

## **1.1 INTRODUCTION**

This section specifies the construction standards that developers and their contractors shall abide for construction projects for the Holyoke Water Works. This section covers specifications for excavation, trench preparation, laying of pipe, installation of mechanical joints, setting valves and fittings, setting hydrants, anchorage, backfilling, testing, and disinfection.

## **1.2 EXCAVATION AND PREPARATION OF TRENCH**

### **1.2.1 General Description**

The trench shall be dug so that the pipe can be laid to the alignment and depth required. Regardless of whether one machine is used for both excavation and handling of pipe or whether a separate machine is used for handling of pipe, trench excavation is not to be advanced substantially ahead of pipe-laying operations.

Backfilling as hereinafter specified is to be carried out as close as possible behind the pipe-laying operation.

Upon completion of operations at the end of the work day, or upon the halting of operations for any reason whatsoever, backfilling is to be completed so that only one length of pipe is exposed in the open trench, and the end of that pipe shall be blocked to prevent entry of soil, water, or animals.

Excavation and backfill are to be planned and carried out so that the trench can be adequately supported and drained and so that pipe-laying operations can be carried out efficiently and satisfactorily.

### **1.2.2 Width of Trench**

The width of trench shall be ample to permit the pipe to be laid and jointed and the backfill to be placed and compacted. The trench width shall be sufficient to permit the convenient placing of supports, sheathing, and/or bracing and for the handling of drainage and groundwater where required.

At locations where valves, fittings, or specials are to be installed, additional width of excavation shall be dug as required for the satisfactory installation and jointing of these items.

Since the ability of the pipe to support external loads is related to trench width and is decreased as trench width increases, the trench width must be maintained as narrow as possible, consistent with pipe-laying requirements. The portion of the trench from 1 foot above the top of the pipe to the bottom limit of excavation should not be wider than the pipe diameter plus 2 feet.

### **1.2.3 Pipe Clearance in Rocks**

Ledge, rock, boulders, and large stones shall be removed to provide a clearance of at least 6-inches below and on each side of all pipe, valves, and fittings.

The specified minimum clearances are the minimum clear distances that will be permitted between any part of the pipe and appurtenances being laid and any part, projection, or point of such rock, boulder, or stone.

### **1.2.4 Excavation to Grade**

The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes. The final excavation shall be done using hand tools so that the finished sub-grade of the pipe is accurately prepared and is undisturbed.

Any part of the bottom of the trench excavated below the required sub-grade shall be corrected with approved material and thoroughly compacted as directed by the Holyoke Water Works.

### **1.2.5 Excavation Below Grade**

In locations where the trench bottom is composed of ledge, cemented gravel, hard pan, or other materials that cannot be properly prepared to provide uniform and continuous support for the pipe, the contractor will be required to excavate 6-inches below the specified sub-grade for the pipe.

Earth pads are then to be placed in the trench bottom in at least two locations to support the pipe above the trench bottom during the process of installing the pipe, aligning the pipe, and centering the spigot of the newly laid pipe in the bell of the adjacent pipe. Prior to making up the joint, additional earth is to be placed along and under the bell of the pipe and is to be thoroughly tamped so as to provide support for the pipe. The earth used for the supporting pads and for backfill under the barrel of the pipe is to be sand or other granular native material. In the event that satisfactory native material cannot be obtained from the excavation, then suitable material shall be brought in to the job.

### **1.2.6 Excavation in Poor Soil and Refilling to Grade**

Where the bottom of the trench at sub-grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable, or other organic material, or large pieces or fragments of inorganic material, the contractor shall excavate and remove such unsuitable material to the width and depth ordered by the Holyoke Water Works. Before the pipe is laid, the sub-grade shall be made by backfilling with an approved material in 3-inch compacted layers. The layers shall be thoroughly tamped so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes.

### **1.2.7 Sub-grade in Rock Trenches**

Where excavation is made in rock or boulders and the clearance specified in Section 6.2.3 is provided, the sub-grade shall be made by backfilling with an approved material in 3-inch compacted layers. The layers shall be thoroughly tamped so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes.

### **1.2.8 Blasting**

Blasting for excavation will be permitted only after securing all required state and local permits as well as conducting a pre-blast survey.

The developer and its contractor shall observe all State laws and City Ordinances relating to the transportation, storage, or handling of explosives. Particular care is to be exercised to see that the explosives are stored so that they will not be lost, mishandled, mislaid, or stolen. Blasting caps shall be stored separately from the explosive itself but shall be subject to the same requirements and regulations.

### **1.2.9 Braced and Sheeted Trenches**

The developer and its contractor shall provide such sheathing, bracing, and support for the trench sides as may be required by state law and local ordinances and as may be necessary to adequately protect life, adjacent property, adjacent structures, or the work under construction.

Use approved trench box and bracing as may be necessary for safety of personnel, protection of work, adjacent work, utilities and structures, or as required by various Regulatory Agencies.

### **1.2.10 Control of Water**

The trench shall always be maintained in a dry and satisfactory condition. Care shall be exercised to see that water does not collect in the bell holes at any time in a depth sufficient to wet the bell of pipes waiting to be jointed.

Under all conditions, the developer and its contractor must maintain the trench so that water does not enter the completed pipeline. This applies equally during pipe laying operations and upon completion of pipe laying operations but prior to placing the pipeline into service. At no time is the completed pipeline to be used as a drain for groundwater or drainage water. All open portions of the pipeline that have not been completed such as hydrant branches, branch lines, and the end of the pipeline during periods when pipe laying operations are shut down, are to be adequately protected so as to prevent the entrance of groundwater and other materials from the trench. The protection is to be watertight and is not to be removed until the trench has been completely dewatered.

### **1.2.11 Trenching by Hand or Machine**

In general, it is expected that the major portion of the excavation will be carried out using machine methods.

The final portion of excavation in the trench bottom is to be carried out using hand methods as described under Section 6.2.4 so as to prevent disturbance to the supporting sub-grade.

In special locations where the use of machinery for excavation may result in damage to adjacent pipelines or structures, the contractor shall use hand methods of excavation. This requirement is especially applicable in the immediate vicinity of conduits, service pipes, and other pipelines where the use of machinery could result in danger.

### **1.2.12 Interruption of Service**

No valve or other control device on the existing water system shall be operated for any purpose whatsoever. No tap or cut-in to the existing water system shall be made by the developer or its contractor without the expressed approval of the Holyoke Water Works and unless an authorized representative of the Holyoke Water Works is present.

## **1.3 LAYING OF PIPE**

### **1.3.1 Handling of Water Main Materials in the Trench**

Proper implements, tools, and facilities shall be provided and used for the safe and convenient prosecution of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece by piece by means of power equipment, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

There shall be no chain or forklift scars on the lining. Any damage to pipe lining or coatings will result in the pipe or fitting being rejected and removed from the job.

### **1.3.2 Inspection**

All pipe and fittings shall be carefully inspected for defects prior to placing them in the trench.

If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner.

### **1.3.3 Cleaning Pipe and Fittings**

All lumps, blisters, and excess coal-tar coating shall be removed from the bell and spigot-end of each pipe, and the outside of the spigot or plain end and the inside of the bell shall be wire-brushed and wiped clean, dry, and free from oil and grease before the pipe is laid.

On all pipe using a rubber type joint, the bell of the pipe and the plain end of the adjacent pipe are to be wire-brushed and cleaned of all rust and dirt. The bell of the pipe and the plain end of the adjacent pipe are then to be lubricated with the joint lubricant furnished with the pipe in accordance with the manufacturer's directions.

#### **1.3.4 Laying Pipe**

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

When laying a rubber-jointed, ductile-iron pipe, the plain end shall be centered in the bell, the pipe forced home, and the joint completely assembled. The pipe is then to be adjusted to correct line and grade and to be secured in place with approved backfill material, properly tamped under and around the pipeline.

At all times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means. This provision shall apply during the noon hour and overnight, as well as during delays in the pipe laying operations.

After joining the pipe, a metal feeler gauge shall be used to verify that the rubber gasket is correctly positioned. Two bronze wedges per joint shall be inserted to provide electrical continuity.

#### **1.3.5 Cutting Pipe**

All cutting of pipe required for inserting valves, fittings, or closure pieces and all cutting of pipe required for nipple pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining. The cutting is to be done so as to leave a smooth end at right angles to the axis of the pipe. Cutting shall be done with a power saw and edges shall be beveled and made smooth with hand grinding tools.

Except for very unusual circumstances, field cutting will not be allowed for ductile iron pipe using rubber push-on joints. Where it is necessary to field cut a pipe, a rubber gasket mechanical joint type connection shall be made.

#### **1.3.6 Direction of Laying**

Pipe is to be laid with the bell facing in the direction of laying. The only exception is in areas of steep grade where the pipe is to be laid with the bells facing uphill and laying is to proceed in an uphill direction.

#### **1.3.7 Permissible Deflection of Joints**

Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that recommended by the pipe manufacturer.

Prior to deflecting the pipeline, the spigot of the pipeline should be marked flush with the bell end to assure that the spigot is not withdrawn as a result of the deflection.

In general, all radius curves called for on the plans or permitted at the time of construction are to be made using full lengths of pipe. The use of short lengths of pipe and extra joints in order to make a smaller radius turn will not be allowed without the written approval of the Holyoke Water Works.

### **1.3.8 Unsuitable Laying Conditions**

No pipe is to be laid in water, in an unsuitable trench, or during unsuitable weather conditions.

### **1.3.9 Polyethylene Encasement**

Polyethylene encasement shall be slipped over the exterior of the pipe and/or fittings prior to placement in the trench. Secure polyethylene to the pipe with compatible polyethylene adhesive tape at several locations along the barrel of the pipe.

At each pipe joint, the wrap shall be overlapped 12-inches minimum, secured with a non-corrosive strap behind the pipe bell, and overlapped with a new section of wrap and secured in place with a second strap on the spigot end.

## **1.4 MECHANICAL JOINTS**

Mechanical joints are to be installed in accordance with the manufacturer's instructions and AWWA Specifications.

The plain end is to be centered in the bell of adjacent pipe or fitting after both the end and the bell have been carefully cleaned, wire-brushed, and lubricated. The gasket is then to be pushed home into the bell and is to be followed by the follower ring.

The bolts are to be tightened using torque measuring or torque indicating wrenches. Under no circumstances shall extension wrenches or an extended handle ratchet wrench be used to gain greater leverage. The normal range of torque to be applied to the joints is as follows:

<b>Joint Size (Inches)</b>	<b>Bolt Size (Inches)</b>	<b>Range of Torque (Ft. lb.)</b>	<b>Length of Wrench</b>
3	5/8"	40-60	8"
4-24	3/4"	60-90	10"
30-36	1"	70-100	12"

When tightening bolts, the gland or follower ring must be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the base of the flange at all points around the socket. This is to be done by partially tightening up opposite bolts, first at the bottom, then at the top, then at either side and finally the intermediate bolts. This cycle is to be repeated until all bolts are within the above range of torque.

Where required by the Holyoke Water Works, retainer glands are to be used.

If effective sealing of the joint is not obtained at the maximum torque indicated, the joint must be disassembled and reassembled after thorough cleaning. Over stressing of the bolts to compensate for poor installation practice is not approved.

## 1.5 SETTING VALVES AND FITTINGS

Valves, fittings, plugs, and caps shall be set and jointed to pipe in a manner heretofore specified for cleaning, laying, and jointing pipe.

All buried valves shall be set solidly in the line so as to prevent movement under unbalanced head conditions. In the case of main line valves, the pipes on each side of the valve shall be butted solidly against the bottom of the valve joint.

A valve box shall be provided for every valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the planned finished pavement or ground surface.

## 1.6 SETTING HYDRANTS

### 1.6.1 Location

Hydrants shall be located as shown on the plan or as directed at the time of construction by the Holyoke Water Works. Hydrants shall be located in a manner as to provide complete accessibility and also in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized.

When placed behind a curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 12-inches from the gutter face of the curb. When set in a lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 6-inches of the sidewalk. When set at the property line, the back of the hydrant shall be at the property line. Hydrant setback and depth of bury requirements are as follows:

<b>Setback Dimensions:</b>	
• Concrete or blacktop sidewalk up to curbing with no grass treebelt	Face of hydrant setback 12 inches off face of curbing
• Concrete or blacktop sidewalk up to curbing with grass treebelt 5ft. from curb	Face of hydrant setback 12-inches off face of curbing or against back of sidewalk
• Grass treebelt up to curbing with concrete or blacktop sidewalk usually to 5 feet off curbing	Back of hydrant setback to edge of sidewalk but no more than 5 feet off face of curb or edge of pavement from face of hydrant

• Grass treebelt up to curbing or edge of pavement with no sidewalk	Face of hydrant setback 5 feet off face of curb or edge of pavement
<b>Depth of Bury:</b>	
• In concrete or blacktop way	Bottom of traffic flange between 2 to 6 inches above finished grade
• In grassed areas	Bottom of traffic flange between finished grade and 6 inches above finished grade

All hydrants in place, but not in service shall be covered with burlap or other suitable material. The covering shall be securely fastened to the hydrant and shall remain in place until such time that the new hydrant has been tested and accepted by the Holyoke Water Works and placed in service.

### **1.6.2 Position**

All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the road, with the pumper nozzle facing the road. Hydrants shall be set to the established grade, with the bottom at least 12-inches above the ground.

### **1.6.3 Connection to the Main**

Each hydrant shall be connected to the main with a 6-inch iron branch. The 6-inch branch is to contain a 6-inch gate valve box. Hydrant tee shall be an anchoring tee.

### **1.6.4 Hydrant Drainage**

Wherever a hydrant is set, drainage shall be provided at the base of the hydrant by placing washed gravel or crushed stone around the bottom of the hydrant.

An area approximately 2 feet in every direction from the center of the hydrant is to be excavated to the bottom of the hydrant. This area is to be backfilled to a point approximately 6-inches above the waste opening in the hydrant using washed or crushed stone. This gravel or stone is to be ¼-inch size or pea stone.

### **1.6.5 Backfill Around Hydrant**

Backfill of excavation around the hydrant barrel is to be accomplished with granular native soil. In the event that a granular native soil is not available from materials excavated from the trench, use gravel borrow.

## **1.7 ANCHORAGE**

### **1.7.1 General**

Unless otherwise specified, all anchorage or supports for the various fittings, specials, valves and hydrants installed shall be accomplished using poured concrete thrust blocks in conjunction with retainer glands.

Thrust blocks of machine-mixed, poured-in-place concrete, having a 28-day compressive strength of 3,000 psi and containing an air-entraining admixture, shall be placed at all bends, caps, offsets, hydrants, tees, dead ends, and similar locations.

The thrust blocks shall be carried to undisturbed solid ground at the side of the trench. All poured-in-place thrust blocks shall be formed with wood forms; rough earth forms will not be acceptable. Pipelines shall be protected from direct adherence of the concrete thrust block by wrapping the pipeline in plastic sheeting. The thrust blocks shall not bear directly on pipe joints and shall not interfere with future adjustments or tightening of the joint. All thrust blocks shall bear against undisturbed soil at the side or end of the trench, perpendicular to the direction of the thrust. Care must be taken that this bearing area is cut clean and vertical so that the back of the thrust block will not have a sloping face.

The thrust blocks shall have a minimum horizontal thickness of 2 feet and shall have the following minimum bearing surface measured perpendicular to the direction of thrust:

8-inch or less	6 square feet (2' x 3')
12-inch	12 square feet (3' x 4')

### **1.7.2 Support for Hydrants**

Each hydrant is to be supported by a stone placed under the hydrant and by a pre-poured thrust block or blocks placed behind the hydrant and wedged against unexcavated earth at the edge of the trench. Retainer glands shall be used at hydrant.

Each hydrant shall be set on a block of concrete or a solid flat stone having an area of more than 2 square feet.

### **1.7.3 Anchorage of Fittings and Specials**

All plugs, caps, tees, and bends shall be provided with a concrete thrust block to prevent movement. This thrust block shall be constructed in accordance with the provisions of Section 6.7.1. Retainer glands are required.

## **1.8 BACKFILLING**

### **1.8.1 General**

All backfill material is to be obtained from the material excavated under the provisions of Section 6.2 of these construction standards.

All rock excavated shall be disposed of off the construction site, and no portion of this rock, regardless of its condition, is to be used as backfill material in the trench.

All backfill material shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks or stones, or other material which, in the opinion of the Holyoke Water Works, is unsuitable. However, from 1 foot above the top of the pipe to the subgrade of the pavement, material containing stones up to 6-inches in their greatest dimension may be used, unless specified otherwise herein.

Frozen material shall not be used as backfill nor should backfill be placed on frozen material.

Clay dams will be required to prevent groundwater migration along the proposed pipeline. Clay dams shall be installed along the proposed water main at 200-foot increments if pipe bending materials utilized are not native materials excavated from the trench line.

### **1.8.2 Use of Excavated Material for Backfill**

In general, use of excavated material for backfilling of the trench will be required. The best, most granular portions of the excavated material shall be used for backfilling purposes with the better material used in the bottom of the trench and around the pipeline.

Where there is insufficient available backfill material due to a rejection of a part of the excavation as unsuitable for backfill, the excavated material shall be disposed of and the developer shall furnish the required amount of sand, gravel, or other approved backfill materials.

### **1.8.3 Initial Backfilling**

All trenches shall be backfilled by hand from the bottom of the trench to a point 1 foot above the top of pipe with the most granular material available from the excavation. This initial backfill is to be placed in layers of approximately 3-inches and thoroughly tamped under the pipe and compacted around the pipe. This initial backfilling shall be deposited in the trench for its full width on each side of the pipe, fittings and appurtenances simultaneously. While this initial backfill is being carried out under and up to the midpoint of the pipeline, one man shall be tamping in the trench for each man shoveling backfill material into the trench. In general, the only time that mechanical backfilling of this portion of the trench will be approved is when the backfilling material is composed of sand and is entirely free of stone and other hard or solid lumps.

### **1.8.4 Backfilling to Grade**

From a point 1 foot above the pipe to the subgrade of the finished road grade, the trench may be backfilled by approved mechanical methods. No heavy stone or rock shall be dropped into the trench, nor large masses of backfilling material be dropped in the trench in such a manner as to endanger to the pipe. No dimension greater than 12" shall be placed in the trench and if larger stones than these are found in the material to be used for backfilling,

they shall be broken up before being placed in the trench or hauled away from the site of the work. Care is to be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material.

Compaction of backfill shall be done by approved mechanical methods in lifts not to exceed 12 inches.

### **1.8.5 Backfilling in Freezing Weather**

Backfilling shall not be done in freezing weather, and frozen material shall not be used for backfilling. No backfill shall be placed in a trench when the material exposed in the trench sides or bottoms is already frozen.

## **1.9 TESTS & DISINFECTION**

### **1.9.1 Tests Required**

On completion of the pipeline, it is to be filled with water and tested. Water used for this purpose is to be drawn from the existing water system by Holyoke Water Works personnel.

A pressure test and a leakage test shall be run simultaneously in accordance with AWWA Specifications. The pressure for these two tests is to be measured at the lowest part of the line and shall be 50% higher than normal operating pressure but in no case less than 150 psi. The test is to be conducted for a period of 4 hours or until such time as the Holyoke Water Works indicates acceptance of the pipeline. Test pressure shall not vary by more than  $\pm 5$  psi (35 MPA or 0.35 bar) for the duration of the test.

All newly installed hydrant and branch connections must be subject to line pressure in an open trench to determine tightness of joints before backfilling, unless they are a part of the overall pipeline pressure and leakage test.

### **1.9.2 Time for Making Test**

No pipeline is to be placed under pressure or subjected to hydrostatic pressure until at least 5 days have elapsed after concrete thrust blocks have been installed. If high early strength concrete is used in the concrete thrust blocks, the hydrostatic pressure can be applied to the main after 3 days have elapsed from time of construction of the thrust blocks.

### **1.9.3 Procedure**

Each section of pipeline to be tested shall be slowly filled with water. The operation of connections to the existing system is to be carried out by the Holyoke Water Works.

After the pipeline has been brought up to normal operating pressure, all air shall be expelled from the pipeline. Hydrants and blow offs are to be used for this purpose to the extent possible. Additional  $\frac{3}{4}$ -inch taps at points of beginning and end of job and at highest elevation in the pipeline shall be installed in order to completely remove all air and to apply

chlorine solution for disinfection. At the conclusion of the test, the taps shall be removed and plugged or left in place at the discretion of the Holyoke Water Works.

After the new line has been placed under normal operating pressure and all air has been expelled, the pressure and leakage test shall be started. The pipeline under test shall be raised to the specified pressure. The developer shall furnish a pump, pipe connections, gauges, all necessary apparatus, and connections to the new main.

The contractor shall raise the pressure in the new section of main to the specified test pressure by means of the pump using clean water from the existing water system and will maintain the specified pressure for a period of 4 hours or until the Holyoke Water Works indicates that the pipeline is satisfactory.

During the test period, an accurate measure of the amount of water required to maintain the test pressure shall be maintained and recorded.

#### **1.9.4 Procedure & Responsibility**

The developer shall employ a firm or person experienced in testing and disinfecting water systems, acceptable to the Holyoke Water Works. The Holyoke Water Works shall supervise and direct the testing and disinfection and determine if the new piping system passes the test. No piping system will be served with municipal water until it passes the leakage test.

The developer shall pay the testing firm directly for the leakage test and the disinfection.

#### **1.9.5 Leakage Test**

The leakage test shall be conducted for 4 hours at the specified test pressure and the leakage test shall be continued until such time as the main and its appurtenances are either rejected as unsatisfactory or accepted as satisfactory within the requirements of these specifications.

Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and air expelled.

No pipe installation will be accepted until the leakage is less than the number of gallons per hour as determined by the Holyoke Water Works per the following formula:

$$L = (ND) P^{0.5}/3700$$

in which L equals the allowable leakage, in gallon per hour; N is the number of joints in the length of the pipeline tested; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

### **1.9.6 Variation from Permissible Leakage**

Should any test of pipe laid disclose leakage greater than the specified in Section 6.9.5, the developer shall, at its own expense, locate and repair the defective pipe or joint until the leakage is within the specified allowance.

### **1.9.7 Disinfection**

The completed pipeline shall be disinfected in accordance with AWWA Specifications. Prior to disinfecting the water main, the main shall be completely filled to remove all air pockets and then flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 ft/s unless the Holyoke Water Works determines that conditions do not permit the required flow to be discharged to waste. Note that flushing is no substitute to preventative measures during construction.

The completed pipeline shall be disinfected with a chlorine concentration of approximately 50 ppm prior to being placed in service. The introduction of this chlorine solution shall be accomplished by pumping hypochlorite (calcium or sodium based) solution into the main at a point not more than 10 feet downstream from the beginning of the new main while flowing in the manner similar to initial filling at the opposite end of each water main segment. The developer shall install taps for chlorination and sampling. The developer shall uncover and backfill the taps as required. Special disinfecting procedure shall be used in connections to existing mains and where the method outlined above is not practical.

The chlorinated water is to remain in the new pipeline for at least 24 hours. After a 24-hour holding period, there should be a free chlorine concentration of not less than 10 mg/L. During this period, proper precautions shall be taken to prevent this chlorinated water flowing back into the existing system. In addition, all valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances.

Following the chlorination period, all treated water shall be flushed from the lines at their extremities and replaced with water from the distribution system. The flushed chlorinated water, meeting all local, state, and federal regulations, shall be discharged to the sewer system or disposed of using other approved means provided in AWWA C651. No discharge to any storm sewer or natural water course may be allowed. Bacteriological sampling and analysis of the replacement water may then be made by the contractor in full accordance with AWWA C651 and under the supervision of the Holyoke Water Works or its Engineer. The contractor will be required to re-chlorinate, if necessary, and the line shall not be placed into service until the bacteriological requirements of AWWA C651 are met. Developer shall pay for coliform tests by a State-approved laboratory.

After all disinfection and testing is completed, the developer will be required to blow out the new water mains under the direction of the Holyoke Water Works. Blowing out of the main is to be accomplished at as high a velocity as possible consistent with the ability of the existing system to supply water and the ability of the area around the blow-off point to drain the water off. After clean water substantially free of chlorine is obtained at the blow-off, the

flow of water at reduced rates is to be continued until tests show normal chlorine residual and no coliform.

After completion of the blowing-off operation, and no coliform is found, the new main is to be placed in service. However, the main is to be checked occasionally to determine if any build-up of chlorine or taste occurs. If any build-up does occur, a blow-off is to be operated at a slow rate for a period sufficient to clear the pipeline.