

ARTICLE 4 WATER

SECTION 4.1 INTRODUCTION

4.1.1 PURPOSE

The purpose of this Article is to provide engineering standards, guidelines, and geometric requirements for the design and construction of the public water system and maintain a reliable and safe water supply, distribution, and storage system within the City of Prescott (COP), the Town of Prescott Valley (TOPV), and the Town of Chino Valley (TOCV). Adherence to these standards will result in reliable water service and fire protection capabilities. This Article is complimentary and supplemental to the Quad City Standard Details (QCSD), Prescott City Code (PCC): Title 2, Chapter 1 Public Works Department, Title 10 Land Development Code (LDC), and Title 16 Street and Utility and Drainage Requirements, and all other Articles of the General Engineering Standards (GES), the Town of Prescott Valley Town Code, specifically Chapter 9 – Health and Sanitation and Chapter 16 – Engineering, and the Town of Chino Valley Town Code.

4.1.2 APPLICABILITY

- A. The standards and guidelines of this Article shall apply to the construction, modification, replacement, and extension of all water distribution mains, pump stations, and other appurtenances as well as any modification of the public water system to be owned, operated, and maintained, by the City of Prescott, Town of Prescott Valley, or Town of Chino Valley (Agency). Privately funded water mains that are proposed to be connected to the Agency’s system are reviewed for compliance with Agency standards. Private water mains shall be extended to new users in a logical and cost-effective manner without adversely affecting existing customers and system performance. This Article is intended for use in plan design, preparation, and review processes. The information provided in this Article is not intended to cover all situations that arise, nor may it be a substitute for sound engineering principles and judgment.
- B. Developers are required to install all improvements necessary to provide water service to their development. This includes any water distribution mains, pump stations, or other facilities, and all required appurtenances, including the payment of all applicable development fees. Developers shall also adhere to the Agency standards for extension of the Agency’s water system to newly developed areas, subdivisions, and in-fill areas inside the Agency’s service area in accordance with the Agency Water Model.

4.1.3 DESIGN STANDARDS AND GUIDELINES

- A. New public and private water supply distribution and storage facilities shall be designed in accordance with Article 1 and Article 4. A civil engineer registered in the State of Arizona shall analyze, design, and seal all proposed water system project plans and specifications. The effects of peak and fire flow demands shall be examined to ensure proper sizing and layout of proposed water system facilities, including impacts to existing off-site facilities where deemed appropriate by the City/Town Engineer.
- B. The operation, maintenance, and repair of private water systems are the responsibility of the water service provider (provider). The provider shall pay the cost for the operation, maintenance, repair, and replacement of private systems. These private systems are connected to main lines operated by the Agency, as identified on the final approved plans. The Agency shall have no obligation or requirement

to assist or provide labor or equipment to perform or supplement any responsibilities pertaining to said private water systems, all of which are those of the provider.

- C. For private water systems, the provide, on a yearly basis, shall submit the firm, contact name, business phone number, and emergency phone number for the private system operator, who shall be certified by the Arizona Department of Environmental Quality (ADEQ) at the required level. All private water systems connected to the Agency’s water system, even if not required by ADEQ to have an onsite operator, shall be subject to the applicable Articles of the Quad City General Engineering Standards (GES).
- D. All components and related appurtenances for construction and repair of water infrastructure shall be domestically manufactured, certified, and submitted to the Agency for review and approval prior to installation.

4.1.4 STATE AND LOCAL REGULATIONS

A. Arizona Department of Water Resources (ADWR)

ADWR regulations are contained within Arizona Revised Statutes (A.R.S.), Title 45 – Waters. They encompass requirements for water supplies and the management thereof. In 1999, the Prescott Active Management Area (PrAMA) was declared to be out of “safe-yield” which enacted more regulations including the Assured Water Supply (AWS) rules. For the COP, this resulted in a Decision and Order of AWS. All new water connections made to the COP’s system require confirmation that the supply exists and that there is entitlement to it.

For the TOPV, the same statutory requirements apply, yet the TOPV meets assured water supply rules by developers providing certificates of assured water supply (CAWS).

B. Arizona Department of Environmental Quality (ADEQ)

ADEQ’s Engineering Manual Bulletins No. 8 “Disinfection of Water Systems” and No. 10 “Guidelines for the Construction of Water Systems” and the Arizona Administrative Code (AAC), Title 18-5-505.B - Approval to Construct, contain specific requirements for submittals, approvals, and notifications when extension of a public water main is proposed. The developer and the Engineer of Record (EOR) are expected to be aware of and comply with the above referenced regulations. Additional information can be found on the ADEQ website at www.azdeq.gov/.

C. Yavapai County Environmental Services Department (YCESD)

1. Before civil infrastructure construction permits are issued, the developer shall submit to the City/Town Engineer an Approval to Construct (ATC) from ADEQ through their delegate.
2. Prior to the City/Town Engineer issuing an Approval to Operate (ATO) and release from the Agency, the developer shall deliver to the Agency: A signed Approval of Construction (AOC) from ADEQ through the YCESD delegation.

D. Agency Approval (City of Prescott, Town of Prescott Valley, or Town of Chino Valley)

1. Issuance of an Approval to Construct by YCEDS or ADEQ does not constitute an approval of plans and reports by the Agency. No construction shall commence prior to the Agency issuing a permit.
2. An as-built plan submittal is required prior to receiving an Approval to Operate and Release from the Agency. As-built submittals shall be in accordance with Article 10.

3. In the COP, a Contractor/Developer may need to energize water mains or set a water meter for fire, life or safety purposes, prior to the COP's final acceptance of the sitework. In these cases, the COP, at its discretion, may offer an Extension Agreement. The Extension Agreement affords the Contractor/Developer an additional three (3) month period to complete the sitework and provide the COP with required documentation. During this time, the Contractor/Developer must make every effort to complete the work and provide the documentation for final acceptance of the site. If the work is not completed to the COP's satisfaction by the end of the agreement, the COP, at its discretion, may shut off water and remove the water meter. When ADEQ Water and Sewer approvals are required, Extension Agreements shall not be issued until ADEQ approvals have been received and accepted by the COP.

SECTION 4.2 GENERAL INFORMATION

4.2.1 WATER AVAILABILITY

A. Prescott Active Management Area (PrAMA)

The Agencies are located within the Prescott Active Management Area (PrAMA), established under the Arizona Groundwater Code of 1980 (A.R.S., Title§ 45). Water providers in the PrAMA are required to follow Arizona Revised Statutes (A.R.S.) and Arizona Administrative Codes. State statute identifies five (5) water management plan periods for initial Active Management Area (AMA)'s, PrAMA included. The fifth management plan for each initial AMA was adopted in 2022, and the conservation requirements in those plans will become effective on January 1, 2025. Pursuant to A.R.S. §45-568(C), these will remain in effect "until the legislature determines otherwise."

B. Water Service Area

The Agency's water service area includes the city limits of Prescott, town limits of Prescott Valley, town limits of Chino Valley, certain surrounding areas of the unincorporated part of Yavapai County, and the Yavapai-Prescott Indian Tribe Reservation. All water service is subject to water contracts or settlements and known under the general terms of water service agreements.

C. Private Water Companies and Water Districts

1. Within the Agency's water service area, there are private water companies and water districts using water from their own sources or master metered by the Agency (all are documented with ADWR). These include Home Owners Associations (HOA), Limited Liability Companies (LLC), or other entities established to provide ownership, operation, and maintenance responsibilities.
2. Proposed private water mains located within the Agency's right-of-way (ROW) or easement shall require an agreement between the Agency and the private water company delineating liability and maintenance responsibilities. Private water line design and materials shall comply with the GES and QCSDs.
3. Private water companies shall review and approve the construction of, and modification to, water systems within their franchise areas. The developer shall submit to the Agency written documentation that the private water company has approved facilities shown on the final plans before the Agency grants approval of the project.
4. The Agency shall review development plans which contemplate new water demands, prior to construction. The Agency cannot provide water service within private water company, franchise areas. If the work occurs within the Agency's ROW or easement, or the private system connects to the

Agency's public water system, then plans shall be reviewed by the Agency and meet Agency standards. In cases where the Agency reviews private water systems, the applicable review fees shall be paid. A note shall be placed on the final construction and as-built plans stating that the operation and maintenance of private main lines and appurtenances is not the responsibility of the Agency. Additionally, the establishment of Conditions, Covenants, and Restrictions (CCR) and/or a Limited Liability Company (LLC) or Home Owner's Association (HOA) shall be required in accordance with Agency Code. The responsibility to blue stake water mains within a private district shall lie with the private entity.

4.2.2 AGREEMENTS

A. COP Water Service Agreement

1. All new water connections made to the COP's system require confirmation that the supply exists and that there is entitlement to it. The COP's Decision and Order is the document that outlines the supplies while PCC and the Water Management Policy outline the rules and policies for water service. Developers making application for a Water Service Agreement (WSA) application are encouraged to meet with staff prior to applying due to the complexity of the issues related to the allocation of water.
2. An application and fee shall be required for all WSA requests. These may be found on the COP's website at www.prescott-az.gov/documents.

B. TOPV Water Service Connection

1. All new water connections made to the TOPV's system require the confirmation that the supply exists and that there is entitlement to it. Developers applying for new water service connections for their subdivision are required to apply for a certificate of assured water supply CAWS through ADWR. Multi-family and commercial site developers are encouraged to meet with staff prior to application due to the complexity of the issues related to the availability of water.
2. An application and fee shall be required for all water service connection requests. These may be found on the TOPV's website at <https://www.prescottvalley-az.gov/DocumentCenter/>.

C. Reimbursement District Agreement

Developers and property owners who install improvements to the public water system may be eligible to request the formation of a reimbursement district allowing for partial reimbursement of costs to design and construct the improvements. Agency may have specific reimbursement district criteria for developers or property owners that allow them to collect main reimbursement charges and compensation for the cost of oversizing or extending water mains in accordance with Agency Code.

PCC Section 2-1-10

TOPV Town Code Article 9-05a

SECTION 4.3 PLAN SUBMITTAL REQUIREMENTS

Improvement plans submitted to the Agency for approval shall adhere to professional engineering standards governed by the State of Arizona Board of Technical Registration. Improvement plans shall be complete and shall comply with Agency and State Board requirements. Improvement plans that do not meet industry

standards or are incomplete shall be returned by the Agency without review comments and shall be determined to be an incomplete project submittal. Repetitive submittals of non-compliant and incomplete improvement documents may be subject to State of Arizona Board of Technical Registration review.

SECTION 4.4 WATER SYSTEM REPORTS

4.4.1 GENERAL INFORMATION

- A. All projects shall be required to submit a Water Master Plan Report and/or a Water System Design Report. The purpose of these reports is to provide the Agency with information regarding the potential water demands of the project and verify the capability of the Agency to provide the domestic water use and fire flow demands that will be required.
- B. All Water System Reports shall be prepared under the direction of a licensed civil engineer in the State of Arizona. The report shall be sealed and signed by the EOR in accordance with the requirements of the State of Arizona Board of Technical Registration and submitted to the City/Town Engineer.
- C. Reports shall provide an analysis of the impact that a development will have on the Agency's water system. The objectives of the Water Reports are to verify the water demand and the system's ability to supply and maintain sufficient fire flow. Demands will be based on the Agency's most recently adopted International Fire Code (IFC), sprinkler flow/hose stream allowance and available system flows, pressures, and proposed hydraulic regimes. All reports submitted to the Agency for review shall be prepared in accordance with Article 1, Section 1.3, in addition to the following guidelines:
 - 1. Format:
 - a. The report and all supporting or supplemental material shall be PDF documents with letter-sized, eight and one-half by eleven (8.5" x 11") inch pages.
 - b. All reports shall have a table of contents, including page numbers.
 - c. Larger exhibits or maps shall be provided in PDF format at their full size, generated from the original drawing files.
 - d. A civil engineer licensed to practice in the State of Arizona shall seal each report in accordance with the requirements of the State Board of Technical Registration.
 - e. The report cover shall contain the following:
 - 1) Project Name
 - 2) Project Location
 - 3) The name, address, and phone number of the developer/owner and the EOR.
 - 4) The original submittal date and all subsequent revision dates.
 - f. Common spreadsheet formats shall be compatible with Microsoft Excel.

2. Existing Conditions:
 - a. Reference any existing master plans or design reports applicable to adjacent development.
 - b. Include excerpts from existing plans or reports as applicable.
 - c. Indicate the dates, times and results of certified flow testing of the existing water system.
 - d. Include a description based on all parts or reference within a platted development.
 - e. Describe the existing topography, and landform features.
 - f. Include the location and description of existing utilities in the vicinity.
 - g. Describe the existing and proposed site zoning and land uses.
 - h. Include reference to elements of the Agency's General Plan and identify any designated character area or studies that will affect the project's design.
3. Proposed Conditions:
 - a. Summarize the proposed development. Include a site plan that indicates the layout of the proposed development with a survey, a minimum of one-hundred (100') feet beyond the project limits, or as determined by the City/Town Engineer.
 - b. Identify the location and size of all proposed connection(s) to the Agency's water system.
 - c. Show all looping and/or extension of water mains into the site.
 - d. Indicate the location of all pressure zone boundary lines.
 - e. Provide a looped system for all water supply demands needed to meet the minimum requirements of the Fire Department, maintain water quality standards, and maintain system redundancy for operational flexibility. For new subdivisions or phases, this would translate to a minimum of two connections off the existing system. Single feeds are not permitted unless otherwise approved by City/Town Engineer.
 - f. Reference which water zone the site is within and address all required fire flows and system pressures.
 - g. Address any maintenance responsibilities of the proposed water system.
4. Mapping:
 - a. All mapping shall conform to Agency adopted CADD standards and the GES Article 8, Survey Controls.
 - b. The project name shall be located on each sheet.
 - c. The name, address, and phone number of the developer/owner and EOR shall be stated on each sheet.

- d. The original submittal date and all subsequent revision dates shall be located on each sheet.
- e. All maps shall be prepared to an appropriate scale that is sufficient to show all required information clearly.
- f. All proposed or existing on-site and off-site facilities including, but not limited to, pump stations, transmission and distribution mains, and reservoirs shall be shown.
- g. All proposed or existing street locations, parcel boundaries, and proposed lots within each parcel. All property lines, ROW, tracts, and easement lines shall be clearly labeled.
- h. Contour lines shall have a maximum of two (2') foot intervals and ten (10') foot labels.
- i. Indicate pressure zone boundaries, pressure-reducing valves (PRV), and corresponding zone valves. Include size and pressure settings for all PRVs.
- j. Include a small vicinity and a more detailed location map showing the general location of the project with major arterial streets labeled along with geographic orientation to a distance of one mile from the exterior boundaries of the project.
- k. Graphics shall present existing utilities as dashed lines and proposed utilities as bold, solid lines.

4.4.2 WATER MASTER PLAN REPORT CONTENT

- A. When phasing is contemplated or required by the City/Town Engineer, a Water Master Plan Report shall be prepared in accordance with the requirements in Section 4.4.1. The report shall also address, but not be limited to the following:
 - 1. The report shall specify the terms and requirements for water service to the development, including any off-site improvements.
 - 2. All development project owners shall be responsible for determining their specific water system needs between interim and build-out.
 - 3. Include the projections for future surrounding developments based on the adopted General Plan Land Use Map to ensure there is no adverse impact on the system.
- B. A computer water network model, which is compliant with Section 4.4.4 shall be used for the analysis of pressure and flow within the distribution system, verifying that adequate pressures, domestic and fire flows will be available within the proposed development based on projected demands and shall include the following:
 - 1. If certified flow tests performed on the system during peak demand to which the project is to be connected do not show that sufficient capacity exists, the computer 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.

2. If the proposed development requires a change in zoning that increases density or proposes a water system different from the Agency's Water Master Plan, then additional upstream and downstream off-site analysis shall be required.
 3. Modification of existing or creation of new pressure zones shall require approval of the City/Town Engineer.
- C. Master plan mapping shall demonstrate the following:
1. Demonstrate compliance with the Agency's Water Model, which encompasses the respective area.
 2. Master planned developments that design a distribution system that will be phased shall provide a synopsis of the phasing with modeling backup to the COP Public Works Department or TOPV Utilities Department, as applicable, prior to acceptance of the development's Water Master Plan.
 3. Each phase of the master plan shall be a standalone document when submitted to the Agency for review of that specific phase.

4.4.3 WATER DESIGN REPORT CONTENT

- A. A Water Design Report shall be prepared in accordance with the requirements of [Section 4.4.1](#).
- B. The system design shall comply with ADEQ Engineering Manual Bulletin No. 10, American Water Works Association (AWWA) and the Arizona Administrative Code (AAC) R18-5 requirements for system performance and redundancy. The developer shall coordinate water system improvements with the Agency's Water Model and the Capital Improvement Plan.
- C. In addition to the general requirements in [Sections 4.3.1](#) and [4.4.1](#), the Water Design Report shall, at a minimum, include the following:
1. Design Documentation
 - a. Note the design compliance with the latest revision of this manual and all other applicable design standards and codes.
 - b. Include a narrative of which design procedures, policies and methodologies will be incorporated into the design engineering of the water system.
 - c. List the title and version of any software used in the design analysis.
 2. A summary of the anticipated water demands for the project:
 - a. The priority of obtaining water design flows for a non-residential facility is: 1) flow measurements from the actual facility; 2) the use of flows from similar facilities in the immediate area; 3) the use of similar flows from similar facilities in other areas; and 4) flow tables as listed in [Table 4-1](#).
 - b. Flows may be calculated on a sub-area basis, however, total flows for the entire development shall also be provided.

- c. Flow rates shall include average day, maximum day, peak hour flows, and fire demand.
 - d. Fire Flow shall be defined as the flow rate of a water supply, measured while maintaining 20 psi system residual pressure, that is available for fire fighting.
 - e. Fire Demand shall be defined as the greater water demand of either the required fire flow or fire sprinkler demand, including hose stream allowances as required for a development. The design professional shall provide highest water demand for review as the fire demand.
 - f. Include fire flow and fire sprinkler system demands that will be required for the development in accordance with the adopted fire code, COP or Central Arizona Fire and Medical Authority (CAFMA) amendments, and site-specific criteria established by the COP or CAFMA Fire Marshal.
3. All projects shall be required to provide a fire analysis that shall demonstrate that there is adequate water available from the Agency's existing system to meet the required fire demands of the proposed development, considering the building construction type, height, layout, etc.
- a. The EOR shall use a hydraulic model to evaluate the ability of the water distribution system to deliver fire demand to the development.
 - b. The developer is responsible for understanding the fire demand requirements of the structures that are to be built and shall assure that the water distribution system within the development is capable of delivering the required fire flows.
 - c. Improvements, including off-site improvements, may be required to meet these criteria.
 - d. The fire demands shall be included in the overall water demand and summarized in the water design report.
 - e. The fire demands shall be the greater of either the required fire flows or fire sprinkler demand, including hose stream allowances as required for the development in accordance with the adopted fire code and Authority Having Jurisdiction.
4. Site Specific Analysis
- a. The fire demand shall comply with the currently adopted IFC and the National Fire Protection Association (NFPA) Standards 13, 13R and 13D, the standards for the installation of sprinkler systems, as adopted by the Agency and the Board of Technical Registration Substantive Policy Statement for fire sprinkler systems. The report shall list the applicable codes and standards and the appropriate engineering practices.
 - b. The "fire demand" section shall provide the following information:
 - 1) EOR name, company, address, city, state, zip code, and phone number.
 - 2) Project name, limits, and address, general location and proposed uses.
 - 3) Detail physical aspects of the proposed on-site structures including:
 - a) Building height (feet)

- b) Number of stories above finished grade
 - c) International Building Code (IBC) construction type
 - d) Building area (square feet)
- 4) The “fire demand” design report shall provide:
- a) Revised IFC and most recent COP/CAFMA amendments for required fire demand.
 - b) The percentage of fire flow reduction allowed for the installation of a fire sprinkler system and resultant system demand as approved by the Fire Marshal, if the fire flow is determined to be the fire demand as defined.
- 5) Projects that install fire sprinkler systems shall be in accordance with the Arizona Board of Technical Registration Substantive Policy Statement regarding fire sprinkler systems. The following information shall be included:
- a) Range of the fire hazards of the project.
 - b) The hazard classification of the intended occupancy, including any special hazards.
 - c) The appropriate engineering practices.
 - d) The availability and adequacy of the water supply.
 - e) Based on a hazard analysis for the proposed use of each building (including special hazards), the appropriate fire sprinkler design density and area of operation shall be provided for each hazard area.
 - f) Anticipated fire sprinkler demand pounds per square inch (psi) and gallons per minute (gpm).
 - g) Required fire demand shall be provided for the project in accordance with the IFC and most recent COP/CAFMA amendments.
- c. In order to ascertain the availability and adequacy of the water supply for the project, the report shall provide field fire hydrant flow and pressure test results performed in accordance with AWWA M17 based on a certified test of the existing water system within the previous sixty (60) days. A flow test shall be witnessed by the design engineer and valves operated by the COP Water Operations by calling (928) 777-1118 or the TOPV Operations Contractor by calling (928) 759-9062. The flow test information shall include:
- 1) Test date
 - 2) Test time
 - 3) Test locations
 - 4) Test and residual hydrants

- 5) Orifice size
- 6) Orifice coefficient
- 7) Flow test data:
 - a) Static pressure (psi)
 - b) Residual pressure (psi)
 - c) Pitot measurement (psi)
 - d) Recorded flow rate (gpm)
 - e) Flow rate (gpm) converted to twenty (20) (psi)
- 8) Testing technician
- 9) A copy of the written Agency Water Operations or Fire Department report showing the flow test was witnessed by Agency personnel.

4.4.4 WATER MODELING

A. Water System Model Analysis

1. The EOR shall provide a model of the planned Water System Master Plan Report or Water System Design Report as delineated in [Sections 4.4.1](#) and [4.4.2](#). This modeling shall be required where new public water mains are being added, modified or extended in the Agency's system. The model shall provide the data necessary to validate that water demands are met to support the project. A water model is also required to demonstrate the required fire flow is adequate in accordance with the adopted fire code and most recent COP/CAFMA amendments.
2. Infill projects may not require a model. Infill projects include single lot development where fire and domestic flows are taken directly from existing Agency mains and where the zoning is in conformance with the Agency's General Plan. If a model is not required, include narrative of the proposed connections to the Agency's system.

B. When water hydraulic modeling information is needed, the following requirements shall be met to deliver model data to the Agency:

1. Model Software

The Agency currently uses the Aquanuity and Innovyze water modeling software, which is EPA-NET compatible. All modeling shall be compatible with the Agency's software.

2. Model Development

The developer or developer's engineer shall create and utilize a hydraulic model to demonstrate that the proposed infrastructure size, hydraulics, etc. are adequate and satisfy the Agency's requirements for domestic and fire flow demands. The Agency may provide specific boundary conditions upon request. The model information shall be delivered to the Agency to be added to the Agency's model, where modeling evaluations may be performed to verify that the proposed infrastructure and demands

will not negatively affect the existing Agency's system. Proposed water systems shall evaluate the Agency's overall water supply, pumping, and storage requirements.

C. Hydraulic Model Data

1. Developer or developer's engineer shall coordinate with the Agency for the appropriate coordinate system and datum for all drawings and model data.
2. Model data shall be free of topology errors in accordance with commonly accepted engineering practices prior to submission to the Agency.
3. Water Distribution System Attributes:
 - a. Mains – Diameter, length, material, location, connectivity with other entities.
 - b. Reservoirs – Base elevation, height, volume, location, connectivity with other entities.
 - c. Pump Stations – Layout, number of pumps, pump curve or design point, elevation, location, connectivity with other entities, pump control scheme.
 - d. Nodes (Connection Points) – Location, elevation, demand.
 - e. Pressure Reducing Valves and Tank Fill Valves – Location, connectivity with other entities, elevation, number of valves, diameter and valve set points.
 - f. Wells – Location, connectivity, design flow, control scheme.
 - g. Polygons – Pressure zone boundaries, zoning/density.
4. All model data shall include the following:
 - a. Demands shall be calculated per [Section 4.4.3.C](#) using average day water demands in gallons per day.
 - b. The system shall be capable of providing maximum day demand plus required fire demand.
 - c. Verification of the ability of the proposed system to provide adequate flow and pressures under the various demand combinations shall be provided.
 - d. Verification that the minimum required pressure throughout the water distribution system is achieved at the highest finished floor elevation or service point in the fire sprinkler line. If the minimum residual pressure under fire flow conditions cannot be achieved, additional private improvements may be required.
 - e. Pipes and nodes – Include item identification, demands, elevation, hydraulic grades, length, status, diameter, velocity, headloss/1,000 feet.
 - f. Reservoirs and pumps – Provide identification, diameter, height, elevation, upstream and downstream hydraulic grade, number of pumps, pump capacity and proposed pump curves.

- g. Pressure Reducing Valves – Provide identification, size, elevation, upstream and downstream hydraulic grade settings.
5. Hydraulic Evaluation
- a. New developments that do not constitute infill shall be modeled to determine if the infrastructure is adequate to serve the development and provide the level of service as defined by the Agency’s performance criteria.
 - b. The Agency’s water model shall be used to verify the ability of the existing water distribution system to deliver adequate water to the proposed development per the design engineer’s proposal. Supplemental fire hydrant tests shall also be used to make this determination. The developer is responsible to make certain that all fire water demand requirements (hydrants and/or sprinklers) within the development satisfies the Quad City GES and adopted fire code requirements.
 - c. The following scenarios shall be modeled:
 - 1) Average Day Demands
 - 2) Maximum Day Demands
 - 3) Fire Flow Demands (Which are defined as the maximum daily demand plus the appropriate fire flow demand)
 - d. Model simulations shall be documented in a graphical and tabular format to demonstrate that the water distribution system shall provide the required flow at suitable pressures and water main velocities.
 - e. Fire flow modeling results shall be documented as follows:
 - 1) Junction Report
 - a) Static Pressures
 - b) Residual Pressures
 - c) Demands
 - d) Calculated Minimum Pressure
 - e) Elevation
 - f) Pressure Head
 - g) Hydraulic grade
 - 2) Pipe Report
 - a) Length

- b) Type
 - c) Diameter
 - d) Velocities
 - e) C-Factor
 - f) Control Status
 - g) Discharge
 - h) Head Loss
 - i) Head Loss Gradient
- f. Boundary conditions that represent the interface between the development and the rest of the distribution system, shall be explained clearly.

**TABLE 4-1
UNIT DESIGN FLOWS FOR WATER**

TYPE OF FACILITY SERVED	APPLICABLE UNIT	WATER DESIGN FLOW PER APPLICABLE UNIT GALLONS PER DAY (GPD)
Airport	Passenger (average daily number)	5
	Employee	18
Auto Wash	Facility	Per manufacturer, if consistent with this Article
Bar/Loung	Seat	36
Barber Shop	Chair	42
Beauty Parlor	Chair	120
Bowling Alley (snack bar only)	Lane	90
Camp		
Day Camp, No Cooking Facilities	Camping Unit	36
Campground, Overnight, Flush Toilets	Camping Unit	90
Campground, Overnight, Flush Toilets and Shower	Camping Unit	180
Campground, Luxury	Person	120 – 180
Camp, Youth, Summer or Seasonal	Person	60
Church, Without Kitchen	Person (maximum attendance)	7
Church, With Kitchen	Person (maximum attendance)	8

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TYPE OF FACILITY SERVED	APPLICABLE UNIT	WATER DESIGN FLOW PER APPLICABLE UNIT GALLONS PER DAY (GPD)
Country Club	Resident Member	120
	Person (maximum attendance)	12
Dance Hall	Patron	6
Dental Office	Chair	600
Dog Kennel	Animal (Maximum Occupancy)	180
Dwellings	Person	96
Fire Station	Employee	54
Hospital, All Flows	Bed	300
Hospital, Kitchen Waste Only	Bed	30
Hospital, Laundry Waste Only	Bed	48
Hotel/Motel, Without Kitchen	Bed (2 Person)	60
Hotel/Motel, With Kitchen	Bed (2 Person)	72
Industrial Facility, Without Showers	Employee	30
Industrial Facility, With Showers	Employee	42
Industrial Facility, Cafeteria Added	Employee	6
Institutions, Resident	Person	90
Institutions, Nursing Home	Person	150
Institutions, Rest Home	Person	150
Institutions, Laundry, Self Service	Wash Cycle	150
Institutions, Laundry, Commercial	Washing Machine	Per manufacturer, if consistent with this Article
Office Building	Employee	24
Park (Temporary Use)		
Picnic, With Showers, Flush Toilets	Parking Space	48
Picnic, With Flush Toilets Only	Parking Space	24
Recreational Vehicle, With No Water and Sewer Connections	Vehicle Space	90
Recreational Vehicle, With Water and Sewer Connections	Vehicle Space	120
Mobile Home/Trailer	Space	300
Restaurant/Cafeteria	Employee	24

TYPE OF FACILITY SERVED	APPLICABLE UNIT	WATER DESIGN FLOW PER APPLICABLE UNIT GALLONS PER DAY (GPD)
With Toilet, Add	Customer	8
Kitchen Waste, Add	Meal	7
Garbage Disposal, Add	Meal	1
Cocktail Lounge, Add	Customer	2
Kitchen Waste Disposal Service, Add	Meal	2
Restroom, Public	Toilet	240
School, Staff and Office	Person	24
Elementary, Add	Student	18
Middle and High, Add	Student	24
With Gym and Showers, Add	Student	6
With Cafeteria, Add	Student	4
Boarding, Total Flow	Person	120
Service Station, With Toilets	First Bay	1200
	Each Additional Bay	600
Shopping Center, No Food or Laundry	Square Foot of Retail Space	0.1
Store	Employee	24
Store, Public Restroom, Add	Square Foot of Retail Space	0.1
Swimming Pool, Public	Person	12
Theater, Indoor	Seat	6
Theater, Drive-In	Car Space	12

SECTION 4.5 WATER SYSTEM DEMAND

4.5.1 SYSTEM DEMAND

The water system demand describes the standards against which the water infrastructure is measured to determine the criteria of the proposed infrastructure. This water system demand criteria is based on the AAC and other applicable regulatory standards.

4.5.2 INFRASTRUCTURE SIZING

Infrastructure shall be sized to supply the maximum day demand plus fire demand. This shall be determined by using the average daily demands listed in [Table 4-1](#) and including a maximum day peaking factor of two (2.0). Fire demand shall be determined by the IFC and most recent COP/CAFMA amendments and identified by the Fire Marshal. [Table 4-1](#) lists water usage in categories that are correlated to sewage collection Unit Design flows as shown in the AAC.

SECTION 4.6 PLANNING

4.6.1 COMPREHENSIVE PLANNING

- A. The Agency has developed a Water System Model to ensure that future improvement requirements are achieved through an orderly development of the Agency planning areas. Any engineer working on the design of public or private water infrastructure shall develop plans consistent with the appropriate sections of the Agency's Model.
- B. Water mains shall be installed along the entire length of the property line frontage in accordance with section 4.7.1B.

4.6.2 WATER FACILITIES

- A. Water facilities (i.e. wells, reservoirs, booster pump stations, etc.) are designed and constructed by the Agency through its Capital Improvement Program. Developers needing to construct water facilities shall contact the COP Public Works/TOPV Utilities Department and request a meeting to coordinate the design of these facilities. The developer shall be prepared to address how the proposed system will conform to the Agency's Water Master Plan. The Agency shall address design issues and the review process for these facilities.
- B. Unless otherwise agreed to in writing by the City/Town Engineer, water facilities shall be located on a tract or lot dedicated to the Agency (conveyed by a general warranty deed) and accompanied by a title policy in favor of the Agency.

C. Wells

- 1. ADWR issues the authority to drill groundwater wells both exempt and non-exempt. Before drilling a well, a Notice of Intent to Drill shall be filed with ADWR and a "drill card" shall be obtained from ADWR. Non-exempt wells require greater ADWR review and public noticing. Post drilling, and well and pump installation, required well logs, and pump completion report shall be filed with ADWR.
- 2. In the event a property has an existing exempt well, and the use continues while a connection is made to the Agency's potable water system, a backflow prevention device is required by Agency Code.

PCC, Section 3-6-2 (International Plumbing Code, Amendments)
TOPV Town Code Article 9-05a-090

- 3. A property owner currently using an exempt well that seeks to discontinue its use for which the Agency is able to provide water supplies, then the well owner shall complete ADWR well abandonment requirements.
- 4. In the COP, water service to the property shall require a water service agreement to document the volume to be served and conditions of the service. Refer to the adopted COP Water Management Policy. Refer to Section 4.7.1 for information regarding the drilling of new exempt wells.

D. Tanks

Storage facilities shall provide operational storage for peak demands above maximum daily demands, emergency storage for power outages and line breaks, and fire protection storage. Facilities shall be

designed to maximize the efficient use of water production wells and pumping facilities. Therefore, storage in each designated service area shall exceed the volume of the sum of 1, 2 and 3 below or the average day demand for the area(s) served, whichever is greater.

1. Operational storage equaling twenty (20%) percent of maximum daily demand.
2. Fire storage as determined by the fire department ranges from four (4) to ten (10) hours for multiple fire occurrences within a pressure zone. Fire demand rates and storage volumes are determined using criteria established by the American Insurance Association according to the following equation: $G=1,020 \sqrt{P(1-.01\sqrt{P})}$.

P = Population of the Area

G = Storage in Gallons

3. Emergency storage equaling ten (10%) percent of maximum daily demand.
4. The City/Town Engineer shall determine final sizing and dimensions.

E. Booster Pump Stations

1. Booster pumps shall be designed to maintain adequate pressure for domestic and fire protection water supply. At a minimum all stations shall provide variable frequency drives, backup power supply, separate electrical room and supervisory control and data acquisition (SCADA) compatible with the Agency's current system. Designers shall refer to ADEQ Engineering Bulletin No. 10 for additional design criteria. The City/Town Engineer shall determine final sizing, number of pumps, pump capacity, SCADA requirements, and building dimensions.
2. A preliminary design report shall be prepared and submitted to the City/Town Engineer for review by the COP Public Works/TOPV Utilities Department prior to submittal of final plans for review. This report shall outline the type of equipment and controls proposed Piping and Instrumentation Diagram (PI&D) and SCADA for the station along with the proposed hydraulics. A final design report prepared by a registered civil engineer licensed in the State of Arizona shall accompany the construction drawings and specifications.

SECTION 4.7 TRANSMISSION AND DISTRIBUTION SYSTEMS

4.7.1 GENERAL INFORMATION

- A. In accordance with A.R.S. § 45-454(C) and ADWR's Substantive Policy Statement GW43, the drilling of an exempt well (e.g., maximum pump capacity of not more than thirty-five (35) gpm and that is used only for non-irrigation purposes) is prohibited on land if any part of the land is within one-hundred (100') feet of an operating distribution system with a Decision and Order of AWS.
- B. Water mains shall be installed along the entire length of the property line frontage of the property being developed. The property line frontage is defined as the portion of a parcel of property that abuts a street, easement, or public ROW. If a parcel to be developed has more than one property line frontage, improvements may be required along all frontages to improve flow, system redundancy, or water quality.
- C. Design Policy

1. The extension of water mains along a frontage, or through a subdivided parcel, shall be required to the boundary where future extension of the water main is possible, providing a point of service to adjacent properties, or as determined necessary by the City/Town Engineer. Reconstruction of residential or commercial structures requires compliance with all current ordinances and design guidelines relating to water main extensions, main sizing, and service lines.
2. Each lot shall have safe, reliable, and potable water in sufficient volume and pressure for domestic use and fire protection. The EOR shall verify this by performing a flow and pressure test during peak demand period, of that part of the potable system to be extended or connected onto. The flows and pressure shall meet minimum requirements for domestic and fire flow per applicable regulatory standards. The EOR shall place a statement verifying this within the design report along with copies of the tests.
3. The Agency maintains multiple pressure zones and care shall be taken to identify boundary conditions when designing near a zone line. The EOR shall contact the COP Public Works/TOPV Utilities Department for verification of water pressure zone boundaries. Static and dynamic water pressure and flow tests shall be performed on fire hydrants located on each leg of the existing water system between zone boundaries where connections are proposed.

D. Design Standards

1. The EOR shall design proposed water infrastructure in accordance with the design standards listed in the GES and QCSDs. These documents contain construction related specifications and details that impact the design of water systems including but not limited to trenching, bedding, backfill and pavement replacement.
2. Water system expansion and extension requirements to serve both new and existing development are outlined in the Agency's Code.

PCC, Article 2, Chapter, 2-1
TOPV Town Code Article 9-05a

4.7.2 WATER MAIN PIPES AND MATERIALS

A. Pipe Sizing

1. The minimum size of a water main for providing fire protection and serving fire hydrants shall be six (6") inches in diameter when service is provided from two (2) directions. A minimum eight (8") inch water main shall be required where service is provided from one (1) direction only and does not exceed two-hundred-fifty (250') feet in length. Larger size mains shall be required as necessary to meet all other design criteria, the development's design report, specific water demands, or the Agency's Water System Master Plan.
2. The maximum length of dead-end fire lines that may be used for fire protection shall be in accordance with the adopted fire code and most recent Agency amendments. Fire lines shall be calculated from the street tap to the building for determining sprinkler design.
3. Public water mains shall be a minimum of six (6") inches unless otherwise approved by City/Town Engineer.

B. Pipe Materials

1. All water mains shall be Class 350 (CL350) Ductile Iron Pipe (DIP) cement mortar lined and seal coated or Polyvinyl Chloride (PVC) pipe as approved by the Agency.
2. The COP shall not allow the use of PVC pipe within the COP service area per PCC.
3. Service connections for meters shall be one (1") inch minimum, Type K copper without splices.
4. Remote Fire Department connection piping shall be CL350 DIP. Below the vertical section at the street, an approved drip valve shall be installed over a bed of gravel as per QCSD 365Q-1 and 365Q-2 "Remote Fire Department Connection". The line shall include tracer wire per QCSD 319Q-1 and 319Q-2.
5. In the COP, fire line services three (3") inches and smaller shall be connected to the main with a minimum four (4") inch DIP, CL350 with a resilient seat valve. The DIP pipe shall be extended beyond the resilient seat valve to the property or easement boundary.
6. Design analysis for wall thickness shall be performed for external loads. These include, but are not limited to, pipelines crossing under stormdrain lines greater than thirty-six (36") inches in diameter, pipelines in the roadway alignment that would be exposed to construction vehicle loads prior to paving, and installations exceeding the pipe manufacturer's maximum depth of bury.
7. All aggregate material within the trench envelope of water mains and/or fire lines shall be noncorrosive as determined by resistivity, presence of chlorides and presence of sulfide ions. Resistivity test shall be greater than three-thousand (3,000) ohm-cm, chlorides shall be less than fifty (50) ppm and sulfide ions shall be less than 1ppm. Lime treated AB shall not be permitted when utilizing DIP or other ferrous pipe material. Test results shall be submitted to the City/Town Engineer prior to construction.

4.7.3 SYSTEM LAYOUT

- A. To provide appropriate water pressure, water circulation and redundancy, all new water mains shall be designed in a looped configuration where feasible, as determined by the City/Town Engineer, providing a minimum of two (2) sources that can be isolated by gate valves.
- B. Maximum number of water connections or dwelling units to be served from a non-looped water main shall be twenty-five (25) or as defined by the Agency.
- C. Water mains shall not be located within ten (10') feet of a building or retaining wall.
- D. For purposes of horizontal and vertical separation, stormdrains, non-potable water systems, and sewer service lines shall be treated as sewer mains. Separation shall be required in accordance with QCSD 402Q.
- E. Existing water main stubs and service lines adjacent to a proposed development that are not used shall be removed. For mains, this includes removing all valves, capping the tee and removing the pipe at the main. For services, this includes removing the saddle and its appurtenances and installing a full circle stainless steel clamp.
- F. Main Locations:

1. Public water mains and appurtenances shall be located within a dedicated public ROW or easement.
2. Horizontal Location: All water mains shall be aligned parallel to property lines or street center lines to the maximum extent possible and shall not cross and re-cross the centerline.
 - a. Water mains located beneath streets within the public ROW shall refer to QCSD 601Q through 606Q.
 - b. Public water mains in commercial, multifamily, and industrial developments shall be located under driveways, or drive aisles and a minimum of ten (10') feet from any structure, including overhangs.
 - c. A minimum twenty (20') foot easement shall be provided, and the water main shall be located in the center of the water main easement unless otherwise approved by the City/Town Engineer.
 - d. Horizontal alignment changes shall be made with eleven and one-quarter ($11\frac{1}{4}^\circ$), twenty-two and one-half ($22\frac{1}{2}^\circ$), forty-five (45°), or ninety (90°) degree bends. Joint deflection shall not exceed fifty (50%) percent of the pipe manufacturer's specification.
 - e. Horizontal and vertical locations shall be consistent with QCSD 601Q through 606Q, and 402Q.
3. Vertical Location:
 - a. New water mains, fire lines, and water service lines shall not pass under detention basins. This does not apply to private landscape irrigation lines downstream of proposed backflow prevention devices or buildings.
 - b. Hydrants, meters, blow-offs and valves shall not be located in washes, detention areas, private driveways, sidewalks, curbs or valley gutters.
 - c. Hydrants shall have a maximum bury depth of six (6') feet.
 - d. Hydrants that require adjustment as a result of improvements shall be adjusted using a "Gradelok" or approved equal when vertical adjustment is in excess of six (6") inches, per QCSD 363Q.

4.7.4 DEAD-END MAINS

- A. The maximum length for a dead-end water distribution main shall be governed by water quality standards and shall be sufficient to provide minimum pressures and fire flows.
- B. Capped dead-end mains shall be fitted with a flushing device per QCSD 390Q. Fire hydrants may be used as a flushing device. Flushing devices shall not be located in washes, detention areas, retention areas, sidewalks, driveways or paved areas.

4.7.5 DESIGN FLOWS

The ultimate design flow within the Agency's water transmission and distribution system shall be based on the Agency's current water master plan. Water demand for each development shall be calculated using the average day demands with appropriate peaking factors applied, as shown in [Table 4-1](#) to ensure that the

existing distribution supply is sufficient. Designs shall include all necessary improvements, including booster-pumping stations, reservoirs, mains and appurtenances to meet the system’s ultimate demand. Design flow C-Factors shall be applied using [Table 4-2](#).

**TABLE 4-2
C-FACTORS**

DIAMETER	C-FACTOR
6	90
8	110
10	115
12	120
14	120
16	130
18	130
20	130
24	130
30	130
36	130

- A. Hydraulic analysis shall demonstrate that the system will provide average day, maximum day demand, and maximum day demand plus fire flow. The average day to maximum day peaking factor is two (2.0) and the average day to peak hour factor is three (3.0).
- B. A minimum of twenty (20) psi shall be maintained at the point of maximum fire flow demand during max day plus fire flow conditions. Impacts to surrounding areas shall also be considered.
 - 1. Water velocity criteria under maximum day demand conditions are as follows:
 - a. Velocity \leq 5 feet per second (fps) for pipes < 36 inches diameter (Head loss, HL= 2-7 feet/1,000 feet)
 - b. Velocity \leq 6 fps for pipes \geq 36 inches diameter (Head loss, HL= 1-2.5 feet/1,000 feet)
 - 2. Velocity criteria under peak hour demand conditions is as follows:
Velocity \leq 7 fps (Head loss, HL < 10 feet/1,000 feet)
 - 3. Velocity criteria under maximum day plus fire demand conditions is as follows:
Velocity \leq 10 fps
- C. Design flows for all distribution systems shall be based upon flow and pressure of the existing system as documented by the EOR.

- D. Prior to acceptance by the City/Town Engineer, all platted subdivisions shall conduct an additional flow test at the fire hydrants or flushing devices having the lowest and highest ground elevation within the subdivision.
- E. Developments that cross pressure zone boundaries shall conduct a flow test within each pressure zone as outlined above. The results of this test, along with a copy of the final plans, shall be submitted to the City/Town Engineer for review and acceptance.

4.7.6 FIRE HYDRANT FLOW TEST REQUIREMENTS

- A. Pressure and available flow information for existing water mains shall be obtained by having a flow test performed on the system at the developer's expense. Flow tests are required for all commercial projects, multi-family residential projects, and public extensions of the Agency's water distribution system. A private fire protection company shall perform the tests in accordance with AWWA M17 and certify the results. The design engineer shall witness all tests and valves shall be operated by Agency Water Operation's personnel. The certified flow test results shall be included in all master plans or design reports submitted to the COP Public Works/TOPV Utilities Department. A copy of the flow test report shall be included when fire sprinkler plans are submitted.
- B. Flow tests shall be scheduled through the Agency, COP Water Operations at (928)777-1118 and TOPV Operations Contractor at (928)759-9062 a minimum of 48 hours prior to the test.

4.7.7 PRESSURE REQUIREMENTS FOR NEW DEVELOPMENT

- A. Pressure extremes in water systems result in the potential for contaminants to enter the network. Low pressures in the water system may allow polluted fluids to be forced into the system, and high pressures may cause ruptures or breaks in the network.
- B. The static pressure in the distribution system shall not exceed one-hundred twenty (120) psi in the COP and one-hundred (100) psi in the TOPV and the system shall be designed to maintain a minimum residual pressure of forty (40) psi at the point of service (box and setter or meter) to be served by system pressure at maximum day demand conditions. The system shall be designed to maintain twenty (20) psi minimum pressure under design maximum day plus fire flow requirements. The twenty (20) psi minimum pressure design requirement accounts for the safety factor included in conservative C-Factors to account for aging infrastructure and flexibility in locating pressure zone boundaries.
- C. All distribution water mains, appurtenances, and service lines shall be designed for a minimum normal internal working pressure of two-hundred (200) psi. Working pressures for transmission mains shall be verified with the COP Public Works/TOPV Utilities Department.
- D. Provisions shall be made to protect the system from water hammer pressures. The occurrence and severity of water hammer can be reduced by using pressure-release valves, combination air/vacuum valves, surge tanks, variable frequency drives, soft start motor controllers, and air chambers.

4.7.8 PRESSURE REDUCING VALVES (PRV)

- A. Approximate pressure zone boundaries and their respective elevations are shown in the Agency's water model. Within the distribution system or to interconnect to other zones, PRV shall be required to maintain pressure zones within the distribution system or to interconnect to other zones. Distribution systems shall not be designed to operate at pressures in excess of one-hundred twenty (120) psi in the COP and one-hundred (100) psi in the TOPV. PRV shall be built in accordance with QCSD 323Q-1,

323Q-2, and 323Q-3. A minimum of one (1) PRV in each pressure zone shall be designed with a high-pressure relief valve.

- B. Vaults shall be located outside of paved areas adjacent to the back of curb or sidewalk. PRV shall be located within the ROW, easement, or an easement within a private street tract, and shall be provided with unobstructed vehicular access, including parking. Curbs adjacent to PRV vaults shall be Type C or Type D in accordance with QCSD 220Q-1, unless other access is provided that is acceptable to the Agency. Site grading shall route storm water and discharge water from relief valves away from the vault. Site design shall consider and mitigate any impacts of discharge water on downstream improvements. The location of pressure relief risers shall be shown on the final plans.
- C. The EOR shall specify in the design report and on final plans, the size of the main and low flow pressure reducing valves, the upstream system pressure, and the design downstream pressure setting.
- D. The COP requires all metered services to have a pressure-regulating valve installed on the private service line. The TOPV requires all metered service to have a pressure-regulating valve installed on the private service line only when static pressures exceed 80 psi.
- E. The Agency requires the installation of isolation valves on all PRV stations to facilitate the operation, maintenance, and expansion of the water distribution system.

4.7.9 VALVES

- A. The Agency requires the installation of isolation valves to facilitate the operation, maintenance, and expansion of the water distribution system. Water main valves shall meet or exceed the pressure classification of the water main.
- B. Gate valves, required to control the operation of the water system, shall be installed per QCSD 301Q.
- C. All four (4") inch through fourteen (14") inch valves shall be resilient seat/wedge gate valves, epoxy-coated interior in accordance with the requirements of MAG Specification 630.3.
- D. Valves sixteen (16") inch and larger shall be butterfly valves, epoxy-coated interior in accordance with MAG Specification 630.5.
- E. Valve operators shall not be placed in parking stalls.

4.7.10 FITTINGS

- A. Joint deflection shall be evaluated and may be allowed for specific conditions and shall not exceed fifty (50%) percent of the pipe manufacturer's specification. Fittings may be required where more than two (2) pipe lengths are deflected.
- B. A minimum distance between fittings shall be specified on the final plans for constructability. All fittings shall be identified on both the plan and profile view with station and elevations. The EOR is responsible for verifying the minimum distance necessary for the type and diameter of pipe and related fittings specified for the project.

Couplings, joints, gaskets, and flanges shall conform to MAG Section 610.10, or equal, unless otherwise approved.

4.7.11 VALVE LOCATIONS

- A. Shutoff valves shall be installed on water mains at locations within the distribution system that allow sections of the system to be taken out of service for repairs or maintenance without significantly curtailing service in other areas. Special consideration shall be given to the number of fire hydrants taken out of service. A sufficient number of valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves shall be located such that closing no more than four (4) valves can isolate any section of the system.

- B. Valve Location
 - 1. A valve shall be located on each side of a vertical alignment per QCSD 370Q, creek, wash, railroad, or highway crossing.
 - 2. Valves shall not be located in curbs, sidewalks, driveways, valley gutters, bike lanes, and vehicle wheel paths.
 - 3. Provide a valve on each fire hydrant lateral and flange the valve to the tee. Provide a valve for all fire protection water supply connections in accordance with the adopted fire code and most recent Agency amendments. Refer to QCSD 360Q.
 - 4. The preferred locations of valves shall be set at the intersecting street adjacent to other valves, or at a fire hydrant location.

- C. Spacing
 - 1. Maximum spacing of water distribution main valves shall be as follows:
 - a. In commercial, multi-family, and industrial areas, valve spacing shall not exceed five-hundred (500') foot intervals.
 - b. In single family residential, valve spacing cannot exceed eight-hundred (800') foot intervals or one (1) per block, whichever is less.
 - 2. Maximum spacing of water transmission main valves shall be as follows:
 - a. Valve spacing shall not exceed one-thousand (1,000') feet.
 - b. Intermediate access points shall be provided between valves for leak detection purposes.

- D. Install all tees with a valve on the lateral main so that the lateral can be taken out of service without interrupting the supply to other locations. At intersections of distribution mains valves shall be required on each leg.

- E. All valves require valve boxes installed per QCSD 391Q. All valves shall be installed with a debris cap. The debris cap handle shall be the appropriate color to indicate valve type. Refer to QCSD 391Q.

- F. All valve frame and cover adjustments shall be per QCSD 391Q.

4.7.12 AIR RELEASE VALVES

Air release valves shall be installed at all local high points of water mains four (4”) inches or larger in diameter, as follows:

- A. When water main changes from a positive slope to a zero slope or a negative slope.
- B. Vertical alignment changes that cross under or over another facility, such as other utilities, drainage washes, etc.
- C. All air release valves shall be per QCSD 317Q-1 and 317Q-2, as applicable for size.
- D. Additional combination air/vacuum release valves shall be required whenever a surge analysis reveals the need for additional valves to protect against water hammer or transients in the water distribution system.

4.7.13 THRUST RESTRAINT

- A. Thrust blocks shall not be allowed for new construction on the Agency’s water system unless approved in writing by the City/Town Engineer. Thrust restraint shall be met by:
 - 1. Welded joints in steel pipelines.
 - 2. Restrained mechanical joints in concrete and ductile iron pipelines (e.g. Mega-lug or equal).
 - 3. Locking gasket and ring systems acceptable to the City/Town Engineer (e.g. Field-Lok Gaskets or equal).
- B. All valves shall be considered dead ends for thrust restraint.
- C. QCSD 303Q-1 and 303Q-2 include acceptable means of joint restraint for both horizontal and vertical deflections. Vertical slopes that exceed twenty (20%) percent require restrained joints, slopes exceeding twenty-five (25%) percent, require additional anchoring, in addition to restrained joints to prevent pipe movement and minimize settling. The EOR shall verify the water pressures and earth bearing pressures assumed by the details. Where joint restraint is not proposed per QCSD 303Q-1 and 303Q-2, the EOR shall submit joint restraint analysis with the plans for review and comments. All restrained pipe lengths shall be specified on the plans and refer to QCSD 303Q-1 and 303Q-2.
- D. Thrust Restraint: Joint restraint shall be used at all bends, elbows, tees, crosses, dead ends, stubs, curb stops, fire hydrants, taps, and valve locations on water mains where water flow changes direction or is stopped. The joint restraint limits, both length of restrained pipe and limits of restraint with stationing, shall be shown on the plan and profile view. Restrained joint analysis shall be prepared and submitted when necessary, keeping in mind that concrete thrust blocks are not to be considered in the analysis in the COP.
- E. Acceptable restrained joint systems include the following manufacturers or approved equivalent:
 - EBAA Iron Inc.
 - Ford Meter Box Company Inc.
 - Romac Industries

Tyler Union

US Pipe

McWane Ductile Iron

American Pipe

F. DIP joint restraint shall comply with QCSD 303Q-1 and 303Q-2.

4.7.14 ELECTRONIC MARKERS

- A. Tracer wire shall be placed above all public water mains, service connections and fire lines per QCSD 319Q-1 and 319Q-2. All splices of trace wire shall be Copperhead Snakebite or 3M DBR moisture displacement connectors.
- B. A continuity test shall be performed at the completion of installation. Passing test results shall be provided for all pipe segments within the EOR's as-built data and plan set.
- C. Tracer wire stations shall be required on all mains without sufficient valves and other points necessary to access the wire to maintain accurate signal strength.
- D. Maximum distance between test stations shall not exceed five-hundred (500') feet. Refer to QCSD 319Q-2.

4.7.15 PIPE COVER

- A. Water mains shall be installed to minimum and maximum depths measured from the proposed finished grade to top of pipe as follows:
 - 1. Water main shall have a minimum cover of four (4') feet.
 - 2. Public water mains that are installed through undeveloped property (i.e., locations where the final finished grade elevation is not known, particularly along future street alignments), shall have a minimum cover of five (5') feet from the existing grades.
 - 3. Subsequent fills that produce a cover depth in excess of six (6') feet shall require the main to be vertically realigned within the four to six (4'-6') foot envelope.
 - 4. Maximum cover over water mains shall be six (6') feet, except at vertical re-alignments necessary to avoid conflicts with other utilities.
- B. If a water main is installed within an area to be filled at a later time, adequate pipe protection shall be provided. This may include a temporary berm or constructing the water main to a minimum cover below existing grade. The EOR shall notify the COP Public Works/TOPV Utilities Department of such occurrences and address them in the design report or master plan and civil plans.

4.7.16 WASH CROSSINGS

- A. All wash crossings shall be constructed using restrained joint Class 350 (CL350) DIP. Bury requirements to place water mains under washes or channels shall be based upon the scour depth of the one-hundred (100) year peak design discharge (Q100) in the channel or wash. The minimum depth of

bury below the design flow line of the channel or wash shall be per [Table 5-7](#), unless site-specific geotechnical and hydraulic data is provided.

- B. Wash crossings with a one-hundred (100) year flow above five-hundred (500) cubic feet per second (cfs), shall have the scour depth estimated using Arizona State Standard Attachment SSA 5-96, Guideline 2, Level I, as published by ADWR. The EOR shall estimate the depth of scour and design the top of pipe to be three (3') feet below the estimated scour depth. The EOR shall provide a detailed analysis of the scour depth with final plans for review and approval.
- C. All pipelines that must be located within the scour zone or do not meet the minimum required depth of bury, as indicated above, shall be protected by installing a cut-off wall, and energy dissipation downstream of the pipeline to stabilize the scour depth to a minimum of three (3') feet above the pipeline. The EOR shall design the cut-off wall energy dissipation and include details on the improvement plans. The City/Town Engineer shall review pipe protection and scour stabilization requirements on an individual project basis.

4.7.17 SEPARATIONS AND VERTICAL REALIGNMENTS

- A. Horizontal and vertical separation distances shall be maintained in accordance with ADEQ, MAG Specifications and QCSO 402Q, 404Q, and 405Q.
- B. For the protection of the public water supply from contamination, all water mains that are considered raw water mains and/or transmission mains (twelve (12") inch and greater) shall be governed by the well separation in the AAC R18-5-502 for separation from a septic tank or subsurface disposal system with a minimum separation of one-hundred (100') feet in any direction.
- C. Horizontal separation from water mains and sewer mains shall be six feet zero inches (6'0") minimum from pipe outside diameter (OD) to pipe OD. Where horizontal separation cannot be maintained, extra protection shall be designed per ADEQ Bulletin No. 11.
- D. Vertical separation between water mains and sewer mains at crossing locations shall utilize the proper water line exclusion and extra protection zones per MAG 404-1 and QCSO 402Q. Extra protection requirements shall be as follows:
 - 1. Where both water and sewer main are proposed for new construction: Both the water and sewer main shall be constructed of Class 350 (CL 350) DIP with restrained joints. Crossing orientation shall be in accordance with MAG 404-2.
 - 2. Where existing water main is not constructed of DIP: Water mains shall be replaced with restrained joint DIP per QCSO 404Q-2.
 - 3. Where the sewer main is existing and is not constructed of DIP: Sewer main shall be replaced with Protecto 401 epoxy lined DIP in accordance with QCSO 404Q.
- E. Water mains shall not pass through or come into contact with any part of a sewer manhole and shall be separated six (6') feet horizontal from the outside edge of a sewer manhole.
- F. Horizontal separation between water mains and storm drains shall be four feet zero inches (4'0") inches minimum from pipe OD to pipe OD. Where horizontal separation cannot be maintained, extra protection shall be designed for the water main as if there was a vertical crossing.

- G. Vertical separation between water mains and storm drains shall maintain both a minimum of twelve (12”) inches vertical separation and the minimum depth of bury. If the design cannot provide these clearances, a vertical realignment may be required.
- H. Separation of water from all utilities shall conform to QCSD 402Q.
- I. Vertical realignments shall be in accordance with QCSD 370Q and shall incorporate the following into the design:
 - 1. Isolation valves shall be installed on each side of the vertical realignment. The COP Public Works/TOPV Utilities Department may consider the location of adjacent valves, fire hydrants and water service mains to help minimize valves at vertical realignments.
 - 2. Tees, fire hydrants, service lines and/or other appurtenances shall not be placed within any portion of the vertical realignment.
 - 3. Air release valves shall be installed at localized high points where air entrapment may occur.
 - 4. Concrete encasement of water mains is prohibited to achieve separation from sewer.

4.7.18 SERVICE LINES AND METERS

- A. The water service line and meter shall be sized based upon the total daily demands for the development and the recommended maximum capacity.

COP: The minimum size service tap, saddle, line and meter set shall be one (1”) inch.
TOPV: The minimum size service tap, saddle, line and meter set shall be three-quarter (3/4”) inch.
- B. That portion of the water service from the water main, up to and including the brass nipple downstream of the meter is public and shall be maintained by the Agency. That portion of the water service beginning at the curb stop after the meter is private and shall be maintained by the property owner. Design of the private on-site portion of the water service shall comply with the current plumbing code and shall include a customer shutoff and pressure-regulating valve. Refer to QCSD 316P-1 and 316P-2 for services within the COP. Refer to QCSD 310PV-1, 310PV-2, 310PV-3 and 310PV-4 within the TOPV.
- C. Due to the Agency’s water billing rate structure, meter sizes shall not exceed the size of the service. (e.g., a one and one-half (1½”) inch meter shall not be allowed on a one (1”) inch service). Extra attention is required when sizing services for custom home lots where demands occasionally necessitate meter sizes exceeding one (1”) inch.
- D. Service lines are necessary to meet domestic, fire and irrigation demands. Residential fire sprinkler and irrigation demand is normally supplied through the domestic service line and meter. Commercial developments may use separate meters for building and landscape service but shall provide separate lines for fire protection.
- E. Installation of one (1”) inch to two (2”) inch metered water services shall be in accordance with QCSD 316P-1 and 316 P-2 within the COP and in accordance with QCSD 310PV-1 and 310PV-3 within the TOPV.

- F. Installation of three (3") inch to six (6") inch metered water services shall be in accordance with QCSD 321Q.
- G. Final plans shall show locations of service lines and meters to each unit referenced with stations and dimensions, or offsets, from the street centerline or monument line. Service line connections shall also be shown in the profile view. Service lines and meter boxes shall be located within a public ROW or a utility easement per QCSD 316P-1 and 316P-2 within the COP or QCSD 310PV-1 and 310PV-3 within the TOPV.
- H. Service taps are not permitted on a fire line, which is designed to service private fire sprinkler systems and/or a fire hydrant.
- I. Water service connections shall be designed perpendicular to the main. Lines shall be continuous from the main to the meter with no splices. Water service lines shall have six (6') feet minimum horizontal separation from sanitary sewer service lines. Multiple service taps at the main shall have a minimum separation of two (2') feet on DIP.
- J. Taps on existing PVC mains shall have thirty-six (36") inches minimum separation per Uni-Bell PVC Pipe Association.
- K. No service connections or fire protection systems shall be made directly to water transmission mains.
- L. All non-copper water service lines in sizes three-quarter ($\frac{3}{4}$ ") inch through two (2") inch which are exposed during construction, shall be replaced in their entirety with one (1") inch minimum Type "K" copper tubing. This includes the replacement of service saddles, box and setter and corporation stop in all cases. Refer to QCSD 316P-1 and 316P-2 within the COP or 310PV-1 and 310PV-3 within the TOPV.
- M. The developer shall install all water services, meter setter, and meter boxes in new development projects.
- N. Water meter boxes shall be installed out of traffic areas and behind back of curb and sidewalk. Refer to QCSD 316P-1 and 316P-2 within the COP or 310PV-1 and 310PV-3 within the TOPV. Metered Services:
 - 1. Subdivision plans shall provide a typical water service location detail.
 - 2. Where water services are being designed for isolated locations, provide stationing and offset to property line.
 - 3. Minimum water service size is one (1") inch with a five-eighths inch by three-quarter inch ($\frac{5}{8}$ " x $\frac{3}{4}$ ") inch meter.
- O. Existing water services not used shall be noted on the approved civil plans and the as-built plan as abandoned at the main with full circle stainless steel repair clamp. The services shall be properly abandoned during construction.
- P. A one (1") inch meter and setter at a minimum is required on domestic meter sets when supplying the water to fire sprinklers and domestic flows of a dwelling.

4.7.19 BACKFLOW PREVENTION AND CROSS CONNECTION CONTROL

- A. The installation of Backflow Prevention Assemblies is required for all developments with the exception of single family residential. The following types of service connections shall require backflow prevention to be installed: commercial meters, master metered systems, irrigation meters, construction meters, hydrant meters, multifamily residential meters, and fire protection connections.

- B. Residential uses are required to have a Backflow Prevention Assembly when a well, pond, submerged make up line, automatic irrigation system or fire sprinkler is present, which may raise the degree of hazard for the site.
 - 1. The type of backflow assembly required is determined by the degree of hazard. Reduced Pressure Zone Assemblies (RPZA) shall be required for all commercial, multifamily residential, master metered systems, private potable water systems and irrigation meters. A testable Double Check Valve Assembly (DCVA) shall be required for all fire protection connections.
 - 2. The Agency Backflow Prevention Program, PCC, Section 2-1-55 and TOPV Town Code Article 9-05a, requires that Backflow Prevention Assemblies be installed according to QCSO 324Q-1 and 324Q-2, as applicable for size and in accordance with the adopted plumbing code.
 - 3. All backflow prevention assemblies shall be approved by the “Foundation for Cross Connection Control and Hydraulic Research of the University of Southern California”, and the applicable Agency.
 - 4. All backflow prevention assemblies shall be freeze protected by an ASSE 1060, Class 1 Hotbox (or approved equal) with electrical power for heat unless installed within a fire riser room or underground vault.
 - 5. Initial certification testing is required upon establishment or restoration of water service to the meter. A certified backflow prevention device tester, approved by the COP Public Works Department/TOPV Utilities Department, shall make all testing, maintenance, and repairs to the backflow prevention assembly at the water service customer’s expense. The initial testing and the required annual testing are the responsibility of the water service customer.
 - 6. Water filled or dry fire protection systems require the installation of an Agency approved testable double check valve backflow prevention assembly (DCVA). An approved RPZA is required for any connection to chemical or anti-freeze filled systems.
 - a. Fire lines that feed building fire sprinkler systems may install a DCVA in an NFPA approved fire riser room if the distance from the public/private interface to the riser room is less than one-hundred fifty (150’) feet. In this case, the DCVA shall be mounted per manufactures instructions on fire riser and prior to any piping that consists of material not International Plumbing Code (IPC) approved for potable water piping. The DCVA shall be installed to allow for clearances per the adopted fire code.
 - b. Fire lines that do not meet the criteria, shall require a double-check, detector-type assembly (DCDA) to be installed in a vault that straddles the public/private interface. The vault shall not be installed in any drainage, retention or detention area, driveway, or parking lot entrance/exit. If the vault is located within a paved area, the vault and lid shall be traffic rated. The DCDA shall be installed in the vault to provide at least minimum clearances per the adopted fire code.

The DCDA shall be a Colt Series C500, FEBCO MasterSeries LF866, Watts Series 709DCDA, or approved equal (see the USC list of approved backflow prevention devices).

- c. Developments that elect to install a private water system that feeds private fire hydrants shall install a detector-type testable DCVA (DCDA) as close to the public/private interface as practicable but not within the utility easement or ROW. DCDA shall be a Colt Series C500, FEBCO MasterSeries LF866, Watts Series 709DCDA or approved equal (see the USC list of approved backflow prevention devices).
 - d. The location of the backflow prevention assembly shall be indicated on the approved civil plans.
- C. Every effort shall be made to locate the water meter and vault in an area that can accommodate a properly installed backflow assembly. When the location of a backflow preventer cannot be accommodated adjacent to the meter, the designer shall:
1. Request in writing to separate the backflow assembly from the meter with a detailed explanation why the applicable standard cannot be met as well as the proposed alternative location and measures that will be taken to ensure no taps can be made between the meter and the device.
 2. Backfill the water line between the meter box and the backflow preventer with 1-sack slurry Controlled Low Strength Material (CLSM) per MAG Section 728. CLSM shall be placed to the full width of the trench and to six (6") inches above top of pipe.
 3. Note on the plans that inspection of the water piping connecting the meter to the backflow preventer be inspected by an Agency Water Protection Specialist prior to CLSM and backfill.
- D. The Agency requires backflow prevention on temporary hydrant meters used to supply construction water, in accordance with the Agency's Water Operations "Hydrant Meter Policy".

4.7.20 EASEMENT, TRACT AND RIGHT-OF-WAY (ROW) REQUIREMENTS

Easements shall only be used for water mains in areas where parcels are already platted, or a sub-division already exists. Easements are not intended and shall not be used in newly platted subdivisions.

A. Easement Requirements:

1. Any public water main or appurtenance that is not located within ROW or a tract with easement dedication shall be placed within an appropriately designated easement.
2. The water main shall be centered in the easement and shall be located a minimum of ten (10') feet from the edge of the easement. The minimum easement width shall be twenty (20') feet. Water mains shall not have more than six (6') feet of cover in a twenty (20') foot easement. Water mains with more than six (6') feet of cover shall require additional easement area.
3. In an easement that contains both a water main and a sewer main, the minimum easement width shall be thirty (30') feet. Additional utilities may require additional width.
4. Utility easements containing water lines, but not sewer lines, may be fenced if unlocked gates with a minimum width of sixteen (16') feet are provided to allow free movement of excavating machines, maintenance equipment, and personnel throughout the full length of the easement.

5. Easements that contain a water main shall be free of obstructions at all times. Easement lines run vertically above and below the ground surface. Overhangs and building foundations, including footings, shall not protrude into the easement.
 6. Fence posts shall not be installed within five (5') feet of the center of the pipeline, and the first post on either side of the pipe shall be set in hand dug holes. To perform normal inspections, maintenance, and repair, access through or around fences crossing the Easement Area must be provided.
 7. No trees, or other permanent plantings are allowed in easements that contain a water main. Lawns, flower beds and vegetable gardens are acceptable uses of the easement area.
 8. Easements located outside of paved areas shall have a twelve (12') foot wide all-weather access road per QCSD 612Q.
 9. Excavation within any portion of an easement with a water main shall not be allowed without approval of the Agency. Excavating closer than two (2') feet vertically or horizontally to the pipeline shall be done by hand until the pipe is exposed and shall be done only under observation of an authorized Agency representative.
 10. Grading within any portion of an easement with a water main shall not be allowed without a grading permit.
 11. No well drilling, septic drain fields, septic tanks or septic treatment facilities are permitted in the easement area.
 12. All other restrictions outlined in each specific easement document shall also apply.
- B. Tract Requirements:
1. Any public water main or appurtenance located in a tract shall have the tract dedicated to Agency as either a public utility easement or water easement at the time of the plat.
 2. The minimum tract width shall be twenty (20') feet if used for one (1) utility and a minimum of thirty (30') feet if used for two (2) utilities. Additional utilities may require additional width. The water main shall be located a minimum of ten (10') feet from the edge of the easement. Water mains shall not have more than six (6') feet of cover in a twenty (20') foot easement. Water mains with more than six (6') feet of cover shall require additional easement area.
 3. Tracts that contain a water main shall not be walled or fenced in or over. Providing a gate over or a single chain with Agency access shall be allowed.
 4. Tracts that contain a water main shall be free of obstructions at all times.
 5. Trees and large shrubs shall be allowed in tracts that contain a water main but shall not be allowed within ten (10') feet of a water main.
 6. Tracts located outside of paved areas shall have a twelve (12') foot wide all-weather access road per QCSD 612Q.

7. Excavation shall be allowed in tracts that contain a water main but shall not be allowed within ten (10') feet of a water main that has less than six (6') feet of cover and shall not be allowed within a distance equal to the depth of cover for water mains over six (6') feet of cover.
8. Grading shall be allowed in tracts that contain a water main but shall not be allowed within ten (10') feet of a water main that has less than six (6') feet of cover and shall not be allowed within a distance equal to the depth of cover for water mains over six (6') feet of cover.

C. Right-of-Way (ROW) Requirements:

1. Water mains or appurtenance shall be located in the public ROW whenever possible.
2. Water mains with less than six (6') feet of cover shall be a minimum of ten (10') feet from the edge of the ROW and placed in accordance with QCSDs 200Q-1 and 601Q through 606Q.
3. Water mains with more than six (6') feet of cover shall require additional separation from the edge of the ROW.

D. Excavation and grading shall be allowed in the ROW with a right-of-way permit.

SECTION 4.8 FIRE PROTECTION

4.8.1 GENERAL INFORMATION

- A. It is the intent of COP and CAFMA Fire Departments to establish requirements consistent with nationally recognized practices for safeguarding life and property from hazards of fire and explosion arising from the storage, handling and use of hazardous substances, materials and devices, and from conditions hazardous to life and property arising from the use or occupancy of buildings or premises.
- B. For information related to the most currently adopted plumbing and fire codes, see the PCC and the IFC, with most recent Agency amendments.
- C. If the property is to be supplied with domestic service and with fire flows from a storage tank or facility, the EOR shall provide a report indicating that the required pressures and volumes exist, as required by the Fire and COP Public Works/TOPV Utilities Departments and are available to meet the required fire demands.
- D. Particular attention shall be given to the fire hydrant locations on final plans for infrastructure where future building locations are not identified. Final building location and elevation may necessitate the addition of water mains, fire hydrants, and/or a fire pump to serve the structure. Compliance with the fire hydrant spacing and pressure requirements are the responsibility of the party requesting a building permit.

4.8.2 FIRE FLOW REQUIREMENTS

Water distribution facilities shall be sized to deliver the following minimum fire flows:

- A. One-thousand (1,000) gpm minimum, for single-family residential properties under three-thousand six-hundred (3,600) square feet.

- B. One-thousand five-hundred (1,500) gpm minimum for commercial, industrial, multi-family residential properties and single-family dwellings three-thousand six-hundred (3,600) square feet or greater.
- C. Larger structures over three-thousand six-hundred (3,600) square feet and non-sprinkled structures may require fire flow above one-thousand five-hundred (1,500) gpm depending on construction type.
- D. The fire flow requirements are subject to change. All fire flows and structural calculations shall be met as stated in the currently adopted IFC and most recent Agency amendments.

4.8.3 HYDRANT LOCATIONS

- A. The spacing of fire hydrants is to be measured along the curb line of the street or roadway in which a fire hose would be laid.
- B. The Fire Department shall stipulate fire hydrant locations during the site planning process or during plan review. The following standards shall be used as a guide:
 - 1. Fire hydrants shall be provided along required fire apparatus access roads and adjacent public streets.
 - 2. The minimum number of fire hydrants available to a building complex or subdivision shall not be less than that determined by spacing requirements listed in the currently adopted fire code. Exception: The Fire Marshal is authorized to accept a deficiency of up to ten (10%) percent where existing fire hydrants provide all or a portion of the required fire hydrant service.
 - 3. Existing fire hydrants on public streets may be considered for adjacent development. Existing fire hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extending between properties, and easements are established to prevent obstruction of such roads.
 - 4. Regardless of the average spacing, fire hydrants shall be located such that all points on streets and access roads adjacent to a building are within the distances listed in the currently adopted fire code.

4.8.4 FIRE LINES AND BUILDING SPRINKLER LINES

- A. The location of on-site fire lines and taps shall be determined by the relative location of the fire department connection, riser location, emergency access, fire hydrant locations and water main locations.
- B. The size of fire lines shall be determined by the EOR for design of the project based on required fire flow demands. Fire systems shall include a backflow preventer in accordance with [4.7.19](#).
- C. All fire lines shall be shown on the approved civil site plan including underground remote fire department connection (FDC) lines.
- D. Fire lines shall not be connected to transmission mains.
- E. Installation of fire service lines:
 - 1. Installation of two (2") inch and smaller fire service lines shall use a saddle connection per QCSO 316P-1 and 316P-2 within the COP or 310PV-1 and 310PV-3.

2. Installation of fire service lines larger than two (2") inches shall use a tapping sleeve and valve per QCSD 340Q-1.
 3. At the discretion of the Agency, meters may be required on services used solely for fire sprinkler systems.
 4. All private fire sprinkler lines shall be installed with trace wire per QCSD 319Q-1.
- F. Fire service lines shall be installed perpendicular to the main within the ROW or easement.
- G. Excessive lengths of line, as determined by the City/Town Engineer, may require additional backflow protection near the main to prevent stagnant water flowing into the active portions of the Agency's system.
- H. No service laterals or irrigation laterals shall be connected to fire lines.

4.8.5 FIRE DEPARTMENT CONNECTION

- A. If a remote FDC for a sprinkler system is required, it shall be installed between four (4') feet and eight (8') feet from the back of curb of a public or private roadway, on-site driveway or sidewalk. The location of the sprinkler system connection shall be unobstructed and readily accessible to the Fire Department. The connection location shall be approved by the Fire Department.
- B. FDCs, whether remote or wall mounted, need to be identified and coordinated on the civil improvement plans and on the building site plan for relationship to fire lanes and fire hydrants. All FDCs shall be appropriately clear of glazing and other hazards and shall be protected from vehicular damage.
- C. Location markers for Fire Department sprinkler system connections shall be provided per the adopted IFC and most recent Agency amendments.

4.8.6 AUXILIARY STORAGE TANKS

Minimum water pressures and discharge flow shall be in accordance with the adopted fire code. A fire pump package with an auxiliary storage tank installation may be required when the building's construction type, occupancy fire load commodities classification, volumetric building areas, building height and individual square footage areas per floor level require a pressurized fire flow in excess of the water transmission mains' capabilities.

ARTICLE 5 WASTEWATER

SECTION 5.1 INTRODUCTION

5.1.1 PURPOSE

The purpose of this Article is to provide engineering standards, guidelines, and geometric requirements for the design and construction of the public wastewater collection system and private sewer systems that discharge into the public collection system within the City of Prescott (COP), Town of Prescott Valley (TOPV), and Town of Chino Valley (TOCV). This Article is complimentary and supplemental to the Prescott City Code (PCC): Title 2, Chapter 1 Public Works Department, Title 10 Land Development Code (LDC), and Title 16 Street and Utility and Drainage Requirements, and all other Articles of the Quad City General Engineering Standards (GES), the Town of Prescott Valley Town Code, specifically Chapter 9 – Health and Sanitation and Chapter 16 – Engineering, and the Town of Chino Valley Town Code.

5.1.2 APPLICABILITY

- A. The standards and guidelines of this Article shall apply to the construction, modification, replacement, and extension of all wastewater mains, lift stations, and other appurtenances as well as any modification of the public wastewater system to be owned, operated, and maintained by the City of Prescott, Town of Prescott Valley, or Town of Chino Valley (Agency). Privately funded sewer mains that are proposed to be connected to the Agency’s system are reviewed for compliance with Agency standards. Private sewer mains shall be extended to new users in a logical and cost-effective manner without adversely affecting existing customers and system performance. This Article is intended for use in plan design, preparation, and review processes. The information provided in this Article is not intended to cover all situations that arise, nor may it be a substitute for sound engineering principles and judgment.
- B. Developers are required to install all improvements necessary to provide wastewater service to their development. This includes any sanitary sewer main, lift station, force main, manhole, vault, or other facilities and all required appurtenances, including the payment of all applicable development fees. Developers shall also adhere to the Agency standards for extension of the Agency’s wastewater system to newly developed areas, subdivisions, and in-fill areas inside the Agency’s service area in accordance with the Agency Wastewater Collection Model.

5.1.3 DESIGN STANDARDS AND GUIDELINES

- A. All public sanitary sewer systems shall be of a gravity flow design, unless other factors dictate the use of a force main and lift station. For lift station and force main requirements, refer to [Section 5.7.2](#) and [Section 5.7.3](#). Developments that require the construction of lift station facilities and force mains shall address the facilities’ compatibility with the Agency’s Wastewater Collection Model.
- B. A civil engineer registered in the State of Arizona shall analyze, design and seal all proposed wastewater system project plans, reports and specifications that are determined by the City/Town Engineer to have an impact on the wastewater collection system. The effects of peak flow shall be examined to ensure proper sizing and layout of proposed wastewater system facilities, including impacts to existing off-site facilities.

5.1.4 FEDERAL, STATE AND COUNTY REGULATIONS

A. U.S. Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) requires the Agency to develop and implement a pretreatment program to control discharges that might harm publicly owned treatment facilities. The program establishes local discharge limits for non-residential users, and provides a permitting process based on the users' discharges and types of businesses.

The EPA's "Onsite Wastewater Treatment Systems Manual" (EPA/625/R-00/008 – Chapter 3), states "Great care should be exercised in predicting wastewater characteristics so as not to accumulate multiple factors of safety that would yield unreasonably high design flows....". Further, "...actual measurement of wastewater flow and quality from a residential dwelling or nonresidential establishment always provides the most accurate estimate for sizing and designing....". Therefore, the priority of obtaining water and wastewater design flows is 1) flow measurements from the actual facility, 2) the use of flows from similar facilities in the immediate area, 3) the use of similar flows from similar facilities in other areas, and 4) flow tables.

B. Arizona Department of Environmental Quality (ADEQ)

Engineering Bulletin No. 11, "Minimum Requirements for Design, Submission of Plans and Specifications of Sewage Works" published by the Arizona Department of Environmental Quality (ADEQ), and the Arizona Administrative Code (AAC), "Title 18 - Environmental Quality" (R18-9), contain specific requirements for submittals, approvals, and notifications when extension of a public sanitary sewer main is proposed. Additional information can be found on the ADEQ website at www.adeq.gov/function/permits/index.html.

Before a permit is issued for the construction of civil infrastructure, the developer shall submit to the City/Town Engineer, Construction Authorization from ADEQ. Before the City/Town Engineer will issue an Approval to Operate (ATO) and release from the Agency, the developer shall deliver to the City/Town Engineer, a signed Discharge Authorization from ADEQ.

C. Yavapai County Environmental Services Department (YCESD)

Before a permit is issued for the construction of civil infrastructure, the developer shall submit to the City/Town Engineer, Construction Authorization from ADEQ through the Yavapai County Environmental Services Department (YCESD) delegation. Before the City/Town Engineer will issue an ATO and release from the Agency, the developer shall deliver to the City/Town Engineer, a signed Discharge Authorization from ADEQ through the YCESD delegation.

Issuance of an Approval to Construct by YCESD or ADEQ does not constitute an approval of plans and reports by the Agency. No construction shall commence prior to the City/Town Engineer issuing a permit.

An as-built submittal is required prior to receiving an ATO and release from the Agency.

D. Agency Approval (City of Prescott, Town of Prescott Valley, or Town of Chino Valley)

1. Issuance of an Approval to Construct by YCESD or ADEQ does not constitute an approval of plans and reports by the Agency. No construction shall commence prior to the Agency issuing a permit.
2. An as-built plan submittal is required prior to receiving an ATO and Release from the Agency. As-built submittals shall be in accordance with Article 10.

5.2 GENERAL INFORMATION

5.2.1 AVAILABILITY OF PUBLIC CITY/TOWN SEWER

- A. The Engineer of Record (EOR) shall submit the required forms for ADEQ approval to the COP Public Works/TOPV Utilities Department. ADEQ approval is delegated to YCESD. Refer to Yavapai County's website <https://yavapaiaz.gov/devserv/environmental-services-division> for further information and applicable forms.
- B. Average daily design flows shall be used for the Treatment Capacity Assurance, while appropriate peaking factors per [Table 5-3](#) and [Table 5-4](#) shall be applied to flows for the Collection Capacity Assurance.
- C. In order to prevent the possibility of differing ADEQ and Agency approved plans, the Agency will **NOT** sign and release the Capacity Assurance Forms until all design and review comments have been resolved. Design and construction scheduling shall account for this requirement. Design issues relative to capacity shall be resolved prior to forms being signed.

5.2.2 PRIVATE WASTEWATER AREAS

- A. Private wastewater collection providers serve portions of the Agency's municipal service area. Placing private sanitary sewer mains within Agency right-of-way (ROW) shall require a license agreement between the private wastewater company and the Agency. The private wastewater company may be Home Owners Association (HOA), Limited Liability Companies (LLC), or other entities established to provide ownership, operation, and maintenance responsibilities.
- B. The private wastewater service provider shall review modifications or construction of wastewater systems within their service areas. When submitting final plans, the developer shall provide written documentation that the private wastewater service provider has reviewed and approved the sanitary sewer mains within its jurisdiction.
- C. The Agency shall review all private wastewater systems as part of the plan review process. A note shall be placed on the recorded plat or lot split survey and on the construction drawings stating the sewer collection system is private or public as well as operation and maintenance responsibilities on each specific portion of the system constructed. The plan cover sheet shall include a signature block for the party responsible for maintenance.
- D. Private wastewater system connections to the Agency system shall be built to Agency standards for public sewer force main discharge as identified in [Section 5.7.3](#). Required testing of the system shall be performed after backfill and compaction have been completed.

5.2.3 PRIVATE ON-SITE SYSTEMS/ALTERNATIVE TREATMENT FACILITIES

The Agency will review the site plan but does not issue approval for the installation of on-site treatment and disposal systems (i.e. septic or alternative systems). Approval for on-site systems, in lieu of connection to the Agency public sanitary sewer system is reviewed and permitted by YCESD, under Delegation Agreement from ADEQ. The property owner is responsible for the design, permitting, construction, operation, and maintenance of these systems in accordance with all permit conditions.

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5.2.4 PRIVATE GRAVITY MAINS/LOW PRESSURE SEWER SYSTEMS

A. The Agency does not own, operate or maintain Low Pressure Sewer (LPS) Systems as these systems are considered private by the Agency. For connection of an LPS to the Agency system for more than one home, the language from Section [5.2.4.B.1](#) is to be added to the project plans, final plat, Conditions, Covenants, and Restrictions (CCR's) and deeds. Formation of a Limited Liability Company (LLC), or other entity approved by the Agency Legal Department for perpetual maintenance responsibilities shall be required.

B. Operation, Maintenance and Repair of Common Elements and Units

1. Operation, Maintenance and Repair of the Private Sewer System:

The individual sewer customers are served by private sewer collection systems, located as shown on the final as-built project plans, the operation and maintenance of which are the responsibility of the Wastewater Service Provider (provider) in perpetuity. The provider shall pay the cost of all operation, maintenance, repair and replacement of private systems. These private systems are connected to main lines operated by the Agency, as identified on the final approved plans. The Agency shall have no obligation or requirement to assist or provide manpower or equipment to perform or supplement any responsibilities pertaining to said private sewer systems, all of which are those of the provider. The provider, on a yearly basis, shall submit the firm, contact name, business phone number and emergency phone number for the private system operator, who shall be certified by ADEQ at the required level, to the Agency's wastewater operation's manager.

2. Identification of Private Sewer System:

All sewer clean out covers associated with the private system, per Quad City Standard Detail (QCSD) 270Q, shall be clearly marked "Private Sewer" with cast lettering on the cover.

3. Homeowner Responsibilities:

Homes within the private LPS area that have sewer ejector pumps shall be owned, operated and maintained by the individual homeowner. The Agency shall have no obligation or requirement to assist the homeowner in maintaining sewer ejector pumps.

4. Arizona 811 (formerly Arizona Bluestake) Responsibilities:

The provider shall, as the owner of underground facilities and as required by State law, join and maintain membership in the Arizona 811 Association at a membership level determined by the Arizona 811 Association, with all the rights and obligations set forth by law.

C. Acceptance of Private Sewer Systems for Agency Ownership, Operation, and Maintenance

The legal entity shall not petition the Agency to accept the private system or any portion thereof for ownership, operation, or maintenance until the systems are reconstructed to meet Agency standards in effect at the time of said petition.

5.3 AGREEMENTS

Developers and property owners who install improvements to the public wastewater system may be eligible

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to request a reimbursement agreement or development agreement with the Agency allowing for partial reimbursement of costs to design and construct those improvements. Only those system components identified in the Agency's current Master Plan shall be eligible for such consideration.

5.4 PLAN SUBMITTAL REQUIREMENTS

The improvement plans submitted to the Agency for approval shall adhere to professional engineering standards governed by the State of Arizona Board of Technical Registration. Improvement plans shall be complete and shall comply with Agency and State Board requirements. Improvement plans that do not meet industry standards, or are incomplete, shall be returned by the Agency without review comments and shall be determined to be an inadequate project submittal. Additional plan review fees may be required. Repetitive submittals of non-compliant and inadequate improvement documents may be subject to State of Arizona Board of Technical Registration review.

Plans for new sewer mains and extensions of existing sewer mains shall comply with the requirements of Agency Code:

PCC, Title 2, Chapters 2-1-11 and 2-1-37
TOPV Town Code Article 9-05

A civil engineer registered in the State of Arizona is required to analyze the wastewater generation from a proposed development while determining the closest and best connection point through discussion with the City/Town Engineer. The EOR shall also determine its impact on the Agency's wastewater collection system. This analysis is required from the development to the downstream system. The Agency is responsible for analysis of sanitary sewer mains shown in the Agency's most recently adopted Wastewater Model.

5.5 WASTEWATER SYSTEM REPORTS

5.5.1 GENERAL INFORMATION

- A. All projects shall be required to submit a Wastewater Master Plan Report and/or a Wastewater System Design Report. The purpose of these reports is to analyze the impact that the development will have on the Agency's wastewater system.
- B. All Wastewater System Reports shall be prepared under the direction of a licensed civil engineer in the State of Arizona. The report shall be sealed and signed by the EOR in accordance with the requirements of the State of Arizona Board of Technical Registration and submitted to the City/Town Engineer.
- C. The objectives of the Wastewater System Reports are to verify the development's wastewater generation rate, analyze the hydraulics of the proposed sanitary sewer system to a point of connection within the Agency's Wastewater System Model and demonstrate conformance for each phase of the development with the accepted master plan for that development. All reports submitted to the Agency for review shall be prepared in accordance with Article 1, Section 1.3, in addition to the following guidelines:
 1. Format:
 - a. The report and all supporting or supplemental material shall be PDF documents with letter-sized, eight and one-half by eleven (8.5" x 11") inch pages.

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- b. All reports shall have a table of contents, including page numbers.
 - c. Larger exhibits or maps shall be provided in PDF format at their full size, generated from the original drawing files.
 - d. A civil engineer licensed to practice in the State of Arizona shall seal each report in accordance with the requirements of the State Board of Technical Registration.
 - e. The report cover shall contain the following:
 - 1) Project Name
 - 2) Project Location
 - 3) The name, address, and phone number of the developer/owner and the EOR.
 - 4) The original submittal date and all subsequent revision dates.
 - f. Common spreadsheet formats shall be compatible with Microsoft Excel.
2. Existing Conditions:
- a. Reference any existing master plans or design reports applicable to adjacent development.
 - b. Include excerpts from existing plans or reports as applicable.
 - c. Indicate the dates, times and results of certified flow monitoring of the existing wastewater system.
 - d. Include a description based on all parts or reference within a platted development.
 - e. Describe existing topography and natural features, site slope and other conditions affecting gravity sewer installation.
 - f. Include the location and description of existing utilities in the vicinity.
 - g. Describe the existing and proposed site zoning and land uses.
 - h. Include reference to elements of the Agency's General Plan and identify any designated character area or studies that will affect the project's design.
 - i. Describe the existing wastewater collection system infrastructure affected by the development.
 - j. Identify lift stations and downstream trunk mains that will be used to convey wastewater from the development.
 - k. Reference any existing master plan(s) or design report(s) applicable from adjacent development. Include excerpts from existing plans or reports, as applicable.

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3. Proposed Conditions:

- a. Summarize the proposed development. Include a site plan that indicates the layout of the proposed development with a survey, a minimum of one-hundred (100') feet beyond the project limits, or as determined by the City/Town Engineer.
- b. Identify the location and size of all proposed connection(s) to the Agency's wastewater system.
- c. Describe any infrastructure required to convey wastewater from the development to the wastewater treatment plant.
- d. Show all extensions of sanitary sewer mains into and within the site.
- e. The ADEQ and/or Agency's design standard requirements that were applied to this project shall be summarized.
- f. Reference which sewer subbasin the site is within and address all required facilities needed to convey the projects generated wastewater to the ultimate outfall via gravity flow or pressurized force mains and lift stations.
- g. Address ownership, operation, and maintenance responsibilities of the proposed wastewater system.

4. Mapping:

- a. All mapping shall conform to Agency adopted CADD standards and the GES Article 8, Survey Controls.
- b. The project name shall be located on each sheet.
- c. The name, address, and phone number of the developer/owner and EOR shall be stated on each sheet.
- d. The original submittal date and all subsequent revision dates shall be located on each sheet.
- e. All maps shall be prepared to an appropriate scale that is sufficient to show all required information clearly.
- f. Include all proposed or existing on-site and off-site facilities, including, but not limited to, wastewater gravity mains, force mains, lift stations, manholes, clean-outs, etc.
- g. Include all proposed or existing street locations, parcel boundaries, and proposed lots within each parcel. All property lines, ROW, tracts, and easement lines shall be clearly labeled.
- h. Contour lines shall have a maximum of two (2') foot intervals and ten (10') foot labels.
- i. Include a small vicinity map and a more detailed location map showing the general location of the project with major arterial streets labeled along with geographic orientation to a distance of one mile from the exterior boundaries of the project.

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- j. Graphics shall present existing utilities as dashed lines and proposed utilities as bold, solid lines.

5. Design Methodology:

- a. Sanitary sewer main design shall provide gravity collection and buildout flows from the ultimate service area and shall allow for future extension of service to adjacent parcels when possible.
- b. Modeling – The software used and specific assumptions in the model shall be identified.
- c. Wastewater Flows – Land use, population, population density, loads and peaking factors shall be identified.
- d. Collection System Network – Mains that will be required to serve the development shall be identified and described.
- e. Lift Stations – Temporary and/or permanent lift stations, where required, shall be described. Design parameters and layouts, when appropriate, shall be provided. Lift stations shall be designed in accordance with Agency standards for materials, equipment, communication and backup power.
- f. Outfalls – Location and size shall be identified and described.

6. Wastewater Model and Results:

- a. Identify main sizes, slopes and other results as obtained from the model.
- b. Include a map of the collection system for each simulation where pipes are color coded or appropriately labeled.
- c. Identify any interim areas that do not have sufficient self-cleansing velocity and may require additional maintenance activities until build out.
- d. Provide a table summarizing parcels, acreages, land use and population.

5.5.2 WASTEWATER MASTER PLAN REPORT CONTENT

- A. A wastewater master plan is required when phased construction is proposed or if required by the City/Town Engineer. The Wastewater System Master plan shall show compliance with the Agency's design criteria and development policies for each phase of the project and establish a skeletal system for the phased development of a master planned project.
- B. The Wastewater Master Plan Report shall specify the terms and requirements for wastewater service to the development.
- C. All development projects shall be responsible for determining their specific wastewater discharge and shall include buildout flows from any upstream developments to ensure the system is designed properly.
- D. If the proposed development contemplates a change in the original master plan or zoning, which

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increases density or increases wastewater system flows differently from the Agency's existing Wastewater System Master Plan, then additional downstream analysis shall be required.

- E. Flows shall be calculated according to the hierarchy established in [Section 5.1.4](#).
- F. An electronic submittal containing all analysis and model files shall be submitted with the model report if the project is determined to be of sufficient complexity. Model files shall be compatible with EPA-NET model software or Aquanuity or Innovyze.
- G. Each model map shall show the following:
 - 1. All proposed on-site and off-site facilities including, but not limited to, lift stations, trunk mains and service connections and laterals.
 - 2. Proposed street locations, parcel boundaries and proposed lots within each parcel.
 - 3. Contour lines, with a maximum of two (2') foot intervals.
 - 4. A separate area location map showing existing and proposed streets, as well as existing parcels surrounding the project to a distance of one (1) mile from the exterior boundaries of the project.
 - 5. An appropriate scale that is sufficient to show all required information clearly.
- H. The Agency requires wastewater mains to be installed along the entire length of the property line frontage of the property being developed. The property line frontage is defined as that portion of a parcel of property that abuts a street, easement or public ROW. If a parcel to be developed has more than one frontage, improvements shall be installed along all frontages where future connectivity is possible.
- I. A construction phase matrix shall be included in a table format for all wastewater related infrastructure required to serve the development. The table shall include each phase, parcel and each system component. A mark in each box shall specify when infrastructure is anticipated to be required for each phase of the development.
- J. The masterplan report shall comply with the adopted Agency Wastewater System Master Plan encompassing the respective area.

5.5.3 WASTEWATER DESIGN REPORT CONTENT

- A. All development projects shall be required to provide an analysis of the project impact on the Agency's wastewater system. If the project involves a subdivision plat or lot split, a preliminary design report is required with submission of the preliminary plat or lot split survey. The final sewer system design report shall be submitted with the civil plans. The civil plans shall not be approved until the sewer system design report has been approved.
- B. The report shall determine the development's wastewater hydraulic load and analyze the hydraulics of the proposed sanitary sewer system and its impact to the Agency's existing system. Additionally, commercial and industrial developments shall include both hydraulic and concentration loads. The analysis shall include the effects of the peak flow to ensure correct sizing and layout of the new wastewater facilities.

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C. Design Documentation

1. A summary of the proposed development shall include a description based on aliquot parts or reference within a platted development and describe the proposed uses.
2. A narrative of which design procedures, policies and methodologies will be incorporated into the design of the proposed wastewater system shall be provided.
3. Compliance with the GES and all other applicable standards and codes shall be noted on the design report.
4. The title and version of any software used in the design analysis shall be listed.

D. Analysis

1. Analysis shall include engineering evaluation and summary tables for all gravity mains, manholes, lift stations, force mains and all other sewer system appurtenances including but not limited to design flow, capacity, velocity, peaking factors, diameter, alignment and other design criteria.
2. Wastewater design flows shall be in accordance with [Section 5.6.2](#). Any variance from the stated design flows shall be verified with the COP Public Works/TOPV Utilities Department.
3. Scour analysis shall be provided if drainage crossings are required. Wastewater modeling results with exhibits shall be included as applicable.

5.5.4 SEWER SYSTEM MODEL ANALYSIS

- A. Provide a model of the planned wastewater system as delineated in Section 5.5. This modeling shall be required where new wastewater infrastructure is being added to the existing Agency system. The model shall be provided in a format compatible with the Agency's master model and verify flows in the Agency system. Minor infill projects may not require a model at the discretion of the City/Town Engineer.

1. Wastewater Model Requirements

The developer or developer's engineer shall create and utilize a hydraulic model to demonstrate that the proposed infrastructure of the wastewater system is adequate and satisfies the performance criteria. Hydraulic modeling information shall be provided to the City/Town Engineer.

2. Model Software

The Agency currently uses the Aquanuity and Innovyze sewer modeling software, which is EPA-NET compatible. All modeling shall be compatible with the Agency's software.

3. Hydraulic Model Data

- a. All final drawings and model data to be submitted shall use the Agency's coordinate system information.
- b. Each physical entity in the Wastewater Collection System model of the proposed development shall require information and attributes as defined below:

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- 1) Gravity Mains – Diameter, material, length, slope, Manning’s coefficient, location, connectivity with mains and manholes, upstream invert elevation, and downstream invert elevation.
 - 2) Manholes – Diameter, location, manhole losses (minimum one-tenth (0.1) foot drop connecting mains), drop manhole details, wastewater load, and invert elevations.
 - 3) Lift Stations – Layout, location, and connectivity with other entities, number of pumps, pump curve, pump start/stop controls, rim elevation, wet well dimensions, wet well invert, outfall location, and elevation.
 - 4) Force Mains – Diameter, material, length, Hazen William’s coefficient, location, connectivity and manholes, upstream invert elevation, and downstream invert elevation.
 - 5) Diversion Structures – Diameter, invert elevation, location, connectivity, weir height and size, control scheme, and desired flow through each diversion.
 - 6) Outfalls – Location, connectivity, and invert elevation.
4. Hydraulic Evaluation
- a. New developments shall be modeled to determine if the proposed infrastructure is adequate to service the development and provide the level of service as defined by the Agency’s design performance criteria in Table 5-1.
 - b. The City/Town Engineer shall use the Agency’s model to determine the available capacity in the Agency’s existing downstream sewer collection system to convey wastewater from the development per the design engineer’s proposal. The developer shall model proposed collector mains and shall be responsible to make certain that wastewater can be safely conveyed from the points of origin to the Agency’s trunk mains. Off-site improvements to the collection system and lift stations may be required for safe conveyance.
 - c. Boundary conditions that represent the interface between the development and the rest of the collection system need to be identified and any deficiencies made clear.
 - d. All improvements required to provide sufficient capacity for project flows shall be identified.
 - e. Steady-state simulations shall be completed utilizing dry weather average day flow multiplied by the appropriate upstream population peaking factor plus ten (10%) percent inflow and infiltration (I&I) factor for new construction. Design documentation shall show that the collection system mains are sized adequately and that slopes are greater than the minimum slope to maintain self-cleansing velocities.

**TABLE 5-1
DESIGN CRITERIA**

Gravity Mains City of Prescott	2.5 fps<V<10 fps
Gravity Mains Town of Prescott Valley	2 fps<V<10 fps
Force Mains	3 fps<V<7 fps
<u>Flow Depth, d/D</u>	
d/D for New Sewer Mains with Diameters less than twelve (12”) inches	=0.50
d/D for New Sewer Mains with Diameters greater than or equal to twelve (12”) inches	=0.75
d/D for Evaluating Existing Mains in Developed Areas	=0.90
<u>Headloss in Existing Mains</u>	
Gravity Mains	Manning’s N=0.013
Force Mains	Hazen William’s C = 120 Max
<u>Changes in Main Size</u>	
When a Smaller Main Joins a Larger Main	Match Crowns (at a minimum)
<u>Headloss At Manholes</u>	
Manholes with Mains Intersecting from 0 to 45 Degrees	Provide a Minimum of 0.1’ Invert Drop
Manholes with Mains Intersecting from 46 to 90 Degrees	Provide a Minimum of 0.2’ Invert Drop

5.6 WASTEWATER DESIGN FLOWS

5.6.1 WASTEWATER COLLECTION ANALYSIS

This section shall describe the measurement standards for gravity sewer mains that are to be used to evaluate the suitability of wastewater collection system improvements and additions.

5.6.2 WASTEWATER SYSTEM LOADS

- A. All projects shall provide a summary of the anticipated sewer loads for the project. Provide an analysis of the anticipated sewer flows. This analysis shall be based on actual flows from similar facilities or the hierarchy established in [Section 5.4.1](#). If flows are unavailable from similar facilities the unit factors listed in [Table 5-2](#) shall be used. If the proposed use does not match the tables, provide an estimate of what the flows shall be from other sources and provide a justification for their use. Flows may be calculated on a sub-area basis but provide a total flow for the entire development as well.

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- B. [Table 5-2](#) lists unit loads that can be easily correlated to acreages for types of land use. The AAC also provides guidelines on appropriate unit loads for different types of development that is not easily related to acreages for types of land use.

**TABLE 5-2
UNIT DAILY DESIGN FLOWS FOR SEWER**

TYPE OF FACILITY SERVED	APPLICABLE UNIT	WATER DESIGN FLOW PER APPLICABLE UNIT GALLONS PER DAY (GPD)
Airport	Passenger (average daily number)	4
	Employee	15
Auto Wash	Facility	Per manufacturer, if consistent with this Article
Bar/Lounge	Seat	30
Barber Shop	Chair	35
Beauty Parlor	Chair	100
Bowling Alley (snack bar only)	Lane	75
Day Camp, no cooking facilities	Camping Unit	30
Campground, Overnight, Flush Toilets	Camping Unit	75
Campground, Overnight, Flush Toilets	Camping Unit	150
Campground, Luxury	Person	100-150
Camp, Youth, Summer, or Seasonal	Person	60
Church, Without Kitchen	Person (Maximum attendance)	5
Church, With Kitchen	Person (Maximum attendance)	7
Country Club	Resident Member	100
Dance Hall	Patron	5
Dental Office	Chair	500
Dog Kennel	Animal, Max occupancy	15
Dwellings	Person	80
Fire Station	Employee	45
Hospital, All Flows	Bed	250
Hospital, Kitchen Waste Only	Bed	25
Hospital, Laundry Waste Only	Bed	40
Hotel/Motel, Without Kitchen	Bed (2 person)	50
Hotel/Motel, With Kitchen	Bed (2 person)	60

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TYPE OF FACILITY SERVED	APPLICABLE UNIT	WATER DESIGN FLOW PER APPLICABLE UNIT GALLONS PER DAY (GPD)
Industrial Facility, Without Showers	Employee	25
Industrial Facility, With Showers	Employee	35
Industrial Facility, Cafeteria Added	Employee	5
Institutions, Resident	Person	75
Institutions, Nursing Home	Person	125
Institutions, Rest Home	Person	125
Institutions, Laundry, Self Service	Wash Cycle	50
Institutions, Laundry, Commercial	Washing Machine	Per Manufacturer, if consistent with this Article
Office Building	Employee	20
Park (Temporary Use)		
Picnic, With Showers, Flush Toilets	Parking Space	40
Picnic, With Flush Toilets Only	Parking Space	20
Recreational Vehicle, With no Water and Sewer Connections	Vehicle Space	75
Recreational Vehicle, With Water and Sewer Connections	Vehicle Space	100
Mobile Home/Trailer	Space	250
Restaurant/Cafeteria	Employee	20
With Toilet, Add	Customer	7
Kitchen Waste, Add	Meal	6
Garbage Disposal, Add	Meal	1
Cocktail Lounge, Add	Customer	2
Kitchen Waste Disposal Service, Add	Meal	2
Restroom, Public	Toilet	200
School, Staff and Office	Person	20
Elementary, Add	Student	15
Middle and High, Add	Student	20
With Gym and Showers, Add	Student	5
With Cafeteria, Add	Student	3

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TYPE OF FACILITY SERVED	APPLICABLE UNIT	WATER DESIGN FLOW PER APPLICABLE UNIT GALLONS PER DAY (GPD)
Boarding, Total Flow	Person	100
Service Station, with Toilets	First Bay	1,000
	Each Additional Bay	500
Shopping Center, No Food or Laundry	Square Foot of Retail Space	0.1
Store	Employee	20
Store, Public Restroom, Add	Square Foot of Retail Space	0.1
Swimming Pool, Public	Person	10
Theater, Indoor	Seat	5
Theater, Drive-In	Car Space	10

5.6.3 PEAKING FACTOR

- A. The peaking factor shall be as defined in the AAC, Section R18-9-E301.D.1.b, and [Table 5-4](#).
- B. In addition to dry weather peaking factors, ten (10%) percent shall be added for wet weather I&I.
- C. Where population estimates are not available or non-residential loads prevail, dry weather peaking factors can be calculated using: $PF=C(Q_{avg})^{-m}$

Where:

C = constant (empirical coefficient)

Q_{avg} = average flow rate (ft³/s, m³/s)

M = exponent

**TABLE 5-3
NON-RESIDENTIAL DRY WEATHER PEAKING FACTORS
FOR WASTEWATER COLLECTION SYSTEMS**

Average Flow (ft ³ /s)	C	M
0.012 < Q _{avg}	1.78	0.16
0.120 < Q _{avg}	1.79	0.15
1.20 < Q _{avg} < 35.0	1.76	0.05

5.7 INDIVIDUAL WASTEWATER FACILITIES

5.7.1 ON-SITE TREATMENT AND DISPOSAL FACILITIES

- A. When wastewater service is not available from the Agency system, an on-site treatment and disposal system, (septic or alternative system), is required. Permitting is required through the YCESD for all on-site treatment.
- B. The property owner is responsible for the design, construction, operation and maintenance of septic systems/on-site wastewater treatment and disposal facilities. The Agency shall not accept any type of on-site system for operation and maintenance but may provide input to the YCESD regarding environmental concerns.
- C. All on-site wastewater treatment and disposal facilities shall be designed, constructed, and maintained by the property owner compliant with the applicable requirements of YCESD.

5.7.2 WASTEWATER LIFT STATIONS

- A. When lift stations are contemplated, the EOR shall meet with the City/Town Engineer to discuss development options and design requirements prior to any design completion. The Agency may deny lift station installations when gravity sewer options are available.
 - 1. Site selection for wastewater lift stations shall consider accessibility, drainage patterns, visual and neighborhood impact, three-phase power availability, function, and design constraints.
 - 2. The potential for flooding shall be considered when selecting a wastewater lift station location. The station's equipment, vaults and manholes shall be protected from damage and remain operable during a one-hundred (100) year flood event.
 - 3. Each tract or lot used for lift station facilities shall include all weather ingress/egress, as shown on QCSD 612Q.
 - 4. Wastewater facilities shall be located on a tract or lot dedicated to the Agency (conveyed by a general warranty deed) and accompanied by a title policy accepted by the Agency.
- B. Lift Station Requirements
 - 1. AAC, Title 18, Chapter 9, "Water Pollution Control," and ADEQ, Bulletin 11 contain minimum requirements for a wastewater lift station. Additional requirements specific to the Agency (including but not limited to wetwell coating, SCADA, electrical, pump preferences, etc.) shall be obtained from the City/Town Engineer before beginning design. At a minimum telemetry, pump and wet well redundancy, backup power supply, three-phase power, odor control, and security perimeter walls shall be required. The site shall be large enough to fully contain all the facilities and service equipment for repairs and maintenance.
 - 2. A preliminary design report shall be prepared and submitted to the City/Town Engineer for review with the preliminary plat. The preliminary report shall outline the type of equipment and controls proposed for the station that meets the Agency equipment standards.

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3. A final design report prepared by a registered professional engineer licensed in the State of Arizona, shall accompany all lift station design drawings and specifications submitted to the Agency for review with the final plat.

C. Lift Station Design

1. In addition to state requirements lift stations shall be sized per the following:

The wetwell shall be sized so that the number of duty pump starts per hour does not exceed three (3) during max day flows, including I&I.

2. Design shall include current, interim, and build out conditions.
3. Station shall have a minimum of two (2) pumps and be capable of operating at the designed flow with any one pump out of service.
4. The individual pump capabilities shall be identical to facilitate operation and maintenance.
5. Pumps shall be submersible type designed for wastewater applications. All pumps shall be of the same manufacturer. Pump manufacturer shall be Flygt or approved equal. All pumps shall be self-cleaning and capable of handling fibrous material.
6. Valve vault with shut-off and check valves shall be included.
7. Aeration and odor control:
 - a. The odor control system (e.g., biofilter, biofilter with optional secondary activated carbon polishing unit, or stand-alone activated carbon filter unit) shall be sized commensurate with hydrogen sulfide concentrations, wetwell size, pumping cycles, and other factors as may be appropriate.
 - b. The unit must be in a non-corrosive enclosure with a four (4") inch minimum static air vent, or a variable frequency drive (VFD) controlled centrifugal fan installed with a sound attenuation enclosure, as determined by the sizing requirements.
 - c. Retention time shall not exceed thirty (30) minutes.
 - d. When aeration is required by the Agency, a compressor with diffuser bar shall be placed in the wetwell, with the compressor sized for two (2) standard cubic feet per minute (SCFM) per one-thousand (1,000) gallons of wetwell storage.
 - e. The diffuser piping shall be constructed of stainless steel with coarse bubble diffusion and deflector shield.
8. Lockable aluminum access covers shall be located directly over the pumps and shall be a minimum of twenty-four (24") inches clear of any equipment in order to remove and replace pumps. Aluminum hatches shall include non-corrosive hardware and internal safety netting.
9. Electrical control unit (EG Controls) shall not be located on the wetwell or adjacent manholes and shall have separate mounting pad and enclosure.

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10. Pre-cast or cast-in-place concrete walls shall be protected against corrosion. Per the COP, all interior walls shall be lined using Sewer Shield 150, Sewer Guard 210S, or Raven 405 and installed by a certified installer in accordance with manufacturers specifications. Per the TOPV, all manhole concrete shall be constructed with Conmicshield additive and mixed and installed by a certified installer in accordance with manufacturers specifications.
11. Controls shall have hour meters, cycle meters, magnetic flow meter, and run and failure lights with audible alarm and rotating beacon light, hand off auto switches, and provide for alternating sequencing of pumps.
12. All pump rails and hardware shall be stainless steel.
13. A diversion by-pass line and manhole with diversion piping and valves shall be included for routine maintenance and emergency pumping.
14. An emergency power source shall be provided that will supply immediate service and have an automatic transfer switch.
15. Communication from the lift station to the Agency's SCADA monitoring system shall be established for operations, monitoring, and security. Nonproprietary hardware and software shall be used.
16. The lift station shall be equipped with visual or audible alarms when high water levels are detected.
17. Level shall be controlled by a level transducer with avocado style floats, normally open for redundancy.

5.7.3 FORCE MAINS

- A. Force mains shall be located within a public ROW or a utility easement. The main shall be located under pavement where possible.
- B. The flow velocity in the force main shall be between three (3') feet and seven (7') feet per second (fps).
- C. Force main detention times and the potential for hydrogen sulfide generation shall be calculated for any interim phasing and full project buildout. Parallel mains of differing sizes may be required if interim/startup conditions result in insufficient discharge rates, velocities and excessive retention times.
- D. All pipe material used in design of the force mains shall have established American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), American Water Works Association (AWWA), and National Sanitation Foundation (NSF) standards of manufacture or seals of approval. All pipes shall be designated as pressure sanitary sewer pipe. Acceptable materials shall include fused High Density Polyethylene Pipe (HDPE), or epoxy lined Ductile Iron Pipe (DIP).
 1. Continuously fused HDPE pipe does not require additional joint restraint.
 2. Force mains shall be restrained in accordance with QCSDs 303Q-1 and 303Q-2. Force mains smaller than four (4") inches in diameter shall be restrained to the requirements of a four (4") inch nominal pipe size. Discharge location of force main shall be treated as a dead-end condition.

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- E. Air/vacuum valve(s) and all appurtenances designed for wastewater shall be stainless steel. Air/vacuum valve(s) shall be provided on force mains at all local high points in accordance with QCSD 416Q.
- F. Cleanouts and flushing points may be required based on length, flow, and topography.
- G. Refer to QCSD 426Q-1 for details regarding discharge into a manhole from a force main.
- H. The separation between the force mains and water mains shall be six (6') feet exterior wall-to-wall horizontally. Where a force main crosses above or below a water main, refer to MAG Standard Details 404-1 and 404-2. Both the water and sewer main shall have additional protection where required per AAC Title 18, Chapter 5, Section 502(C).
- I. Odor control and epoxy lining shall be required at the receiving manhole. Odor control shall be sized according to receiving manhole air volume, pumping rate, and pumping frequency. Additional odor control and epoxy lining may be required on downstream facilities. Acceptable means of odor control include bio-filtration, filtration by media such as activated carbon, Chlorine Dioxide, Permanganate, Alumina, Sulfatreat, or other method approved by the City/Town Engineer.
- J. A tracer wire shall be attached to the force main as part of the installation per QCSDs 319Q-1 and 319Q-2. Tracer wire shall be terminated at tracer wire stations and shall not enter any structure that can potentially have a corrosive environment.

5.7.4 FLOW METERING STRUCTURE

The COP Public Works/TOPV Utilities Department may require the installation of a flow metering structure. In the COP, all flow produced from Prop 400 annexations shall require flow metering. When required, the EOR shall design the flow metering structure as part of the project improvements. The flow metering structure design shall include:

- A. Adequate land area for the structure with access to public ROW.
- B. Security perimeter fence for site.
- C. Locking structure for appurtenances.
- D. SCADA radio monitoring system.
- E. Electrical control system, to include software.
- F. Flow measurement and recording (magnetic, laser or ultrasonic type).
- G. Pipe and conduit penetrations in flow metering structure shall be core drilled. Pipe penetrations shall be sealed with Link Seal.
- H. Aluminum access hatches with minimum five (5') feet by five (5') feet clear opening.
- I. Fiberglass reinforced polymer (FRP) grating.

In the COP a protective liner shall be applied to all interior vault surfaces (vaults constructed of Pre-Cast-Polymer Concrete do not require lining). Surface preparation shall be completed per manufacturer's recommendation. Acceptable liners are limited to Raven 405, Sewer Shield 150 or

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SewerGard 210XHB and shall be installed by a certified installer in accordance with manufacturers' specifications. All liners shall be holiday tested and any discontinuities shall be repaired to manufacturer's recommendation.

In the TOPV an antimicrobial additive shall be included in both precast and cast-in-place concrete mixtures. The amount of additive shall be per the manufacturer's recommendations and included in the concrete mix water per QCSD 446PV. The TOPV's acceptable additive is Conmicshield or approved equal.

5.8 COLLECTION SYSTEM

5.8.1 GENERAL REQUIREMENTS

- A. Property shall be abutting a sewer main for a service connection to be made, unless otherwise allowed pursuant to this section. In cases where the main is not abutting, the main shall be extended at the expense of the property owner before a connection is made.
- B. The Agency requires sewer mains to be installed along the entire length of the property line frontage of that property being developed, unless constrained by topography. The property line frontage is that portion of the property that abuts a street, public utility easement or public ROW. If a parcel to be developed has more than one property line frontage the Agency may require a sanitary sewer main be installed along the entire length of all frontages where parcel development paving is required and future connectivity is possible.
- C. Developers shall install at their expense, all on-site and off-site sewer improvements necessary to serve their developments, including but not limited to gravity mains, force mains, lift stations, and any improvements to existing Agency facilities. Developers shall obtain all necessary permits and meet all regulatory compliance.
- D. All building sanitary sewer service lines shall be privately owned, operated, and maintained.
- E. Extension of sewer mains, which are adjacent to undeveloped parcels, shall be reviewed by the Agency and may be required to install sewer main stubs from the adjoining manhole(s) to facilitate the future extension of the public sewer system to serve future developments. Stubs from the manholes are to be extended to the ROW line and be eight (8") inches minimum in diameter and finished with a vertical clean-out riser and monument per QCSD 270Q.
- F. Users who discharge non-residential wastewater shall install monitoring manholes in accordance with Agency Code.

PCC, Title 2, Chapter 2-1-68-1-C
TOPV Town Code Article 9-05.
- G. Any sewer mains not built to Agency standards shall be privately owned, operated, and maintained in accordance with Section [5.2.2](#).

5.8.2 DESIGN POLICY

- A. Reconstruction of residential or commercial structures requires compliance with all current ordinances and design guidelines relating to sewer main extension.

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- B. For developments where an existing sanitary sewer is not available, a dry sanitary sewer main shall be installed and tested in conformance with all the design requirements for a public sanitary sewer main. In the COP, QCSOs 440P-1 or 440P-2 may be used as applicable to locate the ends of service line stubs on a dry system; in the TOPV MAG 440-1 shall be used. Temporary on-site wastewater treatment systems shall be designed and located such that future removal and connection to the Agency system is possible when sanitary sewer service becomes available.
- C. Wastewater systems shall be designed to serve the ultimate population density expected in the collection basin. The design shall be in conformance with the current Agency approved Wastewater System Model and take into consideration future connections. Where a wastewater collection system extension is possible upstream of a subdivision, the sanitary sewer shall extend through the subdivision to the platted boundary to a point of connection that shall provide wastewater service to adjacent properties. Regulatory guidelines shall be met in order to provide adequate capacity for upstream flows without future reconstruction.

5.8.3 DESIGN STANDARDS

Wastewater collection systems shall be designed in compliance with AAC, Title 18, Chapter 9, "Water Pollution Control", ADEQ, Bulletin 11, and the Agency GES.

5.9 MATERIALS

5.9.1 PIPE SELECTION MATERIALS

- A. In selecting pipe material for sanitary sewer mains, consideration shall be given to the chemical characteristics of wastewater, especially industrial wastes. Consideration shall be given to velocity, the possibility of septicity, external and internal pipeline forces, and preventing infiltration, abrasion, and similar type problems.
- B. The following types of material shall be used for gravity sewer mains:
 - 1. Polyvinyl Chloride (PVC) (ASTM D3034) SDR35 up to fifteen (15") inches in diameter, where cover is twelve (12') feet or less.
 - 2. PVC (ASTM D3034) SDR26 up to fifteen (15") inches in diameter, where cover is greater than twelve (12') feet.
 - 3. Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) pipe as manufactured by HOBAS, or approved equal, including eighteen (18") inches and larger in diameter.
 - 4. PVC (ASTM F679) SDR 26 between and including eighteen (18") inches and twenty-seven (27") inches in diameter.
 - 5. Ductile Iron Pipe (DIP) Class 350 (CL350) ceramic epoxy lined with Protecto 401 or approved equal only used with Agency approval. Where cover is greater than twelve (12') feet, the City/Town Engineer may require DIP CL350 sewer.
- C. The following types of material shall be used for sewer force mains:
 - 1. In the COP projects shall utilize fused High Density Polyethylene Pipe (HDPE) DR17 (or 50psi above maximum working pressure).

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2. In the TOPV projects shall utilize fused High Density Polyethylene Pipe (HDPE) DR17 minimum (or 50psi above maximum working pressure), Polyvinyl Chloride Pipe (PVC) DR14 minimum, or fusible PVC.
3. Pipe materials shall not change between manholes, unless extra protection is required for utility separation.
4. Trench loading conditions shall be analyzed for each pipe type used. The pipe used, including bedding requirements, shall meet Agency and manufacturers specifications for each condition.
5. Pipe material used in design shall have established ASTM, ANSI, or NSF standards of manufacture or seals of approval, and shall be designated for use with wastewater.

5.9.2 SYSTEM LAYOUT

- A. Public sanitary sewer mains within commercial, industrial, or multi-family developments shall be located within drive aisles and a minimum of ten (10') feet from any structure, including overhead projections and footings/foundations. Public sanitary sewer mains shall be located within Agency ROW or public utility easement. No private services are allowed longitudinally within a public utility easement or Agency ROW.
- B. If the horizontal direction, slope, material, or size of the sanitary sewer main changes, a manhole shall be constructed. The horizontal angle formed between an inlet and outlet pipe shall not be less than ninety (90°) degrees.
 1. Curvilinear sanitary sewer mains are not permitted.
 2. Horizontal location of sewer mains shall be aligned parallel to property lines or street center lines to the maximum extent possible and shall not cross and re-cross the centerline
- C. The design report including water and sewer layouts shall be in accordance with the following criteria:
 1. Sanitary sewer mains and manholes shall be located on the alignment shown in QCSDs 601Q through 606Q.
 2. Sanitary sewer mains shall maintain minimum horizontal and vertical clearance to dry utilities per QCSD 402Q.
- D. Gravity sewer main shall be installed when possible at a depth sufficient to promote gravity drainage of wastewater from each service line and shall anticipate the lowest potential finish floor elevation for each building pad to the maximum extent possible.

5.9.3 DESIGN FLOWS

- A. Design flows shall be based on [Table 5-2](#) in [Section 5.6](#). The priority of obtaining wastewater design flows is 1) flow measurements from the actual facility, 2) the use of flows from similar facilities in the immediate area, 3) the use of similar flows from similar facilities in other areas and, 4) flow tables.
- B. Peaking factors in accordance with [Table 5-4](#) shall be used, plus ten (10%) percent I&I.

**TABLE 5-4
WASTEWATER FLOW PEAKING FACTOR**

Upstream Population	Dry Weather Peaking Factor
100	3.62
200	3.14
300	2.90
400	2.74
500	2.64
600	2.56
700	2.50
800	2.46
900	2.42
1,000	2.38
1,001 to 10,000	$PF = (6.330 \times p^{-0.231}) + 1.094$
10,001 to 100,000	$PF = (6.177 \times p^{-0.233}) + 1.128$
More than 100,000	$PF = (4.500 \times p^{-0.174}) + 0.945$
PF = Dry Weather Peaking Factor	p = Upstream Population

5.9.4 HYDRAULIC DESIGN

- A. No public sanitary sewer mains shall be less than eight (8”) inches in diameter.
- B. In the COP sanitary sewer mains shall be designed and constructed to provide full flow velocities of not less than two and one-half (2.5) feet per second (fps), based upon Manning’s Formula, using an “n” value of thirteen thousandths (0.013).
- C. In the TOPV sanitary sewer mains shall be designed and constructed to provide full flow velocities of not less than two (2) fps, based upon Manning’s Formula, using an “n” value of thirteen thousandths (0.013).
- D. EOR shall analyze all mains at average day and peak flow. Any velocities under two and a half (2.5) fps (average day) shall be noted as requiring additional maintenance.
- E. To prevent abrasion and erosion of the pipe material, the maximum velocity shall be below ten (10) fps at estimated peak flow. Where velocities exceed ten (10) fps, the main shall be constructed of a pipe material that is abrasion resistant. In no case shall velocities greater than fifteen (15) fps be allowed.
- F. The sanitary sewer system shall be designed to achieve uniform flow velocities through consistent slopes between manholes.

- G. Minimum slopes shall comply with [Table 5-5](#) and shall ensure a minimum self-cleaning velocity of two and one half (2.5) fps when flowing full.

**TABLE 5-5
MINIMUM DESIGN SLOPES FOR CIRCULAR PIPES**

Pipe Size (inches)	Minimum Slope⁽¹⁾ (ft/ft)
8	0.0050 ⁽⁴⁾
10	0.0025
12	0.0020
14	0.0016
15	0.0015
16	0.0014
18	0.0012
20	0.0010
21	0.0010
24	0.0008

Note:

1. Mains larger than twenty-four (24") inches shall still have a slope no less than eight ten-thousandths (0.0008).
 2. Pipe Capacity presented based on full capacity flow.
 3. Table assumes Manning's N coefficient of thirteen-thousandths (0.013).
 4. Minimum slope for an eight (8") inch pipe shall be five-thousandths (0.0050) ft/ft unless specifically evaluated and approved by the City/Town Engineer.
- H. Analyze junction losses and include them in the design report.
- I. The depth to diameter (d/D) ratio for gravity sanitary sewer mains less than twelve (12") inches in diameter shall be no greater than five tenths (0.50) in the ultimate peak flow condition. The d/D ratio for sewer mains twelve (12") inches or greater in diameter shall be no greater than seventy-five hundredths (0.75) for the ultimate peak flow condition.
- J. Each reach of pipe shall be analyzed for design flow (average day), peak flow, and full flow conditions and placed in a tabular form in the design report. The table shall include average, peak, and full flows, the corresponding velocities, flow depth, and flow depth/diameter ratios for each flow regime.
- K. The Agency may require that the wastewater design report includes an analysis of the potential of the generation of hydrogen sulfide per EPA guidelines, and if so, the design shall provide mitigation.

5.9.5 MANHOLES AND CLEAN OUTS

- A. Manholes in Agency streets shall be located in accordance with QCSDs 601Q through 606Q. Manholes shall not be located in wheel paths, sidewalks, crosswalks, valley gutters, parking stalls and curb and gutter. Horizontal location of sewer mains shall be aligned parallel to property lines or street center lines to the maximum extent possible and shall not cross and re-cross the centerline.
- B. Manholes shall be required at all changes of grade, pipe size, pipe material, or alignment and at distances not to exceed those shown below:

TABLE 5-6
MANHOLE SPACING

Pipe Size (Inches)	Maximum Spacing (Feet)
8 to 15	500
18 to less than 36	600
36 and larger	800

- C. All manhole sections and cones shall be pre-cast concrete as detailed in QCSDs 420Q-1 and 420Q-2. Manhole bases can be precast or cast in place.
- D. COP manhole covers shall be in accordance with QCSDs 423P-1 or 423P-2 as required, for applicable size. TOPV manhole covers shall be in accordance with MAG Standard Detail 423-1 and 423-2.
- E. Manholes shall be lined or coated at the discharge of a force main, at all drop manholes, on sanitary sewer mains fifteen (15”) inches in diameter and larger or in other design situations where corrosive conditions are anticipated. Manholes downstream from force mains and private ejector lines shall be evaluated for hydrogen sulfide and shall be lined or coated. Manholes requiring linings or coatings shall be noted on the final plans.
- F. The manhole shall have a minimum one-tenth (0.10’) foot drop across the trough. Inverts at junctions shall be designed to maintain the energy gradient across the junction and prevent backflow. Where pipe size increases through a manhole, pipe crowns shall be matched on each side.
- G. The difference in invert elevations between inflow and outflow mains shall not exceed two (2’) feet, unless a drop connection is installed. If less than two (2’) feet, QCSD 426Q-2 shall be used. Drop connections greater than two (2’) feet, shall be in accordance with QCSD 426Q-1 per manufacturer recommendation.
- H. Existing manholes shall be replaced to accept new mainline connections unless a drop inlet is designed.
- I. Manholes with multiple inlets shall be configured so that inlet directions are a minimum of forty-five (45°) degrees apart for eight (8”) inch mains. If larger sewer main diameters or smaller inlet angles are being proposed, then a larger diameter manhole or a redesign of the proposed sewer main is required.
- J. Manholes shall be protected from storm drainage and flooding conditions. Sanitary sewer mains shall not be permitted in washes or drainage areas unless otherwise approved in writing, by the City/Town Engineer.

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1. When approved by the City/Town Engineer:
 - a. Manholes located within washes or drainage areas shall have bolted watertight covers, bases and barrels to prevent inflow in accordance with QCSD 420Q-2.
 - b. The rim elevation shall be a minimum of twelve (12”) inches and a maximum of eighteen (18”) inches above adjacent finish grade in accordance with QCSD 420Q-2.
 - c. Structural protection shall be provided against scour from a one-hundred (100) year storm event.
 - d. The manhole shall be designed to structurally exceed the external forces acting upon the manhole from a one-hundred (100) year storm event.
 - e. Manholes shall be verified as non-buoyant, or provisions provided to negate the effects of buoyancy.
 2. Ingress/egress and maintenance roads shall be provided for all public sewer mains and appurtenances. Maintenance roads shall be in accordance with QCSD 612Q.
- K. New main construction in undeveloped areas shall only use a sewer manhole at main line terminations.
- L. Agency may authorize an alteration for cleanouts per QCSD 441Q at the termination of sewer mains that: 1) cannot be extended, 2) are less than one-hundred fifty (150’) feet in length and, 3) have less than four (4) service connections.
1. Service connections shall not be allowed in the terminating manhole.
 2. Service connections shall not be allowed at the end of the main line cleanouts.

5.9.6 PRETREATMENT MONITORING VAULTS AND MANHOLES

- A. The City/Town Engineer has the sole discretion of when the installation of a monitoring vault and or sample collection point will be required for non-residential discharges. The following conditions shall automatically trigger monitoring point and or sample collection point requirements:
1. The projected process wastewater discharge is equal to or greater than twenty-five thousand gallons per day (25,000 gpd).
 2. The projected operation falls under Federal Categorical Classification under 40 CFR Parts 400 – 471.
 3. The projected operation is otherwise classified by the City/Town Engineer, ADEQ, or EPA as a Significant Industrial User (SIU).
 4. The projected operation is classified as a Food Service Facility (FSF) or Vehicle Service Facility (VSF) by the City/Town Engineer.

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5. Any other discharger regulated under the Agency's pretreatment program as described in Agency Code.

PCC, Title 2, Chapter 2-1-45 and 2-1-46
TOPV Town Code Article 9-05

- B. Any developments that meet the criteria in Section 5.9.7 are required to install a monitoring vault and sample collection point in accordance with the following provisions:
 1. Monitoring vaults shall be constructed with a straight channel and no taps or bends for ten (10') feet upstream or downstream or as approved by the City/Town Engineer.
 2. Monitoring vaults shall be located and designed for access at all times by monitoring crews and vehicles.
 3. Monitoring vaults shall be installed to prevent inflow from surface runoff.
- C. New developments that are classified as FSF, VSF, or any other user as determined by the City/Town Engineer that shall be required to install a sample collection point shall meet the following conditions:
 1. The sampling point shall be of sufficient size to allow full access to an opening equal to the inside diameter of the discharge pipe.
 2. The sampling point shall be accessible to Agency staff during regular working hours.
 3. The sampling point shall be installed to prevent inflow from surface runoff.
 4. The sampling point shall be installed immediately downstream of the oil and sand interceptor, grease interceptor, or any other interceptor. Sampling point shall be prior to any downstream connection.

5.9.7 PIPE COVER AND SEPARATIONS

- A. The depth shall include the additional height required for service tap placement at the ten (10) o'clock or two (2) o'clock position in accordance with QCSD 440Q-1 and an anticipated minimum slope of one-quarter ($\frac{1}{4}$ ") inch per foot. The service lateral shall pass below water mains and other utilities where possible.
 1. The standard minimum depth of gravity sewer mains shall be seven (7') feet of cover and in no case shall a sanitary sewer main be installed with less than four (4') feet of cover over the top of the pipe.
 2. All sanitary sewer mains and laterals shall be designed to resist superimposed live loads and backfill overburden without damage or deflection to the pipe material and without adversely affecting the hydraulic characteristics of the pipe. The engineer shall specify minimum depths of cover to be provided during the construction of roadways or other facilities affecting cover over the main and laterals.
 3. All sewer service lines that cross under the flowline of a creek, wash, or drainageway shall be constructed to provide maximum cover within the drainage course. Pipe shall be mechanically restrained and hardened with concrete encasement against erosion or infiltration.

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- B. Caution shall be taken in the design and construction of the sanitary sewer mains to protect all water supplies from wastewater contamination. To minimize the potential of contamination, the EOR shall design the horizontal and vertical separation of water and sanitary sewer mains in accordance with Engineering Bulletin No. 10 “Guidelines for the Construction of Water Systems” published by ADEQ and the AAC, Title 18, Chapter 5, “Environmental Reviews and Certification”.

The minimum horizontal distance from a water main to a sanitary sewer main shall be six (6’) feet, outside to outside. The minimum vertical clearance shall meet MAG Standard Detail 404-1 and 404-2. When extra protection is required, and the sewer line is constructed of PVC, the water main shall be constructed of Class 350 (CL350) DIP with restrained joints and the sewer shall be concrete encased per MAG Standard Detail 404-3.

- C. When extra protection is required, and the sewer line is constructed of VCP, the water main shall be constructed of Class 350 (CL350) DIP with restrained joints and the sewer shall be replaced with epoxy coated CL350 DIP with restrained joints.
- D. Sanitary sewer mains shall have a minimum of ten (10’) feet of horizontal clearance from any structure, including but not limited to footings, landscaping, or plantings, which will obstruct maintenance access to the sewer main. Design shall consider any structural load imposed on the pipe.
- E. Separation from other utilities shall be in accordance with QCSD 402Q.
- F. Sanitary sewer mains crossing less than one (1’) foot below a stormdrain culvert shall require the additional protection of controlled low strength material per MAG 728. Sanitary sewer mains crossing below large structures such as box culverts and bridges shall require casing pipe, be fully restrained, and have scour protection. Sanitary sewer mains crossing over stormdrains and culverts shall be a minimum of one (1’) foot above and be adequately protected from additional structural load that may be imposed on the sewer main.

5.9.8 WASH CROSSINGS

- A. All wash crossings shall be constructed using restrained joint epoxy coated, CL350 DIP or welded HDPE. Bury requirements to place sanitary sewer mains under washes or channels shall be based upon the one-hundred (100) year peak design discharge (Q100) in the channel or wash. The minimum depth of bury below the design flow line of the channel or wash shall be in accordance with [Table 5-7](#), unless site-specific geotechnical and hydraulic analyses are performed to document any reduction.

**TABLE 5-7
BURY REQUIREMENTS FOR WASHES**

100-Year Flow Rate	Minimum Depth of Bury
1 to 49 cfs	5 feet
50 to 99 cfs	6 feet
100 to 499 cfs	7 feet
Greater than 499 cfs	Scour depth based on scour analysis required

- B. Wash crossings with a one-hundred (100) year flow above five-hundred (500) cfs, shall have the scour depth estimated using Arizona State Standard Attachment SSA 5-96, Guideline 2, Level I, as published by the Arizona Department of Water Resources. The engineer shall estimate the depth of scour and

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design the top of pipe to be three (3') feet below the estimated scour depth. The engineer shall provide a detailed analysis of the scour depth with final plans for review and approval.

- C. All pipelines that must be located within the scour zone or do not meet the minimum required depth of bury as indicated above, shall be protected by installing a cut-off wall and energy dissipation downstream of the pipeline to stabilize the scour depth to a minimum of three (3') feet above the pipeline. The engineer shall design the cut-off wall, energy dissipation, and include details on the improvement plans. The City/Town Engineer shall review pipe protection and scour stabilization requirements on an individual project basis.

5.9.9 GRAVITY SANITARY SEWER SERVICE CONNECTIONS

- A. The engineer shall make every effort to use existing sanitary sewer service connections that have been extended to a property through a "stub out" by previous construction. Where the use of a stub out is not feasible, the existing line shall be abandoned at the sanitary sewer main with the appropriate method and materials as approved by the Agency. Service connections shall not be allowed directly into a manhole.

- B. Minimum diameter for a service connection shall be four (4") inch inside diameter.

- C. All service line connections shall be installed perpendicular to the sanitary sewer main in accordance with QCSDs 440P-1 and 440P-2 for the COP and 440PV-1 and 440PV-2 for the TOPV. In addition, service line connections shall be extended to the back of the ROW or public utility easement. No horizontal bends in the service line shall be allowed.

D. Location

- 1. All proposed service line connections shall be shown on the final plans with stations and dimensions or offsets, from sewer centerline.

- a. Each lot or building shall be provided with its own individual service line unless exempt under Agency Code.

PCC, Title 2, Chapter 2-1-15
TOPV Town Code Article 9-05-060

- b. Future lot splitting shall require a separate service line connection for each lot created.

- 2. The service line location shall be coordinated to avoid conflicts with other utilities and driveway locations. Locations shall be on the lower elevation side of the lot, whenever possible.

- 3. A two (2') foot minimum separation between service taps shall be required.

- 4. Sanitary sewer lines shall be designed to allow the sanitary sewer service lines to pass under water mains with twenty-four (24") inches of vertical clearance to minimize potential health hazards.

- 5. When minimum separation is not possible or the sanitary sewer service line passes over the water main, the sanitary sewer service line shall be DIP for a minimum of nine (9') feet on each side of the water main. No joints shall be allowed within nine (9') feet of the water main.

- 6. All sewer services that have wash crossings shall meet the requirements of Section 5.9.9.

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7. All sewer service laterals shall have a sewer backwater valve installed per the most recently adopted International Plumbing Code (IPC) and in accordance with QCSD 440P-3 per the COP and 440PV-2 per the TOPV.
 8. Water and sewer service laterals shall not be installed in the same trench. A minimum six (6') foot horizontal separation shall be maintained.
- E. Sanitary sewer service connections shall be located a minimum of four (4') feet away from a manhole or four (4') feet from the bottom bend of a main line cleanout.

5.9.10 PRESSURIZED SANITARY SEWER SERVICE CONNECTIONS

- A. Pressurized sanitary sewer ejector systems shall be owned, operated and maintained by the property owner. The EOR shall be responsible for the design and hydraulic analysis of the pressurized system.
- B. The sanitary sewer service constructed within the ROW shall be per QCSDs 440P-1 or 440P-2, as applicable. Connection to the gravity service shall be at the cleanout connection located at the ROW or easement line.
- C. Extending private ejector lines across the frontages of adjacent lots or properties or parallel within ROW is prohibited except where it is not feasible to extend the Agency main due to controlling grades. Any such ejector line shall be placed within a private easement shown on the plat or lot split survey. The developer shall extend the Agency main to provide frontage to the maximum extent possible.

5.9.11 GREASE, OIL AND SAND INTERCEPTORS

- A. The installation of interceptors shall be in accordance with Agency Code.

PCC, Title 2, Chapter 2-1-46 2
TOPV Town Code Article 9-05-090
- B. Grease interceptors shall be installed for all FSFs. Oil and sand interceptors shall be provided for VSFs, laundry facilities, car washes, and other similar facilities. The EOR shall contact the City/Town Engineer to determine if an interceptor is required, and what type and size of interceptor is best suited for the proper handling of the projected waste streams. Interceptors shall be installed to be accessible to Utilities Operation staff and vehicles during operating hours.
- C. Each business, restaurant, or establishment shall discharge to a separate interceptor. Each interceptor shall be shown to scale and stationed on the plans.
- D. The EOR shall coordinate with the mechanical engineer to ensure the following are considered in the design of grease interceptors:
 1. Design shall be compliant with the IPC as adopted by Agency Code and approved by the City/Town Engineer.

PCC, Title 2, Chapter 2-1-45-1-E
TOPV Town Code Article 9-05
 2. Tank size shall be appropriate to the maximum projected flow from the establishment and anticipates a ninety (90) day maintenance schedule.

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3. Design shall consider the potential to develop odors.
4. Design shall provide separation from pedestrian areas or corridors.
5. Design shall avoid locating grease interceptor in parking garages, streets, and under public parking spaces.
6. Design shall provide for ease of cleanup after maintenance and pumping.
7. Kitchen garbage grinders shall not be installed.
8. Dishwashing equipment shall not be installed as to cause temperatures in the grease interceptor to inhibit separation of fats, oil, and grease in the interceptor.
9. Grease traps shall only be allowed in lieu of a grease interceptor in very small FSFs.
10. Interceptors shall be traffic rated and constructed of steel reinforced pre-cast concrete or other approved rigid corrosion resistant material.

5.9.12 EASEMENT, TRACT AND RIGHT-OF-WAY (ROW) REQUIREMENTS

Easements shall only be used for sewer mains in areas where parcels are already platted or a subdivision already exists. Easements are not intended and shall not be used in new platted subdivisions.

A. Easement Requirements:

1. Any public sewer main or appurtenance that is not located within the ROW or a tract with easement dedication shall be placed within an appropriately designated easement.
2. The sewer main shall be centered in the easement and shall be located a minimum of ten (10') feet from the edge of the easement. The minimum easement width shall be twenty (20') feet. Sewer mains shall not have more than eight (8') feet of cover in a twenty (20') foot easement. Sewer mains with more than eight (8') feet of cover shall require additional easement.
3. In an easement that contains both a water main and a sewer main, the minimum easement width shall be thirty (30') feet. Additional utilities may require additional width.
4. Sanitary sewer main easements located outside of paved areas shall have a twelve (12') foot wide all weather access road per QCSD 612Q.
5. Fences shall be prohibited within easements containing sanitary sewer. Lateral crossings may be permitted with Agency approval.
6. Easements that contain a sewer main shall be free of obstructions at all times. Items that could restrict the access of sewer service equipment such as trucks, backhoes, CCTV vans, pump hoses, etc. shall not be allowed. Easement lines run vertically above and below the ground surface. Overhangs and building foundations, including footings, shall not protrude into the easement.

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7. No trees, shrubs, or other permanent plantings are allowed in easements that contain a sewer main. Lawns, flower beds, and gardens are acceptable uses of the easement area but may be damaged or removed by the Agency if necessary, with no compensation to the owner for restoration.
8. Excavation within any portion of an easement with a sewer main shall not be allowed without approval of the Agency. Excavating closer than two (2') feet vertically or horizontally to the pipeline shall be done by hand until the pipe is exposed and shall be done only under observation of an authorized Agency representative.
9. Grading within any portion of an easement with a water main shall not be allowed without a grading permit.
10. Fence posts shall not be installed within five (5') feet of the center of the pipeline, and the first post on either side of the pipe shall be set in hand dug holes.
11. No well drilling, septic drain fields, septic tanks, or septic treatment facilities are permitted in the easement area.
12. All other restrictions outlined in each specific easement document shall be applicable to each specific easement.

B. Tract Requirements:

1. Any public sewer main or appurtenance located in a tract shall have the tract dedicated to the Agency as either a public utility easement or sewer easement at the time of the plat.
2. The minimum tract width shall be twenty (20') feet if used for one utility and a minimum of thirty (30') feet if used for two (2) utilities. Additional utilities may require additional width. The sewer main shall be located a minimum of ten (10') feet from the edge of the easement. Sewer mains shall not have more than eight (8') feet of cover in a twenty (20') foot easement. Sewer mains with more than eight (8') feet of cover shall require additional easement area.
3. Tracts that contain a sewer main shall not be walled or fenced in or over. Providing a gate over or a single chain with Agency access shall not be allowed unless approved by Agency.
4. Tracts that contain a sewer main shall be free of obstructions at all times. Items that could restrict the access of sewer service equipment such as trucks, backhoes, CCTV vans, pump hoses, equipment trailers, etc. shall not be allowed.
5. Trees and large shrubs shall be allowed in tracts that contain a sewer main but shall not be allowed within ten (10') feet of a sewer main that has less than eight (8') feet of cover and shall not be allowed within a distance equal to the depth of cover for sewer mains over eight (8') feet of cover.
6. Tracts located outside of paved areas shall have a twelve (12') foot wide all-weather access road per QCSD 612Q.
7. Excavation and/or grading shall be allowed in tracts that contain a sewer main but shall not be allowed within ten (10') feet of a sewer main that has less than eight (8') feet of cover and shall not

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be allowed within a distance equal to the depth of cover for sewer mains over eight (8') feet of cover.

C. Right-of-Way (ROW) Requirements:

1. Sewer mains or appurtenance shall be located in the ROW when possible.
2. Sewer mains with less than eight (8') feet of cover shall be a minimum of ten (10') feet from the edge of the ROW and placed per QCSDs 601Q through 606Q.
3. Sewer mains with more than eight (8') feet of cover shall require additional separation from the edge of the ROW.
4. Trees and large shrubs shall be allowed in ROWs that contain a sewer main but shall not be allowed within ten (10') foot of a sewer main that has less than eight (8') feet of cover and shall not be allowed within a distance equal to the depth of cover for sewer mains over eight (8') feet of cover.
5. Excavation and grading shall be allowed in the ROW with a right-of-way permit.

5.9.13 EASEMENT ABANDONMENT REQUIREMENTS

When a property owner or developer believes a sanitary sewer easement or portion thereof is no longer required by the Agency, abandonment may be requested through the City/Town Engineer. The owner or developer shall submit the request in writing with detailed documentation identifying specifically the reasons for abandonment. The Agency shall make the final decision based upon its long-term needs.

5.9.14 ALTERNATIVE SANITARY SEWER SYSTEMS

Developers or property owners may request that the City/Town Engineer consider the use of alternative wastewater systems upon the EOR's determination that conventional gravity or forced sanitary sewer systems cannot provide service to the development without conflicting with other provisions of these standards.

ARTICLE 6 TRANSPORTATION AND TRAFFIC

SECTION 6.1 INTRODUCTION

6.1.1 PURPOSE

The purpose of this Article is to provide transportation and traffic engineering standards, guidelines, and geometric requirements for the design and construction of both public and private project improvements within the City of Prescott (COP), Town of Prescott Valley (TOPV), and Town of Chino Valley (TOCV). This Article is complimentary to the Quad City Standard Details (QCSD), Prescott City Code (PCC): Title 2, Chapter 1 Public Works Department, Title 10 Land Development Code (LDC), and Title 16 Street and Utility and Drainage Requirements, and all other Articles of these Quad City General Engineering Standards (GES) and the Town of Prescott Valley Town Code, specifically Chapter 11 – Traffic and Chapter 16 – Engineering.

6.1.2 APPLICABILITY

The standards and guidelines of this Article shall apply to the construction, modification, replacement, and extension of all transportation and traffic facilities including arterial, collector, local and rural streets, alleys, traffic signals, roundabouts, medians, street lighting, street signing, pavement markings, public transit, pedestrian facilities, bicycle facilities, traffic calming devices, pedestrian trails, and other traffic related facilities as well as any modifications of a roadway to be owned, and maintained, by the City of Prescott, Town of Prescott Valley, or Town of Chino Valley (Agency). This Article is intended for use in plan design, preparation, and review processes. The information provided in this Article is not intended to cover all situations that arise, nor may it be a substitute for sound engineering principles and judgment.

6.1.3 DESIGN STANDARDS AND GUIDELINES

This Article, and GES, Article 1, refer to design standards and guidelines contained in reference manuals published by various federal, state, and county government agencies, as well as recognized professional organizations. The most recently adopted editions of these design standards and guidelines are approved references and shall be used in conjunction with this Article.

- A. The American Association of State Highway and Transportation Officials Policies on Highway Design, Development of Bicycle Facilities, Roadside Design Guide, and Guide for the Planning, Design and Operation of Pedestrian Facilities (AASHTO).
- B. The Manual on Uniform Traffic Control Devices, prepared by the U.S. Department of transportation (MUTCD).
- C. City of Prescott, Town of Prescott Valley, or Town of Chino Valley (Agency).
- D. City of Prescott (COP).
- E. Town of Prescott Valley (TOPV).
- F. The Maricopa Association of Governments Uniform Standard, Specifications and Details for Public Works Construction (MAG).
- G. Arizona Department of Transportation Manual of Approved Signs (ADOT).

- H. Institute of Transportation Engineers Trip Generation.
- I. Transportation Research Board Highway Capacity Manual (ITE).

SECTION 6.2 PLANNING

6.2.1 TRAFFIC IMPACT ANALYSIS

Traffic Impact Analysis (TIA) shall be required for proposed developments, or additions to existing developments, that generate more than one-hundred (100) vehicle trips during the morning or afternoon peak hour period. In addition, the City/Town Engineer may require a TIA when changes in land use, traffic, and roadways occur, such as proposed property rezoning, when the original TIA is more than two (2) years old or where the projected traffic volumes increase by more than ten (10%) percent. The City/Town Engineer shall make the final determination regarding TIA requirements and the applicable category. The TIA shall be in a format as described in Agency guidelines; COP Land Development Code (LDC) Section 6.14 and TOPV Town Code Chapter 16. The TIA shall be prepared under the direction of a Professional Engineer (Civil) licensed to practice in the State of Arizona and qualified to prepare TIA reports. There shall be no deviation from these requirements.

6.2.2 ROADWAY CLASSIFICATION

The Agency has six (6) street classifications relating to land development. The location and street classification is determined as part of the site planning and platting process and shall be in conformance to the most recent COP Street Classification Map available on the COP's website at https://www.prescott-az.gov/wp-content/uploads/2016/05/street_classification_2019.pdf. The Agency shall review each subdivision plat or new development and shall specify any changes needed to conform to previously planned and approved street alignments or impacts to existing infrastructure. The City/Town Engineer shall also specify the classification for each street involved in the subdivision plat. Refer to QCSDs 601Q-606Q for street typical sections. All land development shall provide for streets in accordance with PCC, the LDC and any other planning documents at their normal alignments, widths, and geometrics, as determined by the City/Town Engineer.

A. Major Arterial (7-Lane)

Facilitate relatively long trip lengths at high (45 MPH) posted speeds with limited access to adjacent properties. Major Arterials serve major centers of activity in urban areas and have the highest traffic volume corridors. These streets are often major gateways to the community.

B. Minor Arterial (5-Lane)

Provide somewhat shorter trip lengths than Major Arterials, interconnected with and augment Major Arterial routes at moderate (35-40 MPH) posted speeds, and allow somewhat greater access to adjacent properties than Major Arterials.

C. Commercial/Industrial Collectors

Collect, distribute, and provide direct access to commercial and industrial properties. The Commercial/Industrial Collector street usually has lower volumes, moderate (30-35 MPH) posted speeds, trip lengths and minimal through traffic, but may experience a proportionally high percentage of truck traffic.

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D. Residential Collector

Collect and distribute moderate amounts of traffic between arterials and local streets at relatively low (25-30 MPH) posted speeds with greater accessibility than major collectors.

E. Local Residential

Provide direct access to abutting properties. Local Residential streets possess relatively low volumes, posted speeds (25 MPH), trip lengths and minimal through traffic movements. Local streets shall be arranged to discourage their use by traffic originating outside the immediate area.

F. Rural Local Residential

Provide direct access to rural abutting properties. Shares many of the properties of Local Residential streets but allows a rural option without curb and gutter and sidewalk.

6.2.3 ROADWAY RIGHT-OF-WAY (ROW) REQUIREMENTS

- A. The public right-of-way (ROW) requirements shall be based upon recommendations of the Agency's General Plan circulation element, Street Classification Map, Airport Area Transportation Plan, and the most recently adopted edition of the Central Yavapai Metropolitan Planning Organization (CYMPO) Regional Transportation Plan; and the ultimate needs of the development. The dedicated ROW shall provide sufficient area for the installation of utilities, cut and fill of slopes, drainage, postal gang boxes, sidewalks and multi-use paths, traffic control devices, access management devices (medians), signs, fire hydrants, landscaping, auxiliary turn lanes, transit facilities and other facilities that may be located adjacent to street corridors. The minimum ROW requirements are provided in QCSDs [601Q-606Q](#) and in [Table 6-1](#):

**TABLE 6-1
STREET RIGHT-OF-WAY REQUIREMENTS**

Classification	Minimum Right-of-Way (1)	Parking	Lanes	QCSD
Major Arterial	130'	None	7 (2)	606Q
Minor Arterial	110'	None	5 (2)	605Q
Comm/Ind Collector	70'	None	3 (2)	604Q
Residential Collector	60'	2 sides	2	603Q
Local Residential	50'	1 side	2	602Q
Rural Local Residential	50'	None	2	601Q

(1) Additional right-of-way may be required in special circumstances. These may include the need for auxiliary traffic lanes, to facilitate transit facilities, offsets and/or roadways shifts.

(2) Shared turn lane/median provided

6.2.4 INTERSECTION SIGHT VISIBILITY TRIANGLE EASEMENTS

Sight visibility triangle easements shall be used as a means to limit the height of structures, vegetation, and other improvements on the portion of property and/or ROW immediately adjacent to intersections, alleys and driveways. However, these minimum sight visibility triangle easements shall not preclude the design engineer from calculating any additional ROW or easements needed for sight visibility per QCSD 611Q. COP projects shall adhere to [Section 6.3.10](#) and [Table 6.3.9](#) of the LDC sets forth the minimum required corner easements by intersection type.

6.2.5 SUBDIVISION STREET PLANNING

The planning of subdivision streets shall discourage through traffic.

A. Street Location and Arrangement

1. Street layout shall provide for the continuation of arterial and collector streets in adjacent areas, and shall conform to a standard grid system, when possible. In certain cases, paved street sections are required beyond the subdivision boundary to provide connectivity to the nearest Agency maintained and paved street. COP projects shall also adhere to Section 7.4.3 B of the LDC.
2. Other classifications shall be required to follow a circulating system as well.
3. Certain proposed streets, as designated by the COP's Classification Map, shall be extended to the sub-division boundary to provide future connection with adjoining un-platted lands. In general, these extensions shall not be farther apart than the maximum permitted length of a block. COP projects shall also adhere to Section 7.4.5 A of the LDC.
4. Arrangement of local streets alignments shall discourage their use as through routes by traffic originating outside the immediate area.

B. Partial Street Improvements

1. When a street is required adjacent to, and parallel with, two subdivision boundaries, the first subdivision to develop shall complete all required improvements. The first subdivision shall submit civil improvement plans to include, in dashed lines, the half street, which will be constructed in the future, and be responsible for the construction of full improvements, at a minimum from their boundary to centerline with the required AC structural section paved width no less than twenty-four (24') feet. Additionally, they shall be required to construct sidewalk, curb and gutter along their development frontage. (Dependent on ROW width, circulation requirements and length of street, the first sub-divider may be required to construct beyond centerline).
2. Half-street improvements shall be constructed with a thickened edge per QCSD 201Q.
3. For all projects, a full street cross-section is required for interior streets and a complete half-street cross-section for perimeter streets if the street centerline is the project's boundary line.
4. The half-street is to be designed to match existing or future construction as much as possible unless doing so is likely to create an unsatisfactory condition as determined by the City/Town Engineer. If changes are needed to correct conditions on an existing half-street to construct the other half of the street, the solutions must be developed in coordination with the City/Town Engineer on an individual project basis. The plans for the new half-street must contain sufficient information on the profile and cross-sections of the existing street to demonstrate that the new construction will match the old construction and result in a full street with proper cross-sections.
5. In lieu of half-street design terminating at the roadway centerline, the City/Town Engineer may specify that partial street improvements be constructed centered about the roadway to be widened symmetrically by later phases or developments. This may include constructing center medians in the initial phase of construction.

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C. Subdivision Blocks

Block lengths, widths and shapes of blocks shall be determined with due regard to:

1. Provision of sites suitable to the type of use contemplated.
2. Zoning requirements, related to lot sizes and dimensions.
3. Need for convenient access, circulation, control and safety of street and pedestrian traffic.
4. Limitations and opportunities of topography.
5. Circulation within the subdivision, and access to the community facilities.
6. Emergency vehicle access and circulation.
7. Lengths as short as practicable, not to exceed one-thousand two-hundred (1,200') feet, measured along the centerline of street and between intersecting street centerlines.
8. Cul-de-sac lengths less than one-thousand three-hundred (1,300') feet in length.

D. Traffic Calming

Traffic calming measures can be implemented in accordance with Agency policy, as part of new communities, or retrofitted into existing neighborhoods. In the COP, the Council adopted Traffic Calming Policy is available on the COP's website at [COP Traffic Calming Policy](#) or at the COP's Public Works Department. If a community design calls for traffic calming elements, as required by PCC, the City/Town Engineer shall work with the project engineer on suggestions and guidance for acceptable treatments. Traffic calming measures can vary depending on the specific application and can include medians, traffic circles, roundabouts, speed humps per QCSD 210Q, raised crosswalks/intersections, chicanes, and street narrowing. The City/Town Engineer must approve the use of traffic calming measures within the Agency ROW.

SECTION 6.3 HORIZONTAL ALIGNMENT

A horizontal curve is required when the angle of change in horizontal alignment is equal to or greater than zero point five (0.5°) degrees. The nature of the surrounding development and topography, and the street classification will establish the factors that determine the radius of the curve for small deflection angles.

6.3.1 MINIMUM CURVE RADIUS

A. The minimum radius of curvature is determined by the design speed or by the stopping distance unless otherwise approved by the City/Town Engineer.

B. Minimum Radii Based on Design Speed:

[Table 6-2](#) contains the minimum radius of curvature for each street classification with and without a super elevation of two-percent (2% or 0.02 ft/ft) as derived from Exhibit 3-40 in Chapter 3 of the AASHTO "Green Book." Wherever possible, the radii used should be larger than that specified. If stopping sight distance conditions require a larger radius than that shown, then that larger radius becomes the minimum radius for the curve.

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**TABLE 6-2
MINIMUM HORIZONTAL CURVE RADIUS**

	Major Arterial	Minor Arterial	Comm/Ind Collector	Residential Collector	Local Residential	Rural Local Residential
Minimum Radius of Horizontal Curve W/O Super Elevation	1000'	600'	450'	320'	205'	135'
Minimum Radius of Horizontal Curve with 2% Super Elevation	800'	500'	375'	270'	150'	100'
Minimum Horizontal Curve Length	500'	400'	200'	150'	100'	80'
Stopping Sight Distance	495'	425'	305'	250'	200'	155'
Design Speed (MPH)	55	50	40	35	30	25
Posted Speed (MPH)	45	45-35	35-30	30-25	25	25

C. Stopping Sight Distance

When walls, buildings, bridge piers, cut slopes, vegetation, or other obstructions are near the roadway on the inside of a curve, they can block a driver's view of the road ahead. If they are too close, the driver will not have sufficient distance along the curved roadway to stop when a hazardous condition comes into view. For design purposes, the driver's eye is assumed to be three and one-half (3½') feet above the center of the inside lane (the driving lane closest to the inside of the curve) and a hazardous condition is assumed to be an object two (2') feet high in the center of the inside lane, or most recent accepted AASHTO standards. The clear distance is measured from the center of the inside lane to the view obstruction. All designs shall ensure that sufficient sight distance exists. Refer to [Table 6-3](#) for the minimum stopping sight distances for various street classifications.

**TABLE 6-3
MINIMUM STOPPING SIGHT DISTANCE**

Street Classification	Design Speed (MPH)	Stopping Sight Distance
Major Arterial	55	495'
Minor Arterial	50	425'
Comm/Ind Collector	40	305'
Residential Collector	35	250'
Local Residential	30	200'
Rural Local Residential	25	155'

6.3.2 SUPER ELEVATION IN CURVES

Super elevation may be used in conjunction with the minimum radius on horizontal curves to provide improved comfort for the road user. Additionally super elevation of two percent (2%) may be used when the minimum radius cannot be provided due to circumstances beyond the control of the City/Town Engineer, such as when the general alignment cannot be changed, if approved by the Agency. Super elevation greater than four percent (4%) shall not be used.

- A. Run-out and Run-off: For super elevation transitions, refer to the AASHTO publication, "A Policy on Geometric Design of Highways and Streets."

- B. Stormdrain Requirement: Whenever super elevation is allowed a storm drainage system to collect the runoff along the median curb shall be provided to ensure that nuisance water from the higher traveled way is not allowed to cross the lower traveled way.

6.3.3 COMPOUND CURVES

- A. Compound curves (two curves with different radii in same direction) shall be avoided unless approved by the City/Town Engineer.
- B. If approved, the shorter radius of the compound curve shall be at least two-thirds ($\frac{2}{3}$) the length of the longer radius when the shorter radius is one-thousand (1,000') feet or less. Compound curves are not permitted when design speeds require the shorter radius to be greater than one-thousand (1,000') feet.

6.3.4 SPECIAL TANGENT SECTIONS BETWEEN CURVES IN THE SAME DIRECTION

- A. On two-lane roads, tangent sections should be provided between two curves in the same direction. If the pavement cross-sections throughout the curves do not have super elevation, then the minimum lengths for tangent sections are per [Table 6-4](#).

**TABLE 6-4
TANGENT SECTIONS
(Curves in Same Direction)**

Design Speed Roadway Type	Minimum Tangent Section (ft)
40 MPH Commercial/Industrial Collector	300'
35 MPH Residential Collector	200'
30 MPH Local Residential	150'
25 MPH Rural/Local Residential	100'

- B. If super elevation is provided in the curved portions of the roadway, then the super elevation transition lengths per AASHTO will determine the tangent lengths.
- C. The City/Town Engineer may approve the elimination of the tangent section between curves in the same direction on an individual project basis, when justified by terrain challenges or special topographic constraint.

6.3.5 TANGENT SECTIONS BETWEEN REVERSE CURVES

- A. Tangent section should be provided between two curves that curve in the opposite direction. Abrupt reversals in alignment should be avoided when possible. The distance between reverse curves should be at least the sum of the super elevation run out length and the tangent run out lengths. The required minimum lengths for tangent sections between reverse curves without super elevation are provided in [Table 6-5](#):

**TABLE 6-5
MINIMUM TANGENT SECTIONS
(Reverse Curves)**

Street Classification	Minimum Tangent Section (ft)
Major Arterial	300'
Minor Arterial	300'
Comm/Ind Collector	200'
Residential Commercial	200'
Local Residential	100'

B. The City/Town Engineer may approve the elimination of the tangent section between reverse curves on an individual project basis when justified by terrain challenges or special topographic constraint.

6.3.6 TANGENT SECTIONS APPROACHING INTERSECTIONS

A tangent section shall be provided between a street intersection and a curve unless otherwise approved by the City/Town Engineer. The minimum tangent length is shown in [Table 6-6](#).

**TABLE 6-6
TANGENT SECTIONS AT INTERSECTIONS**

Street Classification	Minimum Tangent Section (ft)
Major Arterial	200'
Minor Arterial	200'
Comm/Ind Collector	150'
Residential Collector	100'
Local Residential	50'
Rural Local Residential	50'

SECTION 6.4 VERTICAL ALIGNMENT

Vertical curves shall be designed to provide adequate sight distance, public safety and effective street drainage. Refer to AASHTO for sight distance requirements.

6.4.1 VERTICAL CURVES

All straight grades, which deflect by more than one (1%) percent must be joined by a parabolic vertical curve. The length shall be determined using the current AASHTO “A Policy on Geometric Design of Highways and Streets.” The minimum vertical curve length for a given design speed is determined as the greater of the value in the ‘Minimum Length’ column in [Table 6-7](#), Minimum Vertical Curve Length or the length calculated from the ‘Rate of Vertical Curvature’ column by the formula:

$$L = K \times A \text{ where:}$$

L = minimum curve length (ft)
 K = rate of vertical curvature (ft/%)
 A = algebraic difference in grades (%)

**TABLE 6-7
VERTICAL CURVES REQUIREMENTS**

Design Speed (mph)	Minimum Length (Ft.)	Rate of Vertical Curvature K (ft. per % grade change) (Crest)	Rate of Vertical Curvature K (ft. per % grade change) (Sag)
20	60	7	17
25	75	12	26
30	90	19	37
35	105	29	49
40	120	44	64
45	135	61	79
50	150	84	96
55	165	114	115

In all cases, every section of a street’s vertical alignment must meet passing and stopping sight distance requirements for the design speed established for the street.

6.4.2 HORIZONTAL AND VERTICAL CURVES

When horizontal and vertical curves are combined, the horizontal curve should lead or follow the vertical curve, and not be introduced near the top of a crest vertical curve or near the bottom of a sag vertical curve.

6.4.3 LONGITUDINAL STREET GRADES

The maximum longitudinal street grade requirements are per [Table 6-8](#).

**TABLE 6-8
LONGITUDINAL STREET GRADE**

Street Classification	Maximum	Minimum
Major Arterial	6%	0.50%
Minor Arterial	6%	0.50%
Comm/Ind Collector	8%	0.50%
Residential Collector	8%	0.50%
Local Residential	12%	0.50%
Rural Local Residential	12%	0.50%

6.4.4 SPEED LIMITS

Setting Speed Limits

- A. On new roadway construction, speed limits are typically set within the following range as in [Table 6-9](#):

**TABLE 6-9
SETTING SPEED LIMITS**

Rural Local Residential	25 mph
Local Residential	25 mph
Residential Collector	25 – 30 mph
Comm/Ind Collector	30 – 35 mph
Minor Arterial	35 – 45 mph
Major Arterial	45 mph

- B. A reduction in speed limit shall not normally be considered due to topographic, alignment or grade issues that can be resolved through traditional grading or construction techniques.
- C. Final posted speed limits shall be approved by the City/Town Engineer.

6.4.5 STREET INTERSECTION SPACING

Separation of street intersections shall be designed to enhance safe ingress and egress, promote traffic circulation on the roadway system, and conform to the standards noted in [Table 6-10](#). The following schedule shall serve as a guide for allowable street intersection spacing unless otherwise justified by a TIA and approved by the City/Town Engineer.

A. Street Intersections Spacing on State Highways and Major Arterials:

A minimum one-half (1/2) mile spacing shall be required for all full access, signalized or roundabout controlled street intersections in all cases, except where subject to a highway access management plan or as otherwise approved by the Agency. Recorded easements for shared access, provision of acceleration/deceleration lanes, traffic signals and other ROW improvements, may be required prior to approval.

B. Street Intersection Spacing on Minor Arterials:

A minimum, one-quarter (1/4) mile spacing shall be required for all full access, signalized or roundabout controlled street intersections in all cases. Recorded easements for shared access may be required prior to approval for adjoining parcels.

C. Street Intersection Spacing on Commercial/Industrial Collectors and Residential Collectors:

Street Intersection Spacing on Residential Collectors shall be spaced between one-quarter (1/4) mile and six-hundred sixty (660') feet and is subject to the approval of the City/Town Engineer.

D. Street Intersection Spacing on Local Residential and Rural Local Residential Streets:

Street Intersection Spacing on Local Residential and Rural Local Residential Streets shall be spaced between six-hundred sixty (660') feet and two-hundred fifty (250') feet.

**TABLE 6-10
STREET INTERSECTION AND CURB CUT SEPARATION**

Street Classification	Minimum Street Spacing
State Highway & Major Arterial	½ Mile
Minor Arterial	¼ Mile
Comm/Ind And Residential Collector	¼ Mile to 660' feet
Local and Rural Local Residential Streets	660' to 250' feet

6.4.6 AUXILIARY TRAFFIC LANES

Auxiliary turning lanes permit the separation of conflicting traffic movements and remove vehicles from the flow of through traffic. Auxiliary lanes apply to both right and left turn lanes at street intersections and for deceleration lanes at mid-block driveways. The requirements for an auxiliary lane may necessitate additional ROW in addition to the standard sections. Determination of the need for any auxiliary turn lane shall normally be made using the TIA process, or when determined by the City/Town Engineer.

A. General Auxiliary Lane Design Considerations

1. Lane width: Auxiliary lanes shall be at least twelve (12') feet wide for new construction. For modifications to an existing roadway, auxiliary lanes may be ten (10') feet wide or as approved by the City/Town Engineer.
2. Lane length: The length of the auxiliary lanes for turning vehicles consists of two (2) components, entering taper and storage length.
 - a. Entering Taper

A taper rate of eight to one (8:1) (longitudinal: transverse) shall be used for roadways classified as Major Collectors and lower. Fifteen to one (15:1) (longitudinal: transverse) taper rate shall be used for roadways classified as Minor and Major Arterials. When these standards cannot be met, a standard taper length of ninety (90') feet for a single turn lane or and one-hundred fifty (150') feet for a dual turn lane may be considered for urban streets by the City/Town Engineer.

b. Storage Length

At signalized intersections, the storage length needed depends on the signal cycle length, the signal phasing arrangement, and the rate of arrivals and departures of left and right-turning vehicles. The storage length is a function of the probability of occurrence of events and shall usually be based on one and one-half (1 ½) to two (2) times the average number of vehicles that would store per cycle, which is predicated on the design volume. The storage length shall be sufficient to serve heavy surges that occur as determined by a TIA but no less than the lengths outlined in this section. Auxiliary lanes on streets with a design speed greater than 45 mph or signalized intersections shall be a minimum of one hundred and fifty (150') feet and at non signalized intersections shall be a minimum of one hundred (100') feet. A maximum storage of three-hundred (300') feet is allowed for a single left turn lane.

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B. Right-turn lanes

Dedicated right-turn lanes are required at all arterial intersections and may be required by the City/Town Engineer at other intersection and driveway locations as determined by a TIA. Right-turn lanes are required on roadways where right-turning vehicles create delays or safety problems for other traffic movements. The need for a right-turn lane at a site access intersection depends on the speed of traffic on the road, the volume of traffic turning right, and the through traffic volume in the same lane as the right-turning traffic. Right turn deceleration lanes shall be required based on [Table 6-11](#).

**TABLE 6-11
RIGHT-TURN LANE WARRANTS**

Peak Hour Traffic Volume on the Highway in Advancing Direction	Minimum Peak Hour Right-Turn Traffic Volume				
	# of thru lanes per direction				
	1		2 (Undivided)		3
	< 35 MPH Posted Speed	≥ 35 MPH Posted Speed	< 35 MPH Posted Speed	≥ 35 MPH Posted Speed	<u>All Speeds</u>
≤ 200					
201-300	-	30	-	-	-
301-400	-	19	-	55	-
401-500	85	14	-	30	-
501-600	58	12	140	25	-
601-700	27	9	80	18	-
701-800	20	8	53	15	-
801-900	12	7	40	12	-
901-1000	9	6	30	11	-
1001-1100	8	5	23	9	18
1101-1200	7	5	18	8	16
1201-1300	6	4	14	8	15
1301-1400	6	4	11	6	12
1400+	5	3	8	6	10

C. Left-Turn Lanes

Left-turn lanes are required at all Arterials and Commercial/Industrial Collector intersections. Left-turn lanes may also be required at street intersections on Residential Collectors and Local Residential streets based on projected left-turn volume and conflicting through volume, or other safety issues. Left-turn lanes are required on roadways where left-turning vehicles create delays or safety problems for other traffic movements. The need for a left-turn lane at a site access or intersection depends on the speed of

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traffic on the road, the volume of traffic turning left, and the through traffic volume in the same lane as the left-turning traffic. Left-turn lanes can be accommodated with a two-way left-turn lane on most collector streets at uncontrolled minor intersections. Dual left turn lanes should be considered when the turning volume exceeds three-hundred (300) vehicles per hour; or physical constraints signal timing or the TIA, indicates a need as determined by the City/Town Engineer. Left turn lanes shall be required based on [Table 6-12](#).

**TABLE 6-12
LEFT-TURN LANE WARRANTS**

Peak Hour Traffic Volume on the Highway in Advancing Direction	Minimum Peak Hour Left-Turn Traffic Volume			
	# of thru lanes per direction			
	1		2 (Undivided)*	
	< 35 MPH Posted Speed	≥ 35 MPH Posted Speed	< 35 MPH Posted Speed	≥ 35 MPH Posted Speed
≤ 200	30	15	-	-
201-300	12	12	40	30
301-400	12	12	30	25
401-500	12	12	25	18
501-600	12	12	15	12
601-1000	12	12	10	8
1000+	12	8	10	8

**On non-freeway divided highways, left-turn or U-turn lanes should be provided at median breaks.*

D. Acceleration Lanes

Acceleration lanes allow vehicles to make the necessary change between the speed of operation on a highway or street and the lower speed on the intersecting roadway. These lane types may be required on Arterials or State Highways as determined by the TIA and approved by the City/Town Engineer.

6.4.7 DRIVEWAY ACCESS GUIDELINES

To promote efficient traffic circulation, designers shall provide safe ingress and egress into their project while limiting the total number of driveways off the Agency's roadway system.

A. Driveway Spacing

Minimum commercial driveway spacing shall conform to the standards noted in [Table 6-13](#). This minimum spacing applies to proposed site driveway separation, as well as separation from existing or planned driveways on adjacent parcels and across the street. To provide safe turning movements from driveways, on streets without raised medians, new driveways shall align with existing driveways on the opposite side of the street. Corner parcels may be required to have all access from a side street as determined by the City/Town Engineer. A non-vehicular access easement (NVAE) may be required to restrict curb cuts to approved locations. Residential lots with more than one driveway shall have a twenty-five (25') foot minimum separation.

**TABLE 6-13
COMMERICAL DRIVEWAY SPACING**

Street Classification	Minimum Distance Driveway Spacing (Feet)
Controlled Access Facility	None
Limited Access Facility	As determined by TIA
State Highway & Major Arterial	300
Minor Arterial	200
Collectors & Local Streets	As determined by TIA or the City/Town Engineer

B. Driveway Number

[Table 6-14](#) and the following shall serve as a guide for allowable number of driveways on a site unless justified by a TIA. Safe driveway requirements per the above section shall be provided at a minimum.

1. At least one (1) driveway per abutting street shall be allowed unless physical constraints or otherwise directed by the City/Town Engineer.
2. One (1) additional driveway may be allowed for a site with continuous frontage of three-hundred (300') feet or more on a roadway classified as Minor Arterial or lower and four-hundred (400') feet or more on a Major Arterial or higher.
3. Two (2) additional driveways (three (3) total) may be allowed for a site with continuous frontage of more than six-hundred (600') feet or more on a roadway classified as Minor Arterial or lower and eight-hundred (800') feet or more on a Major Arterial or higher.
4. An additional service type driveway may be allowed for a site under the following conditions:
 - a. Continuous frontage of six-hundred (600') feet or more on a roadway classified as Minor Arterial or lower.
 - b. Continuous frontage of eight-hundred (800') feet or more on a Major Arterial or higher.
 - c. The site layout is such that the service driveway is unlikely to be used by customers of the businesses on the site and designed as such.
5. Shared access, internal connectivity and shared curb cuts between adjacent parcels may be required.
6. Driveway location must be evaluated with respect to the particular site layout and location. Variations may be permitted where a TIA, approved by the Agency, justifies a departure from these guidelines.

**TABLE 6-14
NUMBER OF DRIVEWAYS**

Street Classification	Street Frontage (feet)	Number of Driveways
Controlled Access Facility		None
Limited Access Facility	>1 Mile	As determined by TIA
State Highway & Major Arterial	> 800	3*
State Highway & Major Arterial	≥ 400 to 800	2
State Highway & Major Arterial	< 400	1
Minor Arterial & Comm/Ind Collector	>600	3*
Minor Arterial & Comm/Ind Collector	≥300 to 600	2
Minor Arterial & Comm/Ind Collector	< 300	1
Residential Collector & Local Streets	Any	1*

** Actual number to be determined through a TIA or by approval of the City/Town Engineer.*

C. Driveway Location Limitations

1. A new driveway shall not be allowed within twenty (20') feet of any commercial property line except when it is a joint use driveway, serving two (2) abutting commercial properties. Commercial driveways shall not be allowed within fifty (50') feet of the curb face extension of an intersecting local street, one-hundred and fifty (150') feet of an intersecting collector street, two-hundred (200') feet of an intersecting Minor Arterial, and three-hundred (300') feet of an intersecting Major Arterial or as determined by a TIA with approval by the City/Town Engineer.
2. Residential driveways shall not be allowed within fifty (50') feet of the curb face extension of an intersecting street. Driveway extensions in the ROW shall not cross the projection of the property line.
3. Opposing commercial/industrial driveways shall be aligned. Offset shall be within six (6') feet centerline to centerline. On streets with no median where access points cannot be aligned, the minimum offset shall be one hundred, seventy-five (175') feet centerline to centerline.

D. Right-In Right-Out Design

When a right-in-right-out design is required by the Agency, the design engineer shall refer to QCSD 650Q-1 and 650Q-2 for specific design requirements.

6.4.8 MEDIAN DESIGN

In the interest of public safety, traffic management and street aesthetics, medians are used to separate traffic flow, channelize left turns, control access and reduce conflicts.

A. Raised Median

1. Storage Lane Lengths and Tapers: Refer to GES, [Section 6.4.6](#) “Auxiliary Traffic Lanes” for minimum specific dimensions, unless the TIA results or the City/Town Engineer demonstrates longer lengths are required.
2. Median curb type: Refer to GES, [Section 6.6.3](#) “Median Curb” for requirements.

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3. Termination: Medians shall terminate in a bull nose per MAG Standard Detail 223.
4. Full access median openings consist of right-in and right-out and left-in and left-out turning movements. Full access median openings may be required to be signalized.
5. Partial access median openings consist of right-in/right-out and left ingress only while prohibiting left egress. Partial openings allow fewer traffic conflicts and create a lower potential for collisions.
6. Spacing for median openings is measured from the center of the median opening to the center of the adjacent median opening or intersection.
7. All medians shall be signed per the MUTCD guidelines. The beginning of each median where none exists prior, are to be signed.

B. Median Openings

Raised medians on Arterial streets are provided to reduce conflicts, channelize movements for safety, and improve traffic flow. It is not possible to provide an opening in the median for every driveway. Careful consideration shall be given to each request for a median opening to ensure that the safety and the intent of the median is not compromised by a proliferation of median cuts. The preference for access along arterial streets is to have full access median openings that align at not less than one-quarter (1/4) mile intervals. The design engineer shall line up full access openings in compliance with the street system planned for the arterial corridor. Full access openings shall occur at the mile, one-half (1/2) mile, and one-quarter (1/4) mile interval. The preference for access at less than one-quarter (1/4) mile spacing is to have a partial access median opening; however, these openings are subject to such parameters as safety of operation, flow of traffic requirements for storage, and feasibility of geometrics. These parameters shall be addressed in a TIA when requesting a partial access opening. All median openings shall be prohibited within six-hundred sixty (660') feet of an arterial-to-arterial intersection. The applicant shall be required to submit a TIA that also demonstrates the following:

1. The full access opening is spaced safely and shall not conflict with the planned grid system for the corridor.
2. The full access opening shall allow for safe operation.
3. The full access opening shall not compromise storage requirements.
4. The full access opening shall not compromise safety for all other turning movements.
5. The full access opening shall not significantly affect the flow of traffic on the arterial.
6. The full access opening shall not negatively affect access to future property development.

SECTION 6.5 EASEMENTS AND DEDICATIONS

6.5.1 PUBLIC UTILITY EASEMENT (PUE)

A minimum of ten (10') feet wide, Public Utility Easement (PUE) shall be located adjacent to each side of the dedicated street ROW. PUE may not be located within the side or back property lines without the

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approval of the City/Town Engineer. Landscaping installed in a PUE shall be of the shallow root, and non-intrusive variety, and shall be maintained by the property owner.

6.5.2 NON-VEHICULAR ACCESS EASEMENT (NVAE)

- A. An NVAE limits vehicular access to a parcel from the ROW.
- B. For private lots located on local streets which are also contiguous with arterial and/or collector streets, a one (1') foot NVAE shall be required on the lot line(s) contiguous or adjacent with the arterial and/or collector streets.
- C. A one (1') foot NVAE is required on parcels adjacent to all open space parcels, except for private roadway parcels.
- D. A one (1') foot NVAE may be required on private lots to restrict access to a ROW in order to satisfy access restrictions stipulated in Section 6.4.7. NVAE shall be shown on the final plat and dedicated as non-exclusive easement to the Agency.

6.5.3 TEMPORARY CONSTRUCTION EASEMENT (TCE)

An easement placed on a parcel of land temporarily for the use of construction personnel and equipment. The TCEs shall be determined by the EOR and shall be of sufficient width to accommodate the construction type, spoils piles and vehicles necessary to complete the work. The easement shall be extinguished upon the completion of the construction project.

SECTION 6.6 CURB AND GUTTER

6.6.1 VERTICAL CURBS

- A. Vertical curbs are required on all streets classified as Residential Collectors and higher, Local Residential streets at curb returns, adjacent to common areas, and other areas to restrict vehicle access. Vertical curbs may be installed on Local Residential.
- B. The height of all vertical curb shall be six (6") inch unless otherwise approved by the City/Town Engineer. Installation shall be per QCSD 220Q-1, Type "A." Vertical curbs shall be six (6") inch at all medians, and curbs adjacent to landscaping tracts or vertical structures (e.g. cluster mailboxes, utility cabinets, signal equipment, monument signing, etc.).

6.6.2 ROLL CURB

Roll curb per QCSDs 220Q-1, Type "C" and 220Q-2 may be installed on Local Residential. Residential Collector and Commercial/Industrial Collector streets may use roll curb as approved by the City/Town Engineer. Driveways shall use the commercial driveway per QCSD 250Q-1 or 250Q-2 on Commercial/Industrial Collectors.

6.6.3 MEDIAN CURB

In locations where raised medians are constructed, vertical curb or vertical curb and gutter is required. Median curb shall be installed per QCSD 220Q-1, Type "A" with depressed lip and 222Q, Type "A." With the City/Town Engineer approval, roll curb may be used around medians installed in low speed, low volume streets, to facilitate truck turning movements with traffic calming projects, or where needed to maintain adequate width for emergency vehicles.

6.6.4 CURB RETURNS

A. Curb Return Radii on Streets

The radii for curb returns shall be in accordance with [Table 6-15](#): All dimensions are to back of curb.

**TABLE 6-15
CURB RETURN RADII**

Street Classification	Intersecting Street Classification					
	Major Arterial	Minor Arterial	Comm/Ind Collector	Residential Collector	Local Residential	Rural Local Residential
Major Arterial	35'*	35'*	35'	35'	35'	-
Minor Arterial	35'*	35'*	35'	35'	35'	-
Comm/Ind Collector	35'	35'	30'	30'	30'	-
Residential Collector	35'	35'	30'	30'	30'	25'
Local Residential	35'	35'	30'	30'	25'	25'
Rural Local Residential	-	-	-	30'	25'	25'

**Curb radii for Arterial streets may require larger radius based on speed and largest design vehicle determined in a TIA. In all cases, they shall be a minimum thirty-five (35') feet.*

B. Sidewalk Ramp

Sidewalk ramps shall be constructed at all curbed street intersections, at medians with pedestrian refuges, and wherever a pedestrian access route crosses a street. Sidewalk ramps shall align with the sidewalk ramps on the opposite side of the street. If a traffic signal exists or is planned, the sidewalk ramp and apron shall provide access to the pedestrian push button, per the Americans with Disabilities Act (ADA) requirements.

1. Detectable Warning Panels of truncated domes shall be provided at all sidewalk ramps. The minimum area provided shall be two feet by 4 feet (2' x 4') on standard ramp types. The COP requires a cast (ductile) iron panel with an uncoated natural patina finish. The TOPV may approve other materials.
2. Directional or double sidewalk ramps per QCSD 232Q shall be installed at all arterial and collector street intersections.
3. Single sidewalk ramps per QCSD 231Q-1 shall be installed at all Local Residential street intersections.

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4. At T-intersections one sidewalk ramp shall be installed per QCSDs 233Q-1 or 233Q-2. The ramp shall normally be placed on the right-hand side of the TEE and align with ramps on the opposite side of the street.
5. Along routes to schools, any crosswalk location or trail connections, additional sidewalk ramps may be required.
6. Projects that include construction improvements at existing street intersections where sidewalk ramps are located shall note whether the ramps comply with current GES and QCSDs. If the sidewalk ramps are not in compliance, they shall be removed and replaced with sidewalk ramps that meet GES and QCSDs.

SECTION 6.7 SIDEWALKS

Installation of sidewalks shall promote and enhance pedestrian safety and the aesthetic quality of the roadway. Streets constructed to Agency standards shall have sidewalks installed on both sides of the street per QCSD 230Q with the exception of Rural Local Residential X-Section QCSD 601Q. Sidewalks shall remain within the ROW or established easements designated for pedestrian use.

6.7.1 SIDEWALK WIDTHS

A. Arterial Street:

1. Detached Sidewalk = Five (5') feet with separation (parkway) from back of curb per QCSD 605Q-1, 605Q-2 and 606Q.
2. Multi-use path = Twelve (12') feet wide if on one side of the street or can be reduced to ten (10') feet wide if on both sides of the street with separation (parkway) from back of curb per QCSD 605Q-1, 605Q-2 and 606Q.

B. Commercial/Industrial Collector Street:

Detached Sidewalk = Five (5') feet wide with a four (4') foot separation (parkway) from back of curb.

C. Residential Collector and Local Residential Street:

1. Detached Sidewalk with two (2') foot gutter = Five (5') feet wide with a three (3') foot separation (parkway) from back of curb.
2. Detached Sidewalk with three (3') foot gutter = Five (5') feet wide with a two (2') foot separation (parkway) from back of curb.

NOTE: Detached sidewalks and multi-use paths shall connect to the attached sidewalk at each curb return. Detached sidewalks shall use a curved design with a minimum radius of three (3') feet for the connection at curb return sidewalk. Sidewalk dimensions shall not include the curb width. Multi-use paths shall typically connect at the back of a curb ramp per QCSD 231Q-2.

6.7.2 PEDESTRIAN WAYS

Pedestrian ways shall be constructed to connect sidewalks with public and private facilities not located in the public street ROW. Public pedestrian ways shall be within a tract or easement for the purpose of defining

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the access and maintenance responsibility. The minimum width of the easement shall be seven (7') feet, or a width consistent with adjacent trails, and may be used for additional purposes as approved by the City/Town Engineer. If additional uses are approved, the minimum required width may be increased depending on the specific use.

6.7.3 MULTI-USE PATHS/TRAIL FACILITIES

Developments which impact existing or planned trails are required to provide ROW or other accommodation to extend the trail system through or adjacent to the development, as directed by the City/Town Engineer. The development shall design and build appropriate and safe crossings, which shall include consideration of street classification, speed, traffic volume, trail volume, proximity to signalized intersections, and cost; and link new local pedestrian facilities to the regional system.

A. Minimum design criteria for multi-use paths and trail surfaces are as follows:

1. Multi-use paths, where required, shall have a minimum of fifteen (15') foot public ROW or easement dedicated to the public when not included as part of the roadway ROW.
2. Multi-use paths shall be constructed of a firm, stable, and slip resistance material. Concrete shall be used when a multi-use trail is within the roadway ROW and serves as the sidewalk facility on one-side of the roadway as required by the roadway standard detail. Asphalt, six (6") inch compacted ABC or Agency approved material may be used for multi-use paths that are supplementary and adjacent to the required concrete sidewalk within a roadway ROW.
3. Two-way travel standard width is twelve (12') feet to accommodate the use of bicycles, pedestrians and maintenance vehicles.
4. Maximum longitudinal grade shall match that of the roadway it parallels.
5. Minimum one (1') foot graded area adjacent to both sides of the path.
6. Minimum separation of four (4') feet from multi-use path to back of curb.
7. Maintain a minimum vertical clearance of eight (8') feet and keep free of protruding objects.
8. Paths designated for equestrian use shall have a minimum vertical clearance of fourteen (14') feet and be constructed with trail surfaces suitable for that use.
9. Fall protection, if required, shall be a minimum height of forty-two (42") inches for pedestrian facilities and fifty-four (54") inches for facilities with bicycle and equestrian uses.
10. Lighting shall be required for all underground crossings.
11. When a multi-use path connects to a sidewalk section at an intersection it shall intersect perpendicular to the back of the ADA curb ramp and not require users to make sudden swerves, or to be directed towards oncoming traffic. The path tie-in to the curb ramp shall be at the same grade as the back of the ramp landing. The curb ramp shall be as wide as the path.
12. When a multi-use path passes through a drainage structure, an elevated pathway shall be provided to keep nuisance water off the path and allow the water to rapidly drain or be removed. Additional measures may be needed in areas prone to flooding.

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B. Trail Crossing Type and Design

Several federal resources address trail and shared use path design, which can be used, by the design engineer as references. These include the AASHTO “Guide for the Development of Bicycle Facilities”; and the Federal Highway Administration (FHWA) “Equestrian Design Guidebook for Trails, Trailheads and Campgrounds.” Whenever practical, a grade-separated crossing is preferred operationally over an at-grade crossing; however, the City/Town Engineer may consider at-grade crossings based on a technical submittal from the design engineer. This submittal shall either show that the grade separated crossing is unfeasible because of topography or that an at-grade crossing is operationally safe and the added expense and maintenance of the grade-separated crossing is not justified. The following summarizes the requirements of any trail crossings:

1. Trails which consider equestrian at-grade crossings, shall use an alignment that is perpendicular to the street. The crossing shall be on a straight segment of the street, and optimally in a location where motorists might expect an intersection. Consistency in the placement and design of intersections allows all users to identify them more readily.
2. Appropriate tread surfaces at crossings are critical to equestrian safety and the use of rough textured concrete, washed concrete or rubberized railroad type inserts is preferred.
3. Provision of waiting areas is required where trails cross at-grade. These are created by expanding the width of the trail surface as it approaches the street or forming a rectangular or fan-shaped waiting area using fencing.
4. At midblock crossing locations where the street exceeds eighty (80') feet curb to curb a median refuge is required to break the crossing into two (2) legs. The refuge shall be designed to allow storage of tandem bicycles or equestrians without encroachment into travel lanes.
5. Traffic signals or pedestrian hybrid beacons (PHB) can enhance at-grade trail crossings when warranted. Deployment of such devices must not be taken lightly. They shall only be installed at locations with significant trail user volumes as approved by the City/Town Engineer. Signalized crossings serving equestrian users shall consider appropriate push button height.

SECTION 6.8 PAVEMENT

6.8.1 CROSS SECTIONS

A. Undivided Streets

Undivided streets should have a normal crown, that is a two-way cross-slope with the cross section high point on the street centerline. A raised crown with a constant cross slope of two (2%) percent is required on all public streets. Inverted crown sections are not allowed, except when approved by the City/Town Engineer at arterial or collector street intersections and alleyways. Within an arterial or collector street intersection, the cross-slope shall comply with QCSD 600Q to accommodate rideability through the intersection.

B. Divided Streets

Divided streets should have cross-slope on each pavement section. The high point of each slope on each pavement section must occur on the edge of the pavement nearest to the median. Unusual conditions may cause cross-slope requirements to vary (e.g. superelevated sections), but normally, the desirable cross-slope

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is two (2%) percent. The desirable slope from top of median curb to top of median curb shall not exceed fifteen (15%) percent.

6.8.2 PAVEMENT CUTS

A. All pavement cuts shall be in accordance with Agency Code.

PCC, Chapter 8-2, City Right-of-Way
TOPV Town Code – 7-10-030

- B. There shall be no open trenching (pavement cut) on public streets with paved surfaces less than five (5) years old.
- C. Open trenching (pavement cut) may be permitted on streets with paved surfaces that are a minimum of five (5) years old. Backfill and pavement replacement shall conform to QCSO 200Q-1.
- D. Pavement replacement for street cuts shall be made within seventy-two (72) hours of completion of work as specified on QCSO 200Q.
- E. When the trench of any lineal utility project is within three (3') feet or less from lip of gutter, the pavement area between the trench and lip of curb will also require full removal and replacement. Pavement replacement shall be the minimum structural section for said street classification. In no case shall the replacement of existing asphalt be less than four (4") inches asphaltic concrete (AC) over six (6") inches aggregate base course (ABC) (the minimum residential section). In addition, should any raveling or damage occur to the existing pavement within the construction area, the damaged areas shall be saw cut, removed, and replaced. Damage to curb, gutter and sidewalk shall require full panel removal with saw cuts made at each joint. Removal and replacement of any and all existing infrastructure, damaged pavement, concrete, landscaping and irrigation, etc. shall be at the contractor's or private utility's expense.

6.8.3 TRENCHLESS CROSSINGS

In lieu of pavement cuts, developers and contractors may use trenchless technologies. Designs with pavement boring shall include a boring profile to ensure proper separation is maintained from all existing utilities. Profiles of existing utilities shall be potholed prior to start of work and included on the boring profile.

SECTION 6.9 CUL-DE-SACS AND KNUCKLES

6.9.1 CUL-DE-SAC STREET

- A. A cul-de-sac street is a street that serves more than one (1) parcel and has only one (1) direct access to the public street system.
- B. Cul-de-sac streets shall be a maximum of one-thousand three-hundred (1,300') feet in length and terminate in a circular turnaround. Refer to QCSOs 620Q-1 and 620Q-2 for ROW, street improvement requirements and dimensions and Section 7.4.3.D of the LDC.

6.9.2 KNUCKLES

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Knuckles are areas on the roadway expanded to provide a turn-around and additional access or lot frontage on local streets. Knuckles are required at intersections where changes in alignment are present but a centerline curve is not provided. Knuckles are permitted to improve accessibility to odd-shaped sites. The use of knuckles (except on a cul-de-sac) on streets other than local streets must be approved by the City/Town Engineer. Refer to QCSDs 622Q-1 and 622Q-2 for ROW, street improvements and dimensions.

SECTION 6.10 DEAD-END STREETS

Permanent dead-end streets that do not provide future connection shall include a cul-de-sac turn around. A hammerhead turn around, as approved by Emergency Services, may be used where topography and lot layout are such that one or two lots need to be accessed. Private driveways shall not be used for hammerhead or turn around requirements. Where a street connection is necessary to serve adjacent un-platted land that will develop at a future date a stub may be constructed without a cul-de-sac or hammerhead when the length is one-hundred (100') feet or less. A temporary turn around shall be required where the street stub exceeds two (2) lots or one-hundred (100') feet in length. The developer shall provide a sign at the stub declaring that the particular street shall connect with future development.

SECTION 6.11 MAILBOXES

A. Curb Side Mailboxes

1. Curb side mailbox within parkway strip: When an open space exists between the back of curb and the sidewalk of three (3') feet or more (parkway), the mailbox shall be installed so that the front is flush with the back of curb. The mailbox shall be a minimum of forty-two (42") inches above ground, and on a two (2") inch diameter steel or four by four (4"x4") inch wood breakaway post. Refer to QCSDs 134Q-1 and 134Q-2.
2. Curb side mailbox behind sidewalk: When the sidewalk starts at the back of curb, the mailbox shall be installed so that the front is a minimum of twelve (12") inches behind the back of the sidewalk, forty-two (42") inches above ground and on a two (2") inch diameter steel or four by four (4"x4") inch wood breakaway post. Refer to QCSDs 134Q-1 and 134Q-2.
3. Mailbox behind ditch: Where a roadway has no curb but there exists a roadside ditch, the mailbox shall be installed on an elbowed structure of two (2") inch diameter steel such that the mailbox extends over the ditch with its front flush with the edge of the roadway shoulder, if paved, or edge of the roadway, if unpaved. The front of the mailbox shall be between thirty-six (36") and forty-two (42") inches above ground. Refer to QCSDs 134Q-1 and 134Q-2.
4. Mailbox beside shoulder: Where a roadway has no curb and no roadside ditch, the mailbox shall be installed between thirty-six (36") and forty-two (42") inches above ground on a two (2") inch diameter steel post two (2') feet from the edge of the edge of the shoulder. Refer to QCSDs 134Q-1 and 134Q-2.
5. Masonry mailboxes will not be permitted within the street ROW.

B. Cluster Mailboxes

Cluster style mailboxes: a style whereby mailboxes, meeting the specifications of the United States Postal Service (USPS), are assembled and grouped together in a single area of land so that they are regarded as one unit. Requirements:

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1. The location of a cluster mailbox shall be approved by the City/Town Engineer and the local USPS. For cluster boxes in new subdivisions, the location of the unit shall be shown on the preliminary plat.
2. No driveway access shall be constructed within ten (10') feet of the cluster mailbox.
3. Units shall not be installed within one-hundred (100') feet of a street intersection. Units shall not be installed in locations where, because of the position of, shape or color it may interfere with, obstruct the view of or be confused with any traffic sign, signal or device.
4. Cluster mailboxes shall be located on property lines or on a dedicated open tract on the same side of the street designated as a "no parking" zone and in a manner as to provide sufficient sight distance for pedestrian access.
5. A sidewalk shall be constructed perpendicular to the curb adjacent to the unit providing a pedestrian connection from the unit to the curb.
6. The cluster box unit shall be located on a concrete pad and the unit shall be set back a minimum of one (1') foot from the back edge of the sidewalk to the nearest edge of the unit.
7. Cluster mailbox units shall not be located to conflict with any public utilities, including but not limited to manholes, fire hydrants, meters, vaults and cabinets.
8. When in the opinion of the City/Town Engineer it is necessary for pedestrian and vehicular safety, an access driveway turnout shall be required at the developer's expense, built three (3') feet outside of the face of the curb.

SECTION 6.12 ON-STREET PARKING

A. Sign Spacing

Signs restricting on street parking shall normally be placed in accordance with the distances shown in [Table 6-16](#). These may be adjusted as required by the City/Town Engineer when:

1. An assessment of the anticipated parking demand indicates a change is needed.
2. The roadway vertical or horizontal alignment reduces the visibility of the signs.
3. Parking is allowed in some areas and not in others to indicate the beginning and ending of no parking zones. This can be accomplished using "Begin" and "End" plaques, arrows or specific wording on the signs. This also applies when parking time limits are used or handicap spaces are designated, in which case individual stalls shall be signed.
4. For special conditions such as hydrants, fire lanes, sight visibility requirements, special restrictions needed for traffic control devices, etc.

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**TABLE 6-16
PARKING RESTRICTION SIGN SPACING**

Street Classification	Min. Sign Spacing (Feet)	Max. Sign Spacing (Feet)
Major Arterial	400	600
Minor Arterial	400	500
Residential Collector	200	300
Comm/Ind Collector	200	300
Local Residential	150	250
Rural Local Residential	150	250

B. Parking Restriction Guidelines

On street parking shall be restricted on those roadways with insufficient width to allow both parked vehicles and the safe, efficient movement of through traffic as shown in [Table 6-17](#). These parking guidelines assume bike lanes are not used.

**TABLE 6-17
PARKING RESTRICTION GUIDELINES – STREET WIDTH**

Roadway Pavement Width (Feet)	No Parking Allowed	Parking On one Side	Parking on Two Sides
≤ 28	X		
>28 to ≤32		X	
>32			X

C. Sign Type

Signs restricting on street parking shall be of the type and size in accordance with those shown in [Table 6-18](#). Alternative types and sizes shall only be approved for special circumstances as approved by the City/Town Engineer.

**TABLE 6-18
PARKING RESTRICTIONS SIGN TYPE & SIZE**

Street Classification	Approved Sign	Size	Plaque or Arrow	Orientation to Travel Way (Degrees)
Major Arterial	R8-3	30" x 30"	N/A	90
Minor Arterial	R8-3	30" x 30"	N/A	90
Comm/Ind Collector	R8-3	24" x 24"	N/A	90
Comm/Ind Collector	R7-9	12" x 18"	N/A	90
Residential Collector	R7-1	12" x 18"	Begin & End Here to corner	90 30 to 45
Local Residential	R7-1	12" x 18"	Begin & End Here to corner	90 30 to 45
Rural Local Residential	R7-1	12" x 18"	Begin & End Here to corner	90 30 to 45

SECTION 6.13 BUS BENCH LOCATIONS

When properly located, adequately designed, and effectively enforced, bus stops can improve service and expedite general traffic flow. Decisions regarding bus stop spacing and location call for a careful analysis of passenger service requirements (e.g. demand, convenience, and safety), the type of bus service provided and the interaction of stopped buses with general traffic flow. The following guidelines provide direction to the design engineer for the installation of bus stops in accordance with PCC, Title 8-2-17 and TOPV 14-03-100.

A. Stop Spacing

Bus stops are locations where passengers access the transit system, and therefore must be convenient to the places where passengers desire to travel to. Convenience and speed must be balanced in determining appropriate bus stop placement, as too many bus stops can slow down travel times and impede traffic movements. The following guidelines on bus stop spacing shall apply:

1. In the downtown area, bus stops shall have a spacing of eight-hundred (800') feet to one-thousand three-hundred (1,300') feet.
2. Outside the downtown area, bus stops shall be spaced no less than one-thousand five-hundred (1,500') feet apart.

B. Bus Stop Locations

Bus stops shall be placed along the street curb for direct safe passenger access to and from the sidewalk, waiting and walking areas. Bus stops are placed in one of three locations: far side (located immediately after an intersection); nearside (located immediately before an intersection); and mid-block (located between intersections). Each of these locations offers advantages to vehicle drivers and pedestrians. However, the following guidelines apply to their use:

1. Far-side stops are the preferable choice for service because they reduce conflicts between right-turning vehicles and stopped buses, eliminate sight-distance deficiencies on approaches to an intersection, and encourage pedestrian crossing at the rear of the bus.
2. Nearside stops shall be avoided whenever possible. However, they may be considered on an individual project basis if in the opinion of the City/Town Engineer a far-side stop is deemed unsafe or impractical.
3. Mid-block stops are considered special case stops and are to be used only in special circumstances when determined by the City/Town Engineer that there is a special need based on trip attractors, transfer points or other special demands that cannot be accommodated at an intersection nearby. Bus turnouts shall be used for mid-block stops.

C. Bus Stop Benches

1. Each bus stop location shall consist of only one bench or shelter unit unless otherwise approved. Multiple benches at one stop location may only be considered when ridership records indicate a clear need for their installation.
2. Bus benches shall be placed in a manner that sidewalk passage is not narrowed to less than the minimum widths set forth by ADA.

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3. Bus bench placement, which would result in sidewalk widths less than thirty-six (36”) inches, shall require the transit provider to install additional sidewalk width and acquire additional ROW at their expense, as needed to maintain ADA required sidewalk widths.

SECTION 6.14 TRAFFIC CONTROL DEVICE SELECTION

Traffic control device selection is critical to the successful operation of the transportation network. Several options exist for controlling traffic at intersections. This section shall focus on the two highest levels of control, which include traffic signals and roundabouts. These are often interchangeable and the use of one over the other is not always evident. The following information provides guidance for the design engineer on choosing one over the other. This justification procedure shall be documented in the TIA for each intersection requiring all-way stop control or traffic signalization.

A. Installation Warrants

The studies required to justify the installation of a traffic signal are based on the warrants and requirements set forth in the MUTCD. The satisfaction of a traffic signal warrant shall not in itself require the installation of an enhanced control option. No such warrants or requirements exist for roundabouts, however, roundabouts shall be considered as an alternative to traffic signals and all way stop control whenever they are warranted.

B. Roundabout Criteria

Roundabouts shall be considered the most appropriate form of control at any intersection if three (3) general questions can be answered positively.

1. Will a roundabout be expected to perform better than other alternative control modes; will it reduce delay, increase capacity, reduce queue lengths or solve some other operational problem?
2. Will a roundabout be shown to address collision types or trends over other alternative control devices?
3. Will a roundabout be expected to provide improved operational characteristics over other alternative control devices? This includes adjacent access operations and emergency vehicle operations.

C. Comparative Performance

If it is determined a roundabout is the most appropriate form of control based on the operational criteria, the final stage is to compare the construction cost, life-cycle cost, ROW considerations, “reserve capacity” (the ability to accommodate traffic growth), and constructability. If no clear disadvantage is evident with the roundabout then it shall be moved forward as the preferred traffic control device.

D. Roundabout and Traffic Signal Design

1. Roundabout design can be performed by either a general civil engineering firm or a specialized roundabout designer, however, if a general civil is used the plans shall require a final design review by a recognized roundabout expert as agreed upon by the City/Town Engineer and paid for by the developer/engineer.

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2. Traffic signal design shall be conducted by a registered Civil or Traffic Engineer with particular expertise in traffic signal control systems.

E. Roundabout Plan Checklist

The Roundabout Plan Checklist shall be used as a guide to ensure that all of the basic elements are included in the roundabout plans. Any roundabout plan that does not include each of the basic elements included on the checklist shall be returned for revision and re-submittal.

SECTION 6.15 TRAFFIC SIGNALS & LIGHTING

6.15.1 PUBLIC STREET LIGHTING

Developers of all residential, commercial, industrial or other types of properties are responsible for the design and installation of street lighting on all streets within and adjacent to their sites when required by the Agency. Street light plans shall be prepared and sealed by a licensed Electrical Engineer or Civil Engineer registered in the State of Arizona with particular expertise in roadway lighting design. The street lighting design shall be reviewed and approved by the Agency and shall take into account any policy promoting “dark sky initiatives” in recommendations on the number, spacing, and shielding of new street lighting. The street light design shall include numbering of the street light poles as directed by the City/Town Engineer and/or Arizona Public Service (APS).

6.15.2 STREET LIGHT SELECTION

These street lighting criteria and guidelines apply for all standard installations. Alternative street light designs using decorative/architectural style posts and lamps, for example, may also be acceptable by the Agency for public street light systems when consistent with the Historic Globe Street Light Overlay District Map and requested by developers and/or property owners.

6.15.3 STREET LIGHT DESIGN

The developer shall retain a licensed Electrical Engineer or Civil Engineer registered in the State of Arizona with particular expertise in roadway lighting design to prepare the lighting system design and appropriate calculations relative to illumination levels. Illumination design shall follow the recommendations of the American National Standard Practice for Roadway Lighting, Illuminating Engineering Society of North America, IES RP-8. The Luminance criteria, with light loss factors of point eight (0.80), shall be used to determine the compliance with the IES RP-8 and Agency street lighting design guidelines. Light Emitting Diode (LED) fixtures are the standard for all installations.

6.15.4 GENERAL STREET LIGHT NOTES

- A. Street lights shall normally be located on property lines whenever possible, at least five (5') feet from driveways or any above ground facility, and at such locations to maximize their separation from trees.
- B. Streetlights shall be located on the outside edge of the curve for horizontal curvilinear street alignments.
- C. The minimum curb overhang by street light luminaries (excluding decorative globe style) shall be no less than two (2') feet.
- D. Where the sidewalk is separated from the curb (parkway exists), the street light pole shall be centered two (2') feet from the gutter flow line.

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- E. Where the sidewalk is contiguous to the curb and the sidewalk, the street light pole shall be placed one and one-half (1 ½') feet behind the sidewalk.
- F. Street trees can significantly interfere with the efficient lighting of streets and shall not be permitted within thirty (30') feet of any street light standard.
- G. All electrical connections and supplies shall be placed underground.

6.15.5 ROADWAY SAFETY STREET LIGHT LUMINAIRES (COBRA HEAD & ARCHITECTURAL STYLE)

A. Standard Details

For the purpose of simplifying street light inventories, street light maintenance and consistency with APS requirements, the Agency has adopted pre-approved roadway safety (cobra head and architectural) street light standards for use in all Agency owned street light systems (except areas where decorative globe lighting is used).

1. Cobra head streetlights shall be per QCSD 170Q, and shall be gray in color.
2. Architectural style streetlights shall be per QCSD 171Q and shall be bronze in color.
3. All luminaries shall be multi tapped 120-240-277 voltage ready.
4. All lamps for street light systems shall be LED lamps with a correlated color temperature of 3000K to 4000K. These LED lamps shall meet one of the following criteria based on the classification of the roadway and the use specified in [Table 6-19](#). Forty-one (41) watt or four thousand eight hundred (4,800) minimum initial lumens, eighty-eight (88) watt or eight thousand two hundred (8,200) initial lumens, or one-hundred eight (108) watt or eleven-thousand one-hundred (11,100) minimum initial lumens.
5. Special lighting conditions based on roadway character or conditions, as determined by the City/Town Engineer, may result in directed deviation from these lighting standards.

**TABLE 6-19
STREET LIGHT LUMINAIRE WATTAGE**

Street Classification	Head Type (LED)	Location (Use)	Wattage
Major Arterial	Cobra Head	Roadway & Intersection	108
Minor Arterial	Cobra Head & Architectural	Roadway & Intersection	108 to 88*
Comm/Ind Collector	Cobra Head & Architectural	Intersection	108 to 88*
Comm/Ind Collector	Cobra Head & Architectural	Roadway	108 to 88*
Residential Collector	Cobra Head & Architectural	Intersection	88 or 41*
Residential Collector	Cobra Head & Architectural	Roadway	88 or 41
Local Residential	Cobra Head & Architectural	Roadway & Intersection	41
Local Residential	Historic Globe	Roadway	32
Rural Local Residential	Cobra Head & Architectural	Roadway & Intersection	41

* Specific use shall be directed by the City/Town Engineer based on local conditions.

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B. Typical location and spacing

Lighting Layout: The street lighting layout required is dictated by the street classification and shall be continuous. The design engineer shall consult the City/Town Engineer to assist in determining the appropriate street classification. The spacing distances listed below shall be used as general guidance, however final spacing shall ensure that appropriate lighting levels are provided as determined through the lighting system design.

1. Arterial Streets: Average spacing of one-hundred fifty (150') feet (staggered) with spacing of three-hundred (300') feet on each side.
2. Commercial/Industrial and Residential Collector Streets: Average spacing of two-hundred (200') feet. Light may be placed on one side of the street or staggered.
3. Local Streets: At or near the end of cul-de-sacs longer than one-hundred forty (140') feet measured from a typical Stop sign location, at changes of horizontal street alignment of forty-five (45°) degrees or more that are two-hundred (200') feet or more from a street intersection. If optional mid-block locations are used then the spacing of lights is about two-hundred seventy-five (275') feet, but never less than two-hundred (200') feet or more than three-hundred fifty (350') feet.
4. Intersection Lighting: All arterial-to-arterial and signalized intersections shall have four (4) streetlights. All other intersections require at least two (2) streetlights except local-to-local. Residential collector-to-local may have one (1) streetlight as determined by the City/Town Engineer. Knuckles shall require at least one (1) streetlight.

6.15.6 CITY OF PRESCOTT HISTORIC GLOBE STREET LIGHT LUMINARIES

A. Standard Details

1. Historic streetlights shall be Sternberg 4200 Augusta Series – 4208 TFP4 Ten (10') feet tall, four (4") inch tapered Fluted cast aluminum-extruded poles) or approved equivalent.
2. Multi tapped 120-240 voltage ready.
3. All lamps for historic globe street light systems shall be thirty-two (32) watt LED lamps.
4. Eight (8') foot poles are 4208 TFP5 – Verde Green; Globe – A840.
5. Ten (10') foot poles are 5210 TFP – RE5Q and Alzak FH/DBA/Black; Globe – B750.

B. Location and Spacing

1. Lights shall be placed on alternating sides of the roadway at approximately seventy-five (75') foot intervals.
2. Lights shall be used in designated historic districts only as defined by the Historic Globe Street Light Overlay District Map.
3. Light spacing shall be such that at least one (1) streetlight is placed in close proximity of any roadway intersection (within five (5') feet of the back of curb return or edge of curb return). At larger intersections with collector-to-collector or arterial to collector street classifications, two (2)

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lights shall be placed diagonally opposite to one another (within five (5') feet of the back of curb return or edge of curb return).

4. In some cases, cobra head streetlights may be required at intersections requiring higher levels of safety lighting.

6.15.7 TRAFFIC SIGNALS

This section shall present the criteria and procedures to be utilized by consultants when performing traffic signal work in and for the Agency.

A. Traffic Signal Spacing

Street Intersection Spacing on State Highways and Major Arterials:

1. Minimum one-half (1/2) mile spacing shall be required for all warranted traffic signal intersections on all state highways, parkways and Major Arterial in all cases, except where subject to a highway access management plan or as otherwise approved by ADOT. Recorded easements for shared access, provision of acceleration/deceleration lanes, traffic signals and other ROW improvements, for these cuts may be required prior to approval.
2. Minimum one-quarter (1/4) mile spacing shall be required for all warranted traffic signal intersections on Minor Arterials, Major Collectors, and Minor Collectors in all cases. Recorded easements for shared access may be required prior to approval. Adjoining parcels under common ownership may be required to share a curb cut.

B. Traffic Signal Design Guidelines

The following publication most recent editions and approved supplements by the state and Agency are to be used in conjunction with the design criteria when designing traffic signals for the Agency.

1. Manual on Uniform Traffic Control Devices for Street and Highways; USDOT/FHWA.
2. Traffic Signals and Lighting (Standard Drawings); ADOT.
3. ADOT Standard Specifications for Road and Bridge Construction.
4. International Signal Association Specifications.
5. Equipment and Materials Standards of the Institute of Transportation Engineers.
6. General accessibility guidelines as adopted by Agency.

C. Controllers and Cabinets

1. Control cabinet shall be type IV Econolite TS2, Type 1 with elevator base.
2. Meter Pedestal Cabinet shall be Myers PBM 2000 or 1250 UPS with foundation or approved equal.
3. Provision for battery backup shall be provided in all traffic signal cabinets.

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D. Emergency Vehicle Preemption

Emergency vehicle preemption shall be installed at all traffic signal intersections. A complete installation to include Opticom 700 series system, sensors, processors and confirmation hardware or approved equal shall be used.

E. Detectors

All signalized intersection shall be fully actuated. Actuation shall be achieved through the use of video detection. Radar vehicle detection may be used when approved. When designing a traffic signal (new installation or modification), the type of vehicle detection to be used shall be discussed with the City/Town Traffic Engineer.

1. Video Detection Equipment.

Video detection systems used on Agency signals shall be the model listed below. The model number for both presence and advance vehicle detection is listed.

Manufacturer	Radar Detection Model Number
Cubic Transportation Systems	Gridsmart GS-3 (Advance & Presence Video)

2. Radar Detection Equipment

Radar detection systems used on Agency signals shall be the models listed below. These systems shall be considered for special circumstances or when requested by Yavapai County for their traffic signals. The model number for both presence and advance vehicle detection is listed.

Manufacturer	Radar Detection Model Number
Wavetronix	Advance WX-SS-200 (Advance Radar)
	Matrix WX-SS-225 (Presence Detection)

F. Pedestrian Signal Indications

Provide pedestrian signals at vehicular signal locations. Install crosswalks at intersections, when sidewalk connections exist, or are installed. Pedestrian indications shall be LED countdown style with accessible pedestrian push buttons provided.

G. Pedestrian Push Buttons

Provide audible pedestrian push buttons at each crossing location. The button shall emit an audible locator tone (beep) and where directed include a vibrotactile directional crossing arrow. The button when pushed shall provide a pedestrian call and other messages to indicate when to walk. The locator tone (beep) and audible message volume shall have the ability to automatically adjust to ambient noise and be quieted by time of day.

H. Pole and Head Location

Traffic signal pole and head locations shall conform to the MUTCD and direction of the City/Town Engineer.

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I. Street Light Luminaries

All traffic signal installations shall include streetlights on all mast arm equipped poles consistent with the requirements of GES, [Section 6.15.5](#) “Cobra Head Street Light Luminaries.”

J. Pull Boxes

Traffic signal pull boxes shall be No. 7, signal interconnect pull boxes shall be No 5, with locking lid and labeled “TRAFFIC SIGNAL” and shall conform to T.S. 1-4, 1-5, and 1-6 of the ADOT Traffic Signals and Lighting Standard Drawings.

K. Traffic Signal Conduit

Traffic signal conduit shall be three (3”) inch Schedule 40 PVC.

L. Traffic Signal Interconnect

Traffic signal interconnect conduit shall be installed along all arterial roadways and at other locations as directed by the City/Town Engineer per QCSD 640Q to extend the existing interconnect systems. In locations where challenges with infrastructure or topography make in ground conduit unfeasible, traffic signal radio communication systems may be provided as directed by the Agency.

1. Conduit shall be two (2”) inch Schedule 40 PVC.
2. Interconnect cable shall be 6-pair, filled 19-gauge solid, run un-spliced.

M. Traffic Signal Plan Checklist

The Traffic Signal Plan Checklist shall be used as a guide to ensure that all of the basic elements are included in the traffic signal plans. Any signal plan that does not include each of the basic elements included on the checklist shall be returned for revision and re-submittal.

SECTION 6.16 SIGNING

6.16.1 SIGNING

In new development, the applicant shall install all required regulatory traffic control, warning and guide signs. The applicant shall be responsible for supplying and installing the required signs, posts and hardware in accordance with the required standard plans and specifications.

6.16.2 GENERAL SIGNING STANDARDS

The following publications most recent editions and approved supplements by the state and Agency are to be used in conjunction with the design criteria when designing traffic signing for the Agency with regard to size, color, shape and placement.

- A. Manual on Uniform Traffic Control Devices for Street and Highways (MUTCD); USDOT/FHWA.
- B. Manual of Approved Signs (ADOT).

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- C. All signs shall be new other than those shown on the plan to be relocated. All new and relocated signs shall be mounted on new posts with new hardware. Signs designed for installation on existing street light poles shall be mounted with new hardware.
- D. Traffic sign dimensions, colors and lettering shall conform to the latest MUTCD specifications. Traffic sign size shall be standard unless otherwise specified here or on the plans.
- E. All signs shall be located at least one (1') foot from the curb face to the nearest edge of the sign. All other roadways signs shall be mounted from six (6') feet to twelve (12') feet from the edge of the pavement to the nearest edge of the sign.
- F. Roadways with guardrail signs shall be located at least six (6') feet from the face of the guardrail to the nearest edge of the sign.
- G. Sign location shall be coordinated with landscaping plans to ensure sign visibility per AASHTO standards.
- H. Signs shall be mounted on street light poles where feasible.
 - 1. All signs installed in areas where parking or pedestrian movements occur shall be erected at a height of seven (7') feet above the pavement or sidewalk to the bottom of the sign or to the lowest sign in a multiple sign installation assembly with the following exceptions:
 - 2. The height to the bottom of a secondary sign mounted below another sign may be up to one (1') foot less than the height specified above in rural areas where pedestrians are not expected.
 - 3. Object markers shall be installed at least four (4') feet above the pavement.
- I. All R1-1 "STOP" signs and pedestrian warning signs shall be retro-reflective with all sheeting material to be diamond VIP grade, meeting or exceeding ASTM 4956-04.
- J. All other signs are to be retro-reflective with all sheeting material to be high intensity prismatic meeting or exceeding ASTM 4956-04.
- K. Sign blanks shall be 5052-H38 alloy treated aluminum with Alodine 1200 conversion coating, eight-hundredths (0.080") inch thick with rounded corners.
- L. Stop signs are to be shown at all local street intersections within a subdivision unless an engineering study shows that no control or yield control is warranted. Stop signs shall be designed and shown on the minor leg of all collector and non-signalized arterial street intersections.
- M. "STOP" signs and "YIELD" signs shall be a minimum of thirty (30") inches and thirty-six (36") inches in width, respectively. When specified by the requirements of the MUTCD, thirty-six (36") inch and/or forty-eight (48") inch signs may be required on major collectors and arterial streets.
- N. At intersections where all approaches are stop controlled, "All Way" plaques shall be placed below the R1-1 stop signs.

6.16.3 SIGN POSTS

- A. Sign posts shall conform to QCSD 131Q.
- B. For new construction the Telspar, Uni-strut or approved equal twelve-gauge, galvanized steel, four (4) sided perforated square tubing is required. Two (2") inch tubing shall be used for smaller signs while two and one-half (2½") inch tubing shall be used for the larger signs.
- C. The post shall be tall enough to provide the minimum clearances specified in the GES, Section 6.16.3.
- D. The base and sleeve system for the sign shall be anchored in a minimum of a twenty-four (24") inch deep, twelve (12") inch diameter foundation of concrete. The base shall have a breakaway slip base system. The exposed post from the base shall be four (4") inches to six (6") inches high.
- E. Signs over forty-eight (48") inches wide shall be mounted on two (2), two and one-half (2½") inch posts with a horizontal support frame.

6.16.4 STREET NAME SIGNS

- A. Street name signs shall conform to QCSD 132P in the COP and 132PV in the TOPV.
- B. All reflective sheeting material shall be high intensity prismatic, meeting or exceeding ASTM 4956-04.
- C. All transparent acrylic, pressure-sensitive film shall be 3M#177 blue/green electro cut film or approved equal, color determined per Agency.
- D. Letter font shall be uppercase four (4") inch minimum with the block numbers in the 100's with a directional arrow.
- E. These signs are constructed by applying white sheeting to the entire blank. On top of this sheeting, a blue/green translucent pressure-sensitive film from which the legend has been cut and removed is applied. Thus, the green background is applied on top of the white sheeting resulting in a sign with a white legend and a blue/green background, color determined per Agency.
- F. In the COP signs that are located in the center of the block shall have " ← →."
- G. In the COP signs that are at the beginning and end of the block shall have " → " pointing up the block.

6.16.5 LOW WATER CROSSING GATES

- A. Gates shall be required on all new low water crossings.
- B. Two-hundred (200') feet prior to the low water crossing gate a thirty-six by thirty-six (36" x 36") inch black on yellow warning sign shall be posted on each approach that reads "Flood Area Do Not Enter When Flooded."
- C. Black and yellow object marker (OM-3R(L)) shall be mounted on all four (4) corners of the gate facing traffic.

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- D. When the gates are closed, a black on white “Road Closed” (R11-2) shall be affixed to the gate facing oncoming traffic. To the left of the R11-2 sign, in the left most lane shall be affixed to the gate a red on black nine ball (OM4-2).
- E. Knox padlocks will be required on all low water crossing gates.

6.16.6 END OF ROAD BARRICADES

End of road barricades shall conform to QCSD 130Q-1 and 130Q-2. Three types of end of road barricades can be used.

- A. Type A is constructed of two (2) redwood or treated four by four (4” x 4”) inch wood posts sunk in the ground thirty-six (36”) inches and four (4’) feet apart, extending to a height of five (5’) feet. Three (3), eight (8”) inch minimum, twelve (12”) inch maximum by six (6’) foot boards shall be mounted horizontally twenty (20”) inches on center between the posts. The boards shall be painted in a chevron design using white and orange for barricades to indicate temporary status. Starting in the middle of the board the chevrons shall slope to both sides. Attached to the center board shall be a thirty-six by thirty-six (36” x 36”) inch black on yellow warning sign with the words “Road Closed.” The boards shall be painted in a chevron design using white and red to indicate permanent status. Starting in the middle of the board the chevrons shall slope to both sides. Attached to the center board shall be a forty-eight by thirty (48” x 30”) inch black on white warning sign with the words “Road Closed.” Short-term or rolling full closures may utilize a Type A barricade mounted on a base instead of posts set into the ground.
- B. Type B is constructed of two (2) redwood or treated four by four (4” x 4”) inch wood posts sunk in the ground thirty-six (36”) inches and four (4’) feet apart, extending to a height of five (5’) feet. Three (3), eight (8”) inch minimum, twelve (12”) inch maximum by six (6’) foot boards shall be mounted horizontally twenty (20”) inches on center between the posts. The boards shall be painted in a chevron design using white and orange for barricades to indicate temporary status. Starting in the middle of the board the chevrons shall slope to both sides. Attached to the center board shall be a thirty-six by thirty-six (36” x 36”) inch black on yellow warning sign with the words “Road Closed.” The boards shall be painted in a chevron design using white and red to indicate permanent status. Starting in the middle of the board the chevrons shall slope to both sides. Attached to the center board shall be a forty-eight by thirty (48” x 30”) inch black on white warning sign with the words “Road Closed.”
- C. Type C consists of an array (minimum two (2) signs) of thirty-six by thirty-six (36” x 36”) inch red on black OM4-2 type object markers mounted at a minimum of four (4’) feet on twelve (12) gauge two (2”) inch square steel tubing.
- D. In all cases in which a road closure is greater than one-hundred fifty (150’) feet from the nearest street intersection or the roadway alignment obscures the closure, pre-warning signs shall be required and placed as directed by the City/Town Engineer.

6.16.7 SIGNING PLAN CHECKLIST

The Signing Plan Checklist shall be used as a guide to ensure that all of the basic signing and striping plan elements of a project are included in the signing plans. Any signing plan that does not include each of the basic elements included on the checklist shall be returned for revision and re-submittal.

SECTION 6.17 STRIPING

6.17.1 STRIPING

New developments shall be responsible for the installation of all striping and pavement legends as determined by the City/Town Engineer, which shall include but not be limited to lane lines, crosswalks, stop bars, legends and arrows. The applicant shall be responsible for supplying and installing the required striping in accordance with standard plans and specifications.

6.17.2 STRIPING DESIGN GUIDELINES

- A. The corresponding publications referenced in Article 1 and Section 6.1.3, in their most recently adopted editions and approved supplements by the state and Agency, are to be used in conjunction with approved design criteria when designing striping for the Agency.
- B. General Striping Guidelines
1. Striping shall conform to the most recent editions of the MUTCD specifications with regard to size, color, reflectivity and placement unless otherwise specified here.
 2. All roadways classified as Commercial/Industrial Collector or higher shall require centerline striping, lane lines, stop bars, crosswalks (where applicable) and other appropriate legends and arrows. Residential Collector streets or lower may be required to have additional pavement markings.
 3. All thermoplastic applications shall conform to ADOT specification 704. Transverse markings, symbols and legends shall be 90 mil (0.090 inch) thick preformed thermoplastic, longitudinal markings shall be 60 mil (0.060 inch) thick alkyd extruded thermoplastic.
 4. All paint application shall conform to ADOT specification 708 or High Build Waterborne Traffic Paint. High Build Paint shall be applied to all Arterial and Collector streets and shall be 24 – 28 (0.024 – 0.028 inch) mils thick.
 5. All epoxy applications shall be hot applied by spray methods at a thickness of 15 – 20 mils (0.015 - 0.020 inch) and consist of epoxy resin compositions specifically formulated for use as a pavement marking material and for hot-spray application at elevated temperatures.
 6. All conflicting striping, pavement markings, and curb paint shall be removed by wet sandblasting or other approved method prior to the installation of new striping. Slurry or paint shall not be used to cover existing paint. Pavement that is damaged due to the removal of markers or striping shall be repaired to the satisfaction of the City/Town Engineer.
 7. All lanes shall be a minimum of twelve (12') feet in width per QCSD 606Q.
 8. Turn lane widths shall be equal to that of the through lanes but may be reduced to a minimum of ten (10') feet wide per the City/Town Engineer.
 9. Parallel parking lanes adjacent to the curb with a gutter pan shall be a minimum of seven (7') feet in width from the edge of gutter.

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10. Lane striping through an intersection shall be aligned. When approved by the City/Town Engineer a maximum of two (2') foot offset may be permitted.
11. On streets that do not have curb and gutter, four (4") inch solid white edge lines shall be used for posted speed limits of 25 MPH and under and six (6") inch solid white edge lines for streets with posted speed limits over 25 MPH.
12. All skip white or yellow road markings shall be a ten (10') foot long, four (4") inch wide stripe with a thirty (30') foot gap (forty (40') foot repeated interval).
13. Stop bars shall be eighteen (18") inches wide and set back four (4') feet from the crosswalk, or in the absence of a crosswalk placed at the desired stopping point. They are required at all intersection locations where crosswalks are used and at all stop controlled intersections on streets classified a Residential Collector and higher. Additionally stop bars are required at all Local Residential and Rural Local Residential street intersections that intersect streets classified a Residential Collector and higher.
14. Dual turn lanes shall require the installation of lane delineation markings (guide lines) through the intersection, which shall consist of white six (6") inch wide thermoplastic skips placed in a two (2') foot stripe with a four (4') foot gap pattern.

C. Crosswalks

Crosswalks shall be required at all legs of signalized intersections and roundabouts and may be required at other locations in white or yellow, standard or high visibility types as determined by the City/Town Engineer. Refer to QCSDs 630Q and 631Q.

1. Standard crosswalk marking - a white twelve (12") inch transverse crosswalk markings shall be used.
2. High visibility crosswalk where specified – a white crosswalk marking of twelve (12") inch transverse and twenty-four (24") inch longitudinal markings twenty-four (24") inches on center.
3. Standard school crosswalk - a yellow crosswalk with twelve (12") inch transverse and optional diagonal markings shall be used at designated school crossings.
4. High visibility school crosswalk - a yellow crosswalk with twelve (12") inch transverse and twenty-four (24") inch longitudinal markings shall be used at designated school crossings on streets classified as Major Collector and higher.

D. Speed Hump Markings

Speed humps shall be striped in accordance with the QCSD 210Q. The markings shall be white extruded or preformed thermoplastic (90-mil thickness).

E. Bike Lane Marking

1. Bike lane markings shall be installed per QCSD Street Typical Sections and the MUTCD.
2. Bike lane symbols shall be installed as part of on-street bike lane striping at the beginning of each block and at a spacing of six-hundred (600') feet thereafter in the absence of intersecting streets.

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3. Bike lane striping lines shall be six (6") inches in width, solid white unless otherwise specified.
4. Bike lanes shall be a minimum of five (5') feet in width.

SECTION 6.18 GUARDRAIL

All new developments shall provide for the design and construction of guardrail as determined by the warrants, procedures and policies in the AASHTO Roadside Design Guide. Additional length may be required to ensure that the guardrail system has collective post strength to resist failure or total displacement of the system