

**GENERAL
ENGINEERING
REQUIREMENTS
MANUAL**

2008

General Engineering Requirements Manual

Table of Contents

CHAPTER 1 INTRODUCTION	1-1
1.1 Purpose and Intent	1-1
1.2 Integration with City Codes, Ordinances, and Regulations.....	1-1
1.3 Project Classifications	1-2
1.4 Comprehensive Planning	1-2
1.5 Geographic Information System (GIS) Technology	1-3
1.6 Land Surveying.....	1-3
1.7 Technical Reports.....	1-6
1.8 Registrant's Seal and Signature	1-7
1.9 General Improvement Plan Requirements	1-7
1.10 Deviation from City Engineering Standards.....	1-13
CHAPTER 2 GRADING AND DRAINAGE	2-1
2.1 General Information.....	2-1
2.2 Availability of City Storm Drain	2-1
2.3 City Code.....	2-2
2.4 City Policies.....	2-2
2.5 Federal, State and County Regulations.....	2-2
2.6 Drainage Reports	2-4
2.7 Design Standards and Guidelines	2-8
2.8 Onsite Stormwater Management.....	2-9
2.9 Offsite Stormwater Management.....	2-12
2.10 Finished Floor Elevations	2-17
2.11 Grading Improvements.....	2-17
2.12 Retaining Walls.....	2-18
2.13 Final Grading and Drainage Plan Requirements	2-18
CHAPTER 3 TRAFFIC AND TRANSPORTATION.....	3-1
3.1 General Information.....	3-1
3.2 Integration with City Codes, Ordinances and Regulations.....	3-1
3.3 State Route 801 Corridor.....	3-1
3.4 Design Standards and Guidelines	3-2
3.5 Traffic Impact Analysis	3-2
3.6 Street Classification.....	3-2
3.7 Street Right-of-Way Requirements.....	3-3
3.8 Easements and Dedications.....	3-5
3.9 Curb and Gutter.....	3-6
3.10 Sidewalks	3-8
3.11 Pavement Cross Sections	3-9
3.12 Horizontal Alignment	3-10
3.13 Vertical Alignment.....	3-13
3.14 Horizontal and Vertical Curves	3-13
3.15 Longitudinal Street Grades.....	3-14
3.16 Intersections	3-14
3.17 Auxiliary Traffic Lanes	3-16
3.18 Median Design.....	3-17

General Engineering Requirements Manual

Table of Contents

3.19	Street Access and Driveways	3-19
3.20	Cul-De-Sacs, Knuckles and Birdseye	3-20
3.21	Pavement Transition Tapers.....	3-20
3.22	Delineators and Barricades	3-21
3.23	Street Name Signs	3-21
3.24	Partial Street Improvements	3-21
3.25	Dead End Streets	3-22
3.26	Survey Monuments.....	3-22
3.27	Public Transit Facilities	3-22
3.28	Subdivision Street Planning.....	3-23
3.29	Final Street Improvement Plan Requirements	3-24
3.30	Public Street Lighting.....	3-27
3.31	Signing and Pavement Markings	3-32
3.32	Traffic Signal Design	3-33
3.33	Final Traffic Signal Plan Requirements	3-36
CHAPTER 4 WATER SYSTEM DESIGN		4-1
4.1	General Information.....	4-1
4.2	Availability of City Water	4-1
4.3	Water Services Agreement.....	4-1
4.4	Private Water Companies.....	4-1
4.5	City Code.....	4-2
4.6	City Policy.....	4-2
4.7	Federal, State and County Regulations	4-2
4.8	Design Standards and Guidelines	4-3
4.9	Final Water Plan Requirements.....	4-22
CHAPTER 5 WASTEWATER COLLECTION SYSTEM		5-1
5.1	General Information.....	5-1
5.2	Availability of City Sewer	5-1
5.3	Sewer Service Agreement.....	5-1
5.4	City Code.....	5-1
5.5	City Policy.....	5-2
5.6	Federal, State and County Regulations	5-2
5.7	Design Standards and Guidelines	5-3
5.8	Final Sewer Plan Requirements	5-21
CHAPTER 6 AS-BUILT PLANS.....		6-1
6.1	Submittals.....	6-1
6.2	As-Built Plan Submittal Guidelines	6-1
6.3	As-Built Records.....	6-3
CHAPTER 7 NON-CITY UTILITIES (PRIVATE UTILITY COMPANIES)		7-1
7.1	General Information.....	7-1
7.2	Availability of Private Utilities	7-1
7.3	City Code.....	7-1
7.4	City Policy.....	7-2

General Engineering Requirements Manual

Table of Contents

7.5	Plan Requirements and Guidelines	7-2
7.6	Utility Trenching.....	7-3
7.7	Plan Submittal	7-3
7.8	Permit Required.....	7-4
7.9	Fees	7-4

CHAPTER 8 LANDSCAPING AND IRRIGATION.....8-1

CHAPTER 9 GLOSSARY9-1

9.1	Definitions.....	9-1
-----	------------------	-----

LIST OF TABLES

TABLE 1-1	Plan Sheet Scale (1)	1-9
TABLE 2-1	Storm Drain Manhole Spacing.....	2-16
TABLE 3-1	Street Right-of-Way Required	3-4
TABLE 3-2	Intersection Right-of-Way Triangle Requirements.....	3-5
TABLE 3-3	Curb Return Radii.....	3-7
TABLE 3-4	Minimum Horizontal Curve Radius	3-10
TABLE 3-5	Tangent Sections (Curves in Same Direction).....	3-12
TABLE 3-6	Minimum Tangent Sections (Reverse Curves)	3-12
TABLE 3-7	Tangent Sections at Intersections	3-13
TABLE 3-8	Vertical Curves Requirements.....	3-13
TABLE 3-9	Longitudinal Street Grade.....	3-14
TABLE 3-10	Driveway Spacing.....	3-19
TABLE 3-11	Minimum Photometric Distribution Design Requirements.....	3-27
TABLE 3-12	Average Streetlight Spacing and Fixture Height Requirements.....	3-28
TABLE 3-13	Streetlight Luminaries.....	3-29
TABLE 3-14	Fixture Selection.....	3-30
TABLE 3-15	Pole Selection	3-30
TABLE 4-1	Unit Daily Design Flows for Water - Per Land Use.....	4-4
TABLE 4-2	Applicable Unit Design Flows for Water - Non-Residential Land Uses.....	4-5
TABLE 4-3	Water System Performance Criteria Summary.....	4-7
TABLE 4-4	Examples of Incorrect and Correct Topology	4-10
TABLE 4-5	Minimum Waterline Size.....	4-16
TABLE 4-6	Fire Hydrant Spacing.....	4-22
TABLE 5-1	Unit Daily Design Flows for Sewer - Per Land Use	5-3
TABLE 5-2	Applicable Unit Design Flows for Sewer - Non-Residential Land Uses	5-4
TABLE 5-3	Wastewater Flow Peaking Factor.....	5-6
TABLE 5-4	Recommended Minimum Slopes for Circular Pipes	5-14
TABLE 5-5	Manhole Spacing (1)	5-16

PREFACE

The City of Avondale is a rapidly growing community. A recent evaluation of the City Engineering Requirements revealed that the requirements were due for revision. As a direct result, the City of Avondale embarked on creating a more comprehensive, current, and user friendly General Engineering Requirements Manual. The new City of Avondale General Engineering Requirements Manual provides guidance to the design community regarding engineering requirements within the City of Avondale. It outlines the engineering requirements as they pertain to all projects within the City of Avondale. The City of Avondale General Engineering Requirements Manual replaces the previous City of Avondale Engineering Design Standards Manual Dated June 1997. The new manual is a revision to the previous manual which incorporates current municipal standards and regulations. The goal of the new manual is to provide a more user friendly design tool to the engineering community with clear, concise, and current direction regarding the City's engineering requirements.

CHAPTER 1 INTRODUCTION

1.1 Purpose and Intent

The purpose of General Engineering Requirements Manual is to replace the current City of Avondale Engineering Design Standards Manual dated June 1997. The goal of the City of Avondale is to achieve the development and improvement of property in a manner that provides a Quality of Life improvement for public health, safety and welfare. This Manual will provide guidelines and minimum design criteria for the planning and designing of City of Avondale Capital Improvement Projects (CIP) and Development Services (DS) projects as defined in Section 1.3 of this Manual.

The intent of the General Engineering Requirements Manual is to present clear and concise direction regarding technical requirements, policies, and processes to facilitate consistent uniform design during the plan preparation phase. However, the information presented is not intended to supersede sound engineering judgment.

1.2 Integration with City Codes, Ordinances, and Regulations

It is the purpose of Avondale City Code, to outline and establish the minimum acceptable standards for improvement of public streets, utilities, and related infrastructure to define the responsibility of the engineer/subdivider in the design, construction and financing of public improvements, and to establish procedures for review and approval of engineering plans.

The General Engineering Requirements Manual clarifies and supplements requirements in the Avondale City Code, including the zoning ordinances, subdivision, floodplain and stormwater regulations, fire and building codes, and other regulations for land development within the City of Avondale.

The General Engineering Requirements Manual is not intended to interfere with, abrogate, or annul any other ordinance, rule or regulations, statute, or other provision of law except as provided in this Manual. Where any provision of this Manual imposes restrictions different from those imposed by any other provision of law, the provision that is more restrictive or imposes higher standards upon the development and use of land shall control.

The General Engineering Requirements Manual shall govern all Capital Improvement Projects (CIP) and Development Services (DS) projects within City of Avondale's City limits.

1.3 Project Classifications

1.3.1 Development Services Projects (DS):

Development Services (DS) projects are projects with construction improvements that are to be installed as part of a new land development. Requirements are outlined in this Manual as well as the City codes. Refer to the City website www.avondale.org under Development Services for specific information regarding the development services processes. The website includes the applications, permits and a detailed flowchart outlining each step in the process.

1.3.2 Capital Improvement Projects (CIP):

Capital Improvement Projects (CIP) are projects that are installed as part of a Capital Improvement Plan. CIP are City funded projects, usually inside the public right-of-way, that are managed by City staff and done by private engineering consultants. Ultimately, design services and construction of a CIP project are awarded by either the City Council or the City Manager.

1.4 Comprehensive Planning

The City of Avondale has developed water, sewer, and transportation master plans to ensure that future improvement requirements are achieved through an orderly development of the City planning areas. Any Engineer working on construction improvements shall review the comprehensive plans, be aware of them, and incorporate their requirements into their improvement plans submitted to the City.

1.4.1 Transportation Plan:

The Transportation Plan identifies forecasted infrastructure need and sets directions for undertaking transportation projects that will provide the City with an optimal transportation system to effectively serve the future travel demands. The Transportation Plan is available on the City of Avondale website www.avondale.org.

1.4.2 Wastewater Collection System Master Plan and Utility Systems Evaluation:

The City of Avondale is experiencing rapid growth requiring improvements in the water and wastewater infrastructure to serve the growing community. The report outlines the City's water and wastewater systems, and determines how new infrastructure should grow to provide customers with an appropriate level of service, and to function efficiently and effectively along with the City's existing infrastructure. Contact Water Resources for the updated model of the Wastewater Collection System Master Plan and Utility System Evaluation report.

1.4.3 Drainage Master Plan:

The City of Avondale has not developed a drainage master plan that covers the entire jurisdictional boundaries. The Flood Control District of Maricopa County has prepared Area Drainage Master Plans (ADMP) for areas of the City of Avondale which are available at www.fcd.maricopa.gov. Some of the ADMPs include, but are not limited to: White Tanks/Agua Fria Area Drainage Master Plan and Durango Area Drainage Master Plan.

1.4.4 General Plan:

The City of Avondale General Plan is to provide the community, with a vision to guide growth and development. At the same time, the General Plan addresses specific legislative requirements of Growing Smarter and Growing Smarter Plus legislation. The Developer/Engineer shall review the document to assure their proposed construction improvement accommodate the requirements outlined in the General Plan. The General Plan is available at www.avondale.org.

1.5 Geographic Information System (GIS) Technology

The City is using GIS technology for capturing, managing, analyzing, and displaying all forms of geographically referenced data and information. GIS data submitted to the City shall comply with the Arizona Spatial Data Accuracy and Geo-Referencing Standards available from Arizona Professional Land Surveyors (APLS).

1.6 Land Surveying

1.6.1 General Information

The intent of this section is to ensure all improvement of projects that involve surveys, aerial mapping, and right of way improvement plans will apply consistent methods and standards pertaining to ground surface measurement within the City of Avondale.

All survey work in the City of Avondale will be performed under the direction of a professional land surveyor registered in accordance with requirements of the State of Arizona State Board of Technical Registration.

1.6.2 Boundary Survey Standards

A. Boundary Surveys: All land survey work will be performed within the guidelines of the Arizona Boundary Survey Minimum Standards. These standards may be obtained from the State of Arizona Board of Technical Registration at 1110 West Washington Street, Suite 240, Phoenix, Arizona 85007, or online at:

www.btr.state.az.us/regulations/arizonaboundariesurvey.asp

B. ALTA Surveys: ALTA surveys will be based on American Land Title Association, American Congress on Surveying & Mapping, and National Society of Professional surveyors (2005) 2005 Minimum Standard Detail Requirements for ALTA/ACSM Land title Surveys: www.acsm.net/alta.html

1.6.3 Horizontal Datum

A. Horizontal Datum: The horizontal datum for all engineering work (mapping, planning, design, right-of-way engineering and construction) for City of Avondale projects shall be the North American Datum of 1983, (NAD83) as defined by the National Geodetic Survey (NGS) National Spatial Adjustment System (NSRS2007). The physical, on the ground based survey datum shall be Arizona State Plane coordinate system, central zone with a common unit of measure, the International foot.

B. Ground Adjustment Scale Factor: The combined scale factor of 1.000126 shall be used to convert the horizontal control point values (grid) to ground measurements. To convert from ground to grid, multiply by 0.999874.

1.6.4 Vertical Datum

The vertical control datum for use within the City of Avondale is the North American Vertical Datum of 1988 (NAVD88), as defined by the National Geodetic Survey (NGS).

1.6.5 Horizontal and Vertical Control System

A. Horizontal Control: Horizontal control for determining NAD83 coordinates will be based on published NGS control stations of 1st order accuracy or better. More than forty published 1st order accuracy NGS horizontal and vertical control stations are located within or in the immediate vicinity of the City of Avondale planning area. Many of these monuments were established in November 2006 in semi-protected locations readily accessed off traveled roadways. All surveys will reference a minimum of three of these stations. GPS Global Navigation satellite system surveys may use a recognized local continuously operating broadcast/reference (COBS or COR) station signal as an approved alternate method provided they check into two of the NGS control stations. Control station data used will be documented, described and referenced by name, position, elevation and date on the plans.

B. Vertical Control: Vertical control for determining NAVD88 elevations will be based on published NGS control stations of 2nd order class II accuracy or better.

C. NGS Data Sheets: Current NGS survey control data sheets should be downloaded for each project from the following location:

www.ngs.noaa.gov/cgi-bin/datasheet.pr1

1.6.6 Benchmarks

A. Plan Benchmark References: All improvement plans must reference on the cover the published NGS monument used for vertical control. Description and elevation in the required NAVD88 datum will be shown.

B. Plan Datum Reference: All improvement plans shall contain a statement certifying the datum used for all elevations which are represented in the plans. The statement shall be included on the cover sheet immediately below the benchmark.

C. Current Datum: Former City of Avondale Benchmarks in use prior to May, 2007 which used the NGVD29 datum are no longer acceptable for vertical control. If conversions of as-built plans are required to convert from old control in the NVGD29 datum, contact the City of Avondale survey section to obtain an approved equation.

1.6.7 Updating of Standards and Specifications

It is recognized that positioning technologies are continuously evolving and that control available for geo-referencing may be revised or augmented. Therefore these standards will be periodically updated and the version in force during data collection shall be specifically referenced in the project scope.

1.6.8 Digital Images

Digital images shall be obtained to adequately cover the project. The images shall be geo-referenced by survey point number and annotated with the cardinal direction.

1.6.9 Deliverables

A. Non-Digital Media

- Final full size base map drawings signed and sealed by an Arizona registered land surveyor.
- Unrecorded surveys or as-built plans NOT obtained from City of Avondale.

B. Digital Media

Directories and subdirectories shall be created so as to produce an organized structure that is easily followed to obtain the copied files. The following items shall be copied into the appropriate directories of a CD with the City of Avondale project name, work order number, land surveyors stamp and signature on the label.

C. Data Collection Files

All files associated with the data collection, including but not limited to:

- GPS project(s) (i.e. Trimble Geomatics Office, Prism, etc.)
- Digital level runs.

D. Computer Aided Design (CAD)

All files associated with generating the base map drawing, including but not limited to:

- Raw Data – The appropriate raw data for the software utilized.
- Coordinates – Comma delimited ASCII format listing point number, northing, easting, elevation, descriptor code and notes.
- Digital Terrain Model
- Drawings/Exhibits (.dwg)

E. Images: All images taken on the project.

F. Miscellaneous: Any and all files that were used in the conjunction with the base map generation.

1.7 Technical Reports

The following reports may be required during plan preparation phase.

1.7.1 Traffic Impact Analysis (TIA):

Engineer shall be required, at the time of preliminary plat or site plan submittal, to submit a final Traffic Impact Analysis per COA Standards (available on website at www.avondale.org) for review and approval. The TIA shall incorporate Avondale Transportation Plan Guidelines and state any deviations.

Other traffic study requirements for rezoning, PAD's or CUP's and other submittals are listed on the City's website.

1.7.2 Geotechnical Report:

Engineers shall be responsible to submit a geotechnical report with pavement improvement plans. Report shall include boring logs and percolation rates at all proposed retention basin locations, and for underground utilities such as water/sewer/reclaimed/force mains, soil borings are required for pipe material at interval not exceeding 660' and at a depth of two (2') feet below proposed pipe invert. The design engineer is responsible for investigating and evaluating the existing pavement structure.

1.7.3 Drainage Report:

Engineers shall be required, at the time of civil plan submittal, to submit a Drainage Report or memorandum for review and approval. The report shall be prepared in

accordance with the current City of Avondale General Engineering Requirements Manual, and the Flood Control District of Maricopa County Drainage Manuals.

Drainage report should incorporate drainage master plan and area drainage master plan guidelines and state deviations, if any.

1.7.4 Water and Wastewater Design Reports:

Water and wastewater design reports shall provide an analysis of the impact that a development will have on the City's water and wastewater systems. The objectives of the design report are to verify the water demand, verification of sufficient fire flows, available system flows, pressures, proposed hydraulics and determine the wastewater demand capacities, and analyze the hydraulics of the proposed sanitary sewer system. The system design shall comply with ADEQ Engineering Manual Bulletins No.8 and No. 10 for the water system, and Bulletin No. 11 for the wastewater system.

The above reports may be required for CIP projects. The need for the reports will be determined by staff on a case by case basis.

1.8 Registrant's Seal and Signature

The City requires that all Project improvement plans, specifications, reports, and technical documents that are submitted for review be sealed and signed in accordance with the requirements of the State of Arizona Board of Technical Registration.

1.9 General Improvement Plan Requirements

1.9.1 General Information:

All proposed improvement projects that involve construction of engineered improvements (streets, grading and drainage facilities, utilities, etc.) are required to submit plans and supporting reports to the City for review, approval, and permitting. This section describes the general requirements for all civil improvement plans prepared for projects within the City. Additional improvement plan requirements that are specific to the type of improvements proposed are identified in the following chapters of this manual.

1.9.2 Improvement Plan Submittals:

The improvement plans submitted to the City of Avondale for approval shall adhere to professional standards governed by the State of Arizona Board of Technical Registration. Improvement plans shall be complete and shall be in compliance with City and State Board requirements.

Improvement plans that do not meet industry standards, or are incomplete, will be returned by the City without review comments and shall be classified as an inadequate project submittal. Repetitive submittals of non-compliant and inadequate improvement documents may be subject to State of Arizona Board of Technical Registration review.

1.9.3 General Requirements:

A. Civil Engineering Standards: City of Avondale uses the Uniform Standard Specifications and Details for Public Works Construction, as published by the Maricopa Association of Governments (MAG Specifications & Details) available at www.mag.maricopa.gov for engineering standards for construction of public infrastructure, City of Avondale General Engineering Requirements Manual and City of Avondale's Supplement to the MAG Specifications and Details.

B. Sheet Size: Typical improvement plans shall be on 24" x 36" sheets with blue or blackline types with a minimum of a 1½" left border and a ½" border on other sides. The City reserves the right to request scaleable half size sets for review purposes. Additional sizes may be required.

C. Reports: All supporting or supplement reports shall be letter sized (8½" x 11") and bound with the City's project number and title on the spine. Any larger maps included within the reports are to be folded accordion style to letter size, and put in pocket folders.

D. Sheet Orientation: Plans shall be oriented with north towards the top, or right of each sheet. A north arrow and scale (both written and graphic) shall be provided on all sheets. All text should be readable from the bottom and the right of the sheet.

E. Text Designation: Minimum lettering and numbering, size shall be 3/16" for manually drafted or 12 point font for mechanically/electronic produced letters, numbers and symbols. Lettering, numbering line work, and shading must be uniform and with clear definition to be retrievable after microfilming or digitizing.

F. Improvement Plan Designation: Separate improvement plans may be provided for the following:

- Map of Dedication
- Subdivision Plats
- Site Plans
- Street Improvements
- Storm Drain Improvements
- Water System Improvements
- Wastewater Improvements
- Grading and Drainage Improvements
- Traffic Signalization
- Traffic Signing and Pavement Marking Improvements
- Temporary Traffic Control
- Landscape and Irrigation Improvements
- Streetlight Improvements
- Reclaimed Water Improvements

- Storm Water Management Plan (SWMP)

G. Drawing Scales: Table 1-1 represents the standard minimum drawing scales to be used for improvement plans submitted to City. Note: The Engineer shall take into account when selecting drawing scales, line weights and lettering size that the improvement plans may be photocopied, microfilmed or digitally scanned.

**TABLE 1-1
Plan Sheet Scale (1)**

	DS Projects	CIP Projects
Map of Dedication	1" = 40' Horizontal	Not Applicable
Subdivision Plats	1" = 100' Horizontal	Not Applicable
Site Plan	1" = 50' Horizontal	1" = 50' Horizontal
Paving Plans (except Arterial Street)	1" = 40' Horizontal 1" = 4' Vertical	1" = 20' Horizontal 1" = 4' Vertical
Arterial Street Plans	1" = 20' Horizontal 1" = 2' Vertical	1" = 20' Horizontal 1" = 2' Vertical
Storm Drain	1" = 40' Horizontal 1" = 4' Vertical	1" = 20' Horizontal 1" = 4' Vertical
Water	1" = 40' Horizontal 1" = 4' Vertical	1" = 20' Horizontal 1" = 2' Vertical
Wastewater	1" = 40' Horizontal 1" = 4' Vertical	1" = 20' Horizontal 1" = 2' Vertical
Grading and Drainage	1" = 40' Horizontal 1" = 4' Vertical	1" = 40' Horizontal 1" = 4' Vertical
Temporary Traffic Control	1" = 40' Horizontal	1" = 40' Horizontal
Traffic Signalization	1" = 20' Horizontal 1" = 2' Vertical	1" = 20' Horizontal 1" = 2' Vertical
Traffic Signing and Pavement Marking	1" = 40' Horizontal	1" = 40' Horizontal
Landscape and Irrigation	1" = 40' Horizontal	1" = 40' Horizontal
Streetlight	1" = 40' Horizontal	1" = 40' Horizontal
Reclaimed Water	1" = 40' Horizontal 1" = 4' Vertical	1" = 20' Horizontal 1" = 2' Vertical
Storm Water Management Plan	1" = 40' Horizontal	1" = 40' Horizontal

(1) Depending on the complexity of the design, a larger scale may be required by City staff.

H. All existing topography shall be screened, or shown differently. This will typically include existing contours with adequate spot elevations to show:

- Drainage
- Existing aerial and underground utilities
- Existing irrigation facilities
- Adjacent land uses
- City limits
- County limits where applicable
- 100-year floodplain
- Flood elevations and floodway limits, where applicable

I. Plans shall show existing and proposed right-of-way, easements and property lines. Dimensions of these shall be clearly indicated. Note the Assessor Parcel Number (APN), property address and lot numbers.

J. New construction line work and construction notes shall be sufficiently heavier than existing topography, so as to allow it to be quickly and clearly identified.

K. Grade breaks shall be clearly shown with the applicable symbol on the plan and/or profile sheets.

L. “Blue Stake” notification shall be provided on each sheet.

M. Title Blocks: All plan sheets shall note the project’s title and address in a title block on the sheet’s lower right hand corner.

N. Dimensioning: All existing and proposed improvements shall be dimensioned in accordance with the following:

- All plan sheets showing street improvements or dedicated rights-of-way shall be dimensioned per MAG Standard Detail 112.
- All plan sheets showing the construction of new utilities or existing utilities shall be dimensioned per MAG Standard Detail 112.
- All plan sheets showing an easement shall dimension the overall width of the easement.

O. Symbols: Symbols noted on the plan sheets shall be per MAG Standard Detail 110. Special symbols not represented on MAG Standard Detail 110 may be used provided the symbol representation is identified in the legend and approved by the City.

P. Construction Notes: Construction notes for all new construction shall be noted on each plan sheet.

1.9.4 Cover Sheet:

An individual cover sheet is required for each type of improvement plan. Refer to City website www.avondale.org for link to typical CIP or DS projects cover sheet and the required information to be provided on the cover sheet.

A. Provide a Utility Notification Block on the plans.

B. General Notes: All construction shall be in accordance with the City of Avondale Supplement to the MAG Specifications and Details currently on file and available at the City of Avondale Development Services Center.

1.9.5 Plan Design Sheets

Construction plans for improvements typically consist of a variety of types of sheets. All construction plan design sheets shall include the following:

A. Horizontal Control:

- The origination point of all position systems shall be based on an established survey point or monument and identified on the plans and be on a City approved benchmark.
- Position systems shall be designed to proceed from south to north, west to east, left to right.
- All plan sheets shall be stationed in 100-foot intervals minimum.
- Bearing and distance on all horizontal control need to be clearly identified on each sheet. Bearing and distances need to be identified for each change in bearing.
- CIP projects require Temporary Benchmarks (TBM) established by a Project Engineer or Surveyor when it is necessary to maintain vertical control. All TBMs shall be per City datum.

B. Required Information to be shown on Plans:

- All jurisdictions (City, County, and State) in which this project falls. Projects that are adjacent to corporate limits of municipalities, County or State shall delineate the location of the corporate limits and identify the jurisdictions on all applicable sheets.
- Plans shall differentiate between the existing and proposed improvements and show all the existing conditions.
- Plans shall show all existing utilities complete with line sizes, types (water, sewer, gas, electrical, telecommunication, etc) and locations. A distinct line type shall be created for each type of utility that notes the size of the utility and type of line.

1.9.6 Plan and Profile Sheets

A. Plan and profile sheets are required for the following:

- All arterial, collectors, and local streets shall provide separate profiles for left curb or left edge of pavement, right curb or right edge of pavement, profile grade line or left and right median curb profile, and left and right median curb.
- All public waterline improvement plans with pipe diameter 12-inch, or greater. Note the pipe slope and pipe material.
- All public sanitary sewer improvement plans.
- All public storm drain improvement plans.
- All public reclaimed waterline improvement plans with pipe diameter 12-inch and greater.

B. The profile shall indicate elevations and shall utilize the same horizontal control as the plan view.

C. The profile of the existing surface shall be shown with the proposed construction line work and construction notes (i.e. elevations, slopes, grade breaks).

D. The new or existing utility crossings with elevations shall be shown in the profile view. Note the pipe material when known. Utility conflicts and design resolutions shall be noted in all the appropriate profiles with the required minimum clearance dimensioned and maintained per the applicable design standards of MAG, ADEQ, or MCESD.

1.9.7 Detail Sheets

Detail sheets are supplemental sheets that depict special construction details required to clarify some aspect of the proposed improvements.

MAG or City of Avondale Standard Details are not to be included on the detail sheets unless the Detail is being modified. The modifications shall be clearly identified and the detail shall be titled "Modified MAG or COA Detail."

1.9.8 Plan Review Comments

The project's plan review comments (including redlines) shall be addressed by correction or clarification response. If there is a discrepancy concerning a redline comment, contact the City plan review staff. **The redline set of plans shall be returned with the next improvement plan submittal.** Include a separate redline correction response letter addressing each comment and correction measure provided. The letter shall address each comment with plan sheet location noted, along with the applicable resolution of the comment.

For CIP projects, review comments shall be tabulated by the engineer, and an initial disposition shall be attempted. The table shall depict the comment, comment originator, sheet number of the comment, and disposition to the comment. Upon completion the table shall be forwarded to City staff for review prior to the comment resolution meeting. During the comment resolution meeting final disposition will be determined. The subsequent submittal shall then reflect all necessary changes as outlined by the direction in the disposition table. The subsequent submittal shall include a copy of the comment disposing table and final disposition with a set of the revised documents.

Failure to identify all of the changes may result in the return of the plans with an additional review required, and may require additional review fees based on the approved fee schedule. For CIP projects, this may require additional submittals at no cost to the City.

1.9.9 Checklists: Application forms and checklists for projects are available at the City of Avondale website at www.avondale.org.

1.10 Deviation from City Engineering Standards

1.10.1 General Information

An engineering standards deviation is a formal request to allow deviation from the adopted engineering standards required by City of Avondale municipal code. This includes deviation from the code in regards to engineering requirements as well as deviation from any of the standards and requirements set forth in the General Engineering Requirements and City of Avondale Supplement to MAG Specifications and Details.

1.10.2 Qualification Criteria

For an engineering standards deviation request to be considered, the applicant must prove that there is a unique property condition causing substantial hardship. In order to qualify for an engineering standards deviation request, the following criteria must be true:

A. There are unique conditions or circumstances applying to the land use of the subject property in regards to:

- Lot size or shape
- Topography
- Access control
- Drainage patterns
- Distance to nearest Water Service
- Distance to nearest Sewer Service

B. The condition causing hardship was not created by the applicant, owner, or any previous owner of the property. The property hardship cannot be self-imposed.

C. Without the granting of the deviation the property cannot be reasonably used.

D. Authorization of the deviation will not be materially detrimental to persons residing or working in the vicinity, to the adjacent property, to the neighborhood, or public welfare in general.

It is the burden of the applicant to prove all of the above criteria true. If all of the above criteria can be proven, an engineer should contact the Development Services Plan Review Manager to discuss the feasibility of applying for a deviation. In no case shall economic hardship qualify as criteria for evaluating an engineering deviation.

1.10.3 Engineering Standards Deviation Process

In general the appropriate time to submit a formal engineering standards request is in the preliminary stages of a project's development. Once an applicant decides to move forward with the formal request for an engineering standards deviation the applicant must follow the process outlined below and submit the formal request prior to or concurrently with the first report or civil plan submittal affected. Submittal of the formal request for an engineering deviation does not guarantee approval. Therefore the applicant should understand that to proceed with design prior to City staff providing a written determination on the deviation is at the applicant's own risk.

A. The applicant's engineer must discuss the feasibility of applying for a deviation in their specific situation with development engineering plan review manager.

B. Once an applicant decides to move forward with the formal request for an Engineering Deviation the applicant's engineer must submit the following for review.

- A completed Application for Engineering Standards Deviation
 - An Engineering Standards Deviation application must be filled out completely. Applications without the required information may not be accepted in the Development Services Center at the time of submittal. The Engineering Deviation Application form may be downloaded at www.avondale.org.
- Narrative describing the project as well as the proposed deviation. The narrative shall include the following:
 - Section of City engineering standards or code which relates to the proposed deviation outlining the existing City engineering standard and the deviation from the City engineering standard requested.
 - Justification for the proposed deviation. The written request shall state the factors which would make approval of the request necessary, and how the development proposal differs from other developments and adopted standards. The basis for the argument shall be per the criteria listed in section 1.10.2 above.
 - Site/civil plans detailing the proposed deviation shall include at a minimum a drawing showing the applicable conditions, topographic features, traffic patterns and any unusual or unique conditions not generally found in other developments.
 - Supporting documents detailing engineering analysis such as traffic studies, drainage reports, typical sections, alternative designs etc. Each supporting document shall be signed and dated. When required, each document shall be sealed in accordance with the State of Arizona Board of Technical Registration.
 - Other pertinent data.

C. Once the application has been filled out and the technical documents have been prepared, four (4) copies of the Application and the supporting technical documents shall be prepared and submitted with the appropriate fees to the City of Avondale:

Development Services Center
Engineering Plan Review Manager
11465 West Civic Center Drive
Suite 110
Avondale, Arizona 85323-6804

D. Engineering Standards Deviation Fees:

There are two fees for processing an Engineering Standards Deviation. The first fee is an application fee, and the second fee is a City review fee. The application fee is a flat rate fee that is assessed at the time of submittal and covers staff time in processing the submittal and providing a preliminary review for completeness. The City review fee shall be assessed at an hourly rate and shall be dependant on any additional time it takes City staff to review the Engineering Standards Deviation request during the review process. In no case shall an applicant be billed in excess of 40 hours for review of any single deviation from City Engineering Standards. The current Engineering Standards Deviation Fees can be found at www.avondale.org.

E. Once submitted to the City, a preliminary review shall be performed to determine if the application and supporting technical documents are complete in nature. If either is found to be incomplete, the applicant will be contacted within one week of submitting and shall be notified of any inadequacies. The applicant shall then have one opportunity to revise and re-submit the application and technical documents at no charge. Subsequent submittals due to inadequacies shall require the developer pay the deviation application fee each time they need to resubmit.

F. Once the application and technical documents are accepted as complete by City of Avondale Engineering staff, evaluation shall commence. Engineering standard deviations shall be decided upon within 15 working days of the date of acceptance, or within a longer period of time as agreed upon by the applicant and the City.

G. City staff shall evaluate the engineering deviation request and reach a determination based upon the criteria listed below:

- Public Safety (No deviation will be granted which compromises the public's safety)
- Function
- Traffic Management
- Durability
- Cost of Maintenance
- Water and Sewer Service availability
- Environmental Quality

- Storm Water Quality
- Appearance
- Community Development
- Quality of Life
- Other appropriate factors that may contribute to the council goals for the planning and development of the City.

H. Prior to receiving final determination the applicant will be notified of any outstanding review fees assessed by City staff during review of the deviation request. After all fees have been paid, the findings on the deviation request shall be provided to the applicant in a formal letter of determination.

I. Appeals Process:

An applicant has the right to appeal the determination rendered by development services staff, however they must submit a formal appeal to the City Engineer. Submitting a formal appeal requires payment of a subsequent Engineering standards deviation application fee, and the completion of an appeal application with a brief narrative discussing the reasoning for appeal. The City Engineer will evaluate the appeal and make a final determination. The City Engineers determination shall be final. The same standard may not be submitted for deviation review more than one time in the same location.

Although deviation requests can be submitted until the point which construction plans are approved, any additional plan review fees required as a direct result of submitting later in the process will be the sole responsibility of the applicant.

CHAPTER 2 GRADING AND DRAINAGE

2.1 General Information

The purpose of this chapter is to present general information, minimum specific guidelines, and provide minimum design criteria and guidance regarding the preparation of drainage reports and grading, drainage, and storm water facility plans. Storm water facilities may include the following:

- Surface and sub-surface storm drain systems
- Sub-surface retention systems
- Retention basins

The City of Avondale has adopted the Uniform Drainage Policies and Standards for Maricopa County, as published by the Flood Control District of Maricopa County (FCDMC). The FCDMC has developed the Drainage Design Manuals Volume One (Hydrology), Volume Two (Hydraulics), and Volume Three (Erosion Control). Specific guidance is presented for preparing drainage reports and grading and drainage plans using design standards and methodologies developed by the FCDMC.

Refer to FCDMC website at www.fcd.maricopa.gov for the Drainage Design Manuals.

Refer to Chapter 8, Article II Flood Hazard Areas of the City of Avondale City Code for requirements and restrictions of development within an area designated as a special flood hazard area.

2.2 Availability of City Storm Drain

The existing City of Avondale storm drain system is limited. New developments may be required to install a storm system to serve their development. Due to the limited City storm drain system, developments are required to retain their own runoff plus the runoff from adjacent streets onsite.

2.2.1 Area Drainage Master Plan

Area Drainage Master Plans (ADMP) that may impact areas within the City of Avondale are on file with the Flood Control District of Maricopa County, including but not limited to the following:

- The White Tanks/Agua Fria Area Drainage Master Study
- The Durango Area Drainage Master Study

New development shall reference the applicable ADMP's and included the study's pertinent data in the preparation of the development's drainage report.

2.3 City Code

Including, but not limited to City Code, Chapter 8, Drainage and Flood Hazard Areas, Article III Stormwater Quality contains information regarding the control of pollutants in the City storm drain system, operation and management of stormwater structures.

An electronic version of the Avondale City Code can be referred to on the COA website at www.avondale.org.

2.4 City Policies

New land development activities may result in potentially higher storm water drainage, more frequent flooding and increased pollutants. The City of Avondale has developed standards to alleviate or reduce these potential results. The Engineer should be aware of and become familiar with the various standards that pertain to land development with the City of Avondale.

2.4.1 Adequate provisions shall be made for disposal of storm water runoff from both private lots and public streets and to avoid ponding at any point within the subdivision. Existing major surface drainage courses shall be maintained and dedicated as drainage easements including maintenance access. Final location, capacity, and type of drainage ways shall be recommended by the Design Engineer and approved by the City. Where storm water is discharged into any outfall not controlled by the City, the development shall submit satisfactory evidence that the discharge can be accommodated by the outfall and is approved by the owner/custodian thereof.

2.4.2 Projects shall provide retention of the 100-year 2-hour storm even within the project's boundaries. The retention calculations for the project shall include the adjacent streets to the centerline, alleys, easements, tracts or other rights-of-ways.

2.5 Federal, State and County Regulations

2.5.1 Maricopa County Environmental Services Department (MCESD)

Maricopa County Earth Moving Permit and Dust Control Plan: MCESD regulates development projects that involve earth-moving operations or dust-generating operations that will disturb 0.10 contiguous acres or greater.

The Developer/Contractor shall provide the City of Avondale with copies of their Maricopa County Earth Moving Permit and Dust Control Plan in conjunction with the issuance of any Construction and/or Right-of-way Permits.

For additional information refer to: www.maricopa.gov/aq.

2.5.2 Arizona Department of Environmental Quality (ADEQ)

ADEQ regulates water quality and the quality of storm water discharges, including those directed to drywells. Prior to drilling, installing or abandoning a drywell, permission must be obtained from ADEQ. It is the responsibility engineer or drywell owner to obtain the required ADEQ Drywell Registration. For additional information regarding this aspect of ADEQ, refer to: www.adeq.state.az.us/environ/water/permits/.

2.5.3 Storm Water Quality

Projects disturbing one (1) acre or more are subject to the National Pollution Discharge Elimination System (NPDES) requirements for construction sites under the Environmental Protection Agency (EPA) general permit for Arizona. Owners, developers, engineers, and/or contractors are required to prepare all documents required by this regulation, including but not limited to Storm Water Management Plan (SWMP), Notice of Intent (NOI) and Notice of Termination (NOT).

As prescribed by the Arizona Pollutant Discharge Elimination System (AZPDES) General Permit for Discharge from Construction Activities to the Waters of the U.S., any development project in Avondale which will disturb 1.0 contiguous acres or greater, shall complete a Notice of Intent (NOI).

Stormwater runoff from construction sites cannot include pollutants such as phosphorous and nitrogen, pesticides, petroleum derivatives, construction chemicals, solid wastes, and sediment that adversely affect water quality. For additional information refer to: www.adeq.state.az.us/environ/water/permits/.

A. City of Avondale Requirements

The operator of a construction site is responsible to meet the requirements of ADEQ under the AZPDES permit. Operator shall also comply with the requirement of City of Avondale City Code Chapter 8 Drainage and Flood Control Article III Stormwater Quality Protection. The operator can be the owner, developer, general contractor, or individual contractor responsible for operational control.

B. Storm Water Management Plan (SWMP)

The City of Avondale's SWMP is designed to address the need to prevent or reduce discharges of pollutants to Waters of the United States. The following information shall be submitted to the City:

- Submit a Notice of Intent (NOI) to ADEQ for authorization;
- Prepare and implement a Stormwater Management Plan (SWMP) and keep a copy on site;
- Include two (2) copies of the NOI and SWMP with the erosion and sediment control plan submittal to the city.
- Send a Notice of Termination (NOT) to ADEQ and the City once construction is completed, as defined in the general permit.

C. The City will review stormwater management plans and is authorized to enforce stormwater management requirements, and inspect and respond to complaints of violations.

D. Contact ADEQ for specific permit requirements or see their website www.azdeq.gov/environ/water/permits/stormwater.html for NOI and NOT forms and guidance for preparing the SWPPP.

E. Best Management Practices (BMP)

Refer to the City of Avondale City Code Chapter 8 Drainage and Flood Control Article III Stormwater Quality Protection, and the Drainage Design Manual for Maricopa County, Volume III, Erosion Control for the BMP Standard Details to include with the SWMP submittal.

2.6 Drainage Reports

2.6.1 Preliminary Drainage Report

A. A preliminary drainage report shall be provided projects with the preliminary site plan. A preliminary drainage report shall be provided on CIP projects at the 30% submittal. The report shall verify that the site will have sufficient drainage facilities to accommodate the required retention and other required elements of the site plan.

The preliminary drainage report shall delineate the 100-year floodplain and floodway limits for drainage way that serve areas of more than one-quarter ($\frac{1}{4}$) square miles, or which generate an estimated flow rate of more than 500 cfs for the 100-year event per State Standard Attachment SSA 2-96.

B. The preliminary drainage report shall be a shorter version of the final drainage report and shall include:

- Cover
 - Project name
 - Developer's name, address and phone number
 - Engineer's name, address and phone number
 - Engineer's seal
 - Date prepared, along with revision dates
- Introduction
 - Description and location of the project
 - Topography of the site
 - Proposed land use, number of units, etc.
 - General description of the offsite area impacting the site

- Include statement regarding onsite and offsite retention (adjacent half streets) requirements are being met
- The existing floodplain (include a copy of the FEMA map for the proposed site)
- Provide the Flood Insurance Rate Map (FIRM) information as follows:

Community Number	Panel # Panel Date	Suffix	Date of FIRM (Index Date)	FIRM Zone	Base Flood Elevation (in AO Zone use Depth)

- Analyses of onsite and offsite runoff, including HEC models, if applicable.
- Sizing of channels for conveyance of offsite runoff.
- Required volume and capacity of proposed basins
- Locations of drainage facilities, (retention basins, storm drain pipes, catch basins, etc.) drainage easements, and tracts. The size of storm drains and catch basins do not have to be calculated in the preliminary drainage report.
- An overall drainage map with retention basins and sub-basins to improve the proposed Time of Concentration (Tc) flow path.
- Design criteria and assumptions
- Methodology used for onsite and offsite drainage
- Computer programs to be utilized.
- Location and elevation of the site’s outfall

2.6.2 Final Drainage Report

A. The final report shall include a detailed narrative, topographic maps and available aerial maps that describe the location and condition of the property to be developed, the upstream watershed and downstream conditions that may affect the development property. The final drainage report, and the development’s improvement plans shall be submitted to the City for review and approval.

For CIP projects the final drainage report shall be submitted with the 60% submittal.

B. The report shall include the following information:

- Cover
 - Refer to Preliminary Drainage Report Section.
- Table of Contents, including Appendices and Exhibits
- Introduction
 - Refer to Preliminary Drainage Report Section.
- Summary Tables near the front of the report. Include the following tables:
 - Summary of streets and the required curb types and curb heights

- Summary of catch basins or scuppers and sizes
- Summary of retention basins noting the required and provided volumes
- Methodology
 - Description of the existing studies which are referenced for this project.
 - Description of the methods used to quantify runoff.
 - Description of the criteria used to accommodate runoff.
- Offsite Runoff
 - Description of the extent and nature of the watershed contributing offsite flow to the project.
 - Description of flows based on existing or new analyses and how they were developed.
 - Description of how the offsite flows currently enter, exit or pass around the site.
 - Description of the approach to managing offsite flows through or around the site. (i.e., Do offsite flows enter the subdivision at the street connections, or intercepted at other points?)
 - Hydrologic and hydraulic calculations, including HEC analyses where applicable, shall be provided in the Appendix.
- Onsite Runoff
 - Description of the approach to managing onsite runoff and stormwater retention.
 - Description of how runoff volumes are quantified (C-values, rainfall volume, etc.).
 - Summary of retention basin sizing calculations. Include the capacities of the basins being provided.
 - Where insufficient retention volume is being provided for a sub-area, describe where the excess will be stored and how it flows there.
 - A section on emergency overflows shall be provided to describe how each retention basin will overflow and at what elevation. These overflow elevations shall be compared to adjacent finished floor elevations, and in no case shall the overflow elevation be higher than the finished floors.
 - Demonstrate how retained stormwater will be dissipated through a combination of percolation and drywells.
 - Calculations, including hydrologic summary sheets, shall be included in the Report's Appendix.
 - The drainage report should contain a schematic indicating what portion of the storm water runoff flows will be picked up in a specific drainage sub-basin and that excess flows have been accounted for in subsequent downstream sub-basins.
- Street Capacities
 - The Engineer shall demonstrate that the stormwater conveyance for each street within the project does not exceed the City's standards, as outlined in this chapter.

- A spreadsheet or table shall be provided to summarize the street capacity calculations.
- The use of 4-inch or 6-inch high curb throughout the project shall be demonstrated with notations in the summary spreadsheet. Construction plans shall match the spreadsheet.
- Street capacity calculations shall be included in an Appendix, or table.
- Drainage Facilities
 - All facilities shall be designed in accordance with City Standards and Construction Specifications.
 - Calculations for all catch basins, scuppers, pipes and channels shall be provided.
 - Appropriate formulas for sump or on-grade conditions for catch basins or scuppers shall be used.
 - Calculations for flows which weir over sidewalks shall be provided.
 - Pipes shall be sized using a hydraulic grade line analysis including a network analysis where pipes serve multiple inlets.
 - The storm drain analysis shall utilize a hydraulic grade line based on the assumption that the receiving retention basin is one-half full at the time that the pipe is carrying peak discharge.
 - A freeboard of at least one (1) foot shall be provided between the hydraulic grade line and the gutter elevation at the inlet.
 - Profiles of each storm drain system shall be provided showing:
 - Catch basins, pipes, headwalls, and basin floor and water storage elevations.
 - Nomenclature for each inlet and pipe to match the calculation sheets.
 - Proposed finished grade over the pipes.
 - The 10-year 2-hour, or 100-year 2-year hydraulic grade line, pipe diameter and slope, as applicable.
 - Open channel capacity calculations shall be provided along with 100-year 2-hour water surface elevation to determine the finished floor elevations.
- Exhibits
 - A drainage area map drawn to scale shall be provided for offsite and onsite watersheds.
 - The onsite drainage map shall include, as a minimum:
 - Topography in the form of contours.
 - All rights-of-way, street names, lots, tracts and drainage facilities.
 - Drainage sub-area boundaries with Time of Concentration flow path.
 - Flow arrows.
 - North arrow, legend, etc.
 - All retention basins and their emergency overflow points shall be shown.

- Boring log and percolation rates at all proposed retention basins and drywell locations.
- Provide an area drainage map that indicates the inundation limits for the 100-year 2-hour peak storm event.

2.7 Design Standards and Guidelines

2.7.1 General

A. All drainage requirements, guidelines, assumptions and calculations shall be designed using the Maricopa County Drainage Regulation, Flood Control District of Maricopa County (FCDMC) Drainage Design Manuals, Volumes I, II, and III the most current editions.

B. The volume of storage provided onsite must equal the total runoff volume generated by the 100-year, 2-hour storm from all the area within the site for fully developed conditions. Storm drainage retention and conveyance systems shall be designed to eliminate and reduce the storm water runoff impact on downstream properties. No storm water drainage system shall be approved if the effect may cause an increase in peak discharge, volume, velocity of runoff, or change the point of entry of drainage onto another property during the storm runoff event.

C. In no case shall the post-construction runoff volume exceed the pre-construction runoff.

D. All charts, tables, constants and other information used in the calculations shall be attached to the drainage report that is submitted to the City. This information shall be in relative and logical order when submitted.

E. For each project, the design engineer shall account for both onsite and offsite drainage flows and volumes relative to the management and design of storm water management.

All drainage management and design shall be in accordance with City of Avondale requirements, the Maricopa County Drainage Ordinance and the MCFCD Drainage Design Manuals (Volumes I, II, III)

Refer to the MCFCD Drainage Design Manuals for the following:

- Methodology to Calculate the Watershed Areas
- Runoff Coefficients (C). Note: Care should be taken in using weighted runoff coefficients. City staff reserves the right to adjust the coefficient used in the calculations.
- Rainfall Intensity (i)
- Time of concentration (T_c)
- Volume of Retention Required (V_r)

- Basin and Sub-Basin Geometry

The above data shall be included in all Final Drainage Reports submitted to the City for review and approval.

2.8 Onsite Stormwater Management

This section discusses the requirements and provides the criteria for the stormwater management of the onsite portion of the proposed land development site. Onsite drainage is defined as the stormwater runoff generated by the site to be developed. Offsite drainage is runoff which is generated outside the geographic limits of the site and impacts the developing site.

2.8.1 Retention Basins

A. Retention basins shall be designed to retain the runoff, as delineated by the contributing drainage area, for the 100-year, 2-hour storm.

B. The contributing drainage area is the total area being developed, consisting of all private, public, and right-of-way areas, including adjacent collector and arterial half-street rights-of-way.

C. Retention basins shall be designed with a maximum water storage depth of three (3) feet for the 100-year 2-hour volume. Greater depths may be approved provided the retention basin side slopes are a minimum of 6:1.

D. Retention basin side slopes shall not exceed a 4:1 (4 foot horizontal to 1 foot vertical ratio). A side slope of 6:1 is preferred.

E. Freeboard in the amount of one (1) foot minimum shall be provided for all retention basins.

F. Each basin shall have an emergency overflow provided which allows for excess runoff to flow from the basin through an adjacent street or drainage easement without causing any adjacent lots to be inundated.

G. Retention basin floors shall be designed to slope toward the drywells. Minimum slope of retention basin floors is 0.005 ft/ft.

H. Retention in Parking Lots: Retention in parking lots of multi-family developments is not allowed. All retention in such developments shall be in landscaped areas.

Retention in parking lots of industrial/commercial developments is allowed subject to the following standards:

- No more than 25% of the retention volume required may be retained in parking lots. The balance shall be provided in landscaped areas. The parking lot shall be sloped to drain the paved retention areas to the landscaped areas.
 - Depth in parking lots shall not exceed six (6) inches, nor shall it exceed two (2) inches at the midpoint of any parking space for the 100-year 2-hour storm.
 - A continuous emergency vehicle access lane shall be provided throughout the development, and it shall be free of ponded water from the retention areas.
- I. Stormwater retained within basins and on paved surfaces shall be dissipated within 36 hours following the end of the storm through percolation as described below.

2.8.2 Percolation and Drywells

A. The installation of drywells in retention basins that retain less than one (1) foot depth of retained drainage is not required provided that the geotechnical report verifies that the percolation rate will enable the retention basin to drain in the 36-hour time frame. Retention basins with a greater than one (1) foot depth of retention shall provide drywell(s) to drain the basins within the 36 hour time frame. A minimum of one (1) drywell is required for each retention basin.

B. Drywells shall be located away from the inlets to the retention basin to minimize the amount of silt entering the drywells. Once a year, at a minimum, the settling chamber shall be inspected. Sediment shall be removed from the chamber at such time that approximately 25% of original volume of chamber is filled. This requirement shall be noted on the construction plans identifying the name of the entity responsible for compliance.

C. The number of drywells required in each basin shall be determined based on:

- The accepted design disposal rate for a drywell is not to exceed 0.1 cfs per well unless a greater rate can be supported by a detailed, certified geotechnical report. Should the geotechnical report indicate a higher rate, a conservative value of 50% of the higher rate (not to exceed 0.25 cfs per drywell) shall be used to compensate for deterioration over time.
- Percolation rates shall be established for each project based on tests per ASTM standards conducted by a geotechnical engineer at the location of each basin and at the approximate depth of the floor of the basin. Percolation tests shall utilize a hole lined with a 12 inch diameter pipe to eliminate sidewall interference.
- Percolation test results shall be included in the project's drainage report.
- The number of drywells may be reduced for each retention basin by providing the following data:
 - 50% of the retention basins bottom area may be assumed to drain via in-situ percolation. To document the in-situ percolation rate a field investigation and testing in accordance with ASTM Standard D-3385, Double Ring Infiltrometer shall be conducted by a geotechnical engineer.

- The field investigation shall include boring at least 10 feet deep to assure that the soils underlying the basin will not impede percolation.
- One test boring shall be provided for each 2500 square feet of basin bottom.
- The test results shall be reduced by a factor of 10 to allow compensation for actual functional percolation rates due to basin soil compaction, progressive silt loading and actual storm water constituents that clog soil pores.
- A report shall be prepared by a licensed geotechnical engineer that documents the field investigations, testing, adjusted percolation rates and the final proposed design of retention basins.

D. Drywells installed in basins shall comply with the COA Supplement to MAG Specifications and Standard Details.

E. In small retention basins where the drywell cannot be located away from the inlet, or where the storm drain discharges below the floor elevation of the retention basin, a dual chamber type drywell shall be installed.

F. Drywells installed in retention basins within commercial or industrial areas where fueling occurs shall be a dual chamber type drywell. Each chamber shall use a floating absorbent pillow to enhance the removal of petroleum-based organics floating on the water. A hydrophobic petrochemical absorbent with a minimum capacity of 100 ounces shall be provided in each drywell chamber.

G. Drywells installed in basins within sub-areas where fueling occurs shall be specifically designed to process and dispose of surface water from the service station.

H. In no case, shall a storm drain connect directly into a drywell as the only means of outfall.

I. Drywell grates shall be installed at an elevation of at least three (3) inches above the finished grade of the basin.

2.8.3 Underground Storage

Underground stormwater retention may be permitted if approved by the City. The Engineer shall consider the following during the design process.

A. Venting of the underground drainage structure.

B. Access to the underground drainage structure for routine maintenance will be required. All maintenance shall be the responsibility of the property owner or developer. Developer will provide a copy of Operation & Maintenance Manual for underground storage facility to the City for review.

- C. Structural loads including any surface loads.
- D. Buoyancy of the underground drainage structure.
- E. De-watering of the underground drainage structure within the required 36 hours will be required. Drywells used for de-watering shall be a dual chambered design.
- F. The Engineer shall include in the drainage report for the project, design criteria, operational and maintenance schedule for the underground structure and any associated equipment such as pumps.
- G. Geotechnical report for recommendation of corrosion and allowable materials (pH and resistivity).
- H. No portion may be located within public right-of-way, or public utility easement.
- I. The City will not accept liability for maintenance or property damage from failure of the storage system.

2.9 Offsite Stormwater Management

This section reviews the requirements and provides the criteria for offsite drainage for proposed projects including any public street right-of-way.

Offsite drainage is considered to be drainage that originates upstream of the proposed projects and has historically traversed either through or adjacent to the project site.

2.9.1 Offsite Stormwater Requirements

- A. All improvement projects are required to convey the 100-year 2-hour storm peak offsite flows through the project's site. The preferred conveyance route of the offsite flows through the site is in their historic conveyance patterns.
- B. Offsite flows shall be carried through the development and discharged at a location and in a manner consistent with historical flow patterns without adverse impact to adjacent, upstream, or downstream properties.
- C. Offsite flows shall not be mixed with any stormwater flows originating from within the project's contributing drainage area unless specifically approved by the City.
- D. When offsite flows are discharged into public right-of-way, a storm drain analysis shall be prepared and submitted.
- E. Offsite drainage shall be identified either through existing approved drainage or flood control studies or through project-specific studies.

F. Offsite drainage analysis may also be accomplished by updating an existing study through the development of better and more recent topographic information and field work.

G. Offsite runoff shall be modeled by the Engineer for the 100-year, 2-hour, 6-hour, or 24-hour event in accordance with the FCDMC Manual. The 10 year runoff volumes and peak flows shall also be modeled for comparison and verification of stormwater runoff conveyance.

H. For the hydrologic analysis of small watersheds (160 acres or less), the rational method may be used. For larger watersheds (over 160 acres), the HEC-1 model shall be used.

I. The Engineer shall demonstrate through modeling and design that the offsite flows, up to and including the 100-year event, will be stored within the site or will be passed through the site in a safe manner, returned to their historical discharge points, and discharged in the same manner as previous to the development of the site.

J. Offsite flows may be carried in arterial streets as long as the street capacities are not compromised as specified in this manual. A drainage conveyance system shall be provided to carry the offsite drainage that exceeds the street capacities. The designed conveyance system shall not negatively impact adjacent or downstream properties.

2.9.2 Street Design and Capacity

Public street surfaces and the adjacent right-of-way can be utilized as a means to convey stormwater flows subject to the following:

A. Arterial streets and major collectors shall be designed such that the peak flows generated by a 10-year 2-hour peak storm shall be conveyed while maintaining one 12 foot dry traffic lane in each direction.

B. All other public streets shall be designed to carry runoff from a 10-year 2-hour peak storm between the top of curbs.

C. During the 100-year 2-hour peak storm, the runoff shall be confined to the right-of-way limits of the street.

D. No street shall be designed to convey flows greater than 100 cfs, nor with velocities greater than 10 fps.

E. Six-inch vertical curb shall be used where needed to meet the street capacity requirements. Curbs higher than six (6) inches shall not be used without specific permission of the City.

F. Storm runoff being conveyed in streets shall be intercepted by a drainage inlet and removed from the collector street before the intersection with an arterial street. Any exceptions must be approved by the City.

G. Inverted crown designs are not permitted upon public streets without City approval.

H. Conflicts between any of these requirements shall be resolved with the City. The Engineer shall contact the City to review recommended resolution.

2.9.3 Storm Drain Facilities

The installation of storm drain facilities (storm drain pipe, catch basins, scuppers, channel, etc.) will be required where the peak flows exceed the capacity of the public street to convey the peak flows. Storm drain facilities shall be sized to carry the excess flows (i.e., when the 10-year peak exceeds the spread criteria or exceeds the curb capacity of the public street).

A. Catch basins, scuppers, and storm facilities shall be designed to meet the street design criteria for the 10-year 2-hour storm peak event such that spread on street does not exceed the right-of-way limits during the 100-year 2-hour storm.

B. Depressed curb and sidewalk are not permitted for drainage purposes.

C. Grated catch basins are to be avoided where possible. When a grate is required, specify bicycle friendly grates. Catch basins shall be in accordance with the COA Standard Details. Wing lengths and V-depths shall be called out on the plans. Inlet capacities shall be calculated in accordance with:

- The Drainage Design Manual for Maricopa County, Volume II, Hydraulics
- The Engineer shall make allowances for clogging factor of the inlet structure, per FCDMC manual.

D. Scuppers shall be in accordance with COA Standard Details with the length of the scupper called out. In the hydraulic report and the construction plan, all scuppers shall have a handrail installed immediately behind the scupper in accordance with the COA Standard Details.

E. Below grade outlet structures shall be avoided wherever possible. In order to avoid a below grade outlet structures, a depression in the floor of the retention basin at the headwall up to one (1) foot deep may be provided, as long as the depression is large enough to allow a dual chamber drywell to be installed within the depression for positive drainage.

F. Headwalls:

- Headwalls shall be reinforced concrete construction in accordance with MAG Standard Detail 501.
- Headwalls shall be located on the plans such that the ends of the wing walls are located one (1) foot above the toe of slope. The back of the headwall must be located to provide for a minimum of one (1) foot of cover over the pipe.
- Headwalls with pipes greater or equal to 18 inch diameter shall have access barriers. The Engineer shall provide separate details. Barriers shall be flush mounted to the headwall and be child resistant.
- A safety rail per the MAG Standard detail shall be provided at all headwalls.
- Provide erosion protection at outlet and top of headwalls at each location.

G. Drainage channels when required shall be designed to convey up to the 100-year peak flow with a water surface elevation which does not create backwater conditions within the upstream street. Channel calculations shall be provided by the Engineer in the Drainage Report.

2.9.4 Storm Drain

Storm drain shall be designed to convey the storm water from the street inlets to an outfall location. The storm drain line shall be a minimum diameter of 18 inches.

A. Pipe Classification

Storm drains installed with City of Avondale right-of-way shall be designed per the following:

- In street right-of-way pipe shall be designed for H-20 loading factors. The pipe shall be a minimum of one (1) foot below street subgrade.
- The minimum D-load class specification shall be ASTM C-76 Class III, or the actual installation requirement per the pipe manufacturer, whichever is greater.
- Trench loading calculations shall be provided upon request by the City.
- The improvement plans shall clearly identify the class of the pipe for all storm drains, whether public or private within the City of Avondale right-of-way.

B. Pipe Material

- Rubber Gasket Reinforced Concrete Pipe (R.G.R.C.P.).
- High density polyethylene (HDPE) pipe. HDPE not approved in public right-of-way.

C. Velocity

The City of Avondale requires that the minimum velocity at the peak flow conditions of the storm drain shall be two (2) feet per second (fps). The maximum velocity shall not exceed eight (8) fps.

D. Hydraulic Grade Line

The hydraulic grade line for the design storm may be above the pipe, provided that it remains at least one foot below the ground elevation at all manholes, catch basins, inlets, etc.

E. Manholes and Junction Structures

- Manholes shall be per MAG Standard Details and Specifications.
- Maximum spacing for manholes shall be per Table 2-1:

**TABLE 2-1
Storm Drain Manhole Spacing**

Pipe Size (Inches)	Maximum Spacing (Feet)
18" to 36"	400'
42" to 48"	660'
Larger than 48"	(case by case basis)

- Manholes and/or junction boxes are required at the following locations unless otherwise approved:
 - Junctions of two or more pipes (except for 15" lateral pipes). Storm drain to a single catch basin lateral may be done with a tee connection.
 - Changes in grade.
 - Changes in alignment greater than 12.5°. Less than 12.5° shall install a pipe collar per MAG Standard Detail 505.
 - Changes in pipe sizes

2.9.5 Storm Drain Connector Lines

Storm drain connector lines are pipes that connect the inlet structure to the storm drain line or to an outlet structure. The pipe shall be Rubber Gasket Reinforced Concrete Pipe (RGRCP) with a minimum diameter of 15 inches. Use of a smaller diameter pipe requires City approval.

- A.** The top of pipe of the connector pipe shall be a minimum of one (1) foot below street sub-grade.

B. The connection of the connector pipe to the main storm drain pipe(s) shall be per M.A.G. Standard Detail 524 or with a prefabricated tee. Design shall not have an adverse effect to the hydraulics of the storm drain.

2.9.6 Watercourse Crossing of Street

A. Dip or Sag Street Sections: The design of public streets to install a dip/sag section in which to channelize the storm water flows across public streets is prohibited except where specifically approved by the City.

B. Existing dip/sag sections on public streets that are subject to street widening improvements required by the development of the adjacent project site shall be removed and replaced with a storm drain system to convey flows beneath the street.

C. Where the historical watercourse crosses an arterial or collector street, and the streets are required to be improved as part of development services or capital improvement projects, the improvements shall install culverts beneath the street. The culverts shall be designed to convey the 50-year 2-hour peak storm with no flows overtopping the street. The 100-year 2-hour peak storm shall be conveyed by culverts and allow a maximum flow depth of six (6) inches overtopping the street.

2.10 Finished Floor Elevations

A. New construction or substantial improvements to any existing structure shall be constructed to have the lowest finished floor elevation at a minimum of 12 inches above the 100-year flood elevation. In FEMA Flood Zone D, the finished floor elevation shall be two (2) feet above the 100-year base flood elevation with floodway delineation. City of Avondale Subdivision Regulations requires a minimum finished floor of 14 inches above the low top of curb. The COA Building Code may require greater than 14 inches. The finished floor elevation shall comply with most stringent of the requirements.

B. The Engineer shall also demonstrate that finished floor elevations are above all emergency flood conditions (i.e. finish floor to be above the ultimate basin outfall elevation).

C. Mobile/manufactured homes shall be elevated so that the bottom of the structural frame shall comply with Paragraph A of this section.

2.11 Grading Improvements

2.11.1 General

The existing topography shall be noted a minimum of 100 feet beyond the site's boundaries. The proposed grades of the new development shall be designed to match the existing grades adjacent to the site. The general site grading and drainage flows shall be maintained as much as the field conditions will allow.

2.11.2 Design

- A.** Grading in public right-of-way shall not exceed 1.5% from the top of curb to the right-of-way, with the sidewalk draining toward the street.
- B.** Slopes within the PUE shall not exceed 8 to 1.
- C.** Where lots back up to a retention basin, a level area with a minimum width of two (2) feet shall be provided between the wall and the top of slope.

2.12 Retaining Walls

Retaining walls may be used to reduce the horizontal and vertical distances required to construct cut and fill slopes.

- All retaining walls, regardless of height, shall comply with the City building code.
- Acceptable types of retaining walls include stone gravity, structural masonry and reinforced concrete. Other types, such as metal cribbing walls and rock gabion walls, will require special approval by the City.
- For retaining walls greater than six (6) feet in height consider terraced retaining walls in lieu of one continuous retaining wall. The minimum dimension for the landscaped level located between the lower and upper terrace walls shall be at least equal to the visible height of the lower wall, but not less than four (4) feet.
- In general, match the finish material and color of retaining walls with the surrounding structures walls, natural stone, rock, or soil color.
- Plans for retaining walls shall be signed and sealed by a registered Professional Engineer in the State of Arizona.

2.13 Final Grading and Drainage Plan Requirements

Construction Plan Submittal Requirements for the preparation of final plans in the City are described in Chapter 1; this section supplements the requirements of Chapter 1.

2.13.1 Specific Grading and Drainage Plan Requirements

The following requirements apply to all grading and drainage plans prepared for submittal to the City of Avondale

- A.** The plan shall encompass the entire development site and a minimum of 100 feet outside the limits of the development.
- B.** Indicate and clearly label all existing utilities and improvements, topographic features and show topography within the site and 100 feet outside the limits of the development.
- C.** Indicate and clearly label all existing and proposed easements or rights-of-way. Existing easement or rights-of-way should be provided and labeled as to the type of

easement (drainage, emergency and service vehicle access, sight visibility, public utility, sidewalk,). For new easements, the easement type should be labeled.

D. If an overall key map is needed, the map shall provide the proposed street names, and identify the adjacent properties with property lines.

E. Existing topography shall be noted at one (1) foot contours. The five (5) foot contour line shall be darkened and/or utilize a different line type than the remaining one (1) foot contour lines for readability of the plan. If the site is relatively flat, sufficient spot elevations should be added to evaluate the design.

F. All portions of the development within the FEMA 100-year flood zones shall be delineated. If any such areas are identified, FEMA approval is required prior to City approval of improvement plans.

G. For washes with 100-year flow rates of 500 cfs or greater, the 100-year water surface elevations within the limits of 100-year floodplain shall be shown and labeled on the plans.

H. All retention basins shall indicate the volume required, volume provided, bottom elevation and high water elevation for each basin. Label flow rates and depth of flows at all inlets to basins.

I. Plans should include a drywell detail. Drywells shall be drilled a minimum of 10' into permeable porous strata.

J. Typical lot grading detail required for subdivision plans. Minimum side lot slope is 0.5%; no drainage from lot to lot is allowed.

K. Sections views at the outside boundaries of the project indicating how the new construction is matching to the existing conditions.

L. Location and elevation of each drainage area outfall.

M. For culverts and storm drainage, the location of the culvert and storm drain should be shown on the plans with number, material and, size of pipes and upstream and downstream invert elevation labels. Culverts and storm drains should provide a cross reference to the sheet containing the profile for the structure.

CHAPTER 3 TRAFFIC AND TRANSPORTATION

3.1 General Information

3.1.1 This chapter provides standards and geometric requirements for the design and construction of Project improvements within the City of Avondale. Transportation facilities may include arterial, collector, and local streets, alleys, traffic signals, street signing, pavement markings, public transit, pedestrian facilities, bicycle paths, traffic calming and trails, and other facilities. The minimum requirements described herein are primarily based on safety considerations; therefore under most circumstances, standards that provide a greater degree of safety may be used.

3.1.2 The City of Avondale has adopted the Avondale Transportation Plan which addresses the City's long range plans for local and regional transportation requirements. The Transportation Plan and a current traffic impact analysis shall be used to determine the roadway requirements.

3.2 Integration with City Codes, Ordinances and Regulations

Including, but not limited to Chapter 21, Streets and Sidewalks and Chapter 22, Article IV, Subdivision Regulations contains information regarding the development of the public streets in association with land development.

A link to an electronic version of the City code may be found on the COA website at www.avondale.org.

3.3 State Route 801 Corridor

The proposed freeway **State Route 801 (SR 801)** will generally be aligned parallel to and south of the Interstate 10 (I-10), and north of the Salt and Gila Rivers, to connect the proposed South Mountain Freeway with the proposed Loop 303. More information can be obtained on the SR801 from the Arizona Department of Transportation (ADOT).

Freeways are arterial highways with full control of access. They are intended to provide high levels of safety and efficiency in the movement of large volumes of traffic at high speeds. Freeway access will be limited to arterial interchanges.

The City of Avondale will have approximately four (4) miles of frontage on the SR 801 freeway. The proposed SR 801 Corridor would begin with 107th Avenue on the east and Dysart Road on the west.

Development within the SR 801 Corridor shall be required to comply with City standards for construction improvements in the corridor. Construction shall mitigate the effects of freeway noise, and protect the public health, welfare and safety by establishing noise reduction requirements.

3.4 Design Standards and Guidelines

The American Association of State Highway and Transportation Officials (AASHTO) policies on highway design, Development of Bicycle Facilities, and Guide for the Planning, Design and Operation of Pedestrian Facilities, and the Manual on Uniform Traffic Control Devices (MUTCD) prepared by the U.S. Department of Transportation are approved references and shall be used in conjunction with this manual. MAG Uniform Standard Details, City of Avondale Supplement to MAG Specifications and Details, Manual of Approved Signs (ADOT), and Pavement Marking Manual (ADOT & MCDOT) shall also be used.

3.5 Traffic Impact Analysis

Traffic Impact Analysis shall be required for all new development, project expansions, change of use, or rezoning within the City. The Traffic Impact Analysis shall be prepared, signed, and sealed in accordance with the requirements of the State of Arizona Board of Technical Registration. It is the responsibility of the engineer to provide a Traffic Impact Analysis per Avondale Traffic Impact Analysis Procedures available from the City Traffic Engineer, or on the Traffic Engineering Division website.

3.6 Street Classification

The City of Avondale has four (4) basic classifications of streets for use relating to land development. The location and street classification is determined as part of the site planning and platting process. The City will review each subdivision plat and will specify any changes needed to conform with previously planned and approved street alignments. The City will also specify the classification for each street involved in the subdivision plat. Refer to City of Avondale Standard Details for street cross sections. All land development shall provide for public arterial and collector streets in accordance with City of Avondale Transportation Plan at their normal alignments, widths and geometrics, as determined by the City.

3.6.1 Arterial Street: (Six Lane):

Arterials are six-lane roadways to be built with a 130-foot right-of-way envelope, located approximately on the one (1) mile grid serving major traffic within the City connecting neighborhoods and business centers. The typical cross section provides for six (6) through traffic lanes, eight (8) feet wide sidewalks, two (2) bicycle lanes, and a sixteen (16) foot wide raised landscaped median, and the appropriate median openings. Auxiliary turn lanes may be required at intersections or driveways with additional right of way requirements. Refer to the Avondale Transportation Plan and/or street classifications map for the location of the six (6) lane arterial streets.

3.6.2 Phased Arterial Street (Four/Five Lanes):

Phased arterial roadways are to be built within a 130-foot right-of-way envelope. There are two (2) options for phasing as follows:

- Option One: An inside lane widening option with provisions for future widening on the inside (median) of the street section. The street section includes a thirty-eight (38) foot wide median, four (4) through traffic lanes, eight (8) foot wide sidewalks, two (2) bike lanes, and appropriate median openings.
- Option Two: An outside lane widening option with provisions for widening on the outside curb of the street section. The street section includes an optional sixteen (16) foot wide median, four (4) through traffic lanes, eight (8) foot wide sidewalks, two (2) bike lanes, and appropriate median openings.

3.6.3 Collector Streets:

Collector streets provide limited continuity serving the primary function of carrying traffic from local streets to arterial routes, and the secondary function of providing access to abutting properties. Collectors have low access control as they primarily provide connections to the local streets, but connections must be at a safe spacing. Auxiliary turn lanes may be required at intersections with additional right-of-way requirements.

A. Major Collector: Major Collectors are configured with four (4) through traffic lanes, sidewalks, bicycle lanes, and a center turn lane, or optional raised median typically located at one-half ($\frac{1}{2}$) mile alignments.

B. Industrial Collector: Industrial collectors are configured with two (2) through traffic lanes, six (6) foot wide sidewalks and striped bicycle lanes. Bike lane markings may be deleted with the City Traffic Engineer's approval.

C. Minor Collector: Minor Collectors are configured with two (2) through traffic lanes, sidewalks, bicycle lanes, and a center turn lane, or optional raised median typically located at one-quarter ($\frac{1}{4}$) and one-eighth ($\frac{1}{8}$) mile alignments.

3.6.4 Local Street:

Local streets are generally two lane roadways that serve residential neighborhoods within the City facilitating traffic movements between collector streets and adjacent lands involving relatively short distances. Local streets shall be so arranged as to discourage their use by traffic originating outside the immediate area. Local streets shall not be connected to arterial streets unless approved by the City Traffic Engineer.

3.7 Street Right-of-Way Requirements

3.7.1 All public street right-of-way dedication shall be unencumbered and free of environmental contamination per ASTM E-1527 current requirements. All right-of-way purchased by the City of Avondale is subject to the requirements as outlined in Chapter 21 of the Avondale City Code. The public right-of-way requirements shall be based upon the requirements of the transportation plan and the ultimate needs of the development. The dedicated right-of-way shall provide sufficient area for the installation of utilities, cut or fill slopes, sidewalks, traffic control devices, signs, fire hydrants,

landscaping, auxiliary turn lanes, transit facilities, and other public facilities that may be located adjacent to street corridors.

3.7.2 Additional right-of-way widths may be required in special circumstances for the following conditions:

- A.** When auxiliary traffic lanes are required at arterial-to-arterial or collector-to-arterial intersections.
- B.** Auxiliary lanes at commercial driveways.
- C.** To facilitate public transit facilities (bus pull-outs and concrete pads).
- D.** Auxiliary lanes or other conditions per the results of this traffic impact study.
- E.** Offsets or roadway shifts.
- F.** Other conditions that may be required by the City.

3.7.3 The minimum right-of-way requirements are per Table 3-1:

**TABLE 3-1
Street Right-of-Way Required**

Street Classification	Required Right-of-Way
Major Arterial (Six-Lane)	130 feet
Phased Arterial (Four/Five Lane)	130 feet
Arterial to Arterial Street Intersection	160 feet
Collector (Industrial)	60 feet*
Collector (Major)	100 feet*
Collector (Minor)	80 feet*
Local (Streetscape)	60 feet*
Local	50 feet*

*Additional right-of-way at collector or local street intersections as warranted by Traffic Impact Analysis (TIA)

3.7.4 Intersection Right-of-Way Triangle Requirements: All street intersections will require the dedication of a right-of-way corner triangle per Table 3-2.

**TABLE 3-2
Intersection Right-of-Way Triangle Requirements**

Intersection Classification	Minimum Requirements (Feet)
Arterial to Arterial	40 x 40
Arterial to Collector	30 x 30
Collector to Collector	20 x 20
Local to Local	20 x 20
Local to Arterial*	25 x 25

*Local to Arterial intersection must be approved by the City Traffic Engineer

3.8 Easements and Dedications

3.8.1 Public Utility Easements (PUE):

PUEs shall be located adjacent to each side of the dedicated street right-of-way. Public Utility Easements may not be located within the side or back property lines without the approval of the City Engineer. Landscaping installed in PUEs shall be of the shallow root, and non-intrusive variety, and shall be maintained by the property owner.

3.8.2 Vehicular Non-Access Easement (VNAE):

VNAE limits vehicular access to a site from arterial, and collector streets. On local streets a VNAE on private lots is required adjacent to all greenbelts and open space areas. Vehicular access shall be restricted by use of a one (1) foot VNAE, at locations other than street intersections and legitimate driveways. The ownership and maintenance of the VNAE remains with the property owner of the parcel from which the VNAE is granted.

3.8.3 Drainage Easement (DE):

DE dedications shall conform with the lines of any existing water course, drainage way, channel, or stream and such further width or construction, or both, as will be adequate for the purpose. Parallel streets or parkways may be required in connection therewith. All drainage easements shall be outside the roadway right-of-way. The ownership and maintenance of the DE remains with the property owner of the parcel from which the DE is granted.

3.8.4 Sight Visibility Triangle Easement

Sight Visibility Triangle Easements should be used as a means to limit the height of structures, vegetation, and other improvements on corner properties immediately

adjacent to intersections. Refer to COA Standard Details for sight visibility triangle design. Sight visibility triangle easements shall not preclude additional right-of-way requirements or sight visibility triangle restrictions per AASHTO calculations.

3.8.5 Temporary Drainage Easement (TDE):

An easement placed on a parcel of land temporarily for the conveyance or storage of storm water. The easement shall be extinguished upon the development and completion of the permanent drainage facility.

3.8.6 Temporary Construction Easement (TCE):

An easement placed on a parcel of land temporarily for the use of construction personnel and equipment. The easement shall be extinguished upon the completion of the construction project.

3.9 Curb and Gutter

3.9.1 Vertical Curbs

Vertical curbs are required for all streets throughout the City except local residential streets. Vertical curbs shall be used in place of roll curbs on local streets to meet the street drainage requirements.

On local streets the vertical height of the curb shall be four (4) inch, or six (6) inch. On arterial or collector streets the vertical height of the curb shall be six (6) inch unless otherwise approved by City staff. Installation shall be per MAG Standard Detail 220, Type "A". Vertical curbs shall be six (6) inch at all medians, and curbs adjacent to landscaping tracts or vertical structures.

3.9.2 Roll Curb

Roll curb per MAG Standard Detail 220 Type "C" may be installed on local streets as long as the 10-year 2-hour storm can be contained between the street curbs. Roll type curbing shall not exceed four (4) inches in height.

3.9.3 Median Curb

In locations where raised medians are constructed, vertical curb and gutter is preferred. Median curb shall be installed per MAG Standard Detail 220 Type "A" modified with an inverted gutter plan. In certain situations, the City may require curb to be constructed per MAG Standard Detail 222 Type "A". With City 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, provided a deviation from City Engineering Standards is granted per Chapter 1 Section 1.10 of this manual.

3.9.4 Curb Returns

Vertical curb shall be used through the curb return from PC to PT regardless of whether the tangent curb sections are vertical or roll curb. Sidewalk at curb returns shall be per COA Standard Details. The maximum grade at all curb returns is 1.5%.

A. Curb Return Radii on Streets

The radii for curb returns shall be in accordance with Table 3-3: All dimensions are to back of curb.

**TABLE 3-3
Curb Return Radii**

Street Classification	Intersecting Street Classification					
	Arterial	Phased Arterial	Major Collector	Minor Collector	Industrial Collector	Local
Arterial	35'	35'	30'	30'	30'	-
Phased Arterial	35'	35'	30'	30'	30'	-
Major Collector	30'	30'	30'	30'	30'	25'
Minor Collector	30'	30'	30'	30'	30'	25'
Industrial Collector	30'	30'	30'	30'	30'	25'
Local	-	-	25'	25'	25'	20'

B. Sidewalk Ramp:

Sidewalk ramps shall be constructed at all curbed return street intersections, at medians and wherever a pedestrian access route crosses a street, in accordance with the latest adopted Americans with Disabilities Act (ADA) Standards. 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 ADA requirements.

- Directional or double sidewalk ramps per COA Standard Details shall be installed at all arterial and collector street intersections, with exceptions as approved by the City. Where directional sidewalk ramps are required, the minimum curb return radius shall be 20 feet.
- Single sidewalk ramps per MAG Standard Details shall be installed at all local street intersections.
- At Tee Intersections one sidewalk ramp shall be installed per COA Standard Details, or if ramp conflicts with proposed driveway, a joint driveway and sidewalk

ramp per COA Standard Details may be installed. The ramp shall align with one of the sidewalk ramps on the opposite side of the street.

- Along safe routes to school, any crosswalk location or trail connections, additional sidewalk ramps may be required.
- Projects that include construction improvements at existing street intersections where existing sidewalk ramps are located shall note whether the ramps are in compliance with current City Standard Details. If the sidewalk ramps are not in compliance, they shall be removed and replaced with sidewalk ramps that meet City Standard Details.

3.10 Sidewalks

Installation of sidewalks shall promote and enhance pedestrian safety and the aesthetic quality of the roadway. Streets constructed to City of Avondale standards shall have sidewalks installed per COA Standard Details and conform to MAG Standard Detail 230. Sidewalks shall remain within the right-of-way.

Special Note: Sidewalks abutting schools require a minimum width of 10 feet. Sidewalks along designated safe routes to schools may be required to have wider than minimum width as directed by the City. Additional right-of-way or a sidewalk easement may be required to accommodate the extra width sidewalk.

3.10.1 Sidewalk Widths

A. Arterial Street:

- Meandering Sidewalk = Eight (8) feet with a minimum radius of 150 feet with a minimum separation of three (3) feet from back of curb at the closest point of meander, and with a maximum 10 foot separation from back of curb.
- Attached Sidewalk = Eight (8) feet wide. Attached sidewalks adjacent to auxiliary lanes and turning lanes at intersections and bus stops.

B. Collector Street:

- Detached Sidewalk = Six (6) feet wide with a minimum separation from back of curb of three (3) feet.
- Meandering Sidewalk = Six (6) feet wide on major and minor collectors only requires a minimum radius of 50 with a minimum separation of three (3) feet from back of curb at the closest point of meander.
- Attached Sidewalk = Six (6) feet wide. Attached sidewalks will only be approved adjacent to auxiliary lanes and turning lanes at intersections and bus stops.

C. Industrial Collector Street:

- Attached Sidewalk = Six (6) feet wide.

D. Local Street:

- Attached = Five (5) feet wide
- Detached = Five (5) feet wide with a minimum separation from back of curb of five (5) feet to be used on local streetscape section only.

NOTE: Detached and meandering sidewalks shall connect to the attached sidewalk at each curb return. Use a concave type design with a minimum radius of three (3) feet for the connection at curb return sidewalk.

E. Pedestrian Ways:

Pedestrian ways shall be constructed to connect sidewalks with public and private facilities not located in the public street right-of-way. Public pedestrian ways shall be within a tract or easement for such purposes that define the access and maintenance responsibility. The minimum width shall be six (6) feet, or a width consistent with adjacent trails, and may be used for additional purposes as approved by the City. If additional uses are approved, the minimum required width may be increased depending on the specific use.

F. Multi-Use Paths/Trails:

Multi-use path or trail surfaces should be firm, stable, and slip resistant material. Minimum design criteria for multi-use path are as follows:

- Two-way travel: Minimum 12-foot in width.
- Or, 10-foot paved/concrete with a two (2) foot decomposed granite path for joggers.
- One-way travel: Minimum six (6) foot width.
- Maximum longitudinal grade shall be five percent (5%) unless otherwise approved by the City.
- Minimum two (2) foot graded area adjacent to both sides of the path.
- Minimum separation of five (5) feet from a roadway.
- Maintain a minimum vertical clearance of eight (8) feet, and keep free to protruding objects.
- Edge protection if required, shall be a minimum height of 42 inches.
- Paths designated for equestrian and pedestrian use, the vertical clearance must be 10 feet.

3.11 Pavement Cross Sections

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 0.02 (2.0%) is required on all public streets. Inverted crown sections are not allowed, unless otherwise approved by the City, except as required at arterial or collector street intersections. Within an arterial or collector street intersection, the

cross-slope shall comply with City of Avondale Standard Details to accommodate ride ability through the intersection.

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, but normally, the desirable cross-slope is 0.02 (2.0%). The desirable slope from top of median curb to top of median curb shall not exceed 10% percent.

3.12 Horizontal Alignment

A horizontal curve is required when the angle of change in horizontal alignment is equal to or greater than five (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.

3.12.1 Minimum Curve Radius:

The minimum radius of curvature is determined by the design speed or by the stopping distance.

A. Minimum Radii Based on Design Speed:

Table 3-4 contains the minimum radius of curvature for each street classification with and without a superelevation of 0.02 ft/ft. Wherever possible, the radii used should be larger. If stopping sight distance conditions require a larger radius than that shown, then that larger radius becomes the minimum radius for the curve.

**TABLE 3-4
Minimum Horizontal Curve Radius**

	Arterial	Phased Arterial	Major Collector	Minor Collector	Industrial Collector	Local
Minimum Radius of Horizontal Curve without Superelevation	1800'	1800'	1100'	550'	450'	275'
Minimum Radius of Horizontal Curve with 2% Superelevation	1350'	1350'	850'	450'	350'	230'
Minimum Horizontal Curve Length	500'	500'	500'	400'	250'	100'
Stopping Sight Distance	550'	550'	365'	300'	225'	200'
Design Speed (MPH)	55	55	45	35	30	25

B. Minimum Radii Based on 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. Refer to Table 3-3 for the minimum stopping sight distances for various street classifications.

3.12.2 Superelevation in Curves

Superelevation is discouraged on horizontal curves; however, superelevation of 2% may be used when the minimum radius cannot be provided due to circumstances beyond the control of the Engineer, when the general alignment cannot be changed. Superelevation greater than 2% may not be used, except when approved by the City Traffic Engineer. In no case shall a superelevation exceed 6%.

A. Runout and Runoff: For superelevation transitions refer to the AASHTO publication, "A Policy on Geometric Design of Highways and Streets".

B. Storm Drain Requirement: Whenever superelevation is allowed on a divided street, a storm drainage system to collect the runoff along the median curb shall be provided. In no case shall nuisance water from the higher traveled way be allowed to cross to the lower traveled way.

3.12.3 Compound Curves

Compound curves (two curves with different radii in same direction) should be avoided. However if site conditions make the use of compound curve unavoidable, the shorter radius shall be at least two-thirds ($\frac{2}{3}$) the length of the longer radius when the shorter radius is 1,000 feet or less. Compound curves are not permitted when design speeds require the shorter radius to be greater than 1,000 feet.

3.12.4 Special Tangent Sections Between Curves in the Same Direction

On two-lane roads, tangent sections are needed between two curves in the same direction. If the pavement cross-sections throughout the curves do not have superelevation, then the minimum lengths for tangent sections are per Table 3-5:

**TABLE 3-5
Tangent Sections (Curves in Same Direction)**

Arterial	660'
Arterial (Phased)	660'
Collector (Major)	500'
Collector (Minor)	400'
Collector (Industrial)	400'
Local	250'

If superelevation is provided in the curved portions of the roadway, then the superelevation transition lengths per AASHTO will determine the tangent lengths.

3.12.5 Tangent Sections Between Reverse Curves

Tangent section shall 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 superelevation runout length and the tangent runout lengths. The required minimum lengths for tangent sections between reverse curves without superelevation are provided in Table 3-6:

**TABLE 3-6
Minimum Tangent Sections (Reverse Curves)**

Arterial	300'
Arterial (Phased)	300'
Collector (Major)	250'
Collector (Minor)	200'
Collector (Industrial)	250'
Local	100'

The City may approve the elimination of the tangent section between reverse curves provided the reverse curve radii are at least 50% greater than the minimum radii required.

3.12.6 Tangent Sections Approaching Intersections

A tangent section shall be provided between a street intersection and a curve unless otherwise approved by the City. The minimum tangent length is shown in Table 3-7:

**TABLE 3-7
Tangent Sections at Intersections**

Arterial	300'
Arterial (Phased)	300'
Collector (Major)	250'
Collector (Minor)	200'
Collector (Industrial)	200'
Local	100'

3.13 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.

Vertical curves are required when there is grade change equal to or greater than the percentages listed in Table 3-8. All sections of a street's vertical alignment must meet passing and stopping sight distance requirements for design speed established for the street. Refer to the AASHTO publication, "A Policy on Geometric Design of Highways and Streets" for vertical alignment design.

**TABLE 3-8
Vertical Curves Requirements**

Street Classification	Required When Grade Change is this % (Algebraic Difference of the Two Grades)
Arterial	One (1) %
Arterial (Phased)	One (1) %
Collector (Major)	Two (2) %
Collector (Minor)	Two (2) %
Collector (Industrial)	Two (2) %
Local	Three (3) %

3.14 Horizontal and Vertical Curves

When horizontal and vertical curves are combined, the horizontal curve needs to 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.

3.15 Longitudinal Street Grades

The maximum longitudinal street grade requirements are per Table 3-9:

**TABLE 3-9
Longitudinal Street Grade**

Street Classification	Maximum	Minimum
Arterial	6%	0.25%
Arterial (Phased)	6%	0.25%
Collector (Major)	7%	0.25%
Collector (Minor)	7%	0.25%
Collector (Industrial)	7%	0.25%
Local	10%	0.25%

3.16 Intersections

All street intersections share the same aspects to accommodate the traffic movements through the intersection safely. However each intersection shall be evaluated based on individual characteristics. Design shall be based on standard engineering criteria and the Traffic Impact Analysis requirements to minimize conflicts.

3.16.1 Typical Intersection Design Considerations

A. Traffic factors: Street capacities, turning movements, vehicle size and operating characteristics, vehicle speed, ride quality, pedestrian and bicycle movements, transit operations, schools in vicinity, traffic control, percentage of truck traffic, and accident history are factors for the intersection design, and future traffic projections.

B. Physical factors: Existing topography, existing conditions, channelization requirements, and sight distances shall be taken into consideration.

C. Human factors: Driving habits, reaction to surprises, decision and reaction time, and natural paths of movement.

3.16.2 Intersection Offsets (Centerline to Centerline)

Intersections along arterial streets should be kept to a minimum. New public or private street intersections on arterial streets should be located to align with planned median openings. New intersections on collector streets should be located to avoid creating conflicting turning movements with existing intersections or driveways.

A. Arterial streets:

- Arterial to arterial intersection: No offset. Intersections shall align.
- Arterial to collector intersection: Minimum offset is 330 feet.

- Arterial to local intersection: Local streets may not intercept arterial.

B. Collector streets:

- Collector to collector intersection: Minimum offset is 250 feet.
- Collector to local intersection: Minimum offset is 250 feet.

C. Local streets:

- Local to local intersection: Minimum offset is 125 feet.

3.16.3 Lane/intersection alignment: Maximum offset of lanes across street intersections from each other is two (2) feet. The offset dimension is measured from the traffic lane centerline to the corresponding traffic lane centerline across the intersection.

3.16.4 Angle of Intersection

A. Right-Angle

Intersections should be designed with right-angle street intercepts. Right-angle intersections provide the shortest crossing distance for intersecting traffic streams, meet driver expectations and the most favorable condition for drivers to judge the relative position and speed of intersecting vehicles. Where special conditions exist, intersection angles may diverge from a right-angle by a maximum of 2° (up to 4°) with approval of the City.

B. Skewed Angle

For skewed intersections, where any of the intersection angles are less than 88°, sight distances must be calculated in accordance with the procedures described in AASHTO's Policy on Geometric Design of Highways and Streets.

C. Number of Streets at Intersection

The maximum number of streets to intersect at any one intersection is four (4).

3.16.5 Alignment and Profile

Intersections occurring on the inside of horizontal or crest vertical curves of all streets are prohibited. Where the grade of the through roadway is steep, flattening through the intersections is required as a safety measure. The intersecting streets' profiles and cross slopes shall be coordinated with one another to ensure a safe and comfortable driving surface. Typically this may mean extending grades through the intersection for approximately 75 feet to 150 feet. Short vertical curves may be necessary in lieu of grade breaks.

3.16.6 Sight Distance (Intersections and Driveways)

Adequate sight distance shall be provided at all intersections and driveways on all streets, or types of roadways per City of Avondale Standard Details. The determination of whether an object constitutes a sight obstruction shall consider both the horizontal and vertical alignment of both intersecting roadways, as well as the height and position of the object. The sight distance required varies according to traffic speeds on the through road and widths of the intersecting streets or driveways. The Engineer may provide sight distance from their own calculations, as long as they are based on the AASHTO Policy on Geometric Design of Highways and Streets and submitted with the plans.

Continuous unobstructed line of sight must be provided along sight line and throughout the approach to the intersection, providing an unobstructed sight triangle to the side street driver. Sight lines are to be drawn on roadway and landscaping plans to represent the areas that must be free of all objects. There shall be no fence, wall, shrubbery, sign, and any other obstruction to vision between a height of two (2) feet, and seven (7) feet above the centerline grades of the intersecting streets and within the sight triangle. There should not be interference with the line of sight of a driver to an object, such as the overgrowth of a plant that is placed on the edge of the sight triangle.

Visibility must also be provided for traffic control devices, such as STOP signs and signal heads at intersections.

The designer must consider that other vehicles such as opposing left-turn vehicles in a median can block sight distance, and the design must account for this possibility. This is particularly evident along curves.

3.16.8 Valley Gutters at Intersections

Valley gutters and aprons are to be installed per MAG Standard Detail 240. At arterial and collector street intersections modify MAG Standard Detail 240 to increase the valley gutter from three (3) feet to a width of seven (7) feet. Minimum grade for valley gutter is 0.35%.

Transverse valley gutters are prohibited on arterial or collector streets. On local streets if a transverse valley gutter is proposed, it must be approved by the City.

3.17 Auxiliary Traffic Lanes

Auxiliary turning lanes permit the separation of conflicting traffic movements and remove turning vehicles from the flow of through traffic. Auxiliary traffic lanes apply to right and left turn lanes at street intersections and for deceleration lanes at mid-block driveways. The requirement for an auxiliary lane may necessitate additional rights-of-way. Refer to COA Standard Details for specific dimensions. Modifications to the storage and transition lengths may be allowed by the City where the conditions do not allow the full design standard to be met.

3.17.1 Right-Turn Lanes/Deceleration Lanes

A. Right-Turn Lanes:

Dedicated right-turn lanes are required at all major arterial intersections. Dedicated right-turn lanes may be required by the City at collector street intersections and on collector streets at major arterial intersections. Refer to City of Avondale Standard Details for specific dimensions.

B. Deceleration Lanes

Deceleration lanes allow entering vehicles to slow and complete a right-turn out of the through traffic flows. Refer to COA Standard Details. Note that longer storage or tapers may be required depending on the site and the Traffic Impact Analysis. The criteria for deceleration lanes are found in the City of Avondale Traffic Impact Analysis Procedures.

Deceleration lanes may be required on streets in conjunction with driveways per the approved Traffic Impact Analysis, and may require additional right-of-way.

3.17.2 Left-Turn Lanes

Left-turn lanes are required at all street intersections on and with arterials and major collectors. Left-turn lanes may also be required at street intersections on minor collectors based on the projected left-turn volume and conflicting through volume, or other safety issues. Left-turn lanes can be accommodated with a two-way left-turn lane on a collector street at uncontrolled minor intersections. For left turn lanes at signalized intersections, dual turn lanes may be required based the Traffic Impact Analysis, or the Avondale Transportation Plan.

3.18 Median Design

In the interest of public safety, traffic management and street aesthetics, raised medians are required on arterial streets to separate traffic flows, channelize left turns, control access, and reduce conflicts. On collector streets, raised medians help separate conflicting turning movements and can serve as traffic calming measure.

3.18.1 Raised Medians

Raised median islands shall be installed in accordance with Avondale Transportation Plan and COA Standard Details.

- **Storage Lane Lengths and Tapers:** Refer to City of Avondale Standard Details for minimum specific dimensions, unless the Traffic Impact Analysis results or City Engineer demonstrates longer lengths are required.
- **Termination:** Medians shall terminate in a bull nose per COA Standard Details.

3.18.2 Median Openings

Raised medians on arterial streets are provided to reduce conflicts, channelize turning movements for safety, and improve traffic flow. It is not possible to provide an opening in the median for every street intersection or driveway location. Careful consideration should be given to each request for a median opening to insure 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 should line up full access openings in compliance with the street grid system planned for the arterial corridor. Full access openings should generally 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 should be addressed in a Traffic Impact Study when requesting a partial access opening. Lastly, it is the preference of the City that all median openings be prohibited within 660 feet of an arterial to arterial intersection.

Full access median openings at less than one-quarter (1/4) mile intervals or within 660 feet of an arterial to arterial intersection must go through the Engineering Standards Deviation process outlined in Section 1.10 of this manual and be approved by the City Traffic Engineer. The applicant will be required to submit a standard Traffic Impact Study which also demonstrates the following:

- The full access opening is spaced safely and will not be in conflict with the planned grid system for the corridor.
- The full access opening will allow for safe operation.
- The full access opening shall not compromise storage requirements.
- The full access opening shall not compromise safety for all other turning movements.
- The full access opening shall not significantly impact the flow of traffic on the arterial.

Spacing for median openings is measured from the center of the median opening to the center of the adjacent median opening or intersection.

A. Full Access Median Openings: The full access openings consist of right-in/right-out and left-in/left-out turning movements. Full Access median openings may be required to be signalized.

B. Partial Access Median Openings: The partial access 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.

3.19 Street Access and Driveways

All driveways serving property abutting public streets in the City shall conform to the following guidelines.

- Single Family Driveway (w/vertical curb): Install per COA Standard Details
- Multi-Family Driveways: Install per COA Standard Details
- Commercial Driveway: Install per COA Standard Details
- Industrial Driveway: Install per COA Standard Details

3.19.1 Driveway Spacing

Minimum driveway spacing shall conform to the standards noted in Table 3-10. 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 street.

**TABLE 3-10
Driveway Spacing**

Street Classification	Minimum Distance Driveway Spacing
Arterial	250 feet*
Major Collector	250 feet
Minor Collector	150 feet
Industrial Collector	150 feet

*Can be 50% less if right-in/right-out only

3.19.2 Number of Driveways

Per Avondale City Code, the following schedule shall serve as a guide for allowable number of driveways on a site unless justified by a traffic impact analysis. Safe driveway spacing requirements per the above section shall be provided at a minimum.

- At least one driveway per abutting street will be allowed unless physical constraints or otherwise directed by the City.
- One additional driveway may be allowed for a site with continuous frontage of 300 feet or more.
- Two additional driveways (three total) may be allowed for a site with continuous frontage of 600 feet or more.
- An additional service type driveway may be allowed for a site with continuous frontage of more than 600 feet, where 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.
- Joint use of a single driveway by two (2) or more adjoining parcels in encouraged.

Driveway location must be evaluated with respect to the particular site layout and location. Variations may be permitted where a traffic analysis approval by the City Traffic Engineer justifies a departure from these guidelines.

3.19.3 Driveway Location Limitations

A new driveway will not be allowed within 20 feet of any commercial property line, except when it is a joint use driveway, serving two abutting commercial properties and access agreements have been exchanged between, and recorded by, the two abutting property owners. Commercial driveways will not be allowed within 75 feet of the right of way line of an intersecting collector street or within 225 feet of an intersecting arterial street. Exceptions may be permitted by the City Traffic Engineer.

3.20 Cul-De-Sacs, Knuckles and Birdseye

3.20.1 Cul-De-Sac Street

A cul-de-sac street is a street that serves more than one property owner and has only one direct access to the public street system.

Cul-de-sac streets shall be a maximum of 400 feet in length and terminate in a circular turnaround. Refer to COA Standard Details for right-of-way, street improvement requirements and dimensions.

3.20.2 Knuckles

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 each street extends in only one direction from the intersection. Knuckles are permitted between intersections to improve accessibility to odd-shaped sites. The use of knuckles (except for on a cul-de-sac) on other than local streets must be approved by the City. Refer to COA Standard Details for right-of-way, street improvements and dimensions.

3.20.3 Birdseye

Birdseye street design should not be used on collector or arterial streets. The birdseye design provides necessary local street frontage for additional residential lots; and helps to balance lot size. Refer to COA Standard Details for right-of-way, street improvement requirements and dimensions.

3.21 Pavement Transition Tapers

For improvement projects that require the widening of a portion of the pavement of an existing road, pavement transition tapers may be required at each end of the widened portion. Pavement transition tapers shall be constructed with a thickened edge per MAG Standard Detail 201.

A. Transition Tapers to a Wider Pavement Section: The taper rate may be 8:1 for design speeds up to 30 mph and 15:1 for design speeds up to 50 mph, per AASHTO Guidelines with a minimum taper length of 50 feet.

B. Transition Tapers to a Narrower Pavement Section: Taper lengths on roads with a design speed less than 45 MPH shall be: $L = (WS^2)/60^*$

Where the design speed is 45 MPH or greater: $L = WS^*$

Where:

W = Offset from drivable through lane in feet

S = Design speed

L = Taper length

*Source: FHWA, Manual on Uniform Traffic Control Devices

3.22 Delineators and Barricades

Roadside delineators are required to guide traffic along transition pavement tapers. Minimum spacing between delineators is the same as the speed limit (in miles per hour) for the roadway. Refer to MCDOT Traffic Sign Manual for roadside delineator installation at www.mcdot.maricopa.gov/manual.

Temporary dead-end streets are required to be barricaded with advanced warning signs. Traffic barricades are to be installed per MAG Standard Detail 130, Type "A".

A barricade per MAG Standard Detail 130, Type "A" is required to be installed at the back of a temporary turn-around.

3.23 Street Name Signs

Projects are required to install the street name sign posts and street name signs for all public streets within the project and all adjoining or abutting public streets per COA Standard Details.

3.24 Partial Street Improvements

For all DS 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.

A. Design of Cross-Section for Half-Streets

Half-street construction needs to consist of a minimum 24 foot wide pavement. In the event half-street construction is to be provided, the Engineer needs to design the full cross-section of the street. The plans need to include, in dashed lines, the half-street, which will be constructed in the future. The half-street construction needs to provide

adequate transitions and tapers to the adjoining roadways. Half-street improvements terminating at the roadway monument or centerline shall be constructed with a thickened edge per MAG Standard Detail 201 Type "A".

B. Joining Existing Street Pavement

The half-street is to be designed to match existing construction as much as possible unless doing so is likely to create an unsatisfactory condition. If changes are needed to correct conditions on an existing half-street in order to properly construct the other half of the street, the solutions must be developed with City staff on a case-by-case 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.

C. Culverts Under Half-Streets

A culvert to be provided in conjunction with half-street construction must extend a minimum of 10 feet beyond the edge of the traveled way into the area where the other half of the street will be constructed in the future (subject to rights-of-way availability). The 10-foot distance is measured perpendicular to the street alignment. The culvert capacity, flow line slope, and alignment must be based upon the ultimate design requirements for the culvert if it were to be built under the full cross-section where it could be considerably longer.

3.25 Dead End Streets

Dead end streets shall be required where a street connection is necessary to serve adjacent unplatted land that will develop at a future date. A paved temporary turn-around shall be provided within the subdivision at all dead end streets.

3.26 Survey Monuments

Projects are required to install survey monuments at all street intersections, section corners, quarter corners, and points of curvature per MAG Standard Detail 120-1 Type A. The monuments shall be set to the COA datum

3.27 Public Transit Facilities

The Avondale Transportation Plan has identified the existing and future public transit system throughout the Avondale Urbanized Area. Projects that create high-activity centers, such as shopping malls or high-density living areas may require the installation of transit facility improvements. The design of the transit facility shall consider the needs of the transit user, bus operator, the general public, and neighbors adjacent to bus stops.

3.27.1 Bus Pull-Out Bays

Bus pull-out bays are generally installed on the departure side of the intersection and allow buses to pull completely out of the traffic lane while loading and unloading passengers. Bus pull-out bays shall be installed along arterial streets at one mile and one-half ($\frac{1}{2}$) mile locations, or at other locations required by the City's Traffic Engineering staff. The bus pull-out bays shall be designed per COA Standard Details.

3.27.2 Bus Shelter Pads

A bus shelter pad shall be installed at all bus stops locations. Bus shelter pads shall be designed per COA Standard Details and be ADA compliant modified by the City of Avondale standard sidewalk width connections.

3.28 Subdivision Street Planning

The planning of subdivision streets should produce the minimum number of intersections and discourage through traffic.

3.28.1 Street Location and Arrangement

A. Street layout shall provide for the continuation of arterial and collector streets in adjacent areas, and shall conform to a standard grid system. Other street classifications may be required to follow a grid system as well.

B. Certain proposed streets, as designated by the City, shall be extended to the subdivision boundary to provide future connection with adjoining unplatted lands. In general, these extensions should not be farther apart than the maximum permitted length of a block, as specified in the Avondale City Code Chapter 22 Subdivision Regulations, Sub-Section (e) of Section 22-80.

C. Local streets shall be so arranged as to discourage their use as through routes by traffic originating outside the immediate area.

D. Traffic Calming

Traffic calming measures can be implemented as part of new communities, or retrofitted into existing neighborhoods. If a community design calls for traffic-calming elements, as required by the City, the City will work with the project engineer on suggestions and guidance on acceptable treatments. Traffic calming measures can vary, depending on the specific application. Example traffic calming measures include medians, traffic circles, street narrowing, and other elements designed as integral parts of the roadway infrastructure. The City Engineer must approve the use of traffic calming measures within City right-of-way.

E. When a proposed subdivision abuts or contains an existing or proposed arterial route, the City may require limited access streets or reverse frontage with non-access

easements along the arterial route, or such other treatment as may be justified for protection of properties and for preservation of the traffic function of the arterial route.

F. When a residential subdivision abuts the right-of-way of a railroad, a limited access highway, or abuts a commercial or industrial land use, the City may recommend location of a frontage street parallel to such right-of-way or use buffer area at a distance suitable for appropriate use of intervening land, such distance being determined with due regard for approach grades, drainage, bridges or future grade separations.

G. Streets shall be so arranged in relation to existing topography as to produce desirable lots of maximum utility and streets of reasonable gradient, and to facilitate adequate drainage.

H. Alleys: Construction of new alleys shall only be reviewed by the City under the following conditions:

- Contribution to a logical outlet to an existing dead-end alley.
- Extension of an existing alley pattern where utilities are located in alleys.

Construction of new alleys shall provide adequate provision for solid waste and utility vehicle circulation and avoid alley outlets opposite fronts of residential lots.

3.28.2 Subdivision Blocks

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

- A.** Provision of sites suitable to the type of use contemplated.
- B.** Zoning requirements as to lot sizes and dimensions.
- C.** Need for convenient access, circulation, control and safety of street and pedestrian traffic.
- D.** Limitations and opportunities of topography.
- E.** Circulation within the subdivision, and access to the community facilities.
- F.** Lengths as short as practicable and the discouragement of excessive vehicular speeds, but not to exceed 1,200 feet, measured along the centerline of street and between intersecting street centerlines. If longer blocks are approved by the City, traffic calming measures are required.

3.29 Final Street Improvement Plan Requirements

Construction Plan Submittal Requirements for the preparation of final plans in the City are described in Chapter 1; this section supplements the requirements of Chapter 1.

- A.** An index map with the following information:
- Street names.
 - Sheet numbers.
 - City limits, where applicable.
 - Phasing construction limits, phase numbers and identify which phasing the model homes are located in.
- B.** Typical sections for each street to be improved shall be shown on the detail sheet. The sections shall include the following information:
- Right-of-way width.
 - Width of sidewalk.
 - Dimensions to back of curb.
 - Width of paved surface.
 - Type of curb and gutter; i.e. roll, vertical, or ribbon.
 - Pavement cross-section.
 - 2% pavement cross-slope.
 - Pavement structural sections conforming to geotechnical report or minimum COA standard pavement sections.
 - Finished slope behind sidewalk to right-of-way limits.
- C.** The following utility items shall be shown on each sheet:
- All existing and proposed manholes under new pavement must be adjusted to grade per MAG Standard Detail 422 and MAG Specification Section 345 with concrete collar.
 - All existing and proposed valve boxes and covers affected by construction must be adjusted to grade per COA Standard Details and MAG Specification Section 345 with concrete collar.
- D.** The following design items shall be shown on each sheet in plan view:
- Existing right-of-way, with width dimensioned.
 - Existing pavement, with width dimensioned.
 - Existing curbs, with width dimensioned.
 - Existing sidewalk, with width dimensioned.
 - Existing sidewalk ramps.
 - Proposed right-of-way, with width dimensioned.
 - Proposed pavement, with width dimensioned.
 - Proposed curbs, with width dimensioned and standard detail number call-out.
 - Proposed sidewalk, with width dimensioned and standard detail number call-out.
 - Proposed sidewalk ramps at intersections, including T-intersections.
 - Existing items "to be protected in place" shall be noted.
 - Curb transitions.

- Curb return radii with dimensions.
- Curb radii at cul-de-sacs, knuckles and "birdseye" with dimensions.
- Survey monuments, with standard detail number callout.
- City limits where applicable.
- Valley gutters at all locations where storm water will cross the street, with width and standard detail number call out.

E. The following design items shall be shown on each sheet in profile view:

- Existing grade at right curb line.
- Existing grade at left curb line.
- Existing grade at centerline (when no median).
- Proposed grade at right curb line.
- Proposed grade at left curb line.
- Proposed grade at right median curb.
- Proposed grade at left median curb.
- Proposed grade at centerline (when no median).
- The proposed longitudinal grades shall be labeled.
- Longitudinal grades on curves must be computed based on their true lengths.
- Concrete longitudinal slopes around cul-de-sacs, knuckles, "birdseye" and across valley.
- Storm drain, utility and other crossings whenever minimal cover below subgrade, is encountered.

F. All existing water wells within the right-of-way must be shown on the plans with their Department of Water Resources registration number. If not registered, so note on the plans.

G. The following traffic engineering items shall be shown in plan view:

- Street name sign bases.
- Traffic control devices (all signs, signals, flashers, streetlights).
- Temporary turn-around at dead-end streets, and at phase lines.
- Street barricade per MAG Standard Detail 130 Type B.
- Traffic signal conduits, four (4) inch diameter (PVC Schedule 80) with ADOT #7 pull boxes at future signalized intersections (four-way).
- Traffic signal conduits, three (3) inch diameter (PVC Schedule 40) with ADOT #5 pull boxes every 400 feet.

H. The following survey design items shall be shown on each sheet:

- Construction centerline station numbers with sheet reference at all match lines in plan or profile views.
- Centerline survey data.

- Station numbers at all changes in street alignment, intersections, curb returns, and grade breaks in profile.
- Gutter and centerline spot elevations at all grade breaks.
- Gutter spot elevations at all intersections.
- Centerline spot elevations at all intersections.

3.30 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. Street light plans shall be prepared and sealed by a licensed electrical engineer registered in the State of Arizona. The street lighting design shall be reviewed and approved by the City. The street light design shall include the numbering of the street light poles as directed by the City.

A. The developer shall retain a Professional Electrical Engineer, registered in the State of Arizona, to prepare the lighting system design and appropriate calculations relative to illumination levels. Illumination design shall follow the recommendation 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 0.80, shall be used to determine the compliance with the IES RP-8 and City street lighting design guidelines. High Pressure Sodium (HPS) fixtures are the standard for all installations.

B. Photometric Distribution Design Requirements.

**TABLE 3-11
Minimum Photometric Distribution Design Requirements**

Street Classification	Development Type	Minimum ⁽¹⁾ Foot-Candles	Average to Min.
Arterial Street (No Medians)	Commercial	1.58	3 to 1
Arterial Street, (Medians)	Commercial	1.58	3 to 1
Industrial Collector Road	Commercial	1.11	4 to 1
Major/Minor Collector Road	Commercial Residential	1.11 0.56	4 to 1 4 to 1
Local Road	Residential	0.37	6 to 1

(1) All street light designs must meet this photometric requirement.

C. Intersection lighting levels should be at least equal to the sum of the values recommended by IES for each street that forms the intersection. Photometric lighting analysis shall be provided to show that this requirement is satisfied.

3.30.1 Streetlight Spacing and Fixture Heights.

**TABLE 3-12
Average Streetlight Spacing and Fixture Height Requirements**

Street Classification	Average* Spacing (Feet)	Pole Height (Feet)	Mast Arm (Feet)	Fixture Height (Feet)
Arterial Street (No Medians)*	100 ^{***}	32' (Square Decorative)	8' x 8' (Square Decorative)	40'
Arterial Street, (Medians)*	200' (Installed in Medians)	32' (Square Decorative)	8' x 8', dbl (Square Decorative)	40'
Industrial Collector Road	150'	32' (Square Decorative)	8' x 8' (Square Decorative)	40'
Major/Minor Collector Road	100 ^{***}	31'(SRP) 38'(APS)	6' Rad. 8' x 3'	32' 34'
Local Road ^{***}	200'	31'(SRP) 38'(APS)	6' Rad. 8' x 3'	32' 34'

* Average Street light spacing is a recommendation. The minimum photometrics must be verified by a registered Electrical engineer through a sealed photometric lighting analysis.

** Pole spacing per linear mile, staggered. Spacing on each road side shall be 200 ft. on center.

*** Local street pole located on one side of street.

- A.** All poles and mast arms shall be steel construction with a galvanized finish, gray color (except for the architectural style as noted above).
- B.** Pole bottom shall be uniformly half lap taped with Scotch 50 corrosion protection tape or approved equal, up to two (2) inches below hand hole.
- C.** All street light design plans including layout and construction shall be prepared and sealed by a registered electrical Engineer. Construction permits shall not be issued until the design plans and Contractor submittals have been approved by the City.
- D.** Contractors shall submit technical material specifications on all items listed above for City review and approval.

3.30.2 Streetlight Luminary Requirements:

**TABLE 3-13
Streetlight Luminaries**

Street Classification	Lumens	Type	Wattage	Voltage	Ballast	Photometric Distribution
Arterial Street (No Medians)	30,000	HPS	250	Multi	HPF	Type III
Arterial Street, (Medians)	30,000	HPS	250	Multi	HPF	Type III
Industrial Collector Road	30,000	HPS	250	Multi	HPF	Type III
Major/Minor Collector Road	16,000 or 30,000	HPS	150 or 250	Multi	HPF	Type III
Local Road	9,500	HPS	100	120	Reactor HPF	Type II

- A.** All luminaries to be “Cobra” head style, gray color (except for the architectural style as noted above).
- B.** Architectural style light luminaire fixtures shall be the “shoebox” type, dark bronze (cocoa) in color.
- C.** Luminaries to be fuseless with photoelectric control. In-line fuses installed in pullbox (waterproof).

3.30.3 Streetlight Plan Requirements

- A.** Show all utility locations, sizes, easements, rights-of-way, and other structural features.
- B.** A key map with the following information:
 - All streets, alleys, easements, tracts and parcels.
 - Existing utility systems, including fire hydrants and valves in and around the development.
 - Proposed utility systems including fire hydrants and valves.
 - Utility pipe line sizes.
- C.** Provide a legend on the plans identifying the following items:

**TABLE 3-14
Fixture Selection**

Street Classification	Street Width (Back of Curb to Back of Curb)	Lamp Lumens	Lamp Wattage
Arterial Street (No Medians)	76'	30,000	250 W HPS
Arterial Street, (Medians)	76' or 98'	30,000	250 W HPS
Industrial Collector Road	42'	30,000	250 W HPS
Major/Minor Collector Road	50' or 74'	16,000 or 30,000	150 W or 250 W HPS
Local Road	34'	9,500	100 W HPS

- Pole Selection Table

**TABLE 3-15
Pole Selection**

Street Classification	Pole Type	Pole Mounting Type	Fixture Mounting Height ⁽¹⁾
Arterial Street (No Medians)	Square Tube	Foundation	40' (shoebox)
Arterial Street, (Medians)	Square Tube	Foundation	40' (shoebox)
Industrial Collector Road	Square Tube	Foundation	40' (shoebox)
Major/Minor Collector Road	(APS) (SRP) or Square Tube	Embedment or Foundation	34' (APS) 32' (SRP) or 40' (shoebox)
Local Road	(APS) (SRP)	Embedment	34' (APS) 32' (SRP)

(1) Electric service providers Arizona Public Service (APS) or Salt River Project (SRP)

- D.** Meandering sidewalks shall not conflict with streetlight poles.
- E.** All point of curvature and point of tangency to be stationed off of centerline.
- F.** Streetlight poles shall be a minimum of six (6) feet from the edge of a driveway wing.
- G.** Streetlight poles are not to be located in the radius of intersections.

- H.** All streetlights to be located within right-of-way.
- I.** All pole foundations and pull boxes to be at sidewalk grade unless otherwise noted.
- J.** Apply specific construction requirements of APS and SRP.
- K.** Show all existing and proposed waterlines and fire hydrants and provide dimensional ties to waterlines and fire hydrants where potential conflicts may occur.
- L.** All future and existing streetlights adjacent to and within 300 feet from the first proposed streetlight must be shown with stationing and dimensional ties to the street centerline.
- M.** Streetlights on lot frontages in residential areas shall be located at property lines whenever possible. Lights on non-frontage conditions may be located by station only.
- N.** Arterial-to-arterial intersections must have four (4) streetlights. All other intersections require two (2) streetlights, and cul-de-sacs require one (1) streetlight.
- O.** All phasing must be shown on the plans.
- P.** Lights in elbows and cul-de-sacs (anywhere other than standard street locations) require radial ties.
- Q.** Survey Data is required for street centerlines (bearing and distances).
- R.** Provide stations at all intersections and changes of alignment.
- S.** Pole centerline offsets: Refer to COA Standard Details

3.30.4 Final Streetlight Plan Requirements

Submit a streetlight site plan, drawn to scale, indicating the streetlight locations with the corresponding photometric calculations/distribution sheets for review and approval by the City.

The approved streetlight site plan shall be submitted to the appropriate utility company (Arizona Public Service or Salt River Project) to prepare the streetlight improvement plans.

Submit a minimum of two (2) sets of the streetlight improvement plans to the City for issuance of the streetlight improvement construction permit.

Private streetlights must be labeled as "Private Streetlights" and must meet public street illumination standards.

3.31 Signing and Pavement Markings

The most current of the following publications are to be used in conjunction with the design criteria in this Manual for traffic signs and pavement markings design work.

- Manual on Uniform Traffic Control Device for Streets and Highways (MUTCD)
- Signs and Marking – Standard Drawings (ADOT)
- ADOT Traffic Control Design Guidelines (ADOT)
- Manual of Approved Signs (ADOT)
- Traffic Engineering Policies, Guidelines and Procedures (ADOT)
- Pavement Marking Manual (MCDOT)
- Uniform Standard Specifications for Public Works Construction (MAG)
- Uniform Standard Details for Public Works Construction (MAG)
- Construction Specifications and Standard Details Manual, (COA)

3.31.1 Signing Requirements

- A.** Traffic signing and pavement markings plans shall be submitted with a scale no less than 1"=40' and include all centerline curve data.
- B.** Traffic signing and pavement markings design should be in the same plan view of the improvement plans. Dimension all pavement markings to face of curb.
- C.** Include the dimensioning at each change in traffic channelization.
- D.** Entire length of project is to be shown in plan view. Typical sections representative of traffic signing and pavement markings will not be accepted. Show the existing roadway, signing and marking and proposed signing and markings for approximately 500 feet beyond the project limits on each approach to the project.
- E.** Identify all ingress/egress points to include street intersections and residential/commercial driveways within 500 of the project limits on both approaches and on both sides of the street.
- F.** Show all new, existing and relocated signs within the right-of-way and identify them. Label existing signs to remain "EXISTING" and show them screened back. Label existing signs to be relocated or removed, and all new signs. Include sign code, size, and show figure of sign.
- G.** Right-of-way lines, City and County limits are to be clearly identified.
- H.** All islands on arterial roadways shall be signed per the MUTCD guidelines. The beginning of each median where none exists prior, are to be signed. Median breaks in

a continuous median are required to have object markers. Refer to COA Standard Detail.

I. STOP signs are to be shown at all local streets that intersect with collector streets within a subdivision. Local/local street intersections may not be STOP controlled unless directed by the City. STOP signs will be shown at all collector and non-signalized arterial street intersections.

J. All signing and pavement marking shall conform to the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) as supplemented by the Arizona Department of Transportation with regard to size, color, shape, and placement. Sign retro-reflective sheeting shall be in accordance with ADOT Section 1007.

K. Sign location shall be coordinated with landscaping plans to insure sign viability per AASHTO standards.

3.31.2 Pavement Marking Requirements

A. All pavement markings shall conform to the Arizona Department of Transportation and Specifications, or Pavement Marking Manual (MCDOT), unless otherwise specified in the Manual of Uniform Traffic Control Devices, (Latest Editions), or as noted on the plans.

B. Show stationing of all match lines.

C. Add lane width dimensioning of all changes in channelization. All dimensions to be to face of curb.

D. Use MCDOT label notations for each stripe and symbol and include a legend.

E. Restriping over existing pavement marking to nearest intersection, or 200 feet beyond match point may be required to refreshed and clean due to construction.

3.32 Traffic Signal Design

This section will present the criteria and procedures to be utilized by consultants when performing traffic signal design work in and for the City of Avondale.

3.32.1 City of Avondale Traffic Signal Policies

A. Install warranted traffic signals so that one-quarter ($\frac{1}{4}$) mile signal spacing is maintained on expressways, parkways and ALL arterials, where possible. These spacings must be consistent with the City's traffic management system plan.

B. Install warranted traffic signals so that one-half ($\frac{1}{2}$) mile spacing is maintained on major collectors, where possible. These spacings must be consistent with the City's traffic management plan.

C. Provide pedestrian signals at vehicular signal locations and install crosswalks at intersections, when sidewalk connections exist or are installed. At schools and high-activity centers, install countdown signals.

D. Install leading or protected left turn arrows when warranted in accordance with the City of Avondale Engineering Traffic Studies.

E. Any traffic signal improvement that requires traffic signal relocation will require a full traffic signal plan that details the changes to the intersection.

F. Any traffic signal construction shall be supervised by a certified I.M.S.A. Level II Signal Technician on site.

3.32.2 Traffic Signal Design Criteria

A. Abbreviations

- AASHTO - American Association of State Highway and Transportation Officials
- ADOT - Arizona Department of Transportation
- AED - Avondale Engineering Department
- ASTM - American Society for Testing and Materials
- ATSSA - American Traffic Safety Services Association
- AZTECH - Arizona Technology Council
- COA - City of Avondale
- FHWA - Federal Highway Administration
- MAG - Maricopa Association of Governments
- MCDOT - Maricopa County Department of Transportation
- MUTCD - Manual on Uniform Traffic Control Devices
- NEMA - National Electrical Manufacturers Association
- QPL - "Quality Products List"
- USDOT - United States Department of Transportation

B. Traffic Signal Design Specifications

The following publications most recent editions and approved supplements by the State and County are to be used in conjunction with the design criteria when designing traffic signals in the City of Avondale.

- Manual on Uniform Traffic Control Devices for Streets and Highways; USDOT/FHWA
- Traffic Signals and Lighting (Standard Drawings); ADOT
- Informational Guide for Roadway Lighting; AASHTO
- Guide to Standardized Highway Lighting Pole Hardware; AASHTO

- Standard Specifications for Road and Bridge Construction and Supplemental Maintenance Specifications
- Signing and Marking (Standard Drawings); ADOT
- Traffic Control Manual for Highway Construction and Maintenance; ADOT
- Manual of Signs Approved For Use on State Highway System; ADOT
- Policies, Guide and Procedure Manual; ADOT
- Uniform Standard Specifications for Public Works Construction; MAG
- Uniform Standard Detail for Public Works Construction MAG
- City of Avondale Supplement to MAG Specifications and Details

C. Standard Traffic Signal Plan Base Sheet

Upon completion of signal construction, the Consulting Engineer shall provide AED a Standard Traffic Signal Plan for the signal system installation. AED will keep this plan on file for future reference. The content of this plan is discussed in the City of Avondale Supplement to MAG Specifications and Details.

D. Construction Specifications

The specifications for controllers, controller cabinets, lighting and other equipment details are provided in the City of Avondale Supplement to MAG Specifications and Details.

E. Controllers and Cabinets

AED will indicate the type of controllers and controller cabinets to be provided.

F. Emergency Vehicle Preemption

Emergency vehicle preemption shall be required at all traffic signal intersections. AED will inform the consultant concerning requirements for emergency preemption. See City of Avondale Supplement to MAG Specifications and Details for information concerning equipment and construction requirements for emergency vehicle preemption systems.

G. Pedestrian Signals

Pedestrian signals are normally required. If the requirement is to be deleted for a specific signal installation, AED will inform the consultant. ADA compliant audio pedestrian signals, countdown pedestrian signals, and/or pedestrian push buttons for the hearing and visually impaired may also be required.

H. Additional City Specifications

Refer to the City's website for video detection requirements; internally illuminate street name signs and conductor schedules, etc.

3.33 Final Traffic Signal Plan Requirements

A. Design and Construction Specifications

Use the basic specifications provided by AED and modify them as necessary to meet the needs of a specific job. Do not prepare new specifications without first discussing the proposal with AED. Ensure that the latest revision of AED's base specifications are utilized.

B. Construction Plan Submittals

Two sets of the construction plans for a traffic signal installation must be submitted to AED, and one set to the Building Inspector when the design engineer makes his normal submission of improvement plans. This requirement also applies to the second and succeeding plan submissions when plans are revised prior to plan approval. Upon final approval of construction plans, design engineer will provide as-built photo mylar to AED and a copy of as builts to Avondale's Traffic Signal Division.

3.33.1 Traffic Signal Construction Plans

The plans shall be developed in accordance with ADOT standard practices and shall be included with, at a minimum, the following items.

A. Cover Sheet

- Utility company contacts with notification and clearance dates
- Street index map

B. Traffic Signals Plan Sheet

- Layout at 1" = 20' scale, unless otherwise specified by AED. Provide "bearing" for each leg of the intersection and station intersection or reference documentation.
- Location and number of each conduit and conductor run.
- Location of loop detectors or Video Detection Zone (VDZ), stationed from centerline.
- Location and designation of controller, stationed from center line.
- Location of telephone and electrical service pole, stationed from centerline.
- Notes (Construction and General).
- Symbols shall conform to ADOT Standard Drawing T.S. O-I.
- Location and elevation of signal foundations.
- Address and location of the power source.

C. Pole Schedule and Phase Movements Signal Design

- Pole Schedule: (To include traffic signal controller designation, type of auxiliary controller, remarks and location, pole designation, type, mast arm lengths, signals, signs, remarks, location and circuit number.
- A diagram indicating each phase of the signal cycle.
- Pole and cabinet location by station and offset dimension and control cabinet.

D. Conductor Schedule

- AWG number
- Circuit phase
- Number of wires
- Conduit run number
- Conduit size (Legend to identify special cables)

E. Detail Sheet

Details of items not covered by standard details. Requirements to be determined during pre-design conference.

CHAPTER 4 WATER SYSTEM DESIGN

4.1 General Information

The purpose of this chapter is to provide a consistent engineering approach for the minimum criteria for design of water distribution mains, construction, and modifying of the public water system to be owned and operated by the City. The chapter is intended for use in plan design, plan preparation, and the plan review process. The information provided in this chapter is not intended to cover all situations that arise, but shall provide general guidance yet not a substitute for sound engineering principles.

4.2 Availability of City Water

Questions pertaining to the availability of public water service from the City of Avondale should be directed to Development Services.

Questions regarding water system expansion or extension requirements to serve proposed new projects may be directed to Development Services.

4.3 Water Services Agreement

Land subdivision developments are required to file a “Water Service Agreement” document with the Maricopa County Environmental Services Department. This document should be completed by the engineer and submitted with the final plans to the City of Avondale. The agreement will not be signed prior to the City approving the final plans.

The following is the specific information regarding the City of Avondale municipal water system, and the appropriate identification numbers:

- Potable water system # 07088
- System Name: City of Avondale Water Resources
- Address: 399 East Lower Buckeye Road, Avondale, Arizona 85323

4.4 Private Water Companies

Construction Improvement Projects involving certified private water providers shall clearly indicate on the improvement plans the ownership of the proposed public water provider. Provide a signature block on the cover sheet for plan approval by the private water company. The following are the private water companies that provide water service within the City of Avondale service area:

- Algonquin Water Company (formerly LPSCO)
- Rigby Water Company

4.5 City Code

Various City codes apply to the development of the municipal water system including, but not limited to Chapter 22, Subdivision Regulations, Article IV, Street and Utility Improvement Requirements and Chapter 24, Water Sewers and Sewage Disposal, Article II Municipal Water System contains information regarding the development in association with land development.

An electronic version of the Avondale City Code can be referred to on the City of Avondale website at www.avondale.org.

4.5.1 Fire Code

The City has adopted the International Fire Code with local amendments.

The Consultant shall be familiar with the fire code and design the water system to meet the fire code requirements. Provide a signature approval block on the water improvement plans cover sheet for fire department approval.

4.6 City Policy

Developers are required to install, all improvements necessary to provide water service to their development. This includes any waterlines, booster pump stations, or other facilities in accordance with the adopted Wastewater Collection System Master Plan and Utility System Evaluation report, and the payment of all required development fees.

4.7 Federal, State and County Regulations

4.7.1 Maricopa County Environmental Services Department (MCESD)

The MCESD is required to review and approve all public water main extensions and construction of water related facilities within the City's service area, prior to the City approving the final plans.

The developer and the Engineer are expected to be aware of and comply with the MCESD regulations. Maricopa County Environmental Services Department (MCESD) is required to review and approve all public water main extensions and construction of water related facilities within the City's service area. Prior to City approval of final plans, the engineer will submit a cover sheet for the final plans with a completed signature and date of approval from MCESD.

4.7.2 Arizona Department of Environmental Quality (ADEQ)

ADEQ's Engineering Manual Bulletin No. 8 "Disinfection of Water Systems" and No. 10, "Guidelines for the Construction of Water Systems" and the Arizona Administrative Code, "Title 18 - Environmental Quality", contain specific requirements for submittals, approvals, and notifications when extension of a public waterline is proposed. The

developer and the Engineer are expected to be aware of and comply with the above referenced regulations.

4.8 Design Standards and Guidelines

New public water supply distribution and storage facilities shall be designed in accordance with the City of Avondale Supplement to MAG Specifications and Details, Maricopa Association of Governments (MAG) Standard Specifications and Details, and American Water Works Association (AWWA) Standards.

The City of Avondale public water system is a looped system that is grid based, and currently operates as one pressure zone with the exception of the small areas served by the Los Ligas and Dysart PRVs south of the wastewater treatment plant. To insure appropriate water pressure, water circulation, and redundancy, all new water mains must be designed in a looped and interconnected system wherever possible so that there is more than one path for water to flow to supply customer's demands and fire flows.

The City's supply and distribution mains currently include the following components:

- **Transmission Mains**, which are pipelines 16 inches in diameter and larger. Size and location will be in accordance with the City of Avondale Master Plan and Utility System Evaluation report. **NOTE: Service connections will not be allowed on transmission mains without specific City approval.**
- **Distribution Mains**, which are pipelines eight (8) inches to twelve (12) inches in diameter.
- **Service Connections** are pipelines connecting the distribution main to the water meter.
- **Well Transmission Mains** are low pressure pipelines that are used to transfer well water to treatment facilities or booster stations. They are sized in accordance with the City of Avondale Master Plan and Utility System Evaluation Report. Well supply mains may not be tapped for service.

Water mains shall be installed along the entire length of the property line frontage of that property being developed. The property line frontage is defined as that portion of a parcel of property that abuts a street, easement, or public rights-of-way. If a parcel to be developed has more than one frontage, improvements shall be installed along all frontages

4.8.1 Water System Analysis

A. Water System Demand

The water system demand criteria describes the standards against which the water infrastructure is measured to determine the acceptability of the proposed infrastructure.

This water system demand criteria is based on the City's standards as well as the Arizona Administrative Code.

Infrastructure shall be sized to supply the average daily demands listed in Table 4-1 or Table 4-2. Table 4-1 lists water usage in categories that can be easily correlated to acreage. Table 4-2 lists water usage in categories that are not easily correlated to acreage.

**TABLE 4-1
Unit Daily Design Flows for Water - Per Land Use**

Residential Land Use Type	Sub-Category	Unit Demand Estimate (in gallons)		
		per acre	per capita	per house
Single Family Residential	0 – 2.5 DU/ac	891	137	445
	2.5 - 4 DU/ac	1,781	137	445
Medium Density Residential	4 - 8 DU/ac	2,964	114	371
High Density Residential	8 - 12 DU/ac	2,722	114	227
	12 - 23 DU/ac	5,218	114	227
Non-Residential Land Use Type	Sub-Category	Unit Load Estimate (gpd)		
Hotel/Resort	3 - 10 rm/ac	1,086		
	10 - 43 rm/ac	4,428		
Churches	Churches	554		
Community Service Facilities	Community Service Facilities	384		
Improved Open Spaces	Golf Courses	160		
	Private Open and Recreation Areas	820		
	Public Parks, etc.	552		
Industrial	Major Industrial	885		
	Minor Industrial	660		
Institutional Facilities	Institutional Facilities	756		
Mixed Use	Mixed Use	2,894		
Non-Residential Land Use Type	Sub-Category	Unit Demand Estimate (gpd)		
Office	Office	1,206		
Retail	Community	745		
	General	1,333		
	Neighborhood	570		
	Regional	773		
	Specialty/Tourism	1,250		
Schools	Schools	764		
Utilities	Utilities	1,852		

Note: gpad = gallons/acre/day, DU/ac = dwelling units per acre, rm/ac = rooms per acre.

**TABLE 4-2
Applicable Unit Design Flows for Water - Non-Residential Land Uses**

Type of Facility Served	Applicable Unit	Water Design Flow per Applicable Unit, Gallons per Day
Bar/Lounge	Seat	34
Barber Shop	Chair	40
Beauty Parlor	Chair	114
Bowling Alley (snack bar only)	Lane	85
Church		
Without kitchen	Person (max attendance)	10
With kitchen	Person (max attendance)	14
Country Club	Resident Member	200
	Nonresident Member	20
Dance Hall	Patron	10
Dental Office	Chair	602
Dog Kennel	Animal, max occupancy	30
Hospital		
All Flows	Bed	278
Kitchen Waste Only	Bed	28
Laundry Waste Only	Bed	44
Hotel/Motel		
Without Kitchen	Bed (2 person)	56
With Kitchen	Bed (2 person)	67
Industrial Facility		
Without Showers	Employee	29
With Showers	Employee	41
Cafeteria, add	Employee	6
Institutions		
Resident	Person	150
Nursing Home	Person	250
Rest Home	Person	250
Laundry		
Self Service	Wash cycle	57
Office Building	Employee	24
Park		
Picnic, with showers, flush toilets	Parking space	80
Picnic, with flush toilets only	Parking space	40
Recreational Vehicle, no water or sewer connections	Vehicle space	150
Recreational Vehicle, with water and sewer connections	Vehicle space	200
Mobile Home/Trailer	Space	500
Restaurant/Cafeteria		
With Toilet, add	Employee	23
Kitchen Waste and Garbage Disposal, add	Customer	8
	Meal	8

Restroom, public	Toilet	400
School (inside use)		
Staff and Office	Person	22
Elementary, add	Student	17
Middle and High, add	Student	22
with gym & showers, add	Student	6
with cafeteria, add	Student	3
Boarding, total flow	Person	111
Service Station with toilets	First bay	1,136
	Each additional bay	568
Shopping Center, no food or laundry	Square foot of retail space	0.1
Store	Employee	23
Public Restroom, add	Square foot of retail space	0.1
Swimming Pool, Public	Person	20
Theater		
Indoor	Seat	6
Drive-In	Car space	11

B. Water System Analysis Criteria

- The average day to maximum day peaking factor is 1.65.
- The average day to peak hour peaking factor is 3.17.
- Minimum water pressures shall not be less than 40 psi during maximum day and peak hour demand conditions.
- Minimum pressures during fire flow conditions shall not be less than 20 psi.
- Maximum pressures in excess of 80 psi will require service line pressure reducing valves (PRVs) or a distinct subzone created through the use of PRVs.
- Water main velocities for all mains less than 36 inches in diameter shall not exceed five feet per second during maximum day demand conditions. Peak hour velocities shall not exceed seven feet per second.
- Water main velocities for all mains that are 36 inches in diameter and larger shall not exceed six-feet (6') per second during maximum day demand conditions. Peak hour velocities shall not exceed seven-feet (7') per second.
- Water velocities during fire flow conditions shall not exceed 10 feet per second.
- Fire flow demands are 1,000 gpm for two (2) hours for single-family residential areas. Fire flows for commercial and industrial areas are 3,500 gpm for four (4) hours. Large commercial, industrial, or hospital developments may have unique fire flow requirements that would be approved by the City. Appendix 4-A contains the City's fire flow code requirements. A fire flow test shall be conducted to determine fire flow capabilities at hydrants in new developments. Refer to City website www.avondale.org for a sample fire flow test report. If the actual land use type or construction material changes, then a new report and fire hydrant test may be required. The City's Fire Marshal may require other fire flow rates for large commercial or industrial sites.
- Pump stations and reservoirs serve the overall pressure zone within the City, and will be sized according to the City's criteria that is shown in Table 4-3.

Reservoirs, wells, and pump stations are to be sized based on the City's overall requirements and not the requirements for a specific subdivision.

- Pump stations and wells that pump directly into the distribution system shall be designed to deliver water into the distribution system at a hydraulic grade line that is equal to or greater than the prevailing hydraulic grade line for the pressure zone.

**TABLE 4-3
Water System Performance Criteria Summary**

Criteria	Demand Condition	Requirement to Satisfy
Total Supply	Maximum Day	Satisfy demand with largest well out of service
Reliable Supply	Maximum Day	Satisfy demand with all wells operating 18 hours or less
Peak Hour Storage	Peak Hour	Satisfy demand for 4 hours with 50 percent of storage capacity and 50 percent of source capacity
Fire Flow	Maximum Day and Fire Flow	Satisfy demand utilizing all sources and 80 percent of total storage
Operating Storage	Maximum Day	Total storage should be equal to or greater than 20 percent of demand
Emergency Supply	Average Day	Satisfy demand with 80 percent of storage volume and 50 percent of well supply operated no more than 18 hours
Booster Pump Capacity	Maximum Day and Fire Flow or Peak Hour	Satisfy the maximum of the listed demands without the single largest pump in service

4.8.2 Water System Design Report

All projects may be required to submit a Water System Design Report. The purpose of this report is to provide the City with the potential water demands of the project and verify the capability of the City water supply to provide the necessary domestic and fire flows that will be required. The Water Report can have up to three sections as delineated below. The Fire Flow Demand Report can be included in the Water Report, or be submitted as a separate report. The required fire flows for the project must be summarized in the Water Design Report in any case.

The water design report shall be sealed and signed in accordance with the requirements of the State of Arizona Board of Technical Registration, and submitted to Water Resources Department. Report shall be letter sized (8.5" x 11") with any larger maps included within the report shall be folded to letter size and bound or provided in a folder.

A. Water Demand Requirements

All projects shall provide a summary of the anticipated water demands for the project. These figures will be based on the unit factors listed in Section 4.8.1. If the proposed use does not match the tables, provide an estimate of what the flows will 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. Flow rates to be provided include average day, maximum day, and peak hour.

Include in the report fire flows and fire sprinkler system demands that will be required for the development in accordance with the International Fire Code and City Amendments. Flows may be taken from the Fire Flow Demand Report.

B. Water System Model Analysis

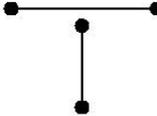
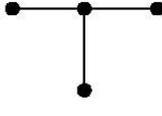
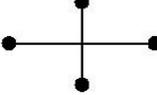
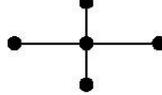
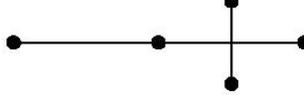
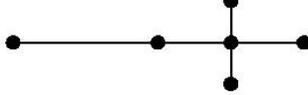
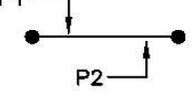
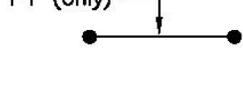
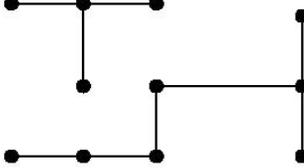
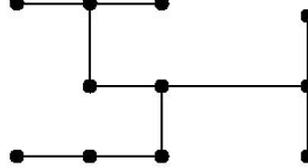
Provide a model of the planned water system as delineated in later section of this manual. This modeling will be required where new public waterlines are being added to the City system. The model will provide the data in a format that will update the City's master model and verify flows in the City system. A water model is required to demonstrate the required fire flow is adequate in accordance with the International Fire Code and City Amendments. Infill projects will not require a model. Infill projects include single lot development where fire and domestic flows are taken directly from existing City mains, where the zoning is in conformance with the City General Plan (i.e., any rezoning has been in conformance with the City's General Plan.), and residential subdivisions of five (5) acres, or less.

Water hydraulic modeling information shall be provided to the City so that this information can be added to the City's hydraulic model. This section describes the requirements to be met to deliver model data to the City.

- **Model Software**
 - The City of Avondale currently uses the H₂OMAP Water software. The modeling software used to evaluate a proposed development does not need to be the same software, but the data needs to be easily transferred into the City's software.
 - For water system models, the EPA-Net model file format is the easiest way to transfer model information. H₂OMAP and most leading software vendors use the EPA-Net hydraulic engine. These software programs allow the user to save the model in an EPA-Net file format. Then the EPA-Net file can easily be read by a different modeling program, with some minor modifications.
- **Model Development**
 - The developer or developer's engineer shall create and utilize a hydraulic model to demonstrate that the proposed infrastructure of the water is adequate, and satisfies the performance criteria. The model or model information will then need to be delivered to the City to be added to the City's models, where modeling evaluations will be performed to verify that the proposed infrastructure will work well with the City's system. For water

- systems, the City's overall water supply, pumping, and storage requirements will be evaluated.
 - The City's model will be updated to include planned infrastructure. This planned infrastructure data will be labeled uniquely in the model to distinguish it from as-built infrastructure data. Once the infrastructure has been constructed, the City or its designated agent will enter the data into the City's GIS system through procedures that have been established by the City. When the City updates its models on a periodic basis using the most current GIS data, planned infrastructure in the model will be replaced with as-built information as contained in the GIS database.
- Hydraulic Model Data
 - Coordinate Systems
 - All drawings and model data shall use the NAD_1983 State Plane Arizona Central coordinate system, with the transverse Mercator projection system. Elevations shall be the elevation above mean sea level. This is the same coordinate system the City plans to use in the future. If drawings are prepared before the City converts to the NAD_1983 coordinate system, then drawings shall be provided in the City's current coordinate system. The developer should check with the City to be certain that the correct coordinate system is being used.
 - Topology
 - Table 4-4 shows the common connectivity errors that must be removed before a model will work. Model data should be free from these errors before delivering to the City.
 - Attributes
 - Each physical entity in the model of the proposed development will require information and attributes as defined below.
 - Water Distribution System
 - Mains – Diameter, length, material, location, connectivity with other entities.
 - Reservoirs – Base elevation, height, volume, location, connectivity with other entities.
 - Pump Stations – Layout, number of pumps, pump curve or design point, elevation, location, connectivity with other entities, pump control scheme.
 - Nodes (Connection Points) – Location, elevation, demand.
 - Pressure Reducing Valves and Tank Fill Valves – Location, connectivity with other entities, elevation, number of valves, diameter, valve set points.
 - Wells – Location, connectivity, design flow, control scheme.

TABLE 4-4
Examples of Incorrect and Correct Topology
(Courtesy of MWH soft)

NAME	INCORRECT	CORRECT
PIPE JUNCTION		
TEE		
FOUR-WAY		
FOUR-WAY		
ORPHAN PIPE		
DUPLICATE PIPE		
ISOLATED NETWORK		

- If a model is not required, include discussion of the proposed connections to the City system, and anticipated connection sizes.
- Hydraulic Evaluation
 - 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 City's performance criteria.
 - The City would use the City's water model to determine the ability of the water distribution system to deliver water to the site of the development. Supplemental fire hydrant tests may also be used to make this determination. The developer is responsible to make certain that all fire flow requirements (hydrants and/or sprinklers) within the development will satisfy the requirements.
 - The following scenarios shall be modeled:
 - Maximum Day Demands

- Peak Hour Demands
- Fire Flow Demands, which are defined as the maximum daily demand plus the appropriate fire flow demand
- Model simulations shall be documented in a graphical or tabular format to demonstrate that the water distribution system will provide the required flow at suitable pressures and water main velocities. Fire flow model results shall also be documented.
- Boundary conditions that represent the interface between the model of the development and the rest of the distribution system need to be explained clearly.

C. Fire Flow Demand Report

All projects shall be required to provide a fire analysis that will demonstrate that there are adequate fire flows available from the City system to meet the required fire demands of the proposed development, considering the building construction type, layout, etc. The exception is residential subdivisions where modeling is being completed as part of the water demand analysis. The Engineer will use the City's hydraulic model to evaluate the ability of the water distribution system to deliver fire flows to the development. The developer is responsible for understanding the fire flow 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. Refer to City website www.avondale.org for a sample of Fire Flow Demand Report.

When preparing the fire flow report, the Arizona Board of Technical Registration Substantive Policy Statement for fire sprinkler systems shall be applied. The fire flow report must be in compliance with the International Fire Code (IFC) and the National Fire Protection Association (NFPA), Standard 13, *Installation of Sprinkler Systems* as adopted by the City of Avondale. The report must list the applicable codes and standards and the appropriate engineering practices.

The Fire Flow Demand Report shall be sealed by a registered professional engineer in the State of Arizona and shall provide the following information:

- Engineers name, company, address, city, state, zip code, and phone number
- Project name, limits, and address
- Detail physical aspects of the proposed on-site structures including
 - Building height (feet)
 - Number of stories above finished grade
 - International Building Code (IBC) construction type
 - Building area (square feet)
- The fire flow demand report shall provide
 - IFC and City Amendment required fire flow
 - Percentage of reduction allowed for the installation of a fire sprinkler system
 - Revised IFC and City Amendment required fire flow

- Projects that install fire sprinkler systems are required to be in accordance with the Arizona Board of Technical Registration Substantive Policy Statement regarding fire sprinkler systems the following information shall be included:
 - Range of the fire hazards of the project
 - The hazard classification of the intended occupancy, including any special hazards
 - The appropriate engineering practices
 - The availability and adequacy of the water supply
 - 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
 - Required fire sprinkler demand (p.s.i. and g.p.m.)
 - Required fire flow and fire sprinkler demand shall be provided for the project in accordance with the IFC and City Amendments
- In order to ascertain the availability and adequacy of the water supply for the project, the fire flow report shall provide test results based on a certified test of the existing water system within the previous 60 days. The flow test information shall include
 - Test date,
 - Test time,
 - Test location,
 - Test hydrants,
 - Orifice size,
 - Orifice coefficient,
 - Flow test data
 - Static pressure (p.s.i.)
 - Residual pressure (p.s.i.)
 - Pitot measurement (p.s.i.)
 - Recorded flow rate (g.p.m.)
 - Flow rate (g.p.m.) converted to 20 (p.s.i)
 - Testing technician
 - Copy of the written fire department report showing they witnessed the flow test

D. Preliminary Water System Design Report

A preliminary report is required at the entitlement stage of a project. The type and size of buildings may or may not be known at this stage. The preliminary report should provide the following information:

- Provide the preliminary water demand requirements (based on either acreage or building size and use.) This data may be refined or changed due to changes in the plan through the entitlement stage. Provide a summary of the minimum fire flow requirements as supported by the Fire Flow Demand Report.
- Provide a water model analysis if required. For single family residential developments, the model may be delayed until the Final Water Report submittal

if desired. Any plan or system changes required due to inadequacies of the system as modeled will require construction plan changes as necessary to meet requirements.

- The Fire Flow Demand Report.
- If no changes are anticipated or required with the construction plans, this report may be submitted as the Final Water Report.

The following sections are to be included in a development water design plan report:

- Cover Page
 - Project Title
 - Prepared For
 - Prepared By
 - Engineer's Seal
 - Date
 - City Datum Benchmarks (BM)
- Executive Summary
 - Provide a one or two page statement indicating that the criteria is met, what criteria was used, and an explanation of specific steps that were taken to modify the design so that the criteria is met. Unique characteristics or challenges associated with the project should also be presented.
- Introduction
 - Provide the project name, size, type of development
 - Purpose of the report
 - Project owner
 - Summarize the content that would be found in each major section of the report
- Project Location
 - Provide a site description
 - Project size
 - Addresses and major streets
 - Township, Range and Section
 - Relationship to other developments or significant water features
 - Include a site map
- Purpose of Report
 - Explain the objectives of the report, which could be to define infrastructure requirements, satisfy regulatory requirements, identify water supplies, or evaluate the impact of the new development on the existing collection system.
- Existing Water System Conditions
 - Describe adjacent infrastructure or existing infrastructure that will provide water or be affected by the new development
 - Include a discussion of intended water sources and storage
- Proposed Water System Conditions

- Describe planned infrastructure that will be added as part of the development.
- Refer to relevant City or adjacent development master plan reports where appropriate.
- Include tables showing the number and size of proposed infrastructure where appropriate.
- Include a map of proposed infrastructure showing locations, sizes, and relationship to streets and property parcels. The map should also be used to correlate demands in tables with specific locations in the proposed development.
- Design Criteria
 - Summarize the City's standard design requirements that were applied to this development.
- Design Methodology
 - Modeling – Identify the model used and key model assumptions such as friction factors, simplifying assumptions, and boundary conditions.
 - Topology and Pressure Zones – Identify the pressure zone(s) where the development is located. The developer should check with the City to determine if pressure zones have been established that affect the development.
 - Water Demand Development – Describe land use categories, population, acreages of various types of land use, demands and demand peaking factors. Include a discussion of phasing and interim demands in cases where the infrastructure for the development will need to be phased.
 - Transmission/Distribution Network – Show a network of mains with location, size, connections, hydrants, valves, and water supply sources.
 - Pumping Wells – Identify well locations if possible, expected well capacities, water quality issues, and well pumping requirements.
 - Water Storage Tanks and Booster Stations – Describe location, pumping requirements, storage volumes, site layout, and fill valves where appropriate.
- Water Model and Results
 - Describe pressures, flows for conditions that have been simulated.
 - Provide a figure containing a graphical representation of the model that is color coded to show pressures at nodes and water velocities in mains for each simulation that is completed to demonstrate infrastructure adequacy.
 - Provide tabular results where appropriate to highlight model results.
- Conclusions
 - Summarize work that has been completed; state recommendations, areas where further evaluation may be needed.
- References
 - List documents used in the report that contain relevant information.
- Appendices
 - Figures
 - Vicinity Map
 - Land Use Exhibit

- Water Master Plan
- Land Use Data
 - Table summarizing parcels, acreages, land use, and population
 - Water System Anticipated Demands
 - Water Storage Calculations
- Model Output
 - Maps showing pressures and pipe velocities from the model maximum day and peak hour demand conditions
 - Maps or tables showing fire flow analysis results using a maximum day demand plus the fire flow
- ADWR Data
 - Wells in the Vicinity
 - Well Data Tables
- E.** Final Water Report

The final report will be required at the time of civil plan submittal. The final report will be basically the same as the preliminary report, but modified to include any charges to the project between the entitlement stage and the construction plan stage.

4.8.3 Water System Design

The water system design shall plan for future extensions to the water system with appropriate placement of valves, stub-outs, etc. to prevent future loss of service and avoid future pavement cuts.

A. Utility Trenching

All trenching, bedding, backfill, compaction, and pavement replacement shall comply with City of Avondale Supplement to MAG Construction Specifications and Standard Details, MAG Specification 601. All pavement replacement shall be accordance with City of Avondale Standard Detail.

B. Pipe Sizing

- Table 4-5 lists the minimum waterline sizes for the City's water distribution system. Larger waterlines may be required if warranted, by the development's water report, specific water demands, or by the City's Master Plan and Utility Systems Evaluation report.

**TABLE 4-5
Minimum Waterline Size**

Street Classification	Size
Residential Street	8 inch
Industrial/Collector (½ mile st.)	12 inch
Arterials or Section Line Streets	16 inch

- Refer to the International Fire Code and City Amendments for the maximum length of dead end fire lines that may be used for fire protection.

C. Pipe Materials

Alternate pipe material may be approved by the City on a case by case basis.

- Waterlines less than 12 inches in diameter:
 - Ductile Iron Pipe (D.I.P.) cement mortar lined and seal coated, or City approved equal.
 - Polyvinyl Chloride (PVC) AWWA C-900, or City approved equal.
- Waterlines 12 inches and larger in diameter
 - Ductile Iron Pipe (D.I.P.) cement mortar lined and seal coated, or City approved equal.
- Service connections for meters
 - Less than four (4) inches shall use copper
 - Four (4) inches and greater shall use DIP
- Electronic Marker
 - Tracer wire shall be placed above all public waterlines.
 - Install radio balls at each waterline bend (11¼, 22½, 45, and 90 degree), per City of Avondale Standard Details.

D. Pipe locations

Public water mains locations are required to be located within dedicated public right-of-way, or waterline easements.

- Horizontal Location: All waterlines will be aligned parallel to property lines or street center lines and shall not cross and re-cross the center line, except in cases justifiable to the City.
 - Waterlines under streets in the public right-of-way refer to City of Avondale Standard Details.
 - Public waterlines in commercial, multifamily, and industrial developments shall be located under driveways, or drive aisles and provided with a 20 feet wide waterline easement. Generally, the waterline shall be in the center of the waterline easement.

- In general, the preferred horizontal location of waterlines shall be 10 feet from the centerline on local streets.
- In all other street corridors the horizontal location shall be determined on a project by project basis. The waterline should maintain minimum spacing from non-potable lines and should be centered in a through lane.
- Vertical Location: Water mains shall be installed to minimum depth measured from the proposed finished grade to top of pipe as follows
 - For waterline 16 inches in diameter and smaller, provide a minimum cover of 48 inches over the top of pipe.
 - For waterlines larger than 16 inches in diameter, provide a minimum cover of 60 inches over the top of pipe.
 - 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 60 inches over the top of the pipe from the existing grades.
 - New waterlines, fire lines, and water service lines are not allowed to pass under retention basins. This does not apply to landscape irrigation lines downstream of proposed backflow prevention devices.

E. Minimum Separation

For the protection of the public water supply from contamination the Engineer shall maintain separation distances in accordance with the Maricopa County Health Code, Arizona Department of Environmental Quality Engineering Bulletin 10, MAG Specification Section 610.5 and MAG Standard Details 404 Water and Sanitary Sewer Separation/Protection.

F. Vertical Realignment

The City of Avondale allows for water mains six (6) inches to twelve (12) inches in diameter to be realigned per Detail 370. Waterlines larger than 12 inches shall have all vertical realignments detailed by the Engineer on the construction plans.

The vertical realignment shall be constructed of ductile iron pipe and shall not be deflected or swept. Air release valves and isolation valves will be installed as per the following:

- Install air release valves at localized high points where air entrapment or cavitation may occur. At pipe line terminations, fire hydrants can be used in lieu of Air release valves, when approved by the City staff.
- Do not place tees, fire hydrants, service lines, and other appurtenances within any portion of the vertical realignment unless approved by City staff.
- Give special attention to vertical realignments on existing waterlines in order to avoid disruption to the distribution system.
- Separation from Storm Drains and Culverts: Water mains shall maintain six (6) feet horizontal and two feet vertical separation from storm drains and culverts.

Water mains crossing less than two (2) feet below a storm drain or culvert shall require additional protection such as the use of ductile iron pipe or concrete encasement per MAG Standard Detail 404-3.

G. Couplings, Joints, Gaskets, and Flanges

Couplings, Joints, Gaskets, and Flanges: Couplings, joints, gaskets, and flanges shall conform to Section 610.13 of the MAG Uniform Standard Specifications, unless otherwise approved.

- Thrust Restraint: Joint restraint shall be used at all bends elbows, tees, crosses, dead ends, stubs, curb stops, fire hydrants, taps, valve locations on large diameter water mains, etc where water flow changes direction or is stopped. The joint restraint limits shall be shown on the plan in the profile view. Restrained joint calculations shall be prepared and submitted when necessary keeping in mind that concrete thrust blocks are not to be considered in the calculations.
- Acceptable restrained joint systems include the following:
 - Ductile Iron Pipe (D.I.P.) joint restraint shall comply with MAG Standard Detail 303.
 - All restrained fitting shall be protected from corrosion by encasement in a polyethylene (Polywrap) wrapping and installed per MAG Specification 610.6.3.
- Thrust Block will not be allowed for new construction on the City's water system unless approved by the City.

H. Easement Width

Waterlines located outside of public right-of-way shall be installed in a minimum 20-foot wide dedicated waterline easement. The easement shall be accessible from public right-of-way, free of obstruction and accessible at all times to City service equipment

- 12 inch and smaller water main Twenty (20) foot typical minimum or as otherwise approved by the City
- 16 inch and larger Width based on design conditions (20 foot Minimum)

The City staff may require additional easement width if in their opinion excessive laying depth of the pipe would require the additional width for maintenance purposes.

I. Easement Dedication

Waterline easements or right-of-way dedication shall be through a map of dedication, or separate instrument. Contact the City for the best method for a particular project. All dedicated land shall be free of environmental contamination per ASTM E-1527 current requirement.

J. Dead-End Waterlines

- Whenever possible, temporary dead-end waterlines must be extended beyond paved surfaces to avoid pavement cutting at time of future connection and must be equipped with a flushing pipe assembly installed out of traffic per MAG Standard Detail 390 Type A.
- A gate valve must be installed on every dead-end waterline between the last fitting and the flushing pipe assembly at the terminus of the waterline. The minimum distance between the gate valve and the flushing pipe assembly shall be 20 feet.

K. Valves

The City of Avondale requires the installation of isolation valves to facilitate the operation, maintenance, and expansion of the water distribution system. Waterline valves shall meet or exceed the pressure classification of the waterline.

Gate valves, required to control the operation of the water system shall be installed per City of Avondale Standard Detail.

L. Valve Spacing

- Twelve inch and smaller
 - Maximum of 600 feet spacing in industrial/commercial districts.
 - Maximum of 800 feet spacing in residential areas.
- Sixteen inch and larger maximum of 1000 feet spacing
 - At every mile section line, install a cross with a valve on each leg of the cross.
 - Valve spacing between the mile section lines shall not exceed 1,320 feet.
- In residential developments, valves shall be located so that a maximum of 30 single family dwelling units, or a maximum of two (2) fire hydrants, or a maximum of four (4) valves are involved in a waterline shutdown.

M. Valve Location

- A valve shall be located on each side of a canal, wash, railroad, or freeway crossing.
- Avoid valve locations in curbs, sidewalks, driveways and valley gutters, bike lanes, and vehicle wheel paths.
- 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 International Fire Code and City Amendments.
- The preferred locations of valves shall be at the curb return of the intersecting street, or at a fire hydrant location.

N. Valve Types

- All valves 12 inches and smaller shall be resilient seat/wedge gate valves, epoxy-coated inside per AWWA C-550.
- Valves 16 inch to 24 inch shall be double disc gate valves, epoxy-coated inside per AWWA C-550.
- Valves larger than 24 inches shall be butterfly valves per MAG Specification 630.5.
- All gate valves shall conform to Section 630.3 of the MAG Uniform Standard Specifications.

O. Air Release Valves

Air release valves will be installed at all changes in slope of waterlines eight (8) inches or larger in diameter, as follows:

- When waterline changes from a positive slope to a zero slope, or a negative slope, in the primary direction of flow.
- For vertical alignment changes to cross under or over another facility (such as other utilities, drainage washes, etc.).
- Slopes on all waterlines shall not be less than 0.002 ft/ft. No zero slopes in the waterline will be approved. In the absence of any changes in slope, air release valves will be installed only at high points.
- All air release valves will be a combination air/vacuum release type, per City of Avondale Standard Details.

P. Service Lines, Water Meters, and Backflow Prevention

Final plans shall indicate the water service, sewer service, and water meter location for each proposed development. For single family residential developments a typical lot layout indicating the water service, sewer service and water meter location in relation to the driveway will be required. Service lines and meter boxes will be located within public rights-of-way, or a public utility easement. Meters are to be accessible to City workers at all times.

Service taps on a line which is primarily designed to service fire sprinkler systems and/or fire hydrants must be approved by City staff. The fire line as well as each service connection requires its own backflow prevention device.

- The Developer shall install all water services and meter boxes in new development projects. The Developer is responsible for application and payment of all applicable fees.
- Water meter boxes shall be installed out of traffic and out of sidewalk ramps. Residential meter boxes are to be at the back edge of the sidewalk.
- Metered Services
 - Subdivision plans shall provide a typical water service location detail

- Where water services are being designed for isolated locations, provide stationing and offset to property line
- Minimum water service size is one (1) inch. For landscape use only water service size may be three-quarter ($\frac{3}{4}$) inch.
- Backflow Prevention Devices (BPD): The City of Avondale is responsible for protecting the quality of the public water supply. To prevent contamination of the public water supply by backflow and cross connections, the installation of backflow prevention devices is required for all developments except single family residential.
 - Per Chapter 24, Municipal Water System, Article I, Section 24-3 of the Avondale City Code, www.avondale.org the following types of backflow prevention devices are approved for installation on the City of Avondale water system:
 - Double Check Valve Assembly (DC);
 - Reduced Pressure Principle (RP) Device;
 - Pressure Vacuum Breaker (PVB) Assembly;
 - Air Gap Separation (AG) Assembly
 - Refer to the above referenced Avondale City Code Section for the types of developments that require an approved backflow preventive device, and the installation method of the said devices.
 - All backflow preventive devices shall be approved by the “Foundation of Cross Connection Control Research of the University of Southern California”, American Water Works Association (AWWA), and the City of Avondale Water Resources Department. The manufacturer shall have a local parts and service center.
 - All testing, maintenance and repairs to the backflow preventive devices shall be made at the water service customer’s expense by a certified backflow prevention device tester approved by the Water Resources Department. The initial testing and the required annual testing are the responsibility of the water service customer.
 - Install a double check valve backflow prevention assembly per City of Avondale Standard Detail at all fire protection water connections. The assembly shall be located within 150 feet of a fire hydrant that is connected directly to a City waterline.
 - Note the backflow prevention device location (if applicable) on the plans. NOTE: Devices shall be located outside the public right-of-way and PUEs.

Q. Fire Hydrants

All new fire hydrants are required to be “wet-barrel” type hydrants. Fire hydrants shall comply with the International Fire Code and City Amendments and be located in the public rights-of-way. NOTE: Separate types of fire hydrants are required in single family subdivisions and commercial and multi-family developments. Refer to the International Fire Code and City Amendments for specific manufacture and models.

The Fire Marshal shall make the determination regarding fire hydrant spacing, flow, and pressure requirements where special fire protection conditions are warranted

- **Fire Hydrant Spacing:** The spacing of fire hydrants shall comply with the International Fire Code and City Amendments and is to be measured along the street or roadway in which a fire hose would be laid. Generally, this spacing is measured along the curb line.

**TABLE 4-6
Fire Hydrant Spacing**

Description	Spacing*
Single Family Residence	500 ft. maximum spacing
Cul de Sacs	250 ft. maximum spacing
Two-Story Townhouses and Apartments	300 ft. maximum spacing
Business and Industrial	300 ft. maximum spacing (including shopping centers), but at least 1 hydrant per 100,000 sq. feet of coverage
Arterial/Collector without Frontage Structures and with Medians	500 ft maximum spacing
Arterial/Collector without Median	1,000 ft. maximum spacing

*Refer to the International Fire Code and City Amendments for fire hydrant spacing with the installation of automatic fire sprinkler system.

- **Locations:** Fire hydrants to have three (3) feet clearance on all sides and a maximum of eight (8) feet from face of curb. Offsets from the street monument line shall comply with MAG Standard Detail 362.
- **Use as Air Release:** Fire hydrants shall be used at the end of the dead-end waterlines on 12 inch and larger as an air release mechanism and installed using a tangential tee.
- **Private Fire Protection Water Supply Systems:** On private property, the fire hydrant shall be contained within a dedicated waterline easement or right-of-way. Fire hydrants not in dedicated easement or right-of-way are considered private and shall comply with the International Fire Code and City Amendments.
- **Pavement Markers:** All fire hydrants shall be clearly identified by installation of reflective blue markers in accordance with City of Avondale Standard Details.

4.9 Final Water Plan Requirements

Construction Plan Submittal Requirements for the preparation of final plans in the City are described in Chapter 1; this section supplements the requirements of Chapter 1.

- A.** Show all existing utility locations, sizes, easements, rights-of-way, and other structural features of the waterline.
- B.** A key map with the following information:

- All streets, alleys, easements, tracts and parcels
 - Existing water system including fire hydrants and valves in and around the development
 - Proposed water system including fire hydrants and valves
 - Pipe sizes
- C.** Note all jurisdictions in which the project is located, including City, State, and County. It is the contractor's responsibility to acquire the appropriate permit.
- D.** Phase limits and phase numbers if applicable
- E.** Match lines and sheet references must be shown on each sheet with stations. Paving match lines may not always work.
- F.** Phase limits and numbers must be shown on all applicable sheets. Phase lines are to follow lot lines where possible.
- G.** All existing waterlines and all existing fire hydrants (within 350 feet) must be shown with dimensions to the centerline of the street.
- H.** All waterlines proposed by adjacent projects shall be shown and dimensioned.
- I.** Station waterlines along the centerline of the street or the pipe. Profile all waterlines 12 inches and larger with slope and invert elevation depicted. Show in profile the finish ground elevations over the waterline where the waterline is constructed outside of paving, or show in profile the finish pavement design elevations where the waterline is constructed under paving.
- J.** Where waterlines cross sewer lines, storm drains, or drainage culverts, show the relationship in both plan and profile with minimum clearances dimensioned. Identify all pipes, valves, and appurtenances, etc.
- K.** No permits for public waterline construction will be issued until the owner or engineer has provided the necessary easements and rights-of-way. The instruments of dedication must be approved and submitted to the City for recording at the Maricopa County Recorder's Office.

Appendix 4-A

Fire Flow Code Requirements

APPENDIX B

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION B101 GENERAL

B101.1 Scope. The procedure for determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix. This appendix does not apply to structures other than buildings.

SECTION B102 DEFINITIONS

B102.1 Definitions. For the purpose of this appendix, certain terms are defined as follows:

FIRE FLOW. The flow rate of a water supply, measured at 20 pounds per square inch (psi) (138 kPa) residual pressure, that is available for fire fighting.

■ **FIRE-FLOW CALCULATION AREA.** The floor area, in square feet (m²), used to determine the required fire flow.

SECTION B103 MODIFICATIONS

B103.1 Decreases. The fire chief is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

B103.2 Increases. The fire chief is authorized to increase the fire-flow requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall not be more than twice that required for the building under consideration.

B103.3 Areas without water supply systems. For information regarding water supplies for fire-fighting purposes in rural and suburban areas in which adequate and reliable water supply systems do not exist, the fire code official is authorized to utilize NFPA 1142 or the *International Urban Wildland Interface Code*.

SECTION B104 FIRE-FLOW CALCULATION AREA

■ **B104.1 General.** The fire-flow calculation area shall be the total floor area of all floor levels within the exterior walls, and under the horizontal projections of the roof of a building, except as modified in Section B104.3.

■ **B104.2 Area separation.** Portions of buildings which are separated by fire walls without openings, constructed in accordance with the *International Building Code*, are allowed to be considered as separate fire-flow calculation areas.

■ **B104.3 Type IA and Type IB construction.** The fire-flow calculation area of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.

■ **Exception:** Fire-flow calculation area for open parking garages shall be determined by the area of the largest floor.

SECTION B105 FIRE-FLOW REQUIREMENTS FOR BUILDINGS

■ **B105.1 One- and two-family dwellings.** The minimum fire-flow requirements for one- and two-family dwellings having a fire-flow calculation area which does not exceed 3,600 square feet (344.5 m²) shall be 1,000 gallons per minute (3785.4 L/min). Fire flow and flow duration for dwellings having a fire-flow calculation area in excess of 3,600 square feet (344.5 m²) shall not be less than that specified in Table B105.1.

■ **Exception:** A reduction in required fire flow of 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system.

B105.2 Buildings other than one- and two-family dwellings. The minimum fire flow and flow duration for buildings other than one- and two-family dwellings shall be as specified in Table B105.1.

■ **Exception:** A reduction in required fire flow of up to 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 of the *International Fire Code*. Where buildings are also of Type I or II construction and are a light-hazard occupancy as defined by NFPA 13, the reduction may be up to 75 percent. The resulting fire flow shall not be less than 1,500 gallons per minute (5678 l/min) for the prescribed duration as specified in Table B 105.1.

SECTION B106 REFERENCED STANDARDS

ICC	IBC	International Building Code	B104.2, Table B105.1
ICC	IFC	International Fire Code	B105.2
ICC	IUWIC	International Urban-Wildland Interface Code	B103.3
NFPA	1142	Standard on Water Supplies for Suburban and Rural Fire Fighting	B103.3

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

**TABLE B105.1
MINIMUM REQUIRED FIRE FLOW AND FLOW DURATION FOR BUILDINGS^a**

FIRE-FLOW CALCULATION AREA (square feet)					FIRE FLOW (gallons per minute) ^c	FLOW DURATION (hours)
Type IA and IB ^b	Type IIA and IIIA ^b	Type IV and V-A ^b	Type IIB and IIIB ^b	Type V-B ^b		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m², 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. The minimum required fire flow shall be permitted to be reduced by 25 percent for Group R.

b. Types of construction are based on the *International Building Code*.

c. Measured at 20 psi.

**CITY OF AVONDALE
FIRE CODE AMENDMENTS
PERTAINING TO FIRE FLOW REQUIREMENTS**

Section B105.2 is deleted in its entirety and replaced with the following:

B105.2 Buildings other than one- and two-family dwellings. The minimum fire flow and flow duration for buildings other than one- and two-family dwellings shall be as specified in Table B105.1.

Exceptions:

1. A reduction in required fire flow of up to 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 of the International Fire Code.
2. Where buildings are also of Type I or II construction and are a light-hazard occupancy as defined by NFPA 13, the reduction may be up to 75 percent. The resulting fire flow shall not be less than 1,500 gallons per minute (5678 l/min) for the prescribed duration as specified in Table B 105.1.
3. In H occupancies, no reduction in required fire flow is allowed when the building is provided with an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 of the International Fire Code. The resulting fire flow shall not be less than 1,500 gallons per minute (5678 l/min) for the prescribed duration as specified in Table B 105.1.
4. In buildings with high-piled storage, a reduction in required fire flow of up to 25 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 of the International Fire Code. The resulting fire flow shall not be less than 1,500 gallons per minute (5678 l/min) for the prescribed duration as specified in Table B 105.1.

Note: The reduction allowed in this Exception does not apply to the flow duration requirements in Table B105.1 or to the number and distribution of fire hydrants in Table C105.1.

Section B105.3 is added as follows:

B105.3 Fire flow, fire sprinkler water demand, and hose demand. When determining the fire-flow requirements for buildings the required fire flow, the fire sprinkler water demand, and the hose demand must be added together.

CHAPTER 5 WASTEWATER COLLECTION SYSTEM

5.1 General Information

The purpose of this chapter is to present a consistent engineering approach for the minimum criteria for design of a public wastewater collection system. This chapter is intended for the use in planning, design, plan preparation, and the plan review process. The information put forth in this chapter is not intended to cover all situations that arise, nor may it be a substitute for sound engineering principles.

5.2 Availability of City Sewer

Questions pertaining to the availability of public sewer service from the City of Avondale should be directed to Development Services. Questions regarding system expansion or extension requirements to serve proposed new projects may also be directed to the Development Services at www.avondale.org.

5.3 Sewer Service Agreement

All sewage collection systems must obtain a General Aquifer Protection Permit from ADEQ prior to construction of sewer infrastructure. The first phase is for construction authorization. The engineer shall submit to ADEQ a Notice of Intent to Discharge for a Sewage Collection System, Sewage Collection System Capacity Assurance form (if applicable), and Sewage Treatment Facility Capacity Assurance form and applicable fee. ADEQ will review the NOI and the supplemental information to verify that the applicant has submitted all required documents. Refer to ADEQ website www.azdeq.gov for further information and applicable forms.

The Water Resources Department of the City of Avondale will issue a letter to Maricopa County Environmental Services Department acknowledging that the City of Avondale has adequate capacity in the public sanitary sewer system to serve the proposed development. The Engineer shall submit the request for the acknowledgement letter to the Water Resources Department. Development of this letter shall be contingent upon the information provided in the Preliminary Sewer Report.

5.4 City Code

Various City Codes apply to the development of the Municipal Wastewater System including, but not limited to, Chapter 24, Article III, Sewers and Sewage Disposal contains information regarding the development of the public wastewater collection system in association with land development.

An electronic version of the Avondale City Code can be referred to on the City of Avondale website at www.avondale.org.

5.5 City Policy

Developers are required to install, all improvements necessary to provide wastewater service to their development. This includes any sanitary sewer lines, lift stations, force mains, or other facilities, and the payment of all required development fees.

Developers must also adhere to the City's standards for extension of the City's wastewater system to newly developed areas and subdivisions inside the City's service area.

5.6 Federal, State and County Regulations

5.6.1 EPA Regulations

The U.S. Environmental Protection Agency (EPA) requires the City to develop and implement a program to control discharges that might harm the Publicly Owned Treatment Works (POTW). The program establishes local discharge limits for non-residential users, and provides a permitting process based on the users' discharges and types of businesses. Details of the program and requirements are found in Chapter 24, Article III (Water, Sewers and Sewage Disposal) of the Avondale City Code. The City is in the process of formulating a sewer Pre-treatment program. Specific information may be obtained by calling the Water Resources Department. Refer to website www.avondale.org/directory.asp for telephone number.

5.6.2 Arizona Department of Environmental Quality (ADEQ)

Engineering Bulletin No. 11, "Guidelines for the Construction of Water Systems" published by the Arizona Department of Environmental Quality (ADEQ), and Arizona Administrative Code, "Title 18 - Environmental Quality", contain specific requirements for submittals, approvals, and notifications when extension of a public sanitary sewer line is proposed.

5.6.3 Maricopa County Department of Environmental Services (MCESD)

Maricopa County Environmental Services Department (MCESD) is required to review and approve all public sanitary sewer line extensions and construction of wastewater-related facilities within the City's service area, prior to the City approving the final plans.

As stipulated by the Maricopa County Health Code, all sewage systems including the installation of septic tank systems require an "Approval to Construct" document, which is issued by the MCESD.

Maricopa County also requires a Sewer Service Agreement be executed by the City of Avondale for all industrial and residential subdivisions including condominiums.

5.7 Design Standards and Guidelines

All public sanitary sewer systems are to be of a gravity flow design, unless other factors dictate the use of a force main and lift station. For force main and lift station requirements, refer to Section 5.7.3 M (Force Mains) 5.7.3 N (Wastewater Lift Station). Developments that need to construct force mains and lift stations facilities shall address the facilities compatibility with the City's Wastewater Collection System Master Plan and Utility Systems Evaluation report.

The Engineer should be familiar with the MAG Uniform Standard Specifications for Public Works Construction and the City of Avondale Supplement to MAG's Uniform Standard Specifications for Public Works Construction, including all applicable Standard Details. These documents contain construction related specifications, and details that impact the design of wastewater systems, including trenching, bedding, backfill, pavement replacement, etc.

5.7.1 Wastewater Collection Analysis

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

A. Wastewater System Loads

Table 5-1 lists unit loads that can be easily correlated to acreages for types of land use. The Arizona Administrative Code 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 lists these unit loads.

**TABLE 5-1
Unit Daily Design Flows for Sewer - Per Land Use**

Residential Land Use Type	Sub-Category	Unit Load Estimate (in gallons)		
		per acre	per capita	per house
Single Family Residential	0-2.5 DU/ac	520	80	260
	2.5-4 DU/ac	1,040	80	260
Medium Density Residential	4 – 8 DU/ac	2,080	80	260
High Density Residential	8 - 12 DU/ac	1,910	80	159
	12 - 23 DU/ac	3,662	80	159
Non-Residential Land Use Type	Sub-Category	Unit Load Estimate (gpd)		

Residential Land Use Type	Sub-Category	Unit Load Estimate (in gallons)		
		per acre	per capita	per house
Hotel/Resort	3 - 10 rm/ac		977	
	10 - 43 rm/ac		3,985	
Churches	Churches		277	
Community Service Facilities	Community Service Facilities		192	
Improved Open Spaces	Golf Courses		0	
	Private Open and Recreation Areas		0	
	Public Parks, etc.		0	
Industrial	Major Industrial		752	
	Minor Industrial		561	
Institutional Facilities	Institutional Facilities		378	
Mixed Use	Mixed Use		1,447	
Office	Office		1,001	
Retail	Community		656	
	General		1,173	
	Neighborhood		502	
	Regional		680	
	Specialty/Tourism		1,100	
Schools	Schools		382	
Utilities	Utilities		1,574	

Note: gpad = gallons/acre/day, DU/ac = dwelling units per acre, rm/ac = rooms per acre.

TABLE 5-2
Applicable Unit Design Flows for Sewer - Non-Residential Land Uses

Type of Facility Served	Applicable Unit	Sewage Design Flow per Applicable Unit, Gallons per Day
Bar/Lounge	Seat	30
Barber Shop	Chair	35
Beauty Parlor	Chair	100
Bowling Alley (snack bar only)	Lane	75
Church	Person (max attendance)	5
	Person (max attendance)	7
Country Club	Resident Member	100
	Nonresident Member	10
Dance Hall	Patron	5
Dental Office	Chair	500
Dog Kennel	Animal, max occupancy	15

Type of Facility Served	Applicable Unit	Sewage Design Flow per Applicable Unit, Gallons per Day
Hospital		
All Flows	Bed	250
Kitchen Waste Only	Bed	25
Laundry Waste Only	Bed	40
Hotel/Motel		
Without Kitchen	Bed (2 person)	50
With Kitchen	Bed (2 person)	60
Industrial Facility		
Without Showers	Employee	25
With Showers	Employee	35
Cafeteria, add	Employee	5
Institutions		
Resident	Person	75
Nursing Home	Person	125
Rest Home	Person	125
Laundry		
Self Service	Wash cycle	50
Office Building	Employee	20
Park		
Picnic, with showers, flush toilets	Parking space	40
Picnic, with flush toilets only	Parking space	20
Recreational Vehicle, no water or 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 and Garbage Disposal, add	Meal	7
Restroom, public	Toilet	200
School		
Staff and Office	Person	20
Elementary, add	Student	15
Middle and High, add	Student	20
with gym & showers, add	Student	5
with cafeteria, add	Student	3
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
Public Restroom, add	Square foot of retail space	0.1
Swimming Pool, Public	Person	10

Type of Facility Served	Applicable Unit	Sewage Design Flow per Applicable Unit, Gallons per Day
Theater	Seat	5
Indoor	Car space	10
Drive-In		

- B. The peaking factor shall be as defined in the Arizona Administrative Code Section R18-9-E301 (Table 5-3).

**TABLE 5-3
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	$PF = (4.500 \times p^{-0.174}) + 1.945$
PF = Dry Weather Peaking Factor	p = Upstream Population

C. Wastewater System Analysis Criteria

- The Manning Coefficient shall be 0.013 for gravity mains. The City may choose to use a lower Mannings Coefficient if, in the City's discretion, doing so would eliminate the need for a lift station.
- The flow depth/diameter (d/D) ratio for sewer mains are as follows:
 - d/D=0.5 for sewer line less than 12-inches.
 - d/D=0.75 for sewer line 12-inches and greater. This maximum d/D Ration applies to the ultimate or buildout peak flow.
- Gravity sewer main velocities shall not be less than two feet per second with the pipe flowing half full in order to maintain cleaning velocities. Table 5-4 lists the minimum slopes for maintaining self-cleaning full flow velocities with d/D = 0.5. The minimum slope listed in the table is 0.0008 ft/ft, which is the minimum practical slope for gravity sewer construction. Greater slopes are desirable as long as the flow velocity does not exceed eight (8) feet per second, but the slopes must be at least equal to the minimum slope.

5.7.2 Sewer System Design Report

All projects involving residential, commercial/industrial subdivisions and land development projects may be required to provide a sewer system design report of the projects impact on the City's wastewater system. The Sewer System Design Report shall be submitted prior to the construction plans. The construction plans shall not be reviewed until the Sewer System Design Report has been approved.

In addition to the report's analysis of the impact to the City's wastewater system the report shall determine the development's wastewater load, and analyze the hydraulics of the proposed sanitary sewer system. The analysis shall include the effects of the peak flow to ensure correct sizing and layout of the new wastewater facilities.

The design report shall be sealed and signed in accordance with the requirements of the State of Arizona Board of Technical Registration, and submitted to Water Resources Department. Report shall be letter sized (8.5" x 11") with any larger maps included within the report shall be folded to letter size and bound or provided in a folder.

A. Sewer Load Requirements

All projects shall provide a summary of the anticipated sewer loads for the project. Provide a calculation of the anticipated sewer flows. These calculations will be based on the unit factors listed in Section 5.7.1. If the proposed use does not match the tables, provide an estimate of what the flows will 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.

B. Sewer System Model Analysis

Provide a model of the planned sewer system as delineated in later section of this manual. This modeling will be required where new public sewers are being added to the City system. The model will provide the data in a format that will update the City's master model and verify flows in the City system. Infill projects will not require a model. Infill projects include the following single lot development where sewer connection is directly to existing City mains and residential subdivisions of five acres or less.

- Sewer Model Requirements
 - Sewer hydraulic modeling information shall be provided to the City so that this information can be added to the City's hydraulic model. This section describes the requirements to be met to deliver model data to the City.
- Model Software
 - The City of Avondale currently uses the H₂OMAP Sewer software. The modeling software used to evaluate a proposed development does not need to be the same software, but the data needs to be easily transferred into the City's software.

- For sewer system models, collection system data can be moved from one modeling program to another using common file formats. The easiest and preferred formats for transferring data to or from H₂OMAP is the GIS shape file format, and the Microsoft Excel file format.
- Model Development
 - The developer or developer's engineer shall create and utilize a hydraulic model to demonstrate that the proposed infrastructure of the sewer system is adequate, and satisfies the performance criteria. The model or model information will then need to be delivered to the City to be added to the City's models, where modeling evaluations will be performed to verify that the proposed infrastructure will work well with the City's system. For wastewater systems, collection main capacity from the development to the treatment plant, treatment plant inflows, and lift station capacity will be evaluated, where necessary.
 - The City's model will be updated to include planned infrastructure. This planned infrastructure data will be labeled uniquely in the model to distinguish it from as-built infrastructure data. Once the infrastructure has been constructed, the City or its designated agent will enter the data into the City's GIS system through procedures that have been established by the City. When the City updates its models on a periodic basis using the most current GIS data, planned infrastructure in the model will be replaced with as-built information as contained in the GIS database.
- Hydraulic Model Data
 - Coordinate Systems
 - All drawings and model data shall use the NAD_1983 State Plane Arizona Central coordinate system, with the transverse Mercator projection system. Elevations shall be the elevation above mean sea level. This is the same coordinate system the City plans to use in the future. If drawings are prepared before the City converts to the NAD_1983 coordinate system, then drawings shall be provided in the City's current coordinate system. The developer should check with the City to be certain that the correct coordinate system is being used.
 - Attributes
 - Each physical entity in the model of the proposed development will require information and attributes as defined below.
 - Sewer Collection System
 - Gravity Mains – Diameter, material, length, location, connectivity with mains and manholes, upstream invert elevation, downstream invert elevation.
 - Manholes – Diameter, location, connecting mains, drop manhole details (if any), wastewater load, and bottom elevation.
 - Lift Stations – Layout, location, and connectivity with other entities, number of pumps, pump design point or curve, number of pumps, pump start/stop controls, elevation, wet well dimensions, wetwell invert, outfall elevation.

- Force Mains – Diameter, location, connectivity, pipe material.
- Diversion Structures – Diameter, invert elevation, location, connectivity, weir height and size, control scheme, desired flow through each diversion.
- Outfalls – Location, connectivity, invert elevation.
- Hydraulic Evaluation
 - New developments that do not constitute infill shall be modeled to determine if the infrastructure is adequate to service the development and provide the level of service as defined by the City’s performance criteria.
 - The City would use the City’s model to determine the available capacity in sewer interceptors to convey wastewater from the development. The developer would be responsible to make certain that wastewater can be safely conveyed from the points of origin to the City’s interceptors.
 - Boundary conditions that represent the interface between the model of the development and the rest of the distribution system need to be explained clearly.
 - The steady-state peak hour of the day simulations shall be completed to show that the collection system mains are sized adequately and that slopes are greater than the minimum slope.

C. Preliminary Sewer System Design Report

A preliminary report is required at the entitlement stage of a project. The type and size of buildings may or may not be known at this stage. The preliminary report should provide the following information:

- Provide the preliminary sewer flow requirements (based on either acreage or building size and use.) This data may be refined or changed due to changes in the plan through the entitlement stage.
- Provide a sewer model analysis if required. For single family residential developments, the model may be delayed until the Final Sewer Report submittal if desired. Any plan or system changes required due to inadequacies of the system as modeled will require construction plan changes as necessary to meet requirements.
- If no changes are anticipated or required with the construction plans, this report may be submitted as the Final Sewer Report.

E. Preliminary Sewer Design Report Format

The following sections are to be included in a development sewer design report:

- Cover Page
 - Project Title
 - Prepared For
 - Prepared By
 - Engineer’s Seal

- Date
- City Datum Benchmarks (BM)
- Executive Summary
 - Provide a one or two page statement indicating that the criteria is met, what criteria was used, and an explanation of specific steps that were taken to modify the design so that the criteria is met. Unique characteristics or challenges associated with the project should also be presented.
- Introduction
 - Provide the project name, size, type of development
 - Purpose of the report
 - Project owner
 - Summarize the content that would be found in each major section of the report
- Project Location
 - Provide a site description
 - Project size
 - Addresses and major streets
 - Township, Range and Section
 - Relationship to other developments or significant sewer features
 - Include a site map
- Purpose of Report
 - Explain the objectives of the report, which could be to define infrastructure requirements, satisfy regulatory requirements, or evaluate the impact of the new development on the existing collection system.
- Existing Collection System Conditions
 - Describe existing collection system infrastructure that affects the development.
 - Identify lift stations, and downstream trunk mains that will be used to convey wastewater from the development.
- Proposed Collection System Conditions
 - Describe infrastructure needed to take wastewater from the development to the water reclamation plant.
- Design Criteria
 - Summarize the City's design standard requirements that were applied to this project.
- Design Methodology
 - Modeling – Identify the software used and specific assumptions in the model.
 - Wastewater Flows – Identify land use, population, population density, loads and peaking factors.
 - Collection System Network – Identify and describe mains that will be needed to serve the development.
 - Lift Stations – Describe temporary and/or permanent lift stations where required. Provide design parameters, and layouts when appropriate.
 - Outfalls – Identify and describe location and size.

- Wastewater Model and Results
 - Identify main sizes, slopes, and other results as obtained from the model.
 - Include a map of the collection system for each simulation where pipes are color coded by d/D to demonstrate that the mains are adequately sized.
- Conclusions
 - Summarize work that has been completed; state recommendations, areas, where further evaluation may be needed.
- References
 - List documents used in the report that contain relevant information.
- Appendices
 - Figures
 - Vicinity Map
 - Land Use Exhibit
- Land Used Data
 - Table summarizing parcels, acreages, land use, and population.

F. Final Sewer Design Report

The Final Report will be required at the time of the civil improvement plan submittal. The Final Report will be basically the same as the Preliminary Report, however, modified to include any changes to the project between the entitlement stage and the construction plan stage.

5.7.3 Wastewater System Design

Sewer main lines installed by improvement projects which are adjacent to undeveloped parcels are required to install main line 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 right-of-way line and be eight (8) inches minimum in diameter.

A. Utility Trenching

All trenching, bedding, backfill, compaction, and pavement replacement shall comply with City of Avondale Supplement to MAG Construction Specifications and Standard Details, MAG Specification 601. All pavement replacement shall be in accordance with City of Avondale Standard Details.

B. Pipe Sizing

Minimum size for sewer main lines shall be eight (8) inches in diameter. Sewer line sizing criteria shall comply with ADEQ Bulletin No. 11. Larger sewer lines may be required if warranted by the project's Wastewater System Design Report, specific sewer loads, or by the City's Wastewater Collection System Master Plan and Utility Systems Evaluation Report.

C. Pipe Material

Alternate pipe material may be approved by the City on a case by case basis.

- Vitrified clay pipe (VCP)
- Polyvinyl chloride (PVC) ASTM D-3034, SDR-35
- Ductile iron pipe (DIP) with approved lining

D. Curvilinear Sewer

The installation of new curvilinear sewer mains for public sanitary sewer collection systems are not permitted within the City of Avondale service area.

E. Sewer Main Locations

Public sewer main locations are required to be within dedicated street right-of-way or a public sewer line easement. Sewer alignments should generally be parallel to property or street center line. Alignment should be straight and uniform within the street or easement.

- Horizontal Locations
 - Minimum horizontal separation from the sewer main to any underground wet utility shall be six (6) feet, outside diameter to outside diameter. Exceptions must be approved by the City.
 - In general, the preferred horizontal location of sewer lines on local streets shall be six (6) feet from the centerline on the opposite side of the waterline placement.
 - In all other street corridors the horizontal location shall be determined on a project by project basis. The sewer line should maintain minimum spacing from potable lines and should be centered in a through lane.
- Vertical Location
 - Sewer mains shall have a minimum five (5) foot cover over top of the sewer main as measured from surface course of finished grade.
 - Trench loading calculations shall be made available to the City upon request.
 - Where a sewer main crosses below an irrigation ditch, there shall be at least two (2) feet of separation between the flow line of the ditch and the top of the sewer.
 - Where cover is less than three (3) feet, due to topography such as unlined canals, washes, etc., the sewer main line shall be constructed of Ductile Iron Pipe (DIP) with an approved lining. The DIP shall extend a minimum of 10 feet each side of the canal, wash, etc., and be protected from any settlement or washout.

F. Minimum Separations

- Caution should be taken in the design and construction of the sanitary sewer lines to protect all water supplies from wastewater contamination. To minimize the potential of contamination, the Engineer must design the horizontal and vertical separation of water and sanitary sewer lines, in accordance with Engineering Bulletin No. 10, "Guidelines for the Construction of Water Systems published by the Arizona Department of Environmental Quality, and the Arizona Administrative Code, Title 18, Chapter 9, "Water Pollution Control" and MAG Specification Section 610.5.
- Separation from Structures: Sanitary sewer lines will have a minimum of six (6) feet of horizontal clearance from any structural footing, or substantial improvement.
- Separation from Storm Drains and Culverts: Sanitary sewer lines crossing less than two (2) feet below a storm drain or culvert, or under large structures such as box culverts and bridges, will require additional protection such as the use of DIP or encasement. Sanitary sewer lines crossing over storm drains and culverts must be a minimum of one (1) foot above and provide extra protection per MAG Standard Detail 404-1 through 404-3.

G. Sewer Line Easement Width

- Sewer mains located outside of public right-of-way shall be installed in a minimum 20 foot wide dedicated sewer line easement. The easement shall be accessible from public right-of-way, free of obstructions and accessible at all times to City maintenance equipment.
 - Sewer line depth of 10 feet or less: Minimum width shall be 20 feet
 - Sewer line depth greater than 10 feet: Minimum width shall be two (2) times the depth (centered in easement).
- Regardless of pipe size, there shall be a minimum of six (6) feet between the sewer line and any property line.
- Sewers placed between private lots shall be required to provide a 30 foot wide public utility easement with the sewer line located in the center of the easement.

H. Easement Dedication

Sewer line easements or right-of-way may be dedicated by a Map of Dedication Subdivision Plat or separate instrument and conveyed to the City. Contact the City for the best method for a particular project. All dedicated land shall be free of environmental contamination per ASTM E-1527 current requirements.

I. Pipe Slopes

- Minimum velocity shall be two (2) feet per second as shown in Table 5-4
- Gravity sewer main velocities shall not be less than two (2) feet per second with the pipe flowing half full in order to maintain cleaning velocities. Table 5-4 lists the minimum slopes for maintaining self-cleaning full flow velocities with $d/D = 0.5$. The minimum slope listed in the table is 0.0008 ft/ft, which is the minimum practical slope for gravity sewer construction. Greater slopes are desirable as long as the flow velocity does not exceed eight (8) feet per second, but the slopes must be at least equal to the minimum slope.
- Maximum velocity shall not exceed eight (8) feet per second.

**TABLE 5-4
Recommended Minimum Slopes for Circular Pipes**

Pipe Size (inches)	Minimum Slope⁽¹⁾ (ft/ft)
8	0.0040
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 24 inches should still have a slope no less than 0.0008.
- (2) Pipe Capacity presented based on full capacity flow.
- (3) Table assumes Manning's N coefficient of 0.013.

J. Manholes and Cleanouts

- Manholes with pipeline deflections of 45 degrees or greater shall provide 0.2 feet of invert drop through the manhole. All other manholes shall provide a minimum 0.1 feet invert drop. Pipeline deflections greater than 90 degrees will not be allowed.
- When pipe sizes change through a manhole, the crown of the upstream pipe(s) shall be equal to or higher than the crown of the downstream pipe. If this causes an invert drop greater than 12 inches, match springlines. In large trunk lines, inverts at junctions should be designed to maintain the energy gradient across the junction and prevent backflow.

- Standard manholes on the City of Avondale public sewer system shall conform to MAG Standard Details 420 -1, 420 -2 and 424. Use only cast in place manhole bases. The manholes shall have no steps. Manholes are required but not limited to, the following situations:
 - Changes in slope.
 - Changes in alignment.
 - Change in pipe size.
 - New main connection into existing main/trunk line.
- Manholes on boundaries of the subdivision shall have stubs with shaped inverts in appropriate directions for future connections.
- Manhole covers to be non-rocking, traffic rated, and located outside the wheel path of vehicles, bike lanes and sidewalk ramps.
-
- Manhole Lining
 - Manholes are required to have a form of corrosion protection. Approved coating systems that provide corrosion protection are listed in the COA Supplement to MAG Specifications and Standard Details.
- Drop Manholes
 - Sewer mains may have a maximum of 12 inches drop (flow line-to-flow line) without a drop connection. Drop manholes are to be avoided due to the increased maintenance issues, generation of odors due to the turbulence of the flow, and safety hazards for maintenance personnel.
 - Engineers that are contemplating the use of drop structures to address grade and depth issues are required to discuss the situations with the City staff and receive approval to proceed with a design that includes drop manholes.
- Approval to Use: The City shall determine when the use of drop manhole structure(s) is appropriate. When specifically approved by the City, the drop manhole structures shall be in accordance with MAG Standard Detail 426.
 - For drops up to and including five (5) feet, use type "A".
 - For drops greater than five (5) feet, use type "B".
- Cleanouts: Sewer cleanout may be utilized on public sewer lines where special conditions exist. City approval is required prior to the design of a cleanout on public sewer lines.

K. Manhole Spacing

- Refer to Table 5-5

**TABLE 5-5
Manhole Spacing (1)**

Pipe Size (Inches)	Maximum Spacing (Feet)
8 to 10	400
12 to 21	500
24 and larger	600

(1) Source: ADEQ Engineering Bulletin 11

L. Sewer Services

Final plans shall indicate the sewer service location for each proposed development. The location shall not be changed in the field except with approval by the City. For single family residential developments a typical lot layout indicating the sewer service in relation to the driveway will be required. Service lines will be located within public rights-of-way, or a public utility easement. As-Built plans shall reflect any revisions made during construction.

- **Building Connections (Sewer Taps)**
 - The Engineer shall make every effort to utilize the existing sewer line that has been stubbed out to the property by previous construction.
 - All building line connections will be installed perpendicular to the sanitary sewer line per MAG Standard Detail 440.
 - Taps into manholes shall be avoided when possible.
 - The maximum number of taps into manholes shall be two. No tap is allowed into a manhole against incoming flow through the manhole.
 - Sewer lines 12 inches in diameter or larger may be tapped only with City approval.
 - All taps shall be a minimum of six (6) feet from the centerline of the manhole.
 - A three (3) foot minimum separation between service taps is required.
 - All taps shall be stationed using the closest downstream manhole as station 0+00.
 - Plans shall be reviewed by the City for backflow prevention valves which are required where finish floor elevations are below either upstream or downstream manhole rim elevations. When a backflow prevention valve is required, the owner of the property will be responsible for maintaining the backflow valve.
 - The owner will be responsible for the sewer service line from the right-of-way line to the service facility.

- An Electronic Locator Ball and Sewer Service Curb Crossing Stamp per MAG Standard Detail 440 shall be installed on each individual sewer tap.
- A single tap per lot is required and permitted. Additional taps for any one lot must specifically provide written request submitted to the City and receive written acknowledgment of approval by the City.
- All sewer taps into existing sewer main lines shall be performed by a licensed contractor. Contractor shall obtain a right-of way permit and provide a not less than a 24-hour notification for inspection services prior to installation of the sewer tap.
- Size of sewer taps shall be determined as follows:
 - Single family residential developments shall be four (4) inch. A four (4) inch diameter tap shall be provided for each platted lot. Additional taps for common areas shall be determined by the Engineer.
 - Multi-family developments shall have a minimum six (6) inch taps.
 - Commercial developments shall have a six (6) inch tap unless a smaller size is demonstrated to be sufficient.
 - Commercial/Industrial subdivisions shall provide six (6) inch services to each lot.
 - All taps larger than six (6) inches require the installation of a manhole.

M. Public Sewer Force Mains

Proposed sewer force mains to serve a land development project will be reviewed and approved on a case by case basis by the City.

Public force mains will be located within a rights-of-way, or sewer line easement. The line should be located under pavement wherever possible.

- Velocity Requirements
 - The operational flow velocity in the force main must be between three (3) and seven (7) fps. The pipe diameter must be approved by the City to verify adequate scour velocity and the City's ability to maintain the pipe.
- Pipe Material
 - All pipe material used in design of the force mains must have established ASTM, ANSI, AWWA, and NSF standards of manufacture, or seals of approval, and shall be designated as pressure sanitary sewer pipe. Force mains must be identified as such, with marking tape buried one (1) foot above the pipe.
 - Force mains will be constructed of restrained ductile iron pipe, or approved equal for the following conditions:
 - All locations where a vertical realignment is required;
 - Drainage wash crossings;
 - Air release assemblies;
 - Clean-out assemblies.

- Air Release Valves
 - Air release valves designed for sewage must be provided on force mains at all peaks in elevation. See City of Avondale Standard Details.
- Line Separation
 - Where a force main crosses a water main or transmission line, protection must be provided as per ADEQ Engineering Bulletin No. 10, and the Arizona Administrative Code, Title 18, Chapter 9, Water Pollution Control. At a minimum, pipe separation and extra protection shall comply with MAG Specification 610.5.5 and MAG Standard Detail 404.
- Odor Control
 - A nuisance odor is defined as an emission of any gas, vapor, fume, or mist, or combination thereof, from a facilities, in whatever quantities, that causes, either alone or in reaction with other air contaminants, injurious effects to human health or safety; unreasonable injurious effects to animal life, plant life or significant value, property; or unreasonable interference with the comfortable enjoyment of life or property.
 - The Engineer must evaluate and provide provisions for the potential for odor to develop from a force main downstream of the receiving manhole. One-way valves on building service lines shall be specified where there is potential for gasses to seep from the waste stream. The valves should be located at or near the building cleanout and include provisions for access and maintenance by the property owner

N. Wastewater Lift Stations

Private lift stations are not permitted to be located within dedicated public rights-of-way or public easement. Lift stations shall be designed and sized to serve a regional area to avoid having multiple lift stations serving specific development. The use of lift stations shall be minimized wherever possible.

- Site Selection
 - Lift station sites shall provide the following:
 - In selecting a site for a sewage lift station, consider accessibility, drainage patterns, visual impact, functions, design constraints, and ultimate street section.
 - Consider the potential for flooding when selecting a pump station location. The station's equipment must be protected from damage and remain operable during a 100 year storm event.
 - Reasonable access for vector trucks and other maintenance vehicles.
 - Visual compatibility with surroundings developments including block walls around the lift station.
- Lift Station Requirements
 - Arizona Administrative Code, Title 18, Chapter 9, "Water Pollution Control", contains minimum requirements for a wastewater lift station. Additional requirements specific to the City must be obtained from the

Water Resources Department before beginning design. At a minimum, telemetry, dual pumps, backup power supply, three-phase power, odor control, and perimeter walls will be required. The site will also be large enough to contain all the equipment and service equipment for repairs.

- Prior to the preparation of construction drawings, a preliminary wastewater design report will be prepared and submitted to the Water Resources Department for review and approval. The preliminary report will outline the type of equipment and controls proposed for the station. A final wastewater design report prepared by a Registered Professional Engineer licensed in the State of Arizona must accompany all pump station design drawings submitted to the City for review.
- Lift Station Design (Submersible Pump)
 - The lift station shall include the following as a minimum:
 - Lift station shall be sized so that the number of pump starts per hour does not exceed seven.
 - Design for current, interim and ultimate conditions.
 - Triple the station's minimum requirements, unless approved otherwise by the City or Water Resources Director.
 - Station shall have a minimum of two (2) pumps and be capable of operating at the designed flow with the largest pump out of service.
 - Size of pumps to be the same, except as approved otherwise by the City or Water Resources Director.
 - Pumps to be submersible (Flygt, or other approved equal).
 - Aluminum trash rack with stainless steel rails. Provide detail on plans.
 - Portable hoists with separate mounts for each pump and trash rack. Provide electric winch (12 volt) with manual override.
 - Valve pit with shut-off and check valves.
 - Aeration odor control.
 - Aluminum access covers.
 - Precast or cast-in-place concrete walls. All interior walls shall be lined per City of Avondale requirements.
 - Electrical control unit (EG Controls, or City approved equal).
 - Controls to have hour meters, run and failure lights with rotating beacon light, HOA switch, auto dialers, and provide for alternating sequencing of pumps.
 - Four (4) inch minimum static vent.
 - All pump rails and hardware should be stainless steel.
 - Six (6) inch DIP emergency by-pass line with valve and a quick coupling hose nozzle with cap, or flanged end with blind flange.
 - Emergency power source and redundant level controls that provide immediate service when required
 - Communication to City's SCADA monitoring system or for operations, monitoring and security.
 - Discharge piping by-pass system.

- Equipped with visual or audible alarms if exceedingly high or low water levels are detected.

O. Flow Metering Structure

The Water Resource Department has sole discretion when to require an engineer to install a flow metering structure for monitoring of the wastewater collection system capacities. The engineer shall design the flow metering structure as part of the projects improvements. The flow metering structure design shall include:

- Adequate land area for the structure with access to public right-of-way
- Perimeter fence for site.
- Parshall flume installed true and level without distortions.
- Vault or structure for flume and appurtenances.
- SCADA radio monitoring system.
- Electrical control system.
- Flow meter (ultrasonic transducer type)
- Ventilation system design including all wiring, conduits, switches and designed to comply with the current OSHA confined space regulations.
- Odor control equipment.
- Pipe and conduit penetrations in vault shall be core drilled.
- Access hatches with 36" clear opening.
- Fiberglass reinforced polyester grating.

P. Wastewater Monitoring Appurtenances

- **Monitoring Vaults**
 - The Water Resource Department has sole discretion when to require an engineer to install a monitoring vault for testing wastewater flow and composition. Generally, properties in industrial land use/zoned areas with a projected wastewater discharge of 25,000 gallons per day will be required to install a monitoring vault.
- **Monitoring Manholes**
 - The Water Resource Department retains sole discretion as to when to require an engineer to install a monitoring manhole. Generally, commercial properties with potential mixed uses, restaurants, and developments that will use chemicals or solvents are required to install monitoring manholes.
 - Monitoring manholes will be constructed per MAG Standard Detail No. 420, with a straight channel, and no taps or bends for 10 feet upstream or downstream, or as approved by the Water Resources Department. Design details for monitoring manholes on sanitary sewer lines six (6) inches or larger with a peak flow greater than 40 gallons per minute (gpm) must be approved by the Water Resources Department.

- Location for Vaults and Manhole
 - Monitoring vaults and manholes will be located in a minimum 20 foot wide access and maintenance easement that extends from the vault/manhole/structure to the existing public wastewater system, and be designed for access at all times to monitoring crews and vehicles.

Q. Septic Systems

The City of Avondale does not issue approval for the installation of a septic system. Approval for septic systems, in lieu of connection to the City of Avondale public sanitary sewer system is granted by the Maricopa County Environmental Services Department. The property owner is responsible for the design, receipt of a permit from MCESD, construction, operation, and maintenance of septic systems.

5.8 Final Sewer Plan Requirements

Construction plan submittal requirements for the preparation of final plans in the City are described in Chapter 1. This section supplements the requirements of Chapter 1.

A. All proposed public sewer lines must be shown in both plan and profile views on the same sheet, and pipe material called out. Sewer lines that are not public sewer lines may not require a profile.

B. Phase limits and numbers must be shown on all applicable sheets. Phase lines are to run on lot lines.

C. Dimensional ties must be provided for all existing sewer lines being connected to. Providing both the street centerline station and the perpendicular distance (offset) from the street centerline usually satisfies this requirement.

D. Manholes on boundaries of subdivisions must have stubs with shaped inverts for future connections. Both slopes and elevations must be shown on all proposed sanitary sewer lines stubbed-out for future extension.

E. Where sanitary sewer lines cross waterlines, storm drain, or drainage culverts the clearance shall be indicated in the profile view.

F. The following items must be shown on the plans: For existing and proposed manholes:

- Rim elevation to the nearest 0.10 foot.
- Invert elevations.
- Manhole station: Each manhole will have a unique identifier and be labeled in both plan and profile.
- Dimensional ties, i.e., station and offset, from the street centerline to the manhole

- Where a proposed manhole is constructed on an existing sewer, horizontal distance from the nearest downstream manhole; the invert elevation of that manhole, and the slope of the existing sewer.
- Distance from centerline to centerline of manholes.

G. Sewer stationing is measured horizontally along the horizontal alignment of the sewer.

H. The minimum cover allowed for sewer mains is five (5) feet. At crossings of open ditches, four (4) feet is required between crown of pipe and flow line of ditch. At canal or wash crossings, minimum cover is three (3) feet from the scour line. If less than three (3) feet cover is designed, the pipe must be DIP with approved lining, and extended six (6) feet beyond each side of the wash and protected from any settlement or washout.

I. All abandoned sewer taps must be capped.

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

K. Lift station plans will show all invert elevations, structural elevations, existing and finished grades, control setting elevations, structural design of the wetwell and drywell, valves and piping, surge control devices, pump suction and discharge details, and any other details necessary to provide construction of the design.

L. Plans and profiles of force mains will show size, invert and grade elevations, material, existing and proposed utility locations, and any other necessary details.

CHAPTER 6 AS-BUILT PLANS

This chapter provides guidance and minimum requirements for the preparation of As-Built plans. It is intended for use during and after construction and documentation of improvements installed.

NOTICE: THE RIGHT-OF-WAY INFRASTRUCTURE IMPROVEMENT CERTIFICATES OF COMPLETION RELEASES AND BUILDING CERTIFICATES OF OCCUPANCY WILL NOT BE RELEASED UNTIL CERTIFIED "AS-BUILT" PLANS HAVE BEEN SUBMITTED TO AND APPROVED BY THE CITY.

6.1 Submittals

A. Two (2) bond sets of plans shall be submitted with as-built redline markings to the City for review. Once the bond set of redlines as-built plans are approved and accepted, the Engineer shall complete the submittal process noted in the paragraphs below.

B. As-Built plans shall be submitted in a digital file, "TIF" or "PDF" format and on 24"x36" mylar (4 mil thickness) and be of quality allowing microfilming.

C. As-Built plans shall be signed and sealed by a Professional Engineer or Land Surveyor registered in the State of Arizona with a completed and sealed "AS-BUILT CERTIFICATION" approval block.

AS-BUILT CERTIFICATION

I HEREBY CERTIFY THAT THE "AS-BUILT" MEASUREMENTS AS SHOWN OR NOTED HEREON WERE MADE BY MYSELF OR UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

SIGNATURE

DATE

REGISTRATION NUMBER

NAME/COMPANY:

ADDRESS:

CITY/STATE / ZIP CODE

PHONE:

6.2 As-Built Plan Submittal Guidelines

All as-builts shall have a company transmittal attached as documentation of who is submitting them. This is necessary in order to process the plans and for contact information when the review is complete. Plans will not be reviewed if transmittal documentation is missing.

As-built plans submitted for review shall consist of two (2) blackline paper sets (copied from the original mylars, not a permit set), containing all the original signatures. One (1) set will be reviewed and returned if there are City comments. All comments must be addressed. Two (2) revised plan sets will be required with each resubmittal along with the previous redlined review set until final City approval is obtained. Items out of tolerance shall be required to be reconstructed and corrected prior to starting the next construction phase. Upon City approval, one (1) set of Mylars (4 mil) shall be submitted to the City for permanent record.

All final as-built plans shall be submitted immediately following completion of the paving phase. Partial as-built information/plans will be required during construction as outlined below. If the project is developed in phases, as-built plans for each phase shall be submitted once the work is complete in that phase. Letters of Completion and Acceptance will not be issued until all items out of tolerance have been corrected and all final as-builts have been submitted and approved by the City.

NOTE: The checklist for the various as-built items may be downloaded at www.avondale.org.

A. Grading As-Built Plans

- Partial as-built plans shall be required when the initial mass grading is complete. Retention basins, channels, and lot pad elevations must be on this initial submittal.
- Final grading as-built plans shall be required immediately after the paving phase is complete. Any storm sewer facilities, offsite sidewalk and other grading related improvements must be as-built. See checklist for items to be included.

B. Water and Sewer As-Built Plans

- For construction inspection purposes, City furnished sewer invert worksheets shall be submitted, reviewed and approved by the City prior to the start of any street/concrete work. All as-built manhole inverts, pipe lengths and recalculated pipe slopes shall be submitted. Items out of tolerance shall be required to be reconstructed prior to starting the next construction phase. The sewer slope and invert worksheet may be downloaded at: www.avondale.org.
- Final water and sewer as-built plans shall be required immediately after the paving phase is completed. See checklist for items to be included.

C. Concrete Only As-Built Plans

- Concrete work only as-builts shall be **submitted and approved prior to the start of any actual paving work**. For construction inspection purposes, two (2) blackline paper sets shall be submitted. Concrete work only as-built plans shall include all curb and gutter elevations, valley gutters, aprons, concrete bus bays, and concrete right-turn/deceleration lanes. All longitudinal gutter slopes shall be

recalculated including the valley gutters. Cross-street valley gutters shall also be included. Items out of tolerance shall be required to be reconstructed prior to starting any adjacent paving construction. Any item/area reconstructed will then need to be as-built as outlined above.

D. Paving As-Built Plans

- Final paving as-built plans including the traffic signage and pavement marking shall be required immediately after the paving phase is completed. See checklist for items to be included.

E. Street Light and Traffic Signal As-Built Plans

- Final Street Light as-built plans and final Traffic Signal as-built plans shall be required immediately after the paving phase is completed. See checklist for items to be included.
- Stationing, location and limits of encasement and caps.

F. Certified Retention Volume

The property owner shall provide the City with certified as-built dimensions of the retention basins and the actual volume of storage provided. This must be based on as-built topographic surveys performed by an Engineer or Land Surveyor licensed in the State of Arizona. These as-built volumes must reflect permanent, finished landscaping in place. The as-built retention volume must meet or exceed the required design volume specified in the approved drainage report. A Letter of Certification prepared by an Engineer licensed in the State of Arizona, must be submitted to the City, stating that the provided volume meets or exceeds the required retention volume, and that the drainage facility is constructed in accordance with the approved construction plans. The volume of storage provided must equal or exceed the approved design volume before the city will issue a Letter of Acceptance.

6.3 As-Built Records

The City of Avondale assumes no responsibility for the accuracy of as-built information provided as a public record.

The following records are required for City owned facilities or facilities that will be transferred to the City, including, but not limited to, test results, permits, certifications, registrations and reports such as:

- Property legal descriptions, survey, registration and certification
- Well abandonment registration and certification
- Drywell registration and drilling log for each drywell
- Acknowledgement of completion to satisfaction of other jurisdiction or agency requirements

CHAPTER 7 NON-CITY UTILITIES (PRIVATE UTILITY COMPANIES)

7.1 General Information

Private utilities are those companies, corporations, or entities that provide some type of utility service, whether it is electricity, telecommunications, water, or information services that are not owned, operated or generated by the City of Avondale. The following utility companies provide non-City owned or operated utility services within the City of Avondale, but not limited to:

- Arizona Public Service,
- Salt River Project (Electric)
- Cox Communications & Fiber Optics
- Insight Cablevision
- Qwest Communications
- Southwest Gas Corporation
- Salt River Project (Irrigation)
- Roosevelt Irrigation District
- El Paso Natural Gas
- Algonquin Water Company

This chapter presents the special provisions for design, permitting, and requirements for construction of private utilities in dedicated City right-of-way.

Prior to the issuance of a permit to allow the excavation and installation of underground utilities, i.e., (electric power, cable, fiber optic, telephone, and water) in any City right-of-way the developer or contractor installing underground private utilities shall conform to the requirements of this Chapter. Refer to COA website www.avondale.org for fee schedule and application forms.

7.2 Availability of Private Utilities

The developer is responsible to contact the individual private utility companies regarding the availability of services, operation and processes to provide services to the development.

7.3 City Code

Various City Codes may apply to the development of non-City utility improvement including, but not limited to, Chapter 22 Subdivision Regulations, Article IV Streets and Utilities Improvement Requirements contains information for the installation of private utilities.

An electronic version of the Avondale City Code can be referred to on the COA website at www.avondale.org.

7.4 City Policy

Private utilities located within City of Avondale public rights-of-way or public easements will require a conflict review by the City prior to the issuance of construction permits. The private utility construction plans for improvements, facilities or structures to be constructed or located within City of Avondale public rights-of-way or public easements are reviewed to ensure that the integrity of the City utilities and the public rights-of-way are maintained.

7.4.1 Power and Telecommunication Lines

City policy requires that existing overhead utility lines including, but not limited to electrical, communication, cable television shall be constructed underground in accordance with the requirements of the Arizona Corporation Commission. All new and existing utility, electrical facilities smaller than 69 KV, cable TV, telecommunications, fiber optics, etc. shall be installed underground as part of the street improvements. If new facilities are proposed in an area that has existing overhead lines, the new facilities shall be installed underground along with any existing overhead facilities.

7.4.2 Irrigation Facilities (Flood Irrigation)

All new developments shall provide for continued and undiminished service of affected irrigation systems. The Developer is responsible to coordinate with the irrigation provider for the design and construction of the irrigation facilities. A license may be required for construction and entry onto the irrigation providers' rights-of-way. New irrigation pipe may be located within the public right-of-way provided prior rights are documented. The exact location shall be coordinated with the City of Avondale.

Private irrigation facilities shall be located outside of public right of way and, within a private irrigation easement. The facility shall be designed to match the capacities of the existing or replaced facilities, or as may otherwise be directed by the City.

7.5 Plan Requirements and Guidelines

Non-City utility plans are submitted to the City by the utility company for approval, to place their facilities within the public rights-of-way. The plans submitted may be of the schematic or "shop drawing" style. The City reserves the right to reject the plans as submitted by the private utility agency. It is recommended that a meeting be scheduled with the City to review requirements and specifications.

Minimum standards of the plans shall meet the following:

- A.** Identify and dimension from the monument and/or centerline of the road all existing and/or proposed public right of way;
- B.** All existing and/or proposed public utility and/or public utility easements.

C. The existing and/or proposed street improvements (pavement, curb and gutter, sidewalk, driveways, street light poles and cabinets);

D. Identify and dimension all existing and/or proposed City of Avondale public utilities, (water, sewer, storm drain, street lights).

E. All above ground facilities including those owned by other providers within the public right of way or public utility easements shall be clearly identified and dimensioned.

F. Plans shall be a minimum sheet size of 11"x17" or a maximum sheet size of 24"x36". Plans shall be legible when digitized for City record drawings.

G. Separation of dry utility lines. Proposed non-city dry utility lines or facilities shall maintain adequate clearances between the proposed non-City dry facility and the City of Avondale public utilities. Minimum clearances are:

- Horizontal – Three (3) feet
- Vertical – One (1) foot

7.6 Utility Trenching

7.6.1 Pavement Cuts

Reserved for Future Use

7.6.2 Horizontal Bores

Designs with pavement boring shall include a boring profile to insure proper separation is maintained from City of Avondale utilities. Profiles of existing City of Avondale facilities that cannot be verified by as-built records shall be potholed.

7.7 Plan Submittal

Non-City utility construction plans for the installation of their facilities for the development project should not be submitted to the City for plan review prior to City approval of the civil improvement plans for the project. Non-City utility providers should coordinate with the project's developer/engineer regarding the appropriate time frame to submit their plans to the City for review and approval.

Plans submitted prior to the City approval of the project's civil improvement plans will not be reviewed, and will be returned to the utility provider without a plan review.

A. Required Copies

Submit three (3) complete sets of plans along with the completed permit application. The applicant is required to pickup their plans, correction comments and/or permit at the Engineering Department.

B. Application Form

Copies of the application form are available online at www.avondale.org. Application shall be signed by an appropriate and authorized representative of the utility provider, and included with the construction plan submittal.

C. Plan Review

City staff will review the proposed non-City utility plans for conflicts with existing or proposed City of Avondale utilities and facilities. Staff will generate plan review comments or will approve for construction.

7.8 Permit Required

Any construction of non-City utilities in public right-of-way requires obtaining a separate right-of-way permit from the City.

Conflict Inspection: The City of Avondale will perform inspections on all facilities located, constructed or installed within the public right-of-way and easements.

7.9 Fees

Fees for the plan review and the permit are available at www.avondale.org.

CHAPTER 8 LANDSCAPING AND IRRIGATION

THIS CHAPTER IS RESERVED FOR FUTURE USE

CHAPTER 9 GLOSSARY

9.1 Definitions

100-Year Flood: A flood with a one percent chance of being equaled or exceeded in any given year. Throughout the United States, the standard for floodplain management is protection from flooding up to and including the 100-year flood event. In hydrology the 100-year flood is determined statistically from long-term records of stream flow or rainfall data.

50 cubic feet per second (c.f.s.): An active stream or wash is defined as having a 100-year storm flow of 50 c.f.s. flow or more within its cross section, as measured from top of bank, or bankfull.

Abandonment Resolution: Document acting as a deed to transfer the public interest back to the adjacent private property owner (as authorized by Arizona Revised State Statutes). It is approved by the City Council, and signed by the Mayor. Recording this resolution is the final step in the public roadway abandonment process.

Adjacent Grade: The elevation of the ground, sidewalk, patio, deck support, or basement entryway immediately next to the structure.

ALTA/ACSM Land Title Survey: A land survey that is performed according to the set of minimum standard requirements. Requirements published jointly by the American Land Title Association (ALTA), American Congress on Surveying & Mapping (ACSM), and the National Society of Professional Surveyors, Inc. (NSPS).

Arterial Route: is a general term including freeways, expressways, major arterial streets and interstate, state or county highways, and usually section line roads.

Arterial Streets: Arterial streets with medians provide regional continuity and carry large volumes of traffic between areas of the City, and through the City. Full access to abutting commercial and multi-family land uses is limited to the greatest extent possible to facilitate the movement of traffic. Pedestrian and bicycle crossings should be grade separated when feasible.

Asphalt Concrete Course: The total depth of asphalt concrete that may be placed in two or more layers.

Backslope: The cut bank formed by the excavation of material on the uphill side of the trail tread.

Batter: The amount that a retaining wall leans into a hillside, usually expressed as a vertical to horizontal ratio.

Bench: The terrace formed when a hillside is excavated for the purpose of constructing a trail.

Berm: A ridge of material formed on the outer edge of the trail tread that is greater in height than the center of the trail tread.

Bike Lanes: An integral section of a roadway that is marked for exclusive bicycle use. Located on each side of the roadway bike lanes are always one-way in the direction of the traffic flow.

Bike Routes: May include shared streets, bike lanes, or multiuse paths, in any combination. Routes may be designated by signing or by placement on a map.

Brushing: The selective removal of vegetation.

Building Envelope: A specified area of a lot or parcel of land within which all buildings, structures, driveways, parking areas, patios, decks, walks, swimming pools, walls, non-native landscaping and utilities are located.

Building Height: The vertical distance measured from the finished ground surface at an exterior wall of a building to the highest point of the building roof. The height of a stepped or terraced building shall be the maximum height of any segment of the building.

Building Height Outline: An outline elevation established from existing grades prior to any development.

Cairn: Constructed mound of rock located adjacent to a trail; used where the trail tread is indistinct.

Capital Improvement Projects (CIP): Improvement projects that are installing construction improvements as part of a City of Avondale Capital Improvement Plan and are funded by the City.

Collector Street: means a street with limited continuity serving the primary function of carrying traffic from local streets to arterial routes, and the secondary function of providing access to abutting properties.

Condominium: A system of individual fee ownership of units in a multi-unit structure, combined with joint ownership of common areas of the structure and the land.

Control Valve: Manual or automatic (electrically operated) valve for control water flow.

Cross Slope: The slope of the surface perpendicular to the center line, expressed as a percent or a ratio. Gradient determined by dividing the difference in elevation from

crown to pavement edge by the horizontal distance from crown to pavement edge, expressed as a percentage.

Datum: A reference point of the earth's surface against which position measurements are made. The City of Avondale uses NAVD 88 Datum elevations.

Destroy: To kill or to cause the death of any protected native plant by any means.

Development Services Projects (DS): Improvement projects that are installing construction improvements required by City Codes, City Ordinances, City Regulations and approved City Manuals.

Easement: means a grant by the owner of the use of a strip of land by the public, a corporation or persons, for specific and designated uses and purposes.

Embankment: An earthen structure formed by placing and compacting earth material using artificial means (used interchangeably with "fill").

Erosion: The entrainment of sediment from the ground surface as a result of movement by wind or water.

Erosion and Sediment Control: refers to actions, measures or best management practices designed to minimize the accelerated erosion and suspension of sediment by water or wind.

Fillslope: Material added to the downhill edge of the trail tread; this material is often removed as part of the backslope, or is derived from nearby borrow pits.

Final Plat: means a map of all or part of a subdivision essentially conforming to an approved preliminary plat, prepared in accordance with all applicable state laws and this chapter.

Floodway: A part of the floodplain which, to facilitate the passage of floodwater, is kept clear of encumbrances (USGS WSP 1541-A, 1960). The channel of a river or stream, and those parts of the flood plains adjoining the channel, which are reasonably required to carry and discharge the floodwater or flood-flow of any river or stream (Erbe and Flores, 1957). The channel of a river and the adjacent floodplain that must be reserved in an unobstructed condition in order to discharge the base flood without increasing flood levels by more than one foot (FEMA FIA-2, 2/1990).

Freeways: Freeways will be designed to safely handle very large volumes of through traffic. Direct access will be limited to regulated/regularly/specifically spaced interchanges. Design, construction, and operations shall be provided by the Arizona Department of Transportation.

GLO: General Land Office of the United States. The Department now incorporated into the Bureau of Land Management (BLM), once charged with the duties of the survey of the Public Lands.

Grade Dip: (also known as “Drain Dip”) - Short segment of trail with a grade opposite of the prevailing grade designed to route surface water off the trail. The lowest point of the dip is outsloped to assure the surface water is routed off the side of the trail.

Grade, Maximum: The steepest grade permitted on any segment of the roadway or pedestrian way, not to exceed a distance specified for the particular roadway classification.

Grade, Sustained: The steepest grade permitted over the majority of the roadway.

Grade-Separated Crossings: Underpasses or overpasses, which serve to isolate motorized and non-motorized traffic from each other at points of intersections.

Hillside Area: Any parcel of land or portion thereof located within the Hillside Landform boundaries, as designated by the City of Avondale.

Improvement Projects: The erection, installation, remodeling, alteration, of durable facilities upon, under, or over the ground. This shall include, but not limited to buildings, roadways and utility pipes, lines, poles, or other structures.

Inslope: Where the trail surface slopes downward from the outside (downhill) to the inside (uphill) edge of the trail. Insloping must be accompanied by a rock-lined swale between the inside edge of the trail and the backslope.

Local Street: means a street serving the primary function of providing access to abutting property; including marginal access streets and cul-de-sac streets.

Longitudinal Slope: The slope of a roadway along the centerline, expressed as a percentage or a ratio.

MAG Specifications: The Uniform Standard Specifications for Public Works Construction distributed by the Maricopa Association of Governments.

Major streets: A group of streets classified as: arterial streets, phased arterial streets and major collector streets.

Major Streets Plan: means an adopted plan which provides locations and standards for development of major streets system of the city.

Major Wash: Those natural washes that demonstrate riverine flow characteristics and have an estimated 100 yr. flow rate in excess of 750 cubic feet per second.

Minor Streets: A group of streets classified as: local residential streets, minor collector streets, and industrial streets.

Minor Wash: Those natural washes that demonstrate riverine flow characteristics and have an estimated 100 yr. flow rate in between 250 and 750 cubic feet per second.

Multiuse Paths: Paved pathways set aside for the exclusive use of non-motorized travel. They are typically separate from the road improvements and intended for two-way traffic.

Multiuse Trails: Unpaved trails designed for equestrians, bicycle and pedestrian travel.

Mutilate: To deface, maim, damage, or disfigure any protected native plant by shooting, chopping, pushing over, burning, cutting, or any other means.

Native Plant: Any plant listed on the City of Avondale protected native plant list.

Native Plant Permit: A permit issued by the City of Avondale pursuant for the purpose of removing from the premises, relocating back on to the site, or destroying any protected native plant.

Native Plant Program: A development plan specifying the proposed treatment of protected native plants for which a native plant permit is required.

Native Vegetation: Indigenous plant materials.

Natural Area: Areas of untouched natural desert and revegetated areas.

Natural Grade: The vertical location of the natural or undisturbed ground surface prior to any grading operation.

NAVD 88: North American Vertical Datum of 1988. Elevations on all improvement plans submitted to the City must use the NAVD 88 datum.

NGVD 29: National Geodetic Vertical Datum of 1929. In 1988, NGVD 29 was adjusted to remove inaccuracies and renamed NAVD 88.

Outslope: Where the trail surface slopes downward from the inside (uphill) to the outside (downhill) edge of the trail.

Patent: An instrument conveying title to land, usually the original conveyance of state, or Federal Government land.

Patent Easement: An easement right which passes with a parcel of land at the time of its original conveyance.

Preliminary Plat: means a preliminary map, including supporting data, indicating a proposed subdivision design prepared in accordance with this chapter and state law.

Property Assemblage: The combination of two (2) or more existing lots or tracts of land into a single lot or tract of land.

Protected Native Plant: Cacti which are three (3) feet or greater in height and indigenous trees which are four (4) inches or greater in caliper.

Public Roadway Dedication: Any document that conveys real property and any subsequent rights to the City of Avondale, and consequently the general public, for use of a particular strip of land over which certain transportation and/or other public facilities are built including but not limited to roads, utilities, drainage structures, bridges and all associated improvements to accommodate those facilities. These public roadways may be dedicated to the City by a number of legal instruments such as subdivision plats dedicating streets; right-of-way dedication documents; roadway easements; and roadway reservations such as General Land Office patent roadway easements.

Public Viewpoint: A location from which the impacts on the viewshed are analyzed. This may include sections of public roadway, a public gathering area, a public park, or public building complex. These points will be identified by the City of Avondale.

Real Property: Real estate, physical land and appurtenances.

Relocate: To transplant a protected native plant to another location on the premises.

Remove: To transport a protected native plant from the premises on which it has been growing for the purpose of transplanting it on another site.

Revegetation: The replacement of indigenous living plant materials or seeds on areas where the natural vegetation has been removed. The areas include disturbed natural areas and manmade cut and fill slopes.

Shared Streets: All streets that do not have bike lanes where bicycles and motor vehicles share the same roadway. This includes all public streets except those specifically posted to prohibit bicycles.

Shared-Use Trail: A natural surfaced trail collectively shared by a range of users including, but not limited to, equestrians, walkers, bicyclists, hikers, and joggers.

Sideslope: The natural slope of the ground measured at right angles to the centerline of the trail.

Slope: The inclined exposed ground surface of an embankment, excavation or natural terrain.

Slough (pronounced “sluff”): Material that has moved downhill from the backslope onto the inside (uphill) edge of the trail.

Soil: All earth material of any origin that overlies bedrock and may include a decomposed zone of bedrock that can be excavated readily by mechanical equipment.

Specimen: A plant that is relatively free of disease and physical deformations and is representative of the form and character of the species.

Stipulations: Design and construction requirements regarding water, sewer, paving, traffic, dedications, grading and planning as well as other conditions that must be met in order to proceed to the next step in the process. Project stipulations are staff recommendations which become development requirements after ratification by the presiding council, commission or board.

Street Structural Section: The combination of an asphalt concrete surface course and one or more base courses of either rock aggregate materials or asphalt concrete.

Subdivision Plat: A surveyed map showing the subdivision of a specifically defined property into lots, tracts, and common areas, and the dedication of roadways, easements, and other rights to accommodate the service needs of the development.

Swale: A constructed watercourse or conveyance channel that directs water away from the roadways and pedestrian ways. Typically lined with rocks to reduce erosion.

Switchback: A sharp short radius curve in a trail that is used on hillsides to reverse the direction of travel and to gain elevation. Switchbacks have relatively level turning platforms.

Title Commitment: A commitment on the part of the insurer, once a title search has been conducted, to provide the proposed insured with a title insurance policy upon closing.

Title Insurance Policy: A title insurance policy insures the status of the state of title to a specific parcel of real property. It insures a party against loss due to a defective title.

Title Report: An abstract of the title to a piece of property. It consists of notes regarding, or copies of, all of the documents pertaining to the title of a particular piece of property, based upon the original documents filed in the office of the Clerk of Court.

Trailhead: The beginning or ending access point to a trail, often accompanied by various trail support facilities such as horse trailer and regular vehicle parking spaces, hitching rails, corrals, bike racks, shade ramadas, picnic tables, drinking fountains, water troughs, restrooms, directional and informational signing, and entrance gates.

Tread: The surface of the trail upon which trail users travel.

Turnout: Short section of widened trail that provides safer passage of trail users. Helpful when visibility along the trail is limited.

Unsalvageable Plant: A protected native plant that cannot be successfully relocated due to any of the following:

- Deteriorated health from disease, infestation, or natural causes.
- Physical constraints related to plant location, soil conditions, orientation, or general conditions that obstruct and/or prevent the application of city-approved relocation techniques.

Vegetation/Habitat: The existing vegetation patterns (type, size, density) and the wildlife habitat that exist are included in this element.

View Corridor: A continuous, undisturbed open space often terminating in a significant visual landmark.

Viewshed: A given, visible area, usually calculated from public viewpoints such as roadways, parks, and open spaces. The viewshed category characterizes specific forms of landmark topography found within each landform. Adjacent viewshed opportunities, including the designation of scenic corridors, are important parameters.

Wash: A natural watercourse, wet or dry.

Waterbar: Drainage structures constructed of rock or logs embedded in the trail surface at a 45° angle to the direction of travel for the purpose of directing surface water off the trail.