one time during daylight hours.

### 3.03 SEPARATION OF SURFACE MATERIALS

- A. From areas within which excavations are to be made, loam, topsoil, sand, and gravel shall be carefully removed and separately stored to be used again as directed; or, if the Contractor prefers not to separate materials, he shall furnish as directed and without additional compensation, clean backfill and loam and topsoil at least equal in quantity and quality to that excavated.
- B. When excavations are to be made in paved surfaces, the Contractor shall machine cut the pavement along the proposed trench lines, with either a pneumatic hammer or mechanical saw in such a manner that the edges of the remaining pavement follow clean, trim, straight lines. If pavement is removed, it shall not be mixed with other excavated material, but shall be disposed of away from the site before the remainder of the excavation is made.

### 3.04 EXCAVATED MATERIAL

- A. Excavated material shall be so placed as not to interfere with travel on the streets and driveways by the occupants of adjoining property, cause undesirable settlement, or obstruct free access to hydrants and gate valves. Access for emergency vehicles shall be maintained at all times. Excavated material shall not be deposited on private property until written consent of owner or owners thereof has been filed with Engineer. Onsite excavated material stockpiles shall be stored as directed by the Engineer. However, if it is impractical or unsafe to stack suitable, excavated, backfill material adjacent to the work, the material shall be hauled and stored at a location provided by the Contractor at no additional expense to the Owner. Excavated material shall not be deposited in brooks or streams. Excavation shall include the removal of unearthed wooden structures.
- B. It is expressly understood that no excavated materials shall be removed from the site of work or disposed of by the Contractor except as directed or approved by the Engineer. All material designated by the Engineer to be removed from the site shall be immediately removed and legally disposed of according to Federal, State and Local codes and regulations. The Contractor will be required to clean any roads and streets of material that is spilled from his operation of hauling and disposing of unsuitable excavated material.
- C. Suitable excavated material may be used for fill or backfill on other parts of the work.
- D. Upon completion of the backfilling, the streets or property shall be cleaned, surplus material removed, and the surfaces restored to the condition in which they were before construction. All materials left over in public highways shall become the property of the Contractor. If the Contractor fails to promptly remove such surplus material, the Engineer may have the work done and charge the cost thereof as money paid to the Contractor.
- E. Material excavated from private property shall belong to the property owner or his representative, and shall be disposed of by the Contractor, as required by said property owner or representative, but the longest haul requested by the Owner shall in no case exceed 5 miles. If the Contractor fails to promptly remove such surplus material, the Engineer may have the same done and charge the cost thereof as money paid to the Contractor.

### 3.05 DRAINAGE

- A. At all times during construction, the Contractor shall provide, place and maintain ample means and devices with which to intercept and/or remove promptly, and dispose properly all water entering trenches and other excavation, or the water may flow along or across the site of work; and keep said excavations dry until the structures, pipes, and appurtenances to be built have been completed to such extent that they will not be damaged. At this time the Contractor shall remove such temporary means and devices.
- B. Every precaution necessary to obtain water-tight construction of all joints in pipe, manholes, wyes, and drop connections must be taken.
- C. All ground water which may be found in trenches or excavations and any water which get may into them from any cause whatsoever shall be removed.
- D. All water pumped or drained from the work shall be disposed of in a suitable manner, satisfactory to the Engineer, without undue interference with other work or damage to pavements, other surfaces, or property.

### 3.06 STRUCTURE EXCAVATION

- A. The Contractor shall excavate to the elevations shown on the plans, or as directed by the Engineer. If the Contractor excavates below the elevations specified, he shall bring the excavation back to the proper elevation by backfilling with screened gravel (Type 6 material) and tamping in 6" layers to provide a compact base. The backfill material must be approved by the Engineer before being placed. If the Engineer directs any changes in elevation or dimension of the structure excavations from that shown on the plans, the Contractor shall be paid for work performed under the appropriate bid item. Any increase in cost resulting from backfilling, or increasing the size of the excavation or foundations because of overexcavation in depth, shall be borne by the Contractor. Cut slopes shall have a maximum slope of 2:1 if not braced. When excavation has reached specified dimensions, the Engineer shall be notified and he will determine if conditions are satisfactorily met before work is allowed to continue.

### 3.07 SLABS ON GRADE

- A. Where slabs on undisturbed earth occur, all loams, organic or other undesirable materials shall be removed as required by the Engineer, and the area grubbed to a depth of at least six (6) inches below the finished subgrade elevation or as indicated on the Contract Drawings. Where slabs on fill occur, the fill will also be compacted in accordance with the related section of the specifications.

### 3.08 TRENCH EXCAVATION

- A. Excavation shall not commence in any section until the pavement covering the proposed excavation has been properly cut.
- B. In general, trenches shall be excavated to such depth as will permit pipe to be laid at elevations, slopes or depths of cover as indicated on the Contract Drawings. Deeper trenches shall be provided where necessary on account of the conformation of the ground and to permit the alignment of the pipe without undue deflection of joints.
- C. Trenches shall be excavated by hand or machinery to the width and depth indicated on the Contract Drawings and specified herein under Paragraph 3.10 "Trench Limits". All

loose material shall be removed from the bottom of the trench so that the bottom of the trench will be in an undisturbed condition, and so as to provide a proper foundation for pipe bedding material.

- D. Particular care shall be taken that no stone 6 inches or larger in any diameter protrudes more than 3 inches from the bottom or side of the trench. Suitable bell holes shall be made in the trench at joints as required.
- E. At completion of a workday, all excavations shall be covered by backfilling to existing grade or plating to entirely cover the opening or completely enclosing with a 6 foot high temporary chain link fence.
- F. In earth excavation in sections where bedding is excluded, the bottom of the trench shall be shaped so as to conform to the outside of the pipe, particular care being taken to recess the bottom of the trench in such a manner as to relieve the bell of all load.

### 3.09 TRENCH EXCAVATION IN FILL

- A. If pipe is to be laid in embankments or other recently filled material which are more than 1 foot below the invert of the pipe, the fill material shall be placed and properly compacted to final grade or to a height of at least 3 feet above the top elevation of the pipe, whichever is the lesser, before laying pipe. Particular care shall be taken to ensure maximum consolidation of material under the pipe. The pipe trench shall then be excavated as though in undisturbed material.

### 3.10 TRENCH LIMITS

- A. The limits of normal trench excavation shall be as shown on the Contract Drawings or specified herein. Trenches shall be excavated to the required depths, adding, however, to such depths the thickness of the pipe and, where applicable, the thickness of the bedding. The width of the trench at the bottom shall always be wide enough to make the joints properly. When, in the opinion of the Engineer, it is necessary to lay a concrete foundation, the excavation shall be made as shown on the details or as ordered by the Engineer.
- B. Where the bottom of the trench, by mistake of the Contractor, has been taken out to a greater depth than above specified, it shall be refilled to the proper grade, using screened gravel material by the Contractor who shall receive no additional compensation whatever therefore. Refilling with earth to bring the bottom of the trench to the proper grade will not be permitted.
- C. The Contractor shall at all times exercise care not to excavate outside the trench limiting lines as shown on the Contract Drawings unless otherwise authorized by the Engineer.
- D. Bedding for pipe will be as detailed on the Contract Drawing and as specified in the related section of the specifications.

### 3.11 EARTH EXCAVATION BELOW NORMAL GRADE

- A. If in the opinion of the Engineer, the material at or below the depth to which excavation for structures and pipes would normally be carried is unsuitable for foundation, it shall be removed to such widths and depths as directed and replaced with suitable material. Such work shall be paid for under appropriate items.

1. Roadway over-excavations shall be backfilled with compacted Type 3 material.

2. Trench over-excavation shall be minimum of 3 feet or as directed by the Engineer and shall be lined with a geotextile fabric.

### 3.12 EXCAVATION NEAR EXISTING STRUCTURES

- A. Attention is directed to the fact that there are pipes, drains, and other utilities in certain locations. Some of these have been indicated on the Contract Drawings, and an attempt has been made to show all of the lines and services, but the completeness of accuracy of the information given is not guaranteed.
- B. All pipes and other utility conduits, shall be located on the ground with pipe finding equipment well ahead of the work at all times. All such locations shall be plainly marked by coded paint symbols on pavement or by marked stakes in the ground. All such location work shall be provided by the Contractor in cooperation with the appropriate utility to the satisfaction of the Engineer at no extra cost.
- C. As the excavation approaches pipes, conduits, or other underground structures, digging by machinery shall be discontinued and the excavation shall be done by means of hand tools, as directed. Such manual excavation when incidental to normal excavation shall be done to the satisfaction of the Engineer at no extra cost.

### 3.13 RELOCATION AND REPLACEMENT OF EXISTING STRUCTURES

- A. Whenever the Contractor encounters certain existing structures as described below and is so ordered in writing, he shall do the whole or such portions of the work as he may be directed, to change the location or, remove and later restore, or replace such structures, or to assist the Owner thereof in so doing. For all such work, the Contractor shall be paid under such items of work as may be applicable, otherwise as Extra Work.
- B. In removing existing pipes or other structures, the Contractor shall use care to avoid damage to material, and the Engineer shall include for payment only those new materials which, in his judgment are necessary to replace those unavoidably damaged.
- C. The structures to which the provisions of the preceding two paragraphs shall apply include pipes, wires, and other structures which (a) are not indicated on the Contract Drawings or otherwise provided for, (b) encroach upon or are encountered near and substantially parallel to the edge of the excavation, and (c) in the opinion of the Engineer will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced.
- D. When fences interfere with the Contractor's operations, he shall remove and (unless otherwise specified) later restore them to at least as good condition as that in which they were found immediately before the work was begun. The restoration of fences shall be done as promptly as possible and not left until the end of the construction period.

### 3.14 CARE AND RESTORATION OF PROPERTY

- A. Excavation machinery and cranes shall be of suitable type and be operated with care to prevent damage to trees not to be cut and overhanging branches and limbs.
- B. Branches, limbs, and roots shall not be cut except by permission of the Engineer. All cutting shall be smoothly and neatly done without splitting or crushing. In case of cutting or unavoidable damage to branches, limbs, and trunks of trees, the cut or damaged portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.



- C. Cultivated hedges, shrubs, and plants which might be injured by the Contractor's operations shall be protected by suitable means or shall be dug up and temporarily replanted and maintained. After the construction operations have been substantially completed, they shall be replanted in their original positions and cared for until growth is reestablished. If cultivated hedges, shrubs, and plants are injured so such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of kind and quality at least equal to the kind and quality existing at the start of the work.
- D. On paved surfaces, the Contractor shall not use or operate tractors, bulldozers, or other power operated equipment, with treads or wheels of which are so shaped to cut or otherwise damage such surfaces. All surfaces which have been damaged by the Contractor's operations shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operation. Suitable materials and methods shall be used for such restoration.
- E. The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

### 3.15 DUST CONTROL

- A. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities so as to minimize the creation of dust. If the Engineer decides that it is necessary to use calcium chloride for more effective dust control, the Contractor shall furnish the material, load, deliver, and spread it as directed.

### 3.16 BACKFILLING - GENERAL

- A. In general, and unless other material is indicated on the Contract Drawings or specified elsewhere, material used for backfilling trenches and excavations around structures shall be suitable material which was removed in the course of construction excavation. Backfilling shall not commence until the Engineer gives permission. Where the trench is in an area to be paved, or in an unpaved vehicular or pedestrian traveled way, or the shoulder of a paved roadway, a suitable pavement base shall be provided to a depth of at least that required in the related sections of the specifications.
- B. Suitable backfill material shall be free from cinders, ashes, refuse, boulders, rocks, or stones greater than 6 inches in any dimension, unsuitable organic material, or other material which, in the opinion of the Engineer, is unsuitable.
- C. Frozen material shall not be placed in the backfill, nor shall backfill be placed upon frozen material. Previously frozen material shall be removed, or shall be otherwise treated as required, before new backfill is placed.

### 3.17 BACKFILLING AROUND STRUCTURES

- A. The Contractor shall not deposit backfill against structures until the structure has obtained sufficient strength to withstand the earth pressure placed upon it and in no case less than seven days, nor before carrying out and satisfactorily completing the tests specified in the related sections of the specifications. Compaction of backfill against concrete structures shall not be carried out by motorized equipment closer to the structure than the depth of the structure below grade. Such backfilling shall be carried up evenly on all walls of a structure simultaneously with maximum allowable variation of 2 feet in elevation at any point. Unequal soil pressures shall be avoided by depositing the material evenly around the structure.
- B. In addition, where pipe is connected to the structure, the backfilling procedure shall be carried out as specified in "Backfilling in Open Trench".

- C. Measurement of fill material under this work will not include any filling made beyond a vertical plan of one foot outside the footings except as directed.
- D. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of the day's operations. Prior to terminating work for the day, the final layer of compacted fill shall be rolled or graded to eliminate ridges of soil left by compaction equipment. No fill shall be placed and compacted on snow, ice, or soil that was permitted to freeze prior to compaction.

### 3.18 BACKFILLING IN OPEN TRENCH

- A. As soon as practical after pipe has been laid in accordance with the appropriate sections and the pipe joints have been properly made, the backfilling shall begin, and shall continue without delay. However, the trench shall be kept open long enough for the Engineer to locate existing utilities uncovered during excavation and to inspect pipe or structure conditions.
- B. If a screened gravel or concrete envelope is not used, the selected material shall be (see Contract Drawings for additional or superseding information) free from large lumps and stones having any dimension greater than 2 inches, and shall be placed simultaneously on both sides of the pipe, so that there will be no tendency to displace the pipe alignment. In placing the material, care shall be taken that stones do not strike the pipe and geotextile fabric shall be installed to the limits shown on the Contract Drawings at the locations specified on the drawings or as directed by the Engineer.
- C. A sand blanket (Type 2 material) shall be placed at the sides of the pipe up to the top of the pipe and shall be hand-placed and thoroughly compacted using approved hand-operated tampers. Backfilling shall be carried up evenly on both sides of the pipe.
- D. Type 2 material shall be extended up to a level of 1 foot above the top of the pipe shall be placed in 6 inch layers, leveled along the length and width of the trench and thoroughly compacted with approved tampers.
- E. The sand blanket (Type 2 material) may be omitted for cast iron, ductile iron and reinforced concrete pipe provided, however, that no stone large than 2 inches is in contact with the pipe.
- F. The backfill in the remainder of the excavation above the top of the screened gravel or concrete envelope, if used, shall be Type 1, backfilled in approximately 12 inch layers and promptly compacted by mechanical tamping. Material used for backfilling to a point two feet over the pipe shall contain no stones larger than three inches in greatest dimension. Backfilling or tamping with trenching machines is prohibited.
- G. Care shall be taken in the use of mechanical or other tampers not to injure or move the pipe or cause the pipe to be supported unevenly.
- H. Large masses of backfilling material shall not be dropped into the trench in such a manner, in the opinion of the Engineer, as to endanger the pipe.
- I. All backfilled trenches shall be thoroughly surface tamped with a tamping machine approved by the Engineer.
- J. Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material.

- K. No compacting shall be done when the material is too wet to be compacted properly; at such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compacting, or such other precautions shall be taken as may be necessary to obtain proper compacting.

### 3.19 MATERIAL FOR FILLING AND EMBANKMENTS

- A. Approved selected materials available from the excavations and not required for backfill around pipes or under structures may be used for site preparation except as otherwise specified. Material needed in addition to that available from construction operations shall be obtained from approved Type 1, 2, 3, or 4 sources.
- B. All material, whether from the excavations or offsite, shall be such nature that after it has been placed and properly compacted in 12 inch layers, it will make a dense, stable fill. It shall not contain vegetation, roots, stones over 6 inches in diameter, or porous material.

### 3.20 GRADING

- A. Grading, in preparation for placing of paved walks and drives and appurtenances, shall be preformed at all places to the lines, grades, and elevations as directed by the Engineer. All unsuitable material encountered, of whatever nature, shall be removed and disposed of as directed. During the process of grading, the subgrade shall be maintained in such condition that it will be well drained at all times. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the prosecution or conditions or the work.
- B. The right is reserved to make minor adjustments or revisions in lines or grades if found necessary as the work progresses or in order to obtain satisfactory construction.
- C. All slopes cut during construction shall be uniformly redressed to the slope, cross-section and alignment existing prior to construction as indicated on the Contract Drawings or as directed by the Engineer.

END OF SECTION

SECTION 02224

FILL AND BACKFILL MATERIALS

PART 1        GENERAL

- 1.01        SCOPE OF WORK
- 1.02        APPROVAL OF MATERIALS
- 1.03        RELATED WORK SPECIFIED ELSEWHERE

PART 2        MATERIALS

- 2.01        TYPE 1 - COMMON BORROW
- 2.02        TYPE 2 - SAND BORROW
- 2.03        TYPE 3 - SAND AND GRAVEL
- 2.04        TYPE 4 - COARSE GRAVEL
- 2.05        TYPE 5 - LOAM BORROW AND TOPSOIL
- 2.06        TYPE 6 - SCREENED GRAVEL MATERIALS
- 2.07        TYPE 7 - CRUSHED STONE

PART 3        EXECUTION OF WORK

- 3.01        PLACING AND COMPACTING

PART 1        GENERAL

- 1.01        SCOPE OF WORK

- A.        The Contractor shall furnish all labor, equipment, fill and backfill material and incidentals for site preparation and to meet finished contours as shown on the Contract Drawing. The use of the fill and backfill material is specified elsewhere. The Engineer may order the use of granular fill materials for purposes other than those specified in other sections, if in his opinion such use is advisable.

- 1.02        APPROVAL OF MATERIALS

- A.        The Contractor shall furnish the Engineer with representative samples and a gradation analysis of each type of soil. If the source of materials changes significantly or a different source is used, resubmittals and reapprovals must be made.

- 1.03        RELATED WORK SPECIFIED ELSEWHERE

- A.        SECTION 02200 - EARTHWORK
- B.        SECTION 02250 - COMPACTION CONTROL AND TESTING

PART 2        MATERIALS

- 2.01        TYPE 1 - COMMON BORROW

- A.        Common Borrow shall be a granular material obtained from approved on-site or off-site natural deposits and unprocessed except for the removal of unacceptable material and stones larger than six (6) inches. It shall not contain vegetation or roots. It shall be free from loam, clay, fine wood, trash, and other objectionable materials or harmful substances.

- B.        Common Borrow shall consist of a material satisfactory to the Engineer and not specified as gravel borrow, sand borrow, special borrow material or another particular kind of borrow. This material shall have the physical characteristics of soils designated as group

A-1, A-2 - 4 or A-3, under AASHTO-M145. It shall have properties such that it may be readily spread and compacted for the formation of embankments.

2.02 TYPE 2 - SAND BORROW

- A. Sand Borrow shall consist of clean, inert, hard, durable grains of quartz or other hard durable rock. It shall be free from clay, loam, vegetable or other objectionable matter.
- B. Material for pipe cover, landscaping, or other uses as determined by the Engineer, shall be well graded as follows or as indicated on the Contract Drawings. The allowable amount of material passing a No. 200 sieve as determined by AASHTO-T11 shall not exceed 10 percent by weight.

<u>Sieve Size</u>	<u>Percent by Weight Passing Through</u>
$\frac{3}{8}$ inch	85 - 100
#16	50 - 85
#200	0 - 10

2.03 TYPE 3 - SAND AND GRAVEL

- A. The sand and gravel material for foundation sub-grades or structural fills shall meet AASTHO-M145, for A-1-a, A-1-b, or A-3 soils. The mixture shall consist of clean hard durable particles or fragments. It shall be free from loam, organic or other objectionable matter.
- B. Subgroup A-1-a includes those materials consisting predominantly of stone fragments or gravel, either with or without a well-graded binder of fine material and with 50% maximum passing the No. 10 sieve, 30% maximum passing the No. 40 sieve and 15% maximum passing the No. 200 sieve. The fraction passing the No. 40 shall have a maximum plasticity index of 6.
- C. Subgroup A-1-b includes those materials consisting predominantly of course sand either with or without well-graded soil binder and with 50% maximum passing the No. 40 sieve and 25% maximum passing the No. 200 sieve. The fraction passing the No. 40 shall have a maximum plasticity of 6.
- D. Group A-3 material shall be fine beach sand without silty or clay fines or with a very small amount of non-plastic silt. The group includes also stream deposited mixtures of poorly-graded fine sand and limited amounts of coarse sand and gravel; 51% minimum shall pass the No. 40 sieve, and 10% maximum shall pass the No. 200 sieve.

2.04 TYPE 4 - COARSE GRAVEL

- A. The material shall consist of clean hard, inert, durable particles or fragments. It shall be free from clay, loam, vegetable or other objectionable matter. Materials that break up when alternately frozen and thawed or wetted and dried, shall not be used.
- B. Material for foundation underdrainage, pavement subbase, or other uses as determined by the Engineer shall be well graded as follows:

SIEVE SIZEPERCENTAGE BY WEIGHT PASSING

3 inch	100
1 ½ inch	70- 100
¾ inch	50- 85
#4	30- 60
#200	0-12 (based on fraction passing No. 4)

- C. The processed material shall be stockpiled in such a manner to minimize segregation of particle sizes. All processed gravel shall come from approved stockpiles.

2.05 TYPE 5 - LOAM BORROW AND TOPSOIL

- A. Material shall conform to related sections of the specifications.

2.06 TYPE 6 - SCREENED GRAVEL MATERIALS

- A. The gravel shall generally conform to ASTM-C33 and shall consist of clean, hard, inert, durable particles or fragments. It shall be free from clay, loam, organic or other objectionable matter. Crushed rock of suitable size and grading may be used instead of screened gravel. The specifications which follow shall apply to whichever material is used.
- B. Material for trench stone fill shall consist of sound angular stones; 50 to 70 percent of which shall weigh at least 500 pounds and the remainder shall weigh not less than 50 pounds each.
- C. Material for trench bedding shall be well graded from ¾ inch to 2 inch.
- D. Material for stabilizing trench base shall be well graded from ½ inch to 1 ½ inch.
- E. Material for pipe bedding, landscaping, or other uses as determined by the Engineer, shall be well graded as follows:

SIEVE SIZEPERCENT BY WEIGHT PASSING

1 inch	100
¾ inch	90 - 100
⅜ inch	20 - 55
#4	0 - 10
#8	0 - 5

2.07 TYPE 7 - CRUSHED STONE

- A. The crushed stone shall consist of clean, hard, inert, durable particles or fragments. It shall be free from clay, loam, vegetable or other objectionable matter.
- B. At least 50% of the material passing a one (1) inch sieve shall have a fractured face. The percent of wear of the crushed stone for pavement base coarse shall not exceed 50.

The stone sizes for the crushed stone shall be as follows:

SIEVE SIZEPERCENT BY WEIGHT PASSING

1 ½ inch	100
1 ¼ inch	85 - 100
¾ inch	10 - 40
½ inch	0 - 8

- C. The equipment for producing crushed stone shall be of adequate size and with sufficient adjustments to produce the required materials without unnecessary waste. The plant shall be capable of removing excess sand. The Engineer may order final screening of crushed stone if flat or elongated pieces are present in objectionable amounts.

### PART 3 EXECUTION OF WORK

#### 3.01 PLACING AND COMPACTING

- A. The material shall be placed and compacted as specified in related specification sections.

END OF SECTION

## SECTION 02250

### COMPACTION CONTROL AND TESTING

#### PART 1 GENERAL

- 1.01 SCOPE OF WORK
- 1.02 RELATED WORK SPECIFIED ELSEWHERE
- 1.03 SUBMITTALS

#### PART 2 MATERIALS

- 2.01 TEST METHODS

#### PART 3 EXECUTION OF WORK

- 3.01 COMPACTION EQUIPMENT
- 3.02 COMPACTION REQUIREMENTS
- 3.03 APPROVAL OF FILL OR BACKFILL MATERIAL
- 3.04 FREQUENCY OF COMPACTION TESTING
- 3.05 FAILED TESTS

#### PART 1 GENERAL

- 1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials and equipment necessary to place and compact fill or backfill. The Contractor shall furnish all equipment necessary to collect soil samples.
- B. Actual testing of soil samples with the exception of insitu-density determinations shall be done by an independent testing laboratory approved by the Owner. Insitu-density determinations shall be made by the Engineer or his representative. Copies of test results shall be furnished by the test laboratory directly to the Engineer.

- 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. SECTION 0200 - EARTHWORK
- B. SECTION 02224 - FILL AND BACKFILL MATERIALS

- 1.03 SUBMITTALS

- A. Prior to commencement of filling and backfilling operation, the Contractor shall submit for approval a detailed list six (6) copies unless otherwise specified) of the types of compacting equipment to be utilized in the work, and the number of each.

#### PART 2 MATERIALS

- 2.01 TEST METHODS

- A. Contractor shall provide heavy duty sample bags for fill or backfill material to be tested. Soils shall be classified as in the in the related sections of the Specifications which include AASHTO specifications M145 Recommended Practice for Classification of Soils as Soil-Aggregate Mixtures for Highway Construction Purposes.
- B. Soil samples shall be prepared for testing according to ASTM D42 Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.



- C. Gradation testing shall be done according to ASTM D2216 Particle Size Analysis of Soils and ASTM D1140 test for Amount of Materials in Soils Finer than the No. 200 sieve.
- D. Moisture content of soil shall be determined by ASTM D2216 Laboratory Determination of Moisture Content of Soil.
- E. Liquid Limits and Plasticity Index shall be determined ASTM D423 Liquid Limit of Soils and ASTM D424 by Plastic Limit and Plasticity Index of Soils.
- F. Maximum dry density for each type of fill shall be determined by ASTM D1557 Method D Moisture - Density Relations of Soils using 10-lb. Hammer and 18-in. Drop.
- G. In-place field unit weight shall be determined by ASTM D- 1556 Density of Soil in Place by the Sand-Cone Method.
- H. Maximum dry density may, at the discretion of the Engineer, be determined in accordance with ASTM D-2049 test for Relative Density of Cohesionless Soils.

### PART 3 EXECUTION OF WORK

#### 3.01 COMPACTION EQUIPMENT

- A. No backfilling shall be done until the compacting equipment list has been submitted and approved as conforming to the Contract requirements. Sufficient compacting equipment shall be available at all times, thereafter while backfilling is being conducted.
- B. Each layer of fill shall be inspected prior to compaction. All visible roots, vegetation, or debris shall be removed. Stones larger than 6 inches in diameter shall be removed. The water content of each layer shall be determined to be suitable for compaction or shall be brought to a suitable condition. Material incorporated in the fill which is not in satisfactory condition shall be subject to rejection and removal at the Contractor's expense. Placement of fill on frozen ground or placement of fill material which is frozen will not be permitted.
- C. Previously placed or new materials shall be moistened by sprinkling, if required, to ensure proper bond and compaction. No compacting shall be done when the material is too wet, from either rain or too great an application of water, to compact it properly; at such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions shall be taken as may be necessary to obtain proper compaction.
- D. Filling shall begin in the lowest section of the area. Fill shall be spread in layers as specified. The surface of each layer shall be approximately horizontal but will be provide with sufficient longitudinal and transverse slope to provide for runoff of surface water from every point. Filling shall be conducted so that no obstruction to drainage from other sections of the fill area is created at any time. Sumps, if any, shall be continuously maintained in effective operating condition.
- E. Each layer of material shall be compacted by the use of only approved rollers or other approved means so as to secure a dense, stable, and thoroughly compacted mass. At such points as cannot be reached by mobile mechanical equipment, or where such equipment is not permitted, the materials shall be thoroughly compacted by the use of suitable power-driven tampers.

- F. The compaction equipment shall be operated so as to make a minimum of three passes over each section of each layer of fill. Each successive pass shall overlap the adjacent pass by not less than 10%. Additional passes shall be made to obtain the required compaction, if necessary.
- G. Compaction by water-jetting will be allowed only if the Engineer deems the conditions suitable for this method. Wherever the material contains excessive amounts of clay or loam to prevent satisfactory drying, water-jetting shall not be used.
- H. If the material is allowed to be compacted by water-jetting, it shall be placed in uniform layers not exceeding 4 ft. deep. Each layer shall be thoroughly saturated throughout its full depth and at frequent intervals until all slumping ceases. For water-jetting, the Contractor shall provide one or more jet pipes, each of sufficient length to reach the specified depth and not less than 1-1/4 in. in diameter. The jet pipe shall be equipped with a quick-acting valve and sufficient fire hose to connect to a hydrant or pump having adequate pressure and capacity. A hydrant shall be utilized only upon approval of the local Water and/or Fire Departments.

### 3.02 COMPACTION REQUIREMENTS

- A. Pipe Bedding: Bedding shall be Type 6 fill placed uniformly in 6 inch layers and compacted unless otherwise specified. Compaction shall be accomplished by 20 lb. hand tampers.
- B. Pipe Sand Blanket: Material shall be Type 2 fill placed uniformly in 6 inch layers and compacted to 90% of maximum dry density of the sand. Compaction shall be accomplished by 20 lb. hand tampers.
- C. Trench Cover: Material shall be Type 1, 2, 3 or 4 fill placed uniformly in 12 inch layers and compacted to 95% of maximum dry density for the type of material used. Compaction shall be accomplished by mechanical tampers. Compaction by water-jetting shall be in accordance with the related sections of the specifications.
- D. Catch Basin and Manhole Base Bedding: Material shall be Type 6 fill placed uniformly in 6 inch layers and compacted. Compaction shall be accomplished by 20 lb. hand tampers or pneumatic tampers.
- E. Structural Fill (foundation sub-grade, foundation underdrainage, pavement sub-grade, pavement sub-base): Material for foundation sub-grade or pavement sub-grade shall be Type 3 fill. Structural fills shall be placed in 6 inch layers compacted to 95% maximum dry density for a given type of material. Compaction shall be by mechanical power driven vibratory compactors. Pavement sub-grade in cut areas shall be rolled and compacted to 95% density of the in situ material.
- F. Fill around structures shall be Type 1, 2, 3, or 4 material placed in 6 inch layers and compacted to 95% maximum dry density. Compaction shall be accomplished by mechanical power driven vibratory compactors. Compaction of backfill against concrete structures shall not be carried out by motorized equipment closer to the structure than the depth of the structure below grade.
- G. Non Structural Fill (Landscaping and other uses as designated by the Engineer): Material shall be Type 1, 2, 3 or 4 placed in 12" layers and compacted to 45% maximum dry density for the given type of material used. Compaction shall be accomplished by mechanical power-driven vibratory compactors.

3.03 APPROVAL OF FILL OR BACKFILL MATERIAL

- A. Before placing or compacting any on-site or borrow material, the Contractor shall submit a sample of the material for testing. No on-site material shall be placed until approved by the Engineer.
- B. The Engineer may at any time require additional laboratory testing should he observe any changes in gradation of the material being placed. No additional fill shall be placed or compacted until the material has been approved. If the material does not meet the required gradation and Atterburg limits for a given type of fill, the Contractor shall remove it at his expense. The Contractor may use the material for other types of fill providing it meets the required gradation and properties of that type.

3.04 FREQUENCY OF COMPACTION TESTING

- A. The Engineer may perform tests of the degree of compaction obtained, in any area he may select. Payment for performing tests will be made by the Owner. If test results are unsatisfactory, all costs involved in correcting deficiencies in compacted material including retesting, shall be borne by the Contractor. If improper compaction methods are used, the Owner shall have the right to discontinue payments from the Contractor for said payment item until the situation is corrected.

3.05 FAILED TESTS

- A. If the percentage compaction at any point is found to be unacceptable, additional compaction with or without modification of the field moisture content as directed by the Engineer, shall be performed and a second moisture-density determination made. This procedure shall be repeated until satisfactory compaction is obtained. If after five (5) tests any fill or backfill material cannot be compacted to the required density it shall be removed and disposed of at the Contractor's expense.

END OF SECTION

## SECTION 02575

### PAVING AND ROAD CONSTRUCTION

#### PART 1 GENERAL

- 1.01 CONTRACT DOCUMENTS
- 1.02 DESCRIPTION OF WORK
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- 3.01 BITUMINOUS PAVING - GENERAL
- 3.02 CARE AND RESTORATION OF PROPERTY
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- 3.06 DELETED
- 3.07 PERMANENT PAVEMENT
- 3.08 MAINTENANCE OF PAVING
- 3.09 SIDEWALKS, DRIVEWAYS AND CURB CONSTRUCTION

#### PART 1 GENERAL

##### 1.01 CONTRACT DOCUMENTS

- A. The general provisions of the Contract, including General and Supplemental Conditions and General Requirements, apply to the work specified in this section.
- B. The Contractor shall be responsible for maintaining all pavements and sidewalks placed as part of the Contract, in a safe and satisfactory condition until the project is accepted as complete. For any pavement or sidewalk area damaged, the Contractor shall remove the entire pavement structure in the damaged area and replace it as directed by the Engineer.
- C. Should the application of the wearing surface be delayed for any reason including bad weather, the Contractor shall provide and maintain the base in acceptable condition until such time as the new pavement is place.
- D. During construction, all existing pavement, not to be removed, shall be protected by the Contractor. Any pavement damaged shall be removed and replaced by the Contractor at the Contractor's expense.

##### 1.02 DESCRIPTION OF WORK

- A. Work under this section consists of furnishing all materials, labor, tools, equipment and supervision necessary to restore existing or construct new pavement subgrades, subbase, bituminous base courses, tack coats and bituminous surface courses for roadways and all curbs, sidewalks, driveways, and parking areas.

- B. The materials and construction methods used for this work shall conform to the Massachusetts Highway Department, "Standard Specifications for Highways and Bridges", 1988 Edition, and subsequent revisions and addenda.
- C. All temporary construction roads, ditches, and drainage facilities shall be removed and the site restored before completion of the project.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. SECTION 02200 - EARTHWORK
- B. SECTION 02224 - FILL AND BACKFILL MATERIALS
- C. DIVISION 2 - SITE WORK -As Appropriate
- D. DIVISION 3 - CONCRETE - As Appropriate

PART 2 MATERIALS

2.01 GENERAL CRITERIA

- A. The Contractor shall be responsible for obtaining any permits and meeting State requirements for all work taking place in State highways.

2.02 SUBGRADE

- A. Sub-grade shall be either Type 1, 2, 3 and 4 material in accordance with related specifications.

2.03 SUBBASE

- A. Sub-base shall be Type 6 screened gravel material in accordance with related specifications or reclaimed material.

2.04 DELETED

2.05 BASE COURSE - PERMANENT PAVEMENT

- A. Base course shall be the first layer of bitumen and aggregate mixture overlying the screened gravel sub-base.
- B. Bituminous base course shall be 2 ½ inch thick Class 1 Bituminous Concrete Base Course Type I-1 as given in the Massachusetts Highway Department Standard Specifications for Highways and Bridges.

2.06 SURFACE COURSE - PERMANENT PAVEMENT

- A. Surface course shall be Class I Bituminous Concrete Pavement as given in the Massachusetts Highway Department Standard Specifications for Highways and Bridges, Section 460.20 to 460.68.
- B. Surface course shall be 1 ½ inches thick for permanent paving.

2.07            SIDEWALKS AND DRIVEWAYS

- A.            Cement concrete for driveways and sidewalks shall be in accordance with the appropriate section in the Massachusetts Highway Department Standard Specifications for Highways and Bridges.

PART 3            EXECUTION OF WORK

3.01            BITUMINOUS PAVING - GENERAL

- A.            All mixtures delivered to the job site shall be accompanied by a Certificate of Compliance. Deliveries not accompanied by a certificate will not be used in the work.
- B.            Construction methods shall conform to the requirements of the Massachusetts Highway Department Standard Specifications for Highways and Bridges, including the following:
  - 1.            Mixtures delivered to the job site shall not possess signs of segregation of ingredients or surface crust.
  - 2.            The temperatures of the mixture when delivered to the spreader will be a minimum of 250 F.
  - 3.            Mixtures shall be placed only upon approved surfaces that are clean from foreign material and are dry; and when weather conditions are suitable. No mixture shall be placed when the weather is foggy or rainy, provided, however, that the Engineer may permit, in the case of sudden rain, the placing of mixture then in transit from the plant, if laid at the proper temperature and if the roadbed is free from pools of water. Such permission shall in no way relax the requirements for the quality of the pavement and smoothness of the surface. No materials shall be placed upon a frozen base, or when wind conditions are such that rapid cooling will prevent satisfactory compaction.
  - 4.            Wherever possible material shall be compacted using steel wheeled rollers.
  - 5.            In areas not accessible to a roller, compaction shall be accomplished by using mechanical compactors or hand tampers, approved by the Engineer.
  - 6.            All material place shall receive final compaction before nightfall of the day placed, unless artificial light, satisfactory to the Engineer, is provided.
  - 7.            The density of completed paving shall not be less than 95% of the density obtained from laboratory compaction of a mixture composed of the same materials in like proportions.
  - 8.            The Engineer may require the Contractor to remove and replace at his own expense, any work deemed defective on the basis of sampling and testing for composition and density, or faulty procedures.

3.02            CARE AND RESTORATION OF PROPERTY

- A.            All streets, sidewalks, gutters, driveways and curbs which have been damaged by the Contractor's operations shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations.
- B.            Suitable materials and methods shall be used for restoration of curbs and other types of gutters, driveways and sidewalks.
- C.            Materials and method of all restoration work shall be subject to approval by the Engineer.

- D. All frames, grates, covers, street boxes, manhole rings and other castings removed or damaged by the Contractor's operations shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations.
- E. All frames, grates, covers, street boxes, manhole rings and other castings within the limits of new paving shall be reset by the Contractor such that they are flush with the new surface.

### 3.03 PREPARATION OF SUBGRADE IN CUT AREAS

- A. If after excavation to the proposed sub-grade elevation the insitu material is determined by the Engineer to be unsuitable, the Contractor shall excavate an additional 1 foot and backfill with Type 3 sand and gravel compacted to 95% of maximum dry density. Changes in the depths and limits of excavations or fills shall be an appropriate bid adjustment item.
- B. The Contractor shall remove loam and topsoil, loose vegetable matter, stumps, large roots, etc., from areas upon which subbase and pavement material will be placed. The subgrade shall be shaped as indicated on the Contract Drawings and shall be compacted to 95% of maximum dry density.

### 3.04 PREPARATION OF SUBGRADE IN FILL AREAS

- A. The Contractor shall remove loam and topsoil, loose vegetable matter, stumps, large roots, etc., from areas upon which embankments will be built or material will be placed for grading.
- B. After the area has been stripped and grubbed as herein specified, Type 1, 2, 3 and 4 material shall be placed thereon and built up in successive layers until it has reached the required elevation.
- C. Layers shall not exceed 6 inches in thickness before compaction. The layers shall be slightly convex toward the center. Layers shall be compacted to 95% of the maximum dry density of the particular material used.

### 3.05 PREPARATION OF SUBBASE

- A. Subbase material shall conform to Type 6 Screened Gravel or reclaimed material as described in the related sections of the specifications.
- B. Screened gravel subbase for either permanent paving shall be a minimum of 12 inches in thickness.

### 3.06 DELETED

### 3.07 PERMANENT PAVEMENT

- A. Permanent paving is to be placed after at least 8 months has elapsed for required compaction to have occurred as determined by the Engineer.
- B. Prior to Permanent paving, the Contractor shall make all final repairs to the previously installed trench paving, and raise for cause to be raised, all existing, manhole, catch basin, valve box, curb box, and utility covers, etc., to conform to the final pavement grade. All loose or damaged material in the existing pavement outside of trench pavements, shall be removed and a leveling course, as hereinbefore specified, shall be installed. Leveling

course shall also be installed at depths and locations, as directed by the Engineer, to fill existing holes and depressions, or to improve roadway crowns. Leveling course quantities used for permanent paving shall be included for compensation under the paving item.

- C. All surfaces to receive Permanent paving shall be dry and thoroughly cleaned of foreign or loose material; a compatible prime or tack coat, shall be applied to the rate of 0.05 to 0.15 gallons per square yard of pavement, depending upon the condition of the existing surface. All castings and edgestones will be protected from the tack coat.
- D. Where curbing is present, the existing pavement shall be planned such that curb reveal shall be substantially the same prior to and following the application of Permanent paving.
- E. Where sloped bituminous curbing is present, the existing sloped bituminous curbing shall be replaced with new sloped bituminous curbing which shall be installed integrally with the permanent paving.

### 3.08 MAINTENANCE OF PAVING

- A. The Contractor shall maintain pavement placed under this Contract until the expiration of the one year guarantee period and shall promptly fill with similar material all depressions and holes that may occur so as to keep the pavement in a safe and satisfactory condition for traffic.

### 3.09 SIDEWALKS, DRIVEWAY AND CURB CONSTRUCTION AND RECONSTRUCTION

- A. All granite curbs, cement concrete sidewalks, and driveways damaged during construction will be reconstructed to their original condition after construction is completed. Granite curbing to be reset shall be removed and reset to proper grade and alignment in accordance with the construction methods of Section 701 of the Massachusetts Highway Department Standard Specifications for Highways and Bridges.
- B. Curbing to be reset shall be carefully removed and stored. The Contractor shall replace any edging damaged or lost due to his negligence. The base upon which the edging is to be set shall be compacted to a firm even surface. Joints shall be pointed with mortar and the exposed portion finished with a jointer. Granite curb inlets shall be set in full mortar beds.

END OF SECTION







