

Appendix F

Engineering Report & Technical  
Specifications for a Water Main  
Extension to Serve Dockside



# ENGINEERING REPORT & TECHNICAL SPECIFICATIONS

FOR A

## WATER MAIN EXTENSION

TO SERVE

## DOCKSIDE

DOCK ROAD

TOWN OF MARLBOROUGH  
ULSTER COUNTY, NEW YORK

PREPARED BY



99 Clinton St. 2<sup>nd</sup> Floor  
Montgomery, NY 12549

JUNE 2011

REVISED SEPTEMBER 2011



## TABLE OF CONTENTS

<b>SECTION</b>	<b>PAGE</b>
1.0 INTRODUCTION .....	1
2.0 SITE DESCRIPTION .....	1
3.0 EXISTING WATER SYSTEM DESCRIPTION .....	1
4.0 PROPOSED WATER SYSTEM FACILITIES .....	2
4.1 PROPOSED DEMAND .....	3
4.2 PROPOSED PRESSURES.....	3
4.3 PROPOSED FIRE FLOW .....	4
5.0 CONCLUSION .....	5

## APPENDICES

- APPENDIX A: LOCATION MAP
- APPENDIX B: FIRE FLOW DATA
- APPENDIX C: OVERALL WATER SYSTEM PLAN
- APPENDIX D: PRESSURE AND FLOW CALCULATIONS
- APPENDIX E: TECHNICAL SPECIFICATIONS



## 1.0 INTRODUCTION

Engineering Properties, P.C. is pleased to submit this Engineers Report for a water main extension to serve the project known as Dockside. The project site consists of several parcels of land totaling  $\pm 27.2$  acres. The proposed project scope includes the construction of 137 townhomes and a clubhouse in a neighborhood style development.

All buildings will be connected to new public water mains and sewer mains to be installed by the project sponsor. The project is within the Town of Marlborough and will receive water service via connection to the existing Marlboro-Milton Water District.

## 2.0 SITE DESCRIPTION

The project site consists of three parcels identified as Town of Marlborough tax lots, Section 108.4 Block 3 Lot 13, 14.2 and 29.1; containing  $\pm 27.2$  acres. Dock Road will serve as the main access to the site which is located south of the property. Dock Road will also be the location of the proposed water service connections to the existing 8" water main. To the west of the property is NYS Route 9W and several small commercial properties. Immediately north of the site is the Marlboro School District Middle School and to east is a marina. A USGS map indicating the site location can be found in Appendix A.

The site was a former sand and gravel mine which has been reclaimed and is currently undeveloped. The site consists of overgrown fields and brush. Topography on the project site is flat to gentle sloping in the center of the site where the floor of the mine was located with steep slopes around the perimeter. The base of the former mine site generally slopes from west to east with a low point in the developed area of 70 feet. From this area, the site slopes steeply up to the north towards the school and steeply down to the south towards dock road.

The highest elevation of the developed portion of the site directly above the proposed water main is approximately 139 feet above mean sea level located in the area of buildings #2 and #3. The lowest elevation directly above the proposed water main is

approximately 91 feet above mean sea level and is found at the east portion of site in front of building #9.

### **3.0 EXISTING WATER SYSTEM DESCRIPTION**

The site is currently serviced by the Marlboro-Milton Water District. This system primarily services the more highly developed areas of the Town of Marlborough in and around the hamlet of Marlboro. According to the *Draft Report on Water Supply Alternatives, Marlboro-Milton Water District*, dated November 2009, by Brinnier and Larios, P.C., the Town's water system was originally supplied directly from the New York City DEP but requirements for better pressure, chlorine contact time, corrosion control and emergency supply led to an Intermunicipal Agreement with the Town of Newburgh. Currently, potable water is supplied with water from the Town of Newburgh's Delaware Aqueduct Station 5A tap pursuant to the Intermunicipal Agreement with the Town of Newburgh dated 2000. This agreement gives the Town of Marlborough contractual rights to purchase up to 1 million gallons per day (MGD) from the Town of Newburgh and is currently using approximately 450,000 gallons per day of this capacity. The Town of Marlborough is currently in discussions with the Town of Newburgh concerning modifications to the agreement in order to share the costs of a new filtrations facility being required on the Delaware Aqueduct Supply.

Hydrant testing was performed by the Town at the intersection of NYS Route 9W and Dock Road. According to Charles Muggeo, Water Superintendent, the normal operating pressure at this hydrant was 145 pounds per square inch (PSI) and an 80 PSI residual pressure was recorded at an estimated flow of 1,670 gallons per minute (GPM). This hydrant is located at a ground elevation of  $\pm 170$  feet.

### **4.0 PROPOSED WATER SYSTEM FACILITIES**

The project sponsor proposes to construct approximately 4,274 linear feet (l.f.) of 8" diameter class 52 double cement lined ductile iron water main to service the project as shown in the Overall Water System Plan in Appendix C. The proposed 8" main will connect to the existing 8" water main on the south side of Dock Road at two locations.

The first will be via a wet tap opposite the proposed entry drive and the second will be via a wet tap opposite the emergency access road. All new water mains shall be designed and constructed in accordance with the Town of Marlborough and Ulster County Health Department requirements. All improvements will be constructed within the existing Town of Marlborough road right-of-ways or on lands of the proposed project. All water mains will be built to Town standards and are proposed to be gratuitously dedicated to the Town.

#### 4.1 PROPOSED DEMAND

As previously mentioned, the development of the Dockside project is designed for a total of 137 townhomes. Based upon NYSDEC standards, it is anticipated that each 3-bedroom townhome will average approximately 320 gallons per day of water usage. The proposed water demand for this project has been calculated as shown below:

*TABLE 1: PROPOSED WATER DEMAND*

<b>UNIT TYPE (SINGLE FAMILY RESIDENCE)</b>	<b># OF UNITS/ USERS</b>	<b>AVERAGE DEMAND (GPD)</b>	<b>AVERAGE DAILY DEMAND (GPD)</b>
3-Bedroom	137	320	43,840
Clubhouse Pool	50	50	400
Clubhouse	50	50	800
Irrigation	1	LS	10,000
		<b>TOTAL</b>	<b>55,040</b>

The total water demand for the project is projected to be 55,040 GPD. As the system capacity is approximately 550,000 GPD, there is sufficient capacity to meet the needs of the project.

#### 4.2 PROPOSED PRESSURES

Based on the fire flow data provided, there is more than adequate pressure to service the domestic needs of the project. Calculations for the minimum and

maximum expected pressures have been provided in Appendix D. Assuming no pressure regulation, a minimum domestic pressure of 158.2 PSI would be expected at the Dockside system's highest point of 139 feet, located in front of units #2 and #3 (Hydrant H-12). The highest domestic pressure in the new water system would occur at the system low point on front of building #9. The elevation at this point is approximately 91 feet and the pressure measured at ground level will be 178.5 psi (near Junction J-6).

The existing system pressure is excessive and will require pressure reduction to service the needs of the project. It is proposed that a pressure reducing station be installed on the existing 8" water main just uphill from Dockside's connection point to the existing water main at an approximate ground elevation of 148 feet. The pressure reducing station shall be set to have a discharge pressure of 47.5 psi. Based on this pressure setting the new water system will have a maximum pressure of 75 psi at the system low point and a low pressure of 54.7 psi at the system high point. All other portions of the mains will have pressures within this range and will therefore comply with Ten State Standards.

### **4.3 PROPOSED FIRE FLOW**

As it is unknown if the new residences will be sprinkled we have reviewed both the sprinkled and un-sprinkled scenario. In regards to fire protection, according to ISO guidelines, the needed fire flow (NFF) for un-sprinkled buildings of this construction type is calculated to be 1,500 GPM at 20 PSI residual, if they are protected by automatic sprinkler systems the NFF is not calculated and may be considered to be 500 GPM at 20 PSI residual (see Appendix D). When considering the fire flow demand you must also consider the maximum daily domestic demand. Maximum demand is typically considered two times the average daily demand. Based on the average daily demand of 38.2 GPM [55,040 GPD / (1440 min/day)], maximum daily demand is calculated to be 76.4 GPM. Therefore the NFF of 1,500 GPM plus the maximum daily domestic demand of 76.4 GPM would result in a peak system demand of approximately

1,576.4 GPM for non-sprinkled buildings and 500 GPM plus the maximum daily domestic demand of 76.4 or 576.4 GPM for sprinkled buildings.

A model of the new system has been prepared and the equivalent pipe length to the “reservoir” (see Appendix D) has been calculated to determine if the minimum system pressure of 20 PSI can be maintained throughout the site during this peak system demand. Based on this model, a peak flow of 2,536 GPM can be maintained with a residual pressure of 20 PSI at the intersection next to building #4 (Node: J-4).

## **5.0 CONCLUSION**

From the above information, it can be concluded that the proposed water mains will meet code requirements for flow and pressures and that the Town of Marlborough water system has sufficient capacity to service the projected water demand.



# APPENDIX A LOCATION MAP



Drawing Name: Z:\989.01 - Dockside @ Marlborough.dwg\SketchPlan3.dwg Date Printed: Jun 15, 2011, 2:55pm



LOCATION MAP

DOCKSIDE @ MARLBOROUGH  
DOCK ROAD  
TOWN OF MARLBOROUGH  
ULSTER COUNTY, NEW YORK

DATE:  
06/02/11

SCALE:  
1"=1000'

JOB #  
989.01

SHEET #  
F-1

**ENGINEERING PROPERTIES**  
Achieving Successful Results with Innovative Designs

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# APPENDIX B

# FIRE FLOW TEST



**HYDRANT FLOW TESTING RESULTS**

WO. NO. <b>989.01</b>	DATE <b>06/13/11</b>	SHEET <b>1 OF 1</b>
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PROJECT TITLE <b>Dockside @ Marlborough</b>	MUNICIPALITY ( C / V / T )	LOCATION <b>Town of Marlborough</b>
PERFORMED BY <b>M.W.D.</b>	WATER DISTRICT <b>Marlborough Water District (M.W.D.)</b>	REF DRAWING(S)

**HYDRANT TEST DATA**

Hydrant Test #: 1      Date: N/A      Time: N/A       AM  PM

Residual Hydrant Location: Northeast corner of Dock Road and Route 9W

Residual Hydrant Elevation: 170.7 feet      Vertical Datum: \_\_\_\_\_

Flowing Hydrant Location: Same Hydrant

Flowing Hydrant Elevation: \_\_\_\_\_ feet      Vertical Datum: \_\_\_\_\_

Aprox. Distance between Hydrants: 0 ± feet

Existing Water Main Size:      6"       8"      10"      12"      \_\_\_\_\_

**RESULTS**

Residual Hyd. Static Pressure (P<sub>S</sub>): 145 PSI = 334.6 Feet of Static Head

Residual Hyd. Flow Pressure (P<sub>T</sub>): 80 PSI = 184.6 Feet of Static Head

Flow Hydrant Measured Flow (Q<sub>T</sub>): 1,670 GPM

Calculated Flow @ 20psi: 2,377 GPM =  $Q_T \times ((P_S - 20) / (P_S - P_T))^{0.54}$

**HYDRANT TEST DATA**

Hydrant Test #: \_\_\_\_\_      Date: \_\_\_\_\_      Time: \_\_\_\_\_       AM  PM

Residual Hydrant Location: \_\_\_\_\_

Residual Hydrant Elevation: \_\_\_\_\_ feet      Vertical Datum: \_\_\_\_\_

Flowing Hydrant Location: \_\_\_\_\_

Flowing Hydrant Elevation: \_\_\_\_\_ feet      Vertical Datum: \_\_\_\_\_

Aprox. Distance between Hydrants: \_\_\_\_\_ ± feet

Existing Water Main Size:      6"       8"      10"      12"      \_\_\_\_\_

**RESULTS**

Residual Hyd. Static Pressure (P<sub>S</sub>): \_\_\_\_\_ PSI = \_\_\_\_\_ Feet of Static Head

Residual Hyd. Flow Pressure (P<sub>T</sub>): \_\_\_\_\_ PSI = \_\_\_\_\_ Feet of Static Head

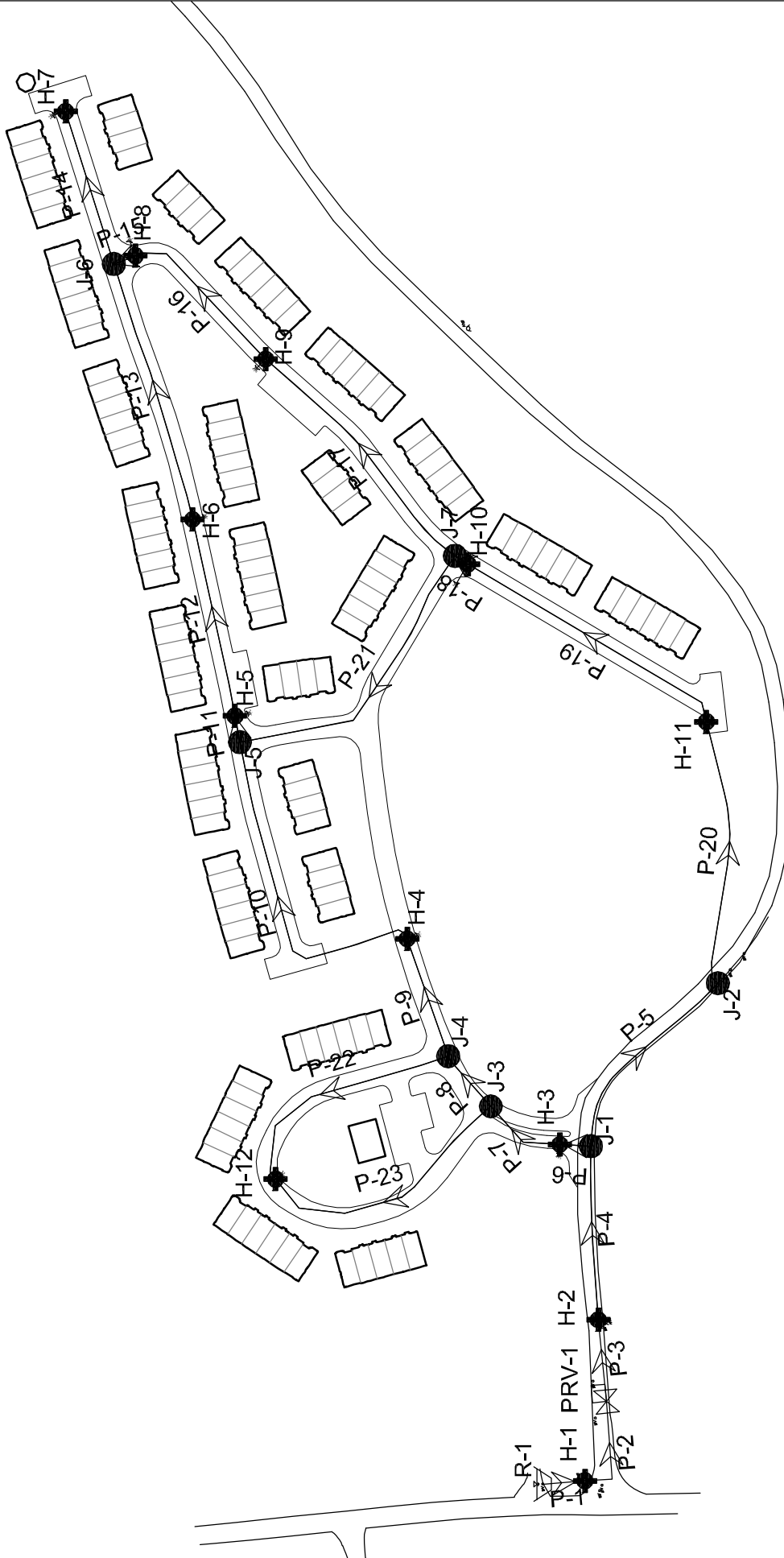
Flow Hydrant Measured Flow (Q<sub>T</sub>): \_\_\_\_\_ GPM

Calculated Flow @ 20psi: \_\_\_\_\_ GPM =  $Q_T \times ((P_S - 20) / (P_S - P_T))^{0.54}$



APPENDIX C  
OVERALL  
WATER SYSTEM PLAN





**WATER SYSTEM LAYOUT**

DOCKSIDE  
DOCK ROAD  
TOWN OF MARLBOROUGH  
ORANGE COUNTY, NEW YORK

DATE:

06/20/11

SCALE:

1" = 200'

JOB #

989.01

SHEET #

F-2



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# APPENDIX D PRESSURE AND FLOW CALCULATIONS





## Equivalent Pipe Length from Friction Headloss Calculation

WO. NO. <b>989.01</b>	DATE <b>06/13/11</b>	REVISED	SHEET <b>1</b>	OF <b>1</b>
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PROJECT TITLE <b>Dockside @ Marlborough</b>	LOCATION <b>Town of Marlborough</b>
CALCULATED BY <b>KW</b>	APPROVED BY <b>RW</b>
REF DRAWING(S)	

### Data from Hydrant Test

$P_{static} =$	145.0 psi	Date Performed :	N/A (Data provided by Water Dept)
$P_{residual} =$	80.0 psi	Flow (Q) =	1,670 gallons/min (gpm)
Elevation :	170.70 feet	Diameter (d) =	8 inches (in)

### Existing Water System Data

Determine equivalent length of water main pipe based on hydrant testing results

$$h_f = ( p_1 - p_2 ) / Y \quad [ \text{Bernoulli Equation} ]$$

$p_1 =$	145.0 lb/in <sup>2</sup>	=	20,880 lb/ft <sup>2</sup>
$p_2 =$	80.0 lb/in <sup>2</sup>	=	11,520 lb/ft <sup>2</sup>
$Y =$	62.40 lb/ft <sup>3</sup>		
$h_f =$	<b>150.0 feet</b>		

$$h_f = ( 10.44 \times L \times Q^{1.85} ) / ( C^{1.85} \times d^{4.8655} ) \quad [ \text{Hazen-Williams Friction Head Loss} ]$$

$$L = h_f / ( 10.44 \times Q^{1.85} ) / ( C^{1.85} \times d^{4.8655} )$$

$Q =$	1,670 gpm
$C =$	110 Hazen-Williams Constant
$d =$	8 in
$h_f =$	150.0 ft
$L =$	<b>2,322 feet</b>















# APPENDIX E

# TECHNICAL

# SPECIFICATIONS



## **SECTION 02660**

### **WATER SYSTEM**

#### **PART 1.0 - GENERAL**

##### **1.01 SUMMARY**

- A. The Contractor shall supply all labor, tools, materials, and equipment to construct, test and disinfect the watermains as described in these specifications and the accompanying drawings. All references to the standards, specifications, regulations, etc., are meant to be their last revisions. The contractor shall comply with the latest regulations, requirements and specifications of the New York State Department of Health, the "Recommended Standards for Water Works", 1997 publication and all appropriate AWWA Specifications.

##### **1.02 PROJECT RECORD DOCUMENTS**

- A. Accurately record the actual locations of all subsurface utilities, structures and obstructions encountered during construction. Provide an as-built survey of the water main and water service locations prior to final payment.

#### **PART 2.0 - PRODUCTS**

##### **2.01 PIPE**

All pipe within Town roads shall be class 52 double cement lined ductile iron pipe with exterior bituminous coating and shall meet the requirements of AWWA C104 and AWWA C151. Pipe shall be supplied in the longest available lengths which will provide for required horizontal and vertical deflections, but shall not exceed 20 feet. Pipe shall be push-on or mechanical joint as required. All fittings and appurtenances to be cast iron. Pipe lengths must be 5' at all connections to fittings and 20 feet at all crossings with storm and sanitary sewers and laterals.

OR

Piping within private roads shall be Polyvinyl Chloride Schedule 80 (PVC) Potable Water Piping approved equal and shall meet the requirements of AWWA C900. Pipe shall be supplied in the longest available lengths which will provide for required horizontal and vertical deflections. Pipe lengths must be 20' at all connections to fittings. Joints shall be heat fused in accordance with the manufacturer's recommendations and the requirements of ASTM D3261. Pipe shall have ductile iron outside diameter with mechanical joint connections to all fittings and appurtenances.

Joints shall be the integral wall bell and spigot type using Elastometric Gasket Joints meeting the requirements of ASTM F-477. All pipes shall be wiped clean and lubricated prior to insertion.

Place detectable identification tape above pipe 12" or less below ground level, or immediately under pavement. The detectable identification tape shall be made of polyethylene with a 1 mil metallic foil core, highly resistant to alkalis, acids or other destructive chemical compounds likely to be encountered in soils. The tape shall have black letters "CAUTION BURIED WATER LINE BELOW" printed on blue background. Tape shall be at least 3" wide, manufactured by Reef Industries, Inc. (TERRA TAPE), Linguard, Inc. or approved equal.

## 2.02 FITTINGS

Fittings shall be cast iron with mechanical joints. Fittings shall be pressure rated at 250 psi, and shall conform to AWWA C110 specifications. Mechanical joint rubber gaskets shall conform to AWWA C-111 standards. Tie rodding should be provided with retainer glands for all fittings as necessary to restrict pipe displacement.

## 2.03 VALVES

Valves shall be Mueller Resilient Wedge Gate Valves Model # A-2360-20 as manufactured by Mueller Company. Valves shall meet all applicable requirements of ANSI/AWWA C509 and be pressure rated to 250 psi working pressure and 500 psi static test pressure.

## 2.04 HYDRANT

All hydrants shall be dry-barrel Mueller Centurion hydrants. Hydrants shall conform to AWWA C502. All hydrants shall be pressure rated to 250 psi working pressure 400 psi static pressure and shall have a main valve opening of 5 inches in accordance with Town of Marlborough requirements.

## 2.05 WET TAP

Wet Taps shall be Mueller Stainless Steel Tapping Sleeve model H-304 as manufactured by Mueller Company. The tapping sleeve shall conform to ANSI/NSF 61 with outlet flange in conformance with ANSI B16.1, class 125. All parts shall be pressure rated to 250 psi working pressure.

## PART 3.0 - EXCAVATION AND PIPE INSTALLATION

### 3.01 BEDDING

The Contractor shall use clean sand for bedding of the water mains. The sand must be free of stones and compacted in accordance with the requirements of Section 02225, Trenching.

### 3.02 LAYING PIPE

The Contractor shall notify the Underground Facilities Protection Organization of New York at 1-800-962-7962 and any other involved utility companies not affiliated with UFPO, prior to any excavation. Pipes that require cutting shall be cut with a pipe saw, wheelcutter or hydraulic cutter as deemed acceptable by the engineer. All pipes shall be backfilled prior to the end of the working day in order to minimize safety hazards. All open ends of pipe shall be plugged and sealed watertight. Blocking and wedging are not permitted for pipe stabilization. Clean sand shall be used to make the bottom of trench uniform. Pipe deflections are permitted to 80% of the maximum allowable limit of 5 degrees for design purposes. All piping must have double line indicators to measure maximum deflections limits in the field. All pipes shall be laid in accordance with AWWA C600 for ductile iron pipe. All pipes, fittings and valves shall be carefully handled to avoid damage and, while they are suspended over the trench, before lowering, they shall be rung and inspected for defects. Before the pipe is laid, all lumps, blisters, excess coal tar, dirt, oil, grease and moisture shall be removed from inside the pipe. After pipe is laid, care shall be taken to avoid the entrance of dirt or water from the trench by use of tight bulkheads. Under no conditions may pipe be installed with standing groundwater in the trenches.

The pipe shall be laid to conform to lines and grades shown on the plans, or as directed by the engineer. The pipe shall have a minimum cover of 4'-0" unless noted otherwise on the drawings.

Each bell and spigot shall be cleaned thoroughly. Each pipe and special fitting shall be firmly supported on good foundations. Mechanical and rubber gasket pipe joints shall be fabricated and used in strict accordance with manufacturer's instructions. Where bolts are used, they shall be drawn up evenly with a torque wrench.

### 3.03 PIPE RESTRAINTS

All pipe fittings shall be restrained to the new watermain on both sides using a retainer glands in accordance with AWWA C111 latest revision. The retainer gland shall be tightly fastened to the pipeline via clamp fittings designed to break off at the required torque. The unit shall be securely fastened to the fitting using nuts and bolts as required. The gland shall be secured to the fitting first before being tightly fastened to the pipeline. Refer to the design plans for more detail.

### 3.04 WATER MAIN, STORM SEWER & SANITARY SEWER CROSSING SEPARATIONS

Separate water and sewer lines at least 10' horizontally edge to edge.

At street intersections, or at other locations where water and sewer lines must cross, including sanitary sewer laterals and house connection potable water services, provide a minimum vertical distance of 18" between the outside of the water main and the outside of the sewer. One full length of water pipe shall be centered on sewer crossings so joints are equidistant and as far as possible from the sewer.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the reviewer's authority must specifically approve any variance from these requirements. As a minimum, concrete encasement must be provided and approved on a case-by-case basis by the engineer. Provide adequate support for both pipes to eliminate any possibility of settling.

## PART 4.0 - INSPECTION AND TESTING

### 4.01 GENERAL

The Contractor shall supply all necessary materials, equipment and labor to test the piping as described below, including pump, piping, valves and labor. The engineer will supply the test gauge or else calibrate the contractor's gauge before and after the tests. All pressure tests must be done in the engineer's presence under his direction. The testing of watermains shall be done in accordance with Section 5 of AWWA Standard C-600.

### 4.02 TESTING

Two tests shall be required at the discretion of the Engineer. The first shall be a hydrostatic pressure test only. This shall be done when a section of line has been completed. The line shall be partially backfilled and braced against movement during the test. All air must be bled out of the section. A 1" tap shall be provided for the required service connection. Taps may be made by means of a tapped coupling left at proper location or by cutting with an approved tapping machine, or by use of service saddles approved by the engineer. Taps shall be of the thread type to accept a standard corporation stops as specified herein.

Taps and corporation stops should be located at least 1'0" from pipe ends. Corporation stops shall be as specified on the approved plans.

The contractor may elect to perform one hydrostatic pressure test at the completion of all improvements. However, the Contractor shall bear the responsibility of locating any underground

leaks and making the necessary repairs. The hydrostatic test shall be of at least two hours in duration. Test pressure at the point of testing shall be as indicated by the Engineer, and in general, shall be one and a half times the actual working pressure or 150 PSI, whichever is greater applied at the lowest point of the section to be tested. A correction shall be made for the difference in elevation between this point and the test gauge. With the required pressure on the line, the entire run shall be examined for evidence of leakage. Any leaks discovered shall be corrected and the test repeated until the engineer is satisfied that the line is tight. The test pressure shall not vary by more than 5 psi for the duration of the test.

After the above work is completed and the line is completely backfilled, a leakage test of two hour duration shall be made at the same pressure as the pressure test measured at the lowest portion of the test section and corrected for test gauge height. No pipe installation will be accepted unless and until the leakage is less than the amounts allowed in AWWA Standard C-600, Section 5.2, and Table 6. Allowable leakage is determined by the following formula:

$$* \quad L = \frac{SD (P)^{0.5}}{133,200}$$

Where L is leakage in gph, S is the length of pipe tested in feet, D is the nominal diameter of the pipe in inches and P is the average test pressure during the test in psi. The hydrostatic pressure test and leakage test may be conducted simultaneously if deemed acceptable by the engineer.

#### 4.03 DISINFECTION OF MAINS

All new work shall be disinfected by the contractor. Disinfection shall be performed in an approved manner in accordance with the American Water Works Association's Standard for Disinfecting Water Mains, Designation C-651-99 except that the tablet method described in Section 5.1 of C-651-99 shall not be used.

#### 4.04 PREVENTATIVE MEASURES DURING CONSTRUCTION

Keeping Pipe Clean and Dry: Precautions shall be taken to protect pipe interiors, fittings and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. When pipelaying is not in progress, as, for example, at the close of the day's work, all openings in the pipeline shall be closed by water tight plugs. Joints of all pipes in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

If dirt that, in the opinion of the engineer or job superintendent, will not be removed by the flushing operation enters the pipe, the interior of the pipe shall be cleaned and swabbed as necessary, with a 5 percent hypochlorite disinfecting solution.

#### 4.05 PRELIMINARY FLUSHING

The main shall be flushed prior to disinfection. The flushing velocity shall not be less than 2.5 ft/sec. The rate of flow required to produce this velocity in various diameters is shown in Table I. No site for flushing should be chosen unless it has been determined that drainage is adequate.

**TABLE I**

Required Openings to Flush Pipelines\*  
(40 psi Residual Pressure)

Pipe Size (in.)	Flow Required to Produce 2.5 fps Velocity (gpm)	Orifice Size (in.)	Hydrant Number	Outlet Nozzles (Size in.)
4	100	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
14	1,200	2-1/4	1	2-1/2

#### 4.06 FORM OF CHLORINE DISINFECTION

The most common form of chlorine used in the disinfecting solutions are liquid chlorine (gas at atmosphere pressure), calcium hypochlorite granules, and sodium hypochlorite solutions.

- A. Liquid Chlorine: shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine gas directly from the supply cylinder is unsafe and shall not be permitted.

The preferred equipment consists of a solution feed chlorinator in combination with booster pump for injecting the chlorine/water mixture into the main to be disinfected. Direct feed chlorinators are not recommended because their use is limited to situations where the water pressure is lower than the chlorine cylinder pressure.

- B. Calcium Hypochlorite: contains 70 percent available chlorine by weight. It is either granular or tabular in form. The tablets, 6-9 to the ounce, are designed to dissolve slowly in water.

A chlorine-water solution is prepared by dissolving the granules in water in the proportion requisite for the desired concentration.

- C. Sodium hypochlorite: is supplied in strengths from 5.25 to 16 percent available chlorine. It is packaged in liquid form in glass, rubber or plastic containers ranging in size from one quart bottles to five gallon carboys. It may also be purchased in bulk for delivery by tank truck.

A chlorine-water solution is prepared by adding hypochlorite to water. Product deterioration must be considered when computing the quantity of sodium hypochlorite required for the desired concentration.

#### 4.07 APPLICATION

The hypochlorite solutions shall be applied to the watermain with a gasoline or electrically powered chemical feed pump designed for feeding the chlorine solutions. For small applications, the solutions may be fed with a hand pump, for example, a hydraulic test pump.

Feed line shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.

4.08 METHODS OF CHLORINE APPLICATION

- A. Continuous Feed Method - This method is suitable for general application. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 25 mg/l available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the current edition of Standard Methods of AWWA M12 - Simplified Procedures for Water Examination.

Table II gives the amount of chlorine residual required for each 100 foot of pipe in various diameters. Solutions of one percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately 1 lb. of calcium hypochlorite in 8.5 gallons of water. If liquid laundry bleach with 5.25% Cl is used, then 4.25 gallons of water is to be mixed with 1 gallon of bleach to obtain 1 percent solution.

**TABLE II**  
Chlorine Required to Produce 25 mg/l  
Concentration in 100 ft. of pipe

<u>Pipe Size (in.)</u>	<u>Volume of 100-ft. length (gallons)</u>	<u>100 Percent Chlorine (lb.)</u>	<u>1 Percent Chlorine Solutions (gal.)</u>
4	65.3	.013	0.16
6	146.5	.030	0.36
8	261.0	.054	0.65
10	408.0	.085	1.02
12	588.7	.120	1.44

During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hour period, the treated water shall contain no less than 10 mg/l chlorine throughout the length of the main.

- B. Tablet Method - The "tablet method" as contained in American Water Works Association Standard C-651-86 is not acceptable to the New York State Department of Health and shall not be used.

4.09 FINAL FLUSHING

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/l. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline. The chlorinated shall not be discharged directly into an existing watercourse (i.e. pond, lake, stream, etc.) but rather to a suitable location where the water can percolate into the ground for treatment. If such a location

is not available, then the wastewater shall be taken off-site to an approved wastewater treatment plant.

#### 4.10 BACTERIOLOGIC TESTS

After final flushing and before watermain is placed in service, a series of samples shall be collected from the main and tested for bacteriologic quantity and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least two consecutive sets of acceptable samples, taken at 24 hours apart, shall be collected from the new main which is currently under disinfection procedures in accordance with AWWA C-651-99, Section 5.1. At least one set of samples shall be collected from every 1,200 ft of the new watermain, plus one set from the end of the line and at least one set from each branch.

Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in collection of samples. A suggested samples tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected the gooseneck assembly may be removed and retained for future use. All testing for bacteriological quality shall be done in accordance with "Standard Methods for the Examination of Water and Wastewater".

#### 4.11 REPETITION OF PROCEDURE

If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated at the Contractors expense until satisfactory samples have been obtained. When the samples are satisfactory, the main may be placed in service.

#### 4.12 PROCEDURE AFTER CUTTING INTO OR REPAIRING EXISTING MAINS

The procedure outlined in this section applies primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the main remains full of water under pressure require no disinfection.

- A. Trench Treatment - When an old line is opened, either by accident or by design, the excavation will likely be wet and badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.
- B. Main Disinfection - Swabbing with Hypochlorite Solution: The interior of all pipe and fittings used in making the repair (particularly coupling and tapping sleeves) shall be swabbed with a 1 percent hypochlorite solution before they are installed.
- C. Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.
- D. Sampling - Bacteriologic samples shall be taken after all repairs, in order to provide a record by which the effectiveness of the procedures used can be determined. If the direction of flow is unknown samples shall be taken on each side of the main break.

END OF SECTION

