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POTABLE WATER SYSTEM REQUIREMENTS

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SECTION II-A - DESIGN CRITERIA

II-A1. POTABLE WATER MAIN SIZING

Potable water mains shall be sized using the Hazen-Williams or Darcy-Weisbach formula. The design criteria to be used to determine the sizes of the mains in the distribution system shall be the values for the following parameters, which are given in the following sections:

1. Design water demand.
2. Pipe friction factor of pipe material.
3. Maximum velocity.
4. Minimum and maximum residual pressure in the main.

Each potable water main reach shall be sized to provide sufficient flow and pressure to meet at all times domestic, commercial demand, and fire flow. Potable water mains designed to serve future development shall also include capacity for future demands. Capacity for future demands shall be as determined by the District Engineer in accordance with the Water Master Plan.

II-A1-1. Design Water Demand

Potable water demand for the development shall be based on the maximum daily demand. Each pipe main reach shall be sized to supply maximum daily water demand of all the service connections being served by the reach based on the following criteria:

Table 1. Flow per Service for each Lot

Service	Maximum Daily Demand
Single family dwelling, residential	0.53 gpm/connection
Multi-family, residential	4.00 gpm/acre
Institutional areas	2.00 gpm/acre
Commercial areas	2.92 gpm/acre
Parks	2.11 gpm/acre

Table 2. Commercial and Institutional Buildings

Type of Business	Maximum Daily Demand
Hair care establishment	3.0 gpm/chair
Dental office	4.0 gpm/chair
Department store	2.0 gpm/employee
Groceries	3.0 gpm/employee
Drug store	5.0 gpm/establishment
Laundry	30 gpm/1,000 lbs clothes
Laundromat	8 gpm/washer
Meat market, supermarket	6 gpm/1,000 sq ft floor area
Motel, hotel	4.0 gpm/unit
Medical office	3.0 gpm/exam room
Restaurant: Seating service	2.0 gpm/table
Restaurant: Drive-in	0.2 gpm/car space
Theaters, movie houses	0.2 gpm/seat
Hospitals	4.0 gpm/bed
Nursing homes	2.0 gpm/bed

Table 1 shall be used when lot dimensions of establishments are determined and size of building design is not known.

Table 2 shall be used to determine flows when the type and size of business establishment or building design is known.

II-A1-2. Fire Flow Requirements

Fire flow requirements for the potable water distribution system shall be set forth by the local Fire District. For preliminary designs, fire flow requirement shall be in accordance with the criteria for fire flows quoted below:

Potable Water Distribution System Criteria for Fire Protection

Analysis and design of potable water distribution systems shall be based upon the following criteria:

1. Fire flow rates and duration

	Flow (gpm)	Duration (hours)
a. Single family residential (non-sprinklered)	2,000	2
b. Single family residential (sprinklered)	1,000	2
c. Multiple family residential (sprinklered)	3,000	3
d. Business and small commercial (sprinklered)	4,000	4
e. Major commercial (sprinklered)	4,000	4

Industrial and medium-to-large commercial developments shall require special evaluation on a case-by-case basis by fire department personnel using procedures as outlined in the Insurance Services Office publication, "Fire Suppression Rating Schedule," Edition 6-80.

2. Pressure

A minimum of twenty (20) psi residual pressure shall be maintained at the hydrant outlet under conditions of the required fire flow rate plus maximum daily demand.

II-A1-3. Combined Conditions

Potable water mains and transmission mains shall be designed for the combined total demand as tabulated below:

Water Mains without Fire Hydrants	**Design Combined Flow**
Residential Area	100 percent of maximum daily residential demand.
Commercial Area	100 percent of maximum daily commercial demand.

Water Mains with Fire Hydrant	**Design Combined Flow (or as directed by the local Fire District)**
Residential Area	100 percent of maximum daily residential demand plus 2000 gpm flow from each of the two (2) nearest fire hydrants.
Commercial Area	100 percent of maximum daily commercial demand plus 4000 gpm flow from each of the nearest three (3) fire hydrants.
Transmission Main	Conveyance flow plus maximum daily residential, commercial demand, and fire flow. Flows to be determined by District Engineer from Water Master Plan.

II-A1-4. Pipe Friction Factor

There are many factors and conditions affecting pipe friction factors and much research has been conducted to determine the amount of friction losses in pipe. Pipe friction factors vary over a wide range and designers and engineers will select different values based on individual judgment of the design conditions. For uniformity of design in the District, the values to be used in the calculation for the pipe friction factor are the following:

Pipe Formula	PVC Pipe	Cement Lined Ductile Iron Pipe	HDPE Pipe
Hazen Williams "C"	130	120	150
Absolute Roughness, ft	0.000005	0.000008	0.00007

II-A1-5. Maximum Velocity

Flow of water in the main is not constant and will continually vary from no flow to a maximum flow depending on the demand and other conditions. Due to the varying flow conditions, the pipe will be subjected to cyclic surging. Its magnitude shall be minimized to keep the stress of the pipe due to water hammer effects within the design strength of the pipe by limiting the allowable operating velocity of the main. The design criteria for the water velocity in the main shall not exceed the following:

Pipe Size	Maximum Velocity, fps		
	PVC	DIP Cement Lined	HDPE Pipe
14 and larger	--	15	7 (DR 11) 6.5 (DR13.5)
8-12	5	15	7 (DR 11) 6.5 (DR13.5)
6 and less	5	8	7 (DR 11) 6.5 (DR13.5)

Higher velocities up to a maximum of ten (10) fps may be allowed for PVC pipes by the District Engineer, in which case specific consideration shall be given to the design and operation of control valves, relief valves, and pumps when included in the potable water system.

II-A1-6. Potable Water Main Pressures

The mains shall be designed to have a minimum static pressure of fifty (50) psi at the highest point of the line. Under fire flow conditions, the main shall be designed to have at least twenty (20) psi measured at the hydrant outlet with the required fire flow.

II-A1-7. Minimum Size

Minimum size of potable water mains shall be eight (8) inches. Upon review and approval, the District Engineer may allow the use of a 6" main in small cul-de-sacs or dead ends with no fire flow requirements or hydrants.

II-A2. LOCATION OF MAIN

Potable water mains and their appurtenances shall be located in areas accessible to District personnel and maintenance vehicles and equipment for maintenance, repair, and servicing at all times. Mains shall be located within public right-of-way and easements. Potable water mains shall be located with the required horizontal and vertical separations from sewer lines in conformance with Section I-C5.

II-A2-1. Street

Potable water mains laid in streets shall be located about ten (10) feet from the street centerline and no closer to the face of curb than three (3) feet. In any case, mains shall be located so that excavation and repair of the main or its appurtenances will not encroach on private property.

II-A2-2. Building and Other Above-ground Structure Set Back from Mains

To minimize hazards to buildings and other above-ground structures when pressure mains are repaired, foundations or footings of buildings and other above-ground structures shall be set back a minimum of seven and one half (7.5) feet from the surface of the potable water main or recycled water main.

The installation of mains less than seven and one half (7.5) feet from the building or above-ground structure shall be subject to the approval of the District Engineer. In such cases, polyethylene wrapped DIP shall be used. No service connection to the water main is allowed within five (5) feet of the building foundation.

II-A3. LOOPING

Looping of potable water mains provides a grid layout or network of piping that provides increased reliability of a potable water supply system. Looping allows reaches to be supplied from each end of the reach, allows confining loss of service due to pipe breaks to small sections by valving, and allows repair and expansion of the system with minimum service disruption to customers. At loop connections, tee or cross fittings shall be used and valves installed at the main or branches. Cross fittings shall have four (4) valves; tee fittings shall have (3) three valves. Potable water mains shall be interconnected or loop-connected so that no reach shall exceed the following length:

Pipe Size	Maximum Unconnected Reach	
	Residential Area	Commercial Area
8-10 inch	1,200 feet	800 feet
12 inch and larger	1,500 feet or as required by Water Master Plan	1,200 feet

II-A4. DEPTH AND MINIMUM COVER

Potable water mains installed below ground shall be provided with a minimum four (4) foot cover.

II-A5. HORIZONTAL AND VERTICAL CURVES

In curved streets, the main shall follow the street curvature, and the alignment shall be planned to minimize crossing the street centerline. In general, horizontal and vertical curves shall be formed by pulling the joints, by bending the pipes, or by the use of fittings.

II-A5-1. Curves for PVC Pipe

PVC pipe shall not be deflected or bent into a curve without the approval of the District Engineer. Deflection shall not occur at the joint of the pipe.

If approved, PVC pipe may be bent in a true arc throughout its length. The maximum allowable bending offset for PVC pipe Class 200 shall be in accordance with the following:

Pipe Size	Maximum Deflection per 20 ft Pipe Length, Inches	Minimum Bending Radius, feet
4”	23	100
6”	16	150
8”	12	200
10”	9	250
12”	8	300

Note: Per Certainteed (Mfg) pipe.

II-A5-2. Curves for Ductile Iron Pipe

For PVC pipe larger than 12-inch diameter, maximum deflection or minimum bending radius shall be as recommended by the manufacturer.

Pipe Size	Angle of Deflections in Degrees-Minutes		Minimum Bending Radius, feet	
	Push-on Joint	Mechanical Joint	Push-on Joint	Mechanical Joint
6	5-0	5-40	206	185
8	5-0	4-15	206	245
10	5-0	4-15	206	245
12	5-0	4-15	206	245
14	5-0	2-50	206	365
16	5-0	2-50	206	365
18	5-0	2-25	206	430
20	5-0	2-25	206	430
24	5-0	1-55	206	540

II-A5-3. Curves for HDPE Pipe

Heat fused HDPE pipe may be cold bent during installation. Allowable bend radius shall be as specified below:

HDPE DR	Minimum Allowable Bend Radius
DR 11.0	Greater than 25 Times Pipe O. D.
DR 13.5	Greater than 25 Times Pipe O. D.

If heat fused tees, ells, or flanges are located in the bend zone, the minimum bend radius shall be increased to one hundred (100) times the outside diameter of the pipe.

II-A6. VALVING

Valves are located in the distribution system to facilitate repair, maintenance, servicing, and extension of the system. Valves are also used to isolate sections where serious leakage or line breakage may occur that may cause property damage and loss of a large volume of water, if not repaired promptly.

Valves shall be located on all branches of the main and between feeder pipes. In addition, on long distribution mains, valves shall be installed at a maximum of eight hundred (800) feet at residential areas and a maximum of one thousand (1,000) feet at commercial areas. Dead ends for future expansion shall be provided with a valve and temporary blowoff. The size of the blowoff shall be as prescribed in Section II-A9. All taps to existing mains shall be provided with tapping valves. Each fire hydrant shall be provided with an isolating valve.

All valves are to be raised to grade within 48 hours of final paving.

II-A7. HYDRANT PLACEMENT

Generally, hydrants shall be located to provide adequate fire stream flow to all structures and

areas in the development and at the dead end of each main. The local Fire Authority has ultimate responsibility for the location of hydrant placement. In single-family residential areas, hydrants shall be located every four hundred (400) feet and every three hundred (300) feet in commercial and multi-family areas, with distances measured along street curbs. Hydrants may be located on the mains by other methods provided such methods will give full or total fire flow coverage of the development.

Hydrants shall be installed near the street curb, shall be accessible to fire trucks, and protected from traffic. Hydrants shall be located four (4) feet or more from a utility pole, traffic control box, or fixed object or structure in conformance with Drawing W-6.

II-A8. COMBINATION AIR RELEASE AND VACUUM RELIEF VALVES

The potable water distribution system shall be designed to minimize high points where air can accumulate. All high points in the distribution system shall be provided with combination air release and vacuum relief valves. The air release valves shall not allow the accumulation of entrapped air at the high point, which will restrict water flow. The vacuum valves shall allow air to enter the pipe and prevent its potential collapse due to the formation of a vacuum condition caused by rapid withdrawal of water. Combination air release and vacuum relief valves shall be provided in accordance with the following:

1. Mains that are 6-inches to 10-inches in diameter shall have 1-inch combination air-vacuum valves.
2. Mains that are 12-inches to 16-inches shall have 2-inch combination air-vacuum valves.
3. Mains that are greater than 16-inches must be engineered to compensate for the size of pipe and the length of run.

Vent lines from air release and vacuum relief valves shall be the same size as the valve outlet and shall run from valve to discharge without traps. The vent line shall be as short as possible and with not more than four (4) elbows. The vent shall terminate with the opening covered by a stainless steel bug screen. The base of the vent shall be provided with concrete support in accordance with Drawings W-15 and W-16.

The need for the installation of air relief valves should be minimized. Where required, a box shall be provided in accordance with Drawings W-15 and W-16. In situations where the air relief valve is located in a traffic or sidewalk area, air relief valves shall be installed in accordance with Drawings W-15A and W-16A.

II-A9. BLOWOFFS

Blowoffs shall be installed at all low points and dead ends. Blowoffs shall be designed to empty sections of the main to periodically remove silt and to repair or maintain appurtenances that cannot be serviced under pressure.

The blowoff assembly shall be designed to discharge into a sewer using a temporary connection or a sump from which water can be pumped to waste. Blowoffs shall not be directly connected

to sewers.

Blowoff sizing shall be as follows:

Pipe Size	**Blowoff Size**
8-inch pipe	2-inch blowoff
10-inch to 12-inch pipe	3-inch blowoff
14-inch to 16-inch pipe	4-inch blowoff

Note: Any pipe larger than 16-inch, blowoff shall be designed by an engineer to allow for proper velocity and flow.

II-A10. BACKFLOW PREVENTION

Backflow prevention devices shall be installed in the branch or service line supplying potable water to residential, commercial, or institutional customers where a potential exists for back-siphonage of water into the distribution main. Backflow preventers shall be installed downstream of the customers water meter. Backflow preventers shall be installed in accordance with the following schedule:

Application	Type of Device
Auxiliary water supply (active)	Reduced pressure
Auxiliary water supply (inactive)	Reduced pressure
Beauty salon, health spa	Reduced pressure
Buildings w/booster system	Reduced pressure
Buildings w/sewage ejectors	Reduced pressure
Buildings w/storage tanks	Reduced pressure
Buildings w/three (3) or more stories	Reduced pressure
Car wash	Reduced pressure
Car wash w/reclamation	Reduced pressure
Cement, concrete, sand, and gravel plants	Reduced pressure
Chemical storage or processing facilities	Reduced pressure
Construction water supply	Reduced pressure
Dairy or cold storage	Reduced pressure
Film processing or printing	Reduced pressure
Fire systems	Double check/detector check
Fire systems w/sprinkler in hazardous location	Reduced pressure w/detector
Heating and air conditioning (using water)	Reduced pressure
Hospital or medical facility (1-1/2” or larger)	Reduced pressure
Irrigation system	Reduced pressure
Irrigation system w/chemical feed	Reduced pressure
Laboratories (commercial or research)	Reduced pressure
Laundry or dry cleaner	Reduced pressure

Application	Type of Device
Manufacturing or processing (w/toxic chemicals)	Reduced pressure
Medical or dental facility (smaller than 1-1/2”)	Reduced pressure
Mobile home park	Reduced pressure
Multi-family dwellings	Reduced pressure
Ornamental pools, ponds or fountains	Reduced pressure
Radioactive or hazardous material handling	Reduced pressure
Recycled water	Reduced pressure
Residential with recycled water service	Reduced pressure
Residential with sewage ejectors	Reduced pressure
Restaurant	Reduced pressure
Restricted or classified facilities	Reduced pressure
Schools and other services larger than 2”	Reduced pressure
Sewage or storm drain facilities	Reduced pressure
Steam generation	Reduced pressure
Swimming pools	Reduced pressure
Systems looped with 2 or more services	Reduced pressure
Tank trucks or chemical spray rigs	Air gap (externally mounted)
Veterinary clinics	Reduced pressure
Warehousing and storage	Reduced pressure

In a case where more than one of the above applications applies to the same service, the most protective device shall apply.

Approved backflow prevention devices as required by Title 22 of the California Administrative Code shall also be installed downstream of the customer’s potable water meter for all customers with both potable and recycled water systems at the same site or parcel.

All new backflow prevention devices shall be tested by a District-approved, certified tester within thirty (30) days of installation and before the device is put into active service.

Any potable water used as seal water for recycled water pump seals shall be adequately protected from backflow.

II-A11. CONNECTIONS TO EXISTING POTABLE MAINS

The minimum potable water service and curb stop shall be one (1) inch for residential developments. The service for homes requiring residential fire service shall be one (1) inch minimum, or as required by the local Fire Authority. Service connections, up to two (2) inches on existing mains, except on High Density Polyethylene (HDPE) mains, shall be made by wet taps using service saddles. Service connections up to two (2) inches on HDPE mains shall be made with a sidewall fused hot tapping tee or an electrofusion hot tapping tee. All fusion procedures shall follow the manufacturer's recommendations. Each service connection shall have a corporation stop. Tapping on existing mains, including HDPE, to connect a branch, feeder, or service line two and one half (2-1/2) inch and larger shall also be made with a wet tap.

Wet tapping shall be made with a tapping sleeve when the branch is greater than two (2) inches. The tapping sleeve shall be provided with a tapping valve. Drilling and tapping machines shall be compatible or designed to attach to the tapping sleeve and tapping valve assembly. Tapping sleeves for connecting to HDPE mains must be approved for use on HDPE pipe by the saddle/sleeve manufacturer. Mechanical saddles/sleeves manufactured for use on PVC or ductile iron pipe are not acceptable for use on HDPE pipe.

The District Engineer may allow a dry tap, if dry tapping will not cause long and undue disruption to other customers. Dry tapping shall be made with a tee fitting with the appropriate couplings to connect to the mains. The tee branch shall be provided with an isolating gate valve.

Tapping of potable mains shall be made using materials and equipment especially designed for tapping water mains for potable water supply.

All dry and wet taps for potable mains shall be provided with thrust blocking as specified in Section II-A13.

II-A12. FIRE LINES

All commercial fire lines in excess of 2 inches in diameter shall have an accessible and clearly marked valve at the main and an approved double detector check installed in accordance with Drawing W-23. The detector meter shall be supplied with a radio read Neptune or Sensus meter. The meter interface units shall be "Datamatic" Firefly meter interface units for AMR systems using encoded registers with Profile PLUS load profiling capability. Fire lines shall connect to the main separate from the domestic supply line serving the same building. Fire lines shall be provided for buildings and establishments as required by the local Fire Authority.

All multifamily fire lines 1 ½ inches or less in diameter that are not equipped with pumper connections shall connect to the main separate from the domestic supply line serving the same building. They shall be provided with a rubber-faced detector check valve assembly installed in accordance with manufacturer's specifications. All systems must be supplied with a rubber-faced check valve on the sprinkler riser as required by NFPA and local Fire Authority specifications. Piping must be connected with CPVC piping. In cases where iron piping is used, refer to commercial fire line application.

All single-unit residential fire lines shall connect to the main service to the property downstream of the water meter. Piping systems shall be constructed of CPVC or other fire department approved piping, except ferrous metals. All systems must be supplied with a rubber-faced check valve on the sprinkler riser as required by NFPA and local Fire Authority specifications.

II-A13. COMBINED DOMESTIC AND FIRE SPRINKLER SERVICES

Water services which supply both domestic and fire sprinkler systems may be allowed for individual residential units, only as permitted by the local Fire Authority. The District Engineer shall determine the type of water meter to be installed to allow for measurement of low domestic flows. Water service lines and meters shall be sized to allow for fire sprinkler flows as required by the local Fire Authority. A plastic tag as shown on Drawing W-31 shall be affixed to the service line downstream of the water meter, with the words "WATER TO DOMESTIC AND FIRE SPRINKLER SYSTEM. NOTIFY FIRE DEPARTMENT PRIOR TO SHUT OFF."

II-A14. THRUST BLOCKS

Thrust blocks shall be provided for all unrestrained bends, tees, crosses, reducers, dead ends, fire hydrants, and where pipe changes in directions of more than 11-1/4 degrees occurring on any plane, and where indicated on the Improvement Plans or as required by the District Engineer.

Buried, heat-fused HDPE pipe and fittings do not require thrust blocks, except at mechanical connections to other pipe materials and unfused fittings, and at termination points.

Thrust blocks shall be designed to resist the thrust reaction forces at the bends or fittings whose magnitude will depend on the pipe diameter and internal pressures, and allowance for water hammer. Thrust blocks shall be designed to transfer and distribute the thrust forces to the undisturbed soil surface. Surface bearing capacity of soil shall be as determined and recommended by a soil investigation or report. In the absence of a soil investigation or report, the soil bearing capacity shall be as determined by the District Engineer. Thrust block shall be designed with a minimum factor of safety of 1.25, and shall be provided in accordance with Drawings W-2 and W-3.

Where thrust blocks are not feasible, restrained joints, tie rods, or other methods of anchoring the pipes shall be provided, and such alternate methods shall be subject to the approval of the District Engineer. If used, all tie rods shall be Type 316 stainless steel.

II-A15. SAMPLING STATIONS

Sample stations shall be installed at locations where required by the District Engineer in accordance with Drawings W-26.

SECTION II-B - CONSTRUCTION STANDARDS

II-B1. MATERIAL OF CONSTRUCTION

This section covers materials for the potable water mains, fittings, and appurtenances in the distribution system. All materials shall be manufactured and approved for potable water systems and comply with NSF 61 potable water regulations.

II-B1-1. Pipe Materials

II-B1-1.01. Polyvinyl Chloride Pressure Pipe

PVC pipe shall conform to the requirements as specified in AWWA C900. Pipe shall be Class 200 minimum. A higher class may be required to meet design conditions as determined by calculations and as indicated on the Improvement Plans. Pipes 14-inch and larger shall comply to AWWA C905.

The standard length of the PVC pipe shall be twenty (20) foot laying lengths and shall have cast iron outside diameters (CIODs).

II-B1-1.01.01. Joints

Joining of PVC pipe shall be with elastomeric-gasket bell ends or couplings.

The bell ends shall be integral thickened bell end or an integral sleeve-reinforced bell end. The bell end joints shall have a minimum wall thickness of the bell or sleeve-reinforced bell equal, at all points, to the dimension ratio (DR) requirements for the pipe. The minimum wall thickness in the ring groove and bell-entry sections shall equal or exceed the minimum wall thickness of the pipe barrel.

One PVC coupling, manufactured of the same material and by the same manufacturer as the pipe, shall be furnished with each length of pipe together with two (2) rubber rings. The couplings shall be designed so as to ensure a watertight joint with the pipe. The coupling's body and sockets shall have a wall thickness equal to the pipe barrel thickness with which the coupling is to be used.

The pipe manufacturer shall furnish all rubber rings. These rubber rings (elastomeric gaskets) shall be manufactured to conform to the requirements of ASTM F477.

II-B1-1.01.02. Fittings

All fittings for use with PVC pipe shall be ductile iron. All fittings shall be double encased with 8-mil polyethylene wrap in accordance with ANSI A 21.5 (AWWA C105).

Ductile iron fittings shall be classified as "compact ductile iron fittings" of material specified in ANSI A 21.53 (AWWA C153). Push-on joints shall be in accordance with ANSI A 21.11 (AWWA C111).

All tees and crosses used with PVC pipe shall have flanged ends. Valves connecting to tees and crosses shall be connected as flanged end by mechanical joint or as flanged end by push-on joint. Flange gaskets shall be 1/8-inch, either ring-type or full face, in accordance with ANSI A 21.15 (AWWA C115).

Hub ends shall be designated as "push-on" fittings designed to accept cast iron outside diameters (CIODs) PVC pipe. Closure shall be facilitated by a rubber ring retained in an internal groove inside the hub. The surface of the hub in the ring area shall be cast free of pits or burrs, smooth and accurate, in order to meet the requirements for water tightness. The manufacturer of the fitting shall furnish the rubber rings. Asbestos-cement pipe to CIOD PVC adapter rings may be used for connection in six (6) and eight (8) inch sizes to existing asbestos-cement fittings as approved by the District Engineer.

II-B1-1.01.03. Coating

Cement lined fittings shall have manufacturer's standard bituminous or asphaltic coating.

II-B1-1.02. Ductile Iron Pipe ("DIP")

DIP shall conform to the requirements as specified in ANSI A 21.51 (AWWA C151). Pipes shall be lined and coated as specified herein.

The minimum thickness class for DIP shall be as indicated in the table. A higher thickness class may be required to meet design conditions as determined by calculations.

Nominal Size	**ANSI Thickness Class**
4-inch to 20-inch	350
24-inch to 26-inch	250

Note: The specified thickness class includes corrosion allowance and foundry tolerance.

II-B1-1.02.01. Joints

Joints for DIP shall be selected to suit the installation condition in the field. Gaskets for push-on joints, mechanical joints, and flanged joints shall be standard styrene butadiene rubber (SBR) in accordance with ANSI A 21.11 (AWWA C111) and ANSI A 21.15 (AWWA C115). Joints shall be in accordance with the ANSI A 21.11 (AWWA C111) for push-on and mechanical joints, and ANSI A 21.15 (AWWA C115) for flanged joints. Minimum rating of all joints shall be 250 psi. Flange gaskets shall be 1/8-inch, either ring-type or full face, in accordance with ANSI A 21.15 (AWWA C115).

II-B1-1.02.02. Fittings

All fittings for use with DIP shall be in accordance with ANSI A 21.10 (AWWA C110) or ANSI A 21.53 (AWWA C153). For fittings twenty-four (24) inches and smaller, the minimum pressure rating shall be 250 psi and 150 psi minimum for fittings thirty (30) inches and larger.

All tees and crosses used with DIP that are attached to valves shall have flanged end by mechanical joint or push-on joint. All other fittings shall be push-on joint or mechanical joint.

Hub ends shall be designated as "push-on" fittings. Closure shall be facilitated by a rubber ring retained in an internal groove inside the hub. The surface of the hub in the ring area shall be cast free of pits or burrs, smooth and accurate, in order to meet the requirements for water tightness. The manufacturer of the fitting shall furnish the rubber rings. Asbestos-cement pipe to ductile iron adapter rings may be used for connection in six (6) inch and eight (8) inch size to existing asbestos-cement fittings as approved by the District Engineer.

II-B1-1.02.03. Lining

Pipe shall be cement lined in accordance with ANSI A 21.4 (AWWA C104).

II-B1-1.02.04. Coating

Pipe and cement lined fittings shall have manufacturer's standard bituminous or asphaltic coating.

II-B1-1.02.05. Polyethylene Encasement

All buried ductile iron pipe shall be encased in eight-mil polyethylene wrap. All buried fittings and appurtenances shall be double encased in an eight-mil polyethylene wrap. Polyethylene wrap shall be manufactured and installed in conformance with ANSI A 21.5.

II-B1-1.03. Steel Pipe

Steel may be used only for special installation where PVC or ductile iron pipe would not be suitable. Steel pipe for special piping installation such as offsets, transition pieces, reducers, tees, wyes, crosses, special heads, and fittings shall be rated for minimum 200 psi and shall be fabricated in accordance with AWWA C208 specifications. All steel pipe shall be cement mortar lined and coated in accordance with AWWA C205.

II-B1-1.04. Piping and Tubing

Service lines shall be polyethylene plastic or copper.

Plastic service lines shall be polyethylene AWWA C901, Class 200, in copper tubing sizes. Polybutylene piping is not acceptable. Tracer Wire TW #10 shall be twined around the polyethylene line, and extend into the meter box.

Copper tubing shall conform to the requirements of AWWA C800 for copper water tube Type K. All copper service lines through two (2) inch shall be annealed.

II-B1-1.05. High Density Polyethylene Pressure Pipe ("HDPE")

HDPE pressure pipe shall conform to the requirements as specified in AWWA C901 or AWWA C906-99. Pipe shall have a minimum working pressure rating of 200 psi (DR 11.0). A higher class may be required to meet design conditions as determined by calculations and as indicated on the Improvement Plans. Thickness calculations shall be provided with Improvement Plans and sealed by a California Registered Professional Engineer.

The standard length of the HDPE pipe shall be forty (40) or fifty (50) feet and shall have cast iron outside diameters (CIODs).

II-B1-1.05.01. Joints

All joints of HDPE pipe shall be heat fused in strict accordance with the pipe manufacturer's recommendations. Heat fusion shall only be performed by technicians who have been certified by the fusion equipment supplier and have a minimum of two (2) years of experience fusing HDPE pipe of similar diameters used on the project. Electrofusion couplings may also be used to fuse HDPE pipe sections.

Mechanical couplers may be used to mechanically connect HDPE pipe provided that the couplers are specifically manufactured for use on HDPE pipe and are approved for use on HDPE pipe, as recommended by the manufacturer of the coupling.

II-B1-1.05.02. Fittings

All fittings shall conform to AWWA C906, Section 2.3. All fittings shall have a Plastic Pipe Institute (PPI) material designation of PE 3408, and have a cell classification of 345464C, per ASTM D3350 with an established hydrostatic-design basis of 1600 psi for water at 73 degrees. The resin shall be listed by the PPI in its pipe-grade registry Technical Report (TR) 4, "Hydrostatic Design Basis and Maximum Recommended Hydrostatic Design for Thermoplastic Piping Materials." All fittings shall be fully pressure rated to provide a working pressure equal to that of the pipe.

Standard fittings are tees, ells, flange adapters, transition fittings, branch and service saddles, and hot-tap tees.

II-B1-2. Appurtenances

II-B1-2.01. Valves

All line valves twelve (12) inches and smaller shall be gate valves and all line valves fourteen (14) inches and larger shall be butterfly valves. All valves adjacent to tees or crosses shall have one (1) flanged end bolted directly to the tee or cross. In-line valves shall be flanged, mechanical joint, or push-on ends.

II-B1-2.01.01. Gate Valves

Gate valves shall be ductile iron and conform to AWWA C509, resilient seated-type valves with non-rising stems, and have "O" ring stuffing boxes. Stuffing boxes shall be bolted and constructed so as to aid valve repair. Valves shall open counterclockwise and be fitted with two (2) inch square operating nuts. All ten (10) inch and smaller valves shall be hydrostatically tested and droptight at a pressure of not less than 500 psi and rated for 250 psi working pressure.

II-B1-2.01.02. Butterfly Valves

Butterfly valves twelve (12) inches and larger shall be rubber seated, Class 150B conforming to AWWA C504. Valves shall open counterclockwise and be fitted with a two (2) inch square operating nut. Each butterfly valve shall be provided with a gear operator designed for buried service.

II-B1-2.01.03. Air Release and Vacuum Relief Valves

Air release and vacuum relief valves shall be combination air release valves, Crispin Universal Model No. UID or APCO Series No. 140. They shall be ported in size for the size of the line and length of the pipe they are protecting.

The valve body shall be designed for a water working pressure of not less than 200 psi and shall have stainless steel floats, and all working parts shall be brass, stainless steel, or other non-corroding materials. Orifices shall be sized for the design pressure of the specific pipe length and size.

Air valves shall be installed in accordance with Drawings W-15 or W-16, as required.

II-B1-2.02. Tapping Sleeve Tee and Tapping Valves

Tapping sleeves for wet tapping of PVC or ductile iron potable water mains shall be ductile iron or stainless steel tapping sleeve assembly, complete with gaskets and bolts. Each tapping sleeve shall include a tapping valve of the same size as the branch to which a drilling machine could be attached for tapping the main. Tapping sleeve and valve shall have a minimum rating of 250 psi working pressure. Tapping valve shall have a two (2) inch square nut for operation.

Tapping sleeves shall be JCM 432 all stainless steel tapping sleeves, Mueller Co. Model H-615, M&H Style 974, or approved equal, and tapping valves shall be Mueller Co. Model T-2360, M&H Style 3751, U.S. Pipe METROSEAL 250® or approved equal.

Wet tapping of HDPE mains shall be accomplished with sidewall fusion or electrofusion couplings as applicable per the manufacturer's approved procedures. Mechanical tapping sleeves may also be used on HDPE pipe, provided that the tapping sleeve is approved for use on HDPE pipe, as recommended and approved by the sleeve manufacturer.

II-B1-2.03. Hydrants

All fire hydrants shall be of the wet-barrel type, which shall conform to the requirements of AWWA C503. The approved fire hydrant for use in the District shall be Clow Ranger Series 950 (1-4 ½ inch and 1-2 ½ inch outlets), or equal for residential applications; and Ranger Series 960 (1-4 ½ inch and 2-2 ½ inch outlets), or equal for commercial applications.

Hydrant buries shall have either mechanical or push-on joints. Hydrant buries shall be lined with fusion epoxy, or equal lining, having a total minimum thickness of six (6) mils.

Fire hydrant bolts should be breakaway type.

Positive break-off check valves or bollards shall be provided at the request of the District Engineer. The check valve will be installed immediately below the break-off risers or extension. Valve shall be Long Beach Iron Works Number LB400, or equal. There shall be a minimum clearance of three (3) feet surrounding the fire hydrant.

Exterior of hydrants shall receive a primer coat and shall be furnished with an enamel finish coat. Hydrant paint color shall be Rustoleum Corporation, Series 5200, light yellow, or equal.

II-B1-2.04. Blowoffs

Blowoffs shall be constructed of the materials indicated on Drawings W-9 through W-12.

II-B1-2.05. Backflow Prevention Devices

Backflow prevention devices shall be of the type shown in the table in Section II-A10 for the appropriate service and situation. Acceptable backflow devices shall comply with California Department of Health Services Title 22 requirements.

II-B1-2.06. Valve Boxes and Valve Box Risers

Valve boxes and valve box risers shall be provided for all line valves and fire hydrant valves. The valve boxes shall be Christy G-5, or approved equal. Valve risers shall be eight (8) inch approved PVC pipe or ductile iron pipe. Valve boxes and valve box risers shall be as shown in Drawing W-l. For valves deeper than twelve (12) feet, risers shall be ductile iron. All valve box risers shall be equipped with a centering block or ring. (Placer Waterworks PW-CR or equal.)

II-B1-2.07. Tracer Wire and Warning Tape

Tracer wire shall be copper wire, Type TW, size AWG No. 10.

Warning tape shall be acid and alkali resistant polyethylene film. Warning tape shall be blue, two (2) inches wide, and printed continuously with the words: "Caution Buried Water Line Below."

II-B1-2.08. Service Taps and Connections

Saddles for service taps on potable water mains shall be suitable for the diameter and pipe material of the water main to be tapped. Saddles for PVC and ductile iron pipes shall be shaped to accurately fit the contour of the main. Saddles for ductile iron pipe shall have double straps and be cast iron epoxy. Straps shall have a flattened design to provide large bearing surfaces for a secure installation. Saddles for PVC shall be constructed of bronze and shall have a neoprene gasket wedged in place at the tapping boss to provide a tight seal at the main.

All single residence potable water service connections shall be a minimum of one (1) inch in diameter, commencing at the main with a Mueller Series 300 ball corporation stop, McDonald 4701BQ, or approved equal, and terminating with a Mueller Series angle meter ball valve, McDonald 4602BT, or approved equal. Service clamps for PVC pipe shall be Mueller H13000 Series, McDonald 3825, or equal. During the construction and testing of interior plumbing in single-family residential units, construction water may be obtained through meter jumpers on the water service. The construction water may only be used for testing of interior plumbing. Meter jumpers may be installed after payment of fees and at District inspection.

Connections for fire sprinkler systems shall be as approved by the local Fire Authority and the District Engineer.

Service connections shall be as shown in Drawings W-7 or W-8.

Service connections to HDPE mains shall use a sidewall fused hot tapping tee or an electrofusion hot tapping tee. All procedures shall follow the manufacturer's recommendations. Mechanical service saddles for service taps on HDPE mains may also be used, provided that the saddles are approved for use on HDPE pipe as recommended by the saddle manufacturer. Mechanical saddles manufactured for use on PVC pipe or DIP are not acceptable for use on HDPE pipe.

II-B1-2.09. Gaskets

Gaskets shall be one-sixteenth (1/16) inch thick, full-faced type, made of neoprene or synthetic rubber.

Where required to connect two (2) different pipe metals, Type E Maloney insulation kit with neoprene gasket facing and one-sixteenth (1/16) inch special sleeves, or equal, shall be used.

II-B1-2.10. Flexible Couplings

Unless otherwise indicated on the Improvement Plans or directed by the District Engineer, flexible couplings shall be Dresser Type 38 or Smith Blair 411 for standard connections, or Dresser Type 39 or Smith Blair 416 for insulated connections, or equal. When connecting PVC to steel pipe, the flexible coupling shall be Dresser Type 162, Smith Blair 433, or Power Seal's Power Max 3506 transition coupling, or equal.

II-B1-2.11. Bolts

All bolts including T-Bolts, All-Thread, etc., shall be mild steel. Fire hydrant bolts shall be breakaway type. Bolts for flanged curb stops and flanged meters shall be fifteen sixteenths (15/16) inch. All bolts shall be torqued to manufacturer's recommendation. All bolts shall be coated with a bituminous coating prior to the fitting being wrapped.

II-B1-2.12. Meter Boxes

Meter boxes shall be provided for all service meters and shall be installed as indicated on Drawings W-19 and W-20. All meter boxes in landscape areas shall be fiberglass. All meter boxes in sidewalks and traffic areas shall be concrete. Meter box lids for sidewalk areas shall be concrete. Meter box lids for all traffic areas shall be H-20 traffic rated steel.

II-B1-2.13. Potable Water Sample Stations

Where determined by the District, water quality sampling stations shall be installed in accordance with Drawings W-26A and W-26B. The sampling stations shall consist of a one (1) inch service connection stubbed out at least twelve (12) inches behind the sidewalk, an in-line corporation stop with a valve box and cover, and an above grade, lockable sampling station. The above grade, lockable sampling station shall be selected by the District Engineer. The station shall be center mounted on a four (4) inch thick concrete slab, two (2) feet square in area. The

District will provide the sample station riser.

II-B1-3. Thrust Blocks

Thrust blocks shall be constructed of Class B concrete as specified in Section I-D10. Dimensions of thrust blocks shall be in accordance with Drawings W-2 and W-3.

II-B2. INSTALLATION OF POTABLE WATER PIPE AND APPURTENANCES

II-B2-1. General

All pipe, fittings, and appurtenances shall be loaded for delivery and unloaded in such a manner as to avoid damage to the pipe or appurtenance.

Delivery of pipe and appurtenances to the site of the Work shall not take place until immediately prior to the installation thereof.

Unless otherwise indicated on the Improvement Plans or directed by the District Engineer, pipe and appurtenances shall be distributed along the trench by the Contractor opposite or near the place where it is to be placed.

All pipe and appurtenances shall be handled with care to avoid damage. Whether moved by hand, skidways, or hoists, the pipe shall not be dropped or bumped against other pipe, accessories, or other projects.

II-B2-2. Pipe and Fittings

Pipe shall be laid and installed in accordance with Section I-D5 Pipe Laying. Minimum working grade cover shall be thirty (30) inches. The type of pipe and size to be used shall be as specified and indicated on the Improvement Plans. Piping runs and alignment indicated on the Improvement Plans shall be followed as closely as possible, except for minor adjustments to avoid obstructions. If major relocations are required due to unforeseen obstructions, the District Engineer shall approve such relocations.

II-B2-2.01. PVC Pipe

PVC pipe shall be laid and installed in accordance with AWWA C605 and AWWA Manual No. 23, PVC Pipe - Design and Installation. Proper implements, tools, and equipment shall be used for the placement of the pipe in the trench to prevent damage. Ductile iron fittings installed with PVC pipe shall be double encased with polyethylene wrap per Section II-B1-1.01.02. The weight of fittings, valves, and other appurtenances shall not be supported or carried by the PVC pipe. Fittings, valves, and appurtenances shall be supported by concrete pad or drain rock, when in the judgment of the District Engineer, soil conditions or trench excavation does provide proper support. Field cut PVC pipe shall have the burrs removed, ends beveled, and marked for proper insertion depth. A factory-finished beveled end shall be used as a guide in beveling. A cut shall be made square to the pipe.

PVC pipe shall not be deflected at the joints. On curved alignments, PVC pipe may be bent. Bending of the pipe shall be as specified in Section II-A5-1.

Pipe shall be laid with bell ends facing the direction of laying. Reverse laying may be allowed subject to the approval of the District Engineer.

II-B2-2.02. Ductile Iron Pipe ("DIP")

Pipes shall be laid and installed in accordance with AWWA C600, Installation of Ductile Iron Water Mains and their Appurtenances.

Piping shall be laid to the lines and grade indicated on the Improvement Plans. On curve alignments, pipe joints may be deflected to make the curve with either shorter pipe sections, or fittings to conform to the alignment or grade as required by the Improvement Plans. Joints shall be deflected or pulled as specified in Section II-A5-2. Joints shall be deflected after the joint is properly assembled. For mechanical joints, the joints shall be deflected before tightening of bolts.

Cutting of pipe shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file or power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitably beveled.

Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI A 21.11 (AWWA C111). Over tightening of bolts to compensate for poor installation practice will not be permitted.

Push-on joints shall be carefully assembled in accordance with the pipe manufacturer's instructions and recommendations for proper jointing operations. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled.

Corrosion protection for ductile iron pipe, fittings, valves, and appurtenances shall be as recommended and designed by a State of California Registered Corrosion Engineer. As a minimum, it shall have a bituminous coating and shall be encased in loose polyethylene tubing for external corrosion protection. Installation of polyethylene encasement shall be in accordance with the requirements of ANSI A 21.5 (AWWA C105).

II-B2-2.03. Steel Pipe

Installation of steel pipe shall conform to AWWA Manual No. 11, Steel Pipe - A Guide for

Design and Installation. The District Engineer will provide complete specifications for steel pipes prior to approval of the Applicant's Improvement Plans.

II-B2-2.04. HDPE Pipe

HDPE shall be placed in strict accordance with the manufacturer's recommendations, with Section I-D5 and Section I-D6 of these Standards, and per ASTM D2321.

Curve alignment of HDPE shall be as specified in Section II-A5-3.

Sections of HDPE pipe having cuts or gouges in excess of ten percent (10%) of the wall thickness of the pipe shall be cut out and removed. Heat fusion or electrofusion methods shall be used to install new sections of pipe. All procedures shall follow the manufacturer's recommendations.

Fused sections of HDPE pipe shall be handled such that damage to the pipe is avoided. Chains or cable type chokers shall not be used in lifting HDPE pipe. Nylon slings with spreader bars shall be used to lift fused HDPE pipe, unless otherwise approved by the District Engineer.

II-B2-2.05. Service Lines

Service lines shall rest on undisturbed earth in the bottom of the trench with a thirty six (36) inch minimum cover (between service line and gutter flow line).

One (1) inch copper lines shall be provided with a six (6) inch minimum offset "Gooseneck" at the corporation stop and tapped at a forty-five degree (45°) angle from the top of the main.

Polyethylene lines shall be snaked in the trench, as recommended by the material manufacturer, from the corporation stop to the angle curb stop. Polyethylene lines shall be continuous from the corporation stop to the angle curb stop. Mechanical couplings are not allowed. To extend beyond one hundred (100) linear feet in length, polyethylene lines may be electro- or heat-fused. All plastic service piping shall be installed with insulated ten (10) gauge copper wire spiraled around service line and extended into the meter box.

Polyethylene tubing shall be cut with a tubing cutter that is equipped with a thin cutting wheel designed specifically for plastics. Make a square clean cut by turning the cutter around the pipe once and then turn the cutter one (1) or more times in the opposite direction to complete the cut.

Compression fittings with insert stiffeners, used to connect polyethylene tubing to corporation and curb stops, shall not be installed with the insert stiffeners protruding beyond the opening of the waterworks brass coupling nut to eliminate the possibility of internally cutting the pipe by the insert stiffener. Insert stiffeners that protrude beyond the coupling nut opening when installed shall be cut to eliminate the protruding piece.

II-B2-2.05.01. Common Trench and Manifold

Domestic, irrigation from a potable service, and fire service shall be provided to commercial establishments by separate metered potable water service lines. Domestic and potable irrigation service lines to a project under one ownership may be allowed to be installed in a common trench. Minimum separation between service lines in the trench shall be six (6) inches, and between taps at the main shall be twenty-four (24) inches. A fire sprinkler service tap shall have a minimum separation of five (5) feet from a domestic tap or an irrigation tap.

Commercial projects with an existing service line who request an increase in water demand may be provided another metered service line by manifolding to the existing service if the existing service is large enough to accommodate increased demand. A maximum of three (3) separate meters shall be manifolded on one (1) existing service line. Manifolded service lines shall be in accordance with Drawings W-24A, W-24B and W-24C, or as approved by the District Engineer.

Brass tags are required on meters whenever a cluster of meters is installed. The tags shall indicate which unit each meter services.

II-B2-2.05.02. Service Line Abandonment

Service lines shall be abandoned at the service saddle or tee at the main. Corporation stops or gate valves shall be removed and replaced with a plug or a blind flange.

II-B2-2.06. Corrosion Protection

All ferrous metal fittings and appurtenances, which will be in contact with backfill after installation, shall be provided with bituminous coating corrosion protection.

Ferrous metal fittings and appurtenances as herein referred to are: valves, tees, elbows, reducers, crosses, plug assemblies, pumping tees, services, blowoff installations, flexible couplings, leak clamps, tie rods, etc.

Joints, fittings, and appurtenances, which are required to be coated by the Contractor, may be coated before or after installation in the trench.

Bare metal pipe, which extends into the soil from a concrete structure such as a pumping plant, venturi pit, valve housing, or similar structure, shall be insulated from the concrete and leak-proofed. The insulation shall extend through the concrete a minimum of three (3) inches on each side. The insulation shall consist of one (1) layer of Scotchrap Tape No. 50 and one (1) coat of bituminous paint. The pipe shall be clean, dry, and free from loose scale before applying the adhesive and tape. The edges of the tape shall be lapped not less than one-half (1/2) inch.

All buried ductile iron shall be encased in eight (8) mil polyethylene wrap. All buried fittings and appurtenances shall be double encased in an eight (8) mil polyethylene wrap. Polyethylene wrap shall be manufactured and installed in conformance with ANSI A 21.5

Bituminous coating shall be two (2) coats of Carboline Bitumastic Super Service, Tnemec 46-449 Heavy Duty Black, or equal, with minimum twenty (20) mil dry thickness. Applications shall be in accordance with manufacturer's instructions.

II-B2-3. Appurtenances

II-B2-3.01. Valves, Valve Boxes, and Valve Box Risers

All valves shall be set plumb, supported against settlement and properly fitted to the adjacent sections of main. A valve box and riser pipe shall be installed over each valve. The valve box and riser pipe must not bear on the valve or main so that surface traffic loads are not transferred to the water pipe. Riser pipes shall be set on manufactured centering rings. (Placer Waterworks PW-CR or approved equal.) When possible, riser pipe shall be one continuous piece. Riser pipe that is not continuous shall be joined by a coupling or a bell end piece of the same material as the riser pipe. The top of the valve box shall be placed flush with finished grade, unless otherwise specified or indicated on the Improvement Plans.

Valves buried more than five (5) feet from finish grade shall be fitted with extension stems, if necessary, to bring the valve operating nut to within twenty-four (24) inches of the finished grade. The extension stem shall be enclosed or housed in a valve box riser. The riser shall extend into the valve box and the valve box shall be made flush with finish grade. Valve box shall be provided with a cover. The cover shall be traffic type when installed on street or roadways.

Valve boxes shall be firmly supported, concrete encased, and maintained centered and plumb over the wrench nut of the valve, with box cover flush with the surface of the finished pavement, finish grade, or as indicated on the Improvement Plans. The interior of the valve riser shall be free of dirt and debris and the wrench nut must be readily accessible for operation.

Installation of line valves shall be in accordance with Drawings W-13 or W-14.

Installation of air release and vacuum relief valves shall be in accordance with Drawings W-15 and W-16.

II-B2-4. Tapping Sleeves and Tapping Valves

Tapping sleeves and tapping valves shall be installed in conformity with the manufacturer's instructions and Drawings W-17 and W-17A. The section of the main where the tapping sleeve will be installed shall be thoroughly cleaned. The main's outside diameter shall be measured and the proper size tapping sleeve and tapping valve shall be installed on the main. Tapping sleeve and tapping valve shall be provided with independent supports and shall not be supported or carried by the main. The assembly shall be provided with thrust blocking per Section II-A13, and bedding and backfilling per Drawing G-2. Tapping valves shall be provided with valve box, valve risers, and extension stems, as specified for valves. Tapping sleeves shall be subject to testing and disinfection, as specified in Section II-B3.

II-B2-5. Hydrants

Hydrants shall be located and installed in a manner to provide complete accessibility and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. All fire hydrants shall be installed in accordance with Drawing W-6 at the location indicated on the Improvement Plans.

A fire hydrant that is improperly installed shall be removed and reinstalled properly at no cost to the District. The setting of hydrants shall conform to the following sections.

II-B2-5.01. Placement Behind Curbs and Sidewalks

Hydrant locations in the street right-of-way shall be in accordance with the following. Distances given shall be measured from center-line of hydrants.

When sidewalks are six (6) feet wide or greater and are without a planter strip, hydrants shall be twenty-four (24) inches from the face of the curb.

When sidewalks are less than six (6) feet wide and are without a planter strip, hydrants shall be twenty-four (24) inches plus the width of the sidewalk from the face of the curb.

When there is a planter strip thirty (30) inches wide or greater between curbs and sidewalks, the hydrants shall twenty-four (24) inches from the face of the curb.

When there is a planter strip less than twenty-four (24) inches wide between curbs and sidewalks, location of hydrants shall be fixed by the District Engineer.

II-B2-5.02. Position of Nozzles

All hydrants shall stand plumb. Hydrants with a pumper nozzle four and one-half (4-1/2) inch and two (2) hose nozzles two and one-half (2-1/2) inch shall be installed with the pumper nozzle perpendicular to the curb. Hydrants with a pumper nozzle four and one-half (4-1/2) inch and one (1) hose nozzle two and one-half (2-1/2) inch, ninety (90) degrees opposed shall be installed so that a line bisecting the ninety (90) degree angle is perpendicular to the curb.

II-B2-5.03. Cleaning

Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

II-B2-5.04. Painting

Hydrants shall be painted with Rustoleum Corporation, Series 5200, light yellow, or approved equal.

II-B2-6. Blowoffs

Fire hydrants may be used as blowoffs and shall be installed at designated locations within public easements to aid in the flushing of water mains.

The hydrants as shown in Drawing W-6 shall be installed at all dead ends mains.

A three (3) inch blowoff as shown in Drawing W-11 shall be installed at the low points of six (6) inch through fourteen (14) inch mains.

II-B2-7. Backflow Prevention Devices

Backflow prevention devices shall be installed above ground and protected against damage and vandalism using insulated green pads or a fiberglass enclosure for devices two (2) inch and smaller. Traffic posts or an enclosure shall be provided when installation is within traffic areas.

Installation of backflow devices shall be in accordance with Drawings W-21 through W-23A as applicable. Backflow prevention devices shall be installed prior to request for installation of water meters.

A District approved reduced pressure principle backflow prevention device is required on all potable water services as outlined in Section II-A10. As required by Title 22 of the State of California Code of Regulations, if the potable water system is used to supplement the recycled water system, an air gap separation is required.

II-B2-8. Tracer Wire and Warning Tape

Tracer wire shall be installed on the top of all pipelines. Tracer wire shall come up into the valve boxes as shown on the Drawings. Plastic warning tape shall be installed above water lines as shown on Drawing G-1. Warning tape shall be blue, two (2) inches wide, and printed continuously with the words: "CAUTION BURIED WATER LINE BELOW."

When potable water is being supplied to a site also being supplied with recycled water, the words "CAUTION - DRINKING WATER LINE" shall be fastened directly to the top of the potable water main and run continuously the entire length of the pipe. This tape shall be at least three (3) inches in width.

II-B2-9. Water Service Connections

Service connections shall be installed in accordance with Drawings W-7 or W-8. Water meters will be installed by the District after all fees have been paid and occupancy requirements have been met. Meter boxes, angle meter stops, meter spud or tail piece, and backflow prevention devices shall be provided and installed by the Applicant and will be properly located prior to meter installation and service connection. Service connections that are improperly installed shall be abandoned at the water main tap and a new service connection shall be installed. Adjustments to any water services in use by customers shall be coordinated with the District and

completed with minimum interruption of water service to customers.

The installation of union connectors on service connections shall not be permitted.

II-B2-10. Meter Boxes

The Applicant shall provide a meter box for each water service connection and is responsible for hooking up the house side of the meter. The District will install and provide the meter and spud after payment of the required fees. Meter box shall be firmly supported and centered over the meter assembly. Meter box shall be provided with gravel or drain rock to keep meter dry. The meter box shall have its cover installed flush with the finished curb, sidewalk, or grade, or as indicated on the Improvement Plans. Installation of meters including meter boxes shall be in accordance with Drawings W-19 or W-20. Unless otherwise specified by the District Engineer, meter boxes shall be provided as follows.

Meter Box Schedule						
Meter	Traffic Areas			Non-traffic Areas		
	Christy Model No.	Inside Width	Inside Length	Christy Model No.	Inside Width	Inside Length
5/8" – 1"	B1324	13 ¼"	24"	FL30	13"	24"
1 ½" – 2"	B1730	17"	30"	FL36	17"	30"
3" – 4"	SYN2436T	24"	36"	SYN2436T	24"	36"
6"	SYN3048T	30"	48"	SYN3048T	30"	48"

Meter boxes in traffic areas shall be H-20 loading rated Christy Concrete or Polymer Meter boxes with Concrete or Polymer covers, or approved equal. Meter boxes in all other areas shall be Christy Fibrelyte or Polymer boxes with Fibrelyte or Polymer lids, or approved equal. Each meter box lid shall have a hole for a reading probe.

Meter boxes for commercial/industrial buildings, or for residential buildings, which require backflow prevention devices, shall have a six (6) inch wide concrete collar around the meter box.

Brass tags are required on meters whenever a cluster of meters is installed. The tags shall indicate which unit each meter services.

II-B2-11. Thrust Blocks

Thrust blocks shall be constructed of Class B concrete as specified in Section I-D10, and shall be provided for all bends, tees, crosses, reducers, and where indicated on the Improvement Plans. Thrust blocks shall be poured against undisturbed earth. If, in the opinion of the District Engineer, the earth against which the anchor bears is unsuitable to support the imposed load, Contractor shall provide such additional anchorages as may be required by the District Engineer. Ground against which concrete is to be placed shall be moistened prior to placing so that it will not absorb excessive moisture from the fresh concrete. Forms, if required, shall be smooth,

mortar tight, and of sufficient strength to maintain shape during the placing of the concrete. Placing methods shall be such that the concrete will be placed in its final position without segregation. All concrete shall be placed and rodded to ensure smooth surfaces along form lines and to eliminate air pockets. The use of mechanical vibrators will not be required on thrust blocks for PVC pipe. Thrust blocks shall be placed in such a manner that pipe and fitting joints will be accessible for repair. Concrete used for thrust blocks shall be in contact with fittings and not with the pipe.

Thrust blocks shall cure at least twenty-four (24) hours prior to backfilling and seven (7) days prior to allowing pressure into the main. Thrust blocks shall be constructed in accordance with Drawing W-2.

Manufactured restraint devices may be used in lieu of concrete thrust blocks for ductile iron and PVC pressure pipelines (water mains and wastewater force mains) on a case-by-case basis when approved by the District Engineer. Manufactured restraint devices shall be designed to tie the pipeline together at fittings and to transfer thrust forces to the adjacent soil by friction and soil bearing. Information to be submitted to the District Engineer when requesting approval for manufactured restraint devices shall include the following:

1. Details of the restraint system
2. Measured site-specific (or assumed worst-case) soil characteristics of importance to thrust resistance of the soil (ref: "Thrust Restraint Design Equations and Tables for Ductile Iron and PVC Pipe," PD-6 (5-95) published by EBAA Iron)
3. Pipe and encasement details which will affect soil friction
4. Trench, pipe bedding, and depth of cover details
5. Test pressure (per II-B3-2 of these Standards)
6. Factor of safety (1.50 minimum)
7. Calculations of length of pipe to be restrained for each situation
8. Thrust Restraint Calculations using the Ductile Iron Pipe Research Association (DIPRA) method is acceptable.

Push-on restrained joint pipe and fittings for ductile iron shall be boltless and capable of deflection after assembly. Restrained joints shall be rated for 350 psi working pressure for sizes 4" through 24" and 250 psi working pressure for sizes 30" and 36". Restrained joint pipe and fittings shall be of the same manufacturer. Push-on restrained joints shall be FIELD LOK350®, TR FLEX® (with the TR FLEX Gripper Ring® for restraining field cuts), or approved equal.

Manufactured restraint systems for mechanical joints shall be wedge type or wedge collar and rod type. Wedge-type restraint systems shall use twist-off bolts to ensure proper gripping pressure. Systems that rely on set screws only will not be acceptable. Mechanical restrained joints for Ductile Iron shall be EBAA Iron Series 1100 Megalug, or approved equal. Mechanical restrained joints for PVC shall be EBAA Iron Series 2000PV Megalug, or approved equal.

Manufactured restraint devices are not acceptable for use on HDPE pipe.

II-B2-12. Curb Marking

The location of all valves, blowoffs, air valves, services, etc., shall be permanently marked in Roman Numerals on the closest curb face, or on four (4) inch by four (4) inch posts where there is no curb. At the point where a service line crosses beneath the curb, the point shall be permanently marked by a "W" stamped on the top of the curb.

II-B3. TESTING AND DISINFECTION OF POTABLE MAINS AND SERVICES

II-B3-1. General

All labor, equipment, and material, including water necessary for the testing and disinfection of potable water mains and services, shall be provided by the Contractor at no cost to the District. Testing shall include corrections, repairs, and retesting until the water mains and services pass the required test. Prior to testing, the Contractor shall provide access to all valves. All water lines shall be tested in the presence of an Inspector. Testing shall be done only after the line is adequately protected from shock loading and the street is no longer subjected to continuous abnormal construction traffic. The intent being that after testing, the possibility of pipe or joint failure due to traffic loading shall be remote. As a guide, the test shall be made after curb, gutter, and sidewalk are poured and six (6) inches of subbase or base is in place and compacted. If the total section below pavement is less than six (6) inches, then the street shall be ready for paving before testing. Additional subbase or base may be required if it appears that the street will carry excessive traffic before paving. Excessive trench failure may require retesting of the pipe in that section of the trench failure and all damaged pipe shall be repaired or replaced. Retesting and pipe repair and replacement shall be done with all cost borne by the Contractor.

All appurtenances such as water services, hydrants, blowoffs and ARVs shall be set to final elevation prior to testing.

All potable water mains, services and appurtenances shall pass testing and disinfection prior to acceptance of the Work by the District.

To provide water for testing, the new potable water pipeline shall be connected to the existing system through a water meter and a District-approved reduced pressure principal backflow prevention assembly downstream of a tap valve to prevent backflow of test water from the new system. After successful completion of all required testing, the valves shall be removed and a permanent connection shall be installed. Assembly shall be two (2) inch for eight (8) inch mains, three (3) inch for ten (10) inch mains, four (4) inch for twelve (12) inch mains, and six (6) inch for fourteen (14) and sixteen (16) inch mains.

II-B3-2. Testing

After the completion of backfill as required by Section II-B3-1, the newly laid pipe or any valved section thereof, shall be subjected to a hydrostatic pressure and leakage test.

If the pipeline under test contains pipes of various diameters, the allowable leakage will be the

sum of the computed leakage for each size.

II-B3-2.01. PVC Plastic Pipe Leakage and Pressure Test

Each section of the pipe to be tested shall be slowly filled with water, and all air shall be expelled from the pipe. The release of the air can be accomplished by opening hydrants, air release valves, and service line cocks at the high points of the system. The valve controlling the admission of water into the section of pipe to be tested should be opened wide before closing the hydrants, air release valves, and service cocks. After the system has been filled with water and all air expelled, all the valves controlling the section to be tested shall be closed.

The test shall subject the pipe for a duration of six (6) hours of sustained pressure of not less than 200 ±5 pounds per square inch for the first two (2) hours then lowered to 150/hr. for the remaining four (4) hours. The leakage shall be accurately measured during this period to determine the rate of leakage. The maximum allowable leakage can be calculated from the following table:

ALLOWABLE LEAKAGE FOR AWWA PVC PIPE

Nominal Pipe Size, inches	**Average Test Pressure in Line, psi**				
	50	100	150	200	250
	Allowable Leakage per 1,000 feet or 50 joints, gal/hr (L/hr)				
4	.19 (.72)	.27 (1.02)	.33 (1.25)	.38 (1.44)	.43 (1.63)
6	.29 (1.10)	.41 (1.55)	.50 (1.89)	.57 (2.16)	.64 (2.42)
8	.38 (1.44)	.54 (2.04)	.66 (2.50)	.76 (2.88)	.85 (3.22)
10	.48 (1.82)	.68 (2.57)	.83 (3.14)	.96 (3.63)	1.07 (4.05)
12	.57 (2.16)	.81 (3.07)	.99 (3.75)	1.15 (4.35)	1.28 (4.84)

II-B3-2.02. Ductile Iron Pipe Pressure Test

Each section of the pipe to be tested shall be slowly filled with water and all air shall be expelled from the pipe. The release of the air can be accomplished by opening hydrants, air release valves and service line cocks at the high points of the system. The valve controlling the admission of water into the section of pipe to be tested should be opened wide before shutting the hydrants, air release valves, blowoffs, and service cocks. After the system has been filled with water and all air expelled, all the valves controlling the section to be tested shall be closed and the piping allowed to soak for a minimum of 24 hours prior to pressure test.

The test shall subject the pipe to a duration of six (6) hours of sustained pressure of not less than 200 psi for the first two (2) hours then lowered to 150 psi for the remaining four (4) hours. The leakage shall be accurately measured during this period to determine the rate of leakage. The maximum amount of leakage can be calculated from the following table:

ALLOWABLE LEAKAGE PER 1,000 FEET (305 m) OF PIPELINE,* gph**

Avg. Test Pressure psi (bar)	Nominal Pipe Diameter, inches															
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450(31)	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400(28)	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350(24)	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300(21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275(19)	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250(17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225(16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200(14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175(12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150(10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125(9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100(7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the arm of the computed leakage for each size.

** To obtain leakage in liters hour, multiply the values in the table by 3.785.

II-B3-2.03. HDPE Pressure Testing

Hydrostatic testing of HDPE pipe shall be in accordance with PPI technical report TR 31/9-79. HDPE pressure pipe shall be tested at 1.5 times the pressure rated capacity of the pipe, adjusted for the ambient temperature of the test section, for three (3) hours.

For any test pressure from 1.0 to 1.5 times the system design pressure, the total test time including initial pressurization, initial expansion, and time at test pressure, must not exceed eight (8) hours. If the pressure test is not completed due to leakage, equipment failure, etc., the test section should be de-pressurized and allowed to "relax" for at least eight (8) hours before bringing the test section up to test pressure again.

The test procedure consists of initial expansion and test phases. During the initial expansion phase, the test section is pressurized to the test pressure, and sufficient make-up water is added each hour for three (3) hours to return to test pressure. After the initial expansion phase, about four (4) hours after pressurization, the test phase begins. The test phase shall be three (3) hours, after which a measured amount of make-up water is added to return to test pressure. If the amount of make-up water added does not exceed the value in the table below, leakage is not indicated.

Nominal Pipe Diameter, Inches																		
	4	5	5- 3/8	6	7-1/8	8	10	12	13-3/8	14	16	18	20	22	24	26	28	30
Make-up Water Allowance, US Gallons per 100 ft.	0.4	0.58	0.62	0.9	1.0	1.5	2.1	3.4	3.7	4.2	5.0	6.5	8.0	10.5	13.3	15.0	16.8	19.2

II-B3-2.04. Tapping Sleeve Leakage and Pressure Test

After the assembly of the tapping sleeve, and prior to drilling of the tap, the tapping sleeve shall be subject to pressure and leakage testing.

The assembled tapping sleeve branch shall be sealed with a blind flange. The blind flange shall be fitted with a three quarter (3/4) inch NPT test plug when the tapping sleeve has no test plug. A calibrated pressure gauge shall monitor the test pressure.

Pressurized air shall be introduced through a tee fitting attached to the test port. The branch tee shall connect to the pressure gauge. The test pressure shall be 100 psi for thirty (30) minutes minimum duration without loss of pressure. When there is a drop in test pressure, the Contractor shall make the necessary corrections to make the tapping sleeve watertight. After the corrections, the tapping sleeve shall be retested.

During the assembly and testing of the tapping sleeve, the Contractor shall take the necessary precautions not to damage the existing main. Any damage to the existing main caused by the Contractor's operations shall be repaired at the Contractor's expense.

II-B3-2.05. Disinfection

Bacteriological samples will not be taken until a satisfactory hydrostatic pressure and leakage test is completed. Water samples from the disinfected pipelines shall be taken by District personnel in cooperation with the Contractor, and samples shall be tested by the District laboratory at the Contractor's expense. If bacteriological samples fail to satisfy minimum requirements, additional chlorination shall be required at the expense of the Contractor until satisfactory samples are obtained. No bacteriological samples shall be taken from fire hydrants. The Contractor shall provide, at his or her expense, an outlet from which to take the samples in accordance with Drawing W-18A. Sample points shall be installed by the Contractor at locations determined by the District Inspector.

A minimum of two bacteriological samples shall be taken from the newly installed and disinfected pipeline. The second bacteriological test sample shall be taken 24 hours after the first sample is taken. Bacteriological sample test results shall be available to the contractor within 48 hours after a sample is taken. The newly installed and disinfected pipeline shall pass two consecutive bacteriological sample tests prior to connection to the District's active potable water distribution system.

II-B3-2.05.01. Method of Disinfection

After completion of the hydrostatic pressure and leakage test, the mains shall be chlorinated in accordance with the latest revision of AWWA C651, Standards for Disinfecting Water Mains. Any one of the methods therein described may be used, with the additional requirement of 50 ppm chlorine minimum initial application. At the end of the contact period, the mains shall be thoroughly flushed and bacteriological samples taken by District personnel.

II-B3-2.05.02. Disinfection of Tie-ins

The Contractor shall disinfect all piping materials used for tie-ins by swabbing with chlorine, or by other approved methods. Following a tie-in, the area affected by the tie-in shall be thoroughly flushed and bacteriological samples will be taken by District personnel.

The exterior surfaces of the main to be enclosed by the tapping sleeve and the interior of the tapping sleeve shall be disinfected by swabbing with chlorine prior to the assembly of the tapping sleeves.

II-B3-2.06. Flushing

After completion of the test and chlorination, the Contractor shall thoroughly flush all water from the line with fresh water from the existing system to completely purge and replace the chlorinated test water. It is the Contractor's responsibility to properly dispose of the flush water in a manner that will not cause damage and/or nuisance to the environment and in compliance with state and local regulations.

II-B3-2.06.01 Tracer Wire Continuity Test

Prior to connection to existing mains and final paving, the contractor is required to conduct continuity testing of all tracer wire installed on water lines. Tests can be conducted using either applied resistance or voltage. All testing is to be conducted in the presence of a District Inspector.

II-B4. CONNECTION WITH EXISTING DISTRICT FACILITIES

II-B4-1. Connection to Existing Mains

All connections to the District's water system will be wet taps unless otherwise specified by the District Engineer. Any potable water main that has not passed a bacteriological test shall not be permanently connected to any existing potable water main or to any potable water main that has previously passed a bacteriological test. All connections shall be made in the presence of an Inspector and with the approval of the District Engineer.

II-B4-2. Valve Operation

Only certified District personnel specifically designated and authorized by the District Engineer shall operate, open, or close any valve in the system.

II-B4-3. Interruption of Service

When a shutdown of the existing system is necessary to make the connection, it will be accomplished by authorized District personnel. The operation of valves in the existing system by other than District authorized personnel will not be permitted unless approved otherwise. The Contractor shall notify in writing the District Engineer not less than seven (7) calendar days prior to the time of a required shutdown so that advance notice to customers and the fire department may be given. The Contractor shall also stipulate the expected length of the shutdown.

In general, shutdown in residential areas shall be made at times when there will be the least interference with meals. Shutdowns in other areas shall take into account any periods of heavy water use. In any event, the District must approve the timing of the shutdown and the tie-in accomplished in such a manner as to minimize the effect on any customer of the District. If the period of shutdown extends beyond the normal working hours, the Contractor shall pay the District for the necessary overtime of District personnel. No tie-ins to existing mains will be permitted until all required testing has been successfully completed.