

CHAPTER 7

SANITARY SEWER

AND

WATER SYSTEM

STANDARDS

CHAPTER 7 - SANITARY SEWER AND WATER SYSTEM STANDARDS

A. GENERAL PROVISIONS

1. General Requirements

- a. All sanitary sewer and water system improvements shall conform to the requirements as described herein.
- b. It shall be the responsibility of the developer to construct any necessary improvements to serve the property. Such improvements may include extension of water and/or sewer lines, improvements to supply, treatment, storage and distribution facilities, and any additional facilities that may be required.
- c. All improvements shall meet or exceed minimum standards of design and construction of facilities, as required by these Standards. Any deviations from these Standards shall be approved by the Department of Public Works / Tehama County Environmental Health and certified by a Civil Engineer registered in the State of California.
- d. All plans and specifications for improvements shall be prepared by a registered civil engineer and shall be submitted to the Department of Public Works for approval. Plans and specifications shall be approved by the Department of Public Works / Tehama County Environmental Health prior to the commencement of any related construction. All construction shall be done by a licensed contractor.
- e. An encroachment permit shall be required for all work within the County rights of way.
- f. Where sanitary sewer or water mains are not aligned within County rights of way, a 20-foot minimum width easement shall be provided. Easements shall allow ingress and egress by maintenance personnel, vehicles and heavy equipment for the purposes of inspecting, maintaining and repairing facilities. In addition, an all-weather gravel road, 12-foot minimum width, shall be provided to all blowoffs, hydrants, air valves, manholes and similar facilities.

2. Approval and Ownership

- a. Prior to approval of sanitary sewer or water system improvements, the applicant shall submit, to the Department of Public Works, as-built plans, a certificate of completion, and all other items specified by the Department of Public Works/ Tehama County Environmental Health and shall pay all inspection, capital improvement, connection fees and other charges as established by the County.

- b. Prior to approval of any sanitary sewer or water system improvements, all facilities to be operated and maintained shall be dedicated to an entity acceptable to the County, along with all related rights of way and easements. The designated entity shall assume ownership of all water service facilities through the meter, including the meter box and cover. All facilities past the outlet side of the meter shall remain the property of the customer, and the maintenance and repair of the facilities shall be the responsibility of the customer. Likewise, the designated entity will assume ownership for all sewer facilities to the property line, including the cleanout. All sewer facilities past the property line shall remain the property of the customer, and the maintenance and repair of the facilities shall be the responsibility of the customer. The County shall assume no responsibility for facilities the County itself does not accept. Maintenance, repair and operation of all non-accepted facilities shall remain the responsibility of the owner and the County shall assume no obligations thereto.
- c. An agreement shall be executed by the applicant guaranteeing all dedicated facilities for a period of one year after acceptance by the designated entity against defects in design, materials and workmanship. The agreement shall require a bond in the amount of seventy-five (75) percent of the estimated construction cost of the improvements, unless waived by the Department of Public Works.

3. Fees and Costs

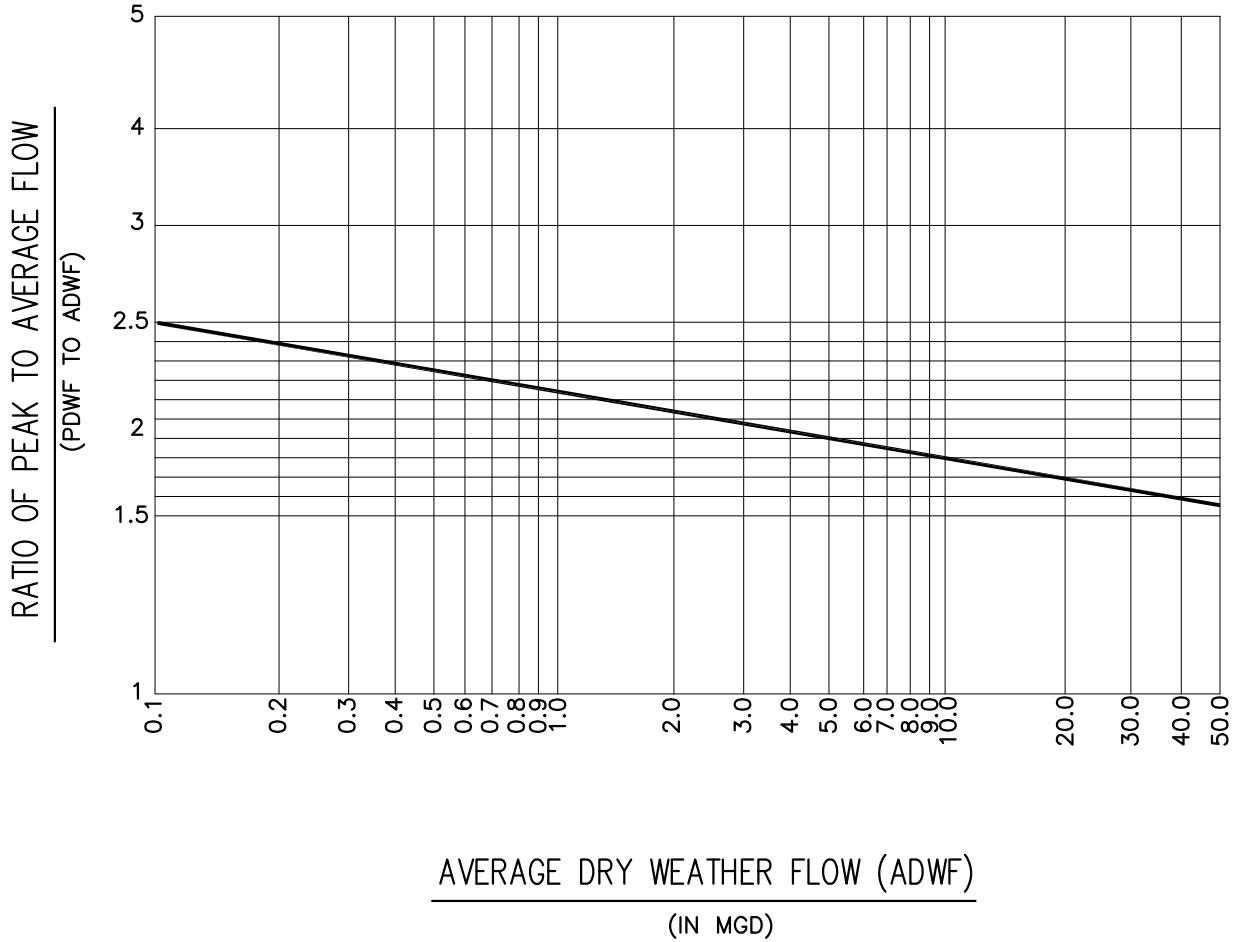
- a. A deposit for the Department of Public Works to review and inspect a proposed community water or sewage disposal system will be required. This deposit shall be in accordance with the Fee Schedule for Plan Check and Inspection Deposit in Chapter 2 of these development standards. Should the water or sewer improvements be part of a subdivision or other development project, only one deposit will be required in accordance with the cost of the entire project.

B. SANITARY SEWER DESIGN AND CONSTRUCTION CRITERIA

1. General Requirements

- a. Sewers shall meet the following design requirements except where specifically approved otherwise by the Department of Public Works. All construction shall conform to latest edition of Standard Specifications for Public Works Construction (SS), unless modified herein.

**FIGURE
7-1**



SEWAGE FLOW PEAKING FACTORS
(DOES NOT INCLUDE I & I)

SCALE: NTS DATE: 1/07

APPROVED BY:

GARY B. ANTONE, P.W.D.

PEAKING FACTORS

BY	DATE	REVISION

2. Acceptable Materials

- a. Trunks, mains, collectors, and sewer service connections (4" and larger) shall be PVC c solid wall SDR 35 per ASTM D-3034. Between a residential structure and the property line, laterals may be ABS conforming to ASTM D2751-83a.

3. Flow Criteria

- a. Design of sewer lines shall be based upon an average daily flow of 250 gallons per household equivalent per day times a peaking factor (Figure 7-1) plus 1,500 gallons per acre per day for stormwater and groundwater infiltration.

4. Resistance Factor

- a. Mains and collector sewer lines shall be designed with a minimum Manning coefficient of $n = 0.013$.

5. Minimum Slope

- a. The minimum slope allowed for sewer lines shall be:

**TABLE 7-2
MINIMUM ALLOWABLE SEWER LINE SLOPE**

DIAMETER	NORMAL MINIMUM SLOPE	ABSOLUTE MINIMUM	NOTE
6"	0.0065	0.0052	Absolute minimum slopes for larger sewers shall be based on 2 feet per second flow when full.
8"	0.0040	0.0033	
10"	0.0030	0.0025	
12"	0.0025	0.0020	

- b. Any dead end line with a length of 200 feet, or less, shall have a minimum slope of $S = 0.0065$.

6. Minimum Size

- a. The minimum size sewer line shall be 6-inch, except 4-inch may be used for laterals for individual services. For mains which serve C, I or MU general plan land use areas the minimum size shall be 8-inch. Sewer mains serving over 100 connections shall be 8-inch minimum. Where

master plans have been developed, the sewers shall be sized pursuant to such plans. When such plans are not available the sewer shall be sized on anticipated ultimate development in the tributary area.

7. Minimum Cover

a. Minimum depth of cover shall be as follows:

- 1) 5.0 feet over main line in street and 3.0 feet in cross country areas
- 2) 4.5 feet to invert of service connections at property line unless otherwise approved by the Department of Public Works.

8. Manhole Spacing

a. Manhole spacing and locations shall be as follows:

- 1) Sewers 6- to 8-inch : 400 feet maximum
- 2) Sewers 10- to 12-inch : 500 feet maximum
- 3) Sewers 15-inch and larger : 1,000 feet maximum
- 4) At all angle points in horizontal and vertical alignment (except where vertical curves are permitted)
- 5) At the terminal end of all lines (except where rodholes are permitted)
- 6) At all connecting sewers

9. Drop Manholes

a. Drop manholes will not be permitted unless approved by the Department of Public Works.

10. Rodholes

a. Rodholes will only be allowed on a sewer less than 200 feet long, and when the line serves four or less connections.

11. Final Testing

a. Prior to acceptance of the sewer, the lines shall be tested for leakage, cleaned, flushed, balled, mandrelled and televised. All final testing discussed herein shall be considered to be part of the work and shall be performed at the expense of the applicant.

12. Plugging

a. The downstream end of all new lines shall be plugged until the sewer is accepted by the Department of Public Works. The plug will be removed by

Department of Public Works personnel at the time the sewers are placed into operation.

13. Maximum Depth of Cover

- a. Mains shall not be designed with cover exceeding fifteen (15) feet from finish surface grade, without special permission from the Department of Public Works.

14. Acceptable Depth for Service

- a. Sewer depth shall be such as to obtain gravity service to all potential building sites using a minimum building sewer grade of one (1) percent (1/8-inch per foot) with the connecting service invert at the crown of the main sewer, and eighteen (18) inches to invert at the building site.

15. Crown Matching and Manhole Inverts

- a. Where pipe sizes increase, the crowns shall match in elevation and the manhole invert shall slope the diameter difference. On all manholes with other than straight through piping the manhole invert shall slope at least 0.17 foot.

16. Vertical/Horizontal Curves

- a. Vertical/Horizontal curves are not permitted.

17. Sewer/Water Main Separation

- a. Sewers shall normally be 10-foot minimum from water mains (clear dimensions). A 15-foot spacing between water and sewer, typically with sewer five (5) feet to one side of road centerline, is required for urban construction. In rural areas water and sewer main lines shall be outside the pavement edge on opposite edges of the road and should not lie directly below any surface drainage ditches. Sewers shall be separated from water mains pursuant to State Health Department Standards when lesser spacing is necessary for practical construction.

18. Property Line Cleanouts

- a. Property line cleanouts shall be installed on laterals on all sewer systems.

19. Laterals Connecting at Manholes

- a. Laterals may enter directly into manholes providing the invert is at the grade of the crown of the exiting sewer.

20. No Service Connections to Force Mains

- a. Laterals shall not be connected to force mains.

21. No Joint Service Laterals

- a. Joint use of a single lateral by two property owners is not permitted.

22. Individual Pumping Systems

- a. Use of individual sewage pump stations or sewage pumps in combination with septic tanks will not be permitted unless approved by the Department of Public Works.

23. Plans

- a. Sewer improvement plans shall be at 1"=100' or larger scale. A profile must be included. Ground elevations along the sewer, at lateral connection points, and at potential building sites, shall be based on field surveys or topographic maps prepared in accordance with National Mapping Standards with contour intervals of two (2) feet or less. Bench mark data, north arrow, scale, street names, invert elevations, property and right of way lines, existing utilities, sewer grades, sewer locations, and special construction features shall be shown on the plans.

24. Inspection

- a. All sewer construction shall be subject to inspection by the Department of Public Works. No work shall be performed without a minimum of five working days advance written notice to the Department of Public Works.

25. Compaction Testing

- a. Where facilities are to be dedicated to the Department of Public Works, compaction tests shall be conducted by a California registered Civil Engineering or Geotechnical Engineering Company, or by an approved materials testing laboratory. Tests shall be taken at a minimum of every 1,000 feet, and no less than two per job, and two additional tests shall be performed for each failing test. Test locations shall be selected by the Department of Public Works inspector. Compaction tests shall be done in compliance with California test methods 216 and 231.

C. WATER SYSTEM DESIGN AND CONSTRUCTION CRITERIA

1. General Requirements

- a. Water systems shall meet the following design requirements except where specifically approved by the Department of Public Works. All construction shall conform to latest edition of Standard Specifications for Public Works Construction (SS), unless modified herein and shall conform to Title 22, State of California Water Works Standards.
- b. Any subdivision that creates five (5) or more residential parcels with any parcel being one-half ($\frac{1}{2}$) acres or less in size shall be provided with a community water system (including fire hydrants) per the requirements of this section.
- c. All commercial and industrial developments/subdivisions (including those projects specified in Chapter 1 of these Land Development and Engineering Design Standards) which have no identified construction type, size or occupancy use shall provide a hydrant system that provides a minimum fire flow of 2,500 gallons per minute (gpm) for ten hours duration. The hydrant system shall be constructed per the requirements of these Land Development and Engineering Standards and the Emergency Water Standards of Tehama County Code, Chapter 9.14.
- d. Commercial and Industrial developments/subdivisions (including those projects specified in Chapter 1 of these Land Development and Engineering Design Standards) which have identified construction type and occupancy shall provide a fire flow amount and duration as determined using the applicable chapters and/or appendices of the current California Building and Standards Commission adopted edition of the California Fire Code. The hydrant system shall be constructed per the requirements of these Land Development and Engineering Standards and the Emergency Water Standards of Tehama County Code, Chapter 9.14.
 - 1) Exception: A reduction in required fire flow of 50 percent, as approved by the Fire Chief, is allowed when the building is a low or moderate hazard and is provided with an approved automatic sprinkler system. The resulting fire flow shall not be less than 1,500 gpm.
 - 2) Exception: A reduction in required fire flow of 25 percent, as approved by the Fire Chief, is allowed when the building is a high hazard and is provided with an approved sprinkler system. The resulting fire flow shall not be less than 1,500 gpm
- e. Construction type and hazard ratings shall be determined by the building official according to the applicable chapters and/or appendices of the

current California Building and Standards Commission adopted edition of the California Building Code.

- f. Modifications upward to the required fire flow may be required by the Fire Chief where special hazards exist indicating a need for additional flow.
 - g. Modifications downward to the required fire flow may be allowed by the Fire Chief where alternate fire protection measures approved by the Fire Chief justify a reduction.
2. Pipe Material
- a. Water main piping shall be either ductile iron pipe or PVC. Services three (3) inches and larger shall be ductile iron, or Class 150 C900 PVC. Services less than three (3) inches shall be copper, except services from 1-1/2 inches to three (3) inches may be Schedule 80 PVC.
3. Pipe Size
- a. All water main piping serving fire hydrants shall be 6-inch minimum.
 - b. Where master plans have been developed, the water main pipe size shall conform to the master plan. In the absence of a master plan, the pipe size shall be adequate to maintain a minimum pressure of 45 psi, and not cause the static pressure to drop more than 20 percent of normal under peak domestic demands at ultimate development. During fire flows, coincident with the maximum daily demand, residual pressures in the mains shall not fall below 20 psi.
 - c. When piping is needed only to accommodate service connections the size shall be large enough to have not more than 3 pounds per square inch of (psi) pressure loss when all services are operating at their maximum meter capacities. Minimum size shall be 2-inch.
4. Fire Hydrants
- a. Fire hydrant type and installation details shall conform to the requirements of these Land Development and Engineering Standards and the Emergency Water Standards of Tehama County Code, Chapter 9.14.
 - b. Minimum required fire flow and flow duration shall be in accordance with the Emergency Water Standards of the Tehama County Code, Chapter 9.14 and applicable chapters and/or appendices of the current California Building and Standards Commission adopted edition of the California Fire Code.

- c. Modifications downward to the required fire flow may be allowed by the Fire Chief.
 - d. Location of fire hydrants shall be in accordance with the Emergency Water Standards of the Tehama County Code, Chapter 9.14 and applicable chapters and/or appendices of the current California Building and Standards Commission adopted edition of the California Fire Code. The developer shall submit plans designating fire hydrant location to the Fire Chief for review and approval.
 - e. Fire hydrants shall not be located any closer than 40 feet to any structure unless approved by the Fire Chief. Center of the hose outlet on each hydrant shall not be less than 18" above final grade, 8' feet from flammable vegetation, no closer than 4' feet from a roadway nor farther than 12 feet unless approved by the Fire Chief.
5. Blowoffs
- a. Blowoffs shall be provided at all pronounced low points and on any main which dead ends more than 10 feet past a fire hydrant.
6. Requirements for Reduced Pressure Backflow Valves, Double Checks, And Detector Checks
- a. Backflow prevention using approved devices to control cross connections shall be accomplished pursuant to the State of California, Title 17, Regulations Concerning Cross Connections. Backflow prevention devices shall be installed on private property, but as close to the water meter connection as practical, and at locations which are available for inspection by, Department of Public Works, County and Health Agencies personnel. Backflow devices shall conform to the attached standard details when applicable.
 - b. Fire services may or may not require a backflow prevention device. Each such service shall be reviewed with respect to State of California Title 17, Assembly Bill 2503, and the memorandum from the State Fire Marshall's Office of December 10, 1984 regarding Cross Connection Control Requirements on Certain Classes of Fire Sprinkler Systems AB 2503.
7. Air Valves
- a. Air valves shall be combination types installed on all high points in the distribution system, except when an active service connection can be placed at the high point and there is no reason for air to accumulate at that high point other than during construction, repair, or total system pressure loss. An air valve shall always be placed at the first high point where air

could gain entry into the system from a well, a surface water supply, or from a hydropneumatic tank.

- b. Air valves shall have a minimum nominal size of 1-inch. Two-inch or larger sizes shall be used on mains larger than ten (10) inches in accordance with engineering principles as recommended by air valve manufacturers.
8. Valves
- a. Line valves shall be spaced generally no more than 1,000 feet apart (pursuant to California Waterworks Standards) except in rural locations or on pipelines larger than 12-inch in diameter. Valves should generally be placed at the beginning of all dead end runs and at intersections of gridded piping.
9. Minimum Cover
- a. Minimum depth of cover shall be 3.0 feet for water mains.
10. Plans
- a. Improvements plans shall be prepared by a State of California registered civil engineer in accordance with standard care of the industry. Plans shall be at 1"=100' or larger scale. High points shall be identified with an elevation. Plans shall include north arrow, scale, street names, property and right of way lines, existing utilities, connection details, location of pipeline within right of way, locations of all appurtenances including: services, valves, fire hydrants, air valves, blowoffs, and other special construction features.
11. Inspection
- a. All water system construction shall be subject to inspection by the Department of Public Works. No work shall be performed without a minimum of five working days advance written notice to the Department of Public Works.
12. Compaction Testing
- a. Where facilities are to be dedicated to the Department of Public Works, compaction tests shall be conducted by a California registered Civil Engineering or Geotechnical Engineering Company, or by an approved materials testing laboratory. Tests shall be taken at a minimum of every 1,000 feet, and no less than two per job, and two additional tests shall be performed for each failing test. Test locations shall be selected by the

Department of Public Works's inspector. Such tests shall be considered to be part of the work and shall be performed at the expense of the applicant. Compaction tests shall be done in compliance with California test methods 216 and 231.

D. TECHNICAL SPECIFICATIONS FOR TRENCH EXCAVATION, BACKFILL AND SURFACE RESTORATION

1. General

- a. Trench backfill above the pipe zone will be divided into the following classifications:
 - 1) CLASS AA@ BACKFILL: Use in all paved areas, graveled roads, shoulders, driveways, and at other locations as shown on the Plans. (See DWG. # 0959)
 - 2) CLASS AC@ BACKFILL: Use in all areas where Class "A" backfill is not utilized. (See DWG. # 0959)
 - 3) CONCRETE ENCASEMENT OR CONCRETE CAP: May be installed when there will be insufficient cover over the pipe for proper protection and prior approval has been obtained from the Department of Public Works. (See DWG. # 0959)

2. Materials

- a. Materials will be divided into the following classifications:
 - 1) TRENCH STABILIZATION MATERIAL: Clean imported gravel, free from clay balls and organic matter. Reasonably uniform gradation from fine sand to 2-1/2-inch maximum. Gradation shall be such as to fill all large voids with fines to prevent piping of native soils and prevent rapid and free movement of groundwater.
 - 2) PIPE BEDDING: Imported clean sand or well graded sand gravel mix, maximum size of 3/4-inch, free from all organic matter and debris; minimum sand equivalent of 28.
 - 3) IMPORTED GRAVEL BACKFILL: A reasonably well-graded silty sand or a well-graded silt, sand, and gravel mixture with a maximum particle size of three (3) inches and a minimum sand equivalent of 28. Aggregate base material may be substituted.

- a) Select native material meeting the above requirements may be used; however, proof that the select native materials meet these requirements will be required.
- 4) NATIVE BACKFILL: Material excavated from the trench. Free of roots and debris with no rocks larger than six (6) inches in greatest dimension.
- 5) AGGREGATE BASE: Aggregate base shall conform to requirements of Chapter 2, Section G-6, ΔAggregate Base.”
- 6) PERMANENT PAVEMENT: Permanent pavement shall conform to the requirements of Chapter 2, Section G-5, ΔAsphalt Concrete.@
- 7) TEMPORARY PAVEMENT: Temporary Pavement shall conform to Class "D2" crushed aggregate per SS 203-6 with SC-800 liquid asphalt per SS 203-2.
- 8) TACK COAT: Tack coat shall conform to SS-1h emulsified asphalt.
- 9) CONCRETE: All concrete for pipe encasements shall, at a minimum, conform to Class 420-C-2000 concrete per SS. 201-1. All concrete for cap in Class "A" backfill shall be Class D high early strength Portland cement concrete (7-sack Type III cement with two (2) percent calcium chloride by weight) Caltrans Standard Specifications.
- 10) SLURRY MIX: Slurry mix shall consist of a concrete mix with each cubic yard containing one sack of Portland cement, 12 gallons of water, 2,600 pounds of 3/8-inch rock, and 800 pounds of sand.

3. Workmanship

a. Workmanship will be divided into the following classifications:

- 1) EROSION CONTROL: All trench excavation, backfill and surface restoration shall comply with Chapter 4, Section D7, ΔErosion Control.@
- 2) EXCAVATION: Water entering the trench shall be controlled such that it does not interfere with bedding, backfill, and pipe placement. The depth of the trench for water piping shall be such as to maintain the minimum cover requirements and to conform to the general slope and grade of the existing terrain. No low spots or high spots will be allowed except at air valves, blow-off valves, where service connections are at high points in pipe profile, or instances where

unknown utility locations require variations from the slopes of the existing terrain. The depth of the trench for sewers shall be such that the pipe inverts may be laid at the Plan elevations.

- 3) OVER EXCAVATION: Any part of the trench extending below the proper grade shall be corrected with approved bedding material.
 - a) If soft, spongy, unstable, or other unsuitable material is encountered upon which the bedding material or pipe is to be placed, this unsuitable material shall be removed to a depth approved by the Department of Public Works and replaced with trench stabilization material suitably densified.
- 4) BEDDING: Bedding shall be defined as that material supporting, surrounding, and extending to 6 inches above the top of the pipe. Where it becomes necessary to remove boulders or other interfering objects at subgrade for bedding, any void below such subgrade shall be filled with bedding material.
 - a) Prior to pipe installation, bedding shall be placed to a minimum depth of 4 inches and then leveled and shaped to provide a firm base for the pipe. Bell holes shall be dug to allow the pipe to be supported by the bottom of the pipe barrel over its full length.
 - b) After the pipe has been laid and approved for covering, bedding shall then be placed and densified by hand tamping with an approved T-bar tool. Particular care shall be taken to provide solid backing against the underside of the pipe. The degree of compaction shall not be less than 90 percent of the laboratory maximum density. Bedding shall be placed in 8-inch maximum lifts. A vibrating plate compactor shall be used at the top of the bedding material, 6 inches above the top of the pipe. Bedding shall be placed in the manner described above, regardless of the class of backfill above the bedding material. For water mains the applicant shall then install the pipe finder tape in the trench as shown on the Standard Details.
- 5) BACKFILL: Class "A" backfill shall be placed in uniform layers not to exceed 8 inches in loose thickness and compacted to 95 percent relative compaction. Compaction shall be by mechanical tamping, vibration, or other approved methods. Compaction shall immediately follow the pipe backfill operation.
 - a) Class "A" native backfill shall be firmly compacted by mechanical means. No specific compaction requirements must

be met, however, any settlement of trenches during the one year guarantee period shall be promptly repaired at no additional cost to the Department of Public Works.

- 6) COMPACTION: Where tests indicate the compaction is unsatisfactory, the Department of Public Works may reject the work up to half the way to the next acceptable test.
 - a) The Department of Public Works may order additional compaction tests at any location where work has been found not to be in conformance with the Specifications. Frequency and other requirements for compaction testing is described in the Design Criteria.

- 7) TEMPORARY SURFACE RESTORATION: Refer to SS 306-1.5.1. Delete the last two paragraphs and add, "Temporary pavement shall be placed within 24 hours after completion of the backfill operation except for the road crossings (or other locations where two-way traffic is impaired) where temporary pavement or slurry mix backfill shall be placed to finish grade at the end of each working day. Where slurry mix backfill to finish grade is used rather than temporary paving, the trench surface shall be repaired with temporary paving as needed in the event of raveling. The temporary pavement mixture shall be placed and compacted per SS 302-5.4 and 302-5.5 except that the mixture may be laid cold. A tack coat will be required to the edges of existing paving per SS 302-5.3. No prime coat is required."

- 8) PERMANENT TRENCH SURFACE RESTORATION: Prior to the installation of permanent pavement the temporary pavement, if used, shall be removed and the subgrade prepared per SS 301-1 excluding Section 301-1.7. Aggregate base placement shall conform to SS 031-2.2 and 301-2.3. Permanent trench surface restoration shall, unless otherwise directed by the Department of Public Works, be applied to the limits of existing pavement. Existing pavement widths from centerline or reference points will be measured where the pipeline will be along the edge of the road. The paving will be replaced to these measured widths and any obliterated fog line striping. Pavement replacement adjacent to normal trench surface restoration may be ordered as well. Placement and compaction of the permanent pavement shall be in accordance with SS 302-5.4, 302-5.5, 302-5.6, and 302-5.7. The contact surface of all cold pavement joints, valve boxes, and the like shall be painted (tack coat) with Grade ss-1h emulsified asphalt immediately before the adjoining asphalt is placed.

- 9) SETTLEMENT: Settlement of pavement over trenches during the one year guarantee period shall be considered a result of improper or inadequate compaction of the backfill or base materials. All pavement deficiencies noted during the guarantee period shall be promptly repaired at no additional cost to the Department of Public Works, regardless of the acceptability of previous compaction tests.
- 10) CONCRETE THRUST BLOCKS: Concrete thrust blocks shall be installed at points along underground pressure piping where a hydraulic thrust exerts a force upon an unrestrained fitting. Thrust blocks shall conform to thrust block details as shown in DWG. # 0948 & 0949.

E. TECHNICAL SPECIFICATIONS FOR SANITARY SEWER

1. General

- a. Types of pipes will be divided into the following classifications:

1) TYPES OF PIPES:

- a) Sewer main and lateral pipe to the property line shall be polyvinyl chloride (PVC).
- b) Lateral pipe from the property line to the structure shall be PVC or ABS sewer pipe.

2. Materials

- a. Types of materials will be divided into the following classifications:

- 1) POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS: PVC pipe and fittings shall comply with ASTM D3034. The minimum standard dimension ratio shall be SDR 35. The joints shall be Ring-Tite manufactured by J-M, Fluid-Tite manufactured by Certainteed, or approved equal.
- 2) ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PIPE: ABS pipe and fittings shall conform to ASTM D2751-83a. All joints shall be solvent welded.
- 3) PIPE COUPLINGS: Pipe couplings used for joining different types of pipe shall be water-tight neoprene using stainless steel bands and shall be Fernco, Calder Co., or approved equal.

- 4) CLEANOUT BOXES: Protective boxes used for lateral cleanouts shall be Cook Concrete Products, No. 10T12 Traffic Box, Christy G-5, or equal. All lids shall have the word "SEWER" cast into the cast iron cover with prominent letters.
- 5) LATERAL TAPS: Lateral outlets on the main sewer shall normally be made with a tee or wye tee such that lateral horizontal alignment is 90E to main. When approved by the Department of Public Works, a tap may be made in the main using a hole saw. The coupon shall be removed and a Romac style CB saddle shall be installed pursuant to manufacturer's directions.
- 6) SEWER SADDLE: Sewer saddles used for joining laterals to main line sewers shall be water tight with adjustable stainless steel strap, bolts, nut, and washers. The body shall be ductile iron with corrosion resistant paint. The gasket shall be rubber compounded for sewer use. The saddle shall be Romac "CB," Sealtite, or equal. The applicant shall obtain approval from the Department of Public Works prior to installation.

3. Workmanship

a. INSTALLATION OF PIPE:

- 1) Before lowering into the trench, the pipe shall be inspected for defects, and all cracked or broken pipe shall be discarded. The ends and interior of the pipe shall be clean. Belled ends shall be laid upgrade. Handling of the pipe shall be accomplished in a manner that will not damage the pipe.
- 2) After lowering the pipe into the trench, the bell or coupling end and spigot shall be cleaned of any foreign matter. The joint shall be made in accordance with the manufacturer's printed instructions. Care shall be taken not to buckle or disturb previously laid pipe.
- 3) Each joint shall be inspected to insure that it is properly made before backfilling is done. Care shall be taken to prevent any dirt or foreign matter from entering the open end of the pipe. Where it is necessary to cut pipe, such cuts shall be neatly made. The laid pipe shall be true to line and grade and, when completed, the sewer shall have a smooth and uniform invert.
- 4) Connections to pipe stubs of a different pipe material shall be made with a suitable connector. Connectors must be approved by the Department of Public Works prior to installation.

- b. LINE AND GRADE TOLERANCE:
- 1) Sewers shall initially be installed within ∇ 1/4-inch (.02') of planned grade. Following backfill and within one year from construction, the sewer grade shall not vary more than ∇ 1-inch from grade and be such as to not cause stagnant water to pond with a depth of more than 12 inches.
 - 2) The horizontal alignment of sewers shall not deviate more than 2 inches from the planned alignment.
- c. TEES AND LATERALS: The exact location of laterals shall be approved by the Department of Public Works. Tee branches shall be fully supported by firm material. Pipe and bends shall be installed to the same standards as specified above. Rubber ring caps shall be installed at the ends of all laterals.
- d. CLEANING SEWERS: The pipe shall be cleaned in the following manner:
- 1) The cleaning shall be completed with an inflatable rubber ball, of a size that will inflate to fit snugly into the pipe, with a rope or cord fastened to the ball so the ball's position can be known and controlled at all times. The ball shall be placed in the last cleanout or manhole on the pipe to be cleaned, and water shall be introduced behind it. The ball shall be passed through the pipe with only the force of the water impelling it. All debris flushed out ahead of the ball shall be removed at the first manhole where its presence is noted. In the event cemented or wedged debris, or a damaged pipe shall stop the ball, the obstruction shall be removed.
- e. MANDREL TEST: All PVC sewers, except laterals, shall have a mandrel test in accordance with SS 306-1.4.6.
- f. WATER-TIGHTNESS TEST:
- 1) Tests for water-tightness shall be performed in the presence of the Department of Public Works' representative. The applicant shall furnish all labor, materials, tools, and equipment required to make the tests. No testing for final acceptance of pipe will be done until the trench has been fully backfilled and acceptably compacted to finish grade, or if the sewer is under pavement, to the pavement subgrade.

- 2) All sections of pipe shall be tested. Tests shall be made from manhole to manhole or manhole to rodhole. The sewer shall be complete with laterals, and trenches shall be backfilled prior to testing.
 - 3) Where leakage is in excess of the specified rate, the sewer shall immediately be uncovered, repaired, and retested until the amount of leakage is reduced to a quantity within the specified rate before the sewer will be accepted.
 - 4) The Department of Public Works will determine whether the test is to be by exfiltration or by infiltration. In most instances, an exfiltration test will be required.
- g. EXFILTRATION TEST: All sanitary sewers shall be tested with air unless approved otherwise by the County.
- h. AIR TESTING:
- 1) Air testing shall be done immediately following cleaning of the pipe. Air testing shall be performed in accordance with the Uni-Bell Plastic Pipe Association's "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe." See Figure 7-3.
 - 2) Air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches 4.0 pounds per square inch greater than the average back pressure of any groundwater that may submerge the pipe, except that the maximum pressure shall not exceed 9 psi. At least 2 minutes shall be allowed for temperature stabilization before proceeding further.
 - 3) The rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease from 3.5 to 2.5 pounds per square inch greater than the average back pressure of any groundwater that may submerge the pipe. Test sections with less than 625 square feet of internal surface area shall be considered acceptable when the leakage rate does not exceed 0.0015 cubic feet per minute per square foot of internal surface area. Test sections with greater than 625 square feet of internal surface area shall be considered acceptable when the leakage rate does not exceed 1.0 cubic foot per minute. See Figure 7-3 for maximum allowable test times that correspond to these limits.
- i. TESTING WITH WATER: When directed, testing with water shall be done by filling the upper manhole with water to a depth of at least 3 feet over the top of the pipe or groundwater level, whichever is higher, with the end

plugged at the lower manhole. The rate of leakage shall be determined by measuring the amount of water required to maintain the water level in the upper manhole. The test shall be maintained for a period of at least 2 hours. Leakage shall not be in excess of the rate of 20 gallons per inch of pipe diameter per 1,000 feet of pipe per day.

j. INFILTRATION TEST:

- 1) In the event that sufficient groundwater is present, as determined by the Department of Public Works, an infiltration test shall be required. In this case, the pipe shall be tested for water tightness by installing plugs at the upper end of the pipe and at the lower end on the exit side of a manhole. The rate of leakage will be determined by periodically removing and measuring the water accumulated at the lower manhole.
- 2) Leakage shall not be in excess of the rate specified for water testing by exfiltration.

k. TELEVISION INSPECTION: Upon completion of balling and cleaning, mandrel testing and leakage testing, and all backfill and compaction to grade, the main sewers (excluding laterals) shall all be television inspected. (Unless exempted for extensions smaller than 1,000 feet per Design Criteria.) During the television inspection, a continuous flow of water of from 1 to 10 gallons per minute shall be flowing in the sewer to allow observation of the profile and the determination of acceptability of any observed sags. Any sags greater than allowed, pipe offsets or broken pipe shall be repaired. Television inspection shall occur no sooner than 7 days after completion of the sewers and no less than 30 days following completion of all sewers for the project. Television inspection shall conform to Section 5 in the 1990 Edition of National Association of Sewer Service Companies (NASSCO).

**FIGURE 7-3
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015**

1	2	3	4									
Pipe Diameter (in)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
7-21 4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	

- NOTES:
1. If length of test section is less than the length for minimum time as shown in Column 3, then required test time equals maximum time shown in Column 2.
 2. If length of test section exceeds length for minimum time as shown in Column 3, then required test time is computed based on formula in Column 4 where $AL@$ = Length of pipe section in feet.
 3. The length of laterals connected to the test section is normally disregarded unless the test fails by a very small amount, then the test time can be recomputed using the appropriate formula.

B. TECHNICAL SPECIFICATIONS FOR MANHOLES

1. Materials

a. PRECAST CONCRETE MANHOLE SECTIONS:

- 1) All precast sections, including riser sections, cones, grade rings, flat slab tops, eccentric cones, all per ASTM C478. Grade rings shall be standard product, manufactured particularly for use in manhole construction, sized to fit the cones on which they are to be placed, and the wall height shall be not less than 2 inches high, nor more than 6 inches high.
- 2) All precast components shall have bell and spigot or tongue and groove ends.

b. MANHOLE FRAMES AND COVERS: All manhole frames and covers shall be casted iron conforming to ASTM Designation A48, Class 30. Each cover shall have the word "SEWER", "S", or "SANITARY SEWER", cast into the top with 2-inch high letters. Castings shall be of a consistently high quality and shall be free of material and manufacturing defects. Following cleanup and final machining, an asphaltic paint or similar protective coating shall be applied.

c. RODHOLE FRAME AND COVER: Cast iron, conforming to ASTM A48, Class 30. D&L Model H6530 (8"), H6520 (6"), Traffic Box, or equal, with the word "SEWER", "S", or Sanitary Sewer cast into the cover with prominent letters.

d. MORTAR: A proportion of one part Portland cement to two parts clean, well graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the surfaces. Mortar mixed for longer than 30 minutes shall not be used.

e. PRECAST MANHOLE BASES: Bases shall be a minimum of 60-inch diameter, 4 inches of concrete below outlet invert with No. 4 horizontal reinforcing bars at 6 inches on center, as manufactured by E.W. Cook Co., Teichert, Inc., or equal. Riser sections in pre-cast bases shall have wall reinforcement equal to standard manhole risers, plus additional reinforcement at openings.

f. WATERSTOPS: Waterstops shall be neoprene rubber gaskets with multiple fins and a stainless steel cinch band.

- g. MECHANICAL RUBBER SEAL (MRS): Mechanical rubber seal (MRS) shall be used at all connections to existing manholes. The MRS shall be a rubber boot type coupling using only rubber, stainless steel or PVC compounds as manufactured by Calpico Co. LinxSeal, KOR-N-SEAL Company, Millford, NH (603/673-8680), PSX by Press Seal Gasket Corp., Ft. Wayne, IN (219/483-0521), Z LOK XP by A LOK Products, Tullytown, PA (215/945-5600), or equal. The internal cavity between the pipe and the structure on the inside of the structure shall be filled with polyurethane caulk (Vulkem, Sikaflex, or equal) flush to the interior surface.

2. Workmanship

a. CAST IN PLACE CONSTRUCTION:

- 1) Manholes shall be constructed only when the temperature is above 32°F. All work shall be protected against freezing. Water shall be removed from the excavation and the excavation maintained "dry" during construction of the manhole and during the time required for the concrete or mortar to develop sufficient strength to resist rupture by groundwater pressure. All pipes connected to manholes shall have a joint within two pipe diameters of the manhole wall.
- 2) Manhole inverts shall be formed as shown in the Standard Details, either by laying pipe through and cutting out the top portion before completion of the base of the manholes or by forming "U" shaped channels in the concrete base slab. Cut edges of pipe laid through the manhole shall be fully covered by concrete when the manhole invert is complete. The finished invert shall be smooth and true to grade. No mortar or broken pieces of pipe shall be allowed to enter the sewers.
- 3) A groove shaped to match the tongue of the first precast concrete riser section of the manhole shall be formed in the base slab. A circular metal form suited to the particular precast manhole manufacturer's joint shall be used to form the groove.

b. PRECAST CONSTRUCTION:

- 1) Except as specified herein, all precast manhole sections and grade rings shall be set in joint sealing compound. Joint sealing compound components shall be applied in the field.
- 2) The top joint between the frame and the first grade ring shall be set with mortar for adjustment of the final cover elevation. Mortar joints shall not be more than 2 inches thick. Excess mortar shall be trimmed flush.

- 3) Joint sealant shall be applied in accordance with the manufacturer's recommendations to the surfaces shown on the Plans. Surfaces receiving joint sealant shall be dry and cleaned of all oil, grease, and loose particles. Sealant shall be applied to the previously placed manhole section.
 - 4) The upper manhole section shall be placed immediately after placing sealant. All excess joint sealant forced out of the joint on the inside of the manhole shall be removed or troweled smooth.
 - 5) After completion of the manhole, all plugs shall be completely removed from the sewers and all loose material shall be removed from the manhole.
- c. LATERAL SEWER CONNECTIONS: Direct connections to manholes shall be installed with the crown of the lateral sewer pipe 4 inches higher than the crown of the downstream main sewer pipe. The manhole invert shall be channeled for lateral sewers in the same manner as for main sewers.
- d. PIPE STUBS: Pipe stubs for future connections shall extend 1-1/2 to 2 pipe diameters beyond the concrete base and shall be plugged with standard gasketed plugs in couplings or caps.
- e. CONNECTION TO EXISTING MANHOLES:
- 1) The connection shall be made in such manner that the modified manhole is equal to a new manhole in appearance and performance. A channel approximately two (2) inches larger all around than the connecting pipe shall be cut in the existing manhole base. The rough cut channel shall be finished to its final smooth and uniform shape with mortar.
 - 2) Particular care shall be taken to obtain a watertight joint where new pipes must penetrate existing manholes. Pipe openings shall be core drilled. A mechanical rubber seal and then mortar shall be installed inside of manhole at cavity. The mechanical rubber seal shall have stainless steel bolts and nuts. Any other method of penetration shall be approved by the Department of Public Works.
- f. WATER-TIGHTNESS TEST:
- 1) Rodholes shall be tested for water-tightness along with the sewers to which they are connected.
 - 2) All manholes will be visually inspected by the Department of Public Works; there shall be no evidence of leakage of water into any manhole from outside sources or any imperfections which allow such

leakage. All manholes shall be tested for water-tightness by the applicant and observed by the Department of Public Works. The test shall be made, with all connecting pipes plugged, by filling the manhole with clean water to within two (2) inches of the bottom of the cast iron frame. The leakage rate for a 4-foot diameter manhole shall not exceed 0.25 gallons per hour per foot of depth or 2.0 gallons per hour, whichever is less, over a test period of not less than one hour. (NOTE: Two gallons per hour leakage is a drop of about 1-inch in a 24-inch diameter grade ring.) Allowable leakage rates will be proportionately increased for manholes with diameters greater than four (4) feet.

- 3) Visible leaks in a manhole that are observed during the one year guarantee period shall be suitably repaired as approved by the Department of Public Works.

C. TECHNICAL SPECIFICATIONS FOR WATER MAIN PIPE AND APPURTENANCES

1. Materials

- a. WATER MAIN PIPE: Water main pipe four (4) inches through twelve (12) inches in diameter, unless otherwise shown, shall be polyvinyl chloride (PVC) or ductile iron (DI). Two-inch and smaller piping shall be copper tubing except where otherwise approved by the Department of Public Works.
- b. POLYVINYL CHLORIDE PIPE (PVC):
 - 1) Polyvinyl chloride pipe (PVC) shall be manufactured, tested, and marketed in accordance with AWWA C900 and shall be Class 150, SDR 18, unless otherwise approved by the Department of Public Works.
 - 2) PVC pipe smaller than 4-inch in diameter shall be Schedule 40 thickness class conforming to ASTM 1785. Pipe joints shall be solvent welded. Fittings shall be Schedule 40 solvent weld-type conforming to ASTM D2466.
 - 3) All fittings for 4-inch and larger PVC pipe shall be either cast iron or ductile iron conforming to ANSI A21.10 (AWWA C110) and cement mortar lining and bituminous coated ANSI A21.4 (AWWA C104) and ANSI A21.6 or ANSI A21.51. As an option for mechanical or push on joint, fittings shall conform to AWWA C153. Buried fittings shall be wrapped in polyethylene film conforming to AWWA C105.

- 4) Fittings for 4-inch and larger PVC pipe may be either mechanical joint or a push-on joint such as Tyler or equal.
- 5) PVC pipe shall not be stored or handled in a manner that will permit exposure to sunlight or high temperatures for an extended period.

c. CAST IRON AND DUCTILE IRON PIPE AND FITTINGS:

- 1) Ductile iron pipe shall conform to SS 207-9.2.1 and SS 207-9.2.2 and AWWA C151. Ductile iron pipe 4 inches and smaller shall be Class 51, and 6 inches and larger shall be Class 50, except where thicker classes are required for threading flanges or other connections.
- 2) Pipe shall be furnished with flanged, mechanical joint, or push on joint for the type of connections.
- 3) Fittings shall be either cast iron or ductile iron fittings manufactured in accordance with SS 207-9.2.3 (AWWA C110). Mechanical joint or push on joint may, as an option, conform to AWWA C153.
- 4) All pipe and fittings shall be cement lined and sealed; and coated in accordance with the SS 207-9.2.4 (AWWA C104).
- 5) The pressure rating, metal thickness class, net weight of pipe without lining, length of pipe, and name of manufacturer shall be clearly marked on each length of pipe in accordance with AWWA C106.
- 6) All flanges shall be flat faced ANSI Class 125. Flange gaskets shall be full-faced, 1/8-inch thick rubber.
- 7) Flanged pipe shall be shop fabricated to the exact lengths required so that no field cutting or threading is required, except where flanged coupling adaptors are specified.
- 8) Bolts and nuts for all underground connections shall be low alloy steel in accordance with the ASTM A193 Class B or AWWA C111 such that the bolts are cathodic to the coupling. Bolts and nuts for aboveground connections shall be either low alloy steel as specified above or cad-plated bolts in accordance with ASTM A307 Grade A or B. Bolts and nuts inside valve boxes and submerged or damp locations shall be 304 stainless steel.
- 9) Where Ductile Iron or Cast Iron Pipe and Fittings are buried, the pipe and fittings shall be encased with polyethylene film conforming to AWWA C105.

- d. PIPE FINDER TAPE: Pipe finder tape shall be a mylar encased aluminum foil bearing the words, "CAUTION: buried waterline below." Printing shall be under the mylar (reverse printed) so as to be readable through the clear mylar. Surface printing on the tape is not acceptable. The tape shall be blue in color, 2 inches wide, Lineguard Detectable Marking Tape, Type 3 Allen Systems, Inc. Detecto-Tape, or equal.
- e. LOCATION WIRE: Location wire shall be solid copper No. 10, insulated, soft drawn wire.
- f. COPPER TUBING: Copper tubing shall be per ASTM B88, Type K. Soft annealed copper shall be used without fittings where buried or encased in concrete. Size as specified on the Plans or in these Specifications shall be OD of the tubing. End connections shall be compression style.
- g. GALVANIZED STEEL PIPE (GSP):
 - 1) Galvanized steel pipe shall be hot dip galvanized, standard weight (Schedule 40) conforming to ASTM A120, unless otherwise approved by the Department of Public Works. Fittings shall be hot dip galvanized malleable iron Class 150 conforming to ASTM A388 and ANSI B16.3. Connections shall be threaded in accordance with ANSI B2.1, Pipe Threads, unless otherwise approved by the Department of Public Works.
 - 2) A coating shall be applied to the exterior surfaces of all buried galvanized steel pipe and fittings. The coating shall be conformable polyethylene-backed butyl tape, 35 mils thick, such as Polyken 930 manufactured by the Polyken Division of the Kendall Company, Chicago, Illinois; Tapecoat Company, Inc., Evanston, Illinois; or equal. The surface preparation, type of primer and application, and application of tape, including the amount of lap, shall be in accordance with the recommendations of the coating manufacturer.
- h. SERVICE SADDLES: Service saddles shall be all brass or bronze when used on PVC pipe, 360-degree support around the pipe. Service saddles for blow-off assemblies and for use on ductile iron pipe shall have ductile iron bodies with two Type 304 stainless steel straps. All service saddles shall be designed for use on PVC pipe or DI pipe, whichever is being used. Brass or bronze service saddles shall be Mueller, Ford, or equal. Service saddles for blow-off assemblies shall be Romac 202S, Ford, or equal.
- i. GATE VALVES, TWO INCHES AND LARGER: Gate valves, two inches and larger, for use on PVC, DI and GSP piping shall be 125-pound, totally encapsulated disk, solid wedge resilient seat valves, with non-rising stem, open to left, and have O-ring seals. Exposed valves shall have handwheel operators. Buried valves shall have two-inch square wrench nuts. The

valves shall be Mueller, Waterous, or equal, and conform to AWWA C509. Buried gate valves shall be wrapped in polyethylene film pursuant to AWWA C105.

- j. VALVE BOXES AND MISCELLANEOUS BOXES: Valve boxes and miscellaneous boxes shall be provided for all valves placed underground. Boxes shall be traffic rated with cast iron ring and cover and concrete main body, Brooks Products, Inc., No. 1-RT, Christy G-5, Cook Concrete Products No. 10T12, or equal. Boxes shall be furnished with 8-inch PVC pipe (SDR 35 MIN) extension sleeves. The lid shall be marked "WATER." The bottom of valve box extensions shall be centered and cut to fit the valve and then sealed with polyurethane foam, mortar, or other approved sealant to prevent soil migration into the box extension.
- k. GATE VALVES, EXPOSED, TWO INCHES AND SMALLER: Gate valves, exposed, two inches and smaller, shall be 125-pound, wedge disk type, with non-rising stem, screwed connections, furnished with handwheel operators. Valves shall be bronze and shall open left. The valves shall be Powell No. 207, Crane No. 438, or equal. Use only bronze valves on copper piping.
- l. BURIED BUTTERFLY VALVES: Buried butterfly valves shall be tight closing, rubber seated, Class 150, in conformance with AWWA C504 and shall have a cast iron body and disk construction with stainless steel shafts and bearings requiring no lubrication. Valve ends shall be flanged mechanical joint or push on joint. Flanges shall have 125-pound facing and drilling. Valves shall be complete with a sealed reducing-type underground operator and 2-inch square operating nut. Valve operators shall be capable of withstanding an overload input torque of 450 foot pounds at full open or closed position without damage to the valve or valve operators and shall require 48 turns to change the valve setting from full open to full closed and shall be Dresser Model 450, Mueller Line Seal III, or equal.
- m. EXTENSION STEMS: Extension stems shall be provided for all buried valves set deeper than 3 feet to the operating nut. Extension stems shall be a minimum of 1-1/2 inches in diameter. Extension stems shall be Schedule 40 steel pipe, with a welded plate box at the bottom which fits over the valve operation nut, a set screw to secure the bottom box to the valve nut, have a 2-inch operating nut welded to the top of the stem, and extend to within 12 inches of the ground surface.
- n. CORPORATION STOPS: Corporation stops shall be bronze, full bore, sized per service line Mueller, Ford, Jones No. J-3403, or equal. End configurations shall be IPS, flare or pack joint.
- o. WATER METERS: Water meters for individual services shall be a Sensus Model SRSG, or approved equal, complete with one meter coupling on the

outlet for adapting to IPS pipe. Meters shall all read in gallons or cubic feet as specified by the Department of Public Works.

- p. ANGLE METER STOPS: Angle meter stops shall be bronze, as manufactured by Ford, Jones, Mueller, or equal, complete with padlock wings, flare nut suitable for copper tubing, and meter coupling nut and gasket for meters specified above.
- q. METER BOXES: Water boxes for meters shall be as follows:

**FIGURE 7-4
WATER BOXES**

METER SIZE	NOTE	BOX SIZE MINIMUM I.D.	COOK CONCRETE* BOX/VAULT #	Christy* Box/Vault #
5/8"x3/4"	(1,5)	103"x173"	B0.75	B9W/B9G Lid
1"	(1,5)	12"x20"	B1.0	B12 W/B12G Lid
12"	(1,5)	133"x24"	B1.5	B30 W/B30G Lid
2"	(1,5)	17"x30"	B2.0	B36 W/B36G Lid
3"	(2)	30"x48"	B4.0	B48
4"	(2)	30"x60"	B5.0	B52
6"	(3,4)	48"x78"	V4.0 6.5	R37P

*or approved equal

Notes:

- 1) Reinforced concrete cover with 5"x8" cast iron hinged reading lid.
- 2) Steel checker plate lids with 5"x8" or 10" round self closing reading lid centered over meter register. For 3" and 4" meters a two piece lid is required. For 6" meters a four piece lid is required.
- 3) Vault design for meters and associated equipment larger than 6" require the approval of the Department of Public Works. Size and depth should be adequate to allow access for maintenance and/or meter removal.
- 4) Vault design for combination domestic/fire detector meters shall meet manufacturers recommendations and shall require the approval of the Department of Public Works.
- 5) H-10 steel traffic lids shall be required for any box in driveways, parking areas, shoulders or areas with rolled curb.

- r. COMBINATION AIR RELEASE AND VACUUM VALVES: Combination air release and vacuum valves shall have cast iron bodies and covers and stainless steel floats, float guides, bushings, and level pins of stainless steel or bronze. Valves shall be designed for operating service to 300 psi, and shall be APCO, Crispin, or approved equal.
- s. COMBINATION AIR VALVE (CAV) ENCLOSURE/BOX: Combination air valve (CAV) enclosure/box shall be as follows:

Case 1 - **Above Grade Enclosure** - See Standard Detail W-21. (Available from Cook Concrete Products with precast concrete slab, or other fabricators)

Case 2 - **Below Grade Box**

**TABLE 7-7
BELOW GRADE BOXES**

VALVE SIZE	NOTE	BOX SIZE MINIMUM I.D.	COOK CONCRETE* BOX #	CRISTY* BOX #
2", 3" & 4"	(1,3)	17"x30"	B2.0	B36
6" & 8"	(2,3)	30"x48"	B3.0	B48

* or approved equal

Notes:

- 1) For 2", 3" & 4" valve box a one piece lid shall be required.
- 2) For 6" & 8" valve box a two piece lid shall be required.
- 3) Lids shall be solid reinforced concrete marked Δ Water,@ except when boxes are in driveway traffic areas or next to rolled curb and gutter, where H-10 steel traffic lids are required.

- t. BACTERIOLOGICAL SAMPLING STATION ENCLOSURE: Bacteriological sampling station enclosure shall be as follows:
 - 1) See Standard Detail W-13 for Materials and Plumbing Installation.
 - 2) See Standard Detail W-14 for Materials and Enclosure Design.
- u. BACKFLOW DEVICE ASSEMBLY BOXES, VAULTS: Backflow device assembly boxes and vaults shall be as follows:

1) Double Check (DC)

- a) Carson Industry Box No. 1419-13 w/No 1419-3 lid - :@ or 1" (DC)
- b) Carson Industry Box No. 1320-13 w/No 1320-3 lid - 12@ or 2" (DC)
- c) Carson Industry Box No. 1730-12B and lid - 3" or 4" (DC)
- d) Cook 6U vault or Christy R37 pit w/approved lid by Water Utility - 6" or 8" (DC)
- e) or equal

2) Single Check (SC)

- a) Christy B-40 w/B40D or equal.

v. BLOWOFF VALVE BOXES: Blowoff valve boxes for blow-off assemblies shall be Cook No. 2.0 meter boxes, Christy B36, or equal.

w. FIRE HYDRANTS:

1) Fire hydrants shall be waterous Pacer WB67, with oil reservoir, bronze seat ring, weather shield and bronze nut, mechanical attached nozzles, Mueller Super Centurion 200, Kennedy Guardian K-81A, or equal, equipped with chained nozzle caps. The fire hydrants shall have a 5-1/4 inch minimum hydrant valve, two 2-1/2-inch hose nozzles, and one 4-1/2-inch steamer nozzle. The operating nut shall be a 1-inch pentagon nut. The hose and steamer nozzles, operating nut, and direction of opening shall be per National Standard Specifications. The hydrant shall have a 42-inch bury to the bottom of the connecting pipe and shall have an automatically operated stop and drain. Fire hydrants shall conform to AWWA C502.

2) A 6-inch diameter lateral and gate valve conforming to these Specifications shall be provided from the main waterline to each hydrant.

x. FLANGED COUPLING ADAPTERS (FCA) AND FLEXIBLE COUPLINGS (FC):

1) Flanges coupling adapters (FCA) and Flexible Couplings (FC) shall be of the style and type recommended by the manufacturer and approved by the Department of Public Works. Steel couplings shall be fusion epoxy lined and coated (8 mil minimum thickness). All couplings shall be supplied with low alloy steel nuts and bolts per AWWA C111 or equal. Flanged coupling adapters shall be furnished and installed with adequately sized thrust protection anchor bosses and anchor studs unless thrust is restrained by concrete thrust blocks. The pipe shall be drilled for installation of the studs. Flanged coupling

adapters and flexible couplings shall be sized to be compatible with the pipe on which they are to be installed and shall be as manufactured by Dresser, Rockwell, or equal.

- 2) Buried flanged coupling adapters and flexible couplings shall be wrapped with polyethylene film per AWWA C105.

2. Workmanship

- a. All work shall conform to Plan details, the Standard Water System Details and the manufacturer's recommendations.
- b. Materials shall be handled in a manner that will not damage the material or its coating. Before installation, each article shall be inspected, and any damaged material discarded. Any damaged coating shall be repaired.
- c. The interior and ends of the pipe and appurtenances shall be clean. When it is necessary to cut pipe, such cuts shall be neatly made.
- d. Pipe and fittings shall be installed in strict conformance with the manufacturer's recommendations. Maximum pipeline joint deflections and minimum curve radii shall conform to these Standards and with published tables prepared by the manufacturers. Additional vertical angle fittings shall be installed where required to maintain conformance with the manufacturer's published tables on maximum pipeline joint deflections and minimum curve radii. Up to one additional coupling per 20-foot length of PVC pipe or in 18-foot length of DI pipe may be installed in lieu of an additional vertical fitting, provided the installation is in compliance with the manufacturer's recommendations.
- e. Pipes shall be laid with the bell end ready to receive the next pipe. Bell holes shall be dug and the trench bottom graded such that the pipe is supported along the barrel and not the bell.
- f. In addition to exercising extreme care to keep the inside of the pipe clear of dirt and debris during installation, temporary plugs shall be inserted or placed over all ends of the pipe except during periods of continuous observation such as during pipeline installation.
- g. PIPE CUTTING: All pipe shall be cut to fit accurately without damaging the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe.
- h. PIPE THREADS: Pipe ends shall be reamed to the full bore of the pipe. Threads shall conform to ANSI B2.1. In making up threaded joints, an accepted thread lubricant shall be applied to the male threads only.

- i. PIPE JOINTING: Pipe jointing for cast iron pipe shall conform to SS 306-1.2.6 and 306-1.2.8, respectively. Pipe jointing for PVC pipe shall conform to SS 306-1.2.9 or 306-1.2.10, as applicable.
- j. METALLIC PIPE COVERINGS: All buried ductile iron pipe, fittings, and valves shall be wrapped with polyethylene film per AWWA C105. All galvanized iron pipe shall be tape wrapped pursuant to the description under Materials in this section.
- k. FLANGED JOINTS: Flanged joints shall be square and watertight with even pressure on the gaskets.
- l. WATER SYSTEM TESTING: Upon completion of the installation of the water mains and appurtenances and all parts of the system shall be pressure tested in the presence of a representative of the Department of Public Works. Each section of water main between line valves shall be tested separately by closing the adjacent line valves and bringing the isolated section up to a test pressure that will cause the pressure at the lowest point in the isolated section to be at least 150 pounds per square inch or 50 pounds per square inch above the maximum working pressure, whichever is greater, and maintain at least that pressure for a minimum of one hour. At the end of the test period, the test pressure shall be at least equal to the starting test pressure in order to properly determine any leakage.
- m. Leakage shall not be in excess of 2 gallons per inch of diameter per 1,000 feet of pipe per 24 hours. Leakage shall be determined by pumping into the closed system from a barrel and maintaining the required pressure or by other means approved by the Department of Public Works. Where leakage is in excess of the specified rate, the amount of leakage shall be reduced to a quantity within the specified rate before the installation is accepted. In addition, all visible leaks shall be repaired.
- n. Where interconnections are made between an existing and a new system at other than existing isolation valves the interconnection piping between the existing system and the first new isolation valve will not have to be pressure tested. However, when these interconnections are made and pressurized, any noticeable leaks shall be corrected.
- o. Where the new system interconnects to an existing system at an existing isolation valve, the new system shall be either tested against the existing isolation valve or against a temporary thrust protected blind flange, cap or plug within 15 feet of the existing valve to test against.
- p. If the second option is used the final connection to the existing valve after the pressure test is completed will not have to be tested but any noticeable leaks shall be corrected.

- q. All Class 200 or SDR 14 8-inch piping shall be tested at 200 psi.
- r. STERILIZATION FOR COMPLETED WATERLINES: Sterilization for completed waterlines shall be done per AWWA C651-86, Section 5.2, Continuous Feed Method. Once the water system has been successfully hydrostatically tested, it shall be flushed of all dirt and debris. Following adequate flushing, the entire system shall be chlorinated by one of the following methods: sodium hypochlorite or calcium hypochlorite and water mixture. Chlorinating agent shall be applied at the beginning of the section adjacent to the feeder connection and shall be injected through a corporation cock, hydrant, or other connection ensuring treatment of the entire line. Water shall be fed slowly into a new line with chlorine applied in amounts to produce a residual of not less than ten parts per million in all parts of the line for a period of not less than 24 hours. During the chlorination process, all valves and accessories shall be operated.
- s. The tablet method of applying the chlorine as specified in AWWA C651-86 may be used. If this method does not provide adequate disinfection, chlorine shall be applied by one of the above described methods until acceptable bacteriological tests are obtained.
- t. After chlorination, the water shall remain in the pipeline, or be diluted until the chlorine residual has dropped to below two parts per million before it is flushed from the extremities of the system. Furthermore, it may be necessary to land apply the chlorinated water or otherwise dechlorinate the water in order to discharge it to any storm drain, drainage channel or surface water where damage could occur to fish or other aquatic life or in violation of any governmental laws or regulations. All of the pipeline shall then be drained and refilled with a bacteriologically acceptable water supply. The new pipeline shall then be tested for bacteriological acceptability as determined by a minimum of four test samples for coliform bacteria taken from Department of Public Works selected points in the pipeline. If such tests indicate contamination, the pipeline shall be disinfected again.
- u. At connections to the existing system where some sections of piping cannot be reasonably disinfected in the normal procedure, all new pipe, fittings, etc. shall be sprayed or swabbed inside and out with a strong (one to five percent) chlorine solution prior to installation and installed in a sanitary manner so as not to contaminate the system. Should contaminants such as dirt or dirty water be allowed to enter the existing piping, the existing water system shall be flushed and disinfected as required by the Department of Public Works.