CHAPTER 5

WATER

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5.1 Potable Water System Design

5.1.1 General Information

A. Introduction

This document provides guidance and minimum design criteria for the modification and construction of water systems within the City of Goodyear. It is intended for use in the planning, design, plan preparation, and construction processes.

The City maintains a citywide Water Master Plan that has been developed to ensure that the City's water system develops in an organized manner. Contact the City Engineering department for further information regarding latest editions and updates to this Master Plan.

Wherever the language of this document refers to equipment or material to be used, or the language of a standard refers to an Approved Materials List, the "Potable Water System Approved Materials List" shall be used. The "Flushing and Disinfecting Meter Program" and Water Line Flushing Procedures" documents shall be followed when installing new meters and water lines. These documents can be obtained from the City's Engineering Department or from the City's website, www.goodyearaz.gov.

B. Abbreviations

1. ACP - Asbestos Cement Pipe
2. ADEQ - Arizona Department of Environmental Quality
3. ADHS - Arizona Department of Health Services
4. ADWR - Arizona Department of Water Resources
5. ARS - Arizona Revised Statues
6. ARV - Air Relief Valve
7. ASETT - Arizona State Environmental Technology Training
8. DIP - Ductile Iron Pipe
9. FDC - Fire Department Connection
10. MAG - Maricopa Association of Governments
11. NFPA - National Fire Protection Association
12. PRV - Pressure Relief Valve
13. RPP - Reduced Pressure Principle
14. SCADA - Supervisory Control and Data Acquisition
15. UPC - Uniform Plumbing Code
16. USC - University of Southern California
17. VFD - Variable Frequency Drive

C. Ordinance Requirements

1. The Developer shall install, at his/her own expense, all on-site and off-site improvements necessary to service the development. This may include but is not limited to: pump stations, reservoirs, transmission mains, fire lines, fire hydrants, pressure reducing valves, and all other facilities necessary to service the development. The Developer shall also remit payment of all required development fees.

2. Each lot in a subdivision shall be supplied with safe, reliable, and potable water in a sufficient volume and pressure for domestic use and fire protection. This shall be verified by the Design Engineer by performing a flow test of that part of the potable system to be extended. The flows and pressures must meet minimum requirements for domestic and fire flow.

3. If the occupancy is to be supplied with domestic service and with fire flows from a storage tank or facility that is not City owned, the Design Engineer must provide a report indicating that sufficient volumes exist as required by the City's Fire Department, and are available to meet calculated fire demands as defined by this manual.

4. Upon development of property within the City limits, the Developer shall submit construction plans for the water system. The plans shall be prepared by a Professional Engineer licensed in the State of Arizona. All water lines and facilities constructed within the City limits shall be inspected by City of Goodyear staff.

5. The City requires developers to install water mains along street frontages of developments, where future extension of the line is required by the City Engineering Department. The street frontage is that portion of the property adjacent to a public right-of-way and/or public utility easement. If a parcel to be developed has more than one street frontage, water mains shall be installed along each frontage.

6. For current information on ordinance requirements, review of the Goodyear Code of Ordinances is recommended.

D. City Policies

Proposed developments that alter land use and are determined by the City Engineering Department to have a significant impact on the City Master Water Plan, and/or propose a water system that differs from the City's Water Master Plan, shall be financially responsible to have the City's Water Master Plan and model updated to reflect changes. The effects of Maximum Day Demand + Fire Flows, and all other water demand scenarios from these developments, will be reviewed by the City Engineering Department to verify the sizing and layout of the proposed water system elements. This information will also be used to assist the City in planning for current and future developments.

E. Private Water Companies

1. Portions of the City's municipal service area are provided water service by private water companies. Private companies shall meet the requirements defined in the ARS.

2. Modifications or construction of water systems within private water company franchise areas shall be reviewed by the City and the private water company. Private water systems shall be designed and constructed to meet the minimum requirements of this manual. The applicable review fees shall be paid and a note placed on the drawings delineating operation and maintenance responsibilities. The City cannot provide water service within private water company franchise areas.

5.1.2 Plan Preparation

A. Reports

1. Preliminary Water Information

a. Preliminary information regarding the water system for a development shall be provided for all General Plan Amendment, Rezone, and PAD applications. The preliminary information provided within these documents shall at a minimum show and discuss the conceptual location and size of the existing and proposed water distribution and transmission mains within and adjacent to the site. The text shall also identify the City water zone, discuss storage and booster facilities, and identify any foreseeable need to provide additional storage or pumping capacity to serve the development. Sites that

will be constructed in phases shall provide a master water report at the time of rezone or PAD application.

2. Master Water Report

A master water report shall be developed for each project in which the project is to be designed and constructed in a phased succession. Typically this level of planning is provided in conjunction with a rezone or PAD application.

The Master Water Report will provide a governing plan by which each individual preliminary and final water reports are based. The Master Water Report shall be prepared in accordance with this manual or as otherwise directed by the City Engineering Department and shall be signed and sealed by a Professional Engineer registered in and licensed to practice in the State of Arizona.

The objective of the report is to provide sufficient information to adequately review the water design for a proposed project.

At a minimum, the Master Water Report shall address the following:

a. The location of storage facilities serving the site, the adequacy of available storage, and the ability to meet fire and domestic flow requirements.

b. All connections to the existing system, supply (size, location, length, etc.), and whether the failure of any single pipe will disconnect the site from the system.

c. Design assumptions and computations, demands, pressure and flows, water production requirements, cathodic protection requirements, and rights-of-way or easements that exist or are being proposed.

(1). The water demand requirements for a development shall be calculated according to the information shown in Table 5.1.1 – Average Day Water Demands.

d. The Master Water Report will become the basis for a Water and Wastewater Service Agreement between the Developer and the City when such agreement is required by the City. The agreement will specify terms and requirements for water and wastewater service to the development. This shall be stated in the introduction to the report.

e. All development projects shall be responsible for determining their specific water system needs.

f. The Master Water Report shall verify that service for proposed developments shall not be provided at the expense of existing customers.

(1). A development's potable water demand requirements shall be calculated according to information shown in Table 5.1-1, Average Day Water Demands.

(2). A development's Fire Flow Demand shall be determined as identified in this chapter.

(3). A development's water storage requirements shall be determined as identified in the City Water Master Plan.

g. Computer Water Models

(1). A water model demonstrating that system pressures do not exceed the maximum nor fall below the minimum operating levels, as identified in this chapter, will be required in each water report.

(2). The water model shall specifically verify that minimum pressures are available within the development's system during the Maximum Day Demand +Fire Flow demand scenario.

(3). When requested, the water model shall be provided to the City electronically for purposes of updating the City Water Model.

(4). Proposed developments that alter land use and are determined by the City Engineering Department to have a significant impact on the City Master Water Plan, and/or propose a water system that differs from the City's Water Master Plan, shall be financially responsible to have the City's Water Master Plan and model updated to reflect changes.

(5). All model data shall include the following:

i. Average Day Demand scenario - based on information in Table 5.1-1.

ii. Maximum Day Demand scenario – 1.7 times the Average Day Demand.

iii. Maximum Day Demand + Fire Flow.

iv. Peak Hour Demand – 2.9 times the Average Day Demand.

v. The fire flows shall be determined per the Fire portion of this chapter.

vi. See the Pressure Requirements section of this chapter for minimum pressure design requirements.

vii. Pipeline calculations verifying that head loss per 1,000 feet of any pipe is no greater than 10 feet/feet during peak period demand conditions, and not more than 8 feet/feet under any maximum day condition.

viii. Sufficient supply for domestic demand must be provided without the use of dedicated fire pumps or backup pumps. Calculations which include both domestic demand plus fire flow may use fire pumps as a portion of the supply.

ix. A data CD containing all electronic calculations shall be submitted along with the Master Water Report.

h. Each Master Water Report shall show or discuss the following information:

(1). All proposed on-site and off-site facilities including, but not limited to: pump stations, transmission and distribution mains, wells, and reservoirs.

(2). Proposed street locations, parcel boundaries, and proposed lots within each parcel.

(3). Contour lines showing the elevation of the land surface shall be at 5- or 10-foot intervals. Sufficient information shall be provided to allow the evaluation of network node elevations.

(4). All water pressure zone boundaries adjacent to or within the project.

(5). A separate area location map shall be provided showing existing and proposed streets, as well as existing parcels surrounding the project, to a distance of one mile from the exterior boundaries of the project. Assessor maps may provide the information required to prepare these composite maps.

(6). The scale of all maps shall be sufficient to show all required information clearly.

i. The Master Water Report shall comply with all other requirements identified as being necessary for the functioning of the City's water system in the area as determined by the City Engineering department and City Environmental Services division.

j. More specific information regarding master water report requirements and the City's requirements for a specific area can be obtained by contacting the City's Engineering Department.

3. Preliminary Water Reports

a. The Preliminary Water Report shall be provided along with a site plan or preliminary plat application which does not require a Master Water Report.

b. When a master water report has previously been approved by the City for a master planned and phased development, the Preliminary Water Report shall follow the same development protocol as identified in the Master Report with the following exceptions:

(1). The Preliminary Water Report shall be developed to identify specific water demand and infrastructure needs for the phase(s) of development being submitted for Site Plan or Preliminary Plat approval.

(2). The Preliminary Water Report will not be the basis of a Water Services Agreement.

4. Final Water Reports

   a. A Preliminary Water Report shall be used as the basis for developing a Final Water Report.

   b. The Final Water Report shall finalize all design calculations and model information provided in the Preliminary Water Report.

   c. The Design Engineer shall have a flow test performed by a private company who will certify the results in writing to the City. The pressures determined in the Master Water Report shall be revised per this flow test information in the final water report. A copy of the flow test shall be provided to the City Engineering department and City Environmental Services division for their records.

   d. If a certified flow test(s) performed on the existing system to which the project will be connected does not confirm that sufficient capacity exists, the final report's water model shall be used to determine the required on-site and off-site facilities such as pump stations and pipelines necessary to serve the project.

B. Site Plan and Preliminary Plat Requirements

All site plans and preliminary plats shall show and label the following:

1. All existing improvements shall be shown in dashed and screened back line types. Existing improvements such as water lines (with line size and line material type clearly labeled), storage reservoirs, well sites, booster pump station sites, and associated transmission mains shall be shown and labeled. It is encouraged that a separate plan sheet be provided to show all of the public wet utilities.

2. All proposed improvements such as water lines, reservoirs, well sites, and booster pump stations shall be shown in dark lines.

3. The service provider for the area shall be labeled.

4. All existing and proposed water line easements shall be shown, labeled, and dimensioned.

C. Construction Plan Requirements

1. Review Guidelines

No permits for public water installation will be issued until the Owner/Developer has provided the necessary easements and rights-of-way. The instruments of dedication must be approved by the City and recorded at the Maricopa County Recorder's Office.

The following paragraphs highlight construction plan requirements pertaining to the preparation of water improvement plans which are to be submitted to the City for approval:

a. Plans shall be prepared per the guidelines in Chapter 2 of this manual.

b. General Construction Notes and Water Construction Notes which apply to construction of the City of Goodyear's sewer system are required on each set of construction plans which include work on the City's water system or a water system which is to be dedicated to the City. These notes are provided in the Administrative chapter of this manual.

2. Water line stationing shall be along the pipe, monument, or roadway centerline.

3. Concrete encasement shall be shown in both plan and profile. The beginning and ending stations of the encasement shall be called out.

4. If a line is to be connected to an existing system, the following note shall be placed on the plans: "Contractor shall verify the location of the existing water line prior to proceeding with trenching".

5. The end invert elevation shall be shown on all proposed water main stubs (profile required for lines larger than 12 inches).

6. Where water lines cross sewer lines, storm drains, reclaimed water lines, or drainage culverts, the relationship shall be shown in both plan and profile and actual separations shall be called out.

7. For permitting purposes, quantities for all items of work within public rights-of-way and public easements shall be included on

the cover sheet of the plans, unless otherwise approved by the City Engineer.

8. The drawings shall show all utility locations, sizes, material types, easements, rights-of-way, and other structural features of the sewer for current and future building construction.

9. Private water lines shall be noted as such on plans. The responsibility for operation and maintenance should also be called out.

10. Easements of record shall be noted and shown in plan view, including docket and page numbers and/or the Maricopa County Recorder's number.

11. There are additional requirements for the preparation of improvement plans in the City. These additional requirements are presented in Chapter 2 of this manual.

12. Prior to issuance of the reclaimed water construction permit, a construction schedule shall be included in table format for all reclaimed water-related construction required to serve a development.

D. As-Built Drawings

A City-approved set of As-Built Drawings are required for all water system improvements constructed in the City prior to acceptance of the system and start of the 2-year warranty period. As-built plans shall be signed and sealed by a qualified Professional Registrant in the State of Arizona. See Chapter 10 of this manual for applicable As-Built standards.

TABLE 5.1-1 – Average Day Water Demands

Land Use	Demand (gpdu)	Demand (gpad)	Demand (gpd/sf)
Agricultural Residential 1 DU per acre	500	-	-
Residential < 2 DU per acre	444	-	-
Residential 2 to 4 DU per acre	390	-	-
Residential 4 to 6 DU per acre	320	-	-
Residential 6 to 10 DU per acre	285	-	-
Residential 10 to 20 DU per acre	256	-	-
Residential >20 DU per acre	222	-	-
Community Commercial	-	2,033	0.14
Regional Commercial	-	2,323	0.16
Luke Compatible Land Use	-	2,323	0.16
City Center	-	12,342	0.17
Ball Park Village	-	8,228	0.17
Light Industrial	-	1,568	0.12
General Industrial	-	2,323	0.16
Public / Quasi-Public	-	2,178	0.15
Prison	-	3,630	0.25
Airport	-	363	0.15

* These numbers may need to be increased to account for irrigation if a reclaimed water system is not constructed or if reclaimed water is not available for use.

5.1.3 Production Systems

A. Construction of Water Production & Treatment Facilities

Facilities constructed for water production and treatment that are to be dedicated to the City shall be designed and built as approved by the City Engineering Department and Environmental Services division.

B. General Requirements for All Water Production Facilities

All water facilities must include the following:

1. All electrical equipment must be air conditioned.

2. Security at the facility shall be provided by constructing a minimum eight-foot block fence with two feet of wrought iron picket extension located at the top of the wall.

3. The facility shall have an automatic rolling entry gate and an access door with automated key pad for access into the facility. Auto key pad shall connect with SCADA and integrate into City access card protocols. A knock box is required for Fire Department access per City Standard Details.

4. Above ground valves eight inches in diameter and greater shall have a motorized operator device to open and close, and shall interface with SCADA.

5. All indicator lights shall be LED and push to test.

6. All equipment shall be designed for ease and safety of maintenance and repair.

7. Security cameras and an intrusion alarm system shall be provided to monitor all access areas in and around the treatment facilities, reservoir, well site, or booster pump station. These areas include, but are not limited to, the following: reservoir tank area, reservoir top hatch tank entry, wellhead area, well master control cabinets, and booster pumps. They also must interface with SCADA.

8. All valves shall be epoxy-coated valves.

9. Gate valves shall be resilient wedge valves.

10. Facility lighting shall be provided to illuminate the site in accordance with City light codes.

C. Well Facilities

1. The City shall be notified of any proposed well drilling, and shall review plans of all proposed groundwater wells.

2. Under the Arizona Groundwater Management Code, the ADWR regulates all groundwater wells in Arizona. Before drilling and installing a well, a "Notice of Intent to Drill" and "Application for a Drilling Permit" must be obtained from and filed with ADWR. The well must subsequently be registered as a recovery well with ADWR. Forms and additional information are available from the ADWR Operation's Division; contact them at 602-417-2400, or www.azwater.gov/dwr.

3. All wells, at a minimum, shall comply with the Arizona Department of Environmental Quality Engineering Bulletin No. 10, Guidelines for the Construction of Water Systems.

4. All well sites shall provide facilities and infrastructure for the application of chlorine disinfection. Any above or below ground equipment or facility associated with the well shall maintain a minimum 3 foot separation from any wall, building, or adjacent piece of equipment.

5. Production well facilities without treatment shall be constructed on a minimum 100-foot by 100-foot area, or as approved by the City Engineering department and Environmental Services division. The dedicated land shall be accessible from a public street right-of-way, or through a dedicated access easement of 23-foot minimum width.

6. Developers and property owners that abandon a water well(s) during development of a property within the City shall inform the Water Resources division and Engineering department prior to abandonment, and shall transfer all water rights into the City's name, where applicable.

7. Water wells shall be abandoned per the Arizona Department of Water Resources guidelines. These may be obtained through the following website: www.azwater.gov/dwr.

8. The well casing shall be of the Moscoe Moss Casing Type.

9. The well screening shall be of the louvered design, manufactured with stainless steel material.

10. Pumping equipment shall be designed as follows:

a. Vertical turbine water-lubricated pump.

b. Submersible pump.

11. Well construction shall include two (2) sounding tubes, one to be dedicated for (a) manual means to collect water level data and the other for (b) a level transducer to monitor continuous static, drawdown, and pumping levels of the production well to interface with SCADA. Measurements shall indicate the distance from the top of well head to the water level.

12. Flow monitoring devices will be of electromagnetic metering technology with a pulse output. The meter shall read flow in gallons per minute, and totalized gallons produced in thousand gallons, and shall be able to interface with SCADA.

13. Well sites shall be equipped with a portable generator quick connect and transfer switch.

14. VFD motor control shall be provided at all production well facilities and shall interface with SCADA, unless otherwise approved by the City Engineer.

15. VFD controls shall be housed in an enclosed climate-controlled building. This building shall be constructed with two entry doors.

16. Sound enclosures shall be provided when required for noise abatement.

17. Wells shall be provided with a flow to waste line. When a sand separator is required, an automatic flushing system with a bypass must be installed along with a discharge line and discharge location. Automatic flushing equipment shall be accompanied with features that allow 24-hour programming with 5-hour minimum increments. Equipment must interface with SCADA.

18. Eye wash stations shall be provided at all facilities that contain chemical applications.

19. Chlorination equipment shall use calcium hypochlorite and shall interface with SCADA.

20. Chlorine residual analyzer shall be installed at all sites requiring disinfection. The monitoring equipment shall interface with SCADA.

21. Chlorination equipment shall be housed in a permanent dedicated building with minimum dimensions of 10 feet by 10 feet and with a minimum of 3' clearance on all four sides. Intrusion alarms must be provided and shall interface with SCADA.

22. Hour meters shall be provided in order to monitor equipment run times and performance. These meters shall interface with SCADA.

23. All well facility equipment shall conform to the City's current SCADA standards.

D. Reservoirs

1. Storage facilities shall provide emergency fire protection and maximize the use of water production facilities. Therefore, storage in each pressure zone shall exceed each of the following criteria:

   a. Three hours Fire Flow Reserve + 25% of Maximum Day Demand, or;

   b. One Average Day Demand.

2. The capacity of new storage facilities shall be rounded up to the nearest 0.25 million gallons when being designed.

3. All tanks and reservoirs shall be supplied with dual measurement devices. 1) A visual level device (target) for tanks and reservoirs, level must be visible 24 hours a day and shall read in feet and tenths of foot increments; and 2) Two electronic level devices, primary and secondary, to interface with SCADA.

4. Retention basins around reservoirs shall be large enough to accept 1-1/2 times the maximum storage capacity.

5. Reservoirs shall be installed on a minimum 3.5-acre parcel. Parcel sizes will be reviewed and approved by the Engineering department and Environmental Services division. The dedicated land shall be accessible from a public street right-of-way or through a dedicated access easement of 23-foot minimum width.

6. All reservoirs shall be constructed with a concrete base ring.

7. Reservoir shall have an interior and exterior access ladder. Design shall meet or exceed OSHA requirements.

8. The tops of all reservoirs shall have a safety railing installed three feet in height surrounding the entire radius of the tank.

9. Reservoir vent structures shall be double contained; disassembly of the vent cover must be possible from the interior of the reservoir only.

10. All reservoirs shall have a top fill inlet and bottom outlet piping structure located at opposite sides of the reservoir.

11. Reservoirs shall be constructed of either steel welded or pre-stressed concrete (DYK), and shall follow American Water Works Association standards.

12. The height of the tank shall not exceed 12 feet from the street final grade in residential and commercial areas, unless otherwise approved by the City Engineer.

13. All steel welded constructed reservoirs shall include a cathodic protection system in order to protect the interior floor and tank walls coating. The cathodic system shall be installed from the roof structure.

14. Reservoir interior tank coating shall be a two-part epoxy process. Prime and finished coat shall have a minimum of 16 mils and must comply with SSPC-SP10. All work must be inspected by an NACE certified inspector.

15. Reservoir exterior finish shall be per the Water Production Approved Materials List and shall consist of a two coats application, and shall meet the SSPC-SP2, SP3 cleaning methods. All work must be inspected by an NACE certified inspector.

16. A 48” diameter manhole entry way shall be provided at opposite sides of the reservoir.

17. A reservoir tank draining system shall be provided for the purpose of draining and cleaning of the interior. This draining system shall consist of a center floor drain located in the interior of the tank. The tank floor shall be sloped in a direction that allows the water within the tank to flow downward and outward to a collection basin that contains additional piping to remove the flow away from the reservoir to the retention area.

18. All reservoir equipment shall conform to the City's current SCADA standards. Each entry shall be designed with a swing hinge mechanism.

E. Booster Pump Stations

1. A "Preliminary" or "Basis of Design" report shall be prepared and submitted to the City Engineering department for approval prior to submission of the station final design. This report shall outline the type of equipment and controls proposed for the station. A final design report prepared by a Registered Professional Engineer licensed in Arizona shall accompany the pump station design drawings.

2. Booster pumps shall be designed to maintain adequate pressure for domestic and fire protection water supply as identified in the City Water Master Plan.

3. Designers shall refer to ADEQ's Engineering Bulletin No. 10 for additional design criteria.

4. NOTE: It is recommended that designers coordinate their pump station design with the City Engineering department and Environmental Services divisions prior to final plan preparation.

5. All stations shall provide chlorine facilities.

6. All pump station control panels shall be designed and constructed to incorporate SCADA.

7. All booster pump station equipment shall conform to the City's current SCADA standards.

8. An analog hour meter shall be provided for each pump inside the control panel and shall interface with SCADA.

9. Pumping stations shall be equipped with electromagnetic (Magmeter) water meters which register flow in gallons per minute, totalized in thousand US gallons.

10. VFD motor controls may be provided for pump motor operation as determined by City Engineering department.

11. VFD controls shall be housed in an enclosed climate-controlled building. This building shall also house master control

equipment for pump and motors, along with any other necessary control equipment.

12. Pump discharge heads shall be provided with adequate space to allow for ease of maintenance and mechanical seal removal. Pump discharge heads shall be provided with approved removable safety guards.

13. Pump discharge equipment shall be epoxy-coated to inhibit rusting of the metal. Coatings shall comply with the approve materials list. Interior coatings shall comply with NSF-61 standards. This coating shall encompass the entire interior of the pump stuffing box area.

14. Pump motors shall be hollow shaft and shall include a coupler assembly for installation of a mechanical seal assembly. Pump design will also include a non-reversal ratcheting assembly to eliminate possible equipment failure. Pump motor design shall include a pressed steady bushing /bearing.

15. Motor assemblies shall be rated no lower than 85% efficiency.

16. Mechanical seals shall be included in all pump equipment designs and shall be a one piece design.

17. Chlorine disinfection shall be table chlorination technology and shall interface with SCADA.

18. A chlorine residual analyzer shall be provided at all sites requiring disinfection. The monitoring equipment shall interface with SCADA.

19. Chlorination equipment shall be housed in a permanent dedicated building with minimum dimensions of 10 feet by 10 feet and with a minimum of three feet of clearance on all four sides. Intrusion alarms must be provided and shall interface with SCADA.

20. Eye wash stations shall be provided at all facilities that contain chlorine disinfection on site.

21. A hydro-tank assembly shall be installed at all booster stations in order to provide an expansion point for possible system water hammer. All hydro-tank ports / taps shall be 3/4-inch or larger. Entry access (manway) shall be located below the midpoint of the end of the vessel and a minimum opening dimension of 18” x 24”.

22. Approved electronic measuring devices shall be installed on all hydro-tank assemblies, along with a measuring sight glass in order to check hydro-tank water/air level. All connecting pipes shall be a minimum of 3/4-inches in diameter.

23. Air compressors shall be provided for hydro-tank control. The air compressor unit shall be protected and enclosed inside a clamshell design lockable cage assembly. The unit shall include automatic purge valve with manual test and by-pass. Air compressors shall be furnished with an H-O-A switch and an hour meter that will interface with SCADA.

24. System pressure monitoring shall be accessed via a pressure transducer and shall interface with SCADA.

25. Standby power emergency diesel generator(s) shall be installed at all facilities. Generator size shall be approved by the City Engineering department and Environmental Services division.

F. Treatment Facilities

1. Reverse osmosis treatment shall be designed around 8-inch spiral wound membrane technology.

2. Arsenic treatment systems shall be design with a Lead-Lag paired configuration.

3. All brine waste line piping shall be constructed of C900 material.

4. All reverse osmosis shall be housed in a permanent building that will include all basic safety equipment and sanitary needs.

5. The reverse osmosis facility shall include a pretreatment filtration system, and pre- and post-chemical treatment as necessary based on water chemistry.

6. A Clean in Place (CIP) system shall be provided with a reverse osmosis facility.

7. Additional information on reverse osmosis design standards can be obtained from the City Environmental Services division.

8. Treatment facility feed water piping shall be constructed of DIP.

9. Treatment facility piping shall either be buried or be located below elevated flooring as much as possible.

10. Treatment facility controls and equipment shall be housed in an enclosed, climate controlled environment.

G. Pressure Reducing/Pressure Sustaining Valve

1. All pressure reducing/pressure sustaining valves shall be telemetry compatible with SCADA.

2. Pressure reducing/pressure sustaining valves shall be designed in accordance with the criteria shown in the City's Standard Details.

5.1.4 Water Lines

A. General Information

The City potable water delivery system, which is based on a grid system, has three basic classifications of water lines which are determined by use. These classifications are transmission, distribution, and service.

1. ADHS Bulletin 10 shall apply to the design of all City water lines.

2. All developments shall design and construct water transmission, distribution, services, and associated equipment of appropriate size, material identified through the City's Master Plan and the project design reports.

3. The City Construction Inspector shall be contacted 48 hours prior to all water system shutdowns. The Contractor shall have all materials and equipment necessary to do the work at the job site prior to shutdown. It shall be the Contractor's responsibility to provide all affected water customers with a written notice of the proposed shutdown. Such notice shall be given a minimum of 24 hours in advance.

4. Water mains shall be identified by:

a. Locating tape labeled WATER and placed a minimum of 12" above the water main.

B. Transmission Lines

Transmission lines are used to convey potable or raw water to storage tanks or other points of distribution. In general, they have

line sizes of 16 inches and larger and are located in arterial or collector streets.

1. Major arterial street alignments shall have 16-inch minimum diameter lines.

2. When existing or future development requirements are such that a transmission water line is required, then a transmission water line of a size approved by the City Engineering department and designed and sealed by a Professional Engineer shall be constructed by the Developer.

3. Design flows for transmission mains shall be based on the current City General Plan and City Water Master Plan. The flow to a new development shall be calculated to confirm that existing supply is sufficient to meet the proposed development's need. When additional improvements are required to increase the flow to a development, all necessary improvements, including but not limited to, pumping stations, reservoirs, lines, and appurtenances shall be a part of the design.

4. Peak flow calculations on transmission mains shall be based on fire flow figures in accordance with the City Fire Code.

C. Distribution Lines

Distribution lines are typically sizes 8 inches to 12 inches in diameter, and are located in arterial, collector, or local streets. Distribution mains are supplied by transmission lines and may have service connections.

1. See the City's Approved Materials List for approved materials.

2. Minor arterial street alignments shall have 12-inch minimum diameter lines.

3. Eight-inch diameter pipe shall be the minimum diameter of a distribution main installed in any street or public easement.

4. These are minimum guidelines; the City may require larger sizes, different materials, and varying locations depending on circumstances.

D. Service Connections

A service connection includes the water line from the distribution main to the meter, and includes the meter and all connections.

1. Water Services to Residential Developments

a. The Developer shall only install 1-inch and/or 2-inch water services in new residential subdivisions.

b. The Developer is responsible for application and payment of all applicable fees.

c. Water services maintained by the City shall be installed within a public right-of-way, PUE, or 20-foot minimum width dedicated water line easement.

d. All water service lines constructed under existing pavement shall be installed by underground boring.

e. Within the right-of-way, cover for water service lines shall be a minimum of 36” measured from existing or proposed finished grade of pavement or natural ground, whichever measurement is greater and results in adequate pipe protection during construction.

f. Water service lines maintained by the City shall not be located in parking spaces, driveways, washes, manmade or natural drainage channels, or retention/detention basins.

g. Construction plans shall indicate the locations of service lines and sewer taps to each unit referenced, with stations and dimensions from the street center line or monument line. Location of the sewer service relative to the water service shall also be shown.

h. Service connections shall not be made to mains 16 inches or larger in diameter or to water lines designed solely to transmit water from one pressure zone to another pressure zone.

i. All galvanized iron and polyethylene (PVC) water service lines and fittings in sizes 3/4-inch through 2 inches, which are exposed during construction, shall be replaced in their entirety with Type “K” copper tubing and bronze fittings. This will include the replacement of iron service saddles with low lead brass saddles, and the

replacement of both the corporation stop and the meter stop with low lead brass fittings in all cases when a direct tap is present.

j. Only soft Type “K” seamless annealed copper is to be used on water services; sweated joints will not be allowed.

k. All service lines for potable water use shall be a separate dedicated line that is tapped off the water main within a public right-of-way, PUE, or water line easement.

l. Branched water service line tees are not allowed.

m. Newly installed water services shall not have a compression coupling installed without written approval from the Environmental Services division.

n. Services damaged after installation are required to be replaced back to the corporation stop.

2. Water Meters

a. General Information

Water meters to be used shall conform to City Standard Specifications and approved materials list for water meters as found on the City Engineering webpage. Information regarding water meters may be obtained from the City Environmental Services division. Types of approved water meters include:

(1). Positive Displacement - Single and multi-family residential.

(2). Compound - Generally residential, this unit is designed for use where most of the flow is low, some intermittent, and no more than occasionally high.

(3). Turbo – Generally irrigation, this shall be used where a wide variety of flows can be expected, but most are at the high end.

b. Each building requiring a separate water bill (including single-family residences) shall have a separate water meter installed.

c. There shall only be one water meter per service line.

d. Manifolding, combining, or connecting several smaller meters to meet a flow demand that could be provided by a single larger meter is not permitted.

e. Water meters shall be sized and designed in accordance with the requirements of the UPC as adopted by the City. Any field changes shall require a letter from the developer with an approval from a registered engineer and the City Engineering Department.

f. Water Meter Installation

All water meters shall be provided by the City, after payment of all prevailing fees.

(1). All 3/4-inch to 2-inch water meters shall be installed by City Public Works personnel.

(2). Water meters 3 inches to 6 inches shall be installed by the Developer in accordance with City Standard Details and MAG Standard Specification, Section 631. After installation, City personnel will inspect and accept the work if all requirements for installation are met.

g. Water Meter Locating

(1). Water meters shall be located outside of street improvements but within the right-of-way or adjacent PUE.

(2). Water meters shall not be located in parking lots, driveways, sidewalks, washes, manmade or natural drainage channels, or retention/detention basins.

(3). Water meters shall not be fenced in or enclosed, and must be accessible by City personnel at all times.

(4). If an existing water service/meter must be relocated, a contractor or property owner may relocate the service a maximum distance of 10 feet, provided the joint is not below concrete, asphaltic pavement or other permanent surfaces without prior approval from the Engineering department. If the desired relocation is greater than 10 feet, the old service must be severed and shut off at the corporation stop

on the main; a new service shall be installed by a licensed contractor. Both services shall be noted on the “as-built” drawings.

3. Water Meter Boxes and Vaults

   a. Residential Water Meter Boxes

      (1). Water meter boxes shall be installed within the right-of-way or PUE at a distance of no less than 1-foot back of curb for detached sidewalks, and no less than 1-foot back of sidewalk for attached sidewalks. The elevation shall be 0.2 feet above the adjacent sidewalk or curb. See City Standard Details.

   b. Water Meter Vaults 3 to 6 inches and Larger

      (1). Water meter vaults for sizes 3 to 6 inches shall be installed in a vault as shown in the City Standard Details.

      (2). Vaults for water meters larger than 6 inches shall be reviewed and approved by the City Engineering department on a case-by-case basis.

4. Taps

   a. Both installation of tapping sleeves and the tapping of an energized water main shall be performed by the Developer, after approval is received by the City Engineering department and City Environmental Services divisions.

   b. A 3-foot minimum separation is required between service taps, and between a service tap and a pipe connection on a main water line.

   c. A double strap low lead brass saddle shall be installed on newly installed water service taps.

   d. Service taps are prohibited on any line primarily designed to service fire sprinkler systems and/or fire hydrants.

   e. Taps

      (1). The Contractor shall make all taps from the City's operational water system.

(2). The Developer is responsible for preparing application and payment of all applicable fees prior to taps being made.

E. Water Quality Division

1. Water lines shall be disinfected in strict conformance with MAG Standard Specification, Section 611.9, and the City's "Flushing and Disinfecting Meter Program" and "Water Line Flushing Procedures". Dry powdered calcium hypochlorite compounds shall not be placed within pipelines during construction.

2. Notify the City Construction Inspector when samples are ready to be taken to verify disinfection of water lines. The City Construction Inspector must be present, and samples shall be collected in strict conformance with MAG Standard Specification, Section 611.15. The Contracting Agency is the City of Goodyear, and it is the responsibility of the Developer to hire a certified lab to process the samples.

3. Sampling Stations

a. The City requires water quality sampling stations to be located in all new developments. The sampling stations are to be located within the right-of-way and in a full flow path area (see City Standard Details). Sampling stations shall be constructed per City Standard Details.

b. A sampling station shall be provided in residential developments at a minimum rate of 1 station for every 100 dwelling units. All residential developments shall have a minimum of one sampling station.

c. A sampling station shall be installed prior to the issuance of building permits for each new group of 100 dwelling units.

F. Pipe Materials

1. Standard material for water lines located within a City right-of-way or PUE shall be per the City Approved Materials List and installed per this manual, City Standard Details and MAG Standard Specifications and Details.

2. All DIP lines larger than 12 inches in diameter shall be encased in polyethylene wrap per MAG Standard Specifications.

Polyethylene wrap shall be installed per manufacturer specifications.

3. Water lines located within private property and not within a City right-of-way, PUE, or water line easement may be constructed of C900 PVC Class 200 pipe.

4. For all concrete cylinder pipe, ductile iron pipe, or other metallic pipe installations, soil corrosivity tests shall be conducted and reported in accordance with the American Ductile Iron Pipe Research Association. Reports shall be filed with the City Engineering Department.

G. Locating Water Lines

1. Where conditions prevent adequate horizontal and vertical separation between a water line and a sewer and/or reclaimed water line, each line shall be constructed of DIP (minimum Class 250 for mains smaller than 24 inches and 200 for mains 24 inches and larger) with mechanical or flanged joints per MAG.

2. Separation of water and electrical or gas lines shall conform to City Standard Details.

3. Locating Water Lines within City rights-of-way

   a. Rights-of-way and/or utility easements shall be dedicated to the City prior to the issuance of construction permits.

   b. Water line location in rights-of-way shall be in accordance with City Standard Details.

4. Cut stakes shall be set for all trenching of waterlines 12 inches or greater in diameter.

5. Locating Water Lines within Easements

   a. A water line shall not be installed unless the property owner has granted all necessary easements and rights-of-way to the City.

   b. All water lines which cross golf courses, open areas, or any area outside a dedicated right-of-way shall be located within a minimum 20-foot wide water line easement that is dedicated to the City.

c. Easements wider than 20 feet will be required if multiple utilities are co-located, or if additional area is required for maintenance equipment access due to the size and/or depth of the lines.

d. No structures of any kind shall be constructed or placed within or over a utility easement except: utilities, wire (or removable section-type) fencing, wood, decomposed granite, grass, or asphalt paving.

e. Easements shall at all times be clear and accessible to City service equipment such as trucks, backhoes, etc. Easements shall be accessible from City rights-of-way or other easements.

f. Easements shall be dedicated prior to the commencement of construction activities.

6. Locating Water Lines in Areas not Accessible by Normal Excavation Methods

a. All pipe in these areas must be restrained DIP through the inaccessible area, extending one full joint-length before and after the section.

b. All pipes must be sleeved using C900 PVC Class 200 pipe.

H. Cover and Bedding Requirements

1. Water mains in arterial and major collector streets shall have a minimum cover of 48 inches over the top of pipe to top of finished grade. Water mains in other locations shall have a minimum cover over the top of pipe as follows:

a. 48 inches for water lines 12 inches and larger.

b. 48 inches for water mains in industrial areas.

c. 36 inches for water lines smaller than 12 inches, and all lines in minor collector streets, residential streets, and in utility easements.

2. Cover for water mains shall be measured from existing or proposed finished grade of pavement or natural ground, whichever measurement is greater and results in adequate pipe protection during construction.

3. The proposed depth shall be clearly noted in each plan sheet. Any changes in depth required to avoid conflicting utilities, etc., shall be noted.

4. When PVC or ACP water lines 12 inches and smaller are exposed during construction and the bedding is disturbed, the water line shall be removed to the nearest joints and replaced with DIP (minimum Class 250) with restrained, mechanical, or flanged joints.

I. Pressure Requirements

Pressure extremes in water systems result in potential for contamination to enter the network. Low pressures in the water system may allow polluted fluids to be forced into the system. High pressures may cause ruptures or breaks in some elements of the network.

1. Engineers designing domestic water systems shall use 20 psi under fire flow conditions per ADEQ as the minimum basis of design for pressure at the highest ground level to be served (highest finished floor elevation). Operating water system pressure shall be a minimum of 40 psi and shall not exceed 100 psi. Any pressures greater than 80 psi will require compliance with the Uniform Plumbing Code. Ultimate pressure requirements shall be approved by the City Engineering department.

2. All water mains and service lines shall be designed for a minimum normal internal working pressure of 150 psi plus appropriate allowances for water hammer.

3. Water hammer may produce momentary pressures greatly in excess of normal static pressures, thus increasing the probability of water main failure.

   a. Suitable provisions shall be made to protect the system from water hammer.

   b. The occurrence and severity of water hammer can be reduced through the use of slow-closing valves, pressure-release valves, surge tanks, VFDs, soft-start motor controllers, and air chambers.

4. In cases where greater than the above noted maximum pressures are required for effective operation, all elements of the system shall be designed accordingly. Pressure information

for existing water lines may be obtained by having a flow test performed on the existing system.

a. A Right-of-Way Permit issued by the City Engineering Department is necessary to perform the flow test.

b. These tests may be performed by a private fire protection company who must certify the results of the tests and submit them to the City Engineering department and City Environmental Services divisions.

c. Flow testing shall be arranged through the City. A minimum of 48 hours notice shall be given prior to testing.

J. Miscellaneous Requirements and Specifications

1. All new water mains shall be designed in a looped configuration, with exceptions being dead-end lines with lengths less than or equal to the maximum allowable length (as determined by fire hydrant limitations).

2. Trenching, backfilling, and compacting shall be in accordance with MAG Standard Specifications unless otherwise specified in this manual.

3. Water lines that terminate at the end of a cul-de-sac shall have a fire hydrant at the non-connected end. The end point of future connections shall have a device for flushing or de-pressurization. In no case shall a fire hydrant be located in a wash, natural or manmade drainage way, detention or retention basin, sidewalk, or driveway.

4. No water line shall be deflected or swept (either vertically or horizontally) in excess of the maximum recommended deflection specified by the manufacturer of the pipe or coupling. The appropriate use of bends or offsets shall be used where the maximum deflection is exceeded. Fittings may be required where more than two pipe lengths are deflected.

5. The minimum clearance under major washes, culverts, storm drain lines, manmade and natural drainage ways, canals, railroads, highways, bridges, airports, etc. shall be 2 feet.

6. All changes in direction in water lines 6 inches or larger in diameter shall be marked with a programmable electronic ball marker. Valve locations permit adequate identification of pipeline location (typically at crosses and tees). Electronic

markers ball manufacturers and models shall comply with the City Approved Materials List.

7. Water lines to be abandoned shall be approved by the City Engineering department.

8. Water lines shall be restrained per MAG standards.

5.1.5 Valves and Zone Splits

A. General Valve Requirements

1. Valve Specifications

a. All gate valves shall be resilient seated, solid wedge gate, and shall open left.

b. Butterfly valves shall be required on water mains larger than 16 inches.

c. At selected locations between the City's water zones, special water zone valves shall be installed if not previously existing.

d. Per City Standard Details, valved bypass lines shall be required on valves larger than 16 inches in diameter.

e. Manholes shall be provided for all butterfly valves as identified in the City Standard Details.

f. Valve box installations and grade adjustments shall be performed per MAG Standard Detail, No. 391-1 Type "A" and 391-2.

g. Debris caps shall be included along with all valve box installations. Debris caps shall conform to City Standard Details.

h. When encountered during construction, existing valve boxes shall be replaced to meet MAG Standard Detail, No. 391-1 Type "A" and 391-2 with associated debris caps.

2. Spacing

a. Valve spacing for transmission mains with no branches shall be no less than 1/4-mile and no more than 1/2-mile.

b. The maximum spacing of valves on distribution mains shall be 660 feet for all types of developments.

c. Valve Isolation

(1). The maximum number of valves required to isolate an area is four, with two or three being the preferred number.

(2). No more than two fire hydrants shall be out of service at any given time due to any given valve closure.

(3). No more than 30 homes shall be without water due to a single valve closure.

d. Valves shall be spaced and located such that they are beneficial to the operation and maintenance of the system. The City Engineering department shall approve all valve locations.

e. Where valves are to be located off of a tee or cross, the valves shall be flanged to the tee or cross.

f. Valves shall be provided to allow for the isolation of lines crossing major washes, culverts, storm drain lines, manmade and natural drainage ways, canals, railroads, highways, bridges, airports, etc. as directed by the City Engineering department.

g. All mains branching from feeder mains or loops shall be valved adjacent to the feeders so that the branch mains can be taken out of service without interrupting the supply to other locations.

h. Any water line that will be extended in the future shall have a valve, along with a 13-foot minimum stub and a fire hydrant at the non-connected end.

3. Operation

   a. Only City personnel are authorized to open and close all existing water valves at all times and in all circumstances: flushing, pressure testing, chlorinating, etc.

   b. Valves that control the Water System Zone Split shall be designated by permanently imprinting the letters "ZS" on the lid.

   c. Valves intended to remain closed shall be designated by painting those valve covers white.

4. Backfilling and Compaction

   a. The area immediately surrounding any City valve shall be compacted. A test(s) verifying the compaction of the soil around the valve shall be provided to the City for each 3-foot depth of trench backfill, and prior to placement of any portion of pavement section materials (ABC or asphaltic concrete).

   b. Compaction testing around valves shall be performed as follows:

      (1). A minimum one test per valve per water valve cluster shall be performed unless additional tests are required by the City Inspector. The test(s) shall be performed within 2 horizontal feet of the valve and directly over the water main. Care shall be taken to prevent damage to the pipe and valve during compaction and testing.

      (2). Additional compaction tests may be required as determined on a case-by-case basis. The need for additional tests will be identified by City Engineering Department representatives.

B. Air Release Valves

Air release valves shall be installed on all water mains 12 inches or larger unless otherwise required by the City Engineer and as follows:

1. When water line changes from a positive slope to a zero slope in primary direction of flow.

2. When water line changes from a positive slope to a negative slope in primary direction of flow.

3. When water line changes from a zero slope to a negative slope in primary direction of flow.

4. When vertical alignment changes to undercross or overcross another facility (i.e. utility, drainage wash, etc.), air release valves shall be installed on both sides of the crossing where conditions identified in standards 1 through 3 above exist. In cases where a positive slope is maintained across the vertical alignment, an air release valve is required on the upstream side only. Isolation valves shall also be constructed on either side of a vertical alignment.

5. NOTE: Slopes less than or equal to 0.002 feet/feet shall be treated as zero slopes.

6. All air release valves shall be a combination air/vacuum release type per the City Approved Materials List.

C. Pressure Reducing Valves

1. Transmission and Distribution Lines

a. PRVs on transmission and distribution lines shall be rated to maintain pressures between 40 psi and 100 psi within the distribution system.

b. PRVs shall be designed in accordance with the criteria shown in City Standard Details and as outlined in the City Water Master Plan.

c. A vault shall be provided for each PRV as shown in the City Standard Details.

d. PRVs shall be located in the right-of-way or water easement accessible from the right-of-way.

2. Residential Services

The City operates its system from wells and pump stations that commonly have pressures exceeding 80 psi. Changes in demand, supply, and the distribution system also vary the pressure at single family residences.

a. The Uniform Plumbing Code requires a PRV to be placed at each structure when local water pressure exceeds 80 psi.

b. The City requires single family residences to have a PRV installed on service lines where pressures at the taps are greater than 80 psi.

D. Zone Splits

The City's water distribution system may be divided into various water zones as defined by the City Master Water Plan. If approved, each zone shall operate as an independent water distribution system. Cross-connections between zones are prohibited.

1. Valves

See the Valve section of this chapter.

2. Special Requirements for Developments Bordering Zone Splits

If a proposed development is located adjacent to a zone split boundary, the Developer shall extend, as necessary, redundant water mains within the development's side of the zone split boundary to close the zone loop.

3. Plans

Plans for water distribution mains adjacent to a zone split boundary shall clearly indicate the different zones involved and the location of the zone split boundary.

5.1.6 Fire Lines and Associated Equipment

A. Fire Lines

1. Location of on-site fire lines and taps should be determined by the site relationships of the fire department connection, riser location, emergency access, and fire hydrant locations. Fire lines sizes shall be determined by City design criteria and flow test data provided by the Design Engineer for the design of the project. All fire systems that connect to a potable water distribution system shall include a double detector check valve backflow assembly, utilizing a meter provided by the Service Provider at each connection.

2. Fire line designs shall be based on a flow test per the Fire Flow Requirements section of this manual. The drawings shall be of uniform size (24-inch by 36-inch) and shall be drawn to scale. One set of the approved civil water plans shall accompany this submittal. Applicable City and NFPA 24 construction notes shall also be included on the construction drawings.

3. All fire lines shall be dedicated for fire use only. No other water lines or water service lines shall be connected to a dedicated fire line. Installation shall be completed per the City-approved construction plans.

4. Private fire line mains shall be installed and inspected per the NFPA 24 Standard, and shall include an isolation valve for each individual fire line.

5. The Owner shall be responsible for maintenance of the sprinkler line/fire line main beyond the service line valve.

6. Fire sprinkler line locations shall be such that maintenance activity will not disrupt normal access to the development.

B. Fire Hydrants

1. General Requirements

a. Fire hydrants and associated bypass assemblies shall be installed as identified in the standard details and this chapter.

b. The Developer shall provide the fire hydrant, materials, and all labor required for installation.

c. All new fire hydrant installations will be installed per manufacturer’s specifications. Extensions shall not be used to reach finished grade.

d. Where the finished grade around existing fire hydrants is changed, an extension kit, installed per manufacturer’s specifications, may be used. Refer to the City Approved Materials List for approved products.

e. One valve shall be placed between each fire hydrant and the water main.

f. Valves for fire hydrant connections shall be flanged to the tee.

g. All fire hydrants that are privately owned shall be painted red.

h. All public fire hydrants shall be painted yellow. See the City Approved Materials List for approved paints.

2. Spacing

a. The spacing of fire hydrants is to be measured along the street or roadway in which a fire hose would be laid. Generally, this spacing is measured along the curb line.

b. Fire hydrants shall be located outside of street improvements but within the right-of-way or public utility easement. General spacing for fire hydrants shall be:

(1). 400 feet maximum in a single-family residential development or a commercial development.

(2). 1,000 feet maximum in a single-family residential development meeting the following requirements:

i. Advance approval is given by the City Engineering and Fire departments.

ii. All residences are equipped with a City-approved fire sprinkler system.

(3). 300 feet maximum in a multi-family residential development.

(4). 300 feet maximum in a high rise, storage, or industrial complex.

(5). 1,320 feet maximum for transmission mains.

(6). Fire hydrants shall not be installed on any portion of a dead-end line which is more than 400 feet from a looped water line.

(7). A fire hydrant shall be located within 150 feet of the fire department connection (FDC).

(8). Fire hydrant spacing shall be maintained along required Fire Department access roads.

3. Locations

   a. The location of a fire hydrant shall be such that the pipe leading to the hydrant will be under the least amount of pavement.

   b. Private and public fire hydrants shall be accessible per the Fire Department requirements.

   c. A 7-foot minimum clearance shall be maintained around the fire hydrant from landscape material with a maturity height exceeding 6 inches per City Standard Details.

   d. Fire hydrant protection is required where no curb is present, per the City standard detail.

4. Backfilling and Compaction

   a. The area immediately surrounding any City fire hydrant shall be compacted per MAG Standards. Test(s) verifying the compaction of the ABC around the hydrant shall be provided to the City for each 3-foot depth of trench backfill, and prior to placement of any portion of pavement section materials (ABC or asphaltic concrete).

   b. Compaction testing around hydrants shall be performed as follows:

      (1). A minimum one test per hydrant per 3-foot depth of trench backfill shall be performed. The test(s) shall be performed within 2 horizontal feet of the hydrant. Care shall be taken to prevent damage to the hydrant, valve, or water main during compaction and testing.

      (2). Additional compaction tests may be required as determined on a case-by-case basis. The need for additional tests will be identified by City Engineering Department representatives.

5. Retro-Reflective Pavement Marker Requirements

   a. Blue retro-reflective pavement markers shall be used as a method of identifying fire hydrant locations. Retro-reflective pavement markers shall be per the City Approved Materials List.

b. Blue marker installations shall conform to the following required marker installation locations:

(1). Two-Way Streets or Roads and Private Drives in apartments, condos, etc: Markers should be placed 6 inches from edge of painted centerline on the side nearest the fire hydrant. If the street has no centerline, the marker should be placed 6 inches from the approximate center of the roadway on the side nearest the hydrant.

(2). Streets with Left Turn Lanes at Intersections: Markers should be placed 6 inches from edge of the painted white line (designating the left turn lane) on the side nearest the hydrant.

(3). Streets with Continuous Two-Way Left Turn Lanes: Markers should be placed 6 inches from the edge of the painted yellow barrier line on the side nearest the fire hydrant.

(4). Street with Raised Medians: Markers should be placed 6 inches from lip of gutter on the side nearest the fire hydrant, and on the top of median curb on the side opposite the fire hydrant.

(5). Freeways and Expressways: Because of higher maintenance at these locations if placed on the roadway, markers should be placed on the shoulder 1 foot to the right of the painted edge line opposite the right-of-way fire hydrant location.

C. Fire Department Connections

1. General Requirements

a. FDCs from service lines (4 inches and larger), and all hydrant connections, shall be constructed of DIP (minimum Class 150 or equal) to the supply line class.

b. All FDCs shall be located in a visible location and shall have an unobstructed access, as approved by the Fire Department.

c. FDCs shall be located and arranged so that the hose can be readily attached without obstructions.

d. FDCs shall be installed on the customer side of the water double detector check valve and shall be painted red.

e. Signage for FDCs shall be used if the FDC is not easily visible and shall be in conformance with the most currently adopted City Fire Code.

f. There shall be a minimum of 18 inches to the bottom and a maximum of 48 inches to the top of the FDC. See the City Standard Details.

g. Fire risers and FDCs located at the building do not need to be co-located.

D. Fire Flow Requirements

1. Water distribution facilities shall be sized to deliver a minimum fire flow of:

a. 3,500 gpm to commercial, industrial, and multi-family residential properties.

b. 1,500 gpm to 1- and 2-family dwelling unit residential properties.

2. Fire flow for builidings with approved automatic sprinkler systems shall be determined based on the requirements of the City Fire Code.

3. Fire flow tests are valid for a period of six months, unless a known significant change has been made to the City's system or private water system within the 6 month period.

E. Fire Equipment & Storage Facilities

1. A double detector check valve backflow assembly is required on all fire line connections to a City water main. Information on backflow prevention may be found in the Cross-Connection Section of this chapter.

2. Auxiliary Storage Tanks

a. Auxiliary storage tanks for commercial developments shall provide pressurized Fire Flow Demand as required by the City Fire Department for a minimum 3 hours time period, per the City's Integrated Master Water Plan (IWMP).

b. Where a building's construction type, occupancy fire load, commodities' classification, volumetric building area, building height and individual square footage areas per floor level require a pressurized Fire Flow Demand in excess of the transmission main's capabilities, a fire pump package shall be installed.

c. For residential storage requirements see the City Ordinance.

5.1.7 Cross-Connection Control

It shall be the responsibility of the City to protect the public water system from health hazards and non-health hazards by the implementation of a cross-connection control program. The program shall consist of inspection by the City Environmental Services division and implementation of a backflow prevention and maintenance program, as outlined in the "Manual of Cross-Connection Control" published by USC.

A. Implementation

1. Air-gap separation shall be required for developments where entry is or will be restricted and cross-connection inspections cannot be made with sufficient frequency or can only be made on short notice. Air-gap separation shall be required in, but not limited to, areas where the following high-hazard conditions exist:

a. Public water system is used to supplement reclaimed water.

b. Wastewater is pumped and/or treated.

c. Reclaimed water is used.

d. Hazardous substances are handled or stored.

e. Irrigation systems exist into which fertilizers, herbicides, or pesticides could be injected.

f. Unapproved water supply exists which is interconnected with the public water system.

g. As required by ADEQ, or the City Public Works and Engineering departments.

2. RPP (or at times DC Valve Assembly backflow prevention) devices shall be required in locations where air-gap is not required, or where entry is not restricted and cross-connection inspection can be made with sufficient frequency or on short notice. Specific uses of these backflow prevention devices are as follows:

   a. An RPP backflow prevention device may be installed on all lines that connect to the City's potable water system, but shall be installed at all connections in which a double check detector backflow prevention device is not permitted.

   b. Double check valve assembly backflow prevention devices may only be installed on dedicated fire lines that supply fire flow to a structure. DC assemblies shall not be installed in the following situations:

      (1). When a chemical is used in the fire suppression system.

      (2). When an on-site private storage tank for fire suppression is located on the premises.

      (3). When an on-site booster pumping system is located on the fire line or private storage tank.

3. Detection Assemblies

   a. RPP detection assemblies may be used on all fire suppression systems, but shall be used on all private waterlines that tap into the City's potable water system with the exception of fire lines that do not. RPP detection assemblies shall be required on all Class V and VI fire sprinkler systems. An RPP detection assembly shall also be required when any hazardous or nonhazardous solutions are added to the fire sprinkler systems or used as part of the fire protection system.

   b. DC detection assemblies may be used on all nonresidential fire sprinkler systems where the City's potable water supply is used. A DC detection assembly may be considered for fire sprinkler systems in residential dwellings that are constructed with approved potable water piping and materials. A DC detection assembly may be used on Class I, II, III and IV fire protection systems.

B. Installation

The Owner, at their own expense, shall purchase, install, operate, and maintain any approved backflow prevention device required by the City. Approved cross-connection equipment manufacturers and models are identified in the City Approved Materials List. Installation of approved backflow prevention devices shall be as follows:

1. All backflow prevention devices shall be constructed with a security enclosure.

2. An air-gap separation shall be located as close as practical to the user's connection at the meter. The piping between the user's connection and the receiving tank shall be entirely visible. The air-gap separation shall be at least twice the diameter of the supply pipe, measured vertically from the flood rim of the receiving vessel to the supply pipe. In no case shall this separation be less than 1inch. See the City Standard Details for approved air-gap separation methods for portable tanks.

3. RPP and DC Valve Assembly backflow prevention devices and detection assemblies shall be located outside of the PUE and shall be installed as close as practical to the user's water meter. See the City Standard Details for backflow prevention methods on portable tanks.

   a. RPP and DC Valve Assembly backflow prevention devices and assemblies shall be installed a minimum of 12 inches above grade and not more than 36 inches above grade, with 12 inches of clearance on both sides, and in a manner where it is accessible for testing.

      (1). For RPP and DC backflow prevention device installation information, see the City Standard Details.

C. Maintenance

Maintenance of backflow prevention devices shall be as follows:

1. Backflow prevention devices shall be tested immediately after installation, relocation, or repair. Devices shall not be placed in service unless they are functioning as required.

2. Devices shall be tested on an annual basis, or more frequently if determined to be necessary. When devices are found to be defective they shall be repaired or replaced.

3. Backflow prevention devices shall be tested by persons certified as a General Tester or Specialist by USC, ASETT, ABPA or IAPMO.

4. Accurate records of these tests shall be maintained by the City for a minimum of 5 years. Copies of these records shall be submitted to the City Environmental Services division.