

WATER & WASTEWATER SYSTEM DESIGN

Technical Design Manuals 1 & 2



Chandler • Arizona

January 2014

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1) Introduction

A. Policy

The City Engineer reserves the right to modify the requirements of this manual when necessary for the public interest.

Please note that City Code Chapter 47-1 Definitions: Off-Site Improvements provides that "...water lines or pipes four or more inches in diameter, sewer lines or pipes eight or more inches in diameter, together with water and sewer services and their appurtenances, shall be deemed off-site improvements as regulated by this chapter of the Code." Please refer to City Code Chapter 47 - Off-Site Construction Improvement Requirements for Property Development for City Code requirements.

Refer to the *Water, Wastewater, Reclaimed Water Master Plan* for additional policy and planning issues.

All pipe trenches shall contain locator wire and identification tape in accordance with Detail C-408. All pipe backfill shall be half-sack CLSM in accordance with MAG Section 728 unless ABC or native material is pre- approved during plan review. Paved surface replacement shall be in accordance with MAG Std Dtl 200, T-Top with a 16" minimum depth of ABC shelf.

I. Potable Water

Please refer to City Code Chapter 52 - Water Services for City Code requirements.

Water lines are required adjacent to all public streets. Water lines shall border each development to be served with municipal water. Developers shall install water lines, service lines, valves, fittings, and appurtenances within and adjacent to developments and as determined by the City Engineer. Stub-outs for future services shall be constructed.

A water system infrastructure analysis shall be required for proposed developments determined by the City Engineer to have a large impact on the water system. The developer of the property shall be responsible for the costs associated with the infrastructure analysis.

Under special conditions the City may accept a public water line on private property. All of the following conditions must be met:

- The water line must be fully integrated with the public water system and the water line must be tied into the public system at each end.
- The water line must be in a dedicated easement.
- The water line must meet City construction standards.
- The City Engineer must determine that acceptance of the water line benefits the City.
- Pipe shall be ductile iron pipe per AWWA C151, pressure class 350.

Per City Code, all water lines 4 inches in diameter and larger are subject to all of the requirements listed in this manual and are not governed by the International Plumbing Code. All private water lines less than 4 inches in diameter are governed by the International Plumbing Code.

The requirements given in the International Plumbing Code shall apply to all situations not specifically covered by this manual.

II. Sanitary Sewer

Please refer to City Code Chapter 51 - Wastewater Services for City Code requirements.

A sewer line shall be constructed adjacent to each development to be provided with sewer service. The developer is required to install all of the sewer lines, service taps, manholes, and appurtenances within and adjacent to his development as determined by the City Engineer. Stub-outs for future services shall be constructed. All sewer line designs shall provide for sufficient capacities and depths to service all of the areas tributary to the development, along with the development itself in accordance with the City *Wastewater Master Plan*.

A sewer system infrastructure analysis shall be required for proposed developments determined by the City Engineer to have a large impact on the sewer system. The developer of the property shall be responsible for all costs associated with the infrastructure analysis.

Per City Code, all sewer lines eight inches in diameter and larger are subject to all of the requirements listed in this manual. Private sewer lines less than eight inches are subject to the provisions of the International Plumbing Code.

Under special conditions the City may accept a public sewer line on private property. The following conditions must be met:

- The sewer line must be in a dedicated easement.
- The sewer line must meet City construction standards.
- The City Engineer must determine that the acceptance of the sewer line benefits the City.

III. Reclaimed Water

Please refer to City Code Chapter 53 - Reclaimed Water Services for City Code requirements.

Reclaimed Water is a valuable resource. Care should be taken in the distribution and use of Reclaimed Water to ensure the public is protected and the resource is used wisely. The City reclaimed water is to be used for commercial, recreational and landscaping purposes. In addition to the design and construction of the Public and Private Reclaimed Water Distribution System, Reclaimed Water Users will be required to complete the Reclaimed Water Service Process prior to the delivery of reclaimed water to a Site/Development.

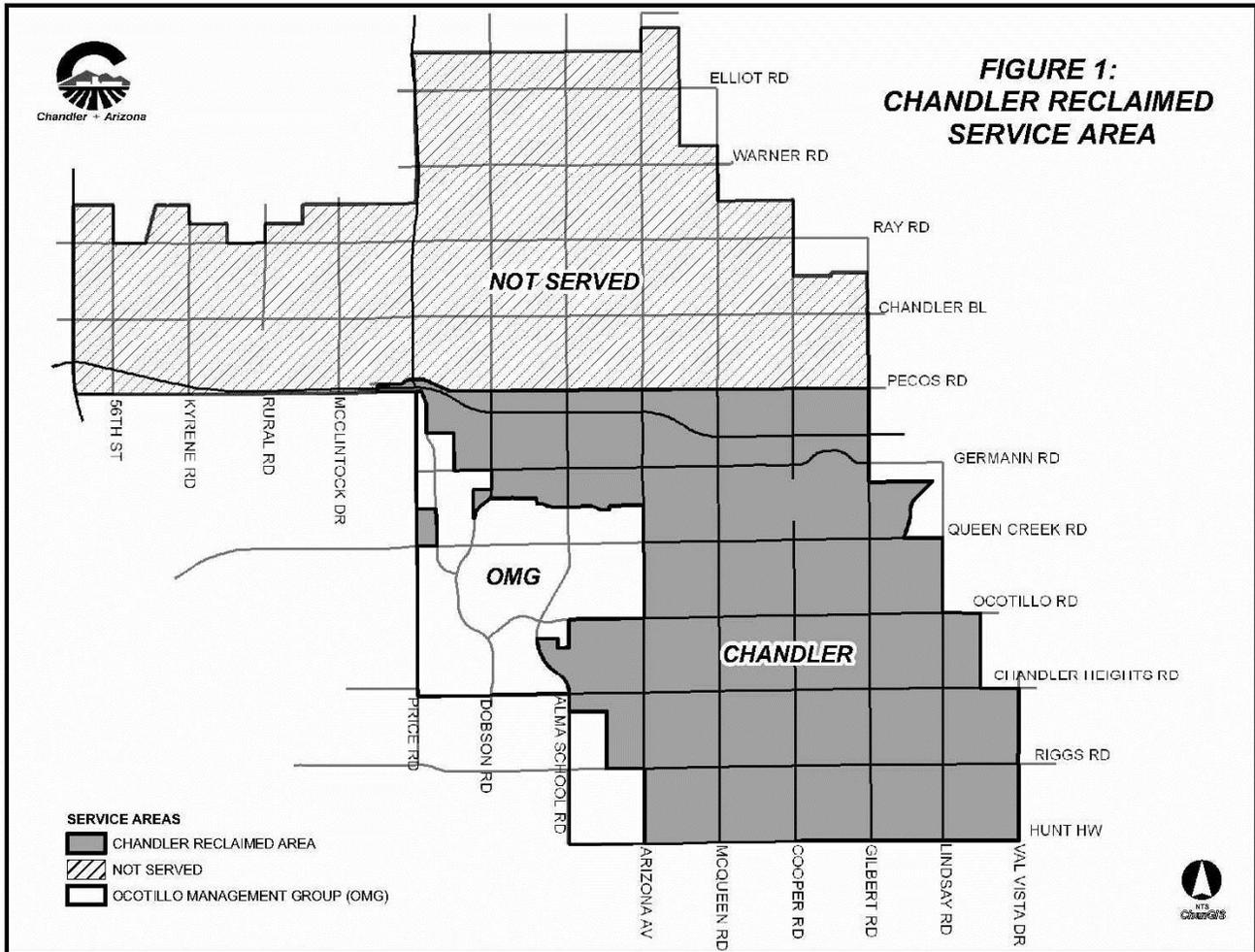
The source water quality of Chandler's Reclaimed Water is A+. The Engineer should check with other reclaimed water purveyors for their class of Reclaimed Water.

Reclaimed water mains shall be constructed by development along the mile and half-mile streets in that portion of the City which is south of Pecos Road and east of Price Road. Please refer to Figure 1, Reclaimed Service Area. If reclaimed water is used, a *Reclaimed Water Use Agreement* will be executed between the owner and the City containing conditions pertaining to the service, and a set of approved irrigation plans will be required prior to connection. Stub-outs for future services shall be constructed.

Reclaimed water lines eight inches in diameter and larger shall be subject to Engineering Administration Division approval, lines less than eight inches shall be subject to Current Planning Division approval.

Within that area west of Arizona Avenue and north of Chandler Heights Road exists, the Ocotillo Management Group which independently delivers reclaimed water. Staff will identify projects within that agency's jurisdiction, and provide contact information.

Figure 1 – Reclaimed Service Area



B. Definitions

Appurtenance: Item attached to a main structure to enable it to function, but not considered an integral part of it.

Air-gap Separation: The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or other device and the flood level rim of the vessel. An approved air-gap shall be at least double the diameter of the supply pipe, measured vertically, above the top of the overflow rim of the vessel, and in no case less than one (1) inch.

Atmospheric vacuum breaker: Also known as the "nonpressure type vacuum breaker," shall mean an assembly containing a float check, a check seat and an air inlet port. The flow of water into the body causes the float to close the air inlet port. When the flow of water stops, the float falls and forms a check valve against backsiphonage and at the same time opens the inlet port to allow air to enter and satisfy the vacuum. A shutoff valve immediately upstream may be an integral part of the assembly. An atmospheric vacuum breaker is designed to protect against a health hazard (i.e. contaminant) under a backsiphonage condition only.

Auxiliary water supply: Any water supply on or available to the premises other than the City's approved public potable water supply. These auxiliary waters may include water from another purveyor's public potable water supply or any source(s) such as well, spring, river, stream, treated effluent, wastewaters, etc., or "used waters" or "industrial fluids."

These waters may be polluted or contaminated or they may be objectionable and constitute an unacceptable water source over which the City does not have sanitary control.

Backflow Prevention Assembly: A double-check valve assembly, reduced pressure principal assembly, or an air-gap separation that meets the requirements of Arizona Administration Code R18-4-215 and is approved by the Building Official of the City.

Building Drain: The main sewer system underneath a building.

Building Sewer: The part of the sewer system that extends from the end of the building drain and conveys to the service tap.

Contamination: An impairment of the quality of the potable water by sewage, industrial fluids, waste liquids, compounds or other materials to a degree which creates an actual or potential hazard to the public health.

Cross-connection: Any physical connection or arrangement of piping or fixtures between two (2) otherwise separate piping systems, one (1) of which contains potable water and the other non-potable water or industrial fluids of questionable safety, through which or because of which backflow may occur into the potable water system. A water service connection between a public potable water distribution system and a customer's water distribution system which is cross-connected to a contaminated fixture, industrial fluid system or with a potentially contaminated supply or auxiliary water system, constitutes one (1) type of cross-connection. Other types of cross-connections include connectors such as swing connections, removable sections, four-way plug valves, spools, dummy sections of pipe, swivel or change-over devices, sliding multi-port tube, solid connections, etc.

Developer: Any person(s), corporation, partnership, or firm desiring municipal water, sewer, or reclaimed water service.

Device Service Line: A pipe carrying water from the public water line to a water meter or other point of distribution.

Distribution System: The network of public water lines 16 inches in diameter and smaller which compose the basic grid and distribution system for water service.

Double check-detector check valve assembly: Means a specially designed assembly composed of a line-size approved double check valve assembly with a specific bypass five-eighths-inch by three-quarter-inch, or three-quarter-inch water meter and a three-quarter-inch approved double check valve assembly. The meter shall register all rates of flow. This assembly shall only be used to protect against a non-health hazard (i.e. pollutant).

Effluent: Effluent which has been treated to achieve a quality suitable for a subsequent use as prescribed by Federal and State regulations.

FDC (Fire Department Connection): A Siamese-headed swivel connection for fire hoses for the purpose of pressurizing building sprinkler lines.

Fire Line: A private water line located on private property which is utilized exclusively for providing water to fixed fire protection systems.

Hazard, degree of: The term is derived from an evaluation of the potential risk to public health and the adverse effect of the hazard upon the potable water system.

A. *Hazard, health*: Any condition, device or practice in the water supply system and its operation which could create or in the judgment of the City may create a danger to the health and well-being of the water consumer. An example of a health hazard is a structural defect, including cross-connections, in a water system.

B. *Hazard, plumbing*: A plumbing type cross-connection in a consumer's potable water system that has not been properly protected by a vacuum breaker, air-gap separation or backflow prevention device. Unprotected plumbing type cross-connections are considered to be a health hazard.

C. *Hazard, pollutant*: An actual or potential threat to the physical properties of the water system or to the potability of the public or the consumer's potable water system but which would constitute a nuisance or be aesthetically objectionable or could cause damage to the system or its appurtenances, but would not be dangerous to health.

D. *Hazard, system*: An actual or potential threat of damage to the physical properties of the public potable water system or the consumer's potable water system or of a pollution or contamination which would have an effect on the quality of the potable water in the system.

Industrial fluids system: Any system containing a fluid or solution which may be chemically, biologically, or otherwise contaminated or polluted in a form or concentration such as would constitute a health, system, pollutant, or plumbing hazard if introduced into an approved water supply. This may include, but not be limited to: polluted or contaminated waters; all types of process waters and "used waters" originating from the public potable water system which may have deteriorated in sanitary quality; chemicals in fluid form, plating acids and alkalis, circulated cooling waters connected to an open cooling tower and/or cooling towers that are chemically or biologically treated or stabilized with toxic substances; contaminated natural waters such as from wells, springs, streams, rivers, urban lakes, irrigation canals or systems, etc., oils, gases, glycerine, paraffins, caustic and acid solutions and other liquid and gaseous fluids used in industrial or other purposes or for fire-fighting purposes.

Interceptor, Trunk, or Main Sewer: A sewer line 18 inches and larger in diameter and tributary to an outfall sewer. It collects sewage from one or more laterals.

Lateral or Submain Sewer: A sewer line equal to or less than 15-inches in diameter and tributary to an interceptor or larger sewer. It collects sewage from two or more service taps.

Municipal Sewer Service: Sanitary sewer service provided for domestic, commercial, and industrial purposes.

Municipal Water Service: Water service provided for domestic, commercial, recreational, and landscaping purposes.

Outfall Sewer: The sewer line that conveys the sewage from interceptors to the final point of discharge or treatment.

PIV (Post Indicator Valve): An above-ground assembly to indicate the position of the gate for an underground water valve.

Pollution: The presence of any foreign substance (organic, inorganic or biological) in water which tends to degrade its quality so as to constitute a hazard or impair the usefulness or quality of the water to a degree which does not create an actual hazard to the public health but which does adversely and unreasonably affect such waters for domestic use.

Pressure vacuum breaker assembly: An assembly containing an independently operating, loaded check valve and an independently operating, loaded air inlet valve located on the discharge side of the check valve. The assembly shall be equipped with properly located test cocks and tightly closing shutoff valves located at each end of the assembly.

Private Sewer Line: Any sewer line not owned and maintained by the City.

Private Water Line: Any potable or reclaimed water line not owned and maintained by the City.

Public Sewer Line: A sewer line owned and maintained by the City.

Public Water Line or Public Water Main: A potable or reclaimed water line owned and maintained by the City.

Reclaimed Water: Wastewater that has completed the stages of treatment at a wastewater treatment plant.

Reclaimed water service: City service to provide reclaimed water for commercial, recreational and landscaping purposes.

Reclaimed Water System (Public): Is the reclaimed water system upstream of the outlet of the reclaimed water meter or turn-out structure.

Reclaimed Water System (Private): Is the reclaimed water system downstream of the reclaimed water meter unless otherwise determined by the City Engineer.

Reclaimed Water User: Shall mean the private entity that executes the City's Reclaimed Water Use Agreement and who is the applicant for ADEQ Type 2 or Type 3 Reclaimed Water General Permit or a private entity that received reclaimed water from another reclaimed water purveyor; or a reclaimed user that lies within the alternate reclaimed water purveyor service area and is located North of Germann Road.

Reduced Pressure Principle Backflow Prevention Assembly: An assembly incorporating two independently acting check valves together with an automatic hydraulically operating, mechanically independent pressure differential relief valve located between the two check valves along with tightly closing shut-off valves located at each end of the assembly, and the necessary appurtenances for testing. The device shall operate to prevent backflow through the device by closing of the check valves and maintaining the pressure in the zone between the two check valves less than the pressure on the potable public water supply side of the device.

Sampling Location(s): As part of the City's Wastewater Pretreatment Program, Municipal Utilities Department shall determine if sampling location is required through *Wastewater Questionnaire* process. The location of the sampling point, if necessary, shall be determined by the Municipal Utilities Department with concurrence from the City Engineer.

Service Tap: That part of the sewer collection system constructed with the City right-of-way that provides a connection between the building sewer and the lateral sewer. Also known as "Building Sewer Connection" (see MAG Std Dtl 440).

Sewer Service Area: A designated area from which sewage flows originate or contribute to the sewer system.

Transmission Main: A public water line larger than 16 inches in diameter.

Water, potable: Any water which, according to recognized standards, is safe for human consumption.

Water, non-potable: Water which is not safe for human consumption or which is of questionable potability.

Water service connections: The terminal end of a service connection from the public potable water system, i.e., where the City loses jurisdiction and sanitary control over the water at its point of delivery to the customer's water system. If a meter is installed at the end of the service connection, then the service connection shall mean the downstream end of the meter. There should be no unprotected takeoffs from the service line ahead of any meter or backflow prevention device located at the point of delivery to the customer's water system. Service connection shall also include water service connection from a fire hydrant and all other temporary or emergency water service connections from the public potable water system. However, except in the case where residential homes incorporate the use of reclaimed wastewater as a water conservation measure, the service connection shall be at the pipe union located beyond the approved backflow prevention device. There shall be no connections made upstream of the pipe union. The City system shall include all piping between the water meter and the pipe union, including the backflow prevention device.

Water, used: Any water supplied by the City from a public potable water system to a consumer's water system after it has passed through the point of delivery and is no longer under the sanitary control of the City.

Wastewater Meter: A wastewater meter is required when there are auxiliary water sources that may contribute to sewer flows from a development.

C. Standard Specifications and Details

Plans and construction documents shall utilize Maricopa Association of Governments (MAG) *Uniform Standard Specifications and Details for Public Works Construction* and the Chandler Supplements for identifying the work. City Supplements to MAG Details include the Water Series (C-3XX), the Wastewater Series (C-4XX), and the Fire Department Series (XXX) Standard Details. City Supplements to MAG Specifications are various; please refer to the individual Sections, as modified.

The latest version of the construction General Notes, Water Notes, Sewer Notes, and/or Reclaimed Water Notes shall be incorporated into the construction plans as applicable to the type of construction.

'MAG Section' and 'MAG Detail' throughout this manual shall refer to the specifications and details of the MAG Uniform Standards, and 'Specification', 'Detail', and 'Fire Department Detail' shall refer to the City Supplements.

Existing asbestos-concrete pipe to be abandoned may be abandoned in place or removed according to the on a case-by-case determination of the City Engineer. Contact the City's Environmental Management Division for specifications to be included in construction documents and staff for construction requirements.

2) Potable Water Distribution and Transmission System

A. Water Main Requirements

I. Jurisdictional Agency Approval

Water systems shall be designed and constructed in accordance with the following regulations.

- Maricopa County Health Code
- Arizona Administrative Code (AAC) Title 18, Chapter 5, Article 5 (Minimum Design Criteria).
- Arizona Administrative Code Title 18 Chapter 4 Article 2 (Backflow Protection)

These are not all-inclusive and the Design Engineer should adhere to all other applicable, City, county, state, Maricopa Association of Government (MAG), and federal regulations.

Plans shall bear the approval signature of the Maricopa County Environmental Service Department (MCESD) prior to approval by the City. Requests for letters of Approval to Construct shall be routed to the City Engineer through Civil Plan Review. The Developer/Designer that has applied for the Approval to Construct is also responsible to submit the Approval of Construction and obtain final sign off through MCESD before the City will accept the infrastructure improvements.

Refer to the AAC, MAG Section 610.5, and MAG Detail 404 for separation requirements for protection against possible contamination. Drainage pipe for areas that receive reclaimed water irrigation and reclaimed water lines shall be considered equivalent to a sanitary sewer for determining separation distances next to water lines. Where protection of the waterline is required, ductile iron pipe shall be utilized.

Refer to City Code Chapter 52- Water Services for City requirements regarding water service. The City Engineer may require an engineering analysis for developments to establish water system requirements.

The *Wastewater Questionnaire* which characterizes the waste flows generated from the new potable water connection must be submitted with non-residential building permit applications.

If water service is being provided to developments/sites that do or will house, generate, or potential discharge from Industrial fluids system, a detailed water quality study for wastewater discharges will be required before the water connection is approved. This may include, but not be limited to:

- polluted or contaminated waters;
- all types of process waters and "used waters" originating from the public potable water system which may have deteriorated in sanitary quality;
- chemicals in fluid form, plating acids and alkalies, circulated cooling waters connected to an open cooling tower and/or cooling towers that are chemically or biologically treated or stabilized with toxic substances;
- contaminated natural waters such as from wells, springs, streams, rivers, urban lakes, irrigation canals or systems, etc.,
- oils, gases, glycerine, paraffins, caustic and acid solutions and
- other liquid and gaseous fluids used in industrial purposes.

II. Engineering Requirements

The following engineering requirements shall apply to all public waterline extensions:

- a. The developer causing extension of a waterline shall locate it in City rights-of-way or easements and shall pay in full the engineering, construction and inspection costs of the lines and appurtenances.
- b. Plans and specifications shall be prepared in accordance with appropriate standards as established by the City Engineer.
- c. Each lot or parcel of land to be served with municipal or industrial water shall abut a water main.
- d. All lines shall be sized in accordance with the latest water master plan, except that the City Engineer reserves the right to increase or decrease the diameter of any and all mains described in the plan when requirements so dictate.

- e. In all new developments, such as subdivisions, multifamily tracts, commercial centers, shopping centers, industrial or other similar developments, the developer shall furnish and install, to City specifications, all water mains, service connections, valves, fittings, fire hydrants and appurtenances within the boundary of the development as well as the streets bounding the tracts, and make waterline extensions as determined necessary by the City Engineer.
- f. The engineering requirements set forth herein are intended to supplement rather than supersede other applicable local county, state and federal requirements and, in the case of conflict, the more stringent requirement shall apply.

The Developer/Designer is responsible to obtain Approval of plans, permits, inspections and acceptance.

- All other Jurisdictional Authority requirements must be met and the Developer/Designer is responsible to submit proof of their acceptance.
- The City shall acquire ownership of all extensions of public mains when completed, approved and accepted. The system shall be conveyed to the City free and clear of all clouds to title, including liens and encumbrances.
- Permanent-type, certified, reproducible as-built record plans shall be filed with the City Engineer upon completion of construction of additions to the system. The mylar executed by the City and other Jurisdictional Agencies is critical to the final acceptance process, the Developer/Designer is responsible to complete all required signature blocks and the associated paperwork. Submission of the fully executed project mylar is a requirement for acceptance of the infrastructure by the City.
- Acceptance of all extensions shall require the written approval of the City Engineer and will be dependent on all inspections, test results and the above noted requirements being met.

III. Easement Requirements

All public water lines shall be placed in either the public right-of-way or within a dedicated easement. The minimum easement width is 12 feet, with the entire easement free of property lines, boundary walls, and other obstructions for its entire length and width. Joint water and sewer line easements shall be 24 feet wide, with eight feet of separation between the lines.

Water lines, service lines, and fire lines are not allowed in retention basins.

IV. Acceptable Pipe Materials and Construction Requirements

Ductile iron pipe shall be utilized under roadways and throughout the extents of vertical water main re-alignments (dipped sections) plus full pipe lengths on each side of the dipped section. Ductile iron pipe shall be utilized where waterline protection is required in accordance with MAG Detail 404.

Refer to the current *List of Approved Products* for product specifications.

Waterlines shall be constructed in accordance with MAG Section 610. Bedding shall conform to Detail C-308. All pipe trenches shall contain locator wire and identification tape in accordance with Detail C-408.

All pipe fittings shall be ductile iron pipe in accordance with MAG Section 750.

g. Restrained Joints for Pipe:

Restrained joints shall be push-on for piping or mechanical joint fittings with wedge-type mechanical pipe-grippers. Restrained joint pipe shall be applied the entire length of pipe (L_R) as shown within the Construction Drawings.

Refer to the current *List of Approved Products* for products that meet Chandler requirements.

No field cuts of restrained pipe are permitted without prior approval of the Construction Manager.

Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations.

h. Restrained Joints for Fittings:

Restrained joints for fittings shall be mechanical joint fittings with wedge-type mechanical pipe-grippers or flange. The wedges shall be ductile iron heat treated to a minimum hardness of 370 BHN. The mechanical joint restraint shall have a working pressure of 350 psi.

Refer to the current *List of Approved Products* for products that meet Chandler requirements.

V. Backflow Prevention

i. General:

The potable water system shall be protected from contamination caused by backflow through unprotected cross-connections. All engineering designs shall conform to Arizona Administrative Code, Title 18, Chapter 9, Article 1, R18-4-215 "Backflow Prevention" and City of Chandler Municipal Code Chapter 52, Article IV "Backflow and Cross-connection Control Program".

j. Approved Backflow Assemblies:

Backflow prevention assemblies shall conform to the current list issued by the Foundation for Cross Connection Control and Hydraulic Research (FCC&HR), University of California and/or the American Society of Safety Engineers and be UL listed or Fire Marshall approved for fire protection use when used for fire protection systems. Backflow assemblies shall be installed in accordance to the FCC&HR.

k. Non-Residential and Multi-Family Backflow Assembly Requirements:

Reduced pressure assemblies (Details C-311 and C-315) shall be installed on all non-residential and Multi-Family potable water services. Double-check valves may be used for dedicated fire sprinkler services without chemical additives (Details FD102 and FD103).

For potable water service lines 3 inches in diameter and under, each backflow prevention assembly shall be located on private property within 6 inches of the potable water meter. For potable water service lines greater than 3 inches, each backflow prevention assembly shall be located on private property and as close as practical to the potable water meter. Upon request, the City Engineer may permit the service line to be encased in a DIP sleeve if this is not practicable.

l. Residential Assembly

Reduced pressure principle assemblies (Detail C-311) shall be installed on residential potable water service within 6 inches of the meter when one or more of the following conditions exist:

- Reclaimed water will be used on the residential property.
- Reclaimed water service is or will be available for use on the residential property. (note: if a reclaimed water line is designed solely to transmit reclaimed water across the residential property a backflow assembly will not be required.)
- Well water from a well is available for use on the residential property
- A cross-connection with a non-potable water source has been identified.

Upon request, the City Engineer may permit the service line to be encased in a DIP sleeve if this is not practicable to install the backflow assembly within 6 inches of the meter.

VI. Construction Plan Requirements

m. Plans (General)

All plans shall be prepared and signed by a registered professional engineer.

Plans shall be submitted on 24" x 36" sheets. The plans shall be drawn to an engineering scale with 1" = 20' and 1" = 40' being the preferred horizontal scales. The vertical scale, when profile is required, need not differ from the horizontal scale by a precise factor of 10. Water, sewer, and paving plans may all be shown on the same plan sheets if a horizontal scale no smaller than 1" = 20' is used.

All water lines and transmission mains 12 inches or larger in diameter shall be shown in both plan and profile views. Twelve inch diameter water lines shall be shown in both plan and profile views whenever existing utilities are likely to be encountered. All dip sections shall be shown in both plan and profile views regardless of the water line size.

The City of Chandler has two policies that should be reviewed: Abandoned Utilities in the City's Right of Way and Private Development Testing Procedures. All utility abandonments with in the City's Right of Way will be reviewed on a case by case basis. All proposed abandonments must be shown on a separate plan sheet that documents the demolition of existing utilities. The Developer/Designer shall confirm that their testing requirements contained within their specifications will meet the City's Private Testing Procedures. Both of these documents are available on the City's Unified Development Manual website.

The engineer shall incorporate into the plans the latest copy of the construction *Water Notes*.

Project Vertical datum shall be NAVD 88 with equations to legacy City Datum NGVD 29 and any as-built plans that affect the project. The nearest City CMCN benchmark shall be utilized for establishing City Datum.

n. Dipped Sections

Ductile iron pipe (mechanical joint or restrained) shall be installed through all dipped sections, plus full pipe lengths on each side of the dipped section. All dipped sections must be shown in profile view and must include the following items:

- Minimum vertical clearance of 2 feet from obstructions.
- Encasement per MAG Detail 404, if applicable.
- Thrust blocks or joint restraint with standard detail call-out.
- Vertical and horizontal location of fittings.

B. Water Transmission System – Additional Design Criteria

I. General

Transmission mains are normally installed under the pavement in the center of a traffic lane. This is graphically shown in Details C-200 and C-201.

Water services, fire hydrants, and fire lines may not be installed on transmission mains.

Minimum pipe cover shall be 48 inches.

II. Valve Requirements

Valves on transmission mains are required only at the section line and one-half section line points where a bypass valve assembly is required. Valves shall be spaced at the one-half mile.

Provisions shall be made to tie the transmission main into the distribution system at the section line and the one-half section line points with sufficient valving to completely isolate the transmission main from the distribution system without obstructing the functional characteristics of either the transmission main or the distribution system. A bypass valve assembly is required wherever a transmission main comes to a dead-end.

Valve box installations shall conform to Detail C-307.

Resilient wedge gate valves shall be used on all water lines, unless otherwise noted and approved through the plan review process. Refer to Detail C-320 for the valve vault detail.

City water valves (this includes new valves on the public system that have not been accepted by the City) shall be operated by City personnel only.

III. Air/Vacuum Valve Assemblies

Air and vacuum release assemblies in accordance with Detail C-319 shall be installed at crest changes in pipe grade where there is a possibility of a depth of trapped air greater than one-fifth of the diameter of the line.

C. Public Water Distribution System – Additional Design Criteria

I. System Design Criteria

Distribution systems shall be designed for peak daily flows combined with required fire flows or peak hourly flow. System pressures in all branches of the network shall be a minimum of 25 psi with velocity of less than 10 feet per second for peak daily with fire. System pressures may range from 50 to 100 psi with velocity less than 5 feet per second for peak hour flow.

a. Domestic Demand

Refer to the latest City of Chandler *Water System Master Plan* for appropriate demand and peaking factors.

b. Fire Flow Demand

Fire flows shall conform to the requirements of the latest adopted *International Fire Code*.

II. General

All lines shall be sized as a minimum in accordance with the current *Water System Master Plan* and the water line size requirements listed below. Lines must generally be looped. Dead-end lines are permitted only with City Engineer's approval.

A 16-inch diameter water line is required along all section line streets. The City Engineer may require the installation of dual parallel 12-inch diameter water lines instead of the single 16-inch water line when special conditions justify it. Dual parallel 12-inch diameter water lines are normally required adjacent to transmission mains, one on each side, or one tier of lots off of the section line street. Depth of cover shall be a minimum of 48 inches. Water services may not be installed on 16-inch water lines.

The standard location for 16-inch and smaller water lines is 1 foot behind the sidewalk, 7 feet behind the back of curb on arterial streets, on the north and east sides of the street. When two water lines are installed adjacent to a street, the

standard locations are one on each side of the street with the location determined as above. See Details C-200, C-201, and C-202.

A 12-inch diameter water line is required at all half-mile section line locations. Depth of cover shall be a minimum of 48 inches.

In the case of a phased development, each successive phase must satisfy all of the requirements listed above irrespective of the future phases.

Water lines are required adjacent to half streets when the east or north one-half is being constructed or, when in the opinion of the City Engineer, special conditions justify the construction of the water line.

Water line construction in arterial and collector streets shall include eight-inch stub-outs to the right-of-way for the purpose of servicing existing parcels and future development.

An 8-inch diameter water line is required at all one-quarter mile section line locations. Depth of cover shall be a minimum of 36 inches.

Eight-inch diameter water lines are generally required in all commercial, industrial, and multi-family residential areas and shall be private unless otherwise directed by the City Engineer. Eight-inch dead-end lines may not exceed 650 feet.

All other water lines shall be a minimum of six inches in diameter. Six-inch dead-end lines may not be longer than 300 feet. Looped six-inch lines may not exceed 1200 feet. Depth of cover shall be a minimum of 36 inches.

Wherever possible, dead-end lines will be extended beyond paved surfaces to avoid pavement cutting at time of future connection and be equipped with a curb stop per Detail C-300. No blow-off assembly shall be located in roadway.

The City Engineer may require an engineering analysis for developments.

III. Extension of a Main

For all extensions of water lines over eleven months in age, a new valve of like size shall be installed in the new line at the point of extension. A 3/4-inch saddle and riser shall be installed in the line between the new valve and the first existing valve in the existing system. This line will be flushed and tested by the City and the 3/4-inch nut and riser removed. After the City accepts the new water system, and the new valve and existing valves are turned on, the operating nut shall be removed from one of the valves, leaving only one valve operable.

IV. Fire Hydrant Requirements

All fire hydrants shall be painted according to Fire Department standards after installation. See Fire Department Detail FD121. They shall not be installed on transmission water lines. See the *List of Approved Products* for fire hydrants that meet Chandler requirements.

Fire hydrant installations must comply with the following requirements:

- 450 feet maximum spacing in single family residential areas.
- 300 feet maximum spacing in other developed areas.
- 1,000 feet maximum spacing in undeveloped areas and along arterial streets, staggered 500' opposite sides of arterial street.
- The locations shall be marked in the street with a pavement marker in conformance to MAG Std Dtl 122.
- One fire hydrant must be installed at all subdivision entrances.
- Fire hydrant installations must conform to Detail C-303, C-304, and C-305.
- Fire hydrants must be stationed.
- Fire hydrant installations at intersections shall be per Detail C-305.
- On cluster developments, a fire hydrant must be located no farther than 250 feet from each structure, measured along a hose-laying line to the farthest corner of the structure.
- Fire hydrant stub valves shall be connected by flange to the service 'tee'.

The City Engineer and the Fire Marshal reserve the right to modify the spacing requirements listed above.

Hydrants located in public right-of-way shall be equipped with locking caps per Detail C-304.

Hydrants out of service shall have collars with "out-of-service" signs until the hydrant is put into service. The signs shall comply with Fire Department Detail FD123 and shall remain on the fire hydrants until the water lines are tested, approved, and pressurized. The signs shall be reinstalled at any time any fire hydrants are taken out of service, regardless of reason or the amount of time the fire hydrants are expected to be out of service, and dispatch shall be notified at 480-782-4130. Only off-site personnel shall remove a sign.

Any development that has a water service that is supplied by only two 6-inch water lines: shall have a maximum of six hydrants. One fire hydrant must be installed at each subdivision entrance.

If a model home area is to be part of a development, then a fire hydrant shall be provided at or near the site entrance. The hydrant shall be located within 75 feet of the access roadway and within 300 feet of the property line of the most remote lot to be built upon. The hydrant shall be connected to an approved water source. If the distance to the water source is more than 400 feet, the system must be looped to an additional source.

All cul-de-sac dead-end lines must have a fire hydrant installed at the end of line. The fire hydrant shall be located 6 feet from the back of curb and the valve shall be located in the pavement 1 foot from the lip of the gutter. All lines longer than 650 feet shall be looped.

V. Valve Requirements

Valve installations must comply with the following requirements:

- Spacing no greater than 600 feet for pipe runs greater than 800'.
- Public distribution line, three valves on each tee (other than service tees) and four valves on each cross.

- Valve box installations must conform to Details C-307, and C-317 in areas not subject to wheel loads. These details shall be specified in the construction notes on the plan. MAG Detail 270 frame and covers are not permitted. The grade of a valve box and cover located outside of a paved area shall be 1/2 inches above sidewalk or adjacent grade.
- In subdivisions, valves at intersections must be located at the first lot line away from the intersection and must be stationed. If no lot line exists, valve is to be located minimum of 6 feet from curb return.
- In subdivisions, valves at tee intersections must be located laterally along the top of the tee to the first lot line clear of the intersection to avoid conflict with sidewalk ramps and must be stationed. Valves on the leg of the tee must be located per item 4 above.
- Refer to valve blocking per MAG Detail 301.
- No valve shall be located in sidewalk, curb, or ramp areas. Exceptions require a variance from the City Engineer.
- Valve locations must be stationed on subdivision plans, and otherwise located on all other plans.

City water valves (this includes new valves on the public system that have not been accepted by the City) shall be operated by City personnel only.

VI. Single Family Residential Water Services and Meter Requirements

Water services may not be installed on 16-inch water lines or transmission lines unless approved by the City Engineer. Water service lines shall be a minimum of 1 inch in diameter and shall not be located in driveways, sidewalks, washes, or retention/detention areas.

Residential services shall be copper with a minimum diameter of 1 inch in accordance with Detail C-301. Each service shall be individually connected to the main. Backflow prevention will be required per Section 2) V Backflow prevention. Meter boxes shall be oriented to the perpendicular of the street.

Service lines shall be copper or ductile iron pipe. Existing service lines may be extended, but compression fittings are not allowed. Existing services to be abandoned shall be turned off at the main.

The City provides and installs water meters. Owner/Contractor shall provide all fittings to accept meter. Meter boxes shall be located within the right-of-way or within a dedicated easement. Meter certificates with sizing calculations are required during plan review for all water services except tract subdivision projects.

D. Commercial Water Distribution System

Commercial developments shall be served by a metered potable water system separated from the building fire sprinkler lines. The sprinkler line (generally looped) shall be easily accessed for pressurization by fire department connections located at entrance drives. Because site fire hydrants shall not be pressurized, the hydrant line shall be hydraulically separated from the sprinkler line. The hydrant line may utilize the sprinkler line if it is isolated by a check valve in accordance with Fire Department Detail FD103, or the hydrants may be supplied from the potable system and the meter sized for fire flows. See Section III. Commercial Fire Sprinkler and Hydrant Mains, below.

Systems shall be looped with connections to the public water system at distant drive entrances.

Private water lines are not allowed within the right-of-way or utility easements.

I. Multi-family Fire Sprinkler Connections

In accordance with Section 28-17 of the City Code, all buildings shall be provided with an approved automatic fire sprinkler system. The Fire Department maintains separate standard drawings, plan notes, and plan review guides. Please refer to these standards and the International Fire Code, as adopted and supplemented by City Code, for the design of site improvements.

Multi-family homes (Group R-1 occupancies) shall have fire department connections (FDCs) located on the building under the audio/visual (horn/strobe) device for the building. The sprinkler line shall be separated from the public water system with a reduced pressure principal assembly in accordance with City Standard Details.

Multi-family installations may combine the fire sprinkler service with the domestic service. Backflow prevention will be required after the meter, as well as between the sprinkler line and the domestic line.

II. Commercial Meter Requirements

Water services may not be installed on 16-inch water lines unless approved by the City Engineer.

Service lines shall be copper or ductile iron pipe. Existing service lines may be extended, but compression fittings are not allowed. Existing services to be abandoned shall be turned off at the main.

The City provides and installs water meters. Owner/Contractor shall provide all fittings required to receive the meter assembly. Meter boxes shall be located within the right-of-way or within a dedicated easement. Meter certificates with sizing calculations are required during plan review for all water services.

Meter boxes shall not be located in driveways and sidewalks.

Individual meter boxes for each building may be ganged within the right-of-way, or a master meter may be provided. Manifolding of meters may only be permitted with the City Engineer's approval, and each meter shall have its separate backflow preventer.

III. Commercial Fire Sprinkler and Hydrant Mains

In accordance with Section 28-17 of the City Code, all buildings shall be provided with an approved automatic fire sprinkler system. The Fire Department requires the use of internally-developed standard drawings, plan notes, and plan review guides. Please refer to these standards and the International Fire Code, as adopted and supplemented by City Code, for the design of site improvements.

Office/recreation building sprinkler systems shall be designed and installed in accordance with NFPA 13. The sprinkler line shall be installed in accordance with Fire Department Details FD102 or FD103, with a public fire hydrant located within 150' of the FDC, on the same side of the entrance drive, so that fire hoses would not block the drive.

A separate fire hydrant supply line, if required by International Fire Code requirements, shall be looped throughout the site independent of the sprinkler line so that the hydrant line would not be pressurized when a pumper truck is connected to the FDC.

These dedicated water distribution systems shall be separated from the public water system with double check valves per Fire Department standard details unless chemicals are added to the system then a reduced pressure principle valve will be required. See Fire Department Detail FD102 for a dedicated sprinkler system, and Fire Department Detail FD103 for the dual fire hydrant/sprinkler configuration. Fire protection flows are not metered by the City, but for the case of onsite fire hydrants, the double check assemblies shall include flow detection meters to monitor for illicit water use.

All valves on the sprinkler line shall be post-indicating (PIV) per the Fire Department detail in Fire Department Details FD102 and FD103. Each building shall have a valve close to the point of entry to the building, unless the Fire Department is provided access to a riser control valve within the building. See Fire Department Detail FD105. Where the sprinkler line is looped for multiple buildings, the sprinkler line shall have at least one PIV at the midpoint for sectional control. PIVs shall be labeled in accordance with FD104.

Site fire hydrants shall be painted Type 2 color coded black and yellow per Fire Department Detail FD121. Locking caps on the operating nut are not required. Blue pavement markers for locating hydrants shall be installed per MAG Standard Detail 122. Fire hydrant tees require only one valve, flanged to the tee, unless the fire hydrant installation is also serving as a stub-out. Additional isolation valves are required at approximately 600-foot intervals or when pipe runs longer than 800 feet are encountered. If the Fire Marshall has approved the installation of fire hydrants on the sprinkler line, fire hydrant shall be painted Type 3 color coded brilliant red per Fire Department Detail FD121 with red pavement markers for locating hydrants shall be installed per MAG Standard Detail 122.

IV. Landscape

The City offers tiered water rates for landscape service connections. The designer may elect to provide a separate service.

Landscape tracts must be approved with services of a size as determined by a landscape architect and must be shown on the civil plans.

These water systems shall be separated from the public water system with a reduced pressure principle assembly per standard detail C-311.

Pipe sleeves are required for service lines extending under roadway pavement within the right-of-way. Sleeves shall consist of a ductile iron pipe conduit, 2 nominal diameters larger than the service line for all service lines except for copper service lines which shall have PVC sleeves.

The City offers reclaimed water for landscaping water for properties south of Pecos Road. Please refer to Section 4 Reclaimed Water Distribution System below, and the Reclaimed Water Use Agreement.

3) Wastewater Collection System

A. Jurisdictional Agency Approval

All sewer lines shall be designed in accordance with the following regulations.

- Maricopa County Health Code
- Arizona Administrative Code, Title 18, Chapter 9, Article 3, Part E, Type 4 General Permits: §R18-9-E301.401 Sewage Collection Systems

These are not all-inclusive and the Design Engineer should adhere to all other applicable, City, county, state, Maricopa Association of Government (MAG), and federal regulations.

Plans shall bear the approval signature of the Maricopa County Environmental Services Department (MCSED) prior to approval by the City. Requests for letters of Approval to Construct shall be routed to the City Engineer through Civil Plan Review. The Developer/Designer that has applied for the Approval to Construct is also responsible to submit the Approval of Construction and obtain final sign off through MCSED before the City will accept the infrastructure improvements.

Refer to the AAC, MAG Section 610.5, and MAG Detail 404 for separation requirements for protection against possible contamination.

Refer to City Code Chapter 51 Wastewater Services for City requirements regarding wastewater service.

The *Wastewater Questionnaire* which characterizes the waste flows must be submitted with non-residential building permit applications.

The City Engineer may require an engineering analysis for developments to establish wastewater system requirements. If wastewater service is being provided to developments/sites that do or will house, generate, or potential discharge from Industrial fluids system, a detailed water quality study for wastewater discharges will be required before the water connection is approved. This may include, but not be limited to:

- polluted or contaminated waters;
- all types of process waters and "used waters" originating from the public potable water system which may have deteriorated in sanitary quality;
- chemicals in fluid form, plating acids and alkalis, circulated cooling waters connected to an open cooling tower and/or cooling towers that are chemically or biologically treated or stabilized with toxic substances;
- contaminated natural waters such as from wells, springs, streams, rivers, urban lakes, irrigation canals or systems, etc.,
- oils, gases, glycerine, paraffins, caustic and acid solutions and
- other liquid and gaseous fluids used in industrial purposes.

B. Engineering Requirements

The following engineering requirements shall apply to all public waste waterline extensions:

- a. The developer causing an extension of a sewer main shall locate it in City rights-of-way or easements and shall pay in full the engineering, construction and inspection costs of the lines and appurtenances.
- b. Plans and specifications shall be prepared in accordance with appropriate standards established by the City Engineer.
- c. Each lot or parcel of land to be served with sanitary sewer service shall abut a sewer main.
- d. All lines shall be sized in accordance with the latest wastewater master plan, except that the City Engineer may increase or decrease the size of mains when requirements so dictate.
- e. In all new developments such as subdivisions, multifamily tracts, commercial centers, shopping centers, industrial facilities or other similar developments, the developer shall furnish and install, to City specifications, all sewer mains, service connections, manholes, service and main stubs and appurtenances within the boundary of the development as well as the streets abutting the development, and shall make sewer line extensions as determined necessary by the City Engineer.

- f. Sewer mains which are not located in public rights-of-way and which do not provide service to other than a single property, will generally not be accepted as a public sewer main. subdivisions, areas to be developed or redeveloped, shall be the full responsibility of the developer and in accordance with the sewer master plan;
- g. The engineering requirements set forth herein are intended to supplement rather than supersede other applicable local county, state and federal requirements and, in the case of conflict, the more stringent requirement shall apply.

The Developer/Designer is responsible to obtain Approval of plans, permits, inspections and acceptance.

- All other Jurisdictional Authority requirements must be met and the Developer/Designer is responsible to submit proof of their acceptance.
- The City shall acquire ownership of all extensions of public mains when completed, approved and accepted. The system shall be conveyed to the City free and clear of all clouds to title, including liens and encumbrances.
- Permanent-type, certified, reproducible as-built record plans shall be filed with the City Engineer upon completion of construction of additions to the system. The mylar executed by the City and other Jurisdictional Agencies is critical to the final acceptance process, the Developer/Designer is responsible to complete all required signature blocks and the associated paperwork. Submission of the fully executed project mylar is a requirement for acceptance of the infrastructure by the City.
- Acceptance of all extensions shall require the written approval of the City Engineer and will be dependent on all inspections, test results and the above noted requirements being met.

C. Easement Requirements

All sewer lines shall be placed in either the public right-of-way or within a dedicated easement. The minimum easement width is 16 feet, with the entire easement free of property lines, boundary walls, and other obstructions for its entire length and width. Joint water and sewer line easements shall be 24 feet wide, with eight feet of separation between the lines.

Sewer lines are not allowed in retention basins unless the City Engineer authorizes the use of a concrete cap over the pipe bedding.

D. Construction Plan Requirements

All plans shall be prepared and signed by a registered professional engineer.

Plans shall be submitted on 24" x 36" sheets. The plans shall be drawn to an engineering scale with 1" = 20' and 1" = 40' as the preferred horizontal scales. The vertical scale need not differ from the horizontal scale by a precise factor of 10. Water, sewer and paving plans may all be shown on the same plan sheets, if a horizontal scale no smaller than 1" = 20' is used.

All sewer lines and utility crossings shall be shown in both plan and profile views.

Project Vertical datum shall be NAVD 88 with equations to legacy City Datum NGVD 29 and any as-built plans that affect the project. The nearest City CMCN benchmark shall be utilized for establishing City Datum.

The engineer shall incorporate into the plans the latest copy of the construction *Sewer Notes*.

The City of Chandler has two policies that should be reviewed: Abandoned Utilities in the City's Right of Way and Private Development Testing Procedures. All utility abandonments within the City's Right of Way will be reviewed on a case by case basis. All proposed abandonments must be shown on a separate plan sheet that documents the demolition of existing utilities. The Developer/Designer shall confirm that their testing requirements contained within their specifications will meet the City's Private Testing Procedures. Both of these documents are available on the City's Unified Development Manual website.

E. Design Flows

All sewer lines shall be designed to provide a minimum peak flow velocity of 2.0 feet per second and a maximum velocity of 10.0 feet per second based on full flow and Manning's equation with a minimum roughness coefficient, "n" factor, of 0.013 for all pipe materials.

The minimum slope requirement for eight (8) inch diameter sewers from an upper confluence point to the final terminal reaches shall be 0.52% to maintain a velocity of 2.5 feet per second based on full flow pipe conditions. The length of 8" line at the 0.52% slope shall be from that point of confluence to the uppermost service tap.

When sewage flow approximations are necessary the values given in the following tables shall be used, unless more accurate information is available. Refer to Arizona Administrative Code R18-9-E301. It is the design professional responsibility to indicated when more accurate information is available for the proposed site/development and to quantify the difference between these approximations in the following tables. Sites that generate flows that are different than these approximations will require City approval and may result in additional design efforts to satisfy the City.

WASTEWATER SERVICE FACTORS:

Type of Service	Average Daily Flow (gallons/person)	Peak Daily Flow (gallons/person)	Peak Factor
Domestic Use	100	300	3.0

Type of Service	Average Daily Flow	Units
Theater	5	gallons/seat/day
Retail	1	gallon/square foot/day
Restaurant	30	gallons/day/seat
Hotel/Motel	130	gallons/room/day
Schools (with lunch & shower facilities)	75	gallons/student/day
Schools (without lunch & shower facilities)	50	gallons/student/day
Other	100	gallons/person/day
Industrial & Commercial	1300	gallons/acre/day

POPULATION FACTORS

Type	Number of People/Dwellings
Single Family (SF)	3.3
Patio Homes (PH)	3.1
Multi-Family (MF)	2.8
Mobile Homes (MH)	2.4

Note: The maximum number of dwellings in a square mile section is 3,000.

F. Pipe Materials

Refer to the *List of Approved Materials* for acceptable pipe products. Pipe bedding shall conform to Detail C-402. The City Engineer may permit the use of PVC at depths greater than 10' if the maximum trench width provisions of MAG Section 601.2.2 can be certified by a registered professional engineer for the extent of that pipe, considering the soil classification at that depth, the project contract plans and specifications, and utilization of special construction observation.

PVC pipe sized greater than 15" in diameter is not allowed.

All pipe trenches shall contain locator wire and identification tape in accordance with Detail C-408.

G. Gravity Sewer Lines

I. General

Pipe bedding shall conform to MAG specifications. Pipe installation shall conform to the City of Chandler Standard Detail C-402. Pipe locator wire and ID tape shall be provided in accordance with Detail C-408.

All sewers and 6" sewer services shall be vactored (or approved equal) and inspected for debris and videotaped prior to final acceptance. Pipe deflections greater than one inch shall not be allowed. Video tapes shall be submitted to the City wastewater collections department. Manholes shall be vacuum tested per ASTM C1244-93, Standard Test Method for Concrete Sewer Manhole by the Negative Air Pressure Test prior to acceptance.

Curved sewer lines are not allowed without specific City Engineer approval.

II. Public Sewer Lines

Public sewer lines shall be a minimum of 8-inches in diameter with a minimum cover of 5 feet.

Sewer lines are required within half streets when the south or west one-half is being constructed, providing that a tributary area exists. The tributary area can either be the development itself or a separate sewer service area that is sewerer through the development. To minimize street cuts, every manhole in undeveloped areas shall have stub-outs to the edge of the street right-of-way.

Where public utility easements are platted, sewer service connections shall be extended eight feet beyond street right-of-way lines to clear all facilities to be installed in public utility easements.

Sewers constructed in arterial streets must be sized in accordance with the Wastewater Master plan. The minimum size for stub-outs at the one-half and one-quarter section lines is 12 inches in diameter. All other stub-outs shall be a minimum of 8 inches in diameter and located to serve adjacent properties. On other than arterial streets, minimum size for stub outs shall be four inches for residential, and six inches for commercial uses.

If a model home area is a part of the development project, sewer lines must, as a minimum, be constructed from the point of out fall up to and including the first manhole upstream from the model area.

In the case of phased development, each successive phase shall provide sufficient sewers to service all of the areas tributary to the phase.

All public sewer lines shall be placed in either the public right-of-way in accordance with Details C-200, C-201, and C-202 or in a dedicated easement.

Manholes and sewer pipe alignment shall be located out of the vehicular wheel paths of arterial and collector streets.

The standard location for sewer lines within the public right-of-way is in the center of a driving lane on the south and west side of the street as shown in the Standard Specifications and Details manual. Generally, sewer lines shall only be permitted to cross and re-cross the street centerline for short distances, providing that the sewer line maintains a clear distance of 3 feet or more from the lip of gutter on the south and west side of the street. Encroachment of more than 4 feet past the street centerline will generally not be allowed.

III. Private Sewer Lines

Developers of commercial and industrial projects are required to complete a Wastewater Discharge Questionnaire.

Wastewater meters are installed for commercial or industrial projects that consume large quantities of water or have auxiliary water sources that could contribute wastewater flows, as determined by the City Engineer, thereby reducing or increasing monthly sewer charges. Wastewater meters shall be installed in a wastewater monitoring vault in accordance with Detail C-417.

Private sewer lines are not allowed within the right-of-way or public utility easements. All manholes on private sewers shall have covers stamped to read "Private Sanitary Sewer".

In addition, private sewer lines 8 inches in diameter and larger are required to include a plan and profile.

Any construction materials allowed under the International Plumbing Code are permitted except High Density Polyethylene Pipe (HDPE).

Cleanouts installed at intervals not to exceed 100 feet are permitted in lieu of the manhole spacing requirements given in this manual. The cleanout spacing requirements are given in Section 708 of the International Plumbing Code.

Construction of sewer lines is not allowed under retention basins without permission from the City Engineer. Should construction under a retention basin be allowed a concrete cap shall be installed over the sewer.

Sewer lines constructed within flood zones or near or adjacent to flood-irrigated areas or retention basins must have water-tight manhole covers as per MAG Standard Detail 423.

H. Force Mains

Refer to the *List of Approved Products* for acceptable pipe materials.

Sewage pump stations shall conform to the requirements of ADEQ Engineering Bulletin No. 11, Chapter IV, C.2 Design Flows for calculating the peaking factors for low volume flows based on population. All sewage pump station wet wells shall include approved coatings. Pump stations are not allowed without approval of the City Engineer.

I. Manholes

All manholes shall be 5-foot diameter with 30-inch diameter covers. All manholes shall be the precast type as detailed in MAG Standard Detail 420 modified without steps.

All manhole frames and covers shall be adjusted per MAG Standard Detail 422.

All manholes on sewers 18 inches and larger in diameter or in arterial streets shall include corrosion-protective coatings or shall have stand-alone fiberglass-reinforced polyester inserts. Refer to the *List of Approved Products* for corrosion-protective coatings and inserts.

Manholes shall be sprayed with a pesticide coating. Refer to the *List of Approved Products* for manufacturers.

A manhole is required wherever the sewer changes pipe material, grade, size, alignment, or intersects another sewer. Where sewer lines of differing sizes enter the same manhole, the smaller sewer lines shall not have their crowns lower than the crown of the largest pipe. All manholes shall have sewer intersections between 90° and 180° inclusive. Manholes with sewer lines intersecting at angles between 90° and 120° shall have a minimum 0.10-foot drop across the manhole. In interceptor and larger sewers, inverts at junctions shall be designed to maintain the energy gradient across the junction and to prevent backflow.

The maximum allowable manhole spacing is 400 feet for sewer lines between 8 inches and 15 inches in diameter. Sewers 18 inches in diameter and greater shall have manhole spacing of 600 feet. A cleanout may be installed in lieu of a manhole at the end of a lateral sewer eight inches in diameter, or less, provided that the distance from the cleanout to the nearest manhole does not exceed 150 feet.

All industrial projects are required to install an Industrial Monitoring Vault (IMV) per Detail C-417. Also, other projects that may potentially create industrial type waste are required to install and IMV, unless exempted by the City Engineer. At a minimum, all industrial sites shall reserve sufficient space for an IMV and install a 6" drop manhole instead of the IMV.

If an IMV is installed, a minimum 4-foot wide easement from the IMV to a point of public access shall be dedicated to the City. The City shall have 24-hour access to the IMV.

J. Service Connections

Service taps may be connected to the manholes on the sewer line. Service tap inverts shall be above the crown of the sewer main. All abandoned sewer service taps shall be capped. Service connections 8 inches and larger shall be made only at a manhole on the main.

All sewer taps shall be the wye type per MAG Standard Detail 440 'A' and sized according to the minimum tap size table, below. All connections to existing sewer mains shall be accomplished by machine tapping, utilizing a PVC saddle, or by

construction of a manhole. Taps on mains 15 inches and larger shall be installed directly into a manhole with no more than four taps in a single manhole.

MINIMUM SERVICE TAP SIZES

Type	Pipe Size (inches)
Residential	4
Multi-Family	6
Industrial	6
Commercial	6

Direct service taps may not be installed on sewers 15-inch and larger. However, a manhole may be constructed on an interceptor or larger sewer, and then a lateral sewer line may be installed. The lateral sewer line extension will terminate upstream in a manhole. Direct service taps then may be installed on the upstream lateral.

All sewer taps should be 4 1/2 feet deep at property line. To raise the tap from the mains deeper than 16 feet, refer to Detail C-410.

The City’s Wastewater Quality Department shall determine if sampling location is required. The location of the sampling point, if necessary, shall be determined by the Municipal Utilities Department with concurrence from the City Engineer.

4) Reclaimed Water Distribution System

A. Jurisdictional Agency Approval

All reclaimed water lines shall be designed in accordance with Arizona Administrative Code, Title 18, Chapter 9, Article 6: §R18-9-602 Pipeline Conveyances of Reclaimed Water and the current City Wastewater Master Plan. Plans shall bear the approval signature of the Maricopa County Department of Environmental Resources prior to approval by the City. Requests for letters of Approval to Construct shall be routed to the City Engineer through Civil Plan Review.

Refer to the AAC, MAG Section 610.5, and MAG Detail 404 for separation requirements for protection against possible contamination.

Refer to City Code Chapter 53 Reclaimed Water Services for City requirements regarding reclaimed water service. Please also refer to the *Reclaimed Water User’s Manual* that can be located on the City of Chandler’s Unified Development Manual (UDM).

The Reclaimed Water user cannot assume that City’s reclaimed water can be used for irrigating farm land or industrial uses. If this is the intent of the Reclaimed Water user please contact the City Engineer prior to commencing plan submittal.

B. Engineering Requirements

The following engineering requirements shall apply to all public reclaimed waterline extensions and onsite reclaimed water delivery systems:

- a. The developer causing extension of a reclaimed waterline shall locate it in City rights-of-way or easements and shall pay in full, less approved City participation as provided above, the engineering, construction and inspection costs of the lines and appurtenances.
- b. Plans and specifications shall be prepared in accordance with appropriate standards as established by the City Engineer.
- c. Each lot or parcel of land to be served with reclaimed water shall abut a reclaimed water main.
- d. All lines shall be sized in accordance with the latest reclaimed water system master plan, except that the City Engineer reserves the right to increase or decrease the diameter of any and all mains described in the plan when requirements so dictate.
- e. In all developments, such as subdivisions, multifamily tracts, commercial centers, shopping centers, golf courses, parks, industrial or other similar developments, the developer shall furnish and install, to City specifications, all reclaimed water mains, service connections, valves, fittings, storage structures, turnout structures and appurtenances within the boundary of the development as well as the streets bounding the tracts, and make reclaimed waterline extensions as determined necessary by the City Engineer.
- f. All main line valves shall use MAG Standard Detail 391-1 Type A or C valve box with a square or rectangular frame and cover with the words "Reclaimed Water" in raised letters on the cover. Debris caps (MAG Standard Detail 392) shall be installed on each valve.
- g. All reclaimed water distribution systems shall be clearly identified in accordance with MAG Specifications Section 616. All subsurface piping and fixtures shall be installed with purple pipe or by wrapping the pipe with Christy's polyethylene encasement (polywrap) or equal and by marking above ground parts, including valves, valve boxes and covers, controllers, piping, hose bibs, and other outlets purple.
- h. Access to the developers reclaimed water distribution system controller box shall be by key.
- i. The engineering requirements set forth herein are intended to supplement rather than supersede other applicable local county, state and federal requirements and, in the case of conflict, the more stringent requirement shall apply.

The Developer/Designer is responsible to obtain Approval of plans, permits, inspections and acceptance.

- All other Jurisdictional Authority requirements must be met and the Developer/Designer is responsible to submit proof of their acceptance.
- The City shall acquire ownership of all extensions of public mains when completed, approved and accepted. The system shall be conveyed to the City free and clear of all clouds to title, including liens and encumbrances.
- Permanent-type, certified, reproducible as-built record plans shall be filed with the City Engineer upon completion of construction of additions to the system. The mylar executed by the City and other Jurisdictional Agencies is critical to the final acceptance process, the Developer/Designer is responsible to complete all

required signature blocks and the associated paperwork. Submission of the fully executed project mylar is a requirement for acceptance of the infrastructure by the City.

- Acceptance of all extensions shall require the written approval of the City Engineer and will be dependent on all inspections, test results and the above noted requirements being met.

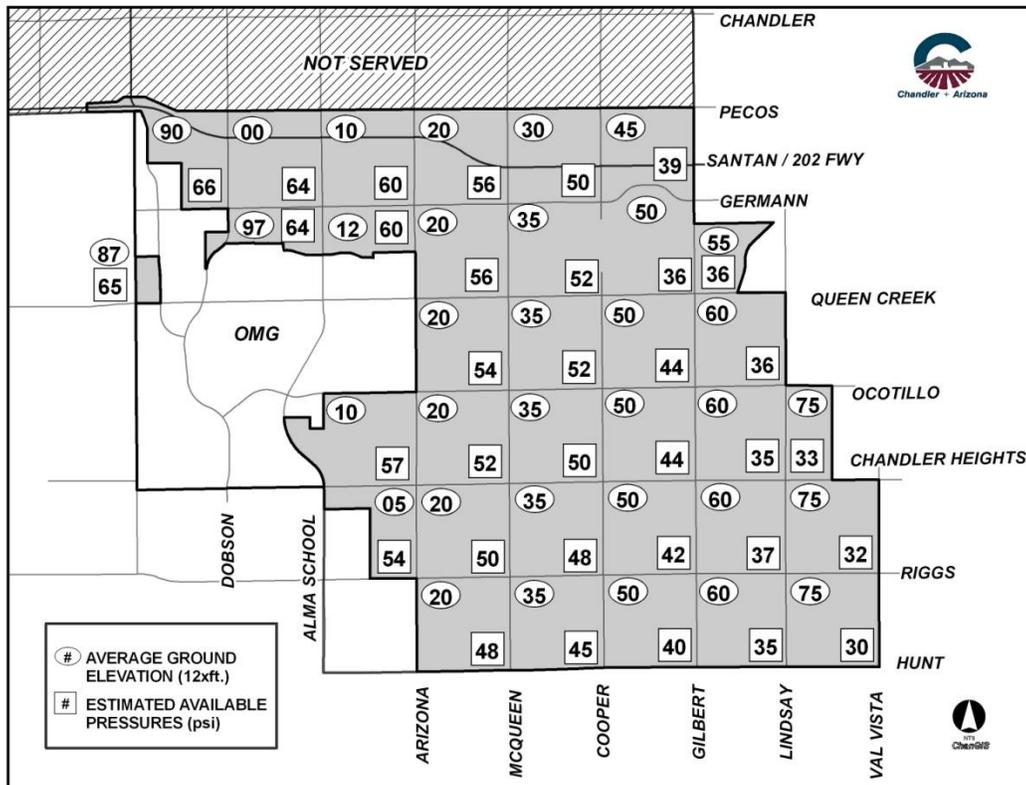
C. Easement Requirements

All public reclaimed water lines shall be placed in either the public right-of-way or within a dedicated easement. The minimum easement width is 12 feet, with the entire easement free of property lines, boundary walls, and other obstructions for its entire length and width. Joint reclaimed water and sewer line or joint reclaimed water and water line easements shall be 24 feet wide, with eight feet of separation between the lines.

D. Volume Considerations

Large volume users (greater than 250,000 gallons per day) may be required to construct storage lakes and utilize a service connection in accordance with Detail C-405. Refer to the specifics of the *Reclaimed Water Use Agreement* for project conditions. Small volume users shall utilize a service connection in accordance with Detail C-404.

The following figure provides a guide of the estimated maximum pressures of the reclaimed water distribution system. Reclaimed water pressures immediately upstream of the reclaimed water meter could vary between 20 psi and 60 psi. There may be intermittent pressure drops below 20 psi. The designer should consider the Reclaimed Water system's pressure fluctuations when designing the onsite distribution system. The design professional is responsible for confirming their design will operate with these system pressure criteria.

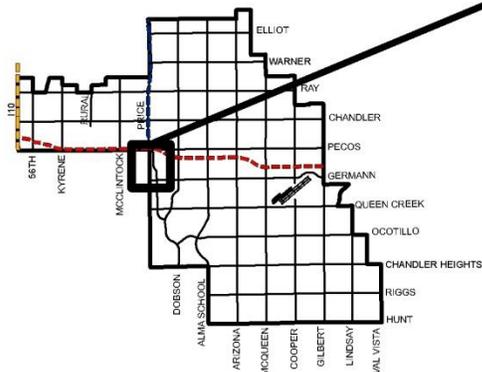
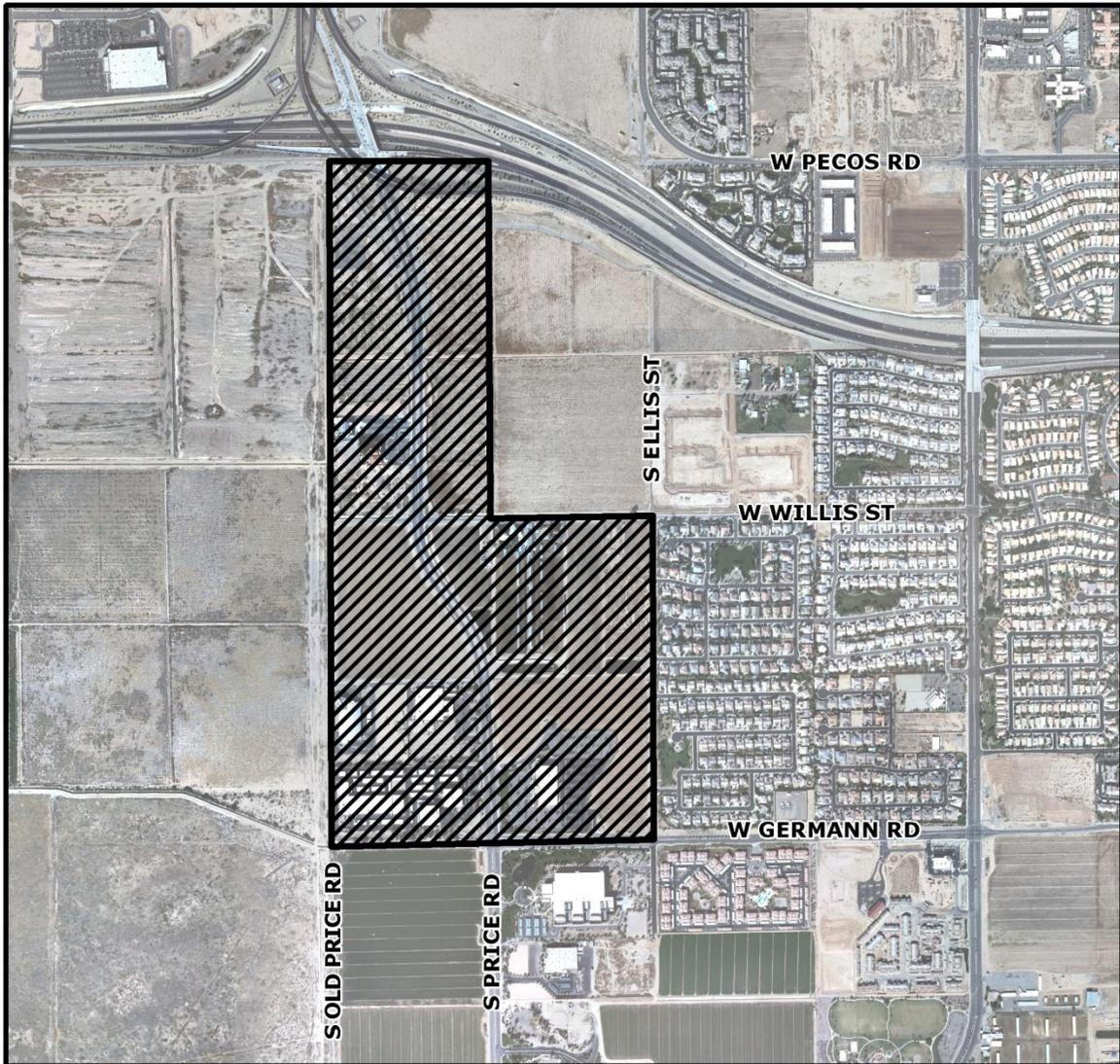


E. Applicable Design Criteria based on Location within Service Area

The City is not the only purveyor of reclaimed water within the City boundary. There are City delivery agreements with other purveyors and the following should be considered when selecting the design criteria for reclaimed water.

Development Location	City Required Documentation	Design Criteria Approvals	Meter Provider	Owner will receive a utility bill from:
Within City Service Area	As noted in this document.	As noted in this document	City Reclaimed Water Meter	City of Chandler based on City utility rates.
Within non-City Service Area	Executed Service Agreement with Reclaimed Water Provider	Non-City Reclaimed Water Purveyor Design standards and approval is required. City may issue an encroachment permit, if required	Developer provided to meet the requirements Non-City Reclaimed Water Purveyor	Non City Reclaimed water Purveyor based on the rate contracted with the purveyor
Within non-city service but served from City Reclaimed (Public) water mains North of Germann Road (See Exhibit Below)	Executed Service Agreement with Reclaimed Water Provider	As noted in this document	City Reclaimed Water Meter	Non City Reclaimed water Purveyor based on the rate contracted with the purveyor

EXHIBIT D



LEGEND

 SERVICE AREA



F. Location

All public reclaimed water lines shall be installed in locations per City of Chandler Standard Detail C-200, C-201 and C-202 unless otherwise determined by the City Engineer. They shall have a minimum of 7 feet cover.

G. Acceptable Pipe Materials and Construction Requirements

Pipe shall consist of approved types in accordance with the *List of Approved Products* and shall be identified as reclaimed in accordance with MAG Section 616.4. Ductile iron pipe shall be utilized under streets.

Construction shall conform to MAG Section 616.

Service connections shall be isolated from the public distribution system by reduced pressure principle backflow assemblies located at the right-of-way line in accordance with Detail C-404.

All pipe trenches shall contain locator wire and identification tape in accordance with Detail C-408.

H. Reclaimed Water Lines

Public reclaimed water mains shall be 12 inches in diameter on arterial streets, and eight inches otherwise unless otherwise indicated in the City's Reclaimed Water Master Plan.

Tees shall be spaced at a distance no greater than 1/4-mile. Crosses shall be installed at the intersection of arterial streets.

All laterals shall be a minimum of 8 inches in diameter. Laterals shall extend past the edge of existing pavement.

Two valves shall be required on each tee (other than service stubs) and three valves shall be required on each cross.

Valve box installations shall conform to City of Chandler Standard Detail C-406. In areas not subject to wheel loading, the concrete ring installations shall also conform to City of Chandler Standard Detail C-317.

No valves shall be located in sidewalk or ramp areas. All valves must be stationed on the plans. Valve nuts shall have a bar welded so as to require a modified tool to operate.

Existing services shall be abandoned by exposing the tap at the main and closing the corporation stop.

Refer to the *Reclaimed Water Use Agreement* for specific design details regarding backflow prevention and on-site storage requirements.

I. Construction Plan Requirements

Reclaimed lines 4" and larger in diameter shall be shown within the civil plan submittal. All plans shall be prepared and signed by a registered professional engineer.

Plans shall be submitted on 24" x 36" sheets. The plans shall be drawn to an engineering scale with 1" = 20' and 1" = 40' as the preferred horizontal scales. The vertical scale need not differ from the horizontal scale by a precise factor of 10. Water, sewer and paving plans may all be shown on the same plan sheets, if a horizontal scale no smaller than 1" = 20' is used.

All reclaimed lines and utility crossings shall be shown in both plan and profile views.

Project Vertical datum shall be NAVD 88 with equations to legacy City Datum NGVD 29 and any as-built plans that affect the project. The nearest City CMCN benchmark shall be utilized for establishing City Datum.

The engineer shall incorporate into the plans the latest copy of the construction *Reclaimed Water Notes*.

The City of Chandler has two policies that should be reviewed: Abandoned Utilities in the City's Right of Way and Private Development Testing Procedures. All utility abandonments within the City's Right of Way will be reviewed on a case by case basis. All proposed abandonments must be shown on a separate plan sheet that documents the demolition of existing utilities. The Developer/Designer shall confirm that their testing requirements contained within their specifications will meet the City's Private Testing Procedures. Both of these documents are available on the City's Unified Development Manual website.

J. Private Reclaimed Water System design considerations

- I. Unless otherwise determined by the City Engineer. The Private Reclaimed Water System is the reclaimed water system that is downstream of the reclaimed water meter.
- II. Turn out design.
 - a. Large volume users (greater than 250,000 gallons per day annual average) who receive Reclaimed Water deliveries from the City will be required to construct storage lakes and follow Detail C-405 for their service connection. The City shall control, maintain, and operate all large turnout structures. The Reclaimed Water User will be required to sign a Turnout Operations Agreement. (See Section 5)B.VI).
 - b. Small volume users (less than or equal to 250,000 gallons per annual average) shall utilize a service connection in accordance with Detail C-404.
- III. Reclaimed water meter – The City shall install the reclaimed water meter. The Engineer shall design the reclaimed water in accordance to Detail C-301 and C-416. When applicable, the desired location is at an existing reclaimed blow-off service connection.
- IV. Reclaimed water pressure: Reclaimed water pressures immediately upstream of the reclaimed water meter could vary between 20 psi and 60 psi. There may be intermittent pressure drops below 20 psi. The designer should consider the Reclaimed Water system's pressure fluctuations when designing the onsite distribution system.
- V. Chandler's potable water system protection. The Private Reclaimed Water System design shall protect Chandler's potable water system from possible Reclaimed Water contamination. At a minimum, the designer shall include the following:
 - a. When Reclaimed Water is used or will be used on single family residences, a reduce pressure principle backflow assembly shall be install as part of the original Private Reclaimed Water System (in accordance to Detail C-311) on the potable water line serving the single family residence. The Engineer shall specify the concrete pad and locking enclosure will not be installed.
 - b. Sleeves on private property – When the Private Reclaimed Water System crosses private property and when there is no intention of using Reclaimed Water on the private property, the private reclaimed water line shall be installed in a pipe sleeve. Pipe sleeves shall be pipe meeting the requirements for the conveyance pipe and shall be two nominal sizes larger. Private Reclaimed Water Systems crossing private property within a public easement shall be installed in a sleeve in accordance with this paragraph.

- c. Sleeves crossing public property - When the Private Reclaimed Water System crosses public property, the private reclaimed water line shall be installed in a pipe sleeve. Pipe sleeves shall be pipe meeting the requirements for the conveyance pipe and shall be two nominal sizes larger.
- VI. Protection of the Public Reclaimed Water System - The Engineer shall determine if a backflow prevention assembly is needed on the Private Reclaimed Water system to protect the Public Reclaimed Water System. If needed, the Engineer shall determine the location, size, and type of backflow prevention device. If the private reclaimed water system plans on injecting any chemicals into private reclaimed water system, a backflow prevention assembly shall be installed within 6-inches of the reclaimed water meter.
- VII. Private irrigation lines are not allowed in City maintained street medians. The onsite private irrigation system shall not be tied into City maintained medians in any way.

K. Reclaimed Water Service Process

The following describes the process that shall be followed before City allows Reclaimed Water to be used on private property. This process must be used for new reclaimed water use or a converting a potable water irrigation system to reclaimed water.

For the purpose of this Section, the term Reclaimed Water User shall mean the private entity who signs City's Reclaimed Water Use Agreement and who is the applicant for ADEQ Type 2 or Type 3 Reclaimed Water General Permit or Reclaimed Water User that receives reclaimed water from the City's Public Reclaimed Water as outlined in Section E.

a. City Contacts:

Engineering, Daryl Racz – 480 728-3336 and/or Jason Richardson 480 782-3141

b. Submittal Requirements:

The Engineer or Reclaimed Water User shall submit TWO copies of the following to the City. Once the City receives all the following documents, the City will begin the process to allow Reclaimed Water use on private property.

- I. Maricopa County approved irrigation plans.
- II. Maricopa County "Approval to Construct".
- III. "As-built" drawings of the Private Reclaimed Water Distribution System. The As-Built drawings shall show: property lines, all reclaimed water lines, all potable water lines (including the potable irrigation lines), potable water lines to be converted to reclaimed lines, and backflow assemblies. The As Built cover sheet shall contain the following statement: "I certify that each property, As Built water line, and As Built reclaimed water line shown on this drawing meets the requirements of Arizona Department of Environmental Quality's rules R18-4-215, R18-9-602, and R18-9-704." with the engineer's signature and professional engineering license number under this statement. Each As-Built sheet shall sealed be as "As-Built" by an engineer registered in the State of Arizona.
- IV. A site map identifying individual lots, common area, and public owed area, and the proposed locations where Reclaimed Water will be or could be applied. An engineer registered in the State of Arizona shall seal the site map.
- V. Completely filled out and signed "Application for the Use of Reclaimed Water".

- VI. For Large user (greater than 250,000 gallons per day annual average demand) – A signed copy of a Turn Out Operations Agreement. This Agreement allows the City to access the turn out site, control, maintain, and operate all the large turnout structures. The agreement defines: the responsible party for the equipment and piping, the responsible party for pipe leading into the turnout if the turnout is on private property, the responsible party for the maintenance of the area inside the fence and the fence.
- VII. Encroachment permit application, if necessary.
- VIII. An ADEQ letter indicating a valid Type 2 or Type 3 Reclaimed Water General Permit applicable for the property that will be irrigated with Reclaimed Water has been issued.
- IX. A cross connection testing plan, schedule, and report. The plan must be submitted by a State of Arizona approved Certified Cross Connection Control Specialist or by a Professional Engineer registered in the State of Arizona. Certified Cross Connection Control Specialist shall mean a Cross Connection Control Specialist approved by ADEQ.
- X. Pay all permit fees that will include all appropriate plan review, inspection and Reclaimed Water buy-in assessments.

c. City Review Process

The City will review the documents submitted by the applicant, once all the documents have been completed and signed, the City will begin to process the documents.

- I. City will review and approve cross connection test.
 - Once the City approves the cross connection test plan and schedule, City will coordinate with the applicant the setting of the Reclaimed Water meter and scheduling of the cross connection test. The cross connection test plan shall be signed by a State of Arizona approved Certified Cross Connection Specialist or by a Professional Engineer registered in the State of Arizona.
 - Applicant shall conduct the cross connection testing in accordance to the approved cross connection test plan. A State of Arizona approved Certified Cross Connection Specialist or by a Professional Engineer registered in the State of Arizona shall be present during the cross connection test. City staff shall be present during the cross connection test. If necessary, City staff may have portions of the cross connection test revised or repeated.
 - Upon successful completion of the cross connection test, the City shall unlock the reclaimed water meter.
 - If the cross connection test is not successful, the City shall lock the reclaimed water meter. Once the cross connection test deficiencies have been corrected, process b, c or d, in this section shall be repeated.

d. Post Cross Connection Test

Upon completion and acceptance of the cross-connection test, the following actions are required.

- I. Applicant shall submit to the City, within 10 working days, a cross connection test report. The cross connection test report shall be signed by a State of Arizona approved Certified Cross Connection Specialist or by a Professional Engineer registered in the State of Arizona.

- II. City Close Out Process. Upon receipt of the County's signed Approval of Construction and the cross connection test report, the City shall:
- Mail a signed copy of the Reclaimed Water Users Agreement to the Reclaimed Water User.
 - Issue reclaimed water rebates, if any.
 - Issue impact fee refunds, if any.