

**CITY OF WOODLAND PARK, COLORADO**

**TITLE 2**

**WATER SYSTEM SPECIFICATIONS**

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## 2.1 DESIGN

### 2.1.1 GENERAL

**DOMESTIC WATER PLAN CHECKLIST.** All drawings submitted must adhere to acceptable drafting standards. The following check list is provided to assist in the development of plans that meet minimum City requirements.

#### PLAN VIEW SHEET FORMAT

		Yes	No	N/A	Comments
1.	Title				
2.	North Arrow				
3.	Sheet size 24" X 36"				
4.	Horizontal Scale 1"= 50'				
5.	Professional Engineer Signature and Seal				
6.	City Approval Block				
7.	Bench Mark (USGS Datum)				
8.	Vicinity Map				
9.	Key Map				
10.	Legend of Symbols				
11.	Sheet Cross Reference				
12.	Title Block				
13.	Revision Blocks				
14.	Ownership and/or Subdivision Information				
15.	Street Names				
16.	Street Dimensions				
17.	Easements with Dimensions				
18.	Lot Lines				
19.	Lot Numbers (Location and Size)				
20.	Existing Utilities Shown				
	a. Water				
	b. Sanitary Sewer				
	c. Storm Sewer				
	d. Electric Service				
	e. Telephone				
	f. Irrigation				
	g. Gas				
	h. Cable Television				
21.	Join to Existing Water Line				
22.	Construction Details				

		Yes	No	N/A	Comments
23.	Construction Notes				
24.	Size and Type of Water Main				
25.	Minimum Clearance Between Water and Sewer				
26.	Location of Fire Hydrants				
27.	Location of Valves				
28.	Size of Valves				
29.	Size and Location of Fittings				
	a. Tees				
	b. Crosses				
	c. Reducers				
	d. Bends				
	e. Plugs				
30.	Location of Blow-offs				
31.	Thrust Blocks				
32.	Crossing of Utilities				
33.	Crossing Detail(s)				
34.	Location of Crossing(s)				
35.	Staking Information				
36.	Note on Standard Depth to Water Main				
37.	Removal of Existing Improvements				
38.	Sewer Service Locations				
39.	Water Service Locations				

**PROFILE FORMAT**

40.	Vertical and Horizontal Grids with Scales (Typically - V 1"= 5'; H 1"=50')				
41.	Datum Elevations				
42.	Datum Locations				
43.	Existing Ground Surface				
44.	Proposed Grade over Lines				
45.	Underdrain Note				
46.	Type, Size, and Length of Main				
47.	Utility Crossings Shown				
48.	Encasement Location				
49.	Can It Be Staked and Built?				

**GENERAL NOTES: When applicable, the following notes shall be placed on all water utility plans.**

1. The contractor shall be solely and completely responsible for conditions at and adjacent to the job site, including safety of all persons and property during the performance of work. This requirement shall apply continuously and not be limited to normal working hours. The duty of the City to conduct construction review of the contractor's performance is not intended to include review of the adequacy of the contractor's safety measures in, on, or near the construction site.
2. The Contractor shall contact the Utility Notification Center of Colorado (UNCC) (811) or (1-800-922-1987) for the location of underground gas, electric, telephone, cable, water, sewer, and storm sewer three (3) business days prior to the commencement of construction. The contractor shall also be responsible for contacting any Tier II Utilities.
3. All materials and workmanship shall conform to the latest edition of the City of Woodland Park Engineering Specifications except where alternates have been designed into the project and approved by the City Engineer or appointed representative. All work shall be subject to inspection and approved by authorized City of Woodland Park personnel.
4. All new water mains twelve (12") inches or less shall be PVC pressure pipe with rubber ring joint gaskets or high density polyethylene (HDPE) with heat fusion welded joints, unless otherwise specified. PVC pipe shall conform to the latest edition of AWWA C900 and HDPE pipe shall conform to the latest edition of AWWA C906. Pipe O.D. shall be equivalent to ductile iron pipe sizes (DIP).
5. Fire hydrants shall be limited to the following manufacturers, or approved equal, approved in writing by the City Engineer or appointed representative, and shall be painted according to the latest edition of the City of Woodland Park Engineering Specifications prior to acceptance.
  - Waterous – 5¼ inch Pacer Fire Hydrant, with 7½ foot bury, conforming to AWWA C502 standards.
  - Mueller Company – 5¼ inch Centurion, with 7½ foot bury, conforming to AWWA C502 standards.
  - Clow – 5¼ inch Medallion, with 7½ foot bury, conforming to AWWA C502 standards.
6. The Contractor shall furnish to the Design Engineer all field modifications and other changes to the approved construction drawings for inclusion in the "as-built" drawings. The "as-built" drawings will be certified/stamped and signed by the Professional Engineer before submitting to the City of Woodland Park.

7. There shall be a minimum of seven (7') feet of cover over all water mains and service lines to finished grade.
8. A pre-construction meeting must be held between the Contractor and City of Woodland Park personnel prior to beginning any construction activities or after construction activities have been interrupted for three (3) months or longer or if there was a change of the Owner/Contractor.
9. The Owner/Contractor shall be responsible for cleaning nearby public streets of mud or debris due to construction activity initiated by said contractor on a daily basis or as otherwise directed by authorized City personnel.
10. All trenches and excavations must meet compaction requirements per Chapter 7 of the Engineering Specifications. Compaction testing shall be conducted by the contractor's geotechnical firm on all trenches and excavations. The frequency of the tests shall be as approved by the City Engineer or appointed representative.
11. The Contractor shall have one signed copy of these approved plans and one copy of the appropriate design and construction standards and specifications on jobsite at all time.
12. The Contractor shall coordinate with gas, electric, telephone and cable TV utility suppliers for installation of all utilities. Minimum cover for all non-City utilities in public rights-of-way shall be 30 inches.
13. The Contractor shall control the water installation using construction staking provided by a licensed surveyor. Water lines shall be staked for line and grade. Cut sheets shall be provided to the City inspector prior to construction of the waterline. The cut sheets shall include dimension ties to all valves.

### **2.1.2 MAIN SIZE, WATER PRESSURE**

The water distribution system shall be designed to meet the maximum hourly water demand plus fire flow requirements. Fire flow requirements shall be determined in accordance with criteria in the latest City adopted edition of a nationally recognized fire code. Where in the opinion of the City Engineer or appointed representative and the Chief of the Northeast Teller County Fire Protection District (NETCFPD), other well-recognized criteria for determining fire flow requirements would result in a more accurate calculation of the requirement for a particular situation, such criteria may be accepted. Calculations using such criteria shall be prepared by a registered professional engineer in the State of Colorado competent in the field of fire protection and submitted to the City Engineer or appointed representative and the Chief of the NETCFPD for approval.

During peak demand and fire demand, the residual water pressure shall not be less than 20 psi at any point in the water distribution system. No main extensions shall be allowed which create or add to a situation where current demands do not maintain 20

psi, except where in the opinion of the City Engineer or appointed representative; such main extensions are not a primary contributor to an already substandard situation. The velocity of the water in the water system shall not exceed 15 feet per second. All fire hydrants are the property of the City of Woodland Park. No private fire hydrants will be acceptable. All fire hydrants shall be located within a street right-of-way or be provided with an appropriate easement. A complete Fire Flow Analysis shall be submitted for all water main extensions unless an exception is specifically approved by the City Engineer or appointed representative. That analysis shall show design parameters used to calculate maximum hourly flows and used to determine minimum fire flow requirements. The analysis shall include a plan drawn to scale of the study area showing existing and proposed mains and hydrants. A copy of the hydraulic computer program inputs and outputs shall be included. Design parameters, including pipe sizes, hydrant elevations, residual water pressures and fire flows available at each fire hydrant shall be presented in table or schematic format.

In addition to the critical condition design, the following minimum conditions shall be met:

- The minimum diameter for water mains in residential areas shall be six (6") inches. Schools, shopping centers and high-density residential areas shall be looped with at least eight (8") inch diameter lines. Larger diameter feeder mains shall be located between distribution mains in general conformance with the City's master plan for water system expansion. These mains shall be looped to provide water from more than one source. In no case shall a line of less than six (6") inches in diameter be used to serve a fire hydrant. All water main extensions shall be designed in loops. These loops may be constructed in stages, but in each stage of construction the water mains must be sized to meet the total flow requirements of the land uses served within that stage. The water system shall be looped in such a way that dead-end lines may only be used when serving not more than twelve (12) residential units.
- Normal operating pressure should be between 40 to 150 psi. High elevation areas which cannot maintain the minimum 20 psi pressure stated above shall be served by a pump station and storage tank. Area in-line service booster pump systems will not be permitted. Low elevation areas with normal operating pressure of over 150 psi shall be equipped with pressure reducing stations to reduce pressures into the normal operating range.

### **2.1.3 FIRE HYDRANTS**

Normally, the number of fire hydrants required and the spacing of hydrants shall be determined by the criteria of the latest edition of the City approved fire code. Whenever possible, fire hydrants shall be placed on one side of the street, rather than on alternating sides. Fire hydrant locations shall be selected to maximize visibility whenever reasonable. It is preferable to install fire hydrants at street intersections. Fire hydrants shall not be located within ten (10') feet of a curb inlet, gas meter, telephone

pedestal, or electric pedestal. Whenever possible, fire hydrants should be located at least 40 feet from building walls.

The number and location of fire hydrants should be mutually agreed upon by the City Engineer or appointed representative and the Chief of the NETCFPD.

#### **2.1.4 PUMP STATIONS, STORAGE TANKS, PRESSURE REDUCING STATIONS, HIGH PRESSURE MAINS**

Pump stations, pressure reducing stations, water storage tanks, and mains which have static pressures of over 150 psi shall be considered as special features and will be dealt with on an individual case basis. The size, capacity, location, and type of each of these facilities shall be approved by the City Engineer or appointed representative. Telemetry equipment approved by the City and compatible within the current City system shall be required. Auxiliary chlorination equipment shall be included in the design and construction of new pump stations where determined to be appropriate by the City Engineer or appointed representative. The City will retain the option of requiring particular brands and models of equipment to reduce parts inventory and improve system efficiency and ease of operation.

Water storage tanks shall be sized based upon the following minimum residential design criteria:

Average Gallons Per Capita Per Day (GPCD)

Residential Density: 2.63 Persons/Dwelling Unit

Maximum Daily Usage: 2.2 x Average Daily Usage in the design area

Fire Flow: Usually 1000 to 3500 gpm. Flow shall be based on fire code criteria for the most critical structure in the design area.

Fire Flow Duration: For 1000 to 2499 gpm, 2 hours  
For 2500 to 3500 gpm, 3 hours

Storage tanks shall be designed in accordance with the latest editions of AWWA D-100; AWWA D-103; AWWA D-110 or AWWA D-115. Tank storage capacity shall be equal to fire flow plus the maximum daily usage for emergency storage plus 30 percent of the maximum daily usage. The City Engineer or appointed representative shall approve acceptable usage estimates for non-residential water uses (office, retail, industrial, etc.) in the design area. These usage estimates shall be added into the average daily usage calculations. The minimum capacity for any tank storage facility in any pressure zone shall be 250,000 gallons. This capacity may be divided between more than one (1) tank. Two (2) tanks are encouraged in any pressure zone to provide duplicity during periods of tank maintenance. Three (3) or more tanks are normally discouraged to avoid duplication of telemetry equipment, maintenance requirements, etc. Steel tanks shall have internal and/or external cathodic protection designed by a NACE International certified Corrosion Specialist in accordance with the latest edition of AWWA D-104. Unless otherwise approved by the City Engineer or appointed representative, pump stations serving tank storage facilities shall be sized so that

average run time for one (1) of the two (2) pumps shall be between two (2) and three (3) hours per day.

Before the warranty period begins for pump stations, storage tanks, and pressure-reducing stations, the City Engineer or appointed representative shall be supplied with three (3) complete sets of equipment operation and maintenance instruction manuals. Manuals shall contain full information for each item of equipment, including instructions for installation, start-up, operation, inspection and maintenance, lubrication schedules, parts lists, control or power circuitry, emergency procedures, and other pertinent data as applicable. If literature covers more than one (1) model, appropriate provisions shall be neatly identified.

Under a separate cover, two (2) copies of all pertinent shop drawings shall be submitted. Two (2) copies of all “as-builts” shall be stamped and submitted, as well as a reproducible Mylar copy of these “as-builts.” Specialty tools and spare parts as may be considered necessary shall be supplied.

Refer to Figures 2.5.20 and 2.5.21 for required design features for pressure reducing stations.

#### **2.1.5 ABOVE GROUND FACILITIES REQUIRED**

Pump stations, pressure regulating stations and similar facilities shall be constructed in appropriate above ground enclosures. Enclosures shall be heated, accessible for maintenance, designed to be resistant to unauthorized entry, constructed of materials not requiring excessive maintenance and designed to minimize negative visual impact on the neighborhood.

#### **2.1.6 AIR VACUUM RELEASE VALVES**

High points in the water system shall be equipped with combination air vacuum release valves to purge trapped air bubbles and prevent damaging vacuum conditions.

Refer to Figure 2.5.19 for required design features.

#### **2.1.7 LOCATION**

- A. **EASEMENTS:** All water mains shall be installed in dedicated street rights-of-way, or dedicated easements. Location for these water mains shall be six (6') feet from the centerline of the street. Water mains shall be installed in easements; either by plat or separate document when determined by the City Engineer or appointed representative, it is not practical to make such installation in a dedicated street ROW. No structures shall be constructed within these easements or ROW without prior written approval, including terms and conditions, as set by the City. The minimum width requirements for water main easements are 20 feet or

twice the depth of the pipe, whichever is greater. The pipeline shall be offset a minimum of five (5) feet from any property line. In the event two (2) utility lines share the same easement, the minimum width for the easement shall be 30 feet.

- B. Relation to other Utilities: Water mains shall be located a minimum distance of five (5') feet from utilities other than sanitary sewers. When other utilities are installed in the vicinity of an existing water main, they shall be installed a minimum distance of five (5') feet, except at crossings which shall be at angles of 45°.

### **2.1.8 WATER AND SEWER SEPARATION**

Water mains shall be located at least ten (10') feet horizontally from existing or proposed sewer mains. Where water mains cross sewer mains, the sewer main should be located at least 18 inches clear distance vertically below the water main.

- A. SANITARY SEWER LINE CROSSING OVER A WATERLINE. When there is less than 18 inches of vertical clearance between the bottom of the sanitary sewer and the top of the water main, the water main shall be ductile iron pipe, bedded in compacted granular material, a minimum of ten (10') feet on each side of the centerline of the crossing. In all cases, regardless of vertical clearance, the waterline shall be encased in reinforced concrete, a minimum of ten (10') feet on each side of the centerline of the crossing.

Refer to Figure 2.5.11.

- B. WATERLINE CROSSING OVER A SANITARY SEWER LINE. When there is less than 18 inches of vertical clearance between the bottom of the water main and the top of the sanitary sewer, the water main shall be ductile iron pipe a minimum of ten (10') feet on each side of the centerline of the crossing. In addition, the sanitary sewer shall be encased in concrete, a minimum of ten (10') feet on each side of the centerline of the crossing.

Refer to Figure 2.5.12.

### **2.1.9 AWWA STANDARDS**

All design criteria not specifically included in these specifications or detail sheets (for example, water tanks, booster pumps, etc.) shall conform to the latest revision of applicable AWWA standards or AWWA manuals.

### **2.1.10 BACKFLOW PREVENTION AND DEVICES**

Backflow prevention devices shall be provided on all new water services. Backflow prevention devices shall be installed by the customer on existing water services per the

Woodland Park Municipal Code when the service is upgraded or otherwise substantially modified, or when notified by the City as part of the City Program to eliminate backflow hazards. Generally backflow prevention devices shall remain in the ownership of the property owner who shall be responsible for the maintenance, testing, reporting and replacement of backflow prevention devices as required by federal, state and local requirements.

The City will provide a backflow prevention dual check valve integral to the water meter setter for single family residences. Dual check valves are prohibited for commercial application by the Colorado Cross-Connection Control Manual. The City will install such devices in existing residential services, as it deems necessary and shall replace or repair such devices as deemed necessary. All commercial applications shall have backflow prevention devices installed at the property owner's expense that meet the minimum requirements as outlined in the latest version of the Colorado Cross-Connection Control Manual.

### **2.1.11 CURVILINEAR WATER MAINS**

Curvilinear water mains requiring bending of the water pipe or deflection at a bell and spigot joint is not allowed. Water alignments requiring curvilinear designs may be designed using 3° formed couplings with straight pieces of water pipe between couplings. Using one (1) 20-foot length of pipe between each 3° formed coupling allows for a 400 foot radius. Using one (1) 10-foot length of pipe between each 3° formed coupling allows for a 200 foot radius.

## **2.2 MATERIALS**

### **2.2.1 MAINS**

- A. PVC pipe (preferred by the City of Woodland Park) shall conform to AWWA C900 Class 150 DR-18 for normal static pressures less than 150 psi and Class 200 DR-14 for normal static pressures between 150 psi and 200 psi. Pipe shall have gasket bell end joints.
- B. Ductile iron pipe (acceptable upon review by the City Engineer or appointed representative) Class 50 cement lined, conforming to AWWA C-151/A21.51-86 shall be used for mains greater than twelve (12) inches in diameter and/or carrying a normal static pressure over 200 psi but not exceeding 325 psi. A strongly adherent asphaltic coating one (1) mil thick shall be applied to the outside of the pipe. Interior cement lining shall conform to AWWA C-104. Joints shall be "push-on" except where "mechanical joint" is noted on the drawing. Push-on or mechanical joints shall conform to ANSI A21.11. The bolts for mechanical joint pipe shall be of Corten material.

- C. HDPE Class 200, ductile iron pipe size, pipe may be used for water transmission mains where taps are not needed or their numbers are minimized. Only heat fusion welded joints and taps completed in strict conformance with the manufacturer's written recommendations will be accepted.
- D. AWWA C900 Class 100 SDR-21 PVC pipe, asbestos/cement (Transite) pipe, and fiberglass/PVC composite pipe shall not be permitted in new water main construction. Mains composed of other types of materials shall not be installed without written approval of the City Engineer or appointed representative.

### **2.2.2 FIRE HYDRANTS**

Fire hydrants shall be Waterous Model WB 67-250, Mueller Super Centurion 200 Model A-423, Clow Medallion or any equal model as approved by the City Engineer or appointed representative with two (2) 2½ inch nozzles with National Standard Thread Number 743, and one (1) 4½ inch pumper nozzle with National Standard Thread Number 40524. The operating nut shall be a 1½ inch pentagon nut, open left (counter clockwise). All hydrant valves shall be placed on to the tee at the main. Placement of the valve within the limits of the curb or gutter or behind the curb is prohibited. The hydrant shall have a 5¼ inch valve opening. A six (6") inch mechanical joint isolation valve shall be provided. Hydrants shall be painted with high-gloss acrylic enamel in OSHA "Safety Red." Surface preparation and paint application shall be in accordance with the paint manufacturer's published instructions. Hydrant paint shall be Rustoleum 3700 DTM Acrylic Enamel in Rustoleum #3764402 Safety Red or equal as approved by the City Engineer or appointed representative. The stem shall be a minimum of 7½ foot bury. If an extender is required, its maximum length shall be two (2') feet. The height from finished grade to the breakaway flange of the hydrant shall be three (3") inches. Unless otherwise specified herein, hydrants shall be designed, manufactured and tested in compliance with the latest edition of AWWA C-502.

Refer to Figure 2.5.2 for additional detail.

Fire hydrant laterals shall be set at right angles to the street main. The hydrant shall be set at the end of the lateral and shall face the street unless otherwise required. No horizontal or vertical bends or offsets shall be used in installing fire hydrant laterals unless approved by the City Engineer or appointed representative. Under no circumstances shall any size or manner of tap be made on a hydrant lateral between the hydrant and the isolation valve.

Fire hydrant protection posts (bollards) shall be six (6") inch steel pipe, schedule 40 or heavier, or six (6") inch ductile iron pipe class 50 or heavier; six (6') feet long, filled with concrete, buried three (3') feet, and painted with high-gloss acrylic enamel in OSHA "Safety Yellow." Surface preparation and paint application shall be in accordance with the paint manufacturer's published instructions. Bollard paint shall be Rustoleum 3700

DTM Acrylic Enamel in Rustoleum #3744402 Safety Yellow or equal as approved by the City Engineer or appointed representative. Protection posts shall be required in areas where, in the opinion of the Design Engineer or City Engineer or appointed representative, the hydrant is vulnerable to damage from traffic or other hazards. Potentially hazardous areas include, but are not limited to, open parking lots.

Refer to Figure 2.5.3 for additional detail.

### **2.2.3 VALVES**

All valves four (4") to twelve (12") inch in diameter shall be resilient seat, bi-directional, wedge style gate valves, conforming to AWWA C-509 Specifications, with non-rising stem. Valves are to open left (counter clockwise), to have a two (2") inch square operating nut, with "O" ring stem seals and epoxy coated inside and outside. Waterous Series 500 or any equal model as approved by the City Engineer or appointed representative shall be used. Valves shall have Type 18-8 stainless steel body bolts and mechanical joints ends with Corten bolts and "O" ring seals. Valves shall be polyethylene wrapped.

All valves two (2") inches and smaller shall be Ford B22 ball type curb stops or equivalent as manufactured by Mueller, McDonald or Romac.

Valve boxes shall be 5¼ inch diameter slip type valve boxes, Castings Incorporated VBA-16-48 with cast iron lid, or any equal model as approved by the City Engineer or appointed representative. The word "WATER" shall be cast on all valve box covers. Debris caps, as manufactured by S. W. Services or approved equal, shall be installed in all valve boxes.

Refer to Figure 2.5.4 for additional detail.

### **2.2.4 FITTINGS**

All fittings necessary for junctions, changes of direction or size, outlets, connections, etc., to be used in the system shall be ductile iron fittings. All ductile iron fittings shall be a mechanical joint and shall conform to AWWA C-153, ANSI A21.53-88, or the latest revision thereto. Fittings shall be cement lined to conform to ANSI Specification A21.4-85 with a bituminous sealer. Corten bolts shall be used. Fittings shall be polyethylene wrapped. All fittings shall be pressure rated at 350 psi.

### **2.2.5 SERVICES**

- A. Direct taps shall not be permitted. Tapping Saddles shall be used in all cases. When tapping AWWA C-900 PVC class 150 and 200 pipe, wide band style brass or stainless steel strap saddles shall be used (Romac 2025 or any equal model as approved by the City Engineer or appointed representative). Taps in ductile iron Class 50 pipe shall be made using stainless steel repair clamp style tapping saddles with full wrap neoprene

rubber gaskets. Taps in HDPE pipe shall be made using heat fusion welded threaded bosses. When tapping Permastran pipe, stainless steel repair clamp style tapping saddles (Romac or any equal model as approved by the City Engineer or appointed representative) shall be used. Saddles for other types of pipe shall be approved by the City Engineer or appointed representative. Tapping machines shall be hand operated and manually driven; electric drill style tapping machines shall not be permitted. Taps shall be worked wet.

For new subdivisions the Contractor shall install taps one inch (1") and smaller. For existing lots that have not been stubbed out with a water service from the existing City water mains, the City will complete the tap for one inch (1") and smaller services. All taps larger than one inch (1") will be completed by a commercial tapping company designated and paid for by the Contractor or Owner/Developer, but approved and inspected by the City.

For new commercial subdivisions the Owner/Developer shall have the Contractor completing the water main into the subdivision install four (4") inch or six (6") inch service stub-outs to each lot so that potential fire sprinklers and domestic services can be served. These stub-outs shall have an isolation valve at the water main but no valve at the property line. The lot owner shall own these services lines from the valve at the main to the building.

- B. Corporation and curb stops shall conform to AWWA standards. 1½ inch and under shall have CC threads. Corporation and curb stops shall be approved by the City. A.Y. McDonald brass ball valves are the only acceptable corporation or curb stop type valves.
- C. Water service lines between the corporation and the meter set (¾ inch through two (2") inch only) shall be constructed of type K copper or 200 psi polyethylene tubing with stainless steel inserts and shall contain an expansion loop (goose neck). The "goose neck" must have seven (7') feet of cover or be laid horizontally in the trench. Water service lines shall be installed with a minimum of seven (7') feet of cover (from finished grade) at all points, including at the goose neck and ditch flowline. Where water service lines cannot be installed with seven (7') feet of cover due to existing conditions, and as approved by the City Engineer or appointed representative, the service line shall be insulated in accordance with Section 3.1.27 of these specifications. All service lines shall have a 12 GA insulated copper tracer wire made accessible from the service box and extending the entire length of the service line ending at the foundation wall. Water service lines over two (2") inches shall be ductile iron or other City approved material and shall conform to the applicable AWWA standards. The minimum diameter of service lines shall be ¾ inch.

Copper water service lines ( $\frac{3}{4}$  inch through two (2") inches only) shall have either straight or flared compression joints. No sweat joints shall be allowed underground; however silver solder joints are acceptable.

- D. All construction shall utilize McDonald Series 5607 steel service boxes. The top shall be set at final grade, adjacent to the property line, with the stem portion plumb.

For two (2") inch and larger curb stops, a regular valve box conforming to Section 2.2.3 shall be used. All lids shall be placed at final grade. In concrete, asphalt, and all areas subject to vehicle loads, a regular valve box top section conforming to Section 2.2.3 shall be used.

Curb boxes shall not be located within five (5') feet of any type of electric, telephone, or cable TV pedestal, or gas meter and ten (10') feet from the sewer line. The contractor shall coordinate placement of the curb stops with the utility companies to insure that a five (5') foot minimum separation is maintained.

- E. For new subdivisions water services for each lot shall be terminated 13 feet beyond the property line with a McDonald 5607 service box or other type as approved by the City Engineer or appointed representative. The location and depth of the end of each stub-out shall be accurately noted on the "as-built" drawings submitted to the City.
- F. All meters placed inside a structure shall be equipped with a remote readout which conforms to AWWA standards. Remote readouts shall be located in an accessible spot in the front half of the house. Meters shall be only a model as approved by the City Engineer or appointed representative and shall be installed horizontally. Meters and remote readouts shall be approved, sold, and installed by the City.

Refer to Figures 2.5.17 and 2.5.18 for additional details.

- G. All service lines shall have seven (7') feet of cover until the service line enters an area of the residence or building having a controlled temperature.

### **2.2.6 JOINT RESTRAINTS**

- A. Joint restraint shall be accomplished using concrete thrust blocks and/or "Megalug" mechanical joint restraint devices.
- B. Thrust Blocks: Concrete for thrust blocks (also referred to as reaction blocks) shall conform to Section 6.2. Concrete thrust blocks shall be provided at all taps larger than two (2") inches, bends, tees, reducers, fire

hydrants, cut and plugs, and all twelve (12”) inch and larger valves. The size, location, and shape of thrust blocks shall be provided by the Design Engineer and shall be located so that the weight and thrust is transferred to the competent, undisturbed soils outside of the trench. Pre-cast concrete thrust blocks are not acceptable. The Contractor shall be responsible for installing temporary thrust blocks to resist the anticipated thrust until the concrete has adequate time to cure. All thrust blocks shall be made of concrete having a 28-day compressive strength of not less than 4,000 psi.

Refer to Figure 2.5.7 for additional detail.

- C. Megalugs: Megalugs (or equivalent restraints), may be used in lieu of thrust blocks or reverse anchors in new construction under the following conditions:
1. Pipe material used is either PVC or ductile iron pipe.
  2. The City Engineer or appointed representative and the Utilities Department shall approve or reject the use of Megalugs for a specific project at or prior to the pre-construction meeting.
  3. Manufacturer’s specifications shall be adhered to in the use and installation of Megalugs.
  4. Megalugs shall be subject to the same warranty requirements as the thrust blocks or reverse anchors they are replacing.
  5. The Design Engineer shall submit design calculations that substantiate the length of pipe that will need to be restrained on each side of a bend, tee, and valve.

### **2.2.7 TRACER WIRE**

A number 12 AWG (insulated) copper tracer wire shall be installed with all new water main installations. Continuity (uninterrupted electrical conductance) of the tracer shall be maintained. Tracer wire shall be accessible at intervals of no more than 250 feet as measured along the pipe. Meeting the 250-foot interval requirement may require installation of an additional valve box for access to tracer wire. The top of the box shall be stamped with “Tracer Wire” for identification. Tracer wire shall be accessible at all fire hydrants and at all valve boxes except as noted below. Tracer wire does not have to be accessible at the fire hydrant isolation valve if it is accessible at the fire hydrant. Tracer wire is not required in more than two (2) valve boxes in any intersection. When blow-offs protrude above ground level, it is preferable to leave the wire exposed beside the pipe. The tracer wire is required for all service lines and shall be accessible at the service box and shall extend from the service box to the foundation wall at final grade.

Refer to Figure 2.5.9 for additional detail and requirements.

## **2.2.8 POLYETHYLENE WRAP**

All ductile iron pipe and ductile iron fittings shall be wrapped with polyethylene. The polyethylene wrap shall be manufactured in accordance with AWWA C105, “Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids”, with the following additional requirements or exceptions:

The raw material used to manufacture polyethylene film shall be Type 1, Class A, Grade E-1, in accordance with ASTM D-1248. The polyethylene film shall meet the following test requirements: Tensile Strength - 1200 psi minimum; Elongation - 300% minimum; Dielectric Strength - 800 V/mil thickness minimum; Thickness – eight (8) mils minimum, nominal with minus tolerance not exceeding ten (10) percent of nominal; Melt Index - .04 maximum.

Refer to Figure 2.5.10 for additional information.

## **2.2.9 PRESSURE REDUCING STATIONS**

Areas with static pressures over 150 psi shall be equipped with pressure reducing stations. Pressure reducing stations shall be constructed above ground and housed in an all weather, secure building. Building materials and style shall be approved by the City Engineer or appointed representative. Pressure reducing stations shall be designed and stamped by a Professional Engineer registered in the State of Colorado.

Refer to Figures 2.5.20 and 2.5.21 for required design features.

## **2.2.10 ENCASEMENT AND BRIDGING OF PIPE**

Pipe encasement is required under certain conditions when water and sewer mains cross. When the sewer main crosses over the water main, the water main shall be installed as a Type I Crossing in accordance with Figure 2.5.11, being encased in reinforced concrete for a distance of ten (10) feet on either side of the point of crossing. When the sewer main is under the water main and less than 18 inches of vertical separation exists, a Type II crossing shall be installed in accordance with figure 2.5.12.

Under certain conditions when the water main is to be installed over or under an existing or proposed utility or structure, the City Engineer or appointed representative may require bridging or encasement of the pipe. If, in the opinion of the City Engineer or appointed representative, there exists the possibility of settlement of the pipe being installed over an existing utility or structure, then bridging of the pipe shall become necessary. This condition shall also apply to other underground utilities or structures being installed over existing water mains. The City Engineer or appointed representative shall determine the site and location of the concrete bridging.

Refer to Figures 2.5.11, 2.5.12, 2.5.13, and 2.5.14 for additional detail.

In cases where ductile iron pipe is cradled in a concrete structure as is shown in Figures 2.5.12 and 2.5.13, a ¼ inch thick neoprene rubber pad shall be installed to separate the pipe from the concrete. A pad is not needed when a ductile iron pipe is completely encased in concrete.

### **2.2.11 PIPE BEDDING MATERIALS**

The bedding of water mains shall conform to Section 7.4 and manufacturer's specifications.

### **2.2.12 AWWA STANDARDS**

All materials not specifically included in these specifications shall conform to the latest revision of applicable AWWA standards.

### **2.2.13 NEW PRODUCTS OR MATERIALS**

New water industry products or materials will be considered, if it is in the opinion of the City Engineer or appointed representative and the Utilities Department that the product or material has some merit. The City Engineer or appointed representative and the Utilities Department will establish the criteria for testing or evaluating the product and reserves the right to accept or reject any product or material regardless of the test results.

## **2.3 CONSTRUCTION**

The following is a recommended guideline for the completion of the water system construction. Any deviation from this guideline must be discussed at the pre-construction conference and approved in writing by the City Engineer or appointed representative. In addition to the requirements specified herein, ductile iron pipe shall be installed in accordance with the requirements of AWWA C600 and PVC pipe shall be installed in accordance with the requirements of AWWA Manual M23–PVC Pipe Design and Installation.

### **2.3.1 RESPONSIBILITY FOR MATERIAL**

- A. **RESPONSIBILITY FOR MATERIAL FURNISHED BY CONTRACTOR.**  
The Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work.
- B. **RESPONSIBILITY FOR MATERIAL FURNISHED BY THE CITY.** In emergency situations, materials that cannot be purchased from private

suppliers may be obtained from the City when in stock. Price shall be at the City's cost plus 15 percent for administration and stocking. Requests for materials should be submitted to the City.

- C. **RESPONSIBILITY FOR SAFE STORAGE.** The contractor shall be responsible for the safe storage of material furnished by or to him and accepted by him and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

### **2.3.2 HANDLING AND STORAGE OF MATERIAL**

- A. **HAULING.** All materials furnished by the contractor shall be delivered and distributed at the site of the contractor.

All pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe shall not be skidded or rolled against pipe already on the ground. Pipe shall not be dragged across sharp objects or abrading surfaces.

- B. **UNLOADING AT WORK SITE.** In distributing the material at the work site, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Do not off-load or store material in the improved portion of right of way. Do not leave pipe on uneven surfaces for a prolonged period of time. PVC pipe shall be protected from ultraviolet light when left exposed. Pipe that is shipped to the site having significant discoloration on the pipe surface is generally considered to be evidence of ultraviolet damage and may be reason for rejection and removal from the project. It is the responsibility of the contractor to protect the pipe from ultraviolet damage during storage at the job site.
- C. **CARE OF PIPE COATING AND LINING.** Pipe shall be so handled that the coating and lining will not be damaged. If any part of the coating or lining is damaged, the repair shall be made by the contractor at his expense in a manner satisfactory to the City Engineer or appointed representative.
- D. **COLD TEMPERATURES.** PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care shall be used in handling and installing PVC pipe during cold weather.
- E. **STORAGE.** Care shall be taken to store pipe and fittings to maintain the condition intended by the manufacturer. To prevent damage and

deformation, PVC pipe shall be stored on level ground for even support. Pipe stored outside shall be protected from ultraviolet light in accordance with the manufacturer's recommendations. Pipe that is more than two (2) years old as evident by the manufacturer's pipe labeling will not be permitted. Hydrants shall be stored with the "shoe" down or wrapped sufficiently to prevent materials from getting into hydrant.

### 2.3.3 ALIGNMENT AND GRADE

**GENERAL CONDITIONS:** The water main shall be installed according to manufacturer's installation recommendations and installed per the approved engineering plans. The road template, which is comprised of the following cross section symmetrical about the centerline: from the center line 12 foot of asphalt; 30 inch curb and gutter section; minimum six (6') foot flat graded section; slope graded to catch point, shall be rough graded to within +/- 0.5 foot (verified by Surveyor if needed) before water installations can proceed. Deviations for fill areas are acceptable if approved by the City Engineer or appointed representative. A minimum of seven (7') feet of cover must be maintained at all times. Street right-of-way and/or property line and lot corner points must be set and in visible evidence before water installations can proceed. Easements outside the standard right-of-way must be set and in visible evidence before water installations are allowed to proceed. Offset stakes, where necessary for alignment and grade, shall be set by the contractor. Any replacement of stakes shall be at the expense of the contractor.

- A. **DEVIATIONS CAUSED BY OTHER STRUCTURES.** Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration is required, the City Engineer or appointed representative shall have the authority to allow a deviation from the line and grade of the structures and/or the removal, relocation and reconstruction of the obstructions.
- B. **CAUTION IN EXCAVATION.** The contractor shall contact utility locating service at 1-800-922-1987 or 811 at least three (3) working days prior to starting work. The contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair and/or cost of repair of such structures when broken or otherwise damaged. The contractor shall also be held responsible for the prompt notification of the proper authorities should any damage occur or service be interrupted.
- C. **SUBSURFACE EXPLORATIONS.** Whenever, in the opinion of the Contractor, Design Engineer, or City Engineer or appointed representative, it is necessary to explore and excavate to determine the location of existing underground structures, the contractor shall make explorations and excavations for such purposes.

- D. DEPTH OF PIPE. The top of the pipe shall be laid to a minimum depth of seven (7) feet and a maximum depth of nine (9) feet from finished surface unless otherwise approved by the City Engineer or appointed representative. The City Engineer or appointed representative retains the right to have any portion of the water main potholed, at the contractor's expense, to insure adequate cover, if he has reason to believe that depth of cover may be inadequate.

#### **2.3.4 EXCAVATION AND PREPARATION OF TRENCH**

Excavation and preparation of trench shall be performed in accordance with Title 7 - Excavation in the Public Right-Of-Way.

#### **2.3.5 LAYING**

- A. LOWERING OF WATER MAIN MATERIAL INTO TRENCH. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece 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. Proper implements, tools and facilities satisfactory to the City Engineer or appointed representative shall be provided and used by the contractor for the safe and efficient performance of the work.

If damage occurs to any pipe, fittings, valves, hydrants or water main accessories in handling, the damage shall be immediately brought to the attention of the City Engineer or appointed representative. The City Engineer or appointed representative may prescribe corrective repairs or rejection of the damaged items.

- B. INSPECTION BEFORE INSTALLATION. All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Spigot ends shall be examined with particular care, as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the City Engineer or appointed representative who may prescribe corrective repairs or rejection. Ductile iron pipe and fittings shall be inspected to insure that the asphaltic coating has not been damaged or otherwise removed. Repairs to damaged coatings may be done using a brush-on coal tar or asphaltic coating approved by the City Engineer or appointed representative.
- C. CLEANING OF PIPE AND FITTINGS. All lumps, blisters and excess coating shall be removed from the bell-and-spigot end of each pipe. The outside of the spigot and the inside of the bell shall be wiped clean and dry and be free from oil and grease before the pipe is laid. Dirt and any

other materials must be removed from barrel of pipe before laying. Any foreign material inside the pipe must be removed by swabbing or another method accepted by the City Engineer or appointed representative before the pipe or fitting is installed. Flushing alone shall not necessarily be considered the only method of cleaning pipe before it is placed into service.

- D. **LAYING OF PIPE.** Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying crew cannot put the pipe into the trench and in place without getting soil into it, the City Engineer or appointed representative may require that before lowering the pipe into the trench, a heavy tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home with a slow steady pressure without jerky or jolting movements and then brought to correct line and grade. The use of backhoes, excavators or other mechanical equipment to push home pipe is prohibited. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. All necessary precautions shall be taken to prevent dirt from entering the joint space. No wooden blocking shall be left at any point under the pipeline.

Field bending or joint deflection of PVC water pipe will not be permitted. High deflection coupling joints shall be used to obtain the desired horizontal curve for PVC pipe. However, where mechanical joint fittings are used deflection shall not exceed the manufacturer's recommendation for the given pipe diameter. Joint deflection of ductile iron pipe and fittings shall not exceed the manufacturer's recommendations for the given pipe diameter.

At times when pipe laying is not in progress or the pipe is left unattended, the open ends of pipe shall be closed by a watertight plug or other means approved by the City Engineer or appointed representative.

- E. **CUTTING OF PIPE.** The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. Cutting method used shall be in accordance with the pipe manufacturers recommendations.
- F. **BELL ENDS TO FACE DIRECTION OF LAYING.** Pipe shall be laid with the bell ends facing in the direction of laying, unless directed otherwise by

the City Engineer or appointed representative. Where pipe is laid on a grade of ten (10) percent or greater, the laying shall start at the top and shall proceed downward with the bell ends of the pipe upgrade.

- G. JOINT RESTRAINTS. Joint restraints shall be used where pipe is laid on a grade of 14 percent or greater.
- H. UNSUITABLE CONDITIONS FOR LAYING PIPE. No pipe shall be laid when, in the opinion of the City Engineer or appointed representative, trench conditions are unsuitable. These may include water in the trench, unstable soil conditions and/or inadequate safety measures.
- I. BRIDGING OF PIPE. Concrete bridging may be required by the City Engineer or appointed representative under certain conditions when the water main is to be installed over or under an existing or proposed utility or structure. If in the opinion of the City Engineer or appointed representative, bridging of pipe is necessary to avoid settlement of pipe being installed, this shall become necessary. This condition shall also apply to other underground utilities being installed over existing water mains. The City Engineer or appointed representative shall approve the design, size and location of concrete bridges.

Refer to Figure 2.5.13 for additional detail.

In certain instances, the City Engineer or appointed representative may require the complete concrete encasement of water mains. The size and location of these encasements shall also be approved by the City Engineer or appointed representative.

Refer to Figure 2.5.14 for additional reinforced concrete encasement detail.

- J. INSULATION BETWEEN DIFFERENT METALLIC PIPE MATERIALS. Whenever it is necessary to join ductile iron pipe with pipe of dissimilar metal, a method of insulating against the passage of electric current (Dielectric connection) shall be provided and shall be approved by the City Engineer or appointed representative.
- K. ENCASEMENT PIPE. Wherever it is necessary to provide an encasement or sleeve pipe for the water main, the water main shall not be inserted into the encasement or sleeve pipe without providing City approved insulating skids for each joint of the water main. In addition, no encasement or sleeve pipe shall be installed without protecting the ends of the pipe with approved manufactured end caps which will deter sand and debris from entering, but at the same time will allow water to escape from the encasement or sleeve pipe. Encasement pipes shall be

protected both inside and out with corrosion resistant materials having a bituminous base. Encasement or sleeve pipe size, length, type and sidewall thickness shall be included in the project design and approved by the City Engineer or appointed representative.

- L. **INTERRUPTION OF SERVICE.** No valve or other control on the existing system shall be operated for any purpose by the contractor. City employees will operate all valves, hydrants, blow-offs and curb stops. A minimum of 24 hours notice shall be given to the City prior to any proposed activity requiring operation of the above mentioned installations.

### **2.3.6 JOINING OF ANY MECHANICAL JOINT PIPE**

- A. **GENERAL REQUIREMENTS.** The general requirements already set forth shall apply except that where the terms “bell” and “spigot” are used they shall be considered to refer to the bell and spigot ends of the lengths of mechanical joint pipe.
- B. **CLEANING AND ASSEMBLY OF JOINT.** The last eight (8) inches outside of the spigot and inside of the bell of the mechanical joint fitting shall be thoroughly cleaned to remove oil, grit, and excess coating or other foreign matter from the joint. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the bell end. The rubber gasket shall be placed on the spigot end with the thick edge toward the gland. Broken or defective glands shall not be used.
- C. **BOLTING OF JOINT.** The entire section of pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell. Care shall be taken to locate the gasket evenly around the entire joint. The cast iron gland shall be moved along the pipe into position for bolting, all of the bolts inserted and the nuts screwed up tightly with the fingers, then tightened with a suitable wrench.

Torques for various sizes of bolts shall be as recommended by the manufacturers for the various type and size of bolts used.

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

- D. **PERMISSIBLE DEFLECTION IN MECHANICAL JOINT PIPE.** Whenever it is necessary to deflect mechanical joint pipe, the amount of deflection shall not exceed the maximum deflection specified by the pipe manufacturer. Long radius curves shall be constructed using preformed 3° couplings and straight lengths of pipe per Section 2.1.11.

### 2.3.7 JOINING OF ANY PUSH-ON JOINT PIPE

- A. GENERAL REQUIREMENTS. The general requirements already set forth shall apply except that where the terms “bell” and “spigot” are used they shall be considered to refer to the bell and spigot of the lengths of push-on joint pipe.
- B. VARIATIONS IN DIMENSIONS. There is only one nominal dimension of the spigot outside diameter and the socket inside diameter for each size of push-on joint pipe. Similar dimensions of the bell-and-spigot pipe may vary with the class of pipe for each size in existing lines. Therefore, care should be taken that the outside diameter of the push-on joint pipe being installed is the same; otherwise a special adapter to join the two (2) lines may be necessary.
- C. CLEANING AND ASSEMBLY OF JOINT. The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, and excess coating or other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket. Since different types of pipe take different types of rubber gaskets, it shall be the responsibility of the contractor to see that the proper type gaskets are installed and installed correctly.

A thin film of gasket lubricant shall be applied to the inside surface of the gasket or the spigot end of the pipe or both. Gasket lubricant shall be as supplied by the pipe manufacturer and approved by the City Engineer or appointed representative.

The spigot end of the pipe shall be entered into the socket with care to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device approved by the City Engineer or appointed representative. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured. Complete assembly instructions are available from the pipe manufacturer. The use of backhoes, excavators, or other mechanical equipment to push home pipe is prohibited.

- D. PERMISSIBLE DEFLECTIONS IN PUSH-ON JOINT PIPE. Whenever it is desirable to deflect push-on joint pipe in order to form a long-radius curve, the amount of deflection shall not exceed the maximum deflection specified by the pipe manufacturer.

### **2.3.8 SETTING OF VALVES AND FITTINGS**

- A. **GENERAL REQUIREMENTS.** Valves, fittings, plugs and caps shall be set and joined to pipe in the manner specified above for cleaning, laying and joining pipe. Valves will be blocked using only precast concrete blocks. No wood blocking shall be allowed.
- B. **NUMBER OF VALVES REQUIRED.** Three (3) valves shall be required on all tees. Four (4) valves are required on all crosses. Exceptions may be approved by the City Engineer or appointed representative.
- C. **VALVE BOXES.** A valve box shall be provided for every valve. Debris Caps, as manufactured by S W Services or approved equal, shall be installed in all valve boxes. Refer to Figure 2.5.4 for additional detail. 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  $\frac{1}{2}$  inch below the surface of the finished pavement or six (6") inches below grade in gravel drives. In untraveled utility easements, valve box covers shall be flush with the surface.
- D. **DEAD-ENDS.** All dead-ends on new mains shall be closed with ductile iron plugs or caps. All such dead-ends shall be equipped with suitable concrete anchors and blow-off facilities. Reverse concrete anchor and rod tiebacks are acceptable. Megalugs with concrete thrust blocks may also be used (Megalugs alone are not acceptable). All-thread rods used for reverse anchors shall be stainless steel.

The contractor shall furnish, install, and remove temporary blow-offs at locations shown on the drawings or designated by the City Engineer or appointed representative. Where indicated on the drawings, the contractor shall install permanent blow-offs. A permanent blow-off is defined as one that will be left in place at the completion of the work.

### **2.3.9 SETTING OF FIRE HYDRANTS**

- A. **LOCATION AND GRADE.** All fire hydrant locations shall be staked by the developer to include both location and grade. Offset stakes no further than 12 feet from the fire hydrant are acceptable. No obstruction of any kind shall be allowed within five (5) feet of a hydrant location.
- B. **POSITION.** All fire hydrants shall stand plumb and shall have the 4½ inch nozzle facing the street. The hydrant flange shall be placed vertically at three (3") inches above final grade.
- C. **CONNECTION TO MAIN.** Each fire hydrant shall be connected to the main with a six (6") inch branch controlled by an independent six (6") inch

resilient gate valve. A mechanical joint or swivel head tee shall be used and the valve shall be located at the main.

- D. FIRE HYDRANT DRAINAGE. Provisions to allow the hydrant barrel weep hole to drain freely shall be constructed with each fire hydrant. A minimum of 1/3 c.y. of ¾" to 1½" washed rock shall be used to create a drain area around the front and sides of the base of the hydrant and extending 12" above the flange between the base and the barrel. Plastic wrap shall not be placed within 6" of the weep hole. A geotextile filter fabric shall be placed below, above and entirely around the rock to prevent fine materials from filling the voids in the rock. This fabric and rock shall be placed in a manner and in a location which does not undermine or otherwise disturb the hydrant blocks below and behind the hydrant base. The area between the back hydrant block and undisturbed, solid native soil shall be filled with concrete to form a thrust block.

Refer to Figure 2.5.2.

If bends are needed to bring fire hydrant to a desired horizontal or vertical position, special concrete reverse anchors, and/or anchor pipe, or stainless steel all-thread tie back rods, or a combination of all of these along with an extension may be called for. Extensions longer than two (2') feet will not be acceptable.

- E. SERVICE LINES. Service lines are not allowed to be tapped onto the fire hydrant lateral at any locations.
- F. SEPARATION FROM SEWERS. Fire hydrants and laterals shall be at least ten (10') feet away from sewer mains and services.
- G. CLEAN UP. Clean up shall include compacting the ground around the fire hydrant to grade and then raking and seeding same. During the warranty period, the contractor is responsible for filling in any subsidence and bringing the ground surface back up to grade.
- H. PRIVATE FIRE HYDRANTS. Private fire hydrants are not allowed.

### **2.3.10 ANCHORAGE**

- A. ANCHORAGE FOR FIRE HYDRANTS. The bowl (also known as the shoe, foot piece, or bottom) of each fire hydrant shall be well braced against the unexcavated earth at the end of the trench with 18 inches x 18 inches x four (4") inches precast concrete blocks behind and beneath the bowl. Concrete shall be poured between the precast blocks and the end of the trench.

Refer to Figure 2.5.2 for additional detail.

- B. ANCHORAGE FOR PLUGS, CAPS, TEES, TAPS, BENDS, AND REDUCERS. Plugs, caps, tees, taps, bends, and reducers shall be provided with a reaction backing where necessary, by the use of concrete with a compressive strength of not less than 4,000 psi at 28 days. Backing shall be placed between solid ground and the fitting to be anchored, plastic bond breakers are to be in place prior to placement of concrete. The area of bearing on the pipe and on the ground in each instance shall be as shown on Figure 2.5.7 unless previously approved by the City Engineer or appointed representative. No wood shall be used as permanent blocking.

Anchorage blocks will be required for taps four (4) inches and larger. Thrust blocks will in all cases be sized and placed in a manner that will adequately transfer thrust reaction to solid undisturbed ground.

- C. MECHANICAL JOINT RESTRAINT FOR PVC AND DIP PIPE. Mechanical joint restraining devices may be used in lieu of thrust blocks on PVC and DIP piping systems four (4") inches through 12 inches in size and up to 150 PSI operating pressure for PVC and 350 PSI operating pressure for DIP. Restraint devices for nominal pipe sizes four (4") inches through 12 inches shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. The devices shall have a working pressure rating equal to that of the pipe on which it is used and must include a minimum safety factor of 2:1 in all sizes.

Joint restraint devices shall be installed in accordance with the manufacturer's written instructions. All joint restraint devices shall be wrapped with polyethylene in accordance with Section 2.2.8 of these specifications. Mechanical joint restraining devices shall be as manufactured by EBAA Iron, Inc., Uni-Flange, Inc. or approved equal.

- D. FORMING FOR CONCRETE. All forming for concrete thrust blocks and anchors will be done by bulk heading around the shape of the thrust block or anchor with burlap or reinforced paper sacks, which have been filled with sand or earth. Sacks will be of a size easily handled by the workmen when the sacks are full. Filled sacks used to form concrete blocks will be left in place in the trench and backfill will be placed around and over them in the usual manner. Any bolt heads or fittings must be left accessible when pouring concrete about them and must remain free of slopped concrete. If the fitting is to be covered completely upon direction of the Engineer, then the joint must be wrapped with polyethylene plastic sheet, which conforms to Section 2.2.8 of these specifications.

Refer to Figures 2.5.7 and 2.5.8 for sizes and other requirements.

- E. **CURING TIME FOR CONCRETE ANCHORS.** Minimum curing time for concrete anchors regardless of additives shall be 36 hours for anchors containing two (2) cubic yards or less, 48 hours for anchors containing more than two (2) cubic yards but less than six (6) cubic yards, and 72 hours for anchors containing more than six (6) cubic yards but less than twelve (12) cubic yards. Anchors containing more than twelve (12) cubic yards will be cured as directed by the Inspector. Curing time for anchors having flanged rods or other accessories embedded in them for tying pipe and/or fittings directly to the anchor will require approximately 25 percent additional curing time.

### **2.3.11 BACKFILLING AND COMPACTION**

Backfilling and compaction shall be performed in accordance with Section 7.5.

### **2.3.12 WATER SYSTEM REPAIRS**

Repairs to the water system shall be performed by or under the direct supervision of the Utilities Department. Materials and methods used shall conform to these specifications, AWWA standards, and shall be reviewed and approved by the City Engineer or appointed representative and Utilities Department.

### **2.3.13 SERVICE CONNECTIONS**

No water service connections shall be made until the water main has passed the pressure and disinfection tests and until the Engineer or Surveyor has set stakes delineating the final property corners. The location for the water service for each lot shall be identified in the field considering topography, trees to be retained, ten (10') feet separation from sewer service and five (5') foot separation from other utilities. Generally locations shall be determined by a representative of the City and a representative of the Owner. Property shutoff valves shall be installed at or just inside the lot line and the service shall be extended a minimum of 13 feet into the property.

### **2.3.14 SERVICE LINE DISCONNECTIONS**

Water Service lines to be replaced with new taps and service lines or for which use is to be discontinued for any other reasons shall be turned off at the corporation stop valve at the main and the service line pipe shall be physically disconnected from the valve and replaced with a cap.

## **2.4 TESTING**

### **2.4.1 TESTING**

The sterilization and flushing of water mains shall be performed in accordance with AWWA Standard C-651-86 and the following specification. Pressure/leakage testing shall be performed in accordance with AWWA Standard C-600 and the following specifications.

### **2.4.2 DISINFECTION**

The chlorination of the finished main shall be done prior to installation of service taps. Mains shall normally be chlorinated using calcium hypochlorite in tablet form. The calcium hypochlorite shall be placed inside each joint of pipe as the pipe is installed. When installation has been completed, the main shall be charged with water at such a rate that water velocity within the main shall not exceed one (1) foot per second (cfs). Care shall be taken to expel all air through fire hydrants, air release valves, or blowoffs. The contractor shall take all necessary precautions to prevent the flow of the strong chlorine solution into existing water facilities during all phases of the disinfection process. Only City Utilities Department employees shall be allowed to operate valves. All valves in the lines being disinfected, except those isolating the line from sections containing potable water, shall be opened and closed several times during the disinfection process.

The initial chlorine concentration of free residual shall be tested at the time the main is charged to insure at least 50 ppm. A second test shall be taken in 24 hours (or 48 hours if the water temperature is less than 41 degrees Fahrenheit), at which time the residual concentration shall be at least 25 ppm. Regardless of recommended doses to obtain these required chlorine levels, the installing contractor has the responsibility of assuring that adequate free chlorine residuals are achieved. If not achieved, the entire disinfection procedure shall be repeated until required chlorine levels are attained.

- A. **THE TABLET METHOD.** The tablet method of disinfection may be used for main extensions of up to 3,000 feet. Care must be taken to avoid allowing foreign material or trench water to enter the main. If these have entered the main, this method of disinfection may not be used. Tablets shall be attached to the top of each section of pipe. The top of the pipe shall be identified by the manufacturer's printed label which shall always face up. The adhesive used to fasten tablets shall be Permatex No. 1 or any equal product as approved by the City Engineer or appointed representative. Necessary chlorine levels are stated in the previous paragraph. Table 1 summarizes the number of tablets normally required to achieve adequate chlorine levels. Additionally, one 5-gram tablet shall be placed in each fire hydrant, hydrant lateral and other appurtenances.

**TABLE 2.1  
NUMBER OF HYPOCHLORITE TABLETS OF 5 GRAMS (3-3/4 grams  
available chlorine per tablet) REQUIRED FOR A DOSE OF 50 ppm:**

Length of Section, Feet	Diameter of Pipe in Inches					
	2	4	6	8	10	12
13 or less	1	1	2	2	3	5
18	1	1	2	3	5	6
20	1	1	2	3	5	7
30	1	2	3	5	7	10
40	1	2	4	6	9	14

- B. CONTINUOUS FEED OR SLUG METHOD. In special cases, the City Engineer or appointed representative may allow the use of the continuous feed or slug method of water main disinfection outlined in AWWA C-651.

**2.4.3 FLUSHING THE LINE**

When the chlorine test has been successfully completed, the line shall be flushed until the chlorine residual is less than two (2) milligrams per liter (or two (2) parts per million). Care shall be taken when flushing the pipeline to prevent erosion, the killing of desirable vegetation, property damage, and danger to the public. Water lines shall be flushed with a velocity of at least 2½ feet per second through the line. Flushing shall be performed prior to bacteria testing. The chlorinated water may be used later for testing other lines, or if not so used, shall be de-chlorinated, desilted and disposed of by the Contractor per applicable state and/or local regulations. The City will not be responsible for loss or damage resulting from such disposal.

**2.4.4 PRESSURE/LEAKAGE TEST**

After the pipe has been laid and backfilled, the pipe shall be filled with water and all air expelled from the pipe. If hydrants, blow offs, or air release valves are not available at high points, the contractor shall have the necessary taps made at all high points to expel the air. Plugs shall be inserted after the air is expelled.

Following the successful completion of the chlorine tests and flushing of the lines, a pressure/leakage test shall be performed by the contractor. The contractor shall furnish all equipment and materials necessary for the test and shall advise the City Engineer or appointed representative with a minimum of 24 hours notice of when the test is ready to be witnessed. The test shall run for three (3) hours. The test shall be monitored with a pressure gage located as close as possible to the lowest elevation point in the section of line being tested. The test pressure shall be at least 50 percent higher than the normal static pressure (or 100 psi, whichever is greater) at the low point and shall not vary by more than five (5) psi during the test period. At the end of the test period, the system shall be again pumped up to the pressure of the system at the start of the test.

The amount of make up water necessary to re-establish this pressure shall be carefully measured.

The allowable leakage for PVC pipe during the test period shall not exceed that given by the formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

This equation shall be used for pipe with mechanical joints or push-on joints. In this equation, L is leakage in gallons per hour, N is the number of joints in the section of line being tested, D is the nominal pipe diameter in inches and P is the average pressure in the line during the test in pounds per square inch. Tables 2.2 and 2.3 give typical values for leakage testing.

Makeup water used to pressurize the system shall be clean and properly chlorinated. Regardless of measured leakage or pressure drop, any visible leak shall be repaired before acceptance.

**ALLOWABLE LEAKAGE TABLES**

**TABLE 2.2 ALLOWABLE LEAKAGE FOR PVC PLASTIC PIPE WITH ELASTOMERIC JOINTS (U.S. Gallons per Hour)**

Nominal Pipe Size, Inches	Average Test Pressure in Line* - P.S.I.				
	50	100	150	200	250
	Allowable Leakage Per 1,000 Feet or 50 Joints				
4	0.19	0.27	0.33	0.38	0.43
6	0.29	0.41	0.50	0.57	0.64
8	0.38	0.54	0.66	0.76	0.85
10	0.48	0.68	0.83	0.96	1.07
12	0.57	0.81	0.99	1.15	1.28
14	0.67	0.95	1.16	1.34	1.50

The allowable leakage for gray and ductile iron pipe during the test period shall not exceed that given by the formula:

$$L = \frac{SD\sqrt{P}}{133,200}$$

This equation shall be used for pipe with mechanical joints or push-on joints. In this equation, L is the allowable leakage in gallons per hour, S is the length of pipe tested in feet, D is the nominal diameter of the pipe in inches and P is the average pounds per square inch.

**TABLE 2.3 ALLOWABLE LEAKAGE FOR GRAY AND DUCTILE CAST-IRON PIPE  
(U.S. Gallons per Hour)**

Nominal Pipe Size  Inches	Average Test Pressure in Line* - P.S.I.										
	100	125	150	175	200	225	250	275	300	350	400
	Allowable Leakage Per 1,000 Feet of Pipeline										
4	0.30	0.34	0.37	0.40	0.43	0.45	0.47	0.50	0.52	0.56	0.60
6	0.45	0.50	0.55	0.59	0.64	0.68	0.71	0.75	0.78	0.84	0.90
8	0.60	0.67	0.74	0.80	0.85	0.90	0.95	1.00	1.04	1.12	1.20
10	0.75	0.84	0.92	0.99	1.06	1.13	1.19	1.24	1.30	1.40	1.50
12	0.90	1.01	1.10	1.19	1.28	1.35	1.42	1.49	1.56	1.69	1.80
14	1.05	1.18	1.29	1.39	1.48	1.58	1.66	1.74	1.82	1.97	2.10

\*Note: For pipe with 18 foot nominal lengths. To obtain the recommended allowable leakage for pipe with 20 foot nominal lengths, multiply the leakage calculated from the table by 0.9. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

**2.4.5 BACTERIOLOGICAL TESTS**

After final flushing and before the water main is placed into service, a sample or samples shall be taken from the end of the line by the Contractor while being witnessed by the City Engineer or appointed representative. This sample shall be tested for bacteriologic quality by a City approved qualified laboratory and shall show the absence of coliform organisms. If the initial disinfection fails to produce satisfactory samples, disinfections shall be repeated until satisfactory samples have been obtained.

No water line shall be accepted, service tapped, or placed into service until it has been properly disinfected, flushed, pressure tested, and written evidence of satisfactory bacteriological tests have been received by the City of Woodland Park.