The purpose of this chapter is to define the recommended water system service and performance standards for evaluating the capacity and performance of the City's potable water distribution system. These standards include recommendations for the required fire flow and flow duration, firm pumping capacity, storage capacity, minimum and maximum system pressures, and maximum pipeline velocity and head loss. A description of the City's emergency groundwater supply plan is also included to describe the potential outage scenarios, durations and approach to meet minimum health and safety water demands during an emergency outage condition. The water system service and performance standards used for this Water Master Plan Update are presented in the following sections:

- General Water System Reliability and Recommendations
- Fire Flow Requirements
- Water Supply Capacity during High Demand Periods
- Pumping Facility Capacity
- Water Storage Capacity
- Water Transmission and Distribution Pipeline Sizing
- Emergency Groundwater Supply Plan

Key water system service and performance standards from the 2006 Water Master Plan have been incorporated into this chapter. However, some of the previous standards have been revised to reflect either more recent or more suitable standards for this Water Master Plan Update. Table 3-1 summarizes the recommended water system service and performance standards for the City, which are discussed in more detail below.

3.1 GENERAL WATER SYSTEM RELIABILITY AND RECOMMENDATIONS

Water system reliability is achieved through a number of system features including (1) appropriately sized storage facilities, (2) redundant or "firm" pumping and transmission facilities, (3) emergency water supplies (groundwater wells), and (4) alternate power supplies. Reliability and water quality are also improved by designing looped water distribution pipeline system configurations and avoiding dead-end distribution mains whenever possible. Looping pipeline configurations reduces the potential for stagnant water and the associated problems of poor taste and low disinfectant residuals. However, if a single-feed water system is necessary, no more than 100 residential units may be served.[1] In addition, proper valve placement allows for water system isolation to maintain reliable and flexible system operation under normal and abnormal operating conditions.

[1] City of Santa Rosa Water System Design Standards, September 10, 2002.

Table 3-1. Summary of Recommended Water System Service and Performance Standards

Component	Criteria	Note(s)
WATER SYSTEM PERFORMANCE		
Fire Flow Requirements		
Single Family Residential	1,500 gpm @ 2 hours	Based on the tri-ennial fire code ordinance adopted by City Council in December 2013. These are general requirements for master planning purposes, and may not be indicative of requirements for specific developments or buildings. Existing development should be evaluated on case-by-case basis.
Multi-Family Residential	2,500 gpm @ 2 hours	
Commercial	2,500 gpm @ 3 hours	
Industrial / Business Park	2,500 gpm @ 4 hours	
School	2,500 gpm @ 4 hours	
Wildland Interface	1,500 gpm @ 2 hours	
Peak Supply Capacity		
Peak Water Demands - Normal Operating Conditions	*In pressure zones with storage:* Provide firm supply capacity equal to maximum day demand; meet peak hour demand from a combination of supply sources and storage. *In pressure zones without storage:* Provide firm supply capacity equal to peak hour demand.	Zones without storage are those which do not have direct access to storage facilities. Water supplies to these zones must be capable of meeting peak hour demand. Although storage varies daily and seasonally, for conservative planning purposes, it is assumed that storage reservoirs are 50 percent full at the start of the hydraulic evaluation.
Peak Water Demands - Fire Flow Conditions	*In pressure zones with storage:* Meet maximum day demand plus fire flow from a combination of supply sources and storage. *In pressure zones without storage:* Provide maximum day demand plus fire flow from supply sources.	Zones without storage are those which do not have direct access to storage facilities. Fire flow may be provided by an adjacent zone, but the supply sources directly serving the zone must have sufficient capacity to supply the recommended fire flow concurrent with a maximum day demand condition. Although storage varies daily and seasonally, for conservative planning purposes, it is assumed that storage reservoirs are 50 percent full at the start of the hydraulic evaluation.
Distribution System Pressures		
Minimum Pressure - Normal Operating Conditions	*Maximum Day Demand:* 40 psi at customer service connection *Peak Hour Demand:* 35 psi at customer service connection	New services with pressure less than 35 psi require an individual booster pump.
Maximum Pressure[a]	120 psi	New services with pressure greater than 80 psi require an individual pressure regulating device.
Minimum Pressure - Fire Flow Conditions	20 psi	
FACILITIES SIZING		
Pumping Facility Capacity		
Pumping Capacity	Firm pumping capacity equal to maximum day demand in zones with storage and equal to maximum day demand plus fire flow or peak hour demand, whichever is larger, in zones without storage.	Firm pumping capacity defined as the total capacity of all pumps serving a pressure zone minus the capacity of the largest pumping unit. However, for pressure zones served by stations equipped with spare pump(s), the firm capacity is equal to the total pumping capacity without accounting for the capacity from the spare pump(s). Pumps located in lower pressure zones must deliver the largest demand requirement of all pressure zones above them.
Backup Power	Equal to the firm capacity of the pumping facility.	On-site generator for critical stations.[b] Plug-in portable generator for less critical stations.
Water Storage Capacity		
Operational Storage	25 percent of the maximum day demand	
Fire Storage	Fire flow demand for the most severe fire recommended in the pressure zone multiplied by the recommended duration	
Emergency Storage	Two times the average day demand	
Total Water Storage Capacity	Operational Storage + Fire Storage + Emergency Storage	
Water Transmission and Distribution Pipelines		
Minimum Pipeline Diameter	8-inch; 12-inch for multi-family residential, commercial, and industrial developments with more than two units	Locate new distribution pipelines within designated utility corridors wherever possible.
Maximum Velocity in Transmission Pipelines 16-inch diameter and greater- Normal Operating Conditions	5 ft/s	Criteria based on requirements for new development. Existing distribution mains will be evaluated on case-by-case basis. Evaluation will include age, material type, velocity, head loss, and pressure.
Maximum Velocity in Distribution Pipelines under 16-inch diameter - Normal Operating Conditions	8 ft/s	
Maximum Velocity - Fire Flow Conditions	10 ft/s	
Maximum Velocity - Service Laterals	15 ft/s	Water service laterals are not typically evaluated during a master planning effort.
Hazen Williams "C" Factor	130 to 140	For consistency in hydraulic modeling.
Pipeline Material	Polyvinyl Chloride or Ductile Iron	For consistency in hydraulic modeling.

[a] Maximum allowable pressure of 120 psi was adopted in the City of Santa Rosa Water System Design Standards, September 10, 2002.

[b] A booster pump station is defined as critical if it provides service to pressure zone(s) without sufficient fire or emergency storage or meets the following criteria:

- The largest facility that provides water to a particular pressure zone;
- A facility that provides the sole source of water to a single or multiple pressure zones and/or service areas; or
- A facility that provides water from a supply turnout.

3.1.1 Water Quality Standards

Water quality standards largely pertain to protecting public health and consistently delivering a satisfactory product to the customer. The U.S. Environmental Protection Agency (USEPA) and the California Department of Public Health (CDPH) are agencies responsible for establishing water quality standards. USEPA and the CDPH prescribe regulations that limit the amount of certain contaminants in water provided by a public water system. As a water purveyor, the City is responsible for ensuring that the applicable water quality standards and regulations are met at all times.

3.1.2 Recommendations for New Developments

Proposed water system facilities located in the future service areas and new developments within the City should meet the recommended water system service and performance standards (*e.g.*, minimum and maximum system pressures) discussed in the following sections.

3.2 FIRE FLOW REQUIREMENTS

This Water Master Plan Update evaluates available fire flows (to assess distribution system adequacy under current and future water demand conditions) by using general land use categories that represent different types of development. Therefore, the fire flow requirements set forth in this Water Master Plan Update are intended only for general planning purposes, and may not be reflective of the actual fire flow requirements required by a specific development's size and construction type, and will not identify specific existing non-conforming developments. The City's Fire Department utilizes a fire flow table for specific development approvals.

The recommended requirements for the Water Master Plan Update fire flow evaluation based on general land use designations and guidelines from the City's Fire Chief are presented in Table 3-1 and are also summarized below.[2]

- Single Family Residential: minimum 1,500 gallons per minute (gpm) for 2 hours
- Multi-Family Residential: minimum 2,500 gpm for 2 hours
- Commercial: minimum 2,500 gpm for 3 hours
- Industrial/Business Park: minimum 2,500 gpm for 4 hours
- School: minimum 2,500 gpm for 4 hours
- Wildland Interface: minimum 1,500 gpm for 2 hours

Fire flows may be reduced by up to 50 percent, but in no case less than 1,500 gpm, for projects installing an approved National Fire Protection Association (NFPA) 13 or 13R fire sprinkler system.

[2] Fire flow requirements were recently revised in the tri-ennial fire code ordinance and were adopted by City Council in December 2013.

Fire flows are to be met concurrently assuming a maximum day demand condition while maintaining a minimum residual system pressure of 20 pounds per square inch (psi) in the City's water system. These fire flow requirements will be used for the evaluation of the City's water system under existing and future water demand conditions. The recommended fire flow criteria are used to determine the appropriate sizing of pipelines to meet current requirements and to guide proper sizing for new pipelines. Additionally, the recommended fire flows and their expected duration are used to establish the fire flow storage capacity requirement.

3.3 WATER SUPPLY CAPACITY DURING HIGH DEMAND PERIODS

Maximum day demand, maximum day demand plus fire flow, and peak hour demand conditions are used to assess the adequacy of the City's water system facilities and transmission/distribution pipelines during high demand periods. Adopted peaking factors to represent maximum day and peak hour demands were discussed in *Chapter 2 Water Demands*. The following sections discuss the assumptions and recommended performance standards for different operating conditions during peak water demands.

3.3.1 Peak Water Demands – Normal Operating Conditions

Generally, in accordance with California Title 22 requirements and typical water system demand criteria, the City's water system should plan to be capable of meeting a maximum day demand condition without the use of storage. Pressure zones without storage should have sufficient supply capacity to meet a peak hour demand condition. Although storage varies daily and seasonally, for conservative hydraulic modeling purposes it is assumed that storage reservoirs are 50 percent full at the start of the hydraulic evaluation for planning purposes during a peak hour demand condition.

Evaluations of maximum day demand and peak hour demand conditions will be conducted assuming the largest booster pump unit at each pump station is in standby mode unless the station is equipped with a spare pump (the extra or spare pump is not included in the calculation of the total pumping capacity). At stations equipped with a spare pump, the evaluations were conducted assuming that the largest pump is not in standby mode. However, in pressure zones served by more than one pump station, only the largest pump serving the zone was assumed to be out of service if these stations were not equipped with a spare pump(s). This conservative assumption ensures the reliability and flexibility of the City's water system to provide sufficient supply. For pump stations equipped with a spare pump, the firm capacity is equal to the total pumping capacity at each station without accounting for the capacity from the spare pump.

3.3.2 Peak Water Demands – Fire Flow Conditions

In accordance with typical industry standards, the City's water system should have the capability to meet a demand condition equal to the occurrence of a maximum day demand concurrent with a single fire flow event while meeting the recommended system performance standards discussed under **Section 3.3.3 Distribution System Pressures**. The fire flow applicable for each pressure zone is based on the highest fire flow requirement designated in that pressure zone of the City's water service area, which will be determined based on land uses as defined in the General Plan.

In pressure zones with storage, maximum day demand plus fire flow would be met by a combination of supply capacity and storage. For planning purposes, it is assumed that storage reservoirs are 50 percent full at the start of the hydraulic evaluation. In pressure zones without storage, supply capacity must be sufficient to meet a maximum day demand plus fire flow condition. Assumptions regarding firm pumping capacity will also apply during a maximum day plus fire flow demand condition.

3.3.3 Distribution System Pressures

Adequate system pressure is a basic indicator of acceptable water distribution system performance. The recommended performance standards for system pressures are:

- Allowable Pressures Under Normal Operating Conditions: 35 psi to 120 psi[3,4]
  - — Minimum Pressure under Maximum Day Demand: 40 psi
  - — Minimum Pressure under Peak Hour Demand: 35 psi
- Minimum System Pressure Under Fire Flow Conditions: 20 psi

These performance standards are applied to all areas that fall within the normal customer service elevation ranges for each pressure zone. Customers outside of the normal service elevation ranges may require an individual pressure regulator or booster pump.

3.4 PUMPING FACILITY CAPACITY

Sufficient water system pumping capacity should be provided to meet the following conditions within the water system:

1. In pressure zones with storage - A maximum day demand with booster pumps assumed to operate at firm pumping capacity. Pumps located in lower pressure zones must deliver the maximum day demand of all pressure zones above them.
2. In pressure zones without storage - A maximum day demand concurrent with a fire flow event (with fire flow requirement based on the highest fire flow requirement for the different land use types within the pressure zone), or peak hour demand, whichever is larger, with booster pumps assumed to operate at firm pumping capacity. Pumps located in lower pressure zones must deliver the largest demand requirement (either maximum day concurrent with fire flow or peak hour demand) of all pressure zones above them.

[3] Maximum allowable pressure of 120 psi was adopted in the City of Santa Rosa Water System Design Standards, September 10, 2002.

[4] Individual services that exceed 80 psi must have an individual pressure regulating device installed on the service line, and services that are less than 35 psi must have an individual booster pump installed on the service line.

Pumping facilities defined as critical[5] should also be equipped with an on-site, backup power generator. Less critical pump stations should be equipped with a plug-in adapter to allow for interconnection to a portable generator, which should be brought to the site by City staff during a prolonged power outage.

3.5 WATER STORAGE CAPACITY

The total treated water storage capacity requirement will be evaluated based on the following three components:

- Operational Storage,
- Fire Storage, and
- Emergency Storage.

Each storage component is discussed below. The recommended water storage capacity for the City's water system will be evaluated by pressure zone.

3.5.1 Operational Storage

Typically, operational storage is used to meet water demands in excess of water supply to the pressure zone and to offset the peak hourly demands. Operational storage is typically replenished during hours when demand is less than the water supply to the zone. Supply is typically provided at a rate equal to maximum day demand.

In accordance with American Water Works Association (AWWA) guidelines, and consistent with the 2006 Water Master Plan, an operational storage volume equal to 25 percent of the maximum day demand is recommended. [6]

3.5.2 Fire Storage

Fire storage is the volume of storage water reserved for fire flows. The fire storage volume is determined by multiplying the required maximum fire flow rate by the required duration time. It is assumed that no more than one fire flow event would occur in any pressure zone at one time.

[5] A booster pump station is defined as critical if it provides service to pressure zone(s) without sufficient fire or emergency storage or meets the following criteria: (1) The largest facility that provides water to a particular pressure zone; (2) A facility that provides the sole source of water to a single or multiple pressure zones; or (3) A facility that provides water from a supply turnout.

[6] AWWA Manual M32 *Distribution Network Analysis for Water Utilities*.

3.5.3 Emergency Storage

A reserve of stored water is also required to meet demands during an emergency. An emergency is defined as an unforeseen or unplanned event that may degrade the quality or quantity of potable water supplies available to serve customers.

Determination of the required volume of emergency storage is a policy decision based on the assessment of the risk of failures and the desired degree of system reliability. The amount of required emergency storage is a function of several factors including the diversity of the supply sources, redundancy and reliability of the production facilities, and the anticipated length of the emergency outage. For the City, as previously discussed with the Board of Public Utilities during preparation of the 2006 Water Master Plan, the emergency storage component was established to be equal to two times the average day demand.

3.5.4 Total Storage Capacity Recommended

The City's recommended total water storage capacity should be the sum of the following components:

- Operational: Volume of water necessary to meet diurnal peaks observed throughout the day, equal to 25 percent of the maximum day demand;
- Fire: Volume of water necessary to supply a single fire flow event; and
- Emergency: Volume of water necessary to provide emergency supply, assumed to be equivalent to two times the average day demand.

The amount of total system storage and system peaking capacity required to meet these standards will change over time as the City continues to grow and water demands increase.

3.6 WATER TRANSMISSION AND DISTRIBUTION PIPELINE SIZING

The following criteria will be used as guidelines for sizing transmission and distribution system pipelines. Although these criteria and guidelines have been established, and will be used to size new pipelines, the City's existing water system will be evaluated using system pressure as the primary criterion. Secondary criteria, such as pipeline velocity, head loss, age, and material type, are used as indicators to locate, and to help prioritize where water system improvements may be needed. Therefore, the City's existing water system will be evaluated on a case-by-case basis. For example, if an existing pipeline experiences velocity or head loss in excess of the criteria described below, this condition, by itself, does not necessarily indicate a problem as long as the minimum system pressure criterion is satisfied. Other conditions such as pipeline age, material type, and location in the system will also be considered.

3.6.1 General Definitions and Standards

The following list summarizes the general definitions and City standards[7] for transmission and distribution pipelines:

- All new pipelines are required to have a minimum diameter of 8-inches. New pipelines serving multi-family residential, commercial, and industrial developments greater than two units must be a minimum of 12-inches in diameter.
- All new pipelines 8-inches, 12-inches and 16-inches in diameter are required to be either polyvinyl chloride or ductile iron material type.
- All new pipelines 20-inches in diameter and larger are required to be either concrete cylinder, wrapped steel or ductile iron material type.
- New pipelines should be located within designated utility corridors wherever possible. These designated utility corridors should be within public rights-of-way to minimize or eliminate the need for utility easements within private property.

3.6.2 Water Transmission and Distribution System Pipelines

For planning purposes, West Yost recommends the following criteria for water transmission and distribution system pipelines:

- Maximum velocity of 5 feet per second (ft/s) during normal operating conditions in transmission pipelines, defined as 16-inch diameter and greater;
- Maximum velocity of 8 ft/s during normal operating conditions in distribution pipelines, defined as less than 16-inch diameter; and
- Maximum velocity of 10 ft/s during fire flow conditions.[8]

For the existing water system pipelines, pipeline velocity criteria are not typically used to identify deficient facilities. However, these constraints are used for sizing new transmission and distribution system pipeline facilities.

[7] City of Santa Rosa Water System Design Standards, September 10, 2002.

[8] Maximum velocity for water service laterals is 15 ft/s. Water service laterals are not typically evaluated during a master planning effort. Source: City of Santa Rosa Water System Design Standards, September 10, 2002.

3.7 EMERGENCY GROUNDWATER SUPPLY PLAN

The following is a summary of the emergency groundwater supply plan described in the City's Groundwater Master Plan[9]. The purpose of the emergency groundwater supply plan is to provide water service to customers should the City's supply from the SCWA be subject to a partial or full outage following a major disaster. This emergency groundwater supply plan evaluated the City's potential emergency water supply needs under two potential SCWA supply outage scenarios to determine the need for and location of emergency groundwater supply wells within the City's water service area, as follows:

- The first supply outage scenario assumes a full outage of supplies from the SCWA as a result from a major earthquake or other catastrophic event which prevents the SCWA from delivering supplies to the City (such as the railcar derailment and formaldehyde spill into the Russian River that occurred in the mid-1970s that completely shut down the SCWA system for about a day).
- The second supply outage scenario assumes a partial outage of supplies from the SCWA resulting from a rupture of the SCWA's Santa Rosa Aqueduct where it crosses the Rodgers Creek Fault.

The assumed SCWA outage durations include a short-term outage of two (2) days and a long-term outage of fourteen (14) days.

Available supplies and demands[10] in each of the City's master zones were evaluated under existing and buildout demand conditions under the two hypothetical SCWA outage scenarios described above. The results from the evaluation indicated that up to 8.4 mgd of additional emergency groundwater supply is required to meet buildout demand conditions assuming a 14-day full loss of the SCWA supply. This is in addition to the City's current emergency groundwater supply of about 4.39 mgd. A number of new emergency wells were recommended and will be required to meet the City's emergency groundwater supply needs under the assumed SCWA supply outages. Some of the new emergency wells are needed to meet existing emergency demand conditions, while others will be needed to meet future emergency demands through buildout.

[9] *City of Santa Rosa Groundwater Master Plan*, West Yost Associates, September 2013.

[10] The Health & Safety Demand required to be served during an emergency condition is equal to 50 percent of an average day demand.