WATER SUPPLIES MANUAL

SAN FRANCISCO FIRE DEPARTMENT

INTRODUCTION

The water supply system of San Francisco is an engineering marvel, and it is important that every member of the San Francisco Fire Department have a thorough working knowledge of this vital system. The intent of this manual is to provide the necessary tools to successfully wade through the depths of this vast subject without drowning in a maelstrom of flotsam and jetsam.

The importance of a reliable source of water cannot be over emphasized. A city without a secure source of water is vulnerable to fire and devastation, and San Francisco knows this fact all too well. Between 1849 and 1906, San Francisco was almost destroyed by fire eight times. The great quake of 1906 caused a vast amount of damage, but most of the destruction was caused by the ensuing conflagration. These catastrophes brought about the birth of the San Francisco Fire Department in 1866 and the creation of the Auxiliary Water Supply System (AWSS) in 1913. The AWSS's purpose is to supply water to fight fires when the domestic supplies fail or are insufficient.

Water for firefighting is supplied by the San Francisco Water Department (SFPUC). This public utility is responsible for the installation and maintenance of all municipal water supply lines and fire hydrants. Additionally, they oversee and maintain the reservoir, water tanks, and pipelines that provide water to the Auxiliary Water Supply System. The SFFD and SFPUC work in close collaboration to provide the highest level of fire protection for the citizens of San Francisco. The agency responsible for giving a municipality its fire insurance rating, Insurance Services Office, weighs the two agencies as almost equal. The fire department accounts for 50% of the rating; the water department is given 40% of the rating, and the remaining 10% is made up of the city emergency dispatch. Extra points are given for community outreach, fire prevention and safety classes.

Due to the fact that San Francisco is situated between two active fault lines, the San Andreas and the Hayward faults, a reliable source of water is extremely important. Considering the historical fragility of the municipal water system, the SFFD and SFPUC are keenly aware of the value of alternative supplies of water. The municipal system has thousands of private connections that are easily compromised by an earthquake event. This fact was proven during the 1989 Loma Prieta Earthquake, when the municipal water supply system suffered hundreds of breaks and was rendered useless in several areas of the City.

San Francisco's history of destruction by fire, seismic uncertainty, and an aging municipal water supply system has led to the creation of the most extensive and reliable auxiliary water supply systems in the world. The AWSS is an independent high-pressure water supply pipeline that is distinct and separate from the domestic water service. The system is normally supplied with potable water from the SFPUC reservoirs and is composed of a dedicated reservoir and two large capacity water storage tanks. Additionally, two saltwater pump stations, and two fireboats are available to augment the system with salt water if demand exceeds the normal rate of flow, or if sections of the system have been damaged. The City has constructed 230 cisterns averaging 75,000 gallons of stored water. These provide over 17,000,000 gallons of water that can be used as an emergency supply of water for firefighting. The SFFD has also invested in a fleet of portable hose tenders that can deploy large diameter hose lines to supply water to sections of the city whose below ground supply system has been compromised.

1. The City Water Supply

City Terminal Reservoirs

There are five transmission mains that deliver water from the Regional Water Storage System to four terminal reservoirs located in San Francisco. The Regional Water System delivers water to University Mound and Merced Manor reservoirs by gravity. Sunset and College Hill reservoirs are located at higher elevations and are supplied by the Harry Tracy Water Treatment Plant or the Baden Pump Station. In the event of a major power outage, all SFWD pump stations are equipped with back-up power generators and are provided with a three-day supply of fuel. If the five main transmission lines are compromised by a major seismic event, the city reservoirs and water tanks contain a three-day supply of water. This three-day supply does not include water that would be used at a large-scale fire event. By direction of the mayor or the SFPUC General Manager, the Lake Merced Pump Station can draw water directly from Lake Merced to refill both Sunset and Sutro Reservoirs.

The four terminal reservoirs are:

1. Sunset Reservoir (177,000,000 gallons) (24^{th} Ave./Ortega St.) (385' elevation)
2. University Mound Reservoir (141,000,000 gallons) (university St./Bacon St.) (172' elevation)
3. College Hill Reservoir (13,500,000 gallons) (Holly Park Cir./Appleton Ave.) (255' elevation)
4. Merced Manor Reservoir (9,500,000 gallons) (2920 23^{rd} Ave.) (187' elevation)

Water is delivered from these terminal reservoirs to smaller reservoirs and tanks that are located at varied elevations in San Francisco.

City Reservoir/Tank/Pump Station Distribution System

San Francisco is a city of hills. The elevations of these hills vary from sea level to the top of Mount Davidson which has an elevation of 928'. The numerous hills and valleys of the city present a unique challenge to provide a steady and reliable source of water for the residents of San Francisco. This is accomplished by a complicated network of reservoirs, water tanks and pump stations.

The city is divided into ten major pressure zones and then further divided into smaller zones for a total of twenty six zones. The major zones are supplied by ten distribution reservoirs. That also include the three terminal reservoirs.

City Distribution Reservoirs and their corresponding pressure districts:

1. Sunset
2. University Mound
3. Sutro
4. Summit
5. College Hill
6. Stanford Heights
7. Merced Manor
8. Potrero Heights
9. Lombard
10. Hunters Point

These reservoirs are located at elevations ranging from 172’ to 800’ above sea level. Their capacities range from 1,000,000 to 177,000,000 gallons and use gravity as a means of distribution.

Due to the topographical extremes in San Francisco, some sections of the city cannot be supplied with water by means of gravity flow. Neighborhoods located on the numerous steep hills of San Francisco are supplied with water by tanks and pump stations. There are six tanks, eight pump stations, and seven hydro-Pneumatic stations that provide water to the higher isolated regions of the city. The tanks sit at elevations ranging from 370’ to 885’. The smallest of these tanks is 75,000 gallons and the largest holds 8,000,000 gallons.

Pump Stations and hydro-pneumatic stations are used to provide water to the storage tanks and distribution reservoirs. These tanks and reservoirs then provide a gravity fed supply of water. These pumps are also used to serve the highest points of the city that cannot be served by a tank or reservoir. The pump stations are electrically driven and have back-up power generators.

The Lake Merced Pump Station has the largest pump capacity and can discharge 54 million gallons of water a day. In the event a large-scale disaster, this station can pump water directly from Lake Merced which can then be used to re-supply the AWSS. This station is staffed 24 hours a day and can remotely operate critical divide and gate valves to begin directing water to affected areas.

Water Distribution Mains

The water distribution pipeline in San Francisco can be divided into four classifications.

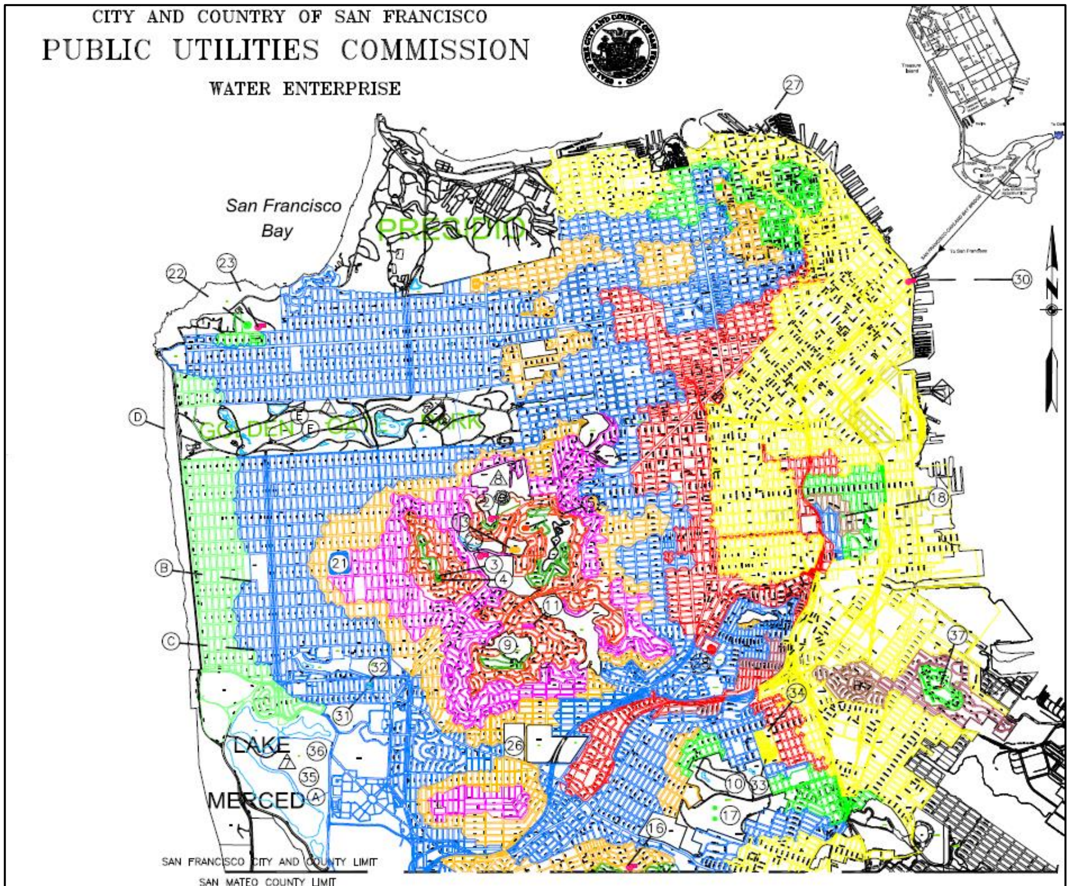
1. Transmission Mains:
   This main pipeline transports water from the original supply source to the city terminal and distribution reservoirs.
2. Primary feeder mains:
   These then transport water from the reservoirs to various points for local distribution from smaller mains.
3. Secondary Feeder Mains:
   These smaller mains form the loop and grid network.
4. Distribution Mains:
   These are the pipes that complete the supply system and serve the residences, businesses, and the low pressure hydrants.

The Secondary Feeder and Distribution mains are arranged in a grid and loop pattern that will provide a supply of water from at least two directions and deliver increased volume. The water mains are manufactured from cast iron, ductile iron, or steel and their size ranges from 4 inches up to 60 inches in diameter.

A newly installed section of the AWSS in Hunters Point is constructed of Earthquake Resistant Ductile Iron Pipe (ERDIP). This pipe has flexible joints that allows the pipe to adjust to ground movement during a seismic event.

Divide Gates are located where pressure zones merge and can be operated by the SFPUC to introduce a supply of water from a higher zone to a lower zone. This will increase flow and pressure to a zone whose available water supply has been exceeded due to firefighting operations at a large-scale fire event. Numerous Gate Valves are installed in the system and allow sections to be isolated because of a main break or scheduled maintenance and repair.

Map of the City Reservoirs and Pressure Zone



RESERVOIRS

	NAME			LOCATION
26	BALBOA	NORTH BASIN (NOT IN USE)		OCEAN AVENUE & PHELAN AVENUE
		SOUTH BASIN (NOT IN USE)		OCEAN AVENUE & PHELAN AVENUE
5	SUMMIT	EAST BASIN		SOUTH OF PALO ALTO AVENUE & GLENBROOK AVENUE
		WEST BASIN		SOUTH OF PALO ALTO AVENUE & GLENBROOK AVENUE
11	STANFORD HEIGHTS		EAST BASIN	AGUA WAY & TERESITA BOULEVARD
			WEST BASIN	AGUA WAY & TERESITA BOULEVARD
13	SUTRO	EAST BASIN		OLYMPIA WAY & CLARENDON AVENUE
		WEST BASIN		OLYMPIA WAY & CLARENDON AVENUE
18	POTRERO HEIGHTS			CAROLINA STREET & 22ND STREET
21	SUNSET	NORTH BASIN		28TH AVENUE & PACHECO STREET
		SOUTH BASIN		28TH AVENUE & PACHECO STREET
27	LOMBARD			GREENWICH STREET & HYDE STREET
28	COLLEGE HILL			APPLETON AVENUE & ELSIE STREET
31	MERCED MANOR		NORTH BASIN	22ND AVENUE & OCEAN AVENUE
			SOUTH BASIN	22ND AVENUE & OCEAN AVENUE
33	UNIVERSITY MOUND		NORTH BASIN	BACON STREET & UNIVERSITY STREET
			SOUTH BASIN	BACON STREET & UNIVERSITY STREET
37	HUNTERS POINT			WHITNEY YOUNG CIRCLE & NEWCOMB AVENUE
38	HARDING PARK RECYCLED WATER			LAKE MERCED BLVD. & HIGUERA AVE.

DOMESTIC GROUNDWATER SUPPLY WELLS

	NAME	LOCATION	ELEV (EST
A	GROUNDWATER WELL NO.1	LAKE MERCED DR & VIDAL DR	30'
B	GROUNDWATER WELL NO.2	QUINTARA & 40TH AVE	104'
C	GROUNDWATER WELL NO.3	WAWONA & 40TH AVE	98'
D	GROUNDWATER WELL NO.4	MLK JR WAY NEAR GRT HWY	31'
E	GROUNDWATER WELL NO.5	CHAIN OF LAKES DR NEAR FULTON	72'
F	GROUNDWATER WELL NO.6	OVERLOOK DR W OF TRAVERSE	240'

SCHEMATIC DIAGRAM OF CITY DISTRIBUTIO
SYSTEM AND PRESSURE ZONES

Water Hammer and Hydraulic Shock

It is important for every firefighter to understand the cause and effect of water hammer. Simply put, water hammer is the reaction of moving water that is forced to stop abruptly. The consequences of water hammer range from an audible "hammering" noise to ruptured water mains and serious injury.

<u>Kinetic Energy:</u>

Kinetic energy is the energy of motion. All moving objects have Kinetic Energy. The power required to make an object move is then transferred to the moving object. When the moving object stops, the movement energy (Kinetic Energy) is then transferred to the object that caused it to stop. When a car traveling at high speed uses its brakes to stop, the kinetic energy is gradually transferred to the brakes and is dissipated as heat. The car will slowly come to a stop. If that same moving car is stopped by a brick wall, all the energy of the moving car is immediately transferred to the brick wall with devasting force. Kinetic energy doubles if the weight of the object is doubled, and if the speed of the object doubles, the kinetic energy is quadrupled.

The measure of the amount of hydraulic shock is a function of three factors. Mass of the object in motion, the velocity of the object and how quickly this moving mass changes its velocity.

When a valve or nozzle is closed, the mass of moving water must come to a complete stop. The kinetic energy stored in the moving water is equal to the force needed to accelerate it. When a nozzle is closed slowly, there is a gradual release of the water's kinetic energy. This energy is easily and safely absorbed by the elastic hose line. The same holds true when a gate valve is closed slowly. The water flowing in the pipeline slowly comes to a stop and safely transfers the stored Kinetic Energy to the pipeline. When a gate valve or nozzle is closed quickly, the kinetic energy is released instantly in the form a violent pressure wave. These hydraulic shock waves travel at speeds of over 2,700 mph and can cause pressure spikes that can easily rupture fire hose and water mains.

The effects of water hammer are greatly emphasized in very long hose lays and closed circuit relay pumping operations. In these situations, high pressures are needed to overcome friction loss and back pressure caused by elevation gains. If the water flow is suddenly stopped, the friction loss is no longer present, and the total pump pressure will be exerted throughout the entire system.

Water hammer has caused serious and extensive damage to the Auxiliary Water Supply System (AWSS) pipeline. 103.5 miles of the AWSS pipeline is made of cast iron. Cast iron is brittle and will break if subjected to strong vibrations and movement. As an example, a Gleeson Valve flowing 1500 gallons per minute from a high pressure hydrant that is being fed from a 3,000 foot length of 18 inch cast iron pipe, can easily create a pressure spike as high as 1,000 psi if that Gleeson Valve is closed quickly. This pressure wave could potentially rupture a section of the pipeline

<u>Gleeson Valve Emergency Shut off Lever:</u>

The Gleeson Valve Emergency Shut Off Lever is to be used only in an extreme emergency. The activation of this lever will immediately stop the flow of water from the Gleeson Valve and cause water hammer. This has the potential of damaging the AWSS pipeline, the High Pressure Hydrant, the Gleeson Valve, and bursting connected hose lines. (Refer to Drill Manual / 3E Hose Evolutions / Lesson Plan 3 & 6 for detailed instruction on Gleeson Valve operations.)

The importance of slowly closing valves and nozzles to avoid the damaging potential of water hammer cannot be emphasized strongly enough. To avoid the dangers of water hammer, it is standard SFFD practice to operate nozzle shutoff valves and hydrant valves slowly. This is particularly true at all greater alarm fires where multiple master streams are operating from numerous High Pressure Hydrants. These multiple alarm fires require large volumes of water that might be supplied by all three high pressure zones of the AWSS. This means water could be coming to the Lower Zone from the Twin Peaks Reservoir. This large volume of flowing water will have a tremendous amount of kinetic energy. Good pipeline control is imperative to avoid the water hammer that would result if this mass of water were stopped suddenly. High Pressure Hydrants that are supplying fire apparatus or master streams should only be shut down under the supervision of a CDD AWSS supervisor, who will be on scene at all greater alarm fires. The Incident Commander on scene, will coordinate with the Water Supply Officer and CDD personnel the controlled shutdown of the AWSS to avoid a hydraulic pressure event that could cause severe damage to the system.

<u>AWSS Operations and Maintenance MOU between SFFD and SFPUC</u>

"During emergencies requiring the use of the AWSS, the SFFD agrees that it will not shut off flow from the system without prior notification to SFWD staff who are scene until such time as proper surge protection is built into the system." (SFFD and SFPUC MOU p. 3 of 16)

Water Main Service Interruptions

When there is a service interruption to a water main due to a repair or a break, the DEC is contacted by the PUC. The DEC will then notify the affected field units, the battalion and division chiefs, and the Water Supply Officer by email and CAD printout. Hydrants that will not have a supply and are completely out of service, will be marked by the Water Department with a red wooden disk affixed to a hydrant outlet. When repairs are completed, and service is restored, all companies in the field will be notified via CAD printout and email. When water service is restored, the DEC will provide a restoration of service notification.

An engine company will be dispatched to the scene of a reported water main break. This response is important for the following reasons:

1. Property near the water main break may be damaged by flowing water and salvage operations may be necessary.

2. Sub-soil beneath the street could be displaced by flooding water causing unsafe conditions for vehicles and pedestrians.

3. Natural gas pipelines and electrical transmission lines near the water main break could be affected by the large volume of flowing water. This will require the response of Pacific Gas and Electric for utility control in the event a gas line is ruptured, or a power line is compromised.

4. If a water main break is extensive, leaving an area of the city without water service, the responding engine company should take note of all affected hydrants. In addition, they should locate the nearest available water source to use as a supply in case a fire occurs in the area affected by the water main break. This includes making use of emergency water supplies or the deployment of a 5" Hose Tender to deliver water from an adjacent pressure zone.

Once a main break has been isolated, it may be possible to bypass the affected area by utilizing hose lines between two hydrants on either side of the damaged section of pipeline. This temporary solution should provide adequate water flow for firefighting purposes and should only be performed on the advice of SFPUC personnel on scene.

After a water main break has been repaired, companies whose response area was affected by the break should ensure that all hydrants have been returned to service.

The SFFD prohibits the operation of SFPUC gate valves by SFFD personnel unless under the direct supervision of SFWD. Opening or closing gate valves can divert large volumes of water within the supply grid and possibly cause serious damage to the water supply system and private property.

2. Low Pressure Hydrants

The primary source of water used as a supply for firefighting operations is the Low Pressure Hydrant system. These hydrants have a direct connection to the SFPUC municipal water distribution system and supplies the same water used by the residences and businesses of San Francisco. This system is separate and distinct from the High Pressure Hydrant System, which is supplied by non-potable water.

All low pressure hydrants installed and maintained by the SFPUC are of cast iron construction and have two 3” National Standard Thread outlets. Each outlet has a dedicated valve stem shut off and can be operated independently by a counterclockwise rotation of the valve spindle operating nut. The opening or closing of one outlet will not affect the function of the second outlet. The low pressure hydrants used in San Francisco are classified as “wet barrel” hydrants, meaning the hydrant barrel is always charged with water.

The main pipelines that supply these hydrants are arranged in a gridiron fashion. This loop and grid design will provide most low pressure hydrants in San Francisco a supply of water from two different directions. This supplies an increased flow of water to the hydrant, and a secondary means of supply, in case a portion of the main line is broken or is out of service for repair.

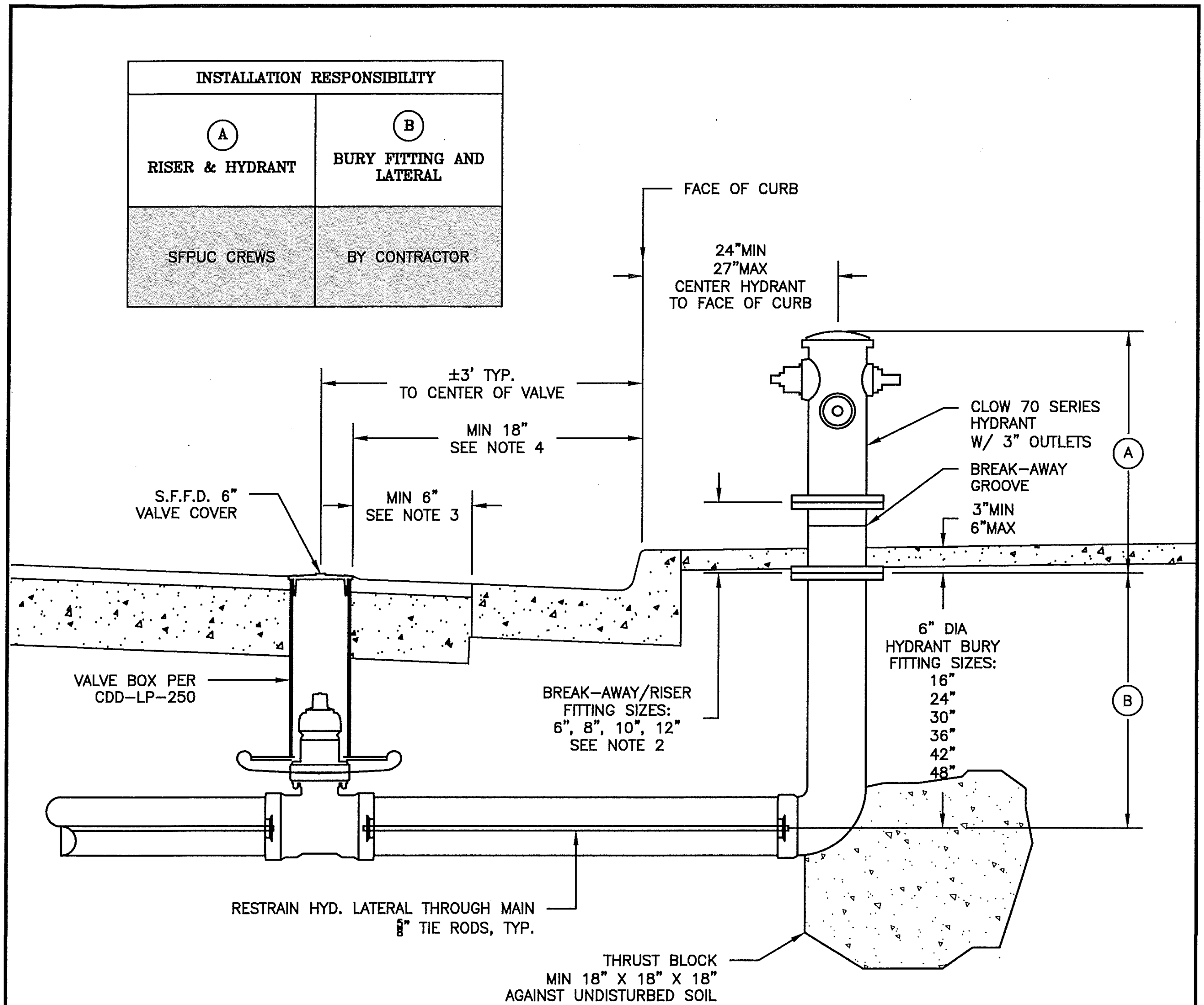
Hydrant Spacing and Installation

All low pressure hydrants are located and spaced in accordance with California Fire Code Appendix B and Appendix C. Appendix B specifies the fire flow (gallons per minute) and the duration of the flow. This is based on building size (square footage) and building construction type. Based on this determined rate of flow and duration, Appendix C specifies the required number and spacing of low pressure hydrants. The spacing will never be further than 500 feet. In the highly congested parts of the city, street corners can have up to three low pressure hydrants. Less densely populated areas will have one or two low pressure hydrants per street corner. Currently there are 8,713 low pressure hydrants in San Francisco, and this number will increase as the City grows in size and population.

Low pressure hydrants are supplied from the water main by either a 4”, 5” or 6” branch pipe. The majority of these branch lines are 5” and all newly installed hydrants will be supplied by a 6” branch pipe. All hydrants will have a hydrant gate valve located in close proximity to the hydrant. This gate valve can be used to shut off the supply of water to the hydrant and are normally in the open position. This gate valve is the only gate valve that the SFFD is authorized to manipulate without supervision of the SF Water Department. Directly beneath the lower flange of the hydrant is the hydrant riser. The hydrant riser connects the hydrant to the branch pipeline and is designed to break if the hydrant is struck by a vehicle. The Break-Away-Grove cast into the hydrant riser allows the riser to break first, thus preventing major damage to the hydrant and the underground pipeline.

The average installed height of the lower outlet is 18” above grade. The upper outlet averages 25” above grade. The hydrant will be set back from the curb face a minimum of 24” and a maximum of 27”.

Diagram of Low Pressure Hydrant Installation



INSTALLATION RESPONSIBILITY	
(A) RISER & HYDRANT	(B) BURY FITTING AND LATERAL
SFPUC CREWS	BY CONTRACTOR

NOTES:

1. SEE CDD–LP–146 AND –147 FOR SCHEDULE OF MATERIALS
2. RISER AND HYDRANT FLANGE PATTERN:
   6 X 3/4"DIA BOLT HOLES ON 9–7/16" BOLT CIRCLE
3. CLEARANCE BETWEEN EDGE OF VALVE BOX COVER CASTING AND LIP OF GUTTER IS 6" WHERE GUTTER IS PRESENT.
4. CLEARANCE BETWEEN EDGE OF VALVE BOX COVER CASTING AND FACE OF CURB IS 18" WHERE NO GUTTER IS PRESENT.
5. A MINIMUM OF 5–FEET OF RADIAL CLEAR SPACE SHALL BE PRESENT AROUND THE OUTSIDE DIAMETER OF THE HYDRANT. NO ABOVE–GRADE OBSTRUCTIONS OR FURNISHINGS ARE PERMITTED IN THIS AREA.

REVISIONS		
⚠	3/7/17	UPDATED HYDRANT MODEL, BURY/RISER SIZES, OFFSET DIMS
SUPERSEDES E–4969R		

Classifications of Low Pressure Hydrants

Originally low pressure hydrants were classified as single hydrants or double hydrants. Single hydrants could only be used as a supply for one engine and double hydrants could supply two engines. Single hydrants are fed by a 4" branch pipe and provide a reduced volume of water. Double hydrants are fed by larger 5" and 6" branch lines.

Low Pressure hydrants that are supplied by 4" and 5" branch lines are systematically being upgraded to a 6" branch pipe. The 6" branch pipe is the new standard specified by State and Federal Regulations.

The engines now used by the SFFD have double or triple the pump capacity of the engines that were in service when this classification system was introduced. These engines have a pump rating of 1,500 GPM and can only be supplied by a single hydrant. For this reason, all low pressure hydrants in San Francisco are considered single hydrants.

However, this system of classification is still relevant and provides an observant pump operator a good indication of the volume of water a hydrant will provide. A single hydrant might not be able to deliver the required flow rate that a large fire event will require. If a driver can make a choice between two hydrants, it would be prudent to obtain a supply from a double hydrant.

Three methods used to identify single hydrants:

1. **Ball Top. These hydrants will have a ball on the top of the bonnet. The ball was used to secure the horse drawn fire engines.**
2. **A ¾" black stripe will be painted above the stenciled main size on the hydrant barrel.**
3. **The hydrant serial number will begin with the letter "D". Double hydrant serial numbers will begin with the letter "B".**

Modified Hydrants

In various locations throughout the city, the SFWD has installed acoustic leak detectors and system pressure monitoring devices on a few low pressure hydrants. The acoustic leak detection system is installed in a modified outlet cap and replaces the standard outlet cap. This new cap does not affect hydrant operation in any way. Simply remove the acoustic cap as you would a standard outlet cap with a supplied SFFD spanner. The pressure monitoring device replaces the hydrant bonnet and provides continuous system pressure monitoring. The pressure monitoring device also does not have any impact on the operation of the hydrant. Pictured to the left is a low pressure hydrant that is fitted with a pressure monitoring device and a leak detecting cap.

Hydrant Markings and Designations

All low pressure hydrants are painted white. Bonnet color is used to indicate the proximity of a cistern or the quality of water supplying the hydrant.

Green Bonnet: A hydrant with a green bonnet signifies a cistern is nearby. The cistern is usually located in the adjacent intersection.

Blue Bonnet: A hydrant with a blue bonnet indicates that the hydrant is supplied by turbid water. These hydrants are typically connected to a nearby lake or non-potable water source and are gravity fed.

The black stenciled number on the hydrant barrel indicates the size of the main pipeline that supplies the hydrant. Pump operators should take note of the hydrant main size when obtaining a supply. If fire flow demand begins to exceed the hydrant output, supplying an engine from a hydrant that is fed by a larger main should provide improved water flow rates.

Also indicated on the Low Pressure hydrant will be the average daytime static pressure, direction and distance to the hydrant gate valve, and the hydrant serial number. Please note that the average static pressure may vary during times of light or heavy domestic use. It is also important to note the difference between static pressure and residual pressure. Residual pressure is the amount of pressure delivered by the hydrant when water is flowing from an outlet. Residual pressure gives a more accurate indication of hydrant capacity and will help a pump operator determine if the hydrant can deliver an adequate water supply. Residual Pressure, and how it relates to pump operations, is explained in greater detail in the SFFD Pump Operations Manual on page 3.6.

Hydrant information location:

The model of hydrant will determine the location of hydrant information.

Greenburg and Clow model low pressure Hydrants:

1. Static pressure will be stamped on the upper spindle nut.
2. An arrow will be scribed on top of the bonnet pointing in the direction of the hydrant gate valve.
3. Distance to the hydrant gate valve will be stamped on the edge of the bonnet.
4. The hydrant serial number will also be stamped on the edge of the bonnet.

Jones model hydrants manufactured by Mueller:

This new model of hydrant is much easier to service and is more corrosion resistant. The corrosion resistant coating has necessitated the relocation of the hydrant information.

1. Static pressure, distance to hydrant gate valve, and hydrant serial number will be stamped on the bronze face of the upper outlet.
2. A stenciled arrow on the top of the bonnet, or a stamped arrow on the bronze upper outlet face, will point in the direction of the hydrant gate valve.

There are three hydrants in the city that are purposely not painted white. The “Little Giant” located on the south east corner of 20th Street and Church street is painted gold. This hydrant is credited as being one of few hydrants in San Francisco that had a supply of water after the 1906 earthquake and was used to save the Mission District from the devasting fire storm. The remaining two are the “Silver Twins”. The first is located at the northeast corner of Hayes Street and Buchanan Street and the second is located at north west corner of Ellis St. and Van Ness Avenue. These hydrants are fittingly painted silver and are also given credit for helping to stop the wall of flames that was engulfing the City. These hydrants are ceremoniously repainted every year on the anniversary of the Great Quake.

Hydrant Inspection

Each engine company will be assigned a monthly list of hydrants that are to be inspected every Saturday. The goal of this inspection program is to have every hydrant inspected once a year.

The hydrants will be inspected for the following:

1. Excessive rust.
2. Missing caps.
3. Absent or improper markings.
4. Incorrect hydrant location designation.
5. Graffiti.
6. Leaking or damaged spindles.
7. Obstructions that prohibit access to outlets or spindle valves.
8. Remove both outlet caps to check condition of outlet threads.
9. Locate and attempt to remove Hydrant Gate Valve Cover.
10. Locate Gate Valve Operating Nut.

Any deficiencies will be accurately detailed in the monthly hydrant and cistern inspection report. This report will be reviewed by the Water Supply Officer and the SFPUC Hydrant Maintenance Division.

If any hydrant is discovered to have an uncontrollable major leak, or found to be non-operational, immediately report this information to the SFPUC dispatch for repair. (415-550-4956)

Gate Valve Cover

The hydrant gate valve cover will be identified with a 6" round cover that is labeled "SFFD". Occasionally these covers will be either partially or completely obstructed with asphalt or concrete. Every attempt should be made to remove the obstruction with the hand tools carried on the engine. If the Gate Valve Cover cannot be removed, this fact will be detailed in the monthly hydrant and cistern report.

Gate Valve Operating Nut

Once the gate valve cover has been removed, locate the gate valve operating nut. If the gate valve operating nut is not accessible due to an accumulation of dirt and debris, attempt to clear the obstructions. If this cannot be accomplished, this shall also be reported in the monthly report. Often the operating nut will be situated much further below street grade than the valve pictured above. If the operating nut cannot be verified visually, attempt to locate the nut by probing with a hand tool carried on the engine.

Being able to remove the hydrant gate valve cover and operate the gate valve is extremely important. Often these covers are paved over during street repair, or the valve operating nut is covered with dirt and debris. These two conditions will make it impossible to shut down the hydrant if it is sheared off due to an automobile accident.

A static pressure reading will also be taken from the hydrant. This can either be done with the engine's compound gauge or a fitting equipped with a pressure gauge and a bleeder. Using the engine to check the static pressure will require the engine to be supplied by the hydrant so the static pressure can be measured with the engine's compound gauge. If a fitting with a pressure gauge is used, the gauge should be periodically checked for accuracy. These gauges, if treated roughly, can give an inaccurate pressure reading. This information will be recorded for the engine company's monthly hydrant and cistern inspection report.

Hydrant Maintenance and Repair

As stated in the 2010 Memorandum of Understanding between the SFFD and the SFPUC (page 5); the SFPUC is responsible for all hydrant repair and maintenance. Occasionally a SFFD unit will be dispatched to investigate a reported leaking hydrant. If the hydrant is found to be leaking, and the issue cannot be easily resolved, the responding unit "shall immediately notify the SFPUC of any required maintenance" (SFFD & SFPUC MOU 2015 p. 5). Old model hydrants can have minor leaks repaired in the field. This is accomplished by tightening the nut that surrounds the spindle. This would tighten the valve packing and stop the leak. Newly manufactured hydrants are equipped with rubber “O” rings and cannot be repaired by SFFD companies. Leaks should be reported to the SFPUC (415-550-4956). Minor leaks will be repaired within 24 hours. For major leaks, a repair crew will be dispatched immediately.

The SFPUC is responsible for marking hydrants that are out of service because of water main breaks, repairs, or improvements. Out-of-service hydrants will be marked with a red disk located beneath an outlet cap. A hydrant that has only one outlet out of service will be marked with a yellow disk located beneath an outlet cap. Before the introduction of the low pressure hydrant manufactured by Mueller, a black disc was used to indicate a hydrant as being out of service. Since the bronze outlet face of these new hydrants can appear as a black disc, a red disc is now being used.

Red Wooden Disk: Indicates a complete hydrant shut down.
Yellow Wooden Disk: Indicates only the marked outlet is out of service.

Out-Of-Service Low Pressure Hydrant

Broken Low Pressure Hydrant

An engine company will be dispatched to every reported incident of a broken low pressure hydrant. A quick response is necessary to prevent water damage to private property damage. If the hydrant cannot be shut down in a timely fashion, the responding engine company should make every effort to divert the cascading water away from homes and businesses until the SFWD can complete shutdown.

Procedure for Broken Low Pressure Hydrant

1. Arrive on scene; confirm that the hydrant is broken, give exact location and have SFWD notified.
2. Request ambulance if needed.
3. Request SFPD for case number.
4. Locate Hydrant Shut-Off Gate Valve and shut down broken hydrant.

   - If Hydrant Shut Off Gate Valve Cover is not readily visible, and if possible, position the broken hydrant in its approximate original position. Outlets will be oriented at a 45-degree angle in relation to the street curb.
   - Hydrant shut off arrow points in the direction of the Hydrant Valve Gate Cover.
   - Distance to shut off will be stamped on the hydrant.
   - The Shut Off Gate Valve Cover will be marked SFFD.
   - Remove Gate valve cover and close the Hydrant Gate Valve using the Low-Pressure Shutoff Wrench. Low Pressure Hydrant Gate Valves are typically closed with a counterclockwise rotation and requires 16 to 28 full rotations.

The Low-Pressure Hydrant Shutoff Wrench consists of three separate parts and is carried by every SFFD engine company. A more detailed description can be found in the SFFD Hose and Hose Appliances manual page 6.8.

Wrench components:

1.	Branch Gate Valve Wrench	4 ½’ long
2.	Wrench Extension	3’ long
3.	Wrench “T” Handle	2 ½’ long

- If no “SFFD” Gate Valve Covers are located, and multiple valves are manipulated in the attempt to shut down the broken hydrant, it is important to make note of all valves that were disturbed. This information must be passed on to SFWD personnel arriving on scene. This will assist them in restoring water service to any areas affected by mistakenly closed gate valves.

5. If the hydrant cannot be shut down, confirm SFWD is responding and give situation update.
6. When hydrant is shut down, attempt to secure the area, and bring the Low Pressure Hydrant back to the firehouse.
7. Collect vehicle information, and if driver is on scene, collect driver's information. This information, along with SFPD case number, will be needed to complete the Report of Broken Hydrant Form.
8. After returning to the station, the officer should then immediately call SFWD Dispatch (415-550-4956). Report the location of the incident and the location of the broken hydrant. SFWD will retrieve broken hydrant.
9. Officer completes Report of Broken Hydrant Form. One copy is attached to broken hydrant. One copy should be forwarded to Support Services. Keep one copy for company records. This form is located on Sharepoint/Document Library/SFFD Forms/Report of Broken Hydrant.
10. Make journal notation recording all actions performed.

There are a few LP Hydrants in Battalions 8, 9, and 10 that are closed with a clockwise rotation. These hydrants were installed by private contractors. All newly installed hydrants will have gate valves that close with a counterclockwise rotation.

This operation is explained in greater detail in the SFFD Drill Manual 3E Hose Evolutions Lesson Plan 5 and on page 6.10 of the SFFD manual Hose and Hose Appliances.

Cross-Connection Control

California Department of Public Health Compliance Order 02-04-95CO-006 requires the City and County of San Francisco to implement a cross-connection control program. The Water Quality Division of the SFPUC is responsible for administering this program.

A cross-connection is defined as an actual or potential connection between a source of contamination with a potable water supply. Backflow can introduce contaminants into the public water supply system. The effects of this contamination can range from foul tasting water to illness and death.

The SFFD has two possible sources of contamination that can be introduced into the municipal water system. The first being the 500 gallons of water carried by each SFFD engine. Each time an engine makes a connection to a low pressure hydrant the potential exists for this water to be introduced to the municipal water supply. The second and larger source of contamination is the threat posed by the AWSS. The potential exists for an engine to be connected to both the low pressure municipal water supply and the AWSS, which can be supplied with non-potable water or salt water. For this reason, three AMES Cross Connection Devices have been issued to all SFFD Engine companies, Attack Hose Tenders, and 5" Hose Tenders. The back flow prevention devices consist of a 3" female swivel coupling for the connection to a Low pressure Hydrant and a 3" male coupling for the connection of a 3" hose line. There is an arrow near the handle to show the proper direction of the water flow to ensure proper placement of the device.

The AMES devices shall be inspected daily and after use. In addition to the SFFD company level inspections, each device will be tested yearly by the SFPUC to ensure proper functioning.   Each Ames Device is stamped with a serial number for ease of identification to facilitate testing and tracking of test results. This serial number is in a position that allows for ease of identification when connected to a Low Pressure Hydrant. If an Ames device is damaged, missing a gasket, or is defective, the Bureau of Equipment shall be notified immediately. The Bureau of Equipment is responsible for the pickup and replacement of the damaged or failed device. The SFPUC is responsible for the repairs to the Ames Cross-Connection Device.

Standard operating procedures of the SFFD state that an engine pumper may be connected to a High Pressure Hydrant using a Gleeson Valve. however, every attempt should be made to make high pressure supply leads directly to the master stream device, and then regulate the supplied pressure from the Gleeson Valve. Occasionally, initial water taken from a Low Pressure Hydrant through an engine is inadequate to supply a master stream device and needs to be augmented by the high pressure water system. When this happens, the low pressure supply shall be disconnected from the master stream device first, and then all further supply leads shall come from a high pressure source. When saltwater from the Bay is being used as a supply for firefighting purposes, it is imperative that no cross connections are made with the potable distribution system.

It is <u>Mandatory</u> that every connection to a low pressure hydrant has an AMES Cross-Connection Device attached to the outlet of the supply hydrant.

A cross-connection control specialist from the Water Quality Division of the SFPUC, who is trained in the identification and prevention of cross connections, will be dispatched to all greater alarm fires. They will inspect all hydrant connections to make sure back flow prevention devices are being used. If necessary, they will make the appropriate reports to the regulating agencies and coordinate backflow mitigation with SFPUC personnel that will be on scene.

BROADWAY TUNNEL HYDRANTS AND GATE VALVES

The hydrant settings in the Broadway Tunnel are distinct from those of normal hydrant installation. A partition wall divides the tunnel into two bores; one bore provides a lane for east bound traffic and the other for west bound traffic. Fourteen SFFD double hydrants are installed in the tunnel pedestrian walkways to provide seven hydrants in each bore at identical locations. Two 6-inch pipelines supply the tunnel hydrants, one in each bore. Each 6-inch pipeline connects to the Water Department mains on Powell Street and on Larkin Street. This setting provides a complete loop pattern with flow supplied from each end of the 6-inch pipeline.
Average static pressure at each hydrant is 60 psi. Gate valves are installed in each 6-inch hydrant supply pipeline near the east and west portals of the tunnel. The gate valves at the east portal of the tunnel are located 75 feet east of the eastern-most tunnel hydrants. Those at the west portal are located 60 feet

west of the westernmost tunnel hydrants. Each gate valve is installed under the pedestrian walkway. In the event of a tunnel hydrant being broken, or in the event of a break in the 6-inch hydrant supply pipeline, the gate valves at each end of the involved 6-inch pipeline must be closed. This procedure shuts off supply to all seven hydrants of the involved tunnel bore. Each tunnel hydrant also has a hand-wheel operated gate valve located under a screwed-down metal deck plate in the pedestrian walkway near the hydrant. These gate valves are provided primarily to shut-off flow to the hydrant during normal hydrant servicing or repair.

Private DISTRIBUTION SYSTEMS

There are several areas within the City limits of San Francisco that are occupied by private industry or government agencies that have installed private water supply and distribution systems. These systems are privately installed and maintained, and water is supplied by the SFPUC through a meter system. The exception to this is the Presidio, which obtains most of its water from Lobos Creek.

These systems can include private storage reservoirs or tanks connected to distributors for supply of standpipes, sprinkler, and hydrant systems as well as for supply of the private domestic or industrial water consumption. It is the responsibility of Fire Department chief officers and companies to be fully aware of such private water distribution systems located within their respective divisions and districts. Furthermore, these systems must be reviewed several times a year. Such reviews are necessary to maintain orientation with the system as it pertains to fire service usage. The more prominent private low pressure water distribution systems located within the City are described as follows.

Bay Bridge (West) Standpipes

Water is supplied to Treasure Island and Yerba Buena Island by a 10" water main that is supported on the upper deck of the Bay Bridge. The design of the 10" pipeline includes specially constructed expansion joints that compensate for lateral and vertical movements of the supporting bridge members that are caused by wind and temperature variations. This 10" pipeline also supplies sixteen wet standpipe branches on each deck of the bridge. The standpipes are located on the north side of the bridge. The East bound lower deck outlets are labeled (H 1) through (H 16). West bound from Y.B.I., the upper deck outlets are labeled (H 66) through (H 51). Each branch is equipped with two 3-inch gated outlets. The spacing of the outlets is approximately 550 feet. There are no standpipes in the tunnel on Yerba Buena Island.

The Bay Bridge Pump Station is equipped with four 900 GPM pumps. Normal operations require two pumps to be operated in series and will provide a flow of 1800GPM. When the Bay Bridge Pumps are not actively supplying water to the storage tanks on Yerba Buena Island. The only water available in the standpipes will be the residual water in the 10" supply main. This static Supply is approximately 32,000 gallons. Central Anchorage is the highest point of the Bay Bridge. Standpipes H 8 (lower deck) and H 58 (upper deck) are located at the Central Anchorage.

SFFD Bay Bridge Standpipe Operations

1. SFFD units responding to a fire event on the western span of the Bay Bridge shall request the DEC to contact the Lake Merced Pump Station to confirm the operational status of the Bay Bridge Pump Station. If the Bay Bridge Pump Station is either inactive, or is actively refilling the Y.B.I. storage tanks, the DEC shall request to have **<u>ONE Bay Bridge Pump Station pump activated.</u>**

Outlet pressures provided by one pump:

1. Central Anchorage outlet 60 psi. @ 900 GPM.
2. Lowest elevation outlets 90 psi. @ 900GPM.

2. If the pressure and flow is found to be insufficient, companies on scene should request the DEC to have the **<u>SECOND Bay Bridge Pump Station pump</u>** activated.

3. When operations have concluded, the incident commander on scene will contact the DEC to have the pump station deactivated.

Responding companies that have not requested that the pump station be activated, should exercise caution when introducing a supply from the bridge standpipes. The station pumps could be actively refilling the Y.B.I. storage tanks and a supply as high as 180 psi could be introduced to the engine's pump.

Bay Bridge (East) Standpipes

Currently, there is **not** a supply of water on the Eastern span of the Bay Bridge. Companies that respond to this section of the bridge shall develop operational plans that address this shortcoming.

Presidio

The Presidio obtains approximately 75% of its water supply from Lobos Creek, with the remainder being purchased from the SFPUC. The water is treated at a facility near Baker Beach and is then pumped to a 6 million gallon reservoir located at the end of Deems Road. Located just north of the reservoir is a hydrant that can be used to access the stored water. Over 90% of the Presidio water distribution system relies on gravity from this reservoir for its pressure. A small area on the south west side of the Presidio (on Washington Blvd. between Compton Rd. intersections) requires a booster station to maintain pressure above 30 psi. The system pressure ranges from 30 psi to 125 psi.

The feeder and distribution mains consist of cast iron, ductile iron, PVC and concrete pipe which range in diameter from 6 to 14 inches. Most of the distribution system is laid in a loop and grid pattern.
There are approximately 311 private hydrants that are well distributed throughout the Presidio. 95 percent of these hydrants have two 2-1/2 inch and one 4-1/2 inch outlets with independent valves
There is a water settling tank which holds 500,000 gallons of water located off Gibson Road near building 1778. Access is always available, and this water can be used to draft.

FORT MASON (Upper and Lower)

The private water distribution system at Fort Mason is supplied through metered connections from the SFPUC. Primarily water is supplied to the system through a bank of meters located on Bay Street near the intersection of Van Ness Avenue. This supply is augmented automatically, on demand, through a second bank of meters located on Bay Street near Octavia Street. Average daily static pressure is 95 psi.

The Fort Mason distribution system supplies twenty private hydrants. These hydrants are not always positioned at street intersections. Responding companies should become familiar with the hydrant layout in the Fort Mason area. These hydrants are equipped with either two 2 ½" inch outlets, or two 2 ½" outlets and one 4 ½" outlet. Independent valves control hydrant outlets. The piers and all main buildings within the Fort area are equipped with automatic sprinklers.

Eight SFFD High Pressure Hydrants have been installed within the Fort Mason area. The four High Pressure Hydrants located in the Lower Fort Mason area are supplied by the lower zone. The four High Pressure Hydrants located in Upper Fort Mason, the residential area, are supplied by the upper zone. There are also numerous High Pressure Hydrants installed on Bay Street and Laguna Street that can be used as a supply in the event of a major fire within Fort Mason.

Presidio Landmark Apartments (1801 Wedemeyer St.)

The Presidio Landmark Apartments are located inside the Presidio and was once the U.S. Public Service Hospital. A new 12-inch water main has been installed at this facility and supplies the sprinkler system as well as private hydrants within the area. Tests produced static pressures of 105 to 110 psi while flow tests have shown a residual of 20psi with over 2900 GPM flowing, making this water supply more than adequate for first alarm engine companies. Hydrant locations are readily accessible for engines required to supply any of the four dry standpipe systems. First Alarm companies shall make orientation inspections of this facility to become familiar with hydrant, sprinkler, and dry standpipe inlet location.

Pier 68 and 70 Shipyard

The shipyards at Piers 68 and 70 were active shipyard for 150 years but they were deactivated in 2017. Pier 70 is currently being developed, and all low pressure hydrants in the area will comply with State and Federal Fire Codes. The existing fire protection services, located at Pier 68, are not being maintained and should not be relied on for a water supply. This includes the saltwater system and much of the freshwater system.

Fort Miley Veterans Administration Hospital

Water for the Fort Miley Hospital complex is supplied by a metered connection from SFPUC mains located at Clement Street and 43rd Avenue. The distribution system consists of 8” feeder pipelines laid in a loop pattern. Two 250 GPM electric pumps are used to increase pressure within the system. A back up diesel powered pump can be activated to increase pressure and flow in the system. This pump can provide 3100 GPM. There are 17 hydrants located within the hospital area. These hydrants are equipped with 2 ½” outlets, however some of these hydrants have been fitted with 2 ½” to 3” increasers. The system also includes an elevated water storage tank of 40,000 gallons. The tank is located in northwest corner of the complex. Two red gated outlets have been installed beneath the tank that give access to this supply. Building 29 houses a ground level reservoir of 500,000 gallons. A suction hydrant has been provided to take advantage of this supply. It is located on the access road to Parking Lot F directly in front of the Building 29 and 30.

Reservoir Suction Hydrant

Water Tank Gated Outlets

Great Highway

Though there are no hydrants located along the Great Highway and the Upper Great Highway on the western boundary of the Richmond and Sunset Districts, but a limited water supply is available through use of 1 ¾” inch hose line and the Park Quill (see Hose Appliance Manual page 2.2). The Park Quill is connected to the below grade outlets that are located near the west curb line of Lower Great Highway. These valves will be found approximately 3 feet in from the curb line and are spaced about every 60 feet from Lincoln Way to Sloat Boulevard. They are delineated by a paint mark on the west curb. Volume and pressure are sufficient for one 1 ¾” line or for the emergency refill of an engine’s tank.

LAGUNA HONDA HOSPITAL

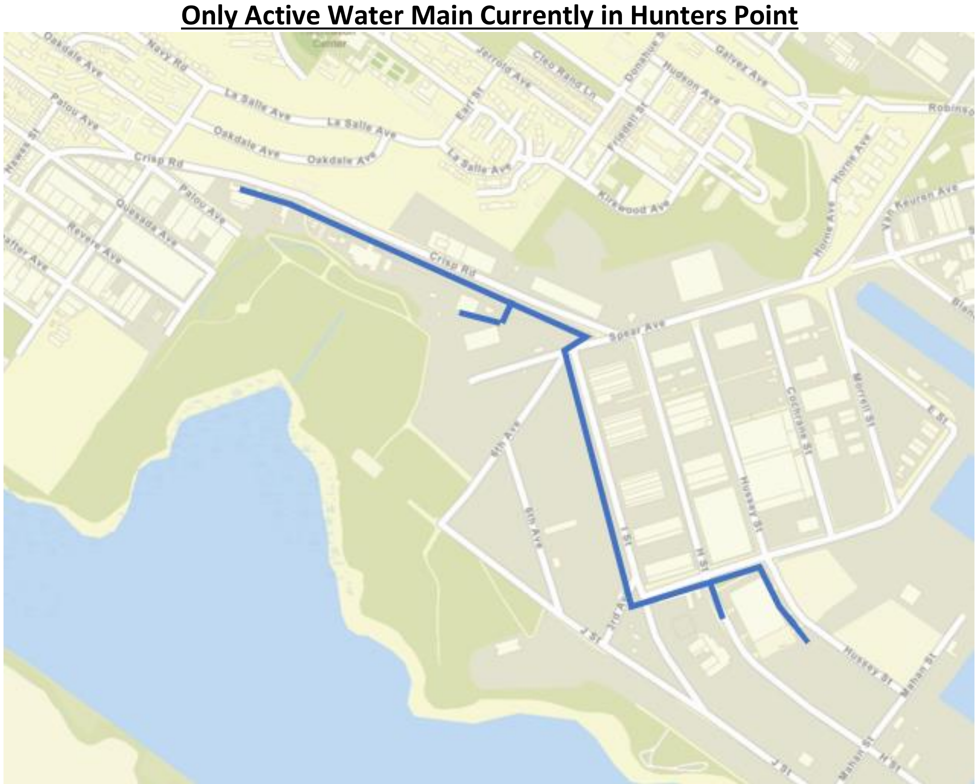
Water is supplied to Laguna Honda Hospital through metered valves connected to the Water Department distribution systems. Electrically operated pumps are provided which pump the supply to two interconnected 275,000 gallon storage tanks located on the hillside at the rear of the property. Standby pumps also are located in the property engine room for use in case of failure of the electric pumps. Water is distributed from the storage tanks for both domestic and fire service use. Standard SFFD hydrants are located throughout the property supplied by pipeline distributors which vary from 6-inch to 10-inch in diameter.

Hunters Point Naval Shipyard

The Hunters Point Naval Shipyard was at one point the largest dry dock facility in the world but has been permanently decommissioned since 1994. Hunters Point is still under Federal jurisdiction, and the United States Navy is responsible for maintaining the infrastructure of this area until it is developed. Development of this area is progressing slowly, and water supply is limited. Municipal water supply extends to the corner of Crisp Road and Palou Avenue and very few hydrants located in Hunters Point have a reliable water supply. Hydrants are equipped with 2 ½” and 4 ½” outlets, with independent valves for each outlet.

Pictured is the only water main that is currently being maintained by the United States Navy, and hydrants on this main will be operational. First due units should be familiar with hydrants that are operational and develop water supply plans for all areas of Hunters Point

Only Active Water Main Currently in Hunters Point



GOLDEN GATE PARK

Water in Golden Gate Park is primarily supplied by wells that are connected to the parks extensive irrigation system. These wells can produce over 4 million gallons of water a day. The irrigation system will be supplemented with water supplied from a new Recycled Water Treatment Facility. Three one million gallon water storage tanks are located in the middle the Park and are directly connected to the hydrant located on the N/W corner of Middle Drive West and Transverse Drive. Very few low pressure hydrants in the Park are supplied by PUC water mains. The majority of the low pressure hydrants are supplied by the Parks irrigation system. This irrigation system is not arranged in a grid network. If a section of the irrigation system is shut down for maintenance or repair, multiple hydrants could be put out of service. The Park's irrigation system can be tapped by using a park quill.

The wells are also used to fill the numerous lakes inside the park. Spreckels and Stow lakes, with a combined capacity of 23 million gallons of water, have a direct connection to the Fulton Street Emergency Hydrants. Additionally, many of these lakes can be drafted from, and engine companies should pre plan suitable drafting locations.

There are five High Pressure Hydrants in Golden Gate Park. Two are located in front of the De Young Museum. The California Academy of Sciences also has two High Pressure Hydrants. One is positioned in the front of the building, and one is in the back. The fifth high pressure hydrant is in front of the San Francisco County Fair Building located at 1199 9th Avenue. These hydrants are supplied by an AWSS 12" cast iron main fed by the Ashbury Tank.

YOUTH GUIDANCE CENTER

The Youth Guidance Center is located on Woodside Avenue near Portola Drive. Its water supply for firefighting comes through a metered connection on Woodside Avenue from an 8-inch Water Department main. From this connection, a 6-inch looped distribution pipeline encircling the facility supplies five low pressure hydrants.

The low pressure hydrants have two 3-inch outlets with independent valves. They are nonstandard in that they have a check valve which shuts them down when the hydrant body is broken off. An opening in the check valve allows the emission of a small stream of water to attract attention.

In the inner court of the detention area is a wet riser with a single 2-1/2 inch gated outlet. Most of the buildings in the complex have 1-1/2 inch outlets on wet standpipes. Only YGC's Central Control opens doors and points of access to the outlet locations. This entire system is for fire fighting only and has no domestic outlets. Static pressure is approximately 120 psi.

Treasure Island and Yerba Buena Island

These two islands are currently in the beginning phases of a large development project. When the project is completed, both islands water supply will be served by three 1.3 million gallon tanks located on YBI. The SFPUC supplies water to the islands from the University Mound Reservoir. The Bay Bridge Pump Station, located at 488 Main Street, then pumps the water through a 10" pipeline suspended from the upper deck of the Bay Bridge to the water storage tanks located on Yerba Buena Island.

Treasure Island will also be provided with a Supplemental Fire Water System. This system is a dedicated high pressure system that will be supplied with high pressure salt water from a pump station located on the southeast side of Treasure Island. A Salt Water Inlet Manifold will also be provided to allow a fireboat to augment the system if additional flow and pressure is required.

UNIVERSITY OF CALIFORNIA MEDICAL CENTER

This property is located on the south side of Parnassus Avenue, between Hillway Avenue and Fifth Avenue. The primary water supply is provided to this area by connection of an 8-inch pipeline from Summit Reservoir service which supplies two 20,000 gallon storage tanks elevated on the hill at the rear of the Medical Center. A secondary water supply is provided by connection of two private pipeline feeders to the Water Department 8-inch main on Parnassus Avenue. This secondary supply is boosted into the private distribution system by three pumps located at the rear of the Medical Center powerhouse. These pumps also can be used to supply the two 20,000 gallon storage tanks in the event the primary supply fails. The water distribution system supplies nine private double 3-inch outlet fire hydrants. Six of these hydrants are located along the roadway at the rear of the main buildings and three are on the road leading up from the main building. Ample distribution of both high and low pressure SFFD hydrants also is provided on the streets surrounding the property. In the Medical Science Building, a "Horizontal Dry Standpipe" leads from the front of the building to two outlet manifolds at the rear of the building. Each outlet manifold consists of six 3-inch gated outlets. This standpipe is installed to aid the Fire Department in providing hose lines at the rear of this building. The inlet manifold is located on the front of the building near the west entrance on Parnassus Avenue. It consists of six 3-inch clapper valve inlets and is clearly identified by a sign "YARD OUTLETS ONLY." A high pressure hydrant is located near the inlet manifold on the same side of Parnassus Avenue as the manifold.

LONG HOSPITAL

This building on the UC campus is an addition physically interconnected with Moffit Hospital. The dry standpipe and sprinkler inlets are located at both the front and rear of the building and are interconnected; however, they have no connection to Moffit Hospital.

SAN FRANCISCO STATE UNIVERSITY

Water is supplied to the San Francisco State University area by metered connection to the Water Department main at l9th Avenue and Veteran Road. The private fire hydrants connected to the distribution system in this area are painted silver with Red Bonnets. All hydrants have 3" inch outlets. There are a few hydrants that have an additional 4-1/2" outlet.

Stonestown Apartment and Shopping Area

This area, located west of l9th Avenue between Eucalyptus Drive and the San Francisco State University is an extensive apartment house and shopping development. Most of the fire hydrants in this area are standard SFFD hydrants; some however, are of private design.
Water is supplied to the distribution system of this area by metered connection to the Water Department pipeline on l9th Avenue. The distribution system in the apartment house area consists of looped and gridded 8-inch pipelines. The primary feeder in the shopping area is a 12-inch pipeline which supplies a well gridded 8-inch distribution system.

Parkmerced Residential Community

Parkmerced is an extensive apartment house residential area located west of 19th Avenue between the San Francisco State University campus and Brotherhood Way. Water is supplied to Parkmerced through metered connections from the mains of the Water Department. The distribution system is well gridded and supplies water for the entire domestic and fire service system of the area. All fire hydrants in Parkmerced are standard SFFD double outlet hydrants.

San Francisco International Airport

The San Francisco International Airport Water System is supplied with 100% of its water from the San Francisco Public Utilities Commission (SFPUC). The Airport is supplied by connections to the Sunset Supply, San Andreas, and Crystal Springs #2 SFPUC transmission lines. These three lines are metered at two locations; one is located at El Camino Real and Meadow Glen Avenue in Millbrae and the other at San Felipe and Huntington Avenues in San Bruno. All three lines are 24” in size and travel across the Bay Shore before they branch off once they reach McDonnell Rd, airport side. Each 24” feed is strategically located as it enters at the North, Center and South end of the airport. Also included is a recently completed pipeline supplied by the city of Millbrae. This 10” service provides an emergency supply of water and ties into the system at the very south end of the airport inside the Feinstein Parking Lot.

The Airports distribution system consists of 4” to 24” pipes of various materials including steel, ductile iron, and PVC. There are 275 fire hydrants, 1100+ in ground valves, and about 39 miles of in ground distribution pipeline. The Airport maintains two steel 800,000 gallon tanks that are used for fire protection exclusively for the United/American Superbay Hanger. The United Airlines Maintenance Facility maintains two 500,000 gallon tanks that are only used for fire protection. United Airlines maintains their facility water system. Most valves in the system are in the “normally open” position. All pressure is supplied from the SFPUC system.

The Airport’s Scheduling Department issues work orders to operate, exercise and maintain all distribution system valves and flush each hydrant. The Airport is in the process of removing the low pressure hydrants with two 3” outlets and a center 4 ½” outlet and will replace them with standard SFFD low pressure hydrants. Flow tests have indicated the hydrants are capable of supplying water to Engine Companies at a daytime residual of 115 psi and can jump to 150 psi at night. There are no pump stations in the field designed to maintain adequate flowing pressure to the distribution system. All pressures in the distribution system are supplied by the incoming pressure from the SFPUC. The majority of the buildings are sprinklered. The International, International Garages A and G, plus the FAA Tower all have their own fire pump systems. In addition, many of the buildings electrical systems are set up with Pre-action and special suppression systems of their own.

3. Auxiliary Water Supply System

Nearly every city of note in the world has at some time or other been visited by a large conflagration, and no one knows when San Francisco's time may again.

Chief Dennis T. Sullivan "The Chief's Trumpet" August 1893

At 5:12 a.m., on Wednesday, April 18, 1906, 296 miles of the San Andreas Fault could hold no longer and slipped. What is now referred to as The Great 1906 San Francisco Earthquake was released on the citizens of San Francisco. The 7.9 magnitude earthquake and the resulting fires destroyed most of the city. The seismic event itself was devastating, but 80% of the destruction was caused by the fires that burned unchecked for four days. The infernos grew to such cataclysmic proportions, not because of a lack of SFFD personnel or equipment, but because of a lack of a reliable water supply. The city's municipal water system suffered over 300 water main breaks and 23,200 service line breaks. This extensive fracturing left only a handful of operating fire hydrants and four intact cisterns in the whole of the city. Water was pumped from the sewers, and tugboats equipped with pumping apparatus were enlisted to help battle the flames. On the morning of April 21st, the fire was contained. The fires were controlled, but the city lay in ruins. 492 city blocks and 28,000 building were burned; 250,000 were homeless and 3,000 people lost their lives.

Prior to this catastrophe, there was much debate and discussion regarding the construction of a dedicated high pressure water supply system. Chief Dennis T. Sullivan, who was tragically killed during the quake, was actively campaigning for the purchase of a fireboat, building more and larger cisterns, and constructing a reservoir on Twin Peaks. The quake put an end to the debate, and in 1908 the citizens of San Francisco approved the issue of a 5.2 million dollar bond. This bond financed the planning and construction of the Auxiliary Water Supply System (AWSS). Construction started in 1908, and the system was officially adopted by the San Francisco Fire Department int 1913.

This dedicated high pressure water supply system was conceived and built over a hundred years ago and still serves as the backbone of our current-day Auxiliary Water Supply System (AWSS). The continued diligence of the SFFD and SFPUC has expanded and improved this already remarkable system. In addition, planning has begun to expand the AWSS to the Richmond and Sunset Districts. Time has passed and many things have changed, but much of San Francisco is still a wooden city that is nestled between two active fault lines, and the threat of "the fearful havoc caused by the April fire" is still very real.

The High Pressure Auxiliary System

The Auxiliary Water Supply System is a standalone high pressure water supply system that is maintained by the SFPUC and is used exclusively by the San Francisco Fire department. This system has been designed and constructed to withstand a significant seismic event. Numerous gate valves have been installed that can be used to isolate sections of the pipeline if there was a main break. This is of particular importance in the areas of the City that are built on infirm ground.

To take advantage of the high pressure and volume the system provides, 1,644 High Pressure Hydrants equipped with three 3 ½" outlets have been installed. A pressure reducing valve is required to regulate the high pressures to a safe level. This valve is called the Gleeson Valve. One of the primary advantages of this system is the design of the High Pressure Hydrant and the Gleeson Valve. Used in combination, a High Pressure Hydrant and Gleeson valve can be used to supply hand lines, ladder pipes, 5" Hose Tenders or an engine. This frees up valuable resources for operations in areas of the city that are not currently served by the AWSS.

The AWSS should be considered any time the low pressure municipal source is not providing an adequate supply of water. Large scale fire events demand a large volume of water and can often tax the low pressure supply. If a high pressure hydrant is available, it should be used to provide the needed extra volume of water. At greater alarm fires, engine drivers should connect a Gleeson valve to nearby High Pressure Hydrants in case a larger volume of water is needed for a supply.

Because of the importance of AWSS, all SFFD personnel should have a thorough understanding of this system and be able to quickly put into operation a Gleeson Valve and a High Pressure Hydrant.

By City ordinance, (Municipal Record of San Francisco, September 26, 1912, Vol V, No. 39), no municipal department, other than the Fire Department, and no private enterprise is permitted to use the High Pressure System. Automatic sprinkler systems are not allowed to be preconnected the system. The system is provided solely for the firefighting purposes of the San Francisco Fire Department.

AWSS Pressure Zones

The system is divided into three zones. Each zone has a dedicated supply of non-potable fresh water that is delivered to high pressure hydrants by force of gravity alone. Additionally, higher elevation zones can introduce their supply of water to the lower zones. This provides an increase in flow and pressure to these zones. If this supply is found to be inadequate or becomes compromised, two saltwater pumping stations can be activated to introduce saltwater to the system. As a third measure of redundancy, five saltwater intake manifolds have been strategically placed along the bay front. These manifolds allow the SFFD fireboats to pump bay water into the AWSS. 230 underground cisterns, averaging 75,000 gallons, have been constructed throughout much the city. These provide a source of water that an engine can draft from.

West of Twin Peaks Zone:

This zone is supplied by the 10,500,000 gallon Twin Peaks Reservoir, which is located opposite the intersection of Marview Way and Farview Court. When Twin Peaks is completely full it sits at an elevation of 758'. The reservoir is elliptical in shape and has a major axis of 375' and a minor axis of 281'. The maximum depth is 26'. It is constructed from sealed concrete slabs and is divided into two bays of 5,250,000 gallons each. The purpose of the bays is to provide a measure of insurance to prevent the total loss of water in case of a structural failure in a section of the reservoir. One bay can also be drained for maintenance without putting the whole reservoir out of service. The reservoir is filled by a supply of water from the 14 million gallon Summit Reservoir which in turn is supplied by Sutro Reservoir which has a capacity of 31.4 million gallons. The supply from Twin Peaks Reservoir can be introduced to both the Upper Zone and the Lower Zone. High pressure hydrants that are in the West of Twin Peaks Zone are identified with a black bonnet.

Twin Peaks Reservoir

Upper Zone:

The Upper Zone is supplied by the 500,000 gallon Ashbury Tank. The tank is located at the intersection of Clayton Street and 17th Street and sits at an elevation of 494'. It has a 55' diameter and a depth of 29'. The tank is constructed of steel and was completely rebuilt in 2015. Normally the Ashbury Tank is kept full by a supply of f domestic water from the SFPUC, however in an emergency it can be refilled from the Twin Peaks Reservoir. The supply from the Upper Zone can be introduced into the Lower Zone. High pressure hydrants that are in the Upper Zone are identified with a red bonnet.

Ashbury Tank

Lower Zone:

The Lower Zone is supplied by the 750,000 gallon Jones Street Tank. This tank is located at 1239 Jones Street and is situated at an elevation of 369'. Jones Street Tank is constructed of concrete and has a diameter of 60' and is 35' high. At the time of construction, this was the largest tank west of the Mississippi. (Municipal Record Vol. VI Thursday June 19, 1913.) Like Ashbury Tank this tank is also supplied from a SFPUC potable supply line. If this domestic supply is interrupted, Jones Street Tank can be refilled from Ashbury Tank. The high pressure hydrants that are in the Lower Zone are identified by a blue bonnet.

Jones Street Tank

When demand exceeds the capacity of the lower or upper zone, system volume and pressure can be increased by introducing a supply from a higher elevation. Twin Peaks Reservoir can augment both the Upper and Lower Zone, and the Upper Zone can be introduced to the Lower Zone.

West of Twin Peaks Zone: This zone is supplied by the 10,500,000 gallon Twin Peaks Reservoir and supplies the areas west and south of the reservoir. These hydrants are identified by a black bonnet.

Upper Zone: This zone is supplied by the 500,000 gallon Ashbury Tank and supplies areas above 150' in elevation. These hydrants are identified by a red bonnet.

Lower Zone: This zone is supplied by the 750,000 gallon Jones Street Tank and supplies areas below 150' in elevation. These hydrants are identified by a blue bonnet**.**

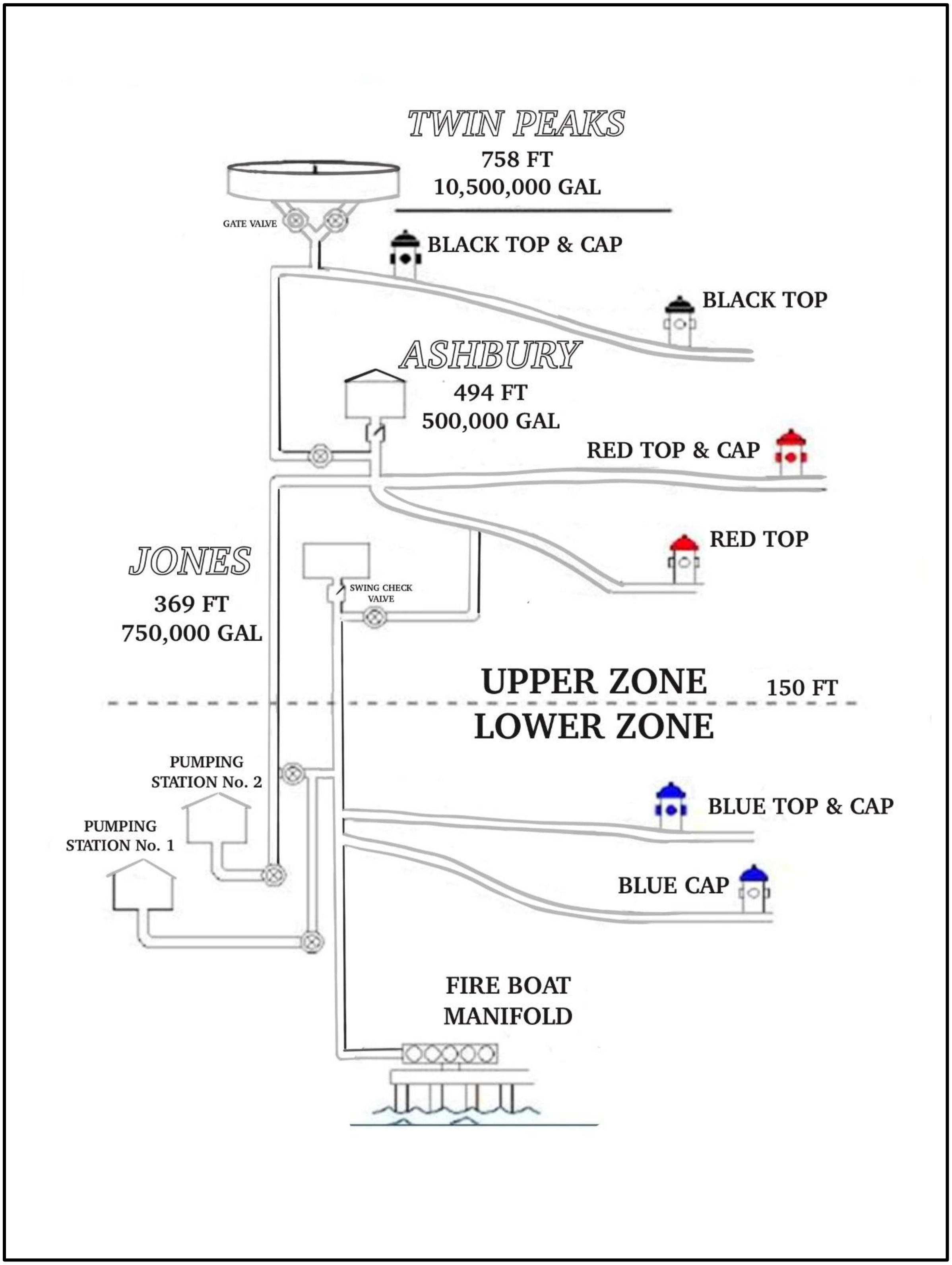
The normal static pressures available at each hydrant are stamped on the edge of the hydrant flange just under the bonnet. The first stamped figure is the normal supply source and the available static pressure.

"J" designates Jones Street Tank static supply.

"A" designates Ashbury Tank supply

"T" designates Twin Peaks Reservoir static supply.

AWSS Schematic



AWSS System Pressures

When water demand does not exceed the capability of the AWSS, supply to the high pressure hydrants is supplied by gravity only. The hydrants that have a similar elevation to their supply source will have lower pressures, and hydrants at the lowest elevations of their respective zones will have higher pressures.

Average Zone Static Pressures:

- West of Twin Peaks average pressure is 140 psi.
- Upper Zone average pressure is 143 psi.
    1. Upper Zone average pressure when supplied by Twin Peaks Reservoir is 264 psi.
- Lower Zone average pressure is 130 psi.

Static pressures measured at foot of Market Street (City Base) when supplied by each zone:

- Jones Street Tank   160 psi.
- Ashbury Tank   214 psi.
- Twin Peaks Reservoir   328 psi.

Residual pressure is the pressure reading from a hydrant outlet while water is flowing. Residual pressure readings will be lower than static pressure readings. Static pressure in the lower zone when supplied from Twin Peaks Reservoir is 328 psi but measured residual pressure will be about 235 psi.

In each of the three zones, there are high pressure hydrants that are situated at similar elevations as the primary water source that supplies them. These hydrants are identified by having their bonnets and outlet caps painted the same color. The static pressure of these hydrants will be less than 120 psi. Engines can use these hydrants as a supply source through the connection of a Gleeson Valve set at or below 80psi. ***A Gleeson valve <u>must be</u> used to keep the supply pressure below 80 ps***i. If the zone receives an increase in pressure from another source, incoming pressure could be increased to dangerous levels. West of Twin Peaks hydrants with black bonnets and black caps do not have the ability to receive a boost in pressure and ***<u>must</u>*** be used as engine supply hydrants through the connection of a Gleeson Valve set at or below 80psi.

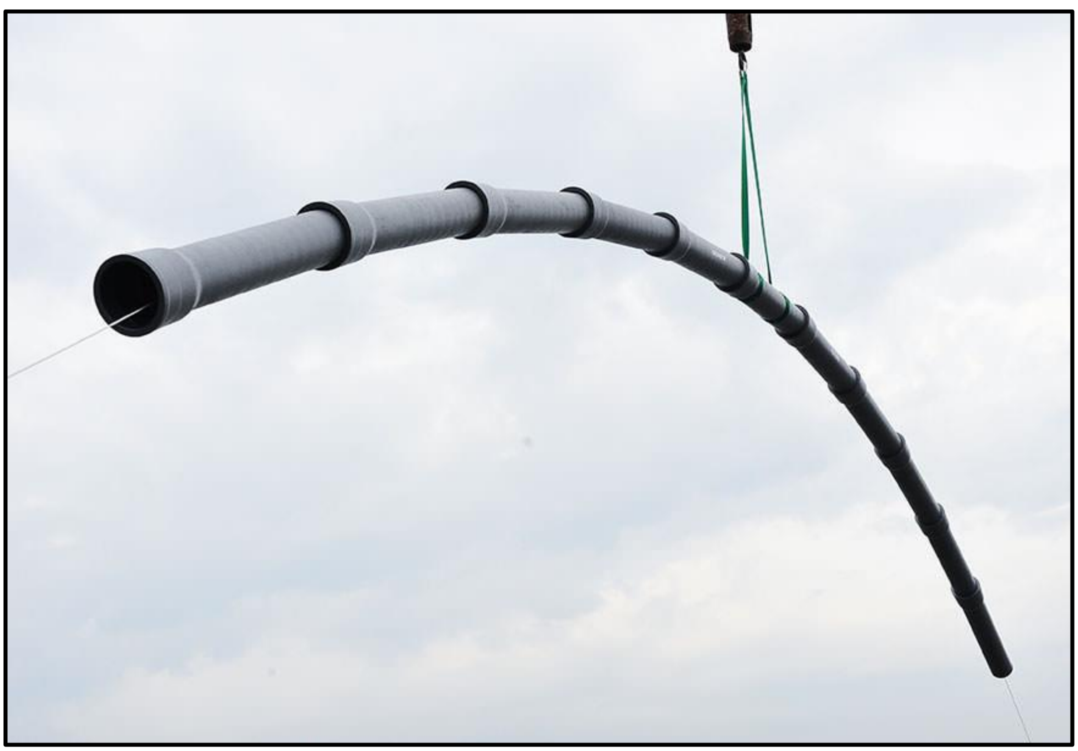
The three zones are designed to receive their supply water of by force of gravity alone. If this supply is found to be insufficient, the two Salt Water Pumping Stations can be placed into action and can provide increased flow and pressure. Pump Station #1 is primarily used to supplement the Lower Zone, and Pump Station #2 can supply both the Upper and Lower Zones. If needed, Water Department Personnel can operate Divide Gates that will allow Pump Station #1 to supply the Upper Zone. Additionally, the fireboats can be called on to pump Bay water into the system by means of the Salt Water Intake Manifolds.

A SFPUC General Foreman and Duty Gateman will respond to all second alarm and greater fires. More PUC personnel will be dispatched as the fire event progresses in size. If a greater volume of water is needed to combat the fire, they will be able to divert water from other pressure zones.

The Pipeline

The pipe first used in the construction of the AWSS was made of thick walled, tar lined cast iron. The molecular composition of Cast Iron makes a strong but brittle pipe. To overcome the brittleness, the pipe was cast with very thick walls to make the pipe more resistant to earthquakes. The tar lining protected the pipeline from the corrosive effects of saltwater. Cast Iron was invented in China in the 5th Century B.C. and has been used to deliver water since the 15th Century. Although production techniques improved over the centuries, the primary characteristics of the material remained the same. In 1943 Ductile Iron was invented and soon after became the industry standard for pipeline construction. Ductile Iron is stronger and more malleable than Cast Iron. This makes it an ideal material to use for pipes that will be delivering water in seismically uncertain soils. Until recently, all expansions made to the AWSS pipeline have been made with cement lined Ductile Iron pipe. The most recent and all future expansions of the pipeline network will use Earthquake Resistant Ductile Iron Pipe (ERDIP). ERDIP is constructed with many flexible joints and can endure both vertical and horizontal ground movement. This pipe can also expand and contract while remaining leak free.

ERDIP Manufactured by the Kubota Corporation



High Pressure Hydrants

The barrel of the High Pressure Hydrant is constructed of extra heavy walled cast iron and has an internal diameter of 10 inches. The average length is 6’ 9” and weighs 1,405 pounds. The hydrant is designed is designed to withstand the corrosive effects of emergency saltwater use. Bronze is used in all metal parts of the valves and valve seats and wherever corrosion is likely to interfere with the durability, strength, or operational use of the hydrant. Normal height of the hydrant above ground level is 3’ 1 ½ “, with an average outlet height of 20”. The hydrant is equipped with three 3 ½” male threaded outlets, and the outlets are protected by a cap secured by a chain. The outlets have independent vertical sliding gate-valves, that are operated by a vertical valve stem. Each of these valve stems has a **<u>square</u>** operating nut on the top of the hydrant bonnet. Flow of water into the hydrant is controlled by the vertical movement of a compression type valve. This valve is located at the base of the hydrant barrel just above the branch pipe elbow. This valve is named the "King Valve" and is equipped with a by-pass valve commonly called the "Pilot Valve." The function of the pilot valve is to permit the equalization of water pressure on both sides of the king valve. After pressure is equalized The king valve and the pilot valve both are operated by a long vertical stem which terminates in a **<u>pentagonal</u>** operating nut located at the center of the hydrant bonnet. All hydrant valves are opened with a counter-clockwise rotation of the valve stem and are closed by a clock-wise rotation. The average number of complete rotations to open the King Valve is **14 turns.**

Top View of a High Pressure Hydrant

The location of the Gate Valve Shutoff is indicated by an arrow stamped on the ornamental bonnet surrounding the King Valve. The distance to the Gate Valve is stamped on the King Valve.

Like Low Pressure Hydrants, High Pressure Hydrants that have been shut down, or have a disabled outlet, shall have either a **RED** (Hydrant Out of Service) or **YELLOW** (Outlet Out of Service) disc attached to a capped outlet.

High Pressure Hydrant Installation

High Pressure Hydrants that are installed in the congested high value districts of the City are spaced to provide 15,000 gallons of water per minute to an area averaging 100,000 square feet. The average length of the hose lines is not to exceed 400 feet. In the less congested parts of the City that are protected by the high pressure system, hydrants are situated so 8000 to 12,000 gallons per minute can be concentrated on any one block. At least one high pressure hydrant is installed at each street intersection where high pressure mains are present. On very long blocks, hydrants will be placed mid-block.

The branch pipe connection between the hydrant and the main have an 8” internal diameter. Bolted tie rods reinforce all joints of the branch pipe. Each branch pipe will have an 8-inch gate valve. The valve stem operating nut is enclosed in a cast iron valve box. The branch pipe elbow is set in a reinforced concrete base and is braced by a concrete brace block. The location of the branch pipe gate valve is indicated by an arrow stamped on the ornamental bonnet which encircles the king valve operating nut. The distance from the hydrant to the gate valve is stamped on top of the king valve operating nut. The hydrant branch gate valve is placed as close to the main as practicable. If a hydrant is damaged or broken, the gate valve will be accessible to shut off the water supply to the hydrant.

Operation of High Pressure Hydrant-Branch Gate Valves

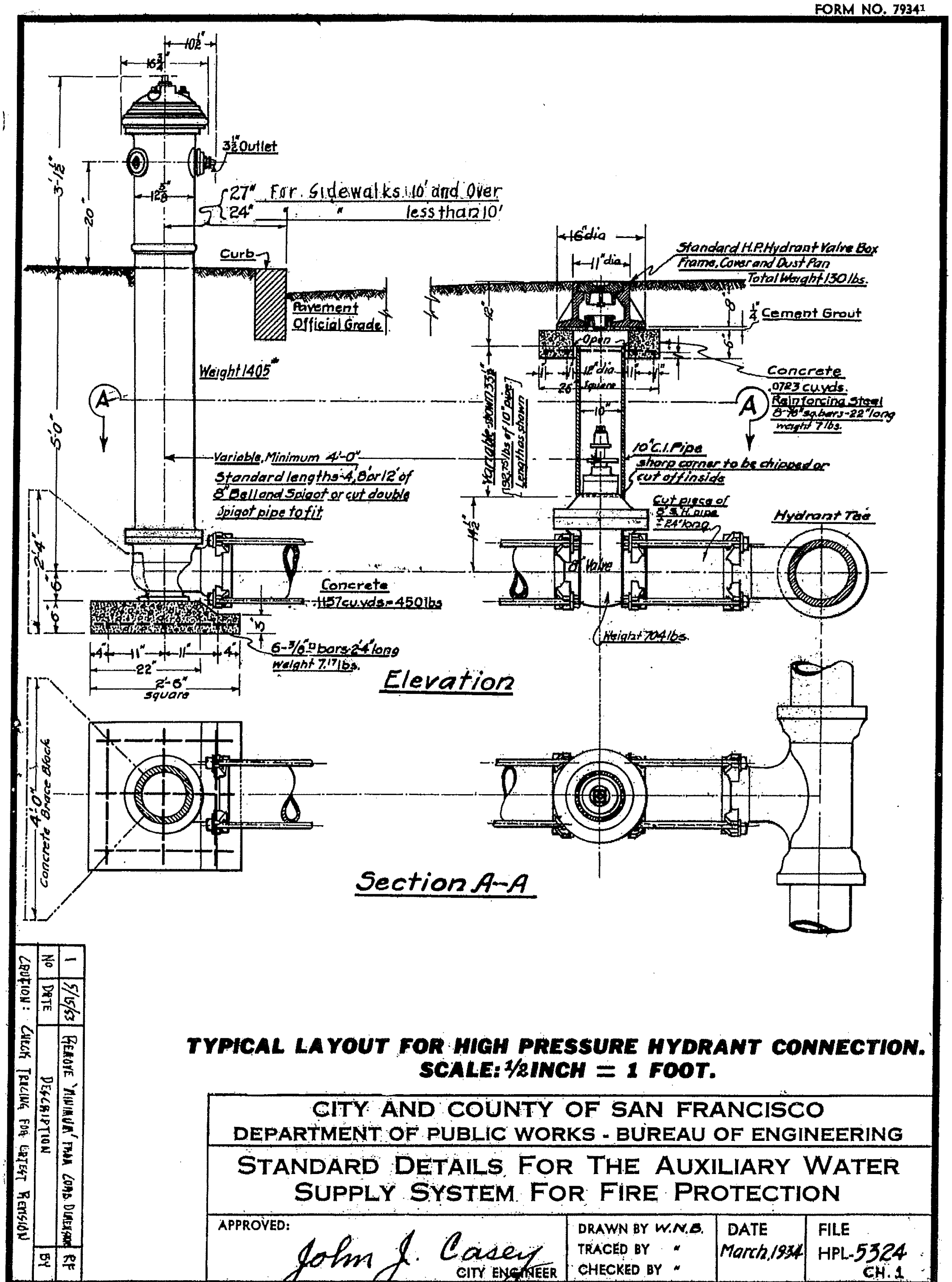
The operation of a hydrant-branch gate valve for the purpose of putting a high pressure hydrant out of service is seldom experienced by members of the SFFD. High Pressure Hydrants are of particular heavy construction and are designed to resist breakage from impact. However, in the event of a broken hydrant, an engine company will be dispatched to shut off the flow supply to the hydrant. The SFPUC will also be dispatched.

A flow of water from a broken high pressure hydrant is also rare, primarily because the king valve opens against the flow of the water and would have to be forcibly dislodged upward from the valve seat by the break. This will seldom occur, because even if the hydrant were sheared off, the stem of the king valve would break away from its operating nut-carrier leaving the valve closed and intact. When a flow of water from a broken hydrant does occur, it is usually due to breakage in the narrow portion of the base elbow below the king valve.

The operation of a high pressure hydrant-branch gate valve is done manually with a High Pressure Wrench as described in the Manual of Standard Practices for Hose and Hose Appliances. The main precaution to observe in this operation is not to jam the gate valve in a closed position. Always back off the gate valve one-half turn after completing the shut-off.

High Pressure Hydrants weigh close to 1500 pounds. Do not attempt to return a broken high pressure hydrant to quarters as required in the case of a broken low pressure hydrant. However, the hydrant must be secured in the most practical manner possible to minimize danger to pedestrians and vehicles.

Diagram of Standard High Pressure Hydrant Installation



AWSS Maintenance and Repair

When maintenance and repair work is being performed on the AWSS, a High Pressure Hydrant is normally left open and draining to prevent pressure from building up in the system. The operating nut is removed from the open gate and a red disc is affixed to indicate this hydrant is out of service.

Under no circumstance should a High Pressure Hydrant with a red disc and/or a missing gate valve nut be tampered with by a SFFD unit. Doing so could result in a buildup of pressure in the high pressure mains causing damage to the system and injury to SFPUC personnel.

High Pressure Hydrant Inspection

SFFD engine companies conduct weekly High Pressure Hydrant inspections. These inspections ensure that the hydrants will be fully functional when needed and provide members an opportunity to become proficient in their operation. These inspections will also provide SFFD engine companies an opportunity to perform the required weekly Gleeson Valve flow test. These tests keep the internal components of the Gleeson Valve lubricated and will identify any problems with the valve that need to be repaired.

Department approved High Pressure Hydrant inspection procedure.

1. **Remove all caps**. If all the caps are not removed before the hydrant is pressurized, a leaking Gate Valve will prevent the cap from being removed.
2. Open all Gate Valves completely. Close all Gate Vales, checking that the valve is centered in the outlet. **Do not force an Outlet Gate Valve below the centered position**. This will damage the Gate Valve Carrier.

The Sliding Outlet Gate Valves are not designed to be watertight when closed, and it is normal for a small amount of water to leak past a closed Outlet Gate Valve when the King Valve is opened. This will admit full hydrant pressure to a capped outlet, and will require the hydrant to be completely shut down to remove a pressurized outlet cap.

3. Pressurize Hydrant:
   a. Open the Pilot Valve (1-4 rotations of the King Valve) until water begins to fill the hydrant barrel. If either the King or Pilot Valves are leaking, the hydrant barrel will be already be charged, and you will not hear the barrel filling after opening the Pilot Valve.
   b. After the hydrant barrel has filled and pressure has equalized, SLOWLY open the King Valve completely. This requires an average of **14 complete rotations.**

Do not open the King Valve all the way until the Pilot Valve has filled the barrel. If the King valve is forced open before pressure equalization, the King Valve can be damaged.

4. Close King Valve.
5. Crack a Gate Valve to drain the hydrant barrel. After hydrant has drained, close and center the Gate Valve.
6. Replace all caps.

7. Locate and attempt to remove Hydrant Gate Valve Shut Off cover. Gate Valve cover has a diameter of 11" and is marked "HYDRANT H·P·F·S"
    a. Direction to the Gate Valve is indicated by a stamped arrow on the bonnet.
    b. Distance to the Gate Valve is stamped on the King Valve
8. Attempt to locate the Hydrant Gate Valve Shutoff Operating Nut.

The hydrants will be inspected for the following:

1. Excessive rust.
2. Missing caps and chains.
3. Absent or improper markings.
4. Incorrect hydrant location designation.
5. Condition of paint and presence of graffiti.
6. Water leaks from hydrant Bonnet, King Valve, Pilot Valve, and excessive leaks from outlet gates.
7. Obstructions that prohibit access to outlets.
8. King and Gate Valves that are difficult to operate.
9. Condition of Hydrant Gate Valve Shutoff Cover
10. Condition of Hydrant Gate Valve Shutoff Operating Nut.

Note any deficiencies in the monthly Hydrant Cistern Report. If any hydrant is discovered to have an uncontrollable major leak, or is found to be non-operational, immediately report this information to SFPUC dispatch for repair (415-550-4956).

If the King Valve or any of the Gate Valves require excessive force to operate, return valves to closed position and report hydrant as nonoperational.

High Pressure Hydrant Shutoff Gate Valve Cover

The Gleeson Valve

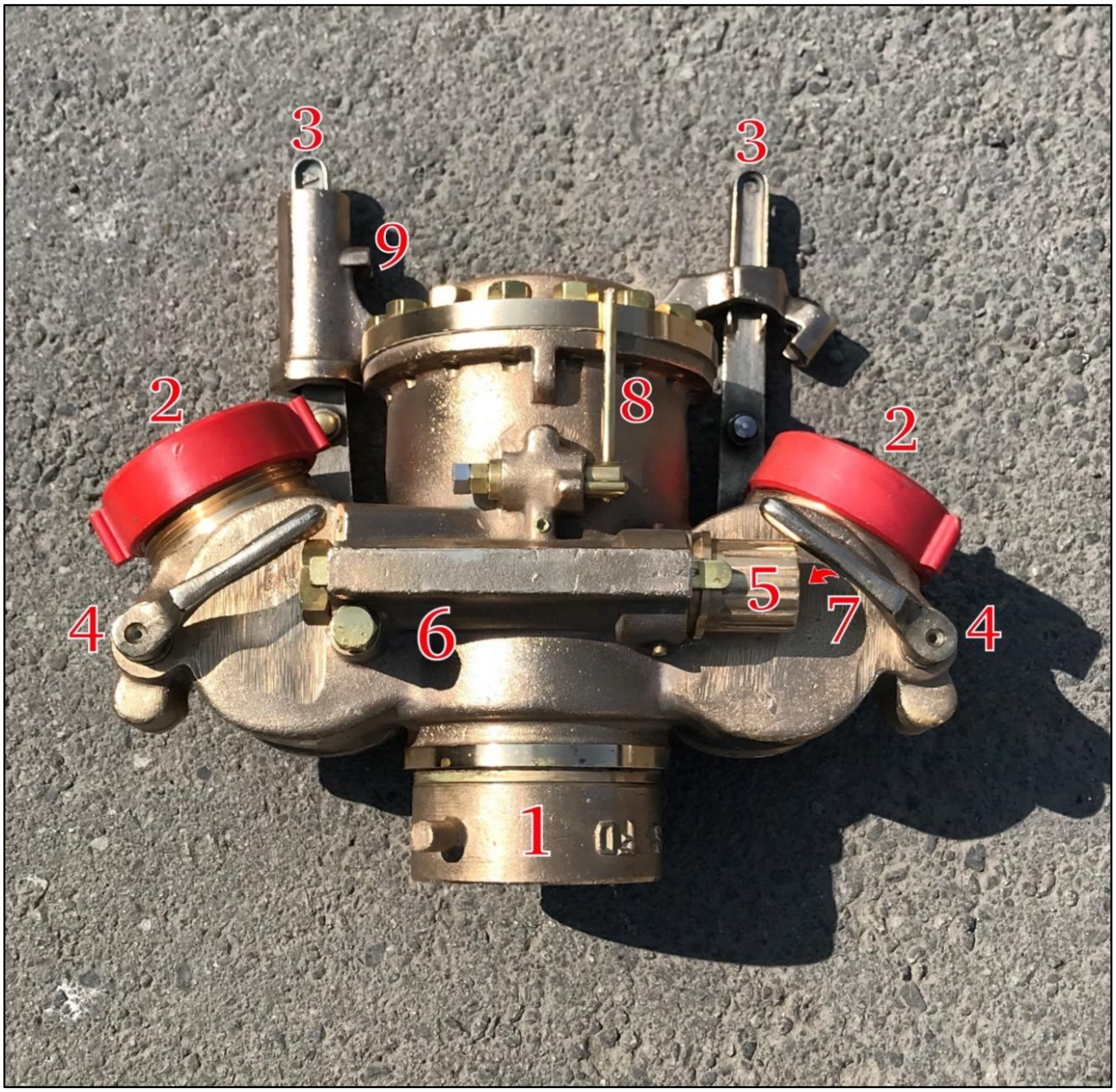
Because of the high pressures provided by the AWSS, a pressure reducing valve must be used to lower the provided pressures to a safe and manageable pressure. This pressure reducing valve is called the Gleeson Valve.   As many as three Gleeson Valves may be attached to one High Pressure Hydrant. This gives the hydrant the ability to supply six large lines with sufficient pressure and volume to meet most firefighting demands. In most instances, the High Pressure Hydrant should be used to supply an appliance and not an engine. The exception to this is hydrants that have bonnets and caps of the same color. Engines may be connected to these hydrants, but SFFD guidelines require that High Pressure Hydrants shall not be used without first connecting a Gleeson Valve to the hydrant. When supplying engines, the Gleeson Valve regulator will be set to 80psi or lower. This pressure will assure ample water supply and eliminate the possibility of injury to firefighters on hose lines, or damage to the pump due to excessive inlet pressure. If a Gleeson Valve is supplying an engine, it cannot be used for any other purpose. When using a high pressure hydrant with a black bonnet and black caps, engine companies SHALL be hooked up to the hydrant through a Gleeson Valve. Since black top hydrants are not capable of having their pressure increased, all needed hose leads for any appliance or handheld line shall be taken from the apparatus outlets.   Do not supply pumpers with both low pressure and high pressure water sources. This may result in a cross connection and a contamination of the potable low pressure supply by non-potable high pressure water. Pumpers shall be supplied by either low pressure or high pressure supply, but not both simultaneously. When members are directed to change from low pressure hydrants to high pressure hydrants, members shall shut down low pressure inlet at the pump panel, then the hydrant. This will avoid the possibility of admitting high pressure water into the domestic water supply system should a pressure imbalance occur at the pump. Once a Gleeson Valve has been connected, a firefighter is to be assigned to that hydrant to control the Gleeson Valve operations. This firefighter is required to remain at the hydrant just as a pump operator is required to remain at their engine's pump panel. For the specifics of Gleeson Valve and High Pressure Hydrant operations, please refer to Block III of the SFFD Drill Manual

Because of the extremely high water pressures and volumes accessible in the Auxiliary Water Supply System and the possibility that pressures in the system can be increased by various means without the knowledge of those operating the hydrants,

<u>NEVER</u> connect hose lines directly to a High Pressure hydrant 3-1/2" outlet!

<u>ALWAYS</u> use a Gleeson Valve on High Pressure hydrants outlets!

Components of the Gleeson Valve



The Gleeson Valve has eight major components:

1. One 3 ½” female swivel inlet.
2. Two 3” male thread gated outlets.
3. Two gated Outlet Control Handles.
    - Outlet(s) are closed when the handles are against the body of the valve.
    - Outlet(s) are open when the handles are away from the body of the valve.
    - Outlet Control Handles will lock in the fully open position.
        - Automatic spring and pin lock.
        - Lock must be released to close Outlet Control Handles.

4. Two Outlet Bleeders
    - One bleeder for each outlet.
    - Bleeder is open when in line with the outlet
    - Used to bleed hose lines that are attached to outlets after gates have been shut down.
5. Pressure Regulator
    - Used to regulate pressure from 0 to 300 psi in 20 psi increments.
    - Counterclockwise rotation increases pressure.
    - Clockwise rotation reduces pressure.
    - Pressure scale moves out from regulator housing as pressure increases.
    - Indicated pressure will be supplied to both outlets.
6. Tell Tale
    - Small hole located on the Valve Body just below the Pressure Regulator.
    - Steady Stream of water
        - Indicates the Gleeson Valve is charged, and hydrant pressure has not been exceeded.

- Always maintain a stream from the Tell Tale.
- Never regulate past the point of a flowing Tell Tale. This is dangerous for two reasons.
  - ✓ You have no idea what pressure you are supplying.
  - ✓ There is no control in place should pressure to the hydrant be increased.

- No Stream
  - Indicates that available hydrant pressure has been exceeded.
  - Dial Pressure Regulator down until there is a steady stream from the Tell Tale.
  - Inform Incident Commander of the available capacity of the hydrant and if warranted request additional zone pressure.

This Gleeson Valve was being used to supply a ladder pipe at the 5th alarm fire on Folsom St. and Erie St. The minimal amount of water flowing from the Tell Tale indicates that hydrant capacity has almost been reached.

7. Tickler Valve
    - This is the Pressure regulator metering valve that also controls water discharge from the Tell Tale.
    - Also used to free sediment that has lodged in the valve's internal mechanisms causing it to malfunction.

- Before operating the Tickler, the regulator pressure must be at or below 80 psi.
- The Tickler Valve is operated by pulling it outward momentarily and then releasing it. Spring tension will return the Tickler to its original position.
- This operation can be performed up to three times. If after three attempts, the obstruction has not been the Gleeson Valve should be taken out of service
- **<u>Never under any circumstances</u>** push in on the Tickler Valve. Doing so will immediately allow full hydrant pressure in the Gleeson Valve and the connected hose lines. The resulting water hammer could damage the water mains, hydrant, Gleeson Valve, and cause injury to SFFD personnel.

8. Emergency Shut Off Lever
   - **<u>Is to be used only in extreme emergency.</u>** Such as a burst hose line that must be immediately shut down to prevent injury to firefighters working nearby.
     - Engaging the Emergency Shut Off Lever instantly shuts off the Gleeson Valve discharge causing extreme water hammer. This has the potential to severely damage the main pipeline, the High Pressure Hydrant, and the Gleeson Valve itself.
   - The Emergency Shut Off Lever is operated by pulling the lever up to a vertical position. Before returning the lever to its original position, the Pressure Regulator must be dialed down to 0 psi.
     - The Emergency Shutoff Lever is purposely curved to allow it to lay flat against the Gleeson Valve body. No attempts must be made to straighten it. Doing so will affect the operation of the Shutoff Lever.
9. Gleeson Valve High Pressure Spanner
   - Spanner is carried attached to the Gleeson Valve Outlet Control Handles.
   - The spanner is necessary for the operation of the Gleeson Valve and the High Pressure Hydrant.

Gleeson Valve Maintenance

Despite the Gleeson Valve's robust outward appearance, the internal mechanisms of the Valve, if not properly cared for, will fail. The High Pressure Hydrant system is useless without the Gleeson Valve; therefore, it is imperative that it is kept in perfect working condition.

1. Do not allow metal polish to invade the Gleeson Valve's 3 ½" inlet and 3" outlets. Do not dip, pour, or submerge the valve into any type of metal polish. This also includes the department issued metal polish. Never use an aluminum brightener acid. Only polish the exterior surface. Do not polish the inlet threads, or any interior surfaces of the valve body. Remarkably the Gleeson Valve has very few moving parts. The parts that do move have very tight tolerances and can become frozen easily. There are four chambers in a Gleeson valve. Three of the four chambers do not see a large flow of water, and once the polish gets into these chambers, it is very hard to remove. This residue will build up over time and bind the Gleeson Valve Piston to the cylinder.

This is a frozen Gleeson Valve piston caused by metal polish build up.

2. All Gleeson Valves shall be tested on a weekly basis. The movement of water through the valve keeps the piston and cylinder lubricated. This also serves as a check to ensure that the Gleeson valve is operating correctly.

3. Do not flush the High Pressure Hydrant before connecting the Gleeson Valve. The large volume of unrestricted water flowing from the hydrant can cause sediment further down the pipeline to break loose. This sediment can, over time, clog the small metering holes inside the Gleeson Valve. When connected to the hydrant, the Gleeson Valve acts as a flow restrictor, this will help prevent sediment from breaking loose and reaching the Gleeson Valve.

4. Do not open the Outlet Gate Handles under pressure. Open the Outlet Gate Handles before dialing up the pressure, or dial down the pressure before opening. They were not designed to be opened under pressure and applying excessive force or using a bigger hammer will only damage the Gleeson Valve.

5. A leaky Gleeson Valve is not a broken Gleeson Valve. It is normal for them to leak water. A reportable leak is one that is leaking with an excessive amount of force from a joint or control lever. It is also normal for some Gleeson Valve Regulators to not completely stop the out flow of water when dialed down to zero. The springs used in the pressure regulator can have differing tensions and can cause each Gleeson Valve Regulator to behave differently.

6. Finally, do not drop them.

AWSS-SCADA

(Auxiliary Water Supply System-Supervisory Control And Data Acquisition)

The AWSS-SCADA System allows for remote monitoring of the Twin Peaks Reservoir, Ashbury Tank and Jones Street Tank. Water levels as well as water flow are communicated real time by the AWSS-SCADA. This system is monitored 24 hours a day by engineers at the Lake Merced Pump Station.

Remote Control Motorized Valve Actuators surround the AWSS's infirm areas. Equipped with seismic sensors these valves are supplied with sufficient battery power to close automatically in the event of a large earthquake. The seismic sensors are located inside stainless steel above ground control vaults. In the event of a significant earthquake, the SCADA fitted valve's seismic sensor will trigger and the valve will close automatically. By isolating the infirm sections of the AWSS the remainder of the system will continue to operate normally. This protects the integrity of the rest of the AWSS until the infirm areas can be assessed by the SFPUC and returned to service. The AWSS-SCADA can monitor and control these valves through redundantly installed remote control stations connected to the individual sites via the 800mhz radio system. There is also a back-up telephone wire line connection, providing another level of insurance and system reliability.

If a main break does occur, operators at the Lake Merced Pump Station are alerted by the AWSS-SCADA of excessive water flow in the system. Gate Valves can then be remotely closed to quickly limit damage to the system and surrounding underground utilities. The system provides decentralized control & telemetry capabilities from many points; this is an invaluable asset in the event of a major disaster.

Units responding to incidents resulting in damage to AWSS-SCADA installations should have the DEM notify the SFPUC. If the damage was caused by criminal negligence or vandalism request SFPD response for a case number.

A listing of remote control valve locations can be found in the Appendix.

Components of the AWSS-SCADA:

1. Above Ground Control Vaults
    - System Status Displays
    - Seismic Sensor
    - Radio Transceiver
    - Battery Charging System

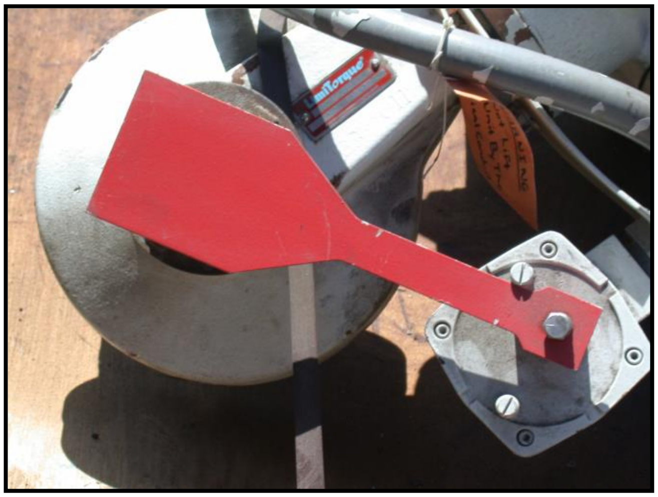
Above Ground Control Vault

2. In Ground Battery Vaults
    - The battery has enough capacity to operate the valve (open or close) three times.
3. Remote Controlled Motorized Valve Actuators
    - Electric Motor
    - Valve Actuator
    - “Red Flag” Actuator Indicator/Disconnect Lever

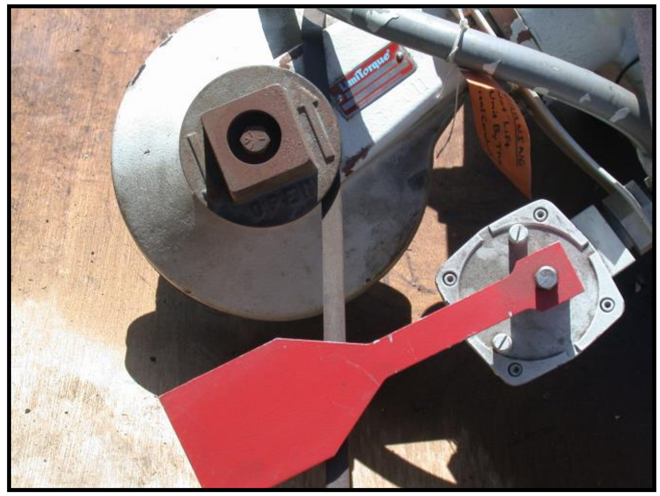
Remote Controlled Motorized Valve Operation

The “Red Flag” Actuator Indicator/Disconnect Lever is used to engage the motorized actuator. When the “Red Flag” is over the valve-operating nut, the valve is in remote control mode. Moving the “Red Flag” to reveal the valve-operating nut puts the valve in local (manual) control mode. At no time are Fire Department Personnel permitted to operate the “Red Flag” Actuator Indicator/Disconnect Lever unless directed to do so by a member of the SFPUC.

Motorized Valve in the Automatic Position



Motorized Valve in the Local (Manual) Position



These valves can be operated remotely from various locations.

1. Lake Merced Pump Station (991 Lake Merced Blvd.)
2. SF Water Department City Distribution Division (1990 Newcomb Ave.)
3. Fire Boat St. Francis

Salt Water Pumping Stations

Two salt water pump stations have been constructed to provide a supply of salt water to the AWSS. Pump Station #1, located at Fire Department Headquarters 698 Second Street, is used to supply salt water to the lower zone. Pump Station #2, located at the foot of Van Ness Avenue in Fort Mason, is used to supply either the lower zone or the upper zone. However, through the operation of Divide Gate Valves, either pump station can be used to supply salt water to the upper zone or lower zone. The Pump Stations can also be used to refill both the Ashbury Tank and the Jones Street Tank.

Both Pump Stations are equipped with four identical 4-Stage Turbine Pumps. Each pump is powered by a 760 horsepower 12 cylinder diesel engine and provides 2,700 GPM. Each station can provide a total output of 10,800 GPM of salt water at 300psi. The stations are equipped with two underground diesel fuel tanks. The tank capacity of the station #1 tanks are 9,000 gallons, and the capacity of the station #2 tanks are 6,840 gallons. This provides enough fuel for Station #1 to operate for four days and Station #2 three days before it becomes necessary to refill the diesel tanks. Each station is also provided with an auto starting emergency generator in the event of a power failure. The water supply to each station is drawn from the Bay through a 5' diameter reinforced concrete tunnel. The inlet tunnels are positioned below the level of low tide to allow sea water to flow directly into the stations. The Bay end of each inlet tunnel can be sealed to allow the tunnels to be drained, inspected, and repaired. Salt water is discharged from the station by two 20" pipelines that are connected to the AWSS pipeline.

Every action needed to operate Pump Station #1 can be performed remotely from the Lake Merced Pump Station. Pump Station #2 requires a SFPUC engineer to be onsite to put the station into operation.

Pump Station #1

Pump Station #2

Pump Room #1 Located in the Lower Level of SFFD HQ

Salt Water Inlet Manifolds

In addition to the Pump Stations, salt water may be pumped into the High Pressure Distribution System through Salt Water Inlet Manifolds. These manifolds are strategically located along the City's bay waterfront and allow a fireboat to supply the system with Bay water.

The manifolds are installed in the following locations:

1. Fort Mason at the end of Pier 1.
2. Foot of Leavenworth Street at Fisherman's Cove.
3. On the Embarcadero opposite the foot of Bay Street. Between Piers 33 and 35.
4. On the east side of the Illinois Street Bridge. Pier 90.
5. In front of Station 35 on Pier 22 ½.

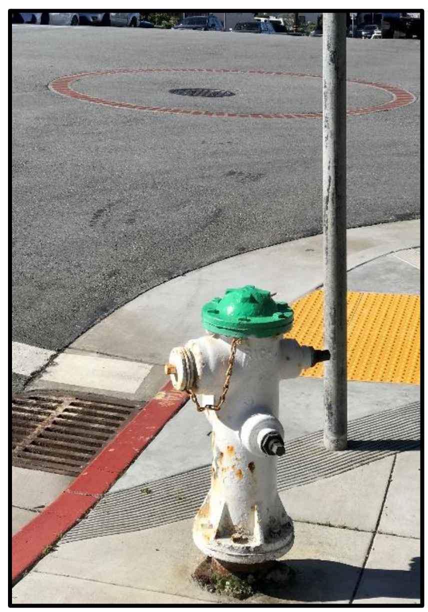
These manifolds are equipped with 10 3" swivel female inlets and are arranged horizontally on the inlet manifold. Each inlet is equipped with clapper valves and a plug that are secured by chains. The pipelines connecting the manifolds to the distribution system of Fort Mason, foot of Bay Street, and Pier 22 ½ are equipped with check valves. The remaining two manifolds do not have check valves. If an additional supply of salt water is needed, ten 3" hose lines may be connected from a fireboat to the inlet manifolds. The fireboat St. Francis can supply the system with 18,000 GPM at 150 psi, or 6,000 GPM at 300 psi. The fireboat Phoenix can provide 9,600 GPM at 150 psi., or 6,000 GPM at 300 psi. These manifolds are designed solely as inlets and cannot be used as a means of obtaining water from the High Pressure System.

Salt Water Inlet Manifold Located at Pier 22 ½

Emergency Water Supplies

CISTERNS

Buried beneath the streets of San Francisco Fire Department lies a network of underground cisterns that have a total storage capacity of approximately 17 million gallons of water. 230 cisterns have been strategically located throughout the City to provide the Fire Department with a dependable emergency supply of water in the event of major damage to the municipal water distribution system and to Auxiliary Water Supply System. The system has two classifications according to the grouping of the cisterns. One classification consists of cisterns individually located at points where it is estimated that the underground water supply mains are most susceptible to damage by earthquake shock. The other classification consists of cisterns located along a point where it is estimated that control of a major conflagration could be affected. A good example of this latter classification are the cisterns located at street intersections along Van Ness Avenue from Bay to Market Streets, and along Dolores Street from Market to 30th Street. The locations and capacities of all Fire Department cisterns are provided in **Appendix A**. A low pressure hydrant with a green painted bonnet indicates the availability of a nearby cistern. Many cisterns are also marked with a ring of brick pavers. Most cisterns are located at street intersections and are available to fire pumpers through manholes at which they may position to draft. There are two manholes for each cistern one in the center and one on the edge. The edge opening is equipped with a ladder that was used during construction of the cistern. This ladder is a permanent installation and may be used to secure lines flowing water at drafting drills. Fire Department cisterns have no connection to either the Municipal or Auxiliary Water Supply System. All cisterns are inspected monthly by the SFFD and are refilled if water levels are found to be low



Suction Connections

There are 35 bay suction connections installed at various locations along the waterfront between the St. Francis Yacht Club in the Marina District and Station 25 on Third Street. These suction hydrants have a direct connection to the San Francisco Bay and provide SFFD engine companies an inexhaustible supply of salt water.

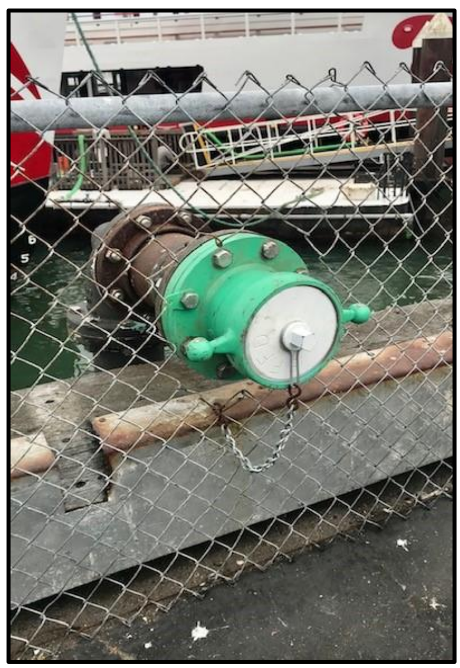
There are two types of waterfront bay suction connections:

- Above grade pier edge connections
- Surface mounted curbside hydrants

Curbside hydrants are installed in a similar fashion to low pressure hydrants. These hydrants are equipped with a 6” National Standard Thread female connection, and do not have an outlet spindle valve. The pier suction connections are also equipped with 6” NST female swivel connections that is attached to a 6” pipe that drops directly into the Bay. These two hydrants differ only in design and not in function. Both types of suction connections are 6” and painted green with either a white bonnet top, or a white inlet cap on the pier mount. The permanent suction intake pipes are submerged deeply enough to be covered by two feet of water at mean low tide. The intake is protected from large objects and debris by a heavy gage stainless steel screen. Most of these connections require only one length of hard suction to make the connection to the engine’s pump inlet. A complete list of the suction hydrant locations is found in **Appendix D**.

Surface Mounted Curbside Hydrant

Above Grade Pier Edge Connection



Fulton Street Emergency Hydrants

Twenty seven low pressure emergency hydrants have been installed in the sidewalk along the south side of Fulton Street. The hydrants begin on 22nd Avenue and conclude on 48th Avenue. These hydrants are equipped with one 6” female swivel outlet. The hydrant barrels are painted green with blue bonnets.

These hydrants receive their supply from a 12” main that is connected to Stow Lake (15,351,000 gallons) inside Golden Gate Park. The hydrant located between mid-block between 34th Ave and 35th Ave. Is supplied by Spreckles Lake (7,810,000). The water levels of the Golden Gate Parks lakes are maintained by the Park’s irrigation system, and this system can be directed to refill the lakes if there is a large demand. The hydrants are gravity fed, and their elevation in relation to Stow Lake will determine the pressure the hydrants will provide. The hydrant on 22nd Avenue provides a pressure of 35 psi, and as the hydrants move west, the difference in elevation increases resulting in an increase in pressure as well. The hydrant on 48th Avenue has a measured pressure of 110 psi.

The Hydrant located between 34th Ave and 35th Ave is positioned at a similar elevation to Spreckels Lake, and only provides a pressure of 5 psi. A length of hard suction must be used to utilize this water source.

Pump operators must be aware of the pressures supplied by the hydrant they are connecting too. If the pressure provided is 30 psi or lower the 6” hard suction must be used. For pressures above 30psi a 6” to 3” reducer and a length of soft suction can be used. The pressure for each hydrant is stamped on the outlet spindle and is also listed in Appendix 2.

Because these hydrants are pressurized, each hydrant has its own individual gate valve shut-off. Additionally, the 12” main has five isolation gate valves. These valves are located at 22nd, 27th, 32nd, 37th and 42nd Avenues.

Pools, Tanks & Lakes

Within the limits of San Francisco, there are public and private water sources that a SFFD engine company can take advantage of. Many of the Cities public and private pools have been outfitted with a gated 3” connection, if under positive pressure, or a 6” drafting connection, if the static pressure is low.

Private Pool Connection

Sava Pool Suction Connection

Engine companies might encounter a situation where the supplied pressure from a pool is less than 30 psi, and the provided connection is 3”. If this situation is encountered, a 3” to 6” increaser must be attached to the connection so a length of 6” hard suction can be used for drafting.

Although not as common as in the past, many of larger buildings in San Francisco are equipped with water storage tanks. These can be located either on the roof or on an upper floor of a high-rise. If these supplies have been made available to the SFFD, a 3” gated connection will be provided to take advantage of this supply. The location of these connections varies, and it is the responsibility of each company to familiarize themselves with every available emergency water source in their district.

Many of the lakes in San Francisco can also be drafted from, and San Francisco Bay will provide an inexhaustible supply of water. Companies should preplan the best locations for extended drafting operations.

All known emergency water supplies that are 5,000 gallons and greater are listed in the Emergency Water Supplies Catalog. This list has been recently updated and provides detailed information on all available emergency water supplies in each company's district. These emergency supplies will change as the City evolves. The removal or addition of a reliable water supply should be reported to the Water Supply Officer. Periodic inspections of emergency water supplies are essential in planning a course of action to use these emergency supplies should the need arise. No supply should be overlooked when planning for emergencies.

Appendix A

Cistern Locations

<u>Battalion 01:</u>

Engine 02:

1. Stockton St. / Pacific Ave. (19,000 gallons)
2. Grant Ave. / Vallejo St. (11,000 gallons)
3. Powell St. / Bush St. (34,000 gallons)
4. Stockton St. / Vallejo St. (9,600 gallons)
5. Grant Ave. / Pacific Ave. (28,000 gallons)

Engine 13:

1. Battery St. / Bush St. (75,000 gallons)
2. Montgomery St. / Washington St. (16,000 gallons)
3. Kearney St. / Sacramento St. (18,000 gallons)
4. Grant Ave. / Pacific Ave. Cistern cover is labeled ”AWSS” and is located on the north side of the cable car tracks. (17,400 gallons)

Engine 28:

1. Grant Ave. / Union St. (15,700 gallons)
2. Van Ness Ave. / Bay St. (75,000 gallons)
3. Van Ness Ave. / Lombard St. (75,000 gallons)

Engine 41:

1. Jones St. / Jackson St. (89,000 gallons)
2. Washington St. / Van Ness Ave. (75,000 gallons)
3. Van Ness Ave. / Broadway (75,000 gallons)
4. Van Ness Ave. / Union St. (75,000 gallons)

<u>Battalion 02:</u>

Engine 01:

1. 6th St. / Howard St. (75,000 gallons)
2. 7th St. / Howard St. (75,000 gallons)
3. 7th St. / Mission St. (75,000 gallons)
4. 5th St. / Folsom St. (75,000 gallons)

Engine 06;

1. Waller St. / Webster St. (75,000 gallons)
2. Duboce Ave. / Sanchez St. (75,000 gallons)
3. Dolores St. / 14th St. (75,000 gallons)
4. Dolores St. / 16th St. (75,000 gallons)
5. Dolores St. / 18th St. (75,000 gallons)
6. Buena Vista East / Duboce Ave. (75,000 gallons)
7. Laguna St. / Herman St. (75,000 gallons)

Engine 36:

1. Civic Center Plaza / East Side @ Larkin St. (243,000 gallons)
2. Civic Center Plaza / West Side @ Polk St. (243,000 gallons)
3. Van Ness Ave. / Grove St. (75,000 gallons)
4. Van Ness Ave. / Market St. / IFO 25 Van Ness Ave. (75,000 gallons)
5. Mission St. / Duboce Ave. (75,000 gallons)
6. Valencia St. / Market St. (75,000 gallons)

Engine 29:

1. 8th St. / Brannan St. (75,000)
2. 8th St / Townsend St. (75,000)
3. 15th St. / Kansas St. (75,000)

Battalion 03:

Engine 04:

1. No cisterns in first alarm area.

Engine 08:

1. Bluxome St. / 5th St. (75,000 gallons)
2. Bryant St. / 4th St. (75,000 gallons)
3. Bryant St. / 5th St. (75,000 gallons)
4. Harrison St. / 4th St. (75,000 gallons)
5. Harrison St. / 5th St. (75,000 gallons)
6. Harrison St. / 6th St. (75,000 gallons)

Engine 35:

1. 1st St. / Folsom St. (75,000 gallons)
2. 2nd St. / Folsom St. (75,000 gallons)
3. 1st St. / Howard St. (75,000 gallons)
4. Beale St. / Howard St. (75,000 gallons)

Engine 48:

1. No cisterns in first alarm area.

Battalion 04:

Engine 03:

1. Geary Blvd. / Gough St. (75,000 gallons)
2. Van Ness Ave. / Ellis St. (75,000 gallons)
3. Van Ness Ave. / Gough St. (75,000 gallons)
4. Van Ness Ave. / Post St. (75,000 gallons)

Engine 16:

1. Bay St. / Fillmore St. (75,000 gallons)
2. Broadway / Scott St. (75,000 gallons)
3. Green St. / Broderick St. (75,000 gallons)
4. Greenwich St. / Baker St. (75,000 gallons)
5. Greenwich St. / Webster St. (75,000 gallons)
6. North Point St. / Scott St. / IFO 2137 North Point St. (55,664 gallons)
7. Union St. / Laguna St. (75,000 gallons)
8. Union St. / Steiner St. (75,000 gallons)
9. Vallejo St. / Webster St. (75,000 gallons)

Engine 38:

1. California St. / Buchanan St. (75,000 gallons)
2. Geary Blvd. / Scott St. (75,000 gallons)
3. Octavia St. / Sutter St. (75,000 gallons)
4. Van Ness Ave. / Broadway (75,000 gallons)
5. Van Ness Ave. / Pine St. (75,000 gallons)

Engine 51:

1. Eddie Rd, / General Kennedy Ave. (? Gallons)

Battalion 05

Engine 05:

1. Divisadero St. / Eddy St. (75,000 gallons)
2. Fulton St. / Laguna St. (75,000 gallons)
3. Geary Blvd. / Laguna St. (75,000 gallons)
4. Geary Blvd. / Webster St. (75,000 gallons)

Engine 10:

1. Baker St. / Pacific St. (75,000 gallons)

2. Baker St. / Sacramento St. (75,000 gallons)
3. Broderick St. / Post St. (75,000 gallons)
4. Bush St. / Lyon St. (75,000 gallons)
5. California St. / Commonwealth St. (75,000 gallons)
6. Clay St. / Laurel St. (75,000 gallons)
7. Divisadero St. / Washington St. (75,000 gallons)

Engine 12:

1. Alma St. / Cole St. (75,000 gallons)
2. Belmont St. / Willard St. (75,000 gallons)
3. Frederick St. / Masonic Ave. (75,000 gallons)
4. Frederick St. / Shrader St. (75,000 gallons)
5. Shrader St. / Page St. (75,000 gallons)

Engine 21:

1. Divisadero St. / Fell St. (75,000 gallons)
2. Fulton St. / Broderick St. (75,000 gallons)
3. Fulton St. / Parker St. (75,000 gallons)
4. Golden Gate Ave. / Lyon St. (75,000 gallons)
5. Masonic Ave. / Oak St. (75,000 gallons)

Battalion 06:

Engine 07:

1. 20th St. / South Van Ness Ave. (74,292 gallons)
2. 22nd St. / Shotwell St. (70,700 gallons - This cistern was one of only four cisterns that remained operational after the 1906 earthquake.)
3. Capp St. / 15th St. (75,000 gallons)
4. Capp St. / 18th St. (75,000 gallons)
5. Folsom St. / 13th St. (75,000 gallons)
6. Harrison St. / 18th St. (75,000 gallons)
7. York St. / 19th St. (75,000 gallons)
8. York St. / 22nd St. (75,000 gallons)

Engine 11:

1. Church St. / 23rd St. (75,000 gallons)
2. Dolores St. / 18th St. (75,000 gallons)
3. Dolores St. / 20th St. (75,000 gallons)
4. Dolores St. / 22nd St. (75,000 gallons)
5. Dolores St. / 26th St. (75,000 gallons)
6. Folsom St. / 13th St. (75,000 gallons)
7. Folsom St. / Ripley St. (75,000 gallons)

8. Guerrero St. / Cumberland (63,600 gallons)
9. Noe St. / 24th St. (75,000 gallons)
10. Noe St. / 29th St. (75,000 gallons)

Engine 24:

1. Diamond St. / 19th St. (75,000 gallons)
2. Douglas St. / Elizabeth St. (75,000 gallons)
3. Eureka St. / 21st St. (75,000 gallons)

Engine 26:

1. Amber Dr. / Duncan St. (75,000 gallons)
2. Chenery St. / Surrey St. (75,000 gallons)
3. Diamond St. / 28th St. (75,000 gallons)
4. Duncan St. / Diamond Heights Blvd. (75,000 gallons)

Engine 32:

1. Crescent St. / Andover Ave. (50,398 gallons)
2. Dolores St. / Surrey St. (75,000 gallons)

Battalion 07:

Engine 14:

1. 22nd Ave. / Geary Blvd. (75,000 gallons)
2. 26th Ave. / Balboa St. (75,000 gallons)
3. 26th Ave. / Lake St. (75,000 gallons)
4. 30th Ave. / Geary Blvd. (55,665 gallons)
5. 30th Ave. / Lake St. (75,000 gallons)

Engine 22:

1. 5th Ave. / Irving St. (75,000 gallons)
2. 9th Ave. / Judah St. (75,000 gallons)

Engine 31:

1. 5th Ave. / Cabrillo St. (75,000 gallons)
2. 5th Ave. / Geary Blvd. (75,000 gallons)
3. 6th Ave. / California St. (75,000 gallons)
4. 14th Ave. / Balboa St. (75,000 gallons)
5. Arguello St. / Clement St. (75,000 gallons)
6. Funston Ave. / California St. (55,665 gallons)
7. Funston Ave. / Geary Blvd. (75,000 gallons)

Engine 34:

1. 34th Ave. / Balboa St. (55,666 gallons)
2. 41st Ave. / Balboa St. (55,667 gallons)
3. 46th Ave. / Geary Blvd. (55,667 gallons)
4. Legion of Honor / Legion of Honor Drive / Located in the back of the building near the public restrooms (75,000 gallons)
5. Legion of Honor / Legion of Honor Drive / Located on the south front lawn near the main entrance (75,000 gallons)

Battalion 08:

Engine 18:

1. 28th Ave. / Moraga St. (75,000 gallons)
2. 36th Ave. / Wawona St. (75,000 gallons)
3. 37th Ave. / Lawton St. (75,000 gallons)
4. 37th Ave. / Ortega St. (75,000 gallons)
5. 37th Ave. / Riviera St. (75,000 gallons)
6. 37th Ave. / Ulloa St. (75,000 gallons)
7. 43rd Ave. / Vicente St. (55,668 gallons)
8. 44th Ave. / Santiago St. / 2275 44th Ave / (100,000+ gallons)

Engine 20:

1. Laguna Honda Hospital / IFO Main Entrance / 375 Laguna Honda Blvd. (75,000 gallons)

Engine 23:

1. 43rd Ave. / Lawton St. (75,000 gallons)
2. Irving St. / 35th Ave. (75,000 gallons)
3. Judah St. / 47th Ave. (75,000 gallons)

Engine 40:

1. 18th Ave. / Moraga St. (75,000 gallons)
2. 18th Ave. / Ulloa St. (75,000 gallons)
3. 28th Ave. / Rivera St. (75,000 gallons)
4. Pacheco St. / 17th Ave. (75,000 gallons)
5. Santiago St. / 18th Ave. (75,000 gallons)

Battalion 09:

Engine 15:

1. Lakeview St. / Josiah St. (75,000 gallons)

Engine 19:

1. 21st Ave. / Ocean Ave. (75,000 gallons)
2. Inverness / Ocean Ave. (75,000 gallons)

Engine 33:

1. Plymouth St. / Sadowa St. (75,000 gallons)

Engine 39:

1. 16th Ave. / Vicente St. (75,000 gallons)
2. Casitas Ave. / Lansdale Ave. (75,000 gallons)
3. Dorchester Way / Ulla St. (75,000 gallons)
4. San Buena Ventura Way / St. Francis Blvd. (75,000 gallons)
5. Yerba Buena Ave. / Saint Elmo Way (75,000 gallons)

Engine 43:

1. Felton St. / Gambier St. (75,000 gallons)
2. Geneva St. / Paris St. (75,000 gallons)
3. Moscow St. / Geneva Ave. (75,000 gallons)
4. Persia St. / Vienna St. (75,000 gallons)

Battalion 10:

Engine 09:

1. Bryant St. / 26th St. (75,000 gallons)
2. Kansas St. / Caesar Chavez (75,000 gallons)
3. San Bruno Ave. / 25th St. (75,000 gallons / Acceptable Leakage)

Engine 17:

1. 3rd St. / Thomas Ave. (50,397 gallons)
2. Fitzgerald Ave. / Hawes St. (50,396 gallons)
3. Ingalls St. / Shafter Ave. (50,397 gallons)

Engine 25:

1. Cashmere St. / Hudson Ave. (75,000 gallons)

Engine 37:

1. 20th St. / Connecticut St. (75,000 gallons)
2. 20th St. / Kansas St. (75,000 gallons)
3. 22nd St. / Pennsylvania (75,000 gallons)
4. Kansas St. / 23rd St. (75,000 gallons)
5. Mariposa St. / Missouri St. (75,000 gallons)

Engine 42:

1. Apollo St. / Williams St. (75,000 gallons)
2. Dwight St. / Hamilton St. (75,000 gallons)
3. Holyoke St. / Silliman St. (75,000 gallons)
4. Silver Ave. / Colby St. (75,000 gallons)

Engine 44:

1. Peninsula Ave. / Blanken Ave. (50,395 gallons)
2. Sunnydale Ave. / Sawyer St. (50,395 gallons)

Appendix B

Cisterns Designated as "Leaking Do Not Fill"

1. 1st St. / Harrison St.
2. 3rd St. / Kirkwood Ave.
3. 3rd St. / Oakdale Ave.
4. 5th Ave. / Irving St.
5. 6th St. / Folsom St.
6. 14th St. / Castro St.
7. 16th St. / Folsom St.
8. 19th St. / Folsom St.
9. Bosworth St. / Diamond St.
10. Broadway / Osgood Place
11. Grant Ave. / Bush St.
12. Grant Ave. / Greenwich St.
13. Grant Ave. / Washington St.
14. Guerrero St. / 18th St.
15. Kearney St. / Bush St.
16. Kearney St. / Merchant St.
17. Kearney St. / Post St.
18. Mason St. / California St.
19. Leavenworth St. / Union St.
20. Lombard St. / Mason St. (IFO 661 Lombard St.)
21. Montgomery St. / California St.
22. Montgomery St. / Commercial St.
23. Montgomery St. / Sansome St.
24. Noe St. / Hill St.
25. Pacific St. / Sansome St.

26. Powell St / Ellis St.
27. Powell St. / Green St.
28. Powell St. / Pacific Ave.
29. Stockton St. / Union St.
30. Taylor St. / Clay St.

Appendix C

Cisterns Designated as Having ”Acceptable Leakage”

1. 1st. St. / Folsom St.
2. 4th St. / Harrison St.
3. 5th St. / Harrison St.
4. 6th St. / Harrison St.
5. 7th St. / Howard St.
6. 8th St. / Brennan St.
7. Beale St. / Howard St.
8. California St. / Commonwealth St.
9. Dolores St. / 20th St.
10. Fulton St. / Laguna St.
12. San Bruno Ave. / 25th St.
13. Webster St. / Vallejo St.

Appendix D

Bay Suction Connection Locations

1. Yacht Road / Near the Marina Lighthouse on the harbor side. (E16)
2. Yacht Road / 300’ east of the main entrance of the St. Francis Yacht Club on the harbor side. (E16)
3. Marina Blvd. / Broderick St. (E16)
4. Marina Blvd. / Divisadero St. (E16)
5. Marina Blvd. / Cervantes Blvd. (E16)
6. Marina Green Dr. / Avila St. (E16)
7. Marina Green Dr. / Fillmore St. (E16)
8. Jefferson St. / Al Scoma Way / IFO 1965 Al Scoma Way (E28)
9. Jefferson St. / Jones St. / Next to 286 Jefferson St. (E28)
10. Embarcadero North / Taylor St. / Pier 43 ½ (E28)
11. Embarcadero North / Powell St. / West of Pier 41 (E28)
12. Embarcadero / Beach St. / East side of Pier 39 / 750’ north of the Embarcadero (E28)
13. Embarcadero / Beach St. / West side of Pier 39 / 250’ north of the Embarcadero (E28)
14. Embarcadero / Bay St. (E28)
15. Embarcadero / Lombard St. / Pier 27 (E13)
16. Embarcadero / Greenwich St. / Pier 27 at the Cruise Ship Terminal. (E13)
17. Embarcadero / Broadway St. / Just south of Pier 9 (E13)
18. Embarcadero / Pacific St. / North corner of Pier 5 (E13)
19. Embarcadero / Ferry Plaza East