DRAFT

Draft Report

Water Master Plan and Rate Study

NOVEMBER 2024

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
PRS	Pressure Reducing Station
HGL	Hydraulic Grade Line

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1 Introduction

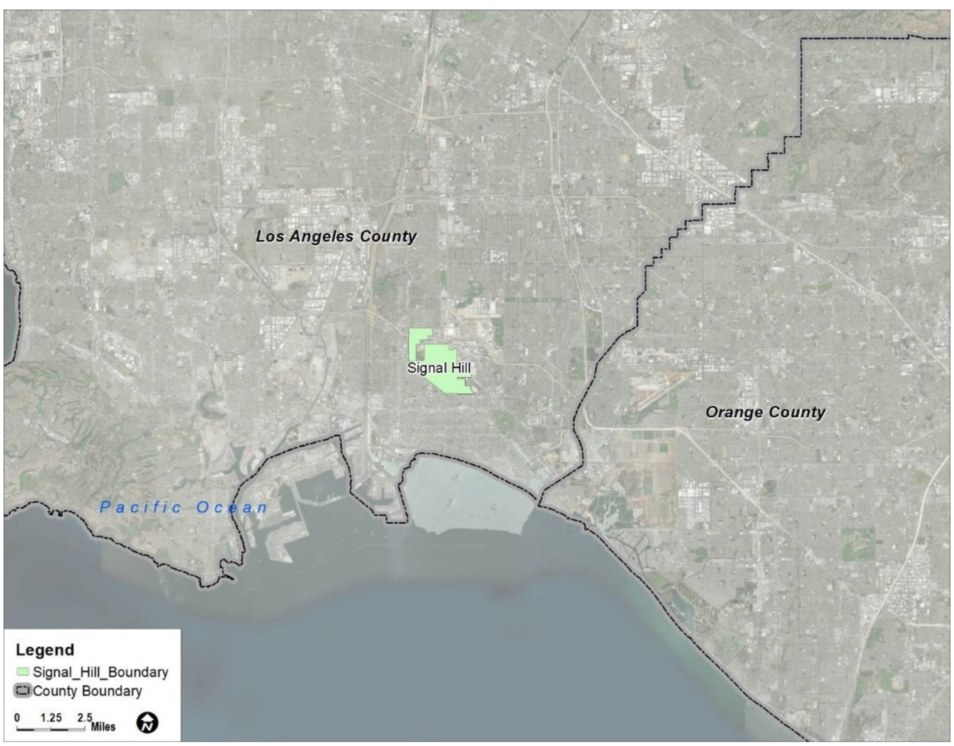
1.1 Background and Master Plan Objectives

The City of Signal Hill (City), California, is a vibrant community nestled within the greater Los Angeles area, characterized by its rich history, diverse population, and unique topographical features. To ensure the sustainability and resilience of its water resources while accommodating its population, it is essential that the City conducted a comprehensive review of its water system and rates for guiding the City's water management strategies over the next two decades.

In 2024, the City retained Dudek, teamed with Raftelis Financial Consultants, Inc. (Raftelis), to prepare a Water Master Plan and Rate Study Services. The primary objective of this Water Master Plan is to provide a strategic framework for the management, distribution, and conservation of water resources within the City of Signal Hill. It aims to assess current water supply and demand, identify potential future needs, and outline the necessary infrastructure improvements and policy initiatives to secure a reliable and sustainable water supply for all residents and businesses. This plan will also serve as a guiding document to ensure compliance with state and federal regulations, including those related to water quality and conservation.

Signal Hill's water supply is sourced from a combination of local groundwater and imported water from regional suppliers. The city's geographical features and location play a significant role in its hydrology, influencing both water availability and quality. The current system includes a network of wells, storage tanks, and distribution pipelines designed to meet the demands of a diverse and growing population.

Figure 1-1: Regional Map



1.2 Service Area Overview

The City of Signal Hill is in Los Angeles County, California. It covers approximately 2.2 square miles situated between the San Diego (I-405) freeway and Pacific Coast Highway and is bordered by the City of Long Beach on all sides. Within the City is a hill having the highest ground elevations in the general area; of 360 feet above mean sea level. The use of the hill for navigation and survey of the coast in the late 1800's lead to the City's name. In the 1920's oil was discovered in the area that became the City of Signal Hill, which lead to extensive oil rig construction and operation. Gradually, the oil rigs common to the City of Signal Hill were replaced with areas of commercial, industrial, and residential development. As the population of the City grew, single family residences were constructed on the hill and at the high elevations. Commercial developments, modern office buildings, and industrial parks were also constructed, creating a blended land use of approximately 38 percent residential, 36 percent industrial, 20 percent commercial, 4 percent public/ institutional, and 2 percent open space. The residential population in the City of Signal Hill nearly doubled from 1980 to 2000. After 2000, the growth within the City became more gradual. In 2013, the City of Signal Hill population was determined to be 11,218. As of 2020, the population is approximately 11,848 (US Census Bureau).

The City of Signal Hill's Water Department operates a water system with four primary pressure zones to distribute water across all the public and private parcels spanning the City's service area. Primarily water supply comes from City operated groundwater production wells. Two of the wells are located in the North Long Beach area, and a third well within City of Signal Hill. Water storage is provided from three reservoirs, and water delivery to the higher pressure zones is achieved from three booster pump stations. The City can also has multiple connections to receive imported water from the Metropolitan Water District regional water transmission system. The City's distribution system includes approximately 50 miles of distribution and transmission pipeline, nearly 3200 domestic service connections, and a groundwater treatment facility.

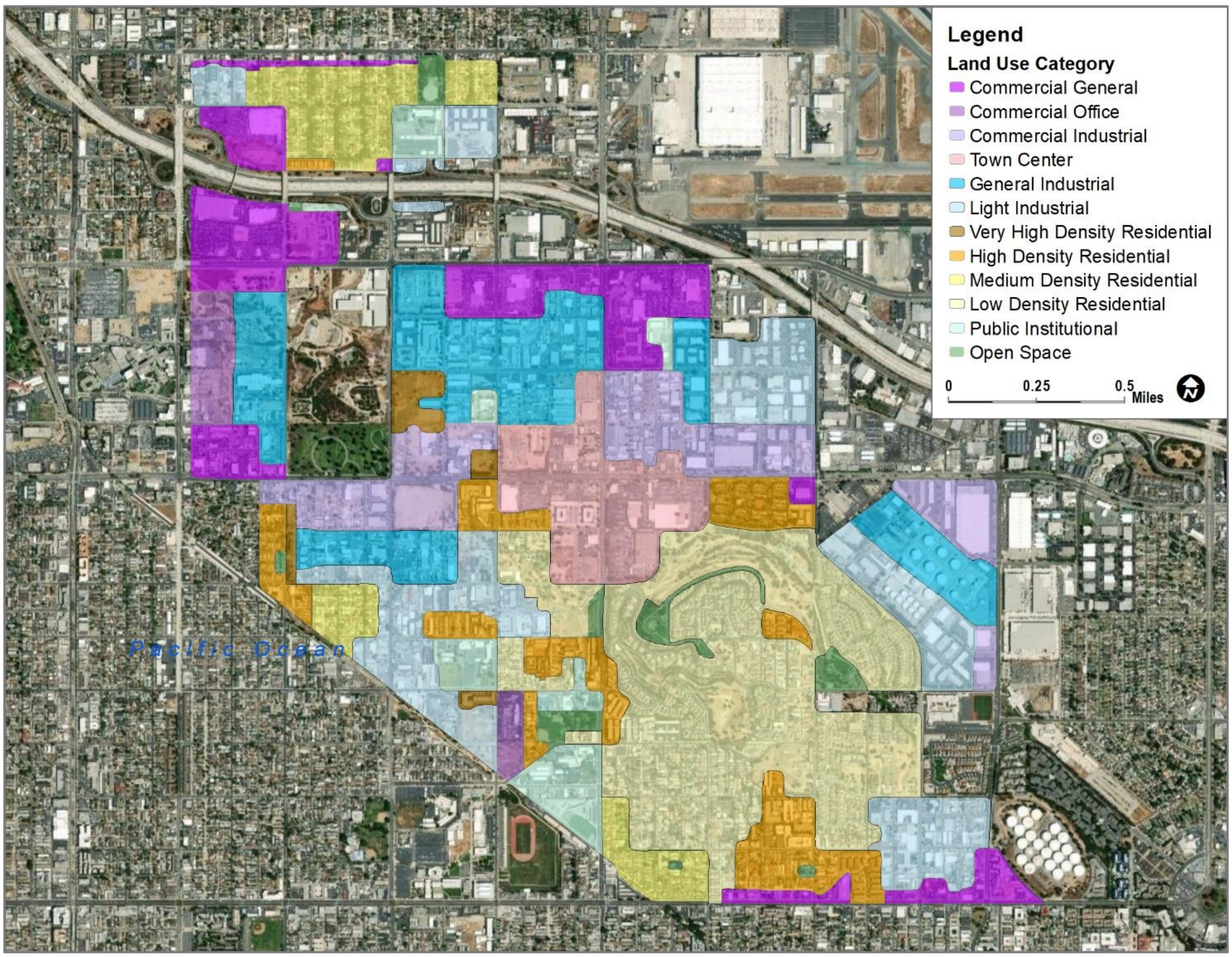
1.3 Report Organization

2 Study Area, Land Use and Population

2.1 Existing Land Use

A review of the land use information for the City of Signal Hill utilized the 2021-2029 Housing Element, dated October 13, 2022. Land use within the City is 38 percent residential, 36 percent industrial, 20 percent commercial, 4 percent public/ institutional, and 2 percent open space, as shown in **Figure 2-1**. Land use change since the 2018 Water Master Plan (WMP) has been minimal.

Figure 2-1: Existing Land Use



2.2 Recent Developments and Completed CIP

The City stated there had been only one completed CIP project since the last 2018 WMP. The old 12-inch cast iron water main on 33rd St from Walnut Ave to California Ave was replaced with new 12-inch Class 150 ductile iron pipe.

2.3 Population

Table 2-1: Historical and Projected City Population and Housing Characteristics

	Historical Population/Housing						Projected	
	1980[1]	1990[1]	2000[1]	2010[1]	2015[1]	2020	2025	2030
Population	5,734	8,371	9,247	10,471	11,896	11,848[2]	11,879[4]	12,045[4]
Total Dwelling Units	2,780	3,670	3,797	4,389	4,678	4,632[3]	4,890[5]	5,149[3]
Occupied Dwelling Units	ND	3,375	3,621	4,157	4,444	4,401	4,646	4,892
Vacant Dwelling Units	ND	295	176	232	234	231[3]	244	257
Percent Vacant	ND	8.0%	4.6%	5.3%	5.0%	5.0%	5.0%[1]	5.0%[1]
Population Density (Population/Occupied Dwelling Units)	ND	2.48	2.55	2.52	2.68	2.69	2.56	2.46

Data Source: [1]2018 Water Master Plan; [2]US Census; [3]2021-2029 Housing Element; [4]2020 Urban Water Management Plan; [5]Linear Interpolation.

2.3.1 Population Growth Projections

As of 2020, the population is approximately 11,848 (US Census Bureau). Population has been steady in recent years since the City is nearly buildout. According to the City's *2020 Urban Water Management Plan (UWMP, Table 3-5, Population – Current and Projected)*, the population within the City is projected to remain steady in the next two decades.

2.4 Water Demand

2.4.1 Historical Water Consumption

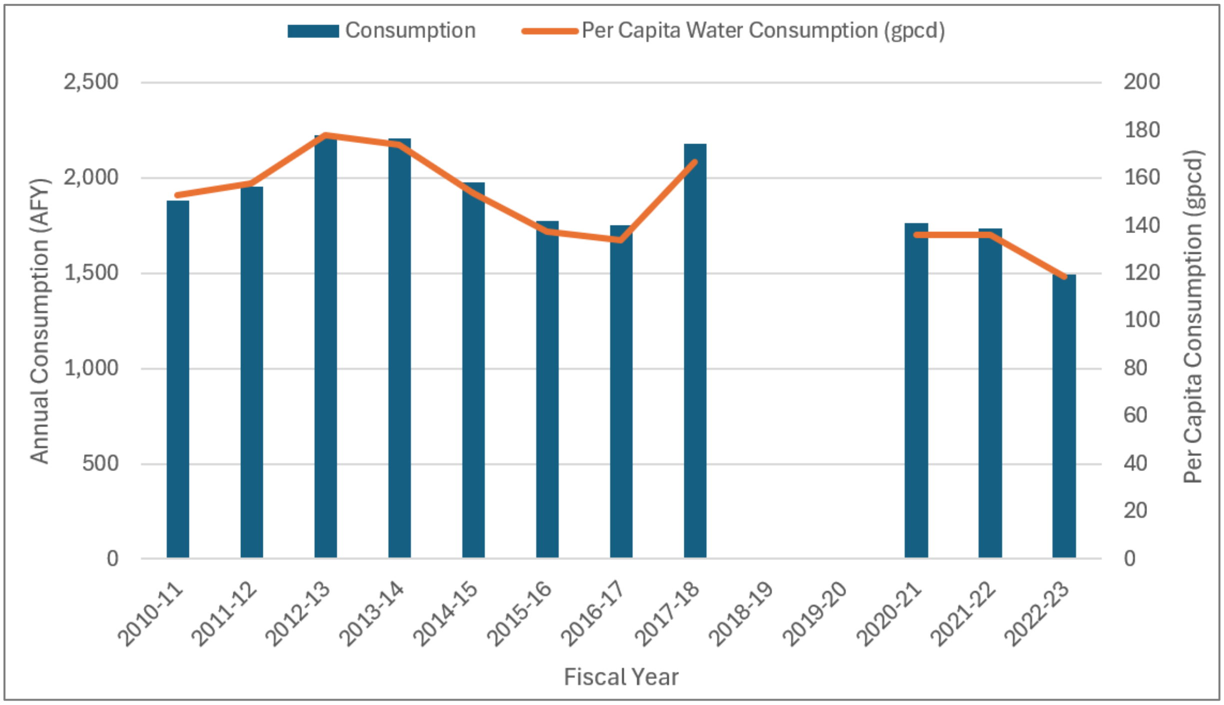
Historical water consumption according to billing records is shown in Table 2-2 and Figure 2-2. As shown, the annual water consumption has decreased in the recent three years compared to earlier years since 2010. Per capita water consumption has also declined accordingly. The correlation between annual water consumption and per capita water consumption corroborates the fact that the City's population has stayed relatively steady since 2010. In fiscal year 2017-2018 water consumption increased, most likely due to lifting of restrictions on water conservation.

The City tracks water consumption and population within the City service area. As a result, per capita water consumption is commonly used to project future water demand. This approach compares the water consumption for the entire City service area, inclusive of all land use categories, to the population of the City. This approach assumes that water demand from commercial and industrial land uses are approximately the same. Since any future growth within the City will be primarily residential, this approach provides a relatively accurate estimate of future water demands.

Table 2-2: Historical Water Consumption

Year	Historic Water Consumption (afy)	Per Capita Water Consumption (gpcd)
2010-11	1883	153
2011-12	1958	158
2012-13	2229	178
2013-14	2207	174
2014-15	1980	154
2015-16	1776	138
2016-17	1752	134
2017-18	2179	167
2018-19		
2019-20		
2020-21	1766	136
2021-22	1735	136
2022-23	1495	119
Average (AF)	1905	150

Figure 2-2: Annual Water Consumption (Acre-Feet)



2.4.2 Unaccounted-for Water

The difference between production and consumption is unaccounted-for water, which results from situations such as water loss and unmetered consumption. Water losses occur due to system leakages, and unmetered consumption occurs due to operations such as hydrant testing and flushing, fire hydrant usage and operations, street sweeping and cleaning operations, installation and testing of new water mains and water facilities, and meter errors.

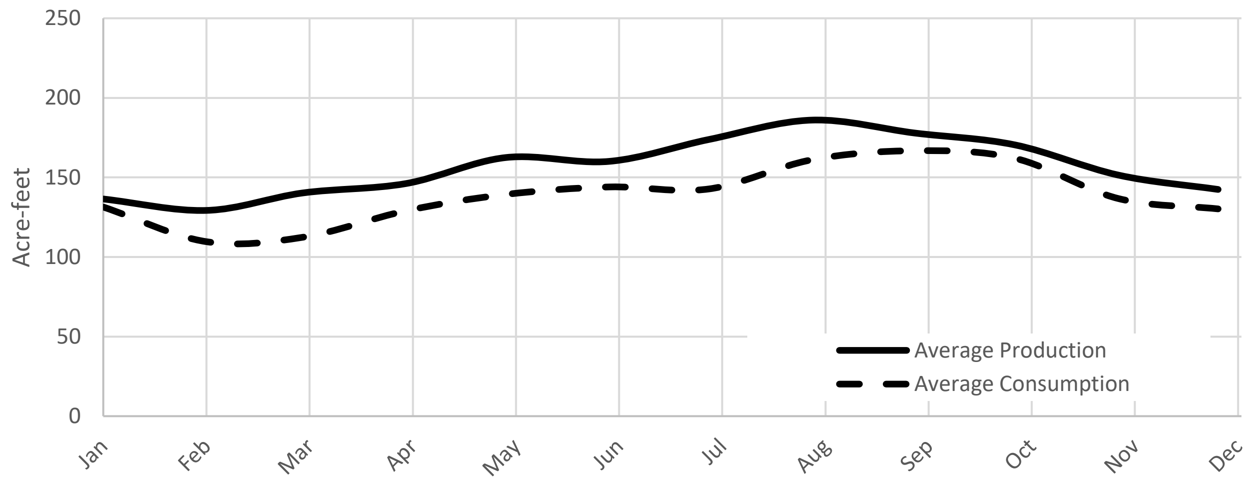
Meter errors can contribute significantly to the quantity of unaccounted-for water. Flow rates outside of the optimal operating range typically read at a lower flow rate, and wear and tear also reduces the accuracy of a flow meter over time. The computerized billing system utilized by the City has the capability to identify abnormal meter readings, and these meters are routinely tested. On average, the City replaces each flow meter every 10 years.

The amount of total unaccounted-for water is determined by comparing the groundwater and imported water supply and the metered water consumption, as shown in Table 2-3. The average unaccounted-for water in the past three years is approximately 11% of total production, which is close to AWWA's benchmark of 10%. To include unaccounted-for water, the average annual total production of FY20-23, 1,877 AFY (1,166 gpm) was used to estimate average annual demand of the system.

Table 2-3: Production vs. Consumption (Acre-Feet)

Average AFY	FY20-21	FY21-22	FY22-23	3-yr Average (AFY)	3-yr Average (gpm)
Production	1,948	2,016	1,666	1,877	1,166
Consumption	1,766	1,735	1,495	1,665	1,034
Consumption / Production (%)	91%	86%	90%	89%	89%

Figure 2-3: Monthly Water Production vs. Consumption (Acre-Feet)



2.4.3 Future Demands

2.4.3.1 Projected Average-Day Demand

Total water uses in the City has generally decreased in the past 3 years. Due to current and planned water conservation measures and programs implemented by the City, it is estimated that water usage will remain similar over the next 20 years. From the past 3 years' (FY 2020-2023) billing records, calculated water use (gpd) per capita dipped slightly in FY22-23 but remained relatively constant the previous two years. A conservative estimate of 158 gpd per-capita was therefore used to estimated projected demands for 2030, 2035, 2040, and 2045, as shown in Table 4-4.

The existing City population in recent years were from US Census. The projected population for 2030, 2035 and 2040 were directly referencing the *2020 Urban Water Management Plan (UWMP, Table 3-5, Population – Current and Projected)*. The projected population for 2045 was assuming growth of 200 persons between 2040 and 2045 (same method used in the 2020 UWMP to project the 2040 population).

Existing demand and demand projections for 2030, 2035, 2040, and 2045 for each pressure zone are presented in Table 2-5. Based on the spatial join between the City's billing records and water meter GIS layer, 76% of the total system demand is placed within Zone 1 with 14% in Zone 2 and 10% in Zone 3/3A.

Table 4-4: Projected Water Demands, Total ADD

	Existing Demands			Projected Demands			
Year	FY 20-21	FY 21-22	FY 22-23	2030	2035	2040	2045
City Population	11,559	11,381	11,249	12,045	12,212	12,412	12,612
Population Growth %	-	-1.5%	-1.2%	-	1.4%	1.6%	1.6%
Water Production (gpd) Per Capita	151	158	132	158	158	158	158
Water Demand (AFY)	1,948	2,016	1,666	2,128	2,157	2,193	2,228
Water Demand (gpm)	1,210	1,252	1,035	1,322	1,340	1,362	1,384

2.4.3.2 Projected Maximum-Day and Peak-Hour Demand

Multiplying the MDD/ADD and PHD/ADD peaking factor by the ADD of the City's water distribution system for 2030, 2035, 2040, and 2045, results in the estimated MDD and PHD shown in Table 2-5.

Table 2-5: Demands by Zone

	Zone 1	Zone 2	Zone 3	Total
Existing				
ADD	890	161	114	1,166
MDD	1,513	275	194	1,982
PHD	2,875	522	369	3,766
2030				
ADD	1,009	183	130	1,322
MDD	1,716	311	220	2,247
PHD	3,260	591	418	4,270
2035				
ADD	1,018	174	147	1,340
MDD	1,739	316	223	2,278
PHD	3,305	599	424	4,328
2040				
ADD	1,035	177	150	1,362
MDD	1,768	321	227	2,315
PHD	3,359	609	431	4,399
2045				
ADD	1,052	180	152	1,384
MDD	1,796	326	231	2,353
PHD	3,413	619	438	4,470

2.4.4 Peaking Factors

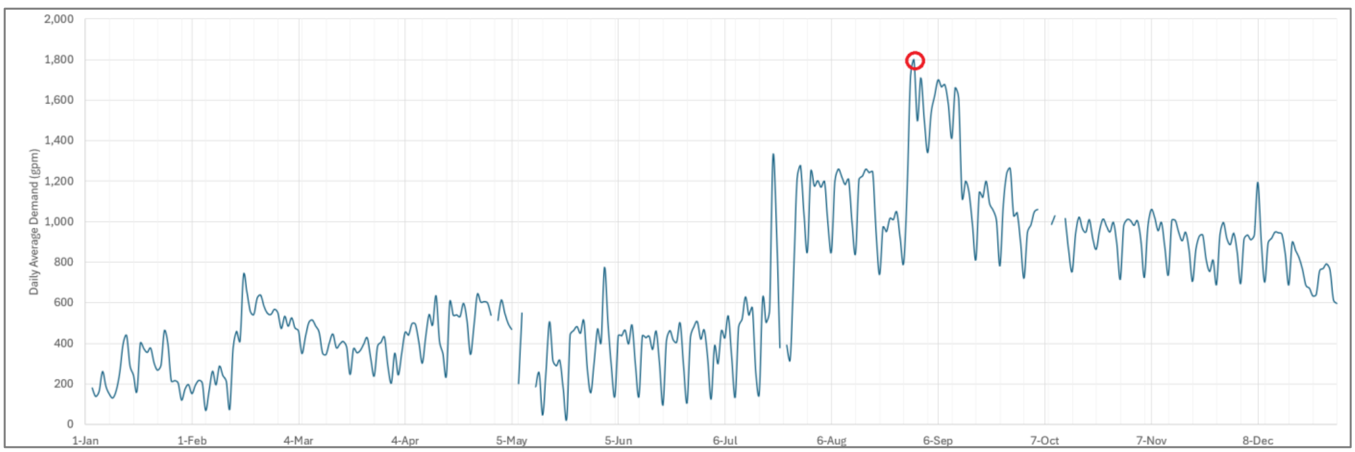
2.4.4.1 Maximum-Day Demands (MDD)

The maximum-day demand (MDD) represents the largest demand day of a given year. This is determined by applying a maximum-day demand factor to the annual average day demand (ADD). To find the day with the maximum demand of the year, Dudek conducted a water balance analysis of the City's entire system, using SCADA data of the storage level changes and flows at key locations.

As a result, the daily demand in 2023 is plotted in Figure *2-4*. Daily demand increases in the summer, and peaked on August 30th, 2023, at 1,797 gpm. MDD/ADD factor was therefore calculated to be 1.67 (the ADD of FY22-23 was 1,074 gpm based on production data). For this mater plan, the MDD/ADD peaking factor is rounded up to 1.7 to be conservative.

MWD flow data was unavailable from January to June, therefore daily demand shown in Figure *2-4* for those months is lower than in Autumn and Winter. However, since the main purpose of this analysis is to find the max daily demand, which historically tends to happen in July and August, this lack of data does not impact the result.

Figure 2-4: Daily Peaking Factor, 2023



**MWD flow data unavailable from January to June. Actual demand in those months is higher than shown.*

2.4.4.2 Peak Hour Demands (PHD)

Peak-hour demand refers to the largest single-hour demand of the year, and this event may or may not occur on the maximum-day in a given year. The peak-hour demand is determined by multiplying the peak-hour demand factor to the average-day demand for that year.

Dudek conducted hourly water balance analysis for all days in August 2023 (maximum month of 2023) using SCADA data. The weekdays between August 1 and August 21 generally showed a morning peak near 8am, as shown in Figure 2-5. The peakiest day was August 21, 2023, with a with PHD/MDD factor of 1.88 at 8am. A peak-hour demand factor of 1.9 was used for this master plan. Peaking factors are summarized in Table 2-6.

Figure 2-5: Hourly Peaking Factor, Weekdays in August 2023

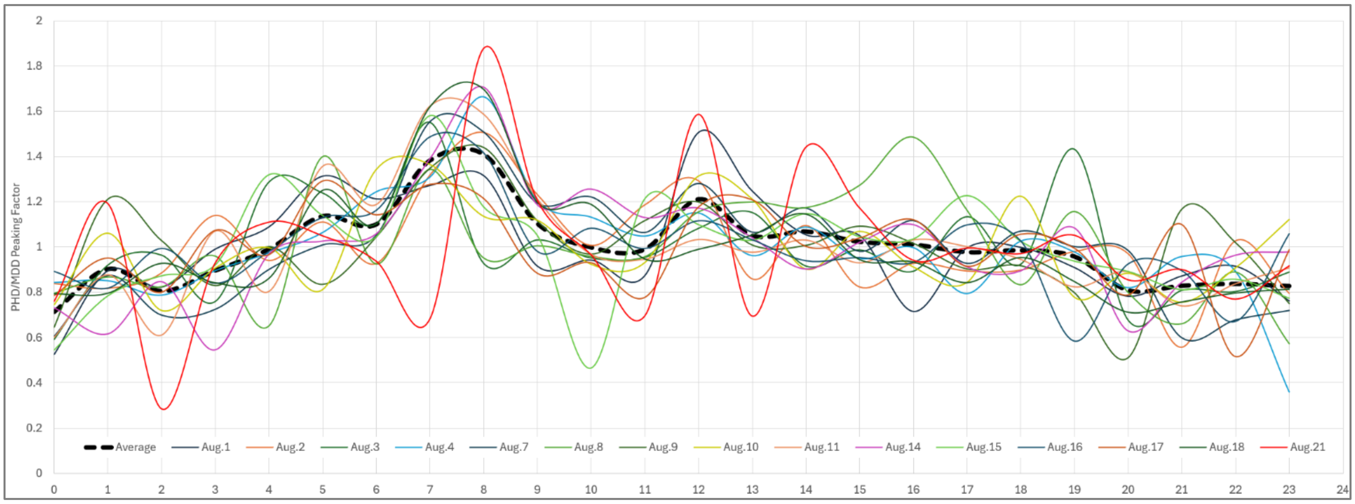


Table 2-6: Peaking Factors

	Peaking Factor (Value x ADD)
Average (ADD)	1.0
Max Day (MDD)	1.7
Peak Hour (PHD)	3.23

2.4.5 Historical Water Production

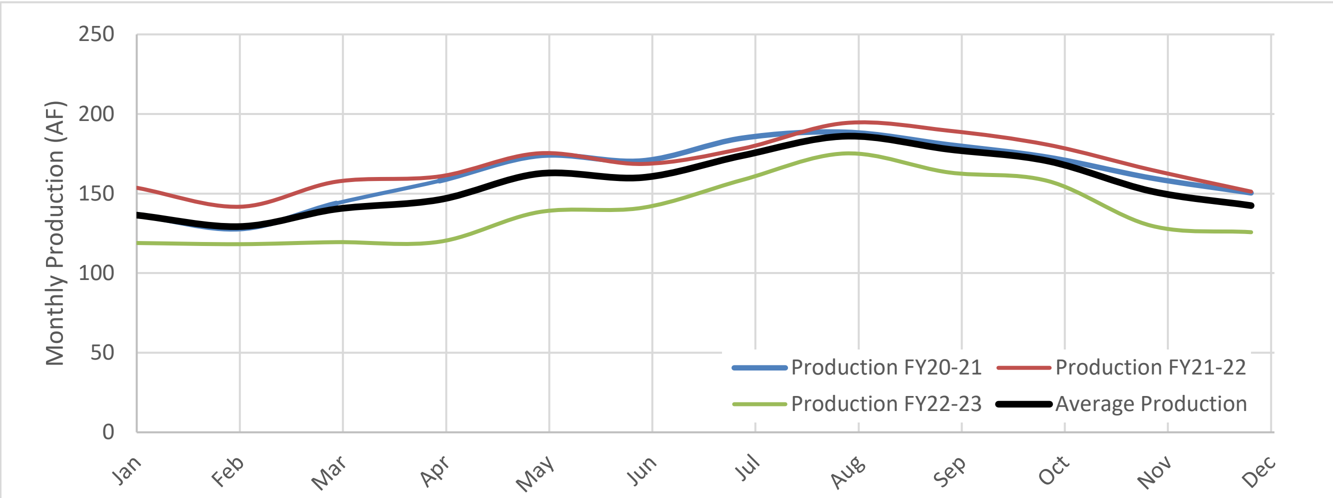
On June 10, 2022, the City's Water Conservation Program moved to Level 2 per mandate by the State Water Resources Control Board. Water usage therefore dropped in FY22-23 compared to the previous two years. The total water production in the City, including groundwater production and import water purchase, are shown in Table 2-7 and Figure 2-6.

Table 2-7: Total Monthly Water Production (Acre-Feet)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (AF)	Ratio to 3-yr Average
FY20-21	137	128	144	158	174	171	185	189	181	173	160	150	1,948	104%
FY21-22	154	142	157	161	175	169	178	194	190	181	165	151	2,016	107%
FY22-23	119	118	119*	120*	138	141	159	175	163	158	130	126	1,666	89%
Average (AF)	**136**	**129**	**140**	**146**	**163**	**160**	**174**	**186**	**178**	**170**	**151**	**142**	**1,877**	**100%**

Note: *Data edited to fix reading error.

Figure 2-6: Monthly Water Production (Acre-Feet)

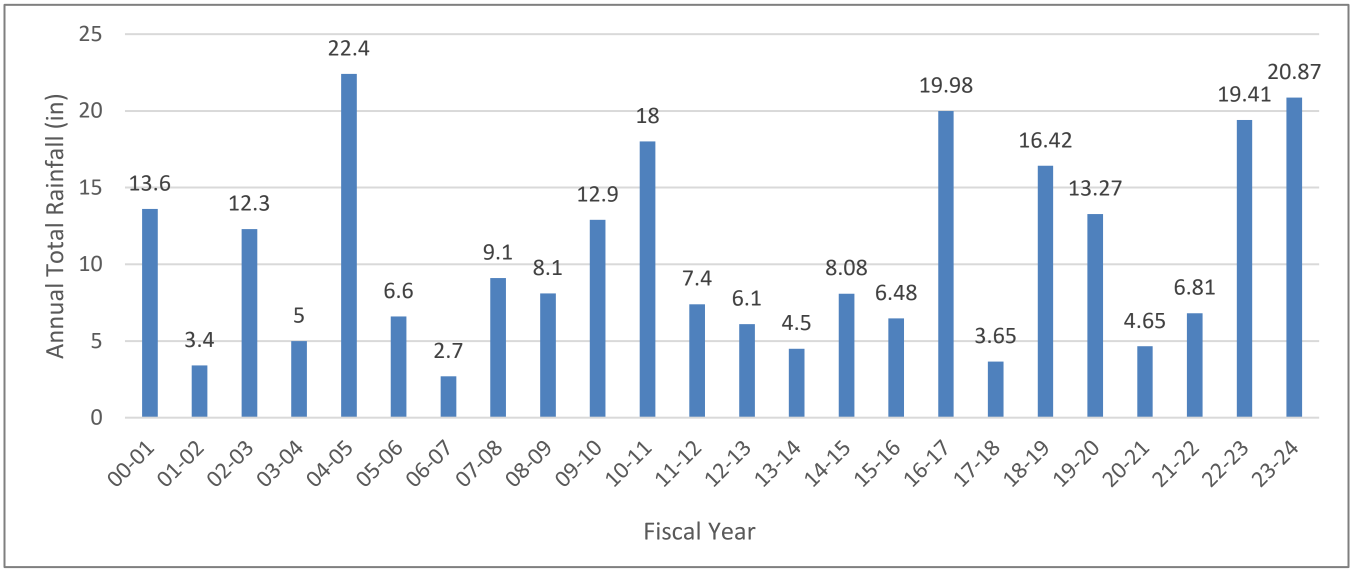


Annual rainfall conditions are important to track, as rainfall can affect water demand (especially for irrigation) and generate some recharge of the underlying groundwater aquifer during wet years. Table 2-4 shows historical rainfall at the City of Signal Hill Rain Gauge Station. As shown, annual rainfall has varied substantially since 2000 and averaged 9.80 inches per year.

Table 2-8: Historical Rainfall at Signal Hill Rain Gauge Station (inch)

Year	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	Avg.
Annual Total	13.6	3.4	12.3	5	22.4	6.6	2.7	9.1	8.1	12.9	18	7.4	
Year	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	11.2
Annual Total	6.1	4.5	8.1	6.5	20.0	3.7	16.4	13.3	4.7	6.81	19.4	23.5	

Figure 2-7: Historical Rainfall at Signal Hill (inch)



3 Water Supply

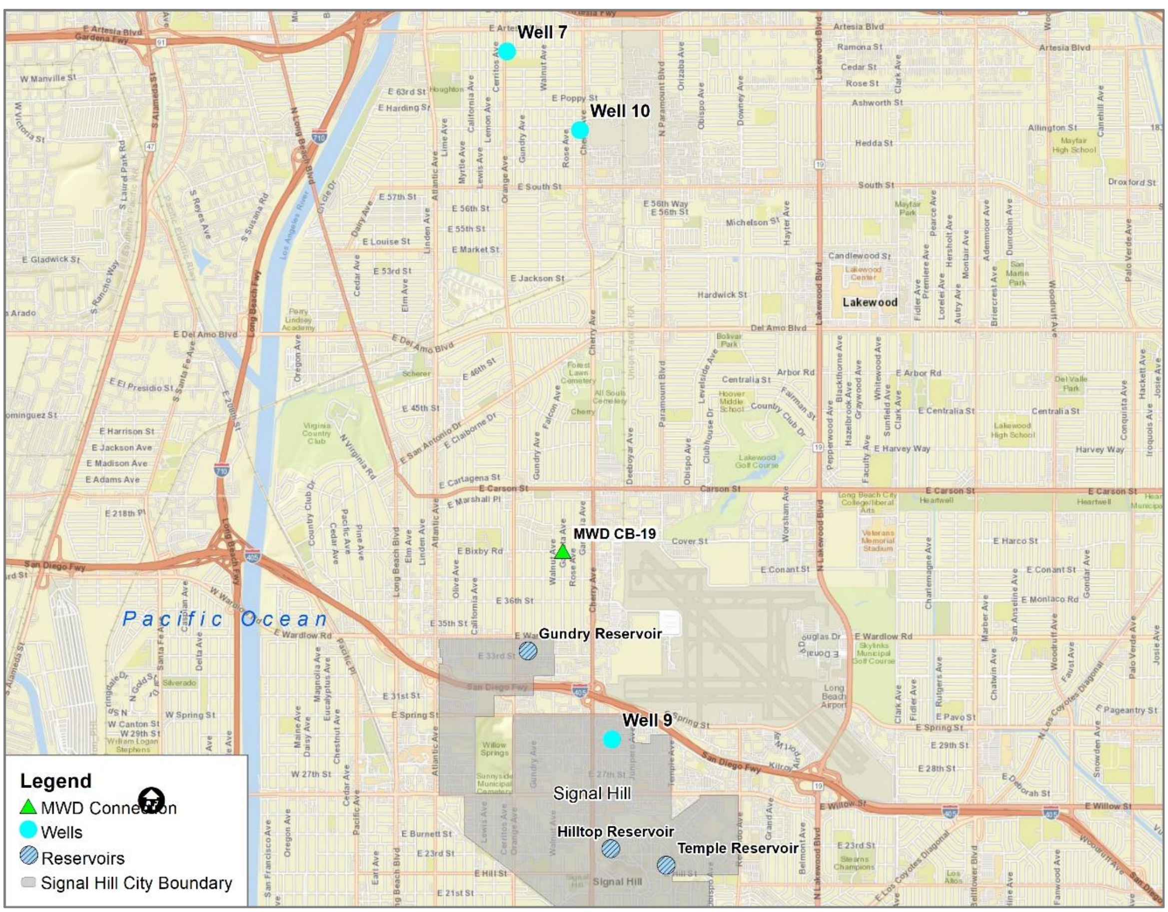
3.1 Overview

The City of Signal Hill water supply is primarily groundwater from local wells drawing from the Central Basin aquifer. The Central Basin is an adjudicated basin managed by the Water Replenishment District of Southern California. There are currently three wells in operation: Well No. 7, No. 9, and No. 10. Well No. 10 replaced No. 8 in 2024. Both Well Nos. 7 and 10 are outside of the City of Signal Hill service area and pump water from the Central Basin aquifer into a transmission pipeline for conveyance to the Gundry Reservoir site prior to distribution to the City's service area. As such, the Gundry Reservoir acts as a general "forebay" to receive water from the existing wells for centralized treatment and disinfection before the water is distributed. Well No. 9 is located within the City and the groundwater pumped from it goes through treatment before being pumped into the distribution system.

In addition, the City of Signal Hill augments water supply with imported water purchased through Central Basin Municipal Water District (CBMWD), which is an agency member to MWD.

Figure 3-1 shows the location of Well Nos. 7, 9 and 10, and MWD connection.

Figure 3-1: Existing Supply Locations



3.2 Groundwater Supply

The City of Signal Hill produces groundwater from the Central Basin aquifer. Over the years, the City has owned four groundwater production wells within the Central Basin. Well No. 6 was constructed in 1969. It operated until 1988 when a rupture in the well casing made the well unusable, and it was deemed inactive. In September 2000, the well was demolished. Well No. 7 was constructed in 1978, and Well No. 8 was constructed in 1980. Both wells are located within the City of Long Beach approximately 4.5 miles north of the Signal Hill service area. Well No. 7 is currently in service and Well No. 8 is currently offline.

Well No. 9 was constructed in 2008; however, due to groundwater quality issues, this well was not placed into service at the time. Treatment options for the water from Well No. 9 were explored. In 2016 and 2017 the well was prepared for return to operation and a treatment facility was built at the site. The well and treatment facility are now in operation, and Well 9 has begun to be utilized as a supply source to the City's distribution system.

At the time of this master plan update, Well No. 10 is currently under construction to replace Well No. 8. Upon completion, Well No. 6, 9, and 10 combined would have enough capacity to cover the majority demand of the City's water system.

3.2.1 Groundwater Entitlement

The City of Signal Hill is entitled to 2,022 acre-feet per year (AFY) from the Central Basin aquifer based on adjudications from the Los Angeles Superior Court. The judgment established the Central Basin Watermaster (Watermaster) as the regulatory agency responsible for managing the basin, and water rights have been adjudicated according to judgment in the Los Angeles Superior Court and succession from Atchison, Topeka & Santa Fe Railroad Company; Coast Water Company, and Perk/Lewis Foods. The Central Basin aquifer is now managed by the Water Replenishment District of Southern California.

Under the judgment, the Watermaster annually establishes the operating safe yield of the basin. The quantity of groundwater that each producer can pump is determined by applying a pumper's share in percent to the operating safe yield of the basin each year. The City of Signal Hill has prescriptive pumping rights to groundwater in the Central Basin equal to 2,022 AF based upon a percentage of the safe yield of total production from the aquifer. The Department of Water Resources previously confirmed that the judgment allows the City to over-extract 20 percent of the allowed pumping allocation plus any carryover provisions.

According to the latest annual report of Central Basin, in addition to the 2,022 AFY allowed pumping allocation in FY 2022-2023, Signal Hill has a net carryover of 1,920.9 AFY from FY 2021-2022, making a total right of 3942.90 AFY. Over the past three years, the water right balance stayed constant, and Signal Hill did not lease its water right to any other agencies. The annual groundwater extractions in Signal Hill in the past three years have been decreasing, at 1595.74 AF, 991.04 AF, 722.6 AF respectively.

3.2.2 Groundwater Quality

Enacted in 1974, the Safe Drinking Water Act (SDWA) regulates potable drinking water standards at the federal level. Under the SDWA, the U.S. Environmental Protection Agency (EPA) sets standards for drinking water quality and oversees the states, localities, and water suppliers who implement these standards.

The State of California Department of Public Health (CDPH) sets potable water quality standards through the Title 22 California Code of Regulations, which include primary and secondary maximum contaminant levels (MCLs). Primary MCLs are established for a number of organic and inorganic chemicals, trihalomethanes, and radioactivity as they relate to public health. Secondary MCLs are established for chemicals or characteristics as they relate to taste, odor, or appearance of drinking water. State MCLs are typically the same as Federal MCLs, or in some cases, more stringent.

The City of Signal Hill water supply maintains a water quality monitoring program consistent with CDPH requirements. The City provides Dudek with the monthly water quality monitoring reports of calendar year 2023, and it shows that the City water supply meets or exceeds all state and federal potable water quality standards and requirements on a consistent basis. The local groundwater undergoes minimal water treatment due to the fact that the water is typically of high quality.

City of Signal Hill disinfects groundwater by means of chloramination to promote greater ease of blending with the imported water, which is chloraminated, as well. The City historically used chlorination as its disinfection method, however, changes were made to transition to chloramination in order to minimize complications when blending with the chloraminated imported water from MWD. Transitioning the entire system to chloramination reduces any disinfection issues during periods of time when the local groundwater supply is augmented with imported water.

The City currently operates a filtration plant at the Gundry Reservoir site, which chloraminated and then filtered water from Well 7 and Well 10 through a greensand filter system to treat for iron, manganese, and arsenic. The Gundry treatment facility does not treat PFOA and PFOS, of which the Maximum Contaminant Level (MCLs) is required by water control resource board. Chloramination is also conducted at the site of Gundry Reservoir, Temple Reservoir and Well 9.

A 20-inch transmission pipeline from the well heads conveys groundwater produced from the City wells to the Gundry Reservoir. The water is chloraminated prior to entry into the Gundry reservoir and then chloraminated again and conveyed via a booster pump station to the Temple Reservoir. The Temple Reservoir provides gravity storage for Zone 1, pressurizes Zone 2 by means of a booster pump station, and functions as a forebay for water pumped to the Hilltop Reservoir. Chloramination at the Temple Reservoir is planned to ensure chlorine residual is maintained throughout the system, and this is most critical during periods of low demand.

3.2.3 Groundwater Capacity

There are three wells that the City of Signal Hill operates, Well Nos. 7, 9, and 10. Well Nos. 7 and 10 are outside of the City of Signal Hill service area and pump water from the Central Basin aquifer into a transmission pipeline for conveyance to the City's service area. A replenishment assessment is paid to Water Replenishment District (WRD) for each acre-foot of water pumped out of the Central Basin aquifer. Well 9 is within the City of Signal Hill and is capable of 1,200 gpm production, which would be decreased to 650 gpm once Well 10 is in operation.

Figure 3-1 shows the location of Well Nos. 7, 9 and 10.

Well 7

Well No. 7 was constructed in 1978 and is located at 6476 Orange Avenue south of 65th Street in the City of Long Beach. Information available from the well log states that Well No. 7 was drilled to a depth of 1,032 feet, and the maximum production rate was estimated to be 1,830 GPM at the time of construction. Production data for Well No.

7 in the past three years shows a decreasing trend, at an annual average production of 585 gpm, 403 gpm and 281 gpm, in FY 2020-2023.

An evaluation of Well No. 7 was performed by Richard Slade and Associates, with a summary memorandum distributed May 2010. It was noted that the new stainless steel casing liner installed in 2005 has extended the life of the well. Over time, the annulus will eventually become clogged with biological growths and successive well rehabilitation events could become increasingly less effective. Additionally, Well 7 is currently sanding and therefore would be advised to be replaced with in the next 3-4 years.

Well 9

Well 9 drilled in the City of Signal Hill's Public Works Yard at 2175 28th Street in 2008. Due to issues with the groundwater color, it was not immediately placed into operation. However, Well 9 now incorporates a treatment facility that was constructed in 2016/2017 and put into operation in 2018. Well 9 is currently pumping at a rate of 650 to 700 gpm when it's operating. The average annual production of Well 9 in the past three years shows a decreasing trend, at 650 AFY, 340 AFY, 270 AFY respectively. Well 9 has not been operating since October 2022 according to the City's monthly production data.

Well 9 has a full design capacity of 1200 gpm to meet future demand but would need to be redrilled, repacked, and redeveloped.

Well 10

Well 10 is located at 6065 Cherry Ave. Well 10 has a design capacity of 1,200 GPM and will be replacing the old Well 8 at proximity. Currently the Well 10 site is experiencing vandalism due to lack of fencing.

Table 5-1 summarizes the City of Signal Hill's existing well capacities.

Table 5-1: Existing City Well Capacities

Well	Year Drilled	Depth (ft)	Groundwater Basin	Rated Capacity (gpm)	Current Production [1] (gpm)	Status
No. 6	1969	844	Central	N/A	0	Demolished
No. 7	1978	1,032	Central	1,000	423	Active
No. 8	1980	1,020	Central	500	0	Offline
No. 9	2008		Central	650	261	Active
No. 10	2024		Central	1,200		Under Construction
Total (GPM)				**3,350**		

Note:[1] FY 2020-2023 three-year average per City's monthly production data.

3.3 Imported Water Supply

The City of Signal Hill also has the capability to import water through the MWD Connection Central Basin-19 (CB-19), which has a capacity to provide up to 3,300 gallons per minute (GPM) of imported water. The connection is located in Bixby Road near Gaviota Street. A 12-inch flow control valve located near the intersection of Walnut Avenue and 33rd Street (Walnut PRS) permits diversion of the flow directly to the Gundry Reservoir, located a few blocks away from the turnout. The imported water supplies Zone 1 of the City's distribution system through the Walnut Pressure Reducing and Flow Control Facility when additional water is required to augment the supply from the wells.

Figure 3-1 shows the location of the MWD (CB-19) connection. Downstream of CB-19, there are two other PRS that allows MWD line to directly feed Hilltop Reservoir and to Zone 3 respectively (Table 4-3).

3.4 Groundwater vs. Imported Water Supply

The majority of the City of Signal Hill water system demands can be met by the available local groundwater supply. The City of Signal Hill has typically utilized imported water to meet peak season demands. The imported water is generally supplied across a four or five month dry-weather period when system demand exceeds maximum groundwater supply. The existing MWD turnout CB-19 has a capacity of 3,300 GPM. As of 2024, the combined supply capacity of the City's operating wells (Nos. 7, 9 and 10) is 2,850 gpm. As the system currently operates, imported water is the only backup supply source if either wells were to experience significant downtime for maintenance or failure.

Table 5-2 depicts the comparison between the quantity of groundwater produced and the amount of imported water purchased in a three-year period beginning with fiscal year 2020-2021. The percentage of imported water has been rising in the past three years.

Table 5-2: Groundwater Production vs. Imported Water Purchases

Supply (AFY)	FY 2020-2021	FY 2021-2022	FY 2022-2023
Total Groundwater	1,596	991	723
Imported Water	352	1,025	944
Total	1,948	2,016	1,666
% Imported Water	18%	51%	57%

The cost of imported water is on the rise. Table 5-3 shows the historical rates for Tier 1 full service treated volumetric cost ($/AF).

Table 5-3: MWD Projected Water Cost

Year	Cost ($/AF)	Year	Cost ($/AF)
2016	942	2021	1,104
2017	979	2022	1,143
2018	1,015	2023	1,209
2019	1,050	2024	1,256
2020	1,078		

Ref: MWD Rate Structure Administrative Procedures Handbook

With the construction of the new Well 10, the City is expected to rely less on imported water. See Section 5.6 for evaluations of supply options under different operating conditions.

<u>Groundwater Storage Plan</u>

The City of Signal Hill, along with the Cities of Cerritos, Downey, Lakewood, and Long Beach created a new groundwater storage plan, which was approved by the Los Angeles Superior Court on December 18, 2013. This plan was created to ensure the sustainability of the water supply in Southeast Los Angeles County, and unlike the previous agreement in 1965, this agreement allows for the storage of groundwater. This permits participating cities to store water into the underground water table and pump it out when necessary and provides the flexibility for the participating cities to purchase water at lower costs during wet years and store the water for use during dry years when purchase costs for water are higher. Under the new agreement, the City of Signal Hill has water rights to pump 2,022 AF per year, in addition to the capability to store an additional 50 percent of the water right allotment and carry-over any unused water up to 60 percent of the water rights in any given year.

3.5 Emergency Connections

The City of Signal Hill has historically participated in an emergency mutual-aid water connection with the City of Long Beach. In an emergency condition, the City of Long Beach has the ability to provide the City of Signal Hill with a 750-800 GPM supply capacity. The connection is located in Willow St and has no meter. It connects a 20-inch Long Beach Main to a 12-inch Signal Hill main through an 8-inch intertie.

Available records indicate that the interconnection was last exercised in August 1983. There is no meter installed at the connection, and therefore, there is no charge for the water consumed. Historical data indicates that the pressure on the Signal Hill side of the connection is slightly higher than the pressure on the Long Beach side. It is recommended that the interconnection be exercised on a regular basis and that a meter be installed to ensure proper operation.

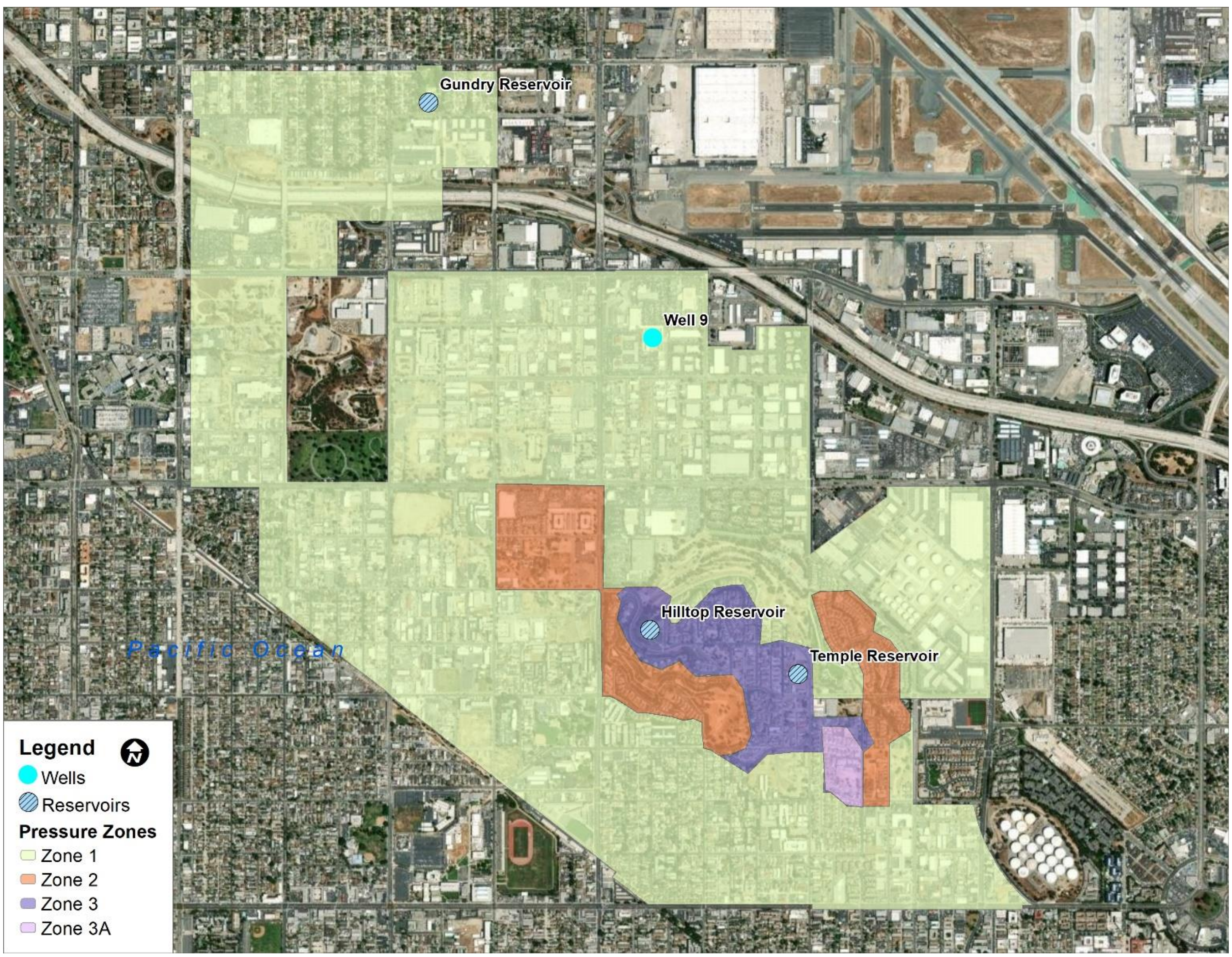
In 2017, an emergency connection to City of Lakewood was built at the 3800 block of Cherry Avenue (City of Long Beach). The vault/interconnection was connected to the City of Signal Hill's new 6" pipeline ending at the sidewalk. On May 24th, 2022, Signal Hill's City Council approved a water interconnection agreement amendment that permits the City of Lakewood to provide treated potable water at a 15% discounted rate instead of the regular rate with the Metropolitan Water District of Southern California as to the City of Signal Hill.

4 System Facilities

4.1 Pressure Zones

Signal Hill's potable water system consists of three (3) pressure zones: Zone 1, Zone 2 and Zone 3, and one sub-zone referred to as Zone 3A, as topography in the City varies significantly. The sub-zone was created after it was determined that the area could not receive normal operating pressure when served directly from Zone 2 or 3. To resolve this, the City created the sub-zone, which receives water through an existing pressure reducing station off the Zone 3 system. Ground elevations within the City of Signal Hill service area range from 20 feet to 358 feet above mean sea level. Elevations are highest toward a central region of the City, and lower elevations occur along the City boundary. As a result, the Zone 1 service area primarily exists near the City perimeter, and the higher pressure; Zone 2 and 3 are located in the central area generally located south of Willow Street and east of Walnut Avenue. These pressure zones are shown graphically in **Figure *4-1***.

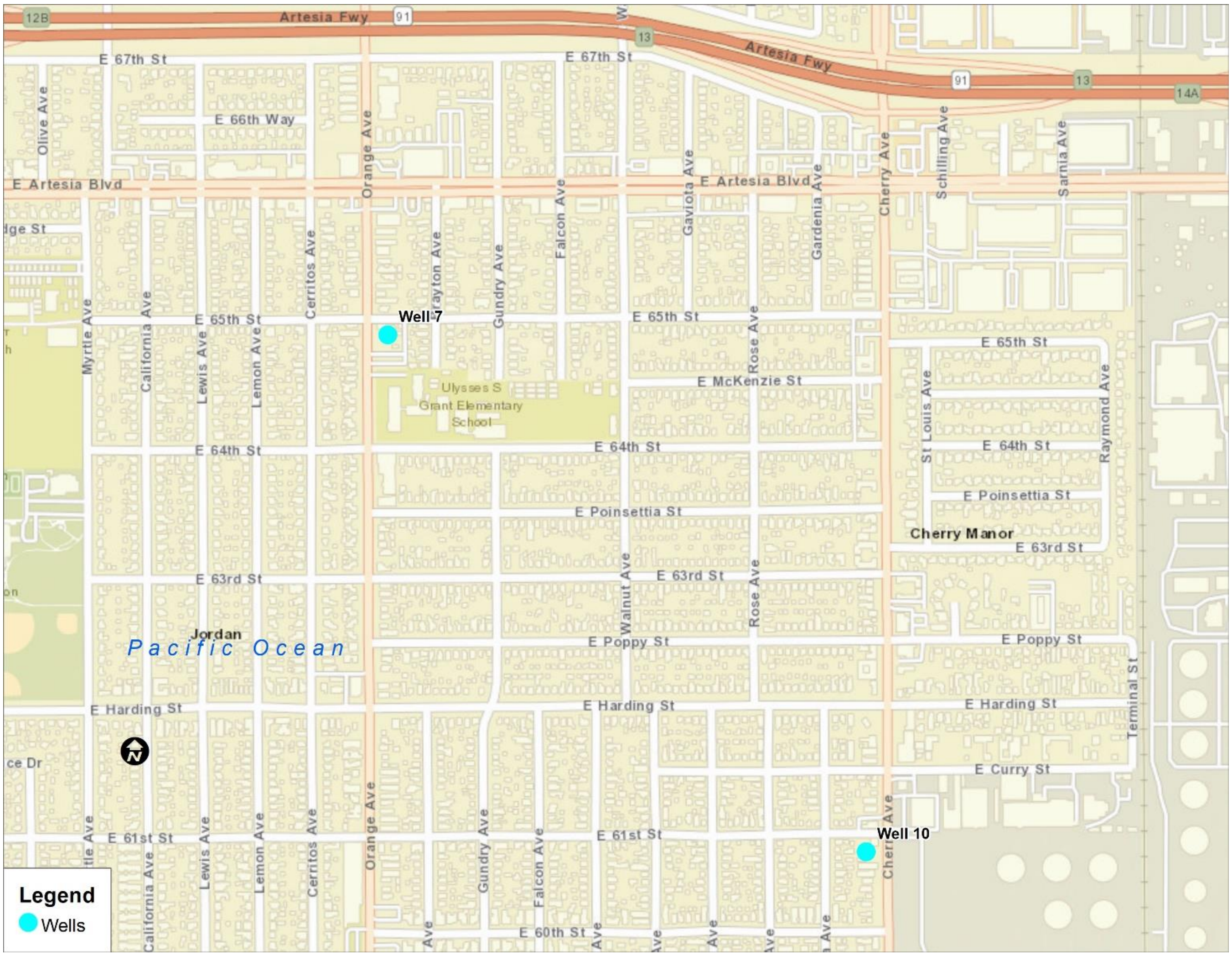
Figure 4-1: Existing Pressure Zones



4.2 Wells

The City has three groundwater production wells. Well 9 (650 gpm) is located within the City's service area, as shown in **Figure 4-1**. Well 7 (1,000 gpm) is located on Orange Ave in the City of Long Beach, about 5 miles to the north of Signal Hill's service area. Well 10 (1,200 gpm) was recently drilled, in replace of the demolished Well 8 near the same site on Cherry Ave, also located in Long Beach (**Figure 4-2**). Both Well 7 and Well 10 pump into the Gundry Reservoir, which is located on the north boundary of Signal Hill's service area.

Figure 4-2: Existing Wells



4.3 Existing Storage Reservoirs

Signal Hill has three (3) reservoirs that provide storage to the system. The total existing storage for the City of Signal Hill is 7.3 million gallons (MG). The majority of the storage is at the forebay level, in the 4.7 MG capacity Gundry Reservoir. Within Zone 1, the Temple Reservoir stores 1.4 MG. Zone 2 storage is 1.2 MG in the Hilltop Reservoir. A summary of existing storage of the City of Signal Hill is provided in Table 4-1.

Table 4-1: Potable Water Storage Reservoirs

Name	Zone	Elevation (ft)	Maximum Level (ft)	HWL (ft)	Dimension	Vol (MG)
Gundry Reservoir	Gundry	50	20	70	200' Diameter	4.7
Temple Reservoir	I	228	25	253	68' x 120' rectangular base	1.4
Hilltop Reservoir	II	311	22	332	97.5' Diameter	1.2
					Total:	**7.3**

Gundry Reservoir is a partially buried circular concrete tank with a metal roof and a storage capacity of 4.7 MG. The reservoir is an important facility for the City of Signal Hill as water supply from Well Nos. 7 and 8 are conveyed to and from the reservoir in route to Zone 1, and the higher-pressure zones. The inside of Gundry Reservoir was recoated in 2006. Groundwater treatment facilities located at the same site as the reservoir and pump station are discussed further in Section 4.8.

Temple Reservoir serves Zone 1 by gravity with a high water level of 253 feet. The reservoir has a storage capacity of 1.4 MG. It was constructed as a rectangular concrete structure with a bottom elevation of 229.75 feet, measuring 68 feet in width and 120 feet in length. The Temple Reservoir stores water for Zone 1 gravity service as well as fire storage for Zone 2 and 3. This is due to the existence of two dedicated sets of fire pumps at the Temple Pump Station equipped to deliver water to Zones 2 and 3.

Hilltop Reservoir is a 1.2 MG circular pre-stressed concrete tank that serves Zone 2 by gravity and enables storage for water to be pumped to Zone 3. The reservoir is located near the intersection of Skyline Drive and Dawson Avenue. It was constructed with a bottom elevation of 313 feet, high water level of 33 feet, and a diameter of 100 feet. During construction the tank was fully buried to enable a park to be constructed above it.

4.4 Pump Stations

Signal Hill has four (4) booster pump stations that move water from the lower to higher pressure zones. Gundry PS (5,000 gpm) is the system's main water supply into Signal Hill and pumps water from the Gundry Reservoir to the Temple Reservoir. From Temple Reservoir, the Temple PS has two sets of pumps: the first set of pumps provide 1,500 gpm capacity to Hill top Reservoir (Zone II); the second set of pumps provide 3,100 gpm capacity to Zone III, among which 2,500 gpm is a fire pump and the rest 600 gpm serves Zone III domestic demand as a backup. The Hilltop PS is the main supply to Zone III under normal operation, moving water from Hilltop Reservoir (Zone II) up to Zone III, then subsequently to Zone 3A through a PRS.

Existing booster pump station and pump information is provided in Table 4-2.

Table 4-2: Potable Water Booster Pump Stations

Pump Station	Supply Zone	Discharge Zone	No. Pumps	Total Capacity (GPM)	Firm Capacity (GPM)	Backup Generator
Gundry PS	Gundry Reservoir	I	4	5,000	3,750	Y
Temple PS	I	II	3	1,500	1,000	Y
Temple PS	I	III	3	3,100	600	Y
Hilltop PS	II	III	2	600	300	N

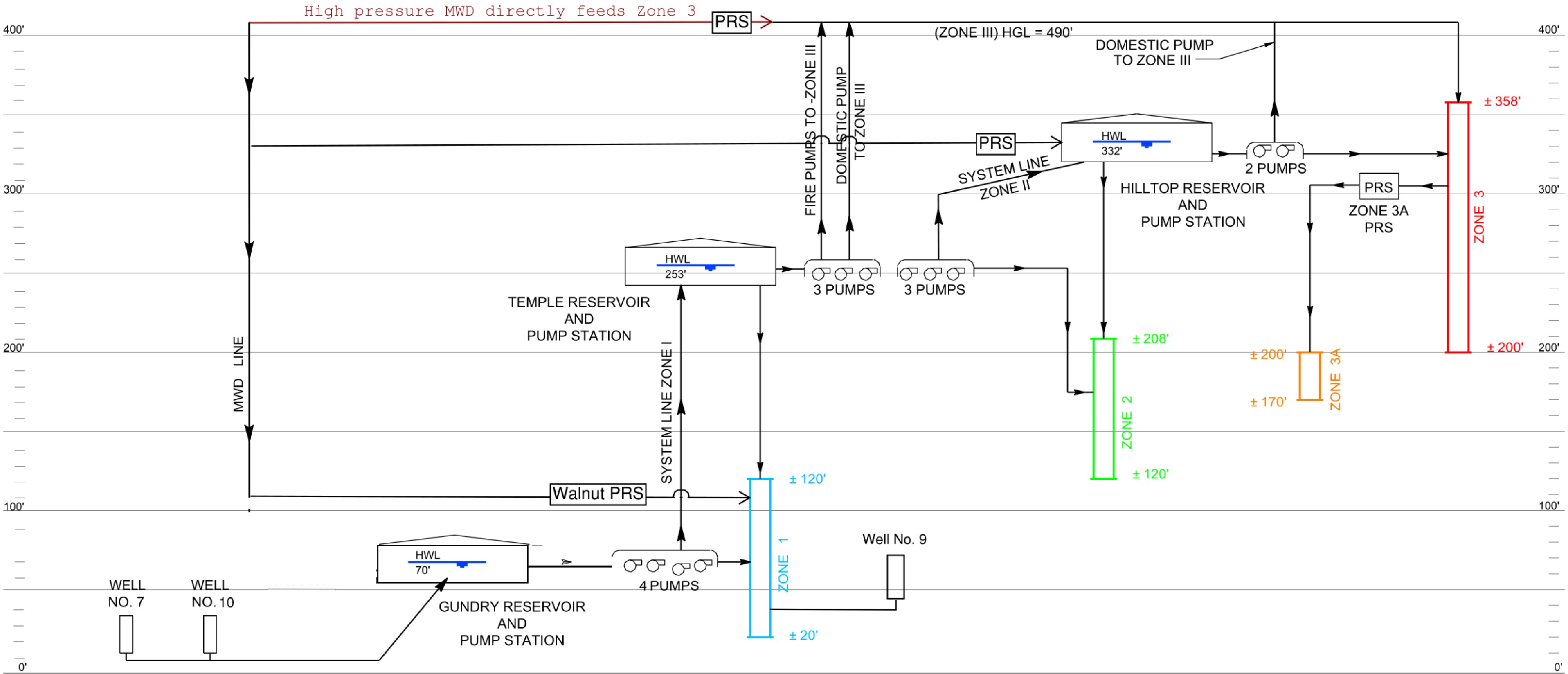
Gundry Pump Station currently has 4 electric driven pumps as shown in Table 4-3. Typical operation includes two of the pumps in lead/lag use. The lead electric driven pump operates regularly with a second pump used occasionally as demands dictate or when boosting water to Temple Reservoir. The other two pumps are standby units. Historically, the water system operates with a lead pump on for approximately 17 hours per day during the summer months. During winter months, the operating hours are typically reduced. To extend the service life of each of the four electric motor driven pumps, each pump is rotated into service to maintain approximately equal hours of operation.

The Temple Zone 2 pump station delivers water from Temple Reservoir to the Zone 2 Hilltop Reservoir at a high water level of 332 feet as well as directly into the Zone 2 distribution system. The Temple Zone 3 pump station delivers domestic and fire flow from Temple Reservoir directly into the Zone 3 distribution system with a high water level of 490 feet. The portion of the Temple pump station dedicated to pumping to the Zone 2 Hilltop Reservoir has sufficient capacity to pump the Zone 2 demands plus a portion of the Zone 3 maximum-day demand in a 16-hour period.

The Hilltop Pump Station is located on the same site as Hilltop Reservoir, pumping water to serve Zone 3.

Another consideration of the pump system operated by the City of Signal Hill is the pumping efficiency and its influence on annual energy use. According to pump efficiency tests conducted by Southern California Edison (SCE) leading up to the 2005 Water Master Plan, the pumps are operating at relatively low efficiencies (i.e., 60 to 65 percent), and the motors are exceeding their service factors at the rated pumping capacities. In 2012, the City of Signal Hill had the electric motors at Well No. 7 and the Gundry Pump Station replaced to increase efficiency.

Figure 4-3: Signal Hill Potable Water System Schematic



4.5 Imported Water Connection

The City of Signal Hill is able to receive imported water through a service connection off the MWD system. The service connection or turnout CENB-19 is located on the second lower feeder, and in Bixby Road near Gaviota Street. The service connection is rated at a maximum capacity of 7.5 cubic feet per second (CFS). The imported water is taken into the lower zone through Walnut Pressure Reducing and Flow Control Facility (Walnut PRS) located near the intersection of Walnut Avenue and 33rd Street (Walnut PRS and PCS). The hydraulic grade line of the MWD water typically ranges from 500 feet to 540 feet elevation. Pressure reducing stations (PRS) in the City of Signal Hill system are designed to take higher pressure water and reduce the hydraulic grade to 236 feet to 258 feet prior to transmission to the Zone 1 system.

4.6 Pressure Reducing Stations

There are four (4) pressure reducing stations (PRS) in the system, as detailed in Table 4-3**Error! Reference source not found.**. The imported water from MWD feeds into the Zone I through the Walnut PRS at around 100-ft hydraulic grade line (HGL). MWD High Pressure Line can also directly feed into Hilltop Reservoir through the Skyline PRS at around 330-ft HGL. There is also another PRS that allows direct MWD supply into Zone III at around 490-ft HGL.

Table 4-3: Existing Pressure Reducing Stations

PRS	Supply Zone	Discharge Zone
Walnut PRS	MWD	I
Skyline PRS	MWD	II (Hilltop Reservoir)
Zone III PRS	MWD	III
Zone 3A PRS	III	3A

4.7 Pipelines

The City of Signal Hill owns and maintains approximately 50 miles of distribution and transmission pipeline. A summary of the length of pipeline by material and age is provided in Table 4-4. 56% of the pipelines consists of aging cast iron or asbestos cement built before 1980. These pipelines would need to be relined or replaced. Relining comes with smaller capital cost but will not address external corrosion.

Table 4-4: Pipe Length Breakdown by Material/Age

Installation Year	Material						Total (ft)
	AC	CI	DI	STL	CML & C WSP	Unknown	
1960s	9,822	46		1,306			11,174
1970s	49,079	648	681	3,801		9	54,218
1980s	34,930		12,925			112	47,967
1990s	50		28,060		789		28,899
2005			1,993				1,993
2012			358				358
Unknown	16,918	76,918	30,780	4,278	14		128,908
Total	**110,799**	**77,611**	**74,796**	**9,385**	**804**	**121**	**273,516**
%	**41%**	**28%**	**27%**	**3%**	**0%**	**0%**	

4.8 Electrical and Controls

4.9 Water Treatment

The City of Signal Hill chloraminates its water supply and operates a filtration plant at the Gundry Reservoir site to remove arsenic, iron and manganese from source water received from Well Nos. 7 and 10.

Since the 2005 Water Master Plan, steps have been taken to convert the City's disinfection methods from chlorination to chloramination in an effort to increase the compatibility of the local groundwater supply with MWD water. An ancillary benefit of converting to chloramination is the potential reduction in the formation of total trihalomethanes (TTHMs). Available water quality reports show that TTHM levels are well below the MCL and not a typical concern in the water system. Future treatment options depend on preferences for future water supply and whether or not additional water treatment is required for each given option.

At the Gundry Reservoir site the City operates two filtration pressure vessels. The filtration system includes a sodium hypochlorite feed system to oxidize iron, manganese and arsenic.

The design criteria of the filtration system are:

- Total Design Flow = 3,000 GPM
- Design Flow per Vessel = 1,500 GPM
- Iron – treated to less than 10 ppm
- Manganese – treated to less than 10 ppb
- Arsenic – treated to less than 5 ppb

A liquid sodium hypochlorite and ammonia solution is used to chloraminate water supplied from Well Nos. 7 and 8 at the Gundry Reservoir site. On-site sodium hypochlorite generation capable of producing 150 pounds of chlorine a day was installed at Gundry Reservoir site. The equipment includes an electrolytic cell, control panel, transformer, brine injection pump, brine tank and water softener. A chlorine residual of 1.0mg/l was established as the target chlorine level leaving the Gundry Reservoir site and entering the distribution system.

A liquid sodium hypochlorite and ammonia solution is used to chloraminate water at Temple Reservoir. On-site sodium hypochlorite generation capable of producing 37 pounds of chlorine a day was installed at Temple Reservoir site. The hypochlorite generation system enables the City to maintain chlorine residual through Zone 2 and 3.

The same solution is also used at Well 9 treatment facility to chloraminate well water prior to distribution from the site.

5 Condition Assessment

6 System Evaluation Criteria

The potable water design criteria listed in this section were used to evaluate the existing water system under different modeled scenarios. These criteria were referenced from industry standards and other nearby water agencies in Southern California (e.g. Western Municipal Water District). The criteria were discussed with Signal Hill staff and were agreed upon in April 2024.

6.1 System Pressures

Potable water system pressure criteria are listed in Table 6-1 and were confirmed by Signal Hill staff in April 2024.

Table 6-1: Potable Water Pressure Criteria

Criteria	Recommended value
Minimum service pressure	40 psi
Maximum service pressure	150 psi
Maximum daily pressure fluctuation	20 psi

6.2 Pipeline Criteria

Potable water system pipeline criteria are listed in Table 6-2 and were confirmed by Signal Hill staff in April 2024.

Table 6-2: Potable Water Pipeline Criteria

Criteria	Recommended value
Maximum velocity (in transmission pipeline under replenishment conditions)	7 fps
Maximum velocity (in any water pipeline during PHD or MDD plus emergency fire flow conditions)	Aim for 7 fps, may temporarily reach up to 10 fps
Minimum transmission pipeline diameter size	12-inch

6.3 Fire Flow Criteria

The fire flow criteria in Table 6-3 were based on general land use designations, discussion with Signal Hill staff and guidelines from LA County Fire Department. These are intended only for general planning purposes and may not be reflective of the actual fire flow requirements sought for specific development approvals.

Table 6-3: Fire Flow Criteria

Structure	Flow (gpm)	Duration (hours)
Single Family Residential	1,250	2
Multi-Family Residential	2,500	2

Commercial (including schools)	3,500	3
Industrial	3,500	3

Note: Fire Flows to be supplied at a minimum residual pressure of 20 psi

6.4 Storage Capacity

Potable water storage facilities are required to meet the peak hour demand (PHD), maximum day demand (MDD), fire flow and other emergency conditions. The following criteria and were confirmed by Signal Hill staff in April 2024:

Equalizing Storage

Any peak demands (i.e. peak hour) greater than MDD must be supplied from storage. Equalizing storage provides the storage to meet these short-term peak demands. Twenty-five percent (25%) of the estimated MDD is used as the criteria needed to meet daily demand fluctuations within each pressure zone.

Fire Flow Storage

Fire flow requirements for each pressure zone must be met through storage. Fire flow requirements for each pressure zone are based on the land use in each pressure zone with the highest fire flow requirement per Table 6-3. This resulted in 0.15 MG fire flow storage required for Zone I (mostly low density residential); 0.3 MG for Zone II (Hilltop area, multi-family residential); and 0.63 MG for Zone III (Commercial and Industrial).

Emergency Storage

Emergency storage capacity is needed to sustain the water needs during periods of total or partial shutdown of the water supply facilities. 200% of the estimated ADD is used to calculate emergency storage by pressure zone.

6.5 Pump Station Capacity

Potable water system pump station criteria were discussed with Signal Hill staff in April 2024. Pump stations must have the firm capacity to meet dependent MDD for each pressure zone. The dependent MDD is the demand from the zone as well as any demand that must be transmitted through the zone to get to reach the intended zone. Firm capacity is the pump station's pumping capacity with the largest pump out of service.

7 System Analysis

7.1 Hydraulic Model

7.1.1 Existing Model

Dudek inherited an existing potable water hydraulic model of Signal Hill's system in Innovyze InfoWater. The existing model had all the major facilities and proper network connectivity but did not have any coordinate system assigned, therefore did not align with the City's streets.

7.1.2 Model Updates

Dudek assigned the correct coordinate system to the existing model and fixed the map display issue.

Dudek also reviewed the City's latest water main GIS data and confirmed that the pipe size in GIS matched the existing model.

Using the City's water meter shapefile, demand of each user was spatially allocated to the closest junction in the model. Based on the 3-year production data of Fiscal Year 2020 to 2023, the annual average demand for the entire system was estimated to be approximately 1,166 gpm, or 1.68 MGD. 94% of this total demand was successfully joined to model junctions, while the rest 6% (due to lack of account number in the water meter shapefile) was evenly distributed to all junctions in the system. This average annual demand (ADD) was saved in demand set "Existing_ADD" in the updated model.

Dudek reviewed the operational setpoints at the pump stations in the model and set the controls to maintain the average tank levels in their corresponding zones.

7.1.3 Model Calibration

Dudek conducted a fire flow calibration, using recent fire hydrant field test data available with the updated model. The test on Gardena Ave measured a static pressure of 84 psi. With ground elevation at 168 ft, this indicated a static head of 362 ft, which conflicted with the HGL of the nearby Hilltop Reservoir that normally runs between 310 and 330 ft of head. Therefore, this fire flow test was considered a reading error and not included in the calibration. The other four tests were replicated in the model without the need to change any C factors.

Table 7-1: Model Calibration

Fire Flow Test Location	Test Date	Zone	Flow Rate (gpm)	Measured Static Pressure (psi)	Measured Residual Pressure (psi)	Modeled Static Pressure (psi)	Modeled Residual Pressure (psi)	Static Pressure % diff.	Residual Pressure % diff.
2998 Cherry Ave	1/2/2024	I	1,126	68	64	71	66	4%	3%

1951 Cherry Ave	4/8/2022	I	1,384	100	94	100	95	0%	1%
720 E Canton St	July 2024	I	650	95	80	94	84	-1%	5%
2027 E 19th St	July 2024	I	1,300	110	105	104	100	-5%	-5%
2600 Gardena Ave	July 2024	II	993	84	79	66	n/a	-21%	n/a

All model simulations were performed as steady state, with storage tanks half full.

7.2 Pipeline Analysis

The model was run under Average Day Demand (ADD), Maximum Day Demand (MDD) and Peak Hour Demand (PHD) for both Existing and 2045 conditions. Results show there's no violation to the City's evaluation criteria in both scenarios. High velocity and high pressure were limited to the MWD import line, and low pressures under 40 psi were limited to transmission mains near storage tanks. Figure 7-1 and Figure 7-2 show the model results of 2045 scenario.

Figure 7-1: 2045 Peak Hour Demand (PHD) System Analysis

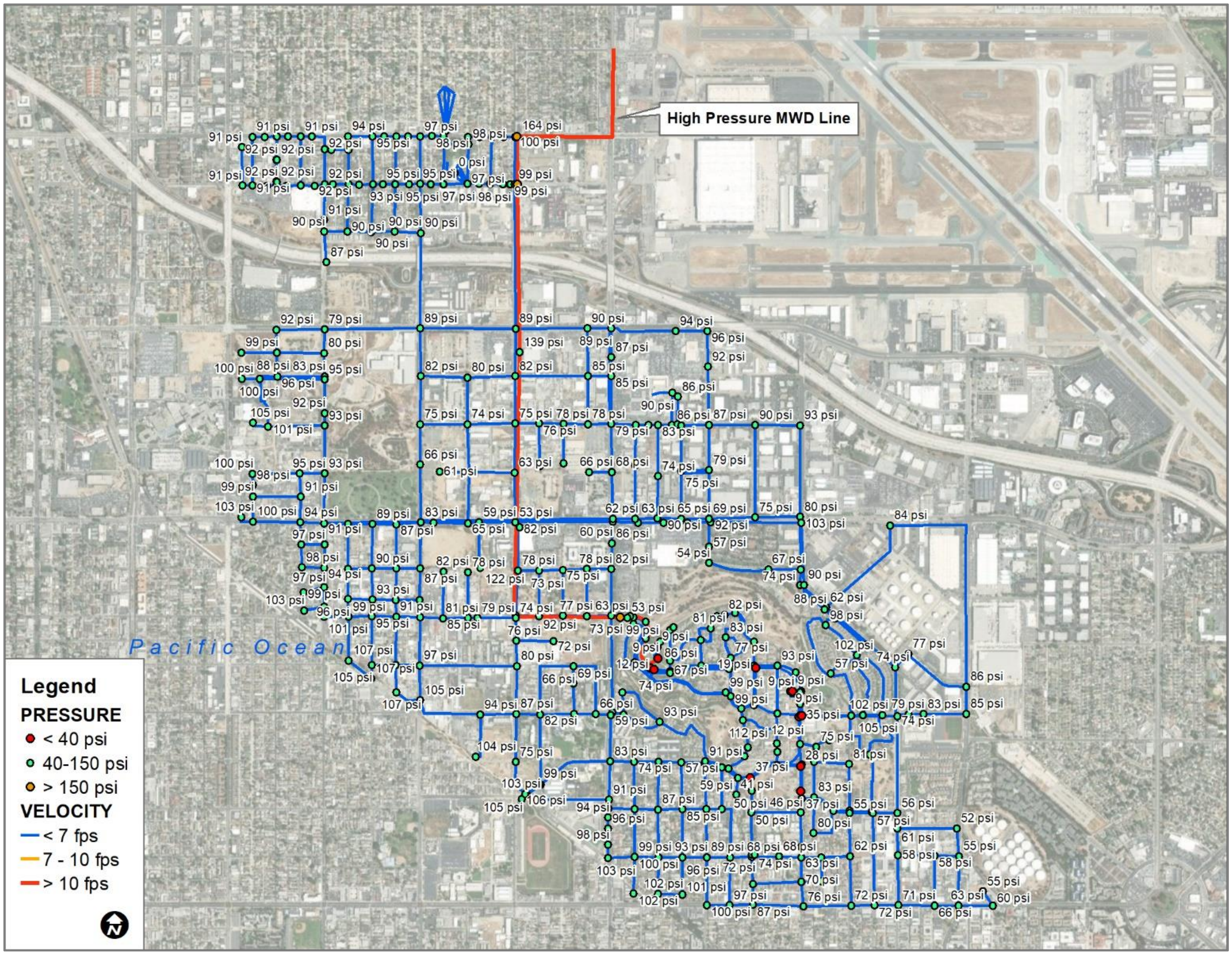
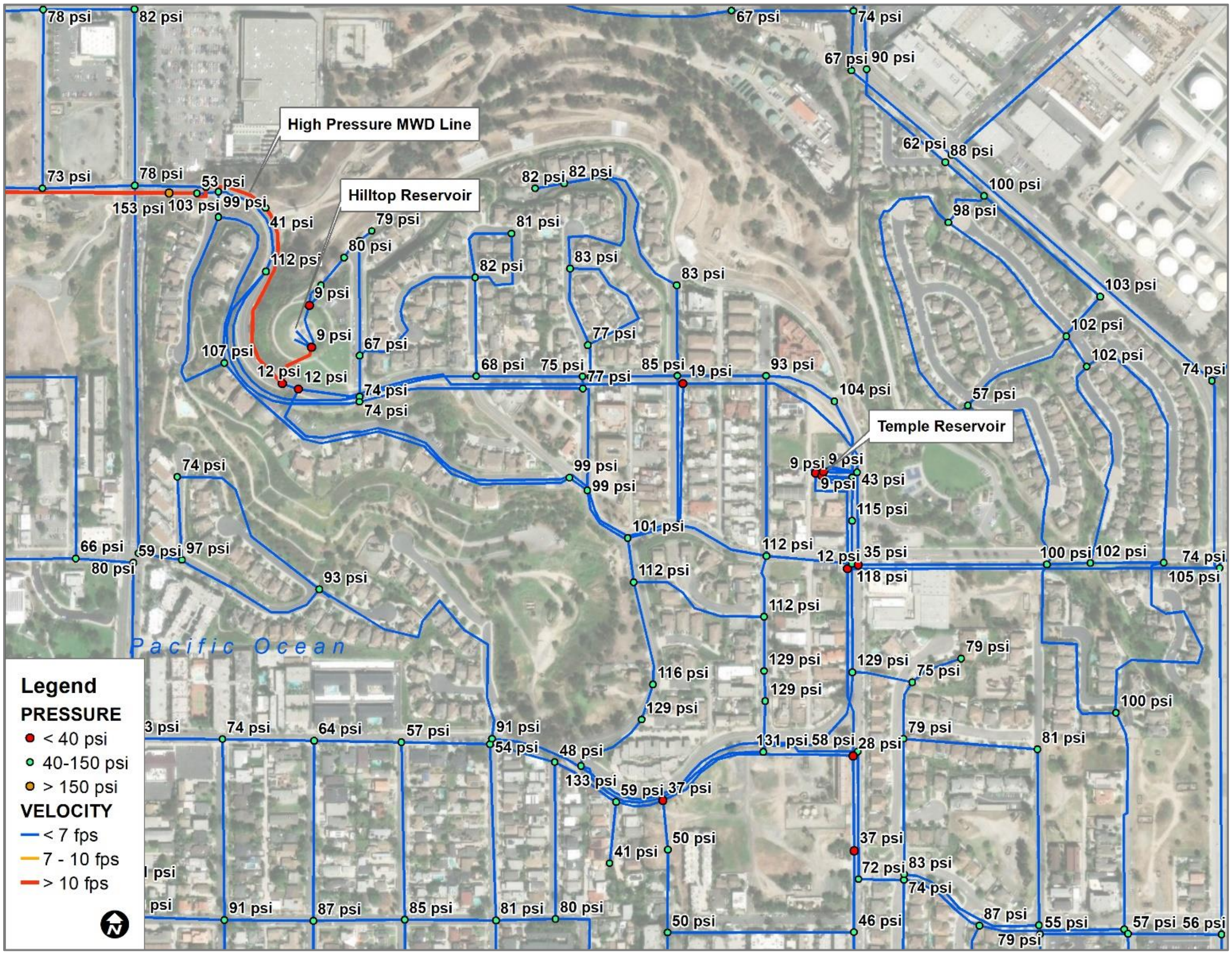


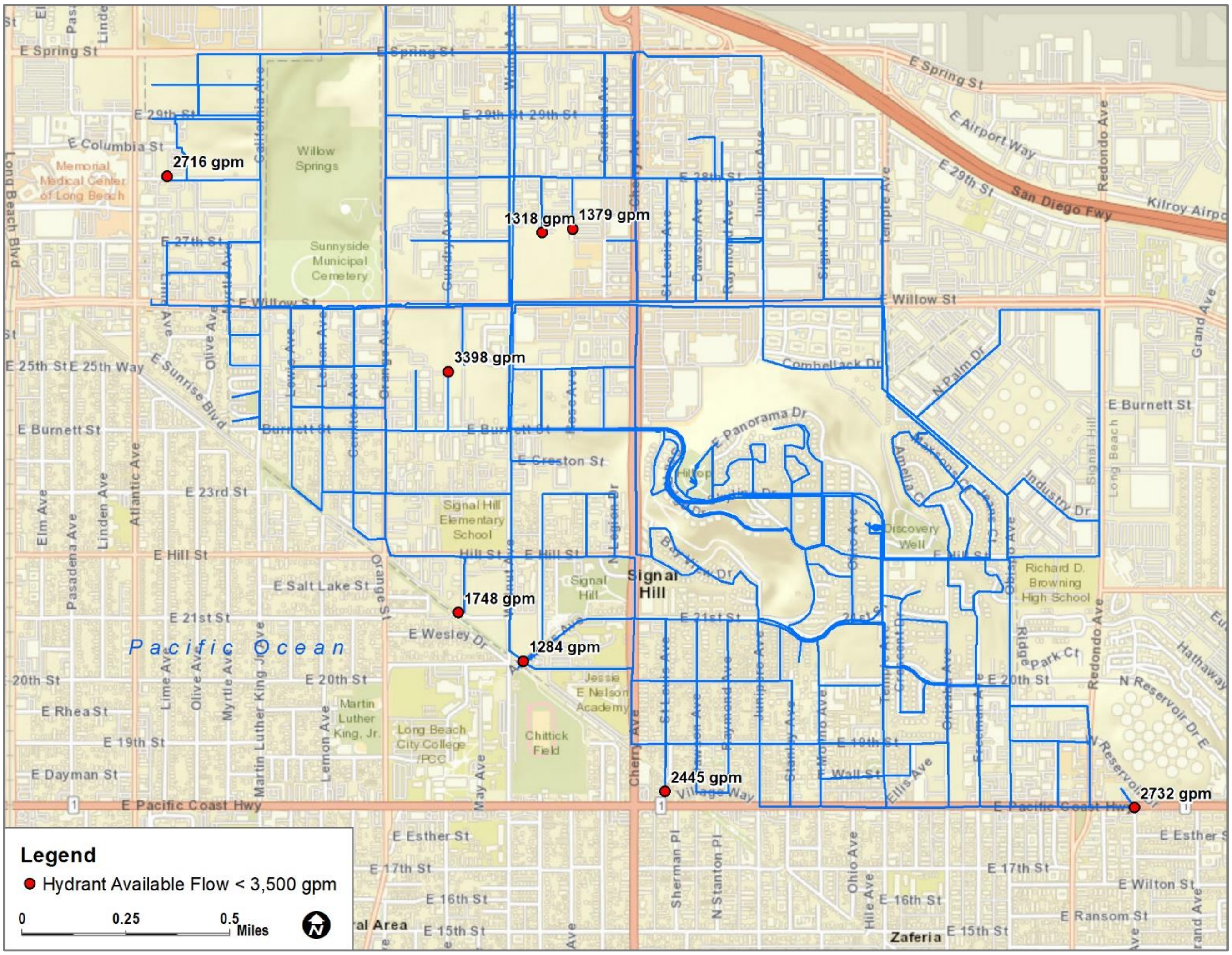
Figure 7-2: 2045 Peak Hour Demand (PHD) Pressure Deficiencies



7.3 Fire Flow Analysis

Fire flow simulations were performed under MDD condition, with the fire flow demand specified in Table 6-3 for each land use category. The results for Existing and 2045 are very similar. Figure 7-3 shows there are a total eight (8) fire flow deficient hydrants.

Figure 7-3: 2045 Fire Flow under MDD Condition



7.4 Supply Analysis

The supply sources were analyzed to determine how effectively water supply can meet all water system operating conditions. Supply sources are typically sized to meet maximum-day demand. Table 7-2 listed the capacity of each supply sources available.

Table 7-2: Existing Supply Sources

Supply	Zone Supplied	Capacity (gpm)	Backup Generator
Well 7	Gundry Reservoir	1,000	N
Well 9	Zone I	650	Y
Well 10	Gundry Reservoir	1,200	Y
MWD	Zone I	3,300	N

The City indicated they hoped to prioritize groundwater supply over imported water. As presented in Table 7-3, in the condition when the largest groundwater supply, Well 10, is out of service, Well 7 and Well 9 combined provide 1,650 gpm, which was 332 gpm less than the system's total maximum-day demand at 1,982 gpm. This means the City has a firm groundwater capacity to meet 83% of existing system demand, but not quite 100%. The remaining 17% would need to be supplemented by imported water. Similarly, in the ultimate 2045 planned timeframe, the supply between groundwater and imported water need to be a 70% and 30% split.

Table 7-3: Supply Analysis – GW Only

Timeframe	Demand (gpm)	GW Supply w/ Largest Source Off (gpm)	Surplus/Deficit (gpm)	Meet Demand %
Existing MDD	1,982	1,650	-332	83%
2045 MDD	2,353	1,650	-703	70%

Table 7-4 presented another emergency operating condition when backup generator is the only electricity source available. In this case, only Well 9 and Well 10 are in operation because other supply sources do not have backup generator. Calculation shows this emergency supply can meet 93% of the demand of Existing MDD and 79% of the ultimate 2045 MDD, indicating the need to expand groundwater well capacity by rehabbing Well 9 to increase capacity, or drilling a new well, or adding backup generator at Well 7.

Table 7-4: Supply Analysis – Emergency

Timeframe	Demand (gpm)	Emergency Supply (gpm)	Surplus/Deficit (gpm)	Meet Demand %
Existing MDD	1,982	1,850	-132	93%
2045 MDD	2,353	1,850	-503	79%

7.5 Storage Analysis

To analyze the storage requirements of the system, the Max Day Demand for the system was broken down per pressure zone. Each zone's required storage was consisted of equalization storage, emergency storage and fire storage, as described in the criteria chapter.

Equalization storage, also called operational storage, enables the City to meet water demands amidst seasonal and daily variations. An operational storage requirement of 25% MDD was used to meet the operational storage requirement for the City of Signal Hill water system. Table 7-5 and Table 7-6 provides operational storage required based on existing demand and 2045 projected demand. As there is no separate storage for Zone III, the Temple and Hilltop Reservoirs provide storage to Zone III through the Temple PS and Hilltop PS. The provided storage availability is determined by the firm capacity at Temple PS and Hilltop PS, and was assumed at a 24-hr firm pumping volume, as shown as "24-hr Pumping Credit" in Table 7-5 and Table 7-6. Similar pumping credit was added to Zone I and II as well. As shown in the two tables, there is sufficient capacity in the existing reservoirs to allow for an operational storage of 25% MDD in both Existing and ultimate 2045 scenario.

Southern California water agencies must consider emergency operations and the capabilities of their water system to store and serve water under emergency conditions. Due to high seismic potential in Los Angeles County and throughout Southern California, emergency conditions must consider system impact following a major earthquake. Signal Hill is located in Seismic Zone 4, which is the highest seismic zone rating (Seismic Zone 1 has the lowest seismic potential) of the four seismic zones. Emergency storage was assumed to be 100% of MDD. The emergency storage requirement in Zone I is larger than the existing storage available, in both Existing and ultimate 2045 scenario, but additional storage can be provided from Well 7 and Well 10 (pumping credit).

Fire storage requirement was assumed to be the most conservative criteria in Table 6-3, at 3,500 gpm for 3 hours.

The existing storage itself cannot meet the total storage requirement, except for Zone II under existing scenario where 1.2 MG barely meet the 1.12 MG requirement.

Overall, the existing storage tanks can meet the requirement of equalization and fire storage at each zone. The existing storage tanks fell short to meet emergency storage requirement, but with the pumping ability from lower zones, there was a surplus in all zones in both existing and 2045 scenario.

Table 7-5: Storage Analysis Results – Existing Scenario

Pressure Zone	Existing Storage	Existing MDD	Equalization 25% MDD	Emergency 100% MDD	Fire Storage			Total Required	24-hr Pumping Credit	Surplus
					Fire Flow	Duration	Total			
	(MG)	(MGD)	(MG)	(MG)	(gpm)	(hour)	(MGD)	(MG)	(MG)	(MG)
Gundry	4.7[1]	0	0	0	0	0	0	0	0	0
I	1.4	2.18	0.54	2.18	3,500	3	0.63	3.35	4.7[2]	2.75
II	1.2	0.40	0.10	0.40	3,500	3	0.63	1.12	1.44	1.52
III	0.0	0.28	0.07	0.28	3,500	3	0.63	0.98	4.90	3.92
Total	**7.3**	**2.85**	**0.71**	**2.85**			**1.89**	3.35	5.40	3.45

[1]The Gundry Reservoir provides available storage for upper zones through booster pump stations.

[2]Unlike other zones pumping credit, which was governed by pump capacity, Zone I's pumping credit was governed by Gundry Reservoir existing storage availability.

Table 7-6: Storage Analysis Results – 2045 Scenario

Pressure Zone	Existing Storage	2045 MDD	Equalization 25% MDD	Emergency 100% MDD	Fire Storage			Total Required	24-hr Pumping Credit	Surplus
					Fire Flow	Duration	Total			
	(MG)	(MGD)	(MG)	(MG)	(gpm)	(hour)	(MGD)	(MG)	(MG)	(MG)
Gundry	4.7[1]	0	0	0	0	0	0	0	0	0
I	1.4	2.59	0.65	2.59	3,500	3	0.63	3.87	4.7[2]	2.93
II	1.2	0.47	0.12	0.47	3,500	3	0.63	1.22	1.44	1.42
III	0.0	0.33	0.08	0.33	3,500	3	0.63	1.05	4.90	3.85
Total	**2.6**	**3.39**	**0.85**	**3.39**			**1.89**	**6.13**	**11.74**	**8.21**

[1]The Gundry Reservoir provides available storage for upper zones through booster pump stations.

[2]Unlike other zones pumping credit, which was governed by pump capacity, Zone I's pumping credit was governed by Gundry Reservoir existing storage availability.

7.6 Pump Station Analysis

To analyze the pumping requirements of the system, the Max Day Demand for the system was broken down per pressure zone. The Dependent Demand was calculated for each zone. Dependent Demand is the demand for the zone that the BPS serves plus all downstream zones that are supplied by the zone. For example, the demand for Zone II and Zone III is served from Zone I, the capacity of the PS in Zone I must be able to meet the demand for all three zones. Using the dependent demand, the pumping capacity was reviewed to determine if it was sufficient to meet the demand for each zone.

Table 7-7: Pump Station Analysis Results – Existing Scenario

Pressure Zone	Ex. Dependent MDD	Ex. Dependent MDD	Total Capacity	Firm Capacity	Surplus (gpm)
	(MGD)	(gpm)	(gpm)	(gpm)	
I	2.97	2,064	5,000	3,750	1,686
II	0.72	500	1,500	1,000	500
III	0.33	230	3,700	900	670
				Total	**2,856**

Table 7-8: Pump Station Analysis Results – 2045 Scenario

Pressure Zone	2045 Dependent MDD	2045 Dependent MDD	Total Capacity	Firm Capacity	Surplus (gpm)
	(MGD)	(gpm)	(gpm)	(gpm)	
I	3.43	2,382	5,000	3,750	1,368
II	0.83	577	1,500	1,000	423
III	0.38	265	3,700	900	635
				Total	2,426

8 Capital Improvement Plans (CIP)

8.1 Source of Projects

8.2 Project Prioritization

8.3 List of Prioritized Projects

A list of capital improvements to the City of Signal Hill water system was developed from a review of facilities and discussion with City staff.

Table 8-1: Capital Improvement Plans

Rec #	Priority	Project name	Total Cost
1	High	Gundry reservoir roof replacement and coating	$3,300,000
2	High	Electrical upgrades at Hilltop PS	$100,000
3	High	SCADA upgrades	$500,000
4	High	Well 9 - Rehab	$300,000
5	High	Rehab of Well 7	$1,500,000
6	High	New well installation	$5,250,000
7	Medium	Automated Meter Reading (AMR)	$800,000
8	Medium	Temple reservoir soil removal / upgrades	$300,000
9	Medium	Gundry pump station rehabilitation	$942,986
10	Medium	Disinfection improvements at Gundry	$300,000
11	Medium	Lakewood water line by-pass	$520,000
12	Medium	Well 9 Treatment Bypass	$2,800,000
13	Medium	Valve replacement	$5,900,000
14	Medium	Cast iron/asbestos cement pipeline replacement	$3,065,040
15	Medium	Site security for Well 10	$20,000

Rec #	Priority	Project name	Total Cost
16	Medium	Upsize pipelines on hydrants that do not meet fire flow requirements	$2,387,582
17	Low	Gundry Reservoir Treatment Enhancement	$9,000,000
18	Low	Rehab MWD connection to Hilltop	$850,000
19	Low	Temple reservoir expansion	$8,000,000
20	Low	Hilltop Disinfection Station	$650,000
		Total	$46,485,608

8.4 Project Descriptions

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Figure 1 Figure Caption

Graphic style – for images needing to be placed within Word file

NOTE: Figures are usually PDFs created by GIS. This page is a slip sheet that will be switched out with the figure when the document is ready for production.

NOTE: slip sheets do not need to be the same orientation as the figures themselves—only the same size. All letter (8.5 x 11)-sized slips sheets should be portrait, and all tabloid (11 x 17) slip sheets should be landscape.

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Figure 2 Figure Caption (Example layout for a tabloid figure of any orientation)

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Appendix A
Appendix Title