

## SECTION 2

### DESIGN CRITERIA

#### 2-1 CITY WATER SYSTEM

A detailed description of the City's Distribution system, reservoirs and their storage capacities, pump stations, turnouts, etc., are contained in the City's Water Master Plan.

#### 2-2 WATER MAIN PRESSURES, CAPACITIES AND SIZES

2-2.1 Quantity of Flow: Flow rates shall be determined from maximum potential population or land use of the area served. For projects involving commercial, industrial, greenbelt areas or schools, etc., the preferable method is to estimate the flow requirements for each building or area and then combine the results. In the absence of such definition, the following shall be used:

Water Demand Factors

Land Use Description	Density (DU/Acre)	Demand Factor	Unit
High Density Residential	15-30	180	gal/du/day
Medium Density Residential	4.5-15	310	gal/du/day
Low Density Residential	2-4.5	405	gal/du/day
Very Low Density Residential	0-2	440	gal/du/day
Reserve Residential (ultimate need)	0-2	440	gal/du/day
Commercial/Residential (High Density)	15	200	gal/du/day
Commercial	-	130	gal/ksf/day
Industrial	-	60	gal/ksf/day
Institutional	-	45	gal/ksf/day
Elementary School	-	15	gal/ksf/day
Intermediate School	-	15	gal/ksf/day
High School	-	15	gal/ksf/day
Existing Parks, Golf Courses, Open Space	-	3400	gal/ac/day
Proposed Park and Recreation Areas	-	3400	gal/ac/day
Residential Developable Land (ultimate need)	0.2-1.0	440	gal/du/day

After calculating the average daily flow, the following peaking factors shall be used to determine the system demands during conditions other than the average daily flow:

Water Peaking Factors

	Multiply Average Daily Flow By Factor Shown
Maximum Month Demand	1.60
Maximum Day Demand	1.75
Peak Hour Demand	4.50

If and when special studies of a particular area are conducted which demonstrate that different water use or peaking factors are appropriate, then those values may be used if approved by the Public Works Director.

- 2-2.2 Fire Flow Requirements: The City of Thousand Oaks follows the requirements of the Insurance Service Office (ISO), the Ventura County Fire Protection District, and the Uniform Fire Code (UFC). Specific fire flow requirements are determined by the Ventura County Fire Protection District. However, the following table can be used for general guidelines:

Typical Fire Flow Requirements

Land Use Type	Fire Flow (gpm)	Duration (hrs.)
Single Family Residential*	1,000-1,250	2
Condominiums	1,500-2,500	2
Apartments	1,500-3,000	2 to 3
Commercial	1,250-4,000	2 to 4
School/Industrial	4,000-6,000	4
-	3,500+	Determined by Fire Dept.

\*Not to exceed 2 stories in height

It is the applicant's responsibility to demonstrate through calculations that the required fire flow can be met while the City's water system is under a maximum day demand. The calculations shall assume that fire flow is achieved from storage not relying on pumping stations or turnouts. Under fire flow conditions, including the maximum daily requirement, the residual pressure in the system shall be no less than 20 psi. The only exception is for a fire hydrant located adjacent to or near a reservoir where there are no domestic water services between the fire hydrant and the reservoir, or where it can be determined that residual pressures less than 20 psi will not adversely impact domestic customers. In making the calculation, the City mains must be considered with

respect to their head loss. In most instances, a computer analyses is used to determine if the City's distribution system can deliver the required fire flow to a given parcel. Where the City performs such analyses, the applicant shall be charged a fee per Council Resolution. Applicants are strongly encouraged to utilize the services of the City in this particular aspect.

2-2.3 Pressure: Water mains shall be designed to provide for service pressures of not less than 45 psi and not more than 150 psi with the following provisions:

1. Service pressure shall mean the pressure at the house or building and shall be interpreted to be the static pressure available with the service reservoir at one-half full. For purposes of calculating the service pressure, the lowest inhabitable finish floor elevation containing a water consumption device shall be considered to be the house or building finish floor elevation.
2. There is a strong desire to keep pressures between 45 and 80 psi since above that value the Uniform Plumbing Code requires individual pressure regulators at the house or building on the customer side of the meter.
3. Where pressures would exceed 150 psi, special approval is required and the applicant most likely will have to install separate pressure regulators ahead of the meters or a pressure regulating station on the main line.

2-2.4 Velocity: In order to minimize head loss and maintain the integrity of pipeline lining, pipelines should be designed to limit internal velocities to the following criteria under the stated demand conditions:

Maximum Day Demand	5 fps or less
Peak Hour Demand	10 fps or less
Max Day + Fire Flow	15 fps or less

Pipe velocities should be a minimum of 1 foot per second (fps) in order to adhere to required water quality regulations and maintain proper circulation throughout the system.

2-2.5 Sizing of Mains: In general, main lines shall be a minimum of 8 inches in diameter. To be included in this category are fire hydrant runs serving more than one fire hydrant. Exceptions are as follows:

1. Dead end mains past the last fire hydrant may be 6 inches in

diameter. A dead end line is one which cannot and will not be extended in the future.

2. Larger size mains may be required, particularly for backbone pipelines or for areas requiring fire flow greater than can be achieved with an 8 inch main.

2-2.6 Pipe Networks: The City encourages the use of "looped" pipe systems while recognizing that not all lines can or should be looped. Most often this occurs on cul-de-sac streets where it is not feasible or practical to tie the main to another pipeline. Nevertheless, the applicant's engineer shall strive to provide multiple sources of water for any subdivision or major commercial/industrial project. In the event a main line is unable to be looped, either a blowoff (at the low point in the main line) or an air-vac (at the high point in the main line) is required.

### 2-3 SELECTION OF PIPE TYPES AND CLASS

2-3.1 General: These Standards cover main lines up to and including 12 inches in diameter.

2-3.2 Main Pipelines: In general, main lines shall be PVC, CML&C Steel or DIP. ACP is not allowed for either main line construction or repair.

When PVC pipe is selected, the pipe shall be in accordance with the requirements of AWWA C900. The following pressure classes shall be used:

STATIC PRESSURE	CLASS OF PVC PIPE
0 to 125 psi	150 (DR-18)
126 to 175 psi	200 (DR-14)

Where Class 200 pipe is used for a portion of a project, the separation between Class 200 and Class 150 shall be at a valve. All fire hydrant runs shall be Class 200.

CML&C Steel pipe and mortar thickness shall be in accordance with the requirements of AWWA C205.

DIP shall be Class 350 and shall be in accordance with the requirements of AWWA C150 and C151.

## 2-4 LOCATION OF LINES AND FIRE HYDRANTS IN STREETS

- 2-4.1 Water Mains: The water main line, wherever possible, shall be located in public streets parallel to and 5 feet north or west of the street centerline.

However, where storm drains or other facilities, other than wastewater, are in the center of the street, the water main line should be located to provide a minimum of 4 feet clearance between the outsides of pipe (measured on a horizontal plane). This pertains as well to any case of paralleling lines.

When an area outside the tract or development project area can be logically served by extension of the water main in future streets or easements, the pipeline shall extend to the tract/project boundary or to the end of a paved street in a manner facilitating future extensions.

- 2-4.2 Fire Hydrants: Fire hydrants are generally located by the Ventura County Fire Protection District. Fire hydrants shall also be located as detailed on the Standard Plates.

- 2-4.3 Criteria for the Separation of Water Mains and Non-Potable Pipelines: Proper separation between water and wastewater (sewer) mains shall be in accordance with the California Department of Public Health guidelines. A copy of which is attached in the appendix of these Standards.

## 2-5 LOCATION OF LINES IN EASEMENTS

- 2-5.1 General: Main lines located in easements should be avoided where a reasonable alternate solution exists. Unless there are either physical limitations or extreme economic penalties, water lines should be installed within public streets. Another instance that might justify creating an easement would be the installation of a looped system. When easements are required, there shall be careful consideration given as to how the line is to be maintained and/or replaced in the future.

In general, a water line within an easement shall be accessible by conventional maintenance vehicles traveling over paved roads or driveways, unless otherwise approved by the Public Works Department.

Service lines should not be connected to a main line within an easement unless specifically approved.

- 2-5.2 Width: Water easements for pipes up to 18 inches in diameter shall be a minimum of 15 feet wide. However, additional easement width shall be required where the depths of pipe are excessive or where deemed necessary. The plans should clearly indicate any known block walls, pavement, trees or other obstructions within a proposed easement. Such items are contrary to Public Works Department policy and require special approval. Included with such approval may be a monetary obligation towards the operation and maintenance of the water line within the easement. Record drawings shall indicate such approval and such installations.
- 2-5.3 Pipeline Location: Pipelines shall be placed in the center of easements. Unless specifically approved, the line shall be straight without horizontal bends or deflections.
- 2-5.4 Easement Location: The full width of an easement shall be on one lot or parcel. It shall be configured in such manner that walls, trees or permanent improvements will not obstruct access to the pipeline. Where this requirement cannot be met without interfering with existing buildings, easements may straddle lot lines providing that special approval is received. Under no circumstance shall main lines be installed on the lot lines.
- 2-5.5 Deeds: Deeds for easements shall restrict both the planting of trees and the construction of permanent improvements within the easement. In addition to providing for the installation and maintenance of water main lines, all easements shall specifically grant the right of ingress and egress to the City or its authorized agents.
- 2-5.6 Easement Provisions: All easements deeds shall include a separate exhibit showing a plan view of the easement area. Easements shall be provided as follows:
- 2-5.6.1 Subdivision Tracts: The owners of land included within the subdivision shall offer to dedicate, for public use, the water easements so designated on the final map.
- 2-5.6.2 Non-Subdivisions: Dedication of water easements shall occur by means of deeds of conveyance to the City of Thousand Oaks for all dedications other than those dedications created by subdivision tract maps on a form and as approved.

## **2-6 DEPTH OF WATER MAINS**

The standard minimum depth of cover to the top of the pipe shall be 36 inches for 8 inch and smaller diameter pipe and 42 inches for 10 inch diameter pipe or larger.

In achieving the above depths of cover it must be recognized that numerous grade changes to achieve 36 or 42 inches of cover are not desirable and the designer shall blend the requirement for a reasonably straight pipeline with those for a relatively uniform depth.

Increases in depth of cover may be required where future road improvements could potentially remove some of the existing cover or where there are other conflicting utilities. Pipelines placed in open, unpaved terrain shall generally have a minimum cover of 42 inches.

## **2-7 LOCATION, TYPE, AND SIZE OF VALVES**

Valves shall be located in such a manner as to allow for the isolation of particular pipe segments in the event that repairs are needed. Each branch line at intersections shall have a valve.

Longer branches of main lines shall require an in-line valve at intervals of no more than 1,000 feet except for lines 10 inches or larger, where valves shall be at intervals no greater than 750 feet.

Resilient wedge gate valves shall be used for all 2 through 12 inch lines. Butterfly valves shall be used for main lines larger than 12 inches. Plug valves shall be used where pressures exceed 150 psi, or where required by the Public Works Department.

All main line valves shall be the same nominal size as the pipeline.

## **2-8 AIR AND VACUUM ASSEMBLIES**

2-8.1 General: Air and vacuum valves perform two important functions in a piping system. They maintain system design efficiency and provide system protection. System efficiency is maintained by venting air via the air valves from the system that can restrict flow. Protection is provided by exhausting and admitting air through the air valves during system operations including startup, shutdown, and critical conditions such as power failures or line breaks. The exhausting and admitting of air during these conditions will reduce the potential for destructive surges and

water hammer normally associated with uncontrolled air or a vacuum condition within the piping system. Air and vacuum valves shall be in accordance with the requirements of AWWA C512.

## 2-8.2 Types of Valves:

2-8.2.1 Air Release Valves: Air release valves allow for the discharge of air, which accumulates at high points along the pipeline. The air is initially entrained in the water. When it accumulates at the high points, it creates a throttling effect as would a partially closed valve.

2-8.2.2 Air & Vacuum Valves: Air & vacuum valves allow large quantities of air to be expelled when water mains are filling, and allow air to re-enter the pipeline when water mains are draining (whether planned or due to a rupture). These valves are also located at high points along the line.

2-8.2.3 Combination Air Release Valves: Combination air release valves combine both the air release and air & vacuum valves as described above. It is this type of valve which shall be installed in the City's water distribution system.

2-8.3 Location: Combination air release valves shall be located at all high points along the pipeline as approved or as required by the Public Works Department.

2-8.4 Sizing: Combination air release valves shall be sized to permit the required air flow rate to be discharged or admitted. However, the minimum size for 8 inch main lines shall be 1 inch, and 2 inches for end of main line valves.

## 2-9 BLOWOFF ASSEMBLIES

2-9.1 General: Blowoff assemblies are placed at low spots in water lines to facilitate draining, and to allow the removal of sediments which accumulate in low areas of the pipeline. Fire hydrants perform the same function as blowoffs and can be installed as a substitute if a bottom outlet tee is used to connect to the main line. The Public Works Department recommends that a fire hydrant be utilized in lieu of a blowoff wherever possible.

On dead-end lines (i.e., cul-de-sacs) where there is not a fire hydrant at the end of the line, a blowoff valve is required to drain and clear the line.

2-9.2 Sizing: Blowoffs should be sized according to the following criteria:

1. In general, a section of pipeline i.e., between valves, should be capable of being drained within 2 to 4 hours.
2. The blowoff should be capable of creating a velocity of not less than 2.5 fps in the pipeline for the removal of sediments. For typical pressures between 45 and 100 psi, this velocity can be created by the following:

PIPE SIZE	BLOWOFF SIZE
6"	2"
8"	2" or 4" *
10"	4"
12"	4"
above 12"	By special design

\* 2 inch blowoff can be used unless the reach being drained is extensive. If such is the case, a 4 inch blowoff is desirable.

## 2-10 DESIGN FOR PROPER FLUSHING

2-10.1 General: Proper flushing of water mains and the prevention of sediment buildup are important aspects of the City's maintenance program. Therefore, the following should be considered:

1. Unnecessary intermediate low points in the lines should be eliminated wherever possible to prevent locations of sediment accumulation.
2. A fire hydrant should be used in place of a blowoff whenever practical.
3. Looped systems are preferable to dead end systems providing that unacceptable easements are not required for the looping.

## 2-11 HORIZONTAL AND VERTICAL CURVES

2-11.1 General: In curved streets, the water line shall generally follow the street curvature, but not crossing the centerline. Allowable joint deflections shall be the more stringent of those set forth below and the manufacturer's recommendations. Where there is a grade break exceeding the allowable deflections in a coupling or joint, then appropriate fittings will be required or a vertical curve should be used in lieu of the grade break.

2-11.2 PVC Pipe: The standard laying lengths for PVC pipe are 20 feet. The pipe must not be bent to a tighter radius than the minimum shown below. Deflection at the pipe joint is not allowed.

PIPE SIZE	MINIMUM RADIUS OF CURVATURE
6"	175'
8"	225'
10"	275'
12"	325'

2-11.3 Steel Pipe: With bell and spigot type steel pipe, the maximum allowable deflection per joint shall be limited to 2-1/2 degrees. Using that value and standard lengths as follows, the minimum radius of curvature would be:

PIPE SIZE	MINIMUM RADIUS OF CURVATURE	
	40' Pipe Segments	20' Pipe Segments
8" to 18"	920'	460'

2-11.4 Ductile Iron Pipe: The maximum allowable deflection when using standard laying lengths of 18 feet would be:

PIPE SIZE	MINIMUM RADIUS OF CURVATURE
6" to 12"	260'
14" to 18"	345'

## 2-12 PROPER SIZING OF WATER METERS AND SERVICE LINES

2-12.1 General: The Public Works Department will select the meter type, however it is the responsibility of the applicant to determine the correct size of meter. Several references are available for discussion of water meter sizing and are published by the American Water Works Association (AWWA). One particularly useful publication is AWWA Manual M22 – “Sizing Water Service Lines and Meters”.

2-12.2 Meter Sizing: Water meters are designed to deliver a maximum flow for short periods of time with a lower flow capacity for sustained usage without damage or above normal wear occurring to the meter. The selection of the size of the meter should be based only on the flow requirement, not on the pressure loss through the meter.

VCFPD requires fire sprinklers in all new residential and commercial buildings, and for certain additions to existing buildings. All commercial buildings, and residential buildings with fire flow requirements over 50 gpm, require a dedicated service line for fire sprinkler purposes. Residential buildings with fire flow requirements of 50 gpm or less require a combined domestic and fire service line with an approved fire rated meter. Prior to receiving a permit for water service the applicant shall provide proof of VCFPD approval of the fire sprinkler system.

Multi-family and commercial projects with landscaped areas of 5,000 square feet or more requires a dedicated irrigation meter and approved backflow device.

If there is a known expansion program or increased meter usage can be anticipated in the future, then provisions should be made for larger facilities. When this occurs, the meter should be installed for the needs at the time, but also with a meter box and connections that are adequate for future requirements.

The sizing of the meter is dependent upon the correct establishment of a maximum flow rate. In general, the meter should not be oversized and for all but residential or small commercial structures, the applicant's engineer should check such items as fixture units and landscape irrigation in arriving at the proper meter size. The California Plumbing Code should also be consulted to determine the minimum size meter for a given application.

To aid in the selection of the appropriate sized meter, the table below has been provided to show the flow range of the meter currently being installed by the City.

Meter Size	Operating Range (gpm)	Max. Continuous Operation (gpm)
5/8"x3/4"	0.25 – 20	10
3/4" Fire Rated	2 – 30	30
1"	1.25 – 70	50
1" Fire Rated	2 – 50	50
1-1/2"	2.5 – 120	80
2"	2.5 – 170	100
2" Compound	0.5 – 200	170
3" Compound	0.5 – 450	400
4" Compound	0.75 – 1000	800

2-12.3 Service Line Sizing: Proper service line sizing is a function of the maximum anticipated flow rates and the allowable pressure loss for adequate pressure. If pressure to the structure is questionable or if flows are anticipated to increase in the future, it is better to oversize the service line than to oversize the meter. The table below lists the required service line size to be used with the respective meter.

Meter Size	Service Line Size
5/8" x 3/4"	1"
1"	1"
1-1/2"	2"
2"	2"
3"	4"
4"	4"

## 2-13 LOCATION OF METER BOXES, FIRE HYDRANTS AND AIR RELEASE ASSEMBLIES

2-13.1 Meter Boxes: Meter boxes shall be installed within the public right-of-way or within a dedicated easement, and shall not be installed in driveways. The applicant's engineer shall take into account the locations of proposed driveways in relation to the plot of the proposed house(s) and keep water meters out of the driveways. In multi-family dwelling projects, meters should be located within a protected area and not in the drive aisle. The Public Works Department reserves the right to require the applicant to remove any water meter which falls within the driveway area. Meter boxes shall also be installed as detailed on the Standard Plates in these Standards.

- 2-13.2 Fire Hydrants: Fire Hydrants are generally located by the Ventura County Fire Protection District, and as detailed on the Standard Plates in these Standards. Particular attention shall be given to minimize the visual impact of fire hydrants by locating them near property lines rather than in the middle of the front yard area.
- 2-13.3 Combination Air Release Assemblies: Combination air release assemblies shall be located as detailed on the Standard Plates in these Standards, and with particular attention to minimize the visual impact of the enclosure by locating them near property lines rather than in the middle of the front yard area.
- 2-13-4 Irrigation Meters: Where the parkways or side landscaping strips along streets are to be irrigated, a separate meter must be installed on each side of the street. In such cases, running an irrigation line from the meter to the other side of the street is not allowed. Where a median strip must be irrigated, the meter may either be in the side parkway or in the median strip, providing that at either location the meter is easily accessible and protected from being covered by landscape materials or other obstructions. The Public Works Department reserves the right to select the meter locations.

## **2-14 STRUCTURAL REQUIREMENTS**

- 2-14.1 Under Roads: All structures and pipe placed under public roads shall be of sufficient strength to support with an adequate factor of safety the backfill, road surfacing and H-20 loading per AASHTO Standard Specifications (truck loading with impact). Higher loading may be as specified by the Public Works Department or as required by good design.
- 2-14.2 Other Pipes and Structures: Water lines designed to cross under or over other pipes or structures shall be protected from damage and shall be constructed to prevent endangering the other pipe or structure. In this regard, particular attention should be given to the possibility and prevention of settlement caused damage. Also, where future replacement of any line may be extremely difficult due to the pipe or structure, special design consideration may be required. Any of the Standard Plates that detail various encasements or other protection may be required in such instances.
- 2-14.3 Flexible Joints: Flexible joints which will allow for differential settlements or other movement of water pipe lines or structures, adjacent pipe and adjacent structures shall be provided where water lines enter

encasements or other structures. Flexible joints shall be within 24 inches of such structure.

**2-14.4 Thrust Blocks:** Thrust blocks are required at the following locations:

1. Abrupt changes in grade or alignment requiring tees or elbows.
2. Changes in pipe size.
3. Dead ends of lines.
4. Locations subject to sudden thrust, such as valves.

**2-14.5 Steep Grades:** Water lines laid on grades steeper than 10 percent which are not under nor intended to be under pavement should be examined for possible erosion protection. Where the slope exceeds 30 percent, backfill stabilizers shall be installed per SPPWC Standard Plan 221-1.

Slopes above 30 percent shall require pipe anchors and backfill stabilizers, and shall be installed per SPPWC Standard Plan 221-1.

Where steep grades are present, CML&C steel pipe with welded joints or DIP may be preferable because of thrust considerations. Pipe without welded joints will require substantial anchorage to prevent separation.

**2-14.6 Design For Earth Loads:** Generally, because of the pipe materials specified and the relatively shallow depth of cover, specific design for earth loads is not necessary. Therefore, the subject will not be covered in any detail in these Standards. However, in cases where earth loads may impact the pipe the applicant's engineer shall consider these loads and design the pipeline accordingly.

## **2-15 SPECIAL CONSIDERATIONS FOR WELDED STEEL PIPE**

Where joints are welded, it is possible to eliminate or reduce thrust blocks. It is the applicant's engineer's responsibility to provide calculations showing that the reduction or elimination of thrust blocks will not over stress the steel pipe, and the shear resistance by the soil to pipe movement is less than the thrust it is trying to resist.

The deflection of the pipe must not exceed 2 percent of the diameter as a result of both live and dead loads. This is to prevent the mortar lining and coating from cracking.

## **2-16 FIRE SERVICE LINES**

Fire service lines are water lines which extend from the main line to a building and are intended solely for fire protection (i.e., fire sprinklers). The Public Works Department has jurisdiction for the design and inspection up to and including the detector check backflow prevention assembly that must be placed on the fire service line. The materials for these lines should be PVC Class 200 pipe underground and ductile iron pipe above ground.

## **2-17 OTHER DESIGN CONSIDERATIONS**

Reservoirs and pumping stations are covered in Section 13.

Wells are covered in Section 14.

Water conservation is covered in Section 15.

The Public Works Department is required by the California Department of Public Health to sample and analyze the potable water within its distribution system for bacteriological quality. Each potable water sample is collected from a sampling station. If the number of active service connections increase within the City's distribution system, such that another sampling station is required, an applicant may be required to install at no cost to the City the sampling station at an approved location within the development.

