

**CITY AND COUNTY OF SAN FRANCISCO**  
**BOARD OF SUPERVISORS**  
**BUDGET AND LEGISLATIVE ANALYST**  
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**Policy Analysis Report**

To: Supervisor Mar  
From: Budget and Legislative Analyst's Office  
Re: Status of Emergency Firefighting Water System Analysis  
Date: December 2, 2020

**SUMMARY OF REQUESTED ACTION**

Your office requested that the Budget and Legislative Analyst study the Emergency Firefighting Water System (EFWS) through an equity lens that includes analysis of what is needed in the western and southern neighborhoods to provide them with fire protection equal to the protection level currently covering the eastern and central areas of the City that are safeguarded by an independent EFWS and by access to unlimited saltwater through two 10,000 gallon per minute pumps; and issue a report to the Board no later than December 31, 2020 on (a) which areas of the City do not have sufficient water supplies for the anticipated demand for water to fight fires following a major earthquake similar in magnitude to the 1906 earthquake, and (b) options to address the issue in both the short term and long term that include acquisition of the high priority hose tender equipment, suggestions for multiple funding sources to finance the equitable citywide fire protection, and a proposed timeline for project completion.

***For further information about this report, contact Severin Campbell at the Budget and Legislative Analyst's Office.***

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**Executive Summary**

- The City is at risk for major fires following an earthquake. According to a 2014 study by the United States Geological Survey (USGS), San Francisco has a 72 percent chance of a magnitude 6.7 or larger earthquake (equivalent to the 1989 Loma Prieta earthquake) prior to 2043. According to a 1992 report to the National Science Foundation, the 1989 Loma Prieta earthquake caused 41 fires in San Francisco, largely due to electrical wiring and electric and gas appliances.
- The City's Emergency Firefighting Water System (EFWS) does not sufficiently cover all areas of the City, placing some neighborhoods at higher risk for fires after an earthquake. According to an analysis by the San Francisco Public Utilities Commission (SFPUC), 15 of 48 Fire Response Areas (FRAs) have reliability scores below 50 percent. This means that after a 7.8-magnitude earthquake these FRAs would have less than half the water supply necessary to meet the median firefighting demands. The western and southern parts of the City, including the Sunset, Richmond, Excelsior, and Visitacion Valley areas, have limited EFWS coverage, and generally have FRA scores of less than 50 percent.

- SFPUC has developed a plan to construct a potable EFWS system in the Sunset and Richmond Districts (EFWS Westside). The estimated cost of the EFWS Westside Phase I project is approximately \$198 million, of which funding from the 2020 Earthquake Safety and Emergency Response (ESER) Bond and Water Enterprise revenues is available. This project is expected to be completed in 2025. Another potential project under consideration to improve EFWS coverage on the City's Westside is a saltwater pump station along the Pacific Ocean. The EFWS system currently has two saltwater pump stations along the Bayfront, but none along the Pacific coast.
- While the EFWS Westside Phase I project would significantly improve coverage on the City's Westside, there would still be system coverage deficiencies in the south and southeastern areas of the City. The Excelsior and Visitacion Valley neighborhoods had low reliability scores in the SFPUC analysis of FRAs. The Board of Supervisors, in response to the 2018-19 Grand Jury report, requested SFPUC to develop a comprehensive EFWS citywide plan by December 31, 2021. As part of the comprehensive citywide plan, the City Administrator's Office, Mayor's Budget Office, SFPUC, and San Francisco Fire Department (SFFD) are analyzing whether to propose a stand-alone ESER bond dedicated solely to funding subsequent phases of the EFWS project.
- In addition to the EFWS, the City maintains a Portable Water Supply System (PWSS) consisting of hose tender trucks to assist with firefighting operations in areas not covered by the EFWS. Funding is available in FY 2020-21 to purchase three new hose tender trucks.
- In response to the 2018-2019 Civil Grand Jury report, the Board of Supervisors has requested SFPUC to complete analyses by June 30, 2021 of (i) additional seawater pump stations in San Francisco, include seawater pump stations on the Westside of San Francisco; and (ii) neighborhood firefighting water demands. As noted above, the Board has also requested SFPUC to prepare a comprehensive EFWS citywide plan by December 31, 2021. Given the risk of fires, especially after an earthquake, and the lack of sufficient EFWS coverage in the western and south/southeastern section of the City, the Board should ensure presentation of these reports in public hearings.

*Project staff: Reuben Holober, Severin Campbell*

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## Current Risks to the City's Emergency Firefighting Water Supply

The City is at risk for major fires following an earthquake. According to a 2014 study by the United States Geological Survey (USGS), San Francisco has a 72 percent chance of a magnitude 6.7 or larger earthquake (equivalent to the 1989 Loma Prieta earthquake) prior to 2043. According to a 1992 report to the National Science Foundation, the 1989 Loma Prieta earthquake caused 41 fires in San Francisco, largely due to electrical wiring and electric and gas appliances. One block in the Marina district was destroyed by fires caused by a broken gas distribution line. When access to nearby fire hydrants and the Palace of Fine Arts lagoon was insufficient to fight the fire, the Fire Department accessed water from the Bay, in which the Phoenix fire boat and three hose tenders were employed. Fire crews set up four major runs of five-inch hose between the fire and the boat using nine portable hydrants. Before all fire operations were concluded in the Marina District, the boat pumped 6,000 gallons per minute for more than 18 hours.<sup>1</sup>

The City completed the first water system for firefighting in 1913, following the 1906 San Francisco earthquake. The original Emergency Firefighting Water System (EFWS, also known as the Auxiliary Water Supply System, or AWSS) system consisted of (i) 72 miles of water pipes, concentrated heavily in the northeast part of the City around downtown; (ii) 889 hydrants; (iii) the Twin Peaks Reservoir; (iv) Ashbury and Jones Street tanks; and (v) Pump Stations 1 and 2. In 2010, San Francisco Public Utilities Commission (SFPUC) assumed responsibility for the operations and maintenance of the EFWS.

The EFWS has been expanded through funding from multiple bond measures over the years. The system now consists of approximately 130 miles of pipes, 229 cisterns, two pump stations, two water storage tanks, and a reservoir. The two seawater pump stations, as well as two fireboats, allow seawater from the San Francisco Bay to be injected into the EFWS. There are five manifolds that allow fireboats to inject seawater into the EFWS. There are 35 suction manifolds along the waterfront that allow seawater to be drawn from the bay and injected into the EFWS.

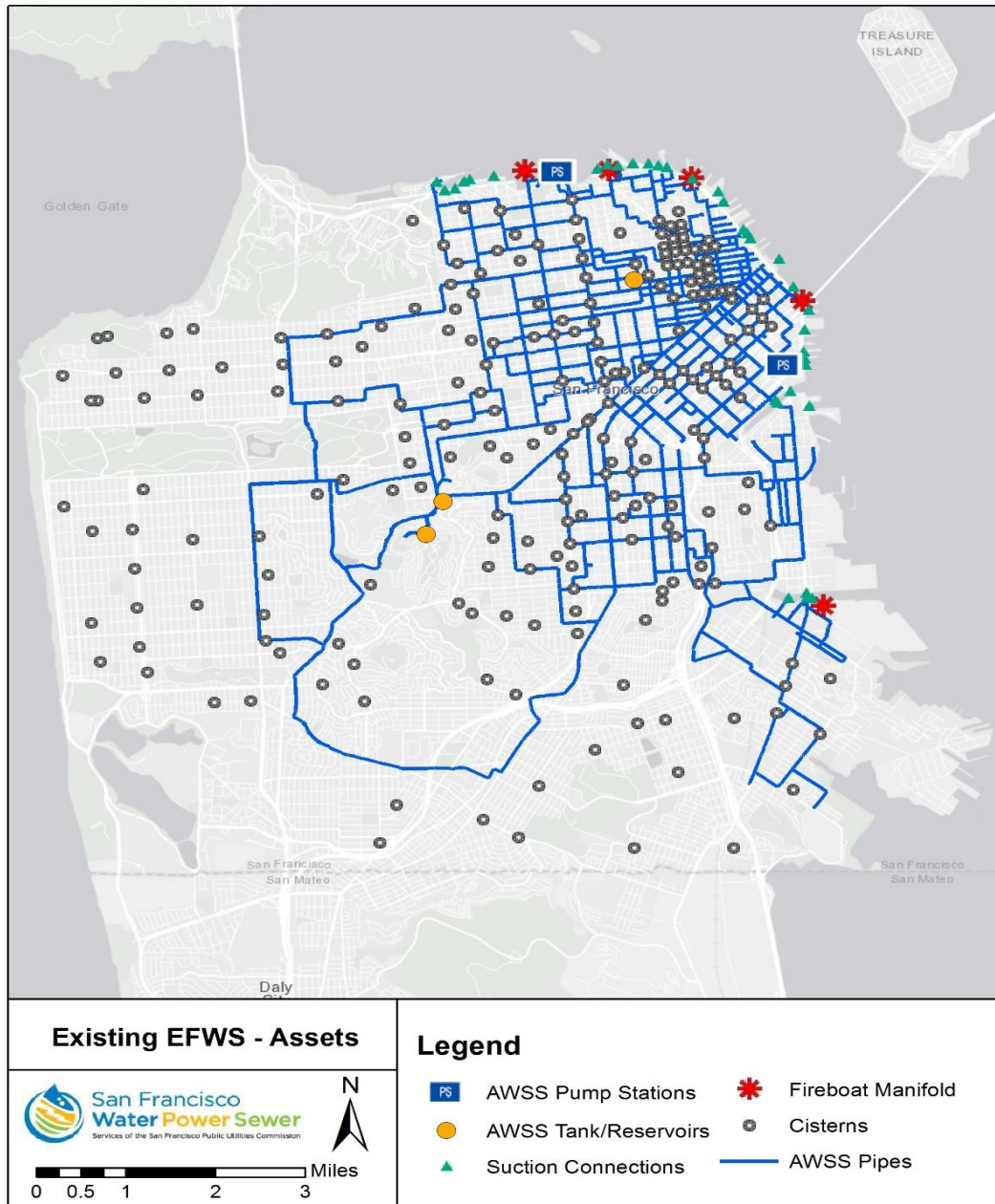
### Limited Emergency Water Supply in Western and Southern Neighborhoods

The EFWS system is still heavily concentrated in the eastern half of the City, largely in the Downtown and South of Market areas. The western and southern parts of the City, including the Sunset, Richmond, Excelsior, and Visitacion Valley areas, have limited coverage. Furthermore, there are no pump stations in the western half of the City to pull water from the Pacific Ocean. Exhibit 1 below shows the existing EFWS system.

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<sup>1</sup> *Investigation of Cause and Effects of Fires Following the Loma Prieta Earthquake*, Jamshid Mohammadi, Sam Aiyasin, D.N. Bak. Report to the National Science Foundation, 1992

### Exhibit 1: Existing EFWS System Assets



Source: SFPUC

As shown in Exhibit 1, the western and southern parts of the City, including the Sunset, Richmond, Excelsior, and Visitacion Valley areas, have limited EFWS coverage.

Exhibit 2 below quantifies the existing EFWS assets by Supervisorial District.

**Exhibit 2: EFWS Assets by Supervisorial District**

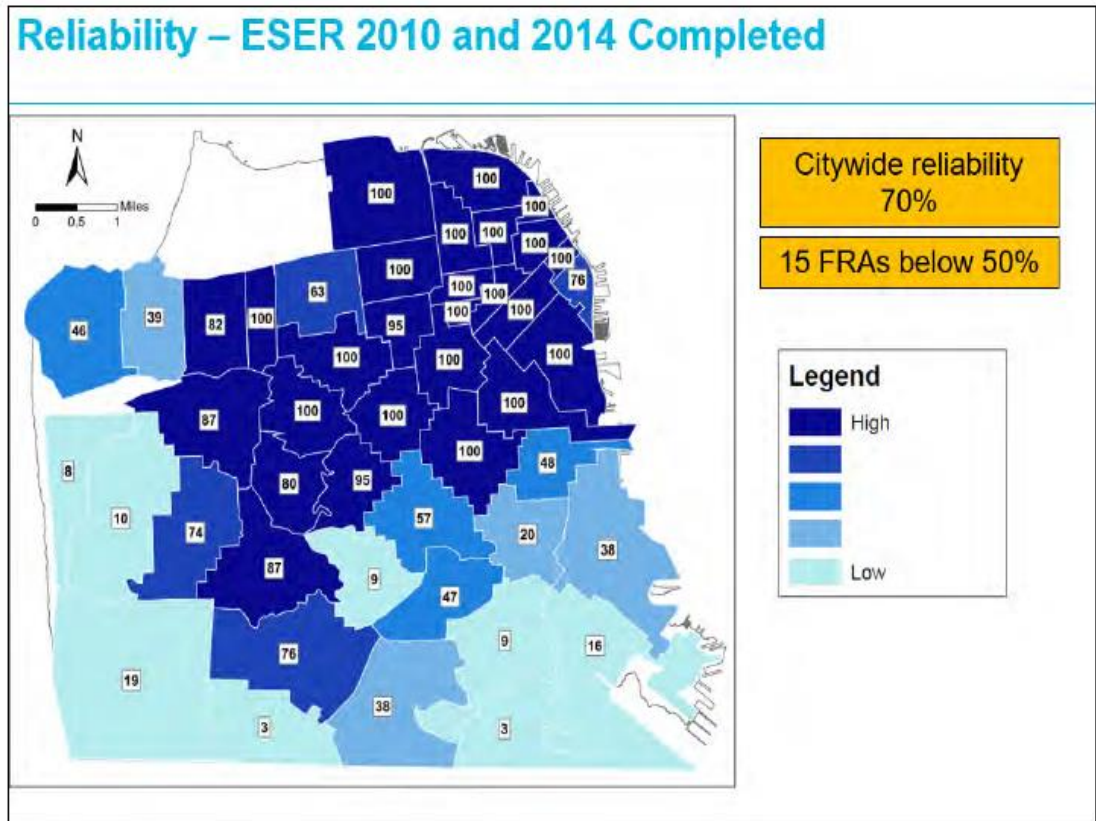
<b>District</b>	<b>Number of EFWS Hydrants</b>	<b>Miles of EFWS Mains</b>	<b>Number of Cisterns</b>
1	42	5	17
2	170	14	23
3	327	23	46
4	3	<1	12
5	188	16	20
6	366	27	26
7	79	7	12
8	110	9	27
9	110	9	21
10	222	18	20
11	24	1	5
<b>Total</b>	<b>1,641</b>	<b>130</b>	<b>229</b>

Source: SFPUC

Districts 1, 4, 7, and 11 have the fewest hydrants, miles of EFWS pipelines, and cisterns. District 4 has particularly poor coverage, with only three hydrants and less than 1 mile of pipeline. Conversely, Districts 3, 6 and 10 have the most hydrants, miles of EFWS pipelines, and cisterns.

SFPUC has conducted analysis to determine EFWS capability to meet median firefighting demands after a magnitude 7.8 earthquake. After voters approved Earthquake Safety and Emergency Response (ESER) bonds in 2010 and 2014, SFPUC was able to improve the EFWS system, including upgrading water supply reliability via projects at Twin Peaks Reservoir, EFWS tanks and pump stations, and adding 30 cisterns. Exhibit 3 below shows the EFWS reliability scores by Fire Response Area (FRA) following the 2010 and 2014 ESER bond improvements.

**Exhibit 3: EFWS Reliability Score by FRA, Following 2010 and 2014 ESER Bonds Improvements**



Source: SFPUC

The EFWS reliability scores by FRA largely mirror the map of the EFWS system buildout. Areas in the northeast portion of the City have high scores, while those in the western and southern portions of the City have lower scores. As noted in Exhibit 3, 15 FRAs have reliability scores below 50 percent. This means that after a 7.8-magnitude earthquake, these FRAs would have less than half the water supply necessary to meet the median firefighting demands.

By each of these metrics, it is clear that the western and southern portions of the City have the least sufficient water supplies needed for fires anticipated after a major earthquake. According to a fire modeling expert, the fire risk of a major earthquake subsumes the scope of all other types of fires possible in San Francisco, such as terrorist attacks, explosions, and wildfires.

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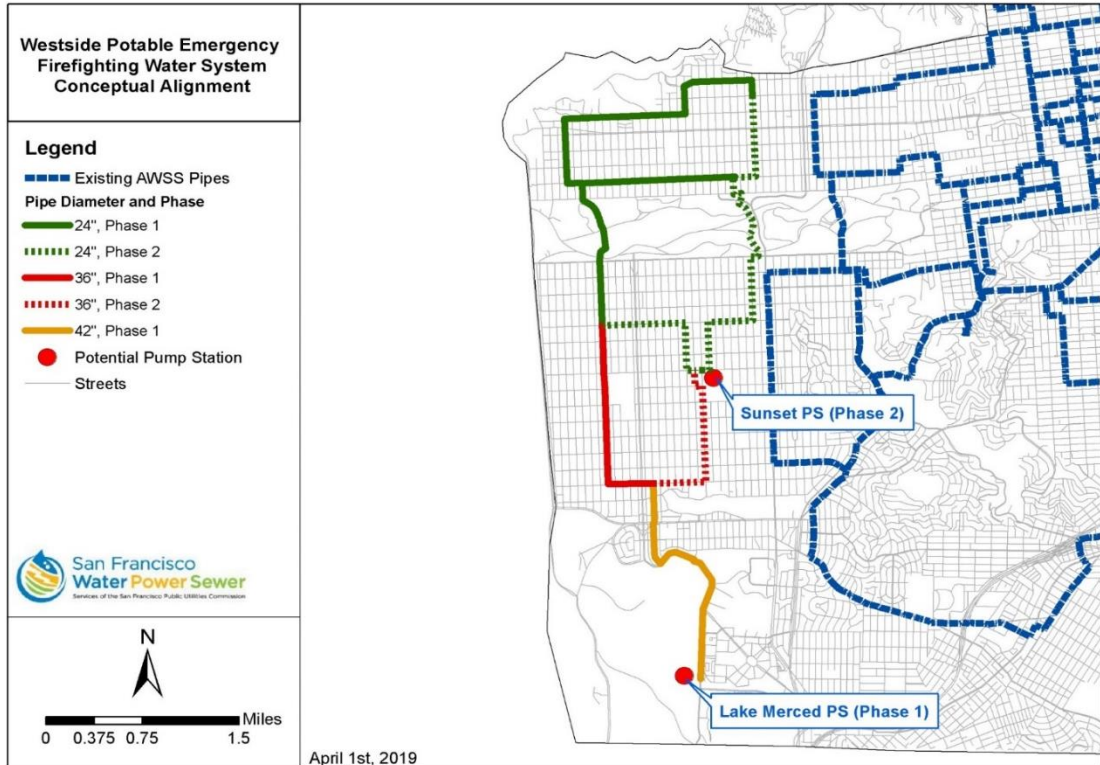
## Options to Improve EFWS Access

### Westside EFWS Options

In 2018, AECOM issued the report “Westside Emergency Firefighting Water System Options Analysis” on behalf of the SFPUC and San Francisco Fire Department (SFFD). The report analyzed 12 options for improving EFWS coverage in the Westside of the City. The options included both building off the existing EFWS system, or a potable EFWS system sourced from the Sunset Reservoir. Of the 12 options, the preferred option was Option 12, a potable EFWS system with a pump station at the Sunset Reservoir and loops around the Sunset and Richmond Districts. The estimated cost was approximately \$109 million.

SFPUC has developed an updated conceptual Westside EFWS alignment based on Option 12 in the 2018 AECOM report. The key difference is that rather than only using Sunset Reservoir as a water source, the proposal would use Lake Merced as the primary source, and potentially use the Sunset Reservoir as a secondary source in a future project phase. Lake Merced contains approximately 1.2 billion gallons of water, while Sunset Reservoir only contains approximately 90 million gallons. However, Sunset Reservoir is supplied water via upgraded, seismically resilient pipelines that are connected to the SFPUC’s Hetch Hetchy Regional Water System. The Westside EFWS Phase I project would connect Lake Merced to the Outer Sunset and Richmond neighborhoods, while Phase II would potentially connect a loop through the Inner Sunset and Richmond neighborhoods. A conceptual alignment of the Westside EFWS is shown in Exhibit 4 below.

### Exhibit 4: Westside EFWS Conceptual Alignment



Source: SFPUC

The estimated cost of the EFWS Westside Phase I project is approximately \$198 million. In March 2020, San Francisco voters approved Proposition B, a \$628.5 million ESER bond that includes approximately \$153.5 million for EFWS projects. The ESER bond funding, as well as approximately \$55 million in Water Enterprise revenue bonds, totaling \$203.5 million, provide sufficient funding to complete the EFWS Westside Phase I project by 2025, pending California Environmental Quality Act (CEQA) review. The issuance of up to \$85 million in 2020 ESER bonds is currently pending Board of Supervisors approval (File 20-1295), and SFPUC anticipates receiving \$20 million of the initial bond proceeds, which will be used for planning, design, and CEQA review for the Westside Phase I project and manifold projects at Fort Mason and Pier 33 ½.<sup>2</sup>

The estimated cost of the potential EFWS Westside Phase II project is \$180 million for which funding has not yet been identified.

Another potential project that may improve EFWS coverage on the City's Westside is a saltwater pump station along the Pacific Ocean. The EFWS system currently has two saltwater pump stations along the Bayfront, but none along the Pacific coast. In response to the Civil Grand Jury report, the Board of Supervisors has directed

<sup>2</sup> The remaining \$543.5 million in ESER bonds will likely be issued starting in the first half of 2021, with an initial sale of approximately \$150-175 million. Of the remaining 2020 ESER bonds, \$133.5 million is allocated to EFWS projects. The estimated cost in 2019 \$s for the potential EFWS Westside Phase II is \$180 million.



SFPUC to complete a study analyzing additional seawater pump stations in San Francisco, include seawater pump stations on the Westside of San Francisco by June 30, 2021.

### **Other EFWS Options**

While the EFWS Westside Phase I project would significantly improve coverage on the City's Westside, there would still be system coverage deficiencies in other portions of the City, including the southeastern areas of the City. The Board of Supervisors has directed SFPUC to complete a more detailed analysis of neighborhood firefighting water demands by June 30, 2021, as well as a comprehensive EFWS citywide plan by December 31, 2021. As part of the comprehensive citywide plan, the City Administrator's Office, Mayor's Budget Office, SFPUC, and San Francisco Fire Department (SFFD) are analyzing whether to propose a stand-alone ESER bond dedicated solely to funding subsequent phases of the EFWS project.

### **Hose Tender Equipment**

In addition to the EFWS, the City maintains a Portable Water Supply System (PWSS) to assist with firefighting operations in areas not covered by the EFWS. The PWSS consists of hose tender trucks that are equipped with approximately one mile of five-inch diameter hose, a portable pump, portable hydrants, and other firefighting equipment. Each fully equipped hose tender costs approximately \$1 million. SFFD currently has five tenders, and all are between 28 and 47 years old and beyond their useful lives. These tenders are only able to transport hose and equipment and do not have pumping capabilities.

The FY 2019-20 budget included \$4 million for four additional hose tenders, and SFFD also received \$1 million in funding from the California Office of Emergency Services to purchase an additional hose tender, totaling \$5 million for purchase of five hose tenders. However, due to the City's budget deficit from the COVID-19 pandemic, \$2 million was reduced by the Mayor's Budget Office as part of the mid-year balancing plan. That leaves \$3 million remaining to purchase three new hose tenders, and the units are currently out to bid by the Office of Contract Administration. These new hose tenders are more efficient and maneuverable than older models. They contain pumps that can siphon water from the Bay, reservoirs, or other sources. The hoses can be connected to carry water several miles from the source. The City Attorney's Office has determined that ESER bonds may not be used to purchase hose tender equipment, so they must be purchased from the General Fund or grant funds.