SECTION 13
WATER SYSTEMS

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TABLES AND FIGURES

SECTION 13
WATER SYSTEMS

13.1 PURPOSE AND DEFINITIONS

13.1.1 Purpose

This Section provides minimum design standards and guidelines for the planning and design of public Water Systems within the City Service Area. This Section generally covers the size, layout, and placement of Mains as well as appurtenant gate valves, Fire Hydrants, Blow-Offs and Services. These standards and guidelines may be amended periodically. It is the Designer's responsibility to check the City of Sacramento Department of Utilities (DOU) website or ask DOU representatives for amendments and to use the latest version of this Section. It is expected that all applicable Sections of this Manual will be reviewed and utilized as determined to be appropriate by the Project owner and Designer.

Compliance with these standards does not relieve a Designer from the additional responsibility to apply conservative and sound professional judgment when designing public owned and maintained facilities. Designers are expected to consider related issues, such as environmental impacts, maintenance of pedestrian and vehicular traffic patterns, constructability, safety, system maintenance and sustainability principles. Designer shall submit a Variance for all proposed deviations from requirements contained herein. All Variances shall be reviewed and accepted by DOU prior to DOU review of affected portions of Plans or studies (Refer to Section 9.2.4).

13.1.2 DOU Water System

The Department of Utilities is responsible for operating and maintaining the public Water System within the City Service Area (roughly 95% of the geographical area of the City together with limited areas outside of the City limits).

The DOU Water System is fed by the Sacramento River and Fairbairn Water Treatment Plants, along with several potable groundwater wells. Refer to Plate 13-3 WATER PURVEYOR MAP.

13.1.3 Definitions

Whenever the following terms or titles are used, the intent and meaning shall be as defined below. Words defined below are shown capitalized throughout this Section. Proper nouns are also capitalized, but not defined below. Refer to Plate 9-2 for utility abbreviations.

100 Year Event: Refer to Section 9.1.3

Backflow Prevention Assembly: An assembled system of gate valves, check valves and reduced pressure principle assemblies used to prevent the reversal of the flow of water from the Customer back into the Water System. Reference should be made to the DOU *Cross*

Connection Control Policy for the particular type of backflow assembly to be used where such assemblies are required.

Blow-Off: A device placed at the Dead End of a Main to provide a means of flushing the Main pipe to remove accumulated sediment or stagnant water from the pipe. Blow-Offs are also placed at low points and minimum intervals along the profile of Transmission Mains to facilitate de-watering.

City: Refer to Section 9.1.3. Same as defined in *City Code* Chapter 13.04.030

City Code: Refer to Section 9.1.3

City Service Area: Refer to Section 9.1.3 and Plate 13-3

Commercial: Refer to Section 9.1.3

Customer: Refer to Section 9.1.3. Same as defined in *City Code* Chapter 13.04.030

Cut-In: A means of making a direct connection of a new Main or Service 4-inch and larger to an existing Main that involves the cutting and removal of a short length of pipe from the existing Main. A fitting is connected to the cut end(s) of the existing Main. The Cut-In type of Tie-In connection requires the existing Main to temporarily be taken out of service.

Dead End Main: A length of Distribution Main with only one Tie-In connection to other Mains in the Water System. The Dead End of the Main is the unconnected terminus of the Dead End Main.

Department of Utilities (**DOU**): Refer to Section 9.1.3. Same as "Department" defined in *City Code* Chapter 13.04.030

Designer: Refer to Section 9.1.3

Director: Refer to Section 9.1.3. Same as defined in *City Code* Chapter 13.04.030

Distribution Main: Mains 12-inches in diameter or smaller. Distribution Mains may be tapped for the installation of Services. Same as defined in *City Code* Chapter 13.04.030

Division of Drinking Water (**DDW**): California Environmental Protection Agency, State Water Resources Control Board, Division of Drinking Water

Domestic Service: A metered Service that is not solely used for fire suppression or irrigation. Domestic Services may require the installation of a Backflow Prevention Assembly. Same as defined in *City Code* Chapter 13.04.030

Easement: Refer to Section 9.1.3

Fire Hydrant: A publicly owned and maintained appurtenance used to supply water for firefighting, as specified in DWG NO. W-201 and Section 10 of the *Standard Specifications*. Same as "Public fire hydrant" defined in *City Code* Chapter 13.04.030

Fire Service: A Service installed for the sole purpose of connection to an On-Site fire suppression system required for certain types of building occupancies. Such fire suppression systems may include wet or dry standpipes, automatic fire sprinkler lines and private fire hydrants located On-Site. Fire Services are not metered but may require the installation of a Backflow Prevention Assembly. Same as defined in *City Code* Chapter 13.04.030

Hot-Tap: A method of making a direct connection of a new Main or Service to an existing Main while the existing Main is kept in service and under pressure

Hydraulic Grade Line (**HGL**): Refer to Section 9.1.3

Irrigation Service: A metered Service installed for the sole purpose of supplying water to a landscape irrigation system. All dedicated Irrigation Services require the installation of a Backflow Prevention Assembly. Same as defined in *City Code* Chapter 13.04.030

Main: Pipe owned by the City and maintained by the DOU placed for the purpose of conveying and distributing potable water to the public. Mains include Distribution and Transmission Mains, and must be located within public streets or alleys. Same as "Public water main" defined in *City Code* Chapter 13.04.030

Major Water Improvement: Scope of improvement or extension to the Water System such that the work must be shown on a separately prepared Water Plan. Such improvements include any of the following:

1. Main extensions 100 feet or more in length,
2. Replacement and/or abandonment of an existing Main,
3. Public Mains located on private property.

Manhole: Refer to Section 9.1.3

Minor Water Improvement: All Water System improvements that are not Major Water Improvements

On-Site: Refer to Section 9.1.3

Plans: Refer to Section 9.1.3

Point of Service: The location where the DOU terminates maintenance responsibility of Services. The Point of Service is at or near the Right-of-Way line. For existing public Mains located in Easements, the Point of Service is located at the Service connection to the Main. Same as defined in *City Code* Chapter 13.04.030

Project: Refer to Section 9.1.3

Residential: Areas that are predominantly zoned for single family residences. Residential areas may include duplexes, community parks, and other facilities complimentary or appurtenant to the residential use. Multi-family developments are considered Commercial.

Right-of-Way (**ROW**): Refer to Section 9.1.3

Round Corner: Refer to Section 9.1.3

Service: Publicly maintained portion of water pipe and appurtenances connected to a Distribution Main for the purpose of supplying water to individual lots or parcels of land. Services provide water for domestic, fire, and/or landscape irrigation purposes to Residential and Commercial consumers. Services range in size from 1-inch through 12-inches in diameter, and extend from the Main to the Point of Service. Same as "Water service" defined in *City Code* Chapter 13.04.030

Shared Service: Privately maintained portion of water pipe and appurtenances that connects to one or more public Services to serve more than one parcel. Shared Services may require maintenance agreements, easements and other provisions to ensure private maintenance.

Standard Specifications: Refer to Section 9.1.3. Same as defined in *City Code* Chapter 13.04.030

Subgrade: Refer to Section 9.1.3

Tap: See "Hot-Tap", "Cut-In" and Plate 13-2 DISTRIBUTION APPURTENANCE PLACEMENT. Same as "Service connection" or "water service connection" defined in *City Code* Chapter 13.04.030

Tie-In: The juncture or point of connection of one Main to another Main

Transmission Main: Water Mains larger than 12-inches in diameter that are used to convey large volumes of water from treatment plants, where the water is produced, to selected points

throughout the Water System as well as to (and from) storage reservoirs to meet fluctuating daily and seasonal demands. Same as defined in *City Code* Chapter 13.04.030

Water Plan: A separately prepared engineered Plan, drawn to scale, showing the layout and details of Water System improvements to be constructed for any given private development or public improvement Project. Separate Water Plans are required for all Major Water System Improvements.

Water System: The complete collection of interconnected elements maintained by the City that store, convey and distribute drinking water to the public for a variety of consumptive uses. The elements making up the Water System include a network of public Distribution Mains and appurtenances (such as meters, Fire Hydrants and Services), storage reservoirs, treatment plants, wells and Transmission Mains and appurtenances. Same as "City water distribution system" or "Water distribution facilities", *City Code* Chapter 13.04.030

13.2 GENERAL REQUIREMENTS

13.2.1 Authority and Responsibility

The Director is given the authority and responsibility to produce and distribute a safe supply of drinking water to the public. The Designer is responsible for adherence to the design standards contained herein.

All improvements to the City Water System shall be designed to meet the applicable and current requirements of the following standards:

1. The Standard Specifications,
2. Title Chapter 13.04 of the Sacramento *City Code*,
3. Applicable provisions of the *Uniform Plumbing Code*,
4. Cross Connection Control Policy of the City of Sacramento Department of Utilities,
5. Requirements of the California Environmental Protection Agency, State Water Resources Control Board, Division of Drinking Water (DDW) relating to domestic water supply, particularly the applicable provisions of California Statutes Related to Drinking Water contained in Title 17 and 22, *California Code of Regulations*, and Guidance Memo 2003-02,
6. American Water Works Association design standards,
7. NSF/ANSI Standard 61.

Conflicts between the various standards shall be identified by the Designer, and corresponding resolutions shall be accepted by the Director prior to implementation.

13.2.2 Disclaimer, Acceptance and Variances

Refer to Sections 9.2.2 for disclaimer, 13.5, 9.2.3 and Plate 9-4 for acceptance and 9.2.4 for variances.

13.2.3 Water Studies

As defined by conditions of approval or when otherwise required by DOU, Designer shall prepare and submit a water study for improvements to the Water System. The water study shall be performed as defined in the *City Water Study Manual* by a licensed engineer utilizing boundary conditions provided by DOU. The study shall demonstrate that the existing or proposed Water System is capable of meeting the needs of the Project while meeting design criteria presented herein.

When a water study is required, a current (less than one year old) water supply test for the Main serving the Project shall be required. Water System improvements shall be designed in the form of an interconnected grid to allow the water pressure throughout the system to be equalized under varying rates and locations of maximum demand.

Water System improvements shall also be designed to satisfy the following conditions:

1. At maximum day peak hour demand, the operating or static pressure at all Service connections shall be at least 30 pounds per square inch,
2. At maximum day demand with fire flow at the point of connection, the residual pressure shall not be less than 20 pounds per square inch,
3. At average day demand (without fire flow), the minimum flow velocity shall not be less than 0.10 feet per second, unless the Main is in a dead-end street without Services that is planned to be extended in the future.

13.2.4 Placement of Mains in Streets

Mains shall be placed under the asphalt-paved portion of public streets north or west of the street centerline. Mains shall not be placed under medians, curb, gutter, sidewalk, or concrete paved streets or alleys.

Within Residential streets (as defined by Plate 15-2), Mains shall not be placed within 4-feet of the lip of gutter. For streets wider than a Residential Street, the Mains shall be placed no closer than 7-feet from the curb and gutter. The 4 and 7-foot dimensions are measured from the nearest edge of the Main to the nearest lip of gutter or edge of island curb (Refer to Plate 13-1 DISTRIBUTION MAIN PLACEMENT).

13.2.5 Horizontal and Vertical Separation of Mains

Mains shall be placed to conform to Section 64572 (a) (5), Article 4, Chapter 16, Division 4, Title 22 of the California Code of Regulations and California Department of health Services Guidance Memo 2003-02, revised October 16, 2003. Refer to:
http://www.dot.ca.gov/hq/esc/Structure_Design/wwe/documents/ca_health_serv_dept_re_pipe_separation.pdf.

Additionally, Mains shall be placed a minimum of:

1. Five-feet horizontally from electrical, gas, or utilities with impressed cathodic protection systems measured from the edge of Main to edge of pipe or edge of trench when encased,
2. Two-feet horizontally from edge of Main to other underground dry utilities such as communications or cable TV, measured from their respective edge of pipe,
3. One-foot vertically from all dry utility crossings.

13.2.6 Depth of Cover Over Mains

Mains shall meet the depth of cover requirements specified below.

Table 13-1 Depth of Cover Over Mains

Application		Inches To Pavement Surface	Inches To Road Subgrade	Notes
Typical Condition	Minimum	36	18	Applies to all Mains placed except where conflicting with a gravity pipeline
	Maximum	48		
Using Ductile Iron Pipe	Minimum	24	12	Applies where raising or lowering Main to avoid conflict with gravity pipeline
	Maximum	60		

Any other depth of cover proposed shall require a Variance submittal that adequately addresses the need to reduce or increase the cover requirements and the additional methods proposed for protecting the pipeline and workers during construction, operation, repair and replacement.

13.2.7 Raising or Lowering Mains to Resolve Grade Conflicts

Grade conflicts between existing water Mains and new or replacement storm drain and sanitary sewer lines are often encountered during construction.

These problems shall be resolved during design of sewer and drainage improvements. Advance potholing of existing Mains at locations of potential conflicts during early stages of design will provide the Designer the information needed to avoid a conflict with Mains when possible, and to efficiently plan for relocation of the Main when unavoidable.

In the field, the work of raising or lowering the existing water Main at the location of the grade conflict requires the isolation, shutdown, and de-watering of a section of the Main. This is followed by the cutting and removal of a length of the existing Main and replacing it with a connected assembly of short lengths of pipe and elbows. All raised and lowered water pipes shall be disinfected and pressure tested. All work to raise and lower Mains shall meet DDW requirements and pipe shall be ductile iron fabricated in the field.

All Mains shall be raised when the depth of cover and separation requirements can be maintained.

Plans shall refer Contractor to DWG. NO. W-106 of the *Standard Specifications* entitled "Raising and Lowering Existing Water Mains" when such conflicts are suspected to occur.

13.2.8 Tie-In Connections

For newly constructed Water System and/or private water improvements, Tie-In connections (whether Hot-Tap or Cut-In) shall be made only after the improvements have been satisfactorily disinfected and pressure tested.

The type of Tie-In connection to be used shall be determined by the DOU during Plan review.

Tie-In connections shall be installed as follows:

1. All Hot-Taps on existing Mains shall be made by City crews after payment of required fees to City. Customer shall provide all applicable surface cutting, excavation, spoil removal, backfill, traffic control and surface restoration,
2. The use of 4-inch Hot-Taps on 4-inch diameter Mains is not permitted,
3. When a connection to a steel Distribution Main is required, the steel Main shall be replaced in both directions with an accepted material up to the nearest valves.

All Water Plans shall indicate the type of Main Tie-In connection (Hot-Tap or Cut-In) to be used and whether the Tie-In connection is to be made by City crews or by the contractor. Tie-ins for Services shall conform to the requirements listed in Section 13.3.5.

13.3 WATER DISTRIBUTION SYSTEMS

13.3.1 Residential Mains

Residential Water Systems shall utilize Mains sized as follows:

1. Twelve-inch diameter Mains shall be placed on approximately one-square-mile grids,
2. Four-inch diameter Mains shall be placed for Dead End Mains less than 250-feet long in cul-de-sacs serving no Fire Hydrant and no more than:
    a. Five single family, or
    b. Four duplexes (8 residential units).
3. Six-inch diameter Mains shall be placed when serving no more than:
    a. Fifteen single family units,
    b. Ten duplexes (20 residential units), or
    c. One Fire Hydrant.
4. Eight-inch diameter Mains shall be used in all other cases.

13.3.2 Commercial Mains

Commercial Water Systems shall utilize Mains sized as follows:

1. Twelve-inch Mains at grid intervals of one-half-mile,
2. Eight-inch diameter Mains within the remainder.

Water Systems that serve both Residential and Commercial properties shall comply with Commercial Water System requirements.

13.3.3 Dead End Mains

All Distribution Mains shall have a minimum of 2-points of connection, except Dead End Mains, which may be allowed for cul-de-sacs and dead end streets as defined below.

The maximum length for Dead End Mains shall be:

1. Four-inch diameter Main: 250-feet. Four-inch Dead End Mains are not allowed in Commercial areas.
2. Six and 8-inch diameter Main: 500-feet. Six-inch Dead End Mains are not allowed in Commercial areas.
3. Twelve-inch diameter Main: 1000-feet. Twelve-inch Dead End Mains are not allowed in Residential areas, unless the dead end street is planned to be extended in the future.

13.3.4 Dual Mains

Dual Distribution Mains (one water pipeline along each side of the street) are required for all streets constructed with either:

1. A raised center median separating opposing lanes of traffic, or
2. A Right-of-Way width of 100 feet or more where Services or Fire Hydrants are needed on both sides of the street.

Refer to Plate 13-1 DISTRIBUTION MAIN PLACEMENT.

13.3.5 Water Services

All Services shall be connected directly to Distribution Mains and shall be installed at right angles to the Distribution Main, in accordance with *City Code* and the City Tap Policy. Tapping a Fire Hydrant branch lead or another Service for the installation of Services shall not be permitted.

Services are available in 1-inch, 1-½-inch, 2-inch, 4-inch, 6-inch, 8-inch, 10-inch and 12-inch nominal diameters. Meter boxes shall be installed over meters for all Services 2-inches in diameter and smaller. Refer to *Standard Specification* DWG NO. W-402 & W-507. Services 4-inches in diameter and larger will require a valve box (Refer to *Standard Specification* DWG NO. W-303) over the gate valve at the connection of the Service to the water Main. Meter boxes shall be installed over meters, unless meter is installed on RP. Refer to *Standard Specification* DWG NO. W-515 & W-608.

Refer to Plate 13-1 DISTRIBUTION MAIN PLACEMENT for typical valve and point of service locations.

Service Hot-Taps:

1. For Services 4-inch and larger, City shall provide the tapping sleeve, gate valve, standpipe and valve box. Customer shall provide and install all required pipe and fittings to complete Service installation,
2. For Services 2-inch and smaller, City shall provide and install saddle, corporation stop, pipe material from the Main to the meter, and metered valve at the Point of Service.

Service connections to the Main shall also conform to the Tie-In requirements listed in Section 13.2.8. Refer to Plate 13-2 DISTRIBUTION APPURTENANCE PLACEMENT.

13.3.5.1 Backflow Prevention

The installation of Backflow Prevention Assemblies shall be required per the *Cross Connection Control Policy*, which includes a complete list of conditions requiring Backflow Prevention Assemblies as well as the particular type of assemblies to be used.

Refer to Section 38 of the *Standard Specifications* for Backflow Prevention Assembly details.

13.3.5.2 Domestic Service

Services for single-family residences and duplexes shall be designed in accordance with *City Code* Section 13.04 and *Standard Specifications* DWG. No. W-401. Services for corner Residential lots are to be placed at the lot frontage with the greater set back distance.

For Commercial developments, the size and location of Domestic Services is determined by the Designer and indicated on the Plans.

The installation of future water Services is not allowed unless the following additional items are submitted and approved by DOU:

1. Size and location of Services, meters and Backflow Prevention Assemblies,
2. Anticipated driveway and building locations,
3. Potential conflicts with other improvements, such as water quality facilities.

Future Services 2-inches in diameter and smaller shall include installation of an idler and meter box and shall be capped at the Point of Service. Four-inch and larger future Services require a 2-inch diameter Blow-Off to be installed as part of the Service installation per *Standard Specifications* DWG NO. W-301.

All future Service construction shall be performed at the Customer's risk and may require abandonment or relocation at Customer cost.

13.3.5.3 Fire Service

Fire Services for private development Projects as well as their size and location shall be determined by the Designer and must be approved by the City Fire Marshall. Fire Services are not metered. Backflow prevention requirements shall be per the City *Cross Connection Control Policy*.

Commercial developments shall not have interconnected Domestic and Fire Services, unless pre-existing, or a Shared Service is approved by DOU.

13.3.5.4 Irrigation Service

Irrigation Services shall be metered, require backflow prevention per City *Cross Connection Control Policy* and shall meet the requirements of *City Code*.

To avoid the cutting of new pavement, future Irrigation Services may be authorized in accordance with Section 13.3.5.2. Irrigation water may be provided from a Domestic Service, except where disallowed by California State regulations.

13.3.5.5 Meters

All Services except for dedicated Fire Services shall be metered. Water meters shall be provided by the City for a fee.

13.3.5.6 Temporary Construction Service

Temporary underground water Services are required at sites where construction activities will extend over a time-period in excess of 60 days. Examples include the site of a multi-story building or at a site involving extensive earthwork and requiring a water truck fill station. All temporary Services used as a source of water for construction shall be equipped with meters as well as with reduced pressure principle Backflow Prevention Assemblies per the City *Temporary*

Water Use Policy. Temporary construction Services will be installed by City crews upon payment of fees at the DOU offices.

13.3.6 Gate Valves

Gate valves shall be placed such that:

1. The requirements illustrated on *Standard Specifications* DWG NO. W303 are met,
2. No more than three-valves need to be closed to shut down and isolate any section of Main,
3. The number of gate valves at each tee or cross is one less than the number of inlet/outlet openings of the fitting (tees will require two gate valves and crosses will require three valves), except:
    a. Only one gate valve (located on the Fire Hydrant lead) is required at a tee placed for a Fire Hydrant.
4. Gate valves are no more than 1200-feet apart for Mains 8-inches in diameter and smaller,
5. Gate valves are no more than 1500-feet apart for Mains 12-inches in diameter,
6. A maximum of 40-parcels may be affected by a Main shutdown,
7. Gate valves are bolted to a fitting,
8. Gate valve is placed on each side of all casings and Distribution Main crossings of bridges, drainage channels, irrigation canals, railroads, etc.

Gate valves shall be the same size as the Main, Service or Fire Hydrant Lead. Refer to Plate 13-2 DISTRIBUTION APPURTENANCE PLACEMENT.

13.3.7 Fire Hydrants

Fire Hydrants shall be placed:

1. Per the requirements illustrated on Plate 13-2 DISTRIBUTION APPURTENANCE PLACEMENT and *Standard Specifications* DWG. NO. W-201,
2. At a maximum spacing of 500-feet in Residential and 300-feet in Commercial areas,
3. At a minimum spacing of 150-feet. Hydrants required with less separation shall be private hydrants,
4. In Minor[1] Streets by measuring along the centerline, and placing Hydrants on either side of the road,
5. In Major[2] streets by measuring along and placing Hydrants on both sides of the road,
6. Outside of Round Corners at street intersections,
7. On property lines between adjacent lots if placed between street intersections. The spacing of Fire Hydrants shall take precedence over the placement of Fire Hydrants at street intersections,
8. On 6-inch diameter or larger Distribution Mains,

[1] Minor streets have less than 4 lanes and no median as illustrated in Plates 15-2 thru 15-5
[2] Major streets include 4 or more lanes, medians or as otherwise illustrated in Plates 15-6 thru 15-8

9. In cul-de-sacs in both Residential and Commercial areas. Fire Hydrants shall be placed at the beginning of the reverse curve transition to the bulb of the cul-de-sac, unless otherwise required by the Fire Marshall,
10. A minimum of 3-feet from any fence, bush, power pole, wall, traffic signal standard, or other obstruction, to allow access for operation and maintenance,
11. Such that they do not cross retaining walls or pedestrian curb ramps.

13.3.8 Blow-Offs

Blow-Offs shall be installed at the Dead End of all Distribution Mains as shown on Plate 13-2 DISTRIBUTION APPURTENANCE PLACEMENT:

1. Six inches and smaller Mains may use a 2-inch diameter Blow-Off per *Standard Specifications* DWG NO. W-301. A Fire Hydrant may be placed in lieu of a Blow-Off where space allows.
2. Eight inches and larger Mains shall use a Fire Hydrant for a Blow-Off.
3. When Fire Hydrants are used as Blow-Offs in cul-de-sacs, Main size shall be reduced after last Fire Hydrant as necessary to meet demand and water quality requirements, and shall be extended into cul-de-sac bulb to serve remaining properties.

13.3.9 Air Release Valves

Air release valves shall be installed on Distribution Mains at the high point where crossing a bridge, and as otherwise directed by DOU.

13.3.10 Water Sample Stations

Where developments include 50 Residential units or more, or the installation of more than 1000-feet of Main, water sample stations shall be required. Location and number of sample stations shall be determined by DOU during Plan review.

13.3.11 Levees

Public Distribution Mains and Services shall not be placed within or crossing levees.

13.4 WATER TRANSMISSION SYSTEMS

13.4.1 Butterfly Valves

Butterfly valves shall be used to isolate Transmission Mains:

1. Per Standard Specifications DWG. NO. W-801,
2. At a maximum spacing of 2000-feet,
3. At any connection, if required by DOU.

At least one Blow-Off and one Air Release Valve shall be placed between Butterfly Valves.

13.4.2 Blow-Offs

Blow-Offs shall be placed:

1. Per *Standard Specifications* DWG. NO. W-804 and W-805,
2. At all low points,
3. When required by Section 13.4.1.

13.4.3 Insulated Joints

To effectively isolate metallic piping between dissimilar metals, insulated joints shall be placed:

1. Per the *Standard Specifications* DWG. NO. W-801, W-902 and W-905,
2. At each change in Main material,
3. At each butterfly valve,
4. At all appurtenance connections,
5. At all Main connections,
6. Where required to isolate cathodically protected systems, as determined by the City.

13.4.4 Access Manholes

Access Manholes shall be placed between butterfly valves per *Standard Specification* DWG. NO W-702.

13.4.5 Air Release Valves

Air Release valves shall be placed:

1. Per *Standard Specifications* DWG. NO. W-802 and W-803,
2. At all high points,
3. With the vent above the 100 Year Event HGL,
4. When required by Section 13.4.1.

13.4.6 Cathodic Protection

Test Stations shall be installed as follows:

1. Corrosion monitoring test station: at a maximum spacing of every 1000-ft,
2. Insulated joint test station: at all locations where an insulated joint is required (see 13.4.3, “Insulated Joints”),
3. Anode test station: at all locations where a sacrificial anode is installed,

4. Foreign pipe test station: at all locations where a metallic Main crosses a cathodically protected utility pipe,
5. Casing test station: at both ends of a metallic casing.

A soils report shall be submitted to the City to confirm the corrosivity of the soils at the depth of the Main. A soil sample shall be collected for every 1000-feet of new Main installed within the alignment of the new Main. The sample(s) shall be tested for (at a minimum) Redox, pH, sulfate, resistivity (100% saturation) and chloride. Based on the results of the samples, additional sampling and tests may be required by the City.

Cathodic protection shall be installed where adverse environments (including but not limited to soils conditions, foreign pipelines or stray current) are considered corrosive, highly corrosive, or extremely corrosive to buried metallic infrastructure. Design and testing of the cathodic protection system shall be:

1. Conducted by a registered Corrosion Engineer with the State of California, or a NACE certified Corrosion Specialist,
2. Reviewed and accepted by the DOU before Plan approval and notice of completion,
3. Planned for a minimum 30-year life expectancy.

The cathodic protection system shall be retested by the Corrosion Specialist or Corrosion Engineer 1-year after initial activation to confirm the system is functioning per design. A system is considered “cathodically protected” when it meets the minimum NACE standards for cathodic protection of buried metallic infrastructure.

13.4.7 Fire Hydrants

A Fire Hydrant shall be placed between all butterfly valves, and shall not be considered when evaluating Fire Hydrant spacing requirements.

13.4.8 Water Services

The installation of a Service Tap of any size on a Transmission Main is not permitted.

13.5 PLAN PREPARATION AND REVIEW

13.5.1 Separate Water Plans

All Major Water Improvements shall be shown on a separate Water Plan.

Major Water Improvements shall also be shown screened and without notes on Plan sheets for other improvements, including sanitary sewers, storm drains and streets.

Minor Water Improvements may be solely depicted on Plans showing other improvements.

13.5.2 Development Water Plan Review

Plans that include the construction of Major as well as Minor Water Improvements shall be submitted to Public Works Development Engineering Section for routing, review and comment. Copies of special provisions prepared for Projects involving the construction of water improvements shall also be submitted for review, if applicable.

A 51 series file number will be assigned by DOU and placed on the Water Plan sheets for all Projects involving the construction of Distribution Mains. A 60 series file number will be assigned by DOU and placed on the Water Plan sheets for all Projects involving the construction of Transmission Mains.

The DOU will review the Water Plans for compatibility with the Water System. The Water Plans will also be reviewed to determine the type of Tie-In connections to be made to the existing system and whether the Tie-In connections are to be made by City crews or by a contractor.

The Water Plan shall show the following at a minimum:

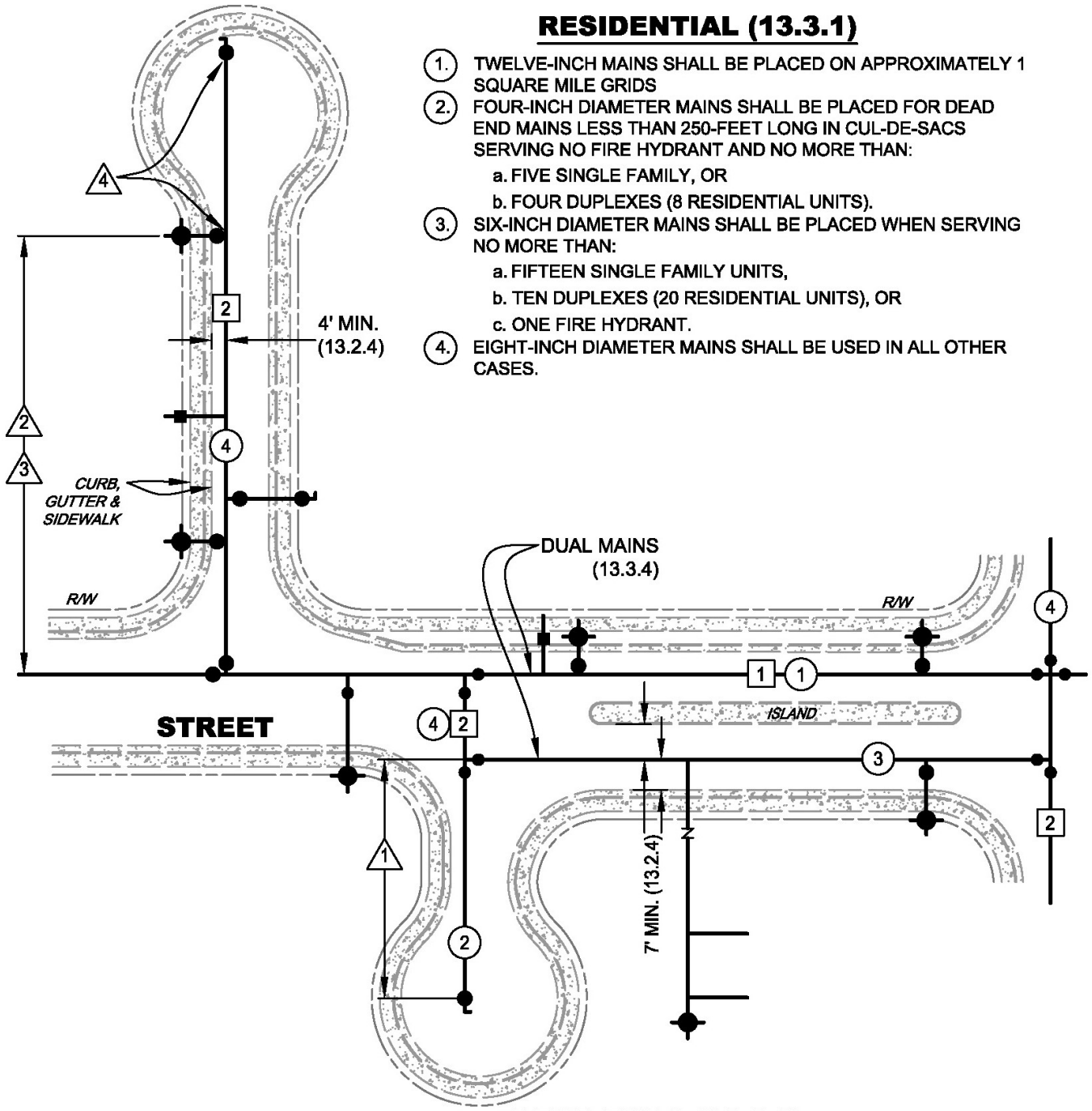
1. Street alignments, Right-of-Way width and names,
2. Configuration of the lots and lot numbers,
3. Scale (consistent with Engineer's scale), stationing and a north arrow,
4. Proposed Main size, location and material,
5. Gate valves, Services, Fire Hydrants and all other water appurtenances,
6. Water title block with approved signature line[3],
7. Construction Information Block[1],
8. City standard General Water Notes[1],
9. Detail sheets as required.

Plans for On-Site privately owned and maintained common interest development water systems shall meet the requirements listed herein. The Shared Service shall be denoted as "Private".

[3] See http://portal.cityofsacramento.org/Utilities/Resources/Specs-and-Drawings

APPENDIX

Plate 13-1 DISTRIBUTION MAIN PLACEMENT



RESIDENTIAL (13.3.1)

1. TWELVE-INCH MAINS SHALL BE PLACED ON APPROXIMATELY 1 SQUARE MILE GRIDS
2. FOUR-INCH DIAMETER MAINS SHALL BE PLACED FOR DEAD END MAINS LESS THAN 250-FEET LONG IN CUL-DE-SACS SERVING NO FIRE HYDRANT AND NO MORE THAN:
   a. FIVE SINGLE FAMILY, OR
   b. FOUR DUPLEXES (8 RESIDENTIAL UNITS).
3. SIX-INCH DIAMETER MAINS SHALL BE PLACED WHEN SERVING NO MORE THAN:
   a. FIFTEEN SINGLE FAMILY UNITS,
   b. TEN DUPLEXES (20 RESIDENTIAL UNITS), OR
   c. ONE FIRE HYDRANT.
4. EIGHT-INCH DIAMETER MAINS SHALL BE USED IN ALL OTHER CASES.

COMMERCIAL (13.3.2)

[1.] TWELVE-INCH MAINS SHAL BE PLACED AT GRID INTERVALS OF ONE-HALF-MILE,

[2.] EIGHT-INCH DIAMETER MAINS SHALL BE PLACED WITHIN THE REMAINDER.

DEAD ENDS (13.3.3)

THE MAXIMUM LENGTH FOR DEAD END MAINS SHALL BE:

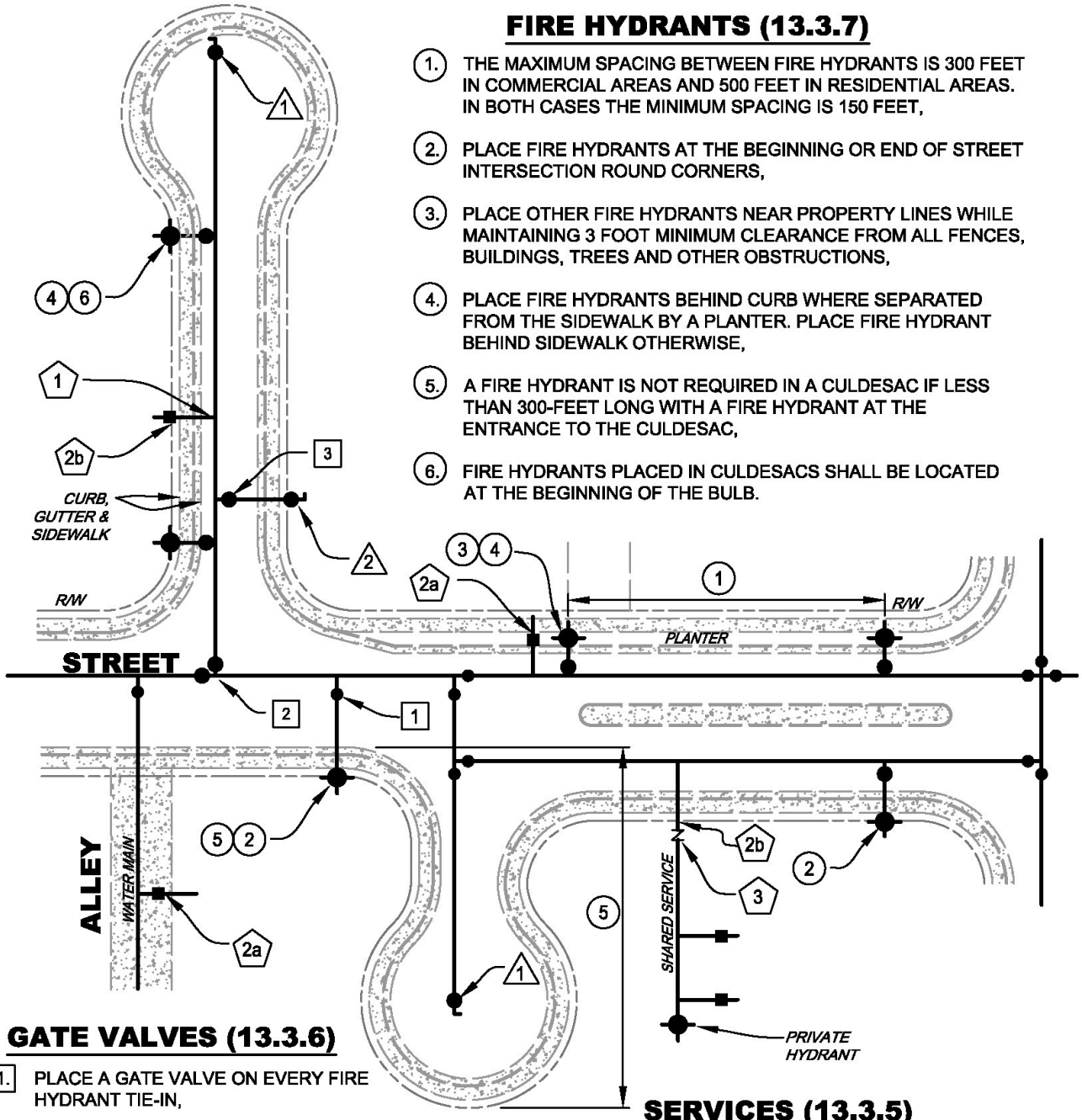
△1. FOUR-INCH DIAMETER MAIN: 250-FEET,

△2. SIX AND 8-INCH DIAMETER MAIN: 500-FEET,

△3. TWELVE-INCH DIAMETER MAIN: 1000-FEET

△4. WHEN HYDRANTS ARE USED AS BLOW-OFFS IN CULDESACS, MAIN SIZE MAY BE REDUCED AS NECESSARY AFTER LAST HYDRANT AND EXTENDED TO SERVE REMAINING PROPERTIES

Plate 13-2 DISTRIBUTION APPURTENANCE PLACEMENT



FIRE HYDRANTS (13.3.7)

1. THE MAXIMUM SPACING BETWEEN FIRE HYDRANTS IS 300 FEET IN COMMERCIAL AREAS AND 500 FEET IN RESIDENTIAL AREAS. IN BOTH CASES THE MINIMUM SPACING IS 150 FEET,
2. PLACE FIRE HYDRANTS AT THE BEGINNING OR END OF STREET INTERSECTION ROUND CORNERS,
3. PLACE OTHER FIRE HYDRANTS NEAR PROPERTY LINES WHILE MAINTAINING 3 FOOT MINIMUM CLEARANCE FROM ALL FENCES, BUILDINGS, TREES AND OTHER OBSTRUCTIONS,
4. PLACE FIRE HYDRANTS BEHIND CURB WHERE SEPARATED FROM THE SIDEWALK BY A PLANTER. PLACE FIRE HYDRANT BEHIND SIDEWALK OTHERWISE,
5. A FIRE HYDRANT IS NOT REQUIRED IN A CULDESAC IF LESS THAN 300-FEET LONG WITH A FIRE HYDRANT AT THE ENTRANCE TO THE CULDESAC,
6. FIRE HYDRANTS PLACED IN CULDESACS SHALL BE LOCATED AT THE BEGINNING OF THE BULB.

GATE VALVES (13.3.6)

1. PLACE A GATE VALVE ON EVERY FIRE HYDRANT TIE-IN,
2. PLACE 2 GATE VALVES ON A TEE AND 3 ON A CROSS IN THE MAIN,
3. PLACE A GATE VALVE ON EVERY 4-INCH AND LARGER SERVICE TAP.

BLOW OFFS (13.3.8)

1. PLACE A BLOW-OFF OR FIRE HYDRANT AT THE END OF ALL DISTRIBUTION MAINS,
2. PLACE A BLOW-OFF AT THE END OF ALL 4-INCH AND LARGER FUTURE WATER SERVICES.

SERVICES (13.3.5)

1. PLACE A BURIED CORPORATION STOP ON EVERY 2-INCH AND SMALLER SERVICE TAP,
2. PLACE A METER ON ALL SERVICES, UNLESS FUTURE OR DEDICATED TO FIRE PROTECTION. THE POINT OF SERVICE IS:
   a. AT THE DOWNSTREAM SIDE OF THE METER WHEN METERED AND INSIDE THE RIGHT OF WAY,
   b. AT THE RIGHT OF WAY LINE WHEN METER EXTENDS OUTSIDE OF RIGHT OF WAY.
3. PLACE A BACKFLOW PREVENTER AS REQUIRED BY THE CROSS CONNECTION CONTROL POLICY.

Plate 13-3 WATER PURVEYOR MAP