San Simeon CSD Water System Master Plan and Wastewater Collection System Evaluation

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San Simeon Community Services District

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1.0 Introduction

1.1 Overview

San Simeon is located on the central coast of San Luis Obispo County, California, along Highway 1 north of Cambria as shown in Figure 1. The San Simeon Community Services District (SSCSD) serves an area of approximately 100 acres, with elevations ranging from sea level on the west side of the highway, to approximately 85 feet above sea level on the east side. The District boundary is shown on Figure 3-1.

In 2000, there were approximately 320 dwelling units in San Simeon, and the residential population was estimated to be approximately 247 persons[1]. Motel rooms, restaurants, and other tourist facilities are a major component in the Community's water and sewer usage. According to the Draft Community Plan, there were 706 existing hotel/motel units in the District service area (2003). Tourist populations vary with the seasons.

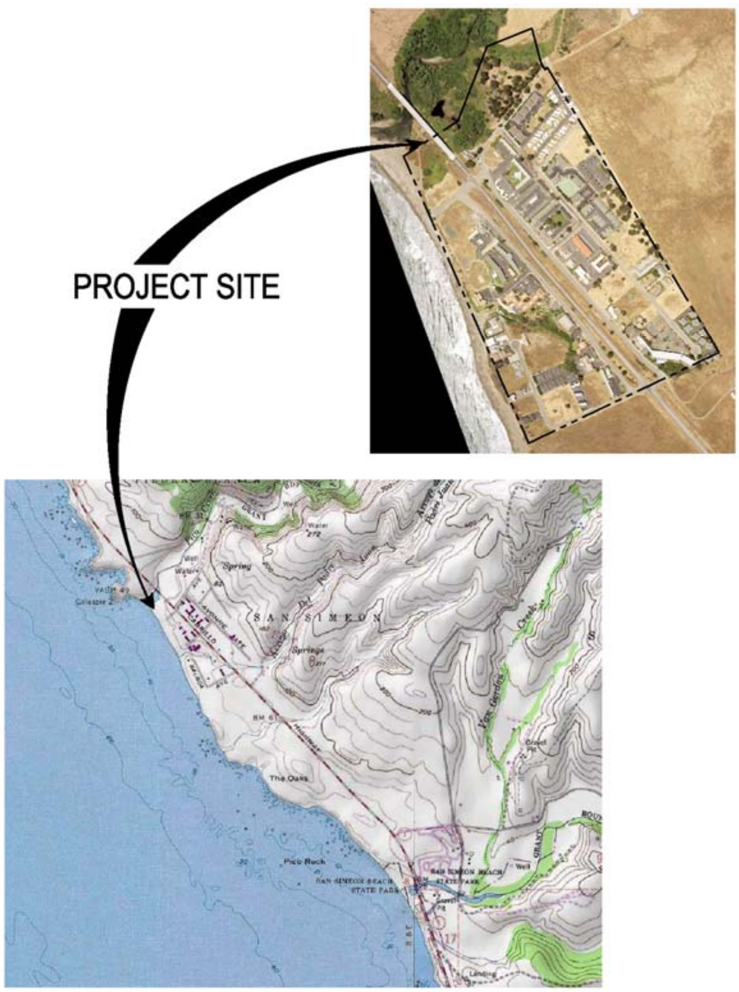

Figure 1-1: Vicinity Map

[1] Based on the Draft Cambria and San Simeon Acres Community Plan Update, April 2006.

1.2 Purpose and Scope

The purpose of this study is to develop a Water Master Plan and Wastewater Collection System Capacity Evaluation for the San Simeon Community Services District. This study will identify system improvements required to meet existing and projected demands. Specific tasks that were undertaken to accomplish this include:

a. Data Collection and Review

Information pertaining to the water production and distribution system was collected, including water production records, District consumption (billing) records, population data, well and storage characteristics, land use plans, topographical mapping, and aerial photography. Information on the wastewater collection system was also collected, including existing atlas and record drawing information, as well as wastewater treatment plant records. The 2006 Draft Cambria and San Simeon Acres Community Plan Update to the North Coast Area Plan was used for projected land use and population estimates.

b. Water Demand Estimates

Historic production and consumption records were used to estimate existing average daily and maximum day demands.

Fire flow requirements were established by the California Department of Forestry (CDF) Fire Marshall, and the California Fire Code.

c. Existing System Operations

SSCSD staff members were consulted to verify system operation specifics, discuss known deficiencies, and identify recurring operational problems.

d. Computer Modeling

A hydraulic model was prepared using WaterCAD software (by Bentley Systems) to simulate the operation of the water system. A "skeleton" model of the system was developed using the District's most recent record drawings, well production records, available pump curves, elevations of tanks and wells, and available topographic mapping[2]. The model was calibrated using field hydrant testing.

The completed model was used to evaluate fire protection, water main capacity, and pressure issues throughout the community under existing and future demand scenarios. Model runs were developed to simulate average daily flows, peak hour demands, maximum day demands, and fire flows at various locations throughout the system under scenarios with the wells on and/or off.

[2] Elevations in the southwest portion of the District were based on a survey performed by Engineering Development Associates (EDA) dated 12/01/05. The remaining elevations were based on USGS topographical mapping.

e. Existing Water Supply Evaluation

A review of condition, capacity, and safe yield of the District's groundwater wells was completed in October 2006. The results of this review were provided to the District in a report titled "San Simeon Water Production Well Evaluation." Boyle evaluated the ability of the existing wells to meet increasing District demands, addressed safe yield, condition of casing, performance and efficiency of pumps, and made recommendations for floodproofing and security improvements.

f. Future Regulations

Boyle has reviewed pending and draft regulations from California Department of Health Services (DHS) to determine if any may be significant to District facilities and operations.

g. Water Distribution System Improvements and Recommendations/Engineer's Opinion of Probable Cost

Recommendations were provided for improving the modeled facilities to meet existing and future demands and proposed waterworks standards. These recommendations include preliminary pipe sizes, alignments, and storage facilities.

An engineer's opinion of probable capital costs was also provided.

h. Wastewater Collection System Capacity Evaluation

A model of the collection system was created using existing information. Boyle reviewed existing wastewater expenses and revenue for the last five years, typical usage patterns from the last five years, and performed a peaking factor analysis based on existing data and land use information to project future usage patterns. Data from a temporary flow metering project (performed December, 2005) was also utilized. Based on this data, recommendations for capital improvements for the collection system were made. An engineer's opinion of probable cost for recommended improvements was also provided.

Recommendations were based on necessary improvements identified for the collection system alone. Current improvement programs related to the wastewater treatment plant were not considered in the study.

1.3 Community Plan and Future Growth Projections

On May 6, 2003, the San Luis Obispo County Board of Supervisors directed County Planning staff to update the Community Plan for Cambria and San Simeon Acres separately from the remainder of the 1988 North Coast Area Plan (NCAP). The Board of Supervisors approved the

April 2006 draft of the Community Plan which now awaits certification by the California Coastal Commission.

The Approved Draft of the Community Plan was used as the chief planning document for this Water Master Plan. According to the Community Plan, ***due to countywide growth management provisions, limitations on water supply and public services, and a general inability of the natural environment to sustain full buildout, the North Coast Planning Area is not expected to reach full buildout within the twenty-year term of the NCAP.*** Although historic growth rates along the North Coast have been higher than the County average, growth rates in San Simeon have decreased in recent years, primarily due to a District-imposed moratorium and other resource constraints. The Community Plan projects a managed growth projection of 2.3% per year in San Simeon for the twenty-year life of the Plan.[3]

Consistent with the Community Plan, this Water Master Plan assumes a managed growth projection of 2.3% per year, compounded annually for twenty years. Ultimate buildout projections were outside of the scope of this study.

[3] Countywide, the number of new dwelling units allowed annually is generally 2.3% of the existing dwelling units.

2.0 Existing Water Demands

2.1 Historic Demand

Historic water production and billing data from 2000 to 2005 was obtained from the District. Reliable data was not available prior to 2000. From this data, it was determined that approximately 19 percent of the historic water consumption was attributed to residential uses, 3 percent was attributed to commercial uses, 57 percent was attributed to hotel/motel use, 13 percent was attributed to restaurant uses, and 7 percent was attributed to other uses. This data is shown in Table 2-1.

Table 2-1: Historic Water Use

		Historical Water Usage (gpd)				
Year	**Well Production (gpd)**	**Residential**	**Commercial**	**Hotel**	**Restaurant**	**Other**
2000	96,614	18,067	3,478	55,456	12,753	6,860
2001	95,260	17,814	3,429	54,679	12,574	6,763
2002	91,096	17,035	3,279	52,289	12,025	6,468
2003	98,831	18,481	3,558	56,729	13,046	7,017
2004	97,015	18,142	3,493	55,686	12,806	6,888
2005	95,666	17,890	3,444	54,912	12,628	6,792
Average	**95,747**	**17,905**	**3,447**	**54,959**	**12,639**	**6,798**
Percent of Total Production	**100.0%**	**18.7%**	**3.6%**	**57.4%**	**13.2%**	**7.1%**

In San Simeon, seasonal demands are typically highest in July and August, and lowest December through February.

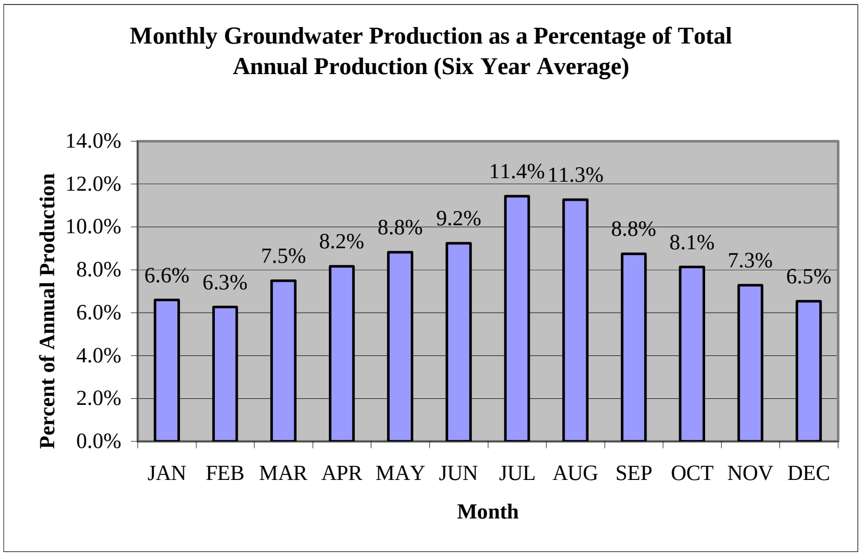

Figure 2-1 Average Monthly Groundwater Production

2.2 Peaking Factors

The three demand conditions used to assess the distribution system were maximum day demand (MDD), peak hour demand (PHD) and MDD plus fire-flow (FF). MDD is defined as the demand during the maximum usage day of the year, PHD is the demand during the maximum usage hour of the maximum demand day, and MDD+FF represents specific fire-flow requirements during the maximum day.

2.2.1 Maximum Day Peaking Factor

The maximum day peaking factor represents the ratio of the MDD to the average day demand (annual average) for a given year. Since daily records were not available for San Simeon, the maximum day was estimated using California Proposed (Draft) Waterworks Standards[4]. The Draft Waterworks Standards recommend multiplying the maximum month flow (the average day demand during the maximum month) by a peaking factor of at least 1.5. Since San Simeon is very sensitive to transient (tourist) population, a conservative maximum day peaking factor of 2.0 was used for planning purposes. This peaking factor is consistent with similar coastal communities.

2.2.2 Peak Hour Peaking Factor

Hourly production records were not available to evaluate peak hour demands. The California Draft Waterworks Standards recommends a minimum peak hour factor of 1.5 be applied to the maximum day demand. Anticipating high peaks associated with heavy tourist demands typical in San Simeon, a conservative peak hour peaking factor of 2.0 times the maximum day demand (or 4.0 times the average day demand) was assumed for this study. This peaking factor is considered to be conservative, and is consistent with the peaking factor used for planning purposes in Cambria (2004 Potable Water Master Plan).

[4] California Proposed Waterworks Standards. Article 1, Section 64554 (b)(2)(D), November 12, 2004.

2.3 Existing Peak Demands Used for Planning

Peaking factors were applied to the six-year average discussed in Section 2.1 to estimate existing peak demands since detailed production data was not available.

Table 2-2: Existing Demand Estimates for Planning Purposes

Condition	Peaking Factor	Existing Demand (gpd)
Existing ADD		95,747
Existing MDD	2.0 x ADD	191,500
Existing PHD	4.0 x ADD	383,000

3.0 Projected Water Demands

3.1 Water Duty Factor Determination

3.1.1 Duty Factors Based on Existing Conditions

Using District billing records and information provided by San Luis Obispo County Planning Department, duty factors based on existing conditions were calculated for each land use category. A land use map is shown in Figure 3-1. Because of the large number of vacation homes and correspondingly high vacancy rates, it is very difficult to obtain accurate estimates for the permanent population of San Simeon. According to the U.S. Census, the 1990 population was 128 people. Year 2000 estimates from the San Luis Obispo County Planning Department place the number of permanent residents at approximately 247 persons. For this report a population of 247 persons was assumed. It was assumed that due to the existing moratorium, there was no population growth between 2000 and 2006.

LEGEND

MULTI–FAMILY RESIDENTIAL

COMMERCIAL/RETAIL

BOYLE ENGINEERING CORPORATION

SAN SIMEON COMMUNITY SERVICES DISTRICT

WATER SYSTEM MASTER PLAN LAND USE

BEC PROJECT NO.	FIGURE
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Table 3-1: Duty Factors Based on Existing Conditions

Use Category	Existing Usage	Existing Conditions		Duty Factor
Residential	17,905 gpd	247[3]	persons	72 (gpd/person)
		22[3]	acres	811 (gpd/acre)
		320[3]	dwelling units	56 (gpd/DU)
Commercial/Retail	3,447 gpd	46,024[1]	square feet	0.1 (gpd/SF)
Hotel	54,959 gpd	706[3]	units	78 (gpd/unit)
Restaurant	12,639 gpd	621[2]	seats	20 (gpd/seat)
Other	6,798 gpd			
Total non-Residential	77,842 gpd	22.7	acres	3426 (gpd/acre)

[1] From SLO County Planning Dept. Staff

[2] Boyle Telephone Survey, June 2006

[3] Based on April 2006 Cambria and San Simeon Acres Community Plan Update, and review of aerial photography

3.1.2 Gross Per Capita Water Usage

Using the District records shown in Table 3-1, gross per capita water consumption was calculated. It was assumed that due to the existing moratorium, there was no population growth between 2000 and 2006. This is the typical effect of a moratorium in coastal communities in northern San Luis Obispo County such as Cayucos and Morro Bay.

The average gross per-capita water use was determined to be 388 gallons per capita per day (gpcd), and is shown in Table 3-2.

Table 3-2: Gross per Capita Duty Factor

Year	Population	Total Well Production (gpd)	Gross Per Capita Duty Factor (gpcd)
2000	247	96,614	391
2001	247	95,260	386
2002	247	91,096	369
2003	247	98,831	400
2004	247	97,015	393
2005	247	95,666	387
		Average	**388**

3.2 Residential Water Demands Used for Planning

There are two land use categories in San Simeon: Multi Family Residential (MFR), and Commercial/Retail (CR). Although residential dwellings are permitted in the CR zone, it was assumed that all future residential development would occur in the MFR zone, and all commercial/retail development would occur in the CR zone.

Since several methods were available for the residential demand projection, future residential water demands were estimated using three techniques:

- Projected residential population estimates with residential per capita duty factor;
- Projected dwelling unit estimates with dwelling unit based duty factor; and
- Projected land use estimates with land use based duty factor.

3.2.1 Projected Residential Demand Using Residential Per Capita Duty Factor

According to SLO County Planning Department Staff, the density per dwelling unit varies seasonally between 0.75 and 1.4 persons per dwelling unit (DU). This variance is likely due to the large number of vacation homes in the community and the corresponding seasonal vacancy rates. Based on this range, future residential population was estimated in the Community Plan to be between 400 and 740 people.[5] Considering potential conversion of vacation homes to permanent residences, the higher dwelling unit density of 1.4 persons per dwelling unit was selected as the 20-year future density for this Master Plan. This corresponds with a future population of 740 persons.

Multiplying future estimated population of 740 persons by the residential per capita duty factor of 72 gpd/person results in a projected residential demand of approximately 54,000 gpd.

3.2.2 Projected Residential Demand Using Dwelling Unit Based Duty Factor

According to the Community Plan, a total of 530 dwelling units are anticipated over the 20-year life of the plan (an additional 210 units over the existing 320 units). Again, this assumes a 2.3% managed growth rate in the community.

[5] The Community Plan assumed a straight-line growth management rate of 2.3% per year for housing, resulting in a total of 530 future dwelling units (an additional 210 units above the existing 320 units) over the 20-year life of the plan. (530 DU)*(.75 persons/DU)=400 persons. (530 DU)*(1.4 persons/DU)=740 persons.

Multiplying the land use based duty factor of 56 gpd/DU (from Table 3-1) by 530 dwelling units results in a projected residential water demand of approximately 30,000 gpd.

It is possible that the character of residential development in the community will change over the next twenty years, both in terms of dwelling unit density and number of persons per dwelling unit. Accordingly, projecting residential demands using dwelling unit-based duty factors may result in lower demand projections if density increases.

3.2.3 Projected Residential Demand Using Land Use Based Duty Factor

Using the Community plan and recent aerial photography, it was determined that approximately 39.2 acres of land is zoned MFR, and approximately 22 acres are currently developed. Assuming all 39.2 acres were developed in a manner similar to existing conditions (comparable building density and character, etc.), multiplying the land use based duty factor of 811 gpd/acre by 39.2 acres results in a projected residential water demand of 32,000 gpd.

It is possible that the character of residential development in the community will change over the next twenty years, both in terms of dwelling unit density and number of persons per dwelling unit. Accordingly, projecting residential demands using dwelling unit-based duty factors may result in lower demand projections.

Table 3-3 shows a summary of future residential demand estimates using three different techniques.

Table 3-3: Projected Residential Demand Estimates

Methodology	Duty Factor (From Table 3-1)	Future Condition	Future Residential Demand Estimates
Residential Per Capita Duty Factor	72 gpd/person	740 persons	54,000 gpd[1]
Dwelling Unit Based Duty Factor	56 gpd/DU	530 DU	30,000 gpd
Land Use Based Duty Factor	811 gpd/acre	39 acres	32,000 gpd

[1] 54,000 gpd was selected as the future projected residential demand for this Water Master Plan, as it would be the most conservative demand.

3.3 Non-Residential Water Demands Used for Planning

Since the Community Plan did not project future uses or occupants for non-residential uses, a land use based duty factor was used to estimate future demands for non-residential uses.

Using the Community plan and recent aerial photography, it was determined that approximately 42.5 acres of land is zoned CR. Approximately 22.7 acres are currently developed. Assuming all 42.5 acres were developed in a manner similar to existing conditions (comparable building density and character, etc.) and multiplying the land use based duty factor of 3426 gpd/acre (from Table 3-1) by 42.5 acres, results in a projected non-residential water demand of approximately 146,000 gpd.

Table 3-4: Projected Water Demand for Commercial/Retail

Land Use Category	Total Acreage	Developed Acreage	Existing Usage	Land Use Based Duty Factor (gpd/acre)	Total Future Demand (gpd)
Commercial/Retail	42.54	22.72	77,842	3,426	146,000

3.4 Projected Water Demand (ADD) Used for Planning

As described above, total estimated future demand for the community was calculated using per capita based duty factors for residential demands, and land-use based duty factors for commercial/retail demands (from Tables 3-3 and 3-4). Table 3-5 shows the total projected ADD.

Table 3-5: Total Projected Water Demand Using Duty Factors

Land Use Category	Estimated Future Demand
Multi Family Residential (using per capita based projections)	54,000 gpd
Commercial/Retail (using land use based projections)	146,000 gpd
Total	**200,000 gpd (224 AFY)**

3.5 Projected Peak Demands Used for Planning

The peaking factors summarized in Section 2.2 were applied to the projected ADD to estimate future peak flows, as shown below.

Table 3-6: Projected Demand Estimates for Planning Purposes

Condition	Peaking Factor	Projected Demand
Projected ADD		200,000 gpd
Projected MDD	2.0 x ADD	400,000 gpd
Projected PHD	4.0 x ADD	800,000 gpd

3.6 Fire Flow Requirements

Fire flow requirements frequently govern the sizing of distribution system elements, particularly in smaller systems. Fire flow requirements were provided by CDF Fire Marshall Robert Lewin in a memo dated August 30, 2006. A minimum residual system pressure of 20 psi is required during fire-flow for all development types. Table 3-7 summarizes the District's fire-flow criteria for both land use categories.

Table 3-7: Fire Flow Criteria

Development Type	Required Fire-Flow at 20 psi Min. Residual
Multi-Family Residential	1,500 gpm
Commercial/Retail	2,500 gpm

For the hydraulic analysis performed in this study, the fire-flows were modeled under MDD conditions and all production wells were assumed to be non-operational. Under these conditions, fire-flow is provided directly from the District's reservoir. Only one fire-flow event was assumed when assessing storage requirements.

3.7 Unaccounted for Water

Unaccounted for water is the difference between production and consumption records (i.e. water that is not recorded by water meters). A range of five to eight percent is considered typical for similar water systems.

The District provided billing records for 2004-2006. The analysis for the total system, as shown in Table 3-8 compares the total water billed with the total water produced for the period from June 1, 2004 to May 1, 2006. Averages from the previous five-years were used for months where production data was unavailable.

Table 3-8: Unaccounted for Water (2004-2006)

Production (gallons)	67,816,000
Metered Consumption (gallons)	49,909,000
Unaccounted for Water	17,907,000
Percentage Unaccounted	26%

The two-year average water loss is approximately 26 percent. Through conversations with water operations staff, several possible contributing factors have been identified and are listed below:

- There were many older water meters in the system during the period data was collected. The District has since replaced all meters in the system.

- System leaks are a possibility, however there is no direct evidence to substantiate this possibility.

- Historical data may be unreliable, and was compiled and calculated with various, sometimes antiquated, system software.

- Use of non-metered water at the WWTP or to irrigate any open space areas can contribute to unaccounted for water.

It is recommended that the District continue to track and monitor water production and usage. New meters and system software may result in more accurate figures.

4.0 Existing System

4.1 Overview

The San Simeon Community Services District (SSCSD) serves an area of approximately 100 acres via one main pressure zone. Water is supplied to the community by two wells in the Pico Creek valley, and storage is provided by a 150,000-gallon reservoir (overflow elevation of 164.5 feet MSL).

An aerial photograph of the District can be seen in Figure 4-1, and a schematic of the District water system can be seen in Figure 4-2.

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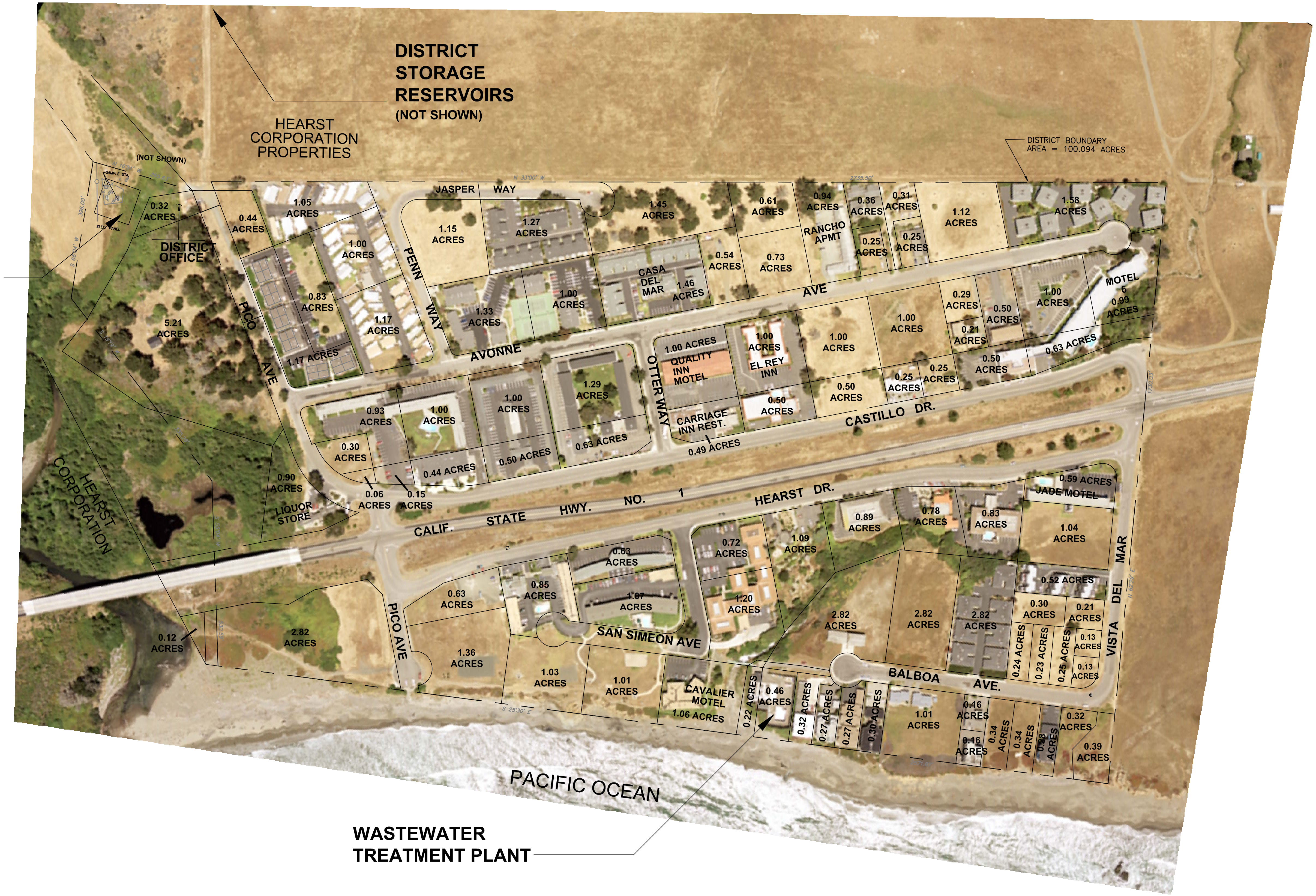

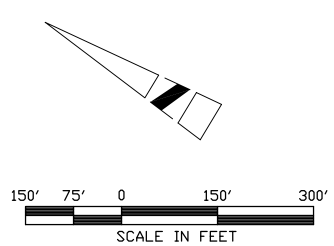

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WATER SYSTEM MASTER PLAN
OVERVIEW MAP

BEC PROJECT NO.
20020.03

FIGURE
4-1

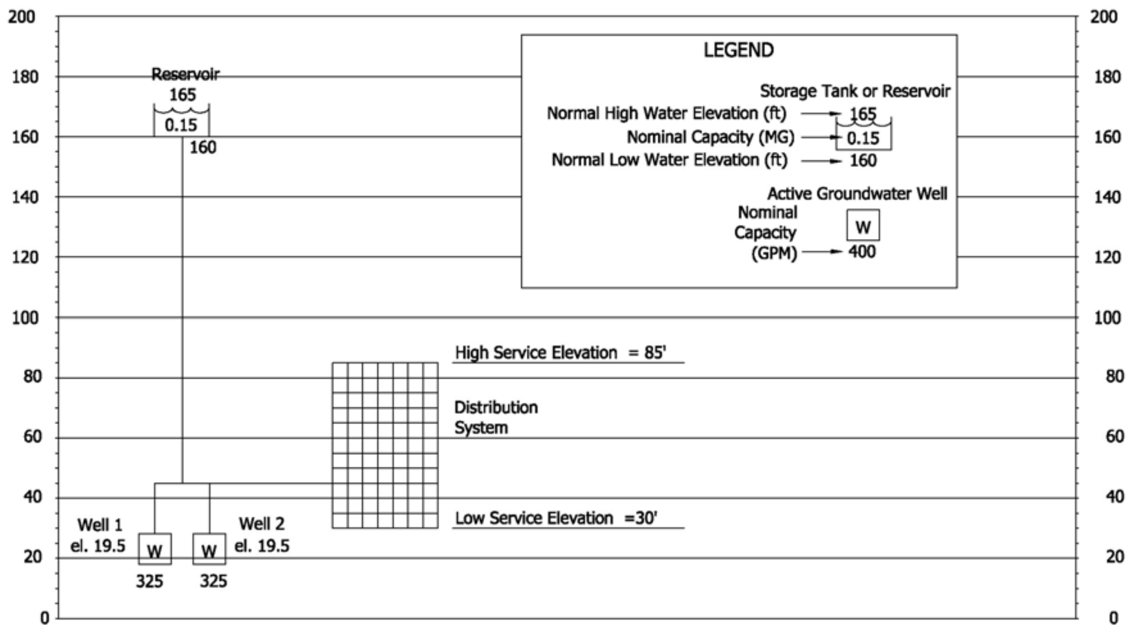

Figure 4-2: Hydraulic Profile of Existing System

4.2 Water Production Wells

A comprehensive evaluation of the District wellfield was completed by Boyle in September 2006[6], and is included in the Appendix.

The District wellfield consists of two production wells.[7] The wells are operated under a State Water Resources Control Board (SWRCB) License for Diversion and Use of Water from the Pico Creek underflow.[8] This license permits a diversion of up to 140 acre-feet per calendar year at a rate of 0.27 cubic feet per second (CFS) or at higher rates that do not exceed an average of 0.27 CFS during any 7-day period, provided there is no interference with other vested rights and instream beneficial uses.

Well 1 was constructed in 1952 using a 12-inch diameter steel blank casing (1/4-inch wall thickness) from the wellhead to a depth of 15 feet, and a 12-inch diameter perforated casing with ¼ x 3 inch milled slots from 15 to 47 feet.

[6] "San Simeon Water Production Well Evaluation (Task 500 of Water Master Plan)", Boyle Engineering, September 2006.

[7] A third standby well is located on Hearst property and is available for emergency use.

[8] State of California State Water Resources Control Board Permit 12465, License 12272 (June 16, 1987).

Well 2 was constructed in 1967 using a 12-inch diameter steel blank casing (3/16-inch wall thickness) from the wellhead to a depth of 50 feet, and a 12-inch diameter perforated casing with louvers from 50 to 60 feet.

Table 4-1 – San Simeon CSD Groundwater Production Well Summary

Well	Capacity (gpm)	State Well Number	Year Drilled	Total Depth (ft)	Casing Diameter (in)	Perforation Interval (ft)
1	325	27S/8E-6G1	1952	49	12	15 to 47
2	325	27S/8E-6G2	1967	60	12	50 to 60

4.3 Storage

The District has one reservoir that provides 150,000 gallons (0.15 MG) of regulatory, fire, and emergency storage. The covered, earthen reservoir is square in shape with a floor measuring approximately 23 feet by 23 feet at an elevation of approximately 151 feet MSL. The sides of the reservoir slope at approximately 1:1 (h:v). Maximum water level is approximately 165 feet MSL, at which point the reservoir measures approximately 51 feet by 51 feet. Normal operating high water level is approximately 164.5 feet MSL.

Figure 4-3: Reservoir and Telemetry

Figure 4-4: Reservoir and Piping

4.4 Distribution and Transmission Pipelines

The existing potable water system consists of more than 2 miles of distribution piping. Based on District information, the majority of the transmission piping (approximately 8,500 feet) is 6-inch asbestos-cement (ACP) pipe with 1,150 feet of 8-inch ACP. The remainder (approximately 1,375 feet) consists of 8-inch polyvinyl chloride (PVC) pipe. Two 6-inch transmission lines transport water underneath State Highway 1 to the west side of the District. One transmission line crosses near Pico Avenue and the other is located near Otter Way. Information on the age or condition of the piping was not available.

5.0 Computer Hydraulic Model

5.1 Introduction

A hydraulic model was prepared using WaterCAD software (by Bentley Systems) to simulate the operation of the water system. WaterCAD incorporates the Hazen-Williams formula as a basis for calculating flow distributions and pressures throughout the water system. A representative model of the pipes, tanks, pumps, and wells was developed using the District's most recent Water Atlas map, well production records, available pump curves, and topographical information. The model was used to evaluate fire protection, water main capacity, and system pressures throughout the community under existing and build-out demand scenarios.

Existing survey data and USGS topographical maps were used to provide elevation data. The Approved Draft of the Community Plan was used along with aerial photography and input from District staff to develop existing and future land use maps. These maps were used in conjunction with the projected demands presented in Table 3-6 to model demand distribution within the District. The existing demands were scaled to match the existing ADD used for planning (see Section 2.3). Future demand distribution was modeled in a similar manner with a total demand equal to that presented in Section 3.5.

In order to distribute a demand pattern within the model, the District's AutoCAD basemap was divided into land use areas. Billing records were used to calculate the existing demands associated with each land use category. For the Residential land-use category, the total recorded usage was distributed throughout the Residential Zone. Aerial photography was used to distribute point demands appropriately according to existing building density. For Commercial/Retail, the top fifteen water users were identified from billing records and were located on a map. Point demands were then distributed throughout the CR zone according to building density and according to the location of major users.

The demand distribution described above represents the modeled flow and distribution of the average day demand. These demands were then adjusted by peaking factors and fire-flows described in Sections 2-3 and 3-6 to develop the necessary modeling scenarios used in the analysis. A summary of the modeling scenarios and initial model settings are presented in Table 5-1.

Table 5-1 – Initial Model Settings

Item	Average Day Demand (ADD)	Peak Hour Demand (PHD)	Maximum Day Demands Plus Fire flow (MDD +FF)
Supply Wells	on	on	off
Reservoir Level	¾ full (by volume)	¾ full (by volume)	¾ full (by volume)

5.2 Model Calibration

After the system piping, tanks, wells, appurtenances and demand patterns were constructed in the model, a series of calibration tests were performed to determine how closely the computer model simulates actual field conditions. To accomplish this, District staff conducted a series of eight hydrant tests at various locations throughout the District as shown in Figure 5-1. Static pressures were measured with a pressure gage at a nearby hydrant before each test. The production wells were off for each of the tests and the tank levels were recorded prior to flowing a hydrant. The hydrant was then equipped with a pitot measuring device and fully opened. While flowing, the pitot flow measurement and residual pressure were simultaneously recorded (residuals were taken at the same location as the static pressures).

The static and residual pressure results of each test were compared to a similar flow and demand pattern applied to the model. If the model predicted static pressures within 5 psi, and residual pressures within 10 psi, the model was considered to be in reasonable agreement with field conditions. All measured static and residual pressures fell within the range of acceptable predicted values for both ADD and MDD scenarios (5 psi). Table A-1 in the Appendix summarizes field measurements and modeling results.

A 4-inch AC waterline along Avonne Avenue east of Otter Way is shown parallel to the 6-inch AC pipeline on the District's water system map. It is not known if the 4-inch pipeline is abandoned. A fire hydrant test was performed at a location near the end of the 4-inch pipeline to determine if the hydrant was connected to the 4-inch or 6-inch main. The water model results were insufficient to determine which case was definite. The model results are slightly closer (1.5 psi) to field conditions when the hydrant is modeled to be on the 6-inch pipeline.

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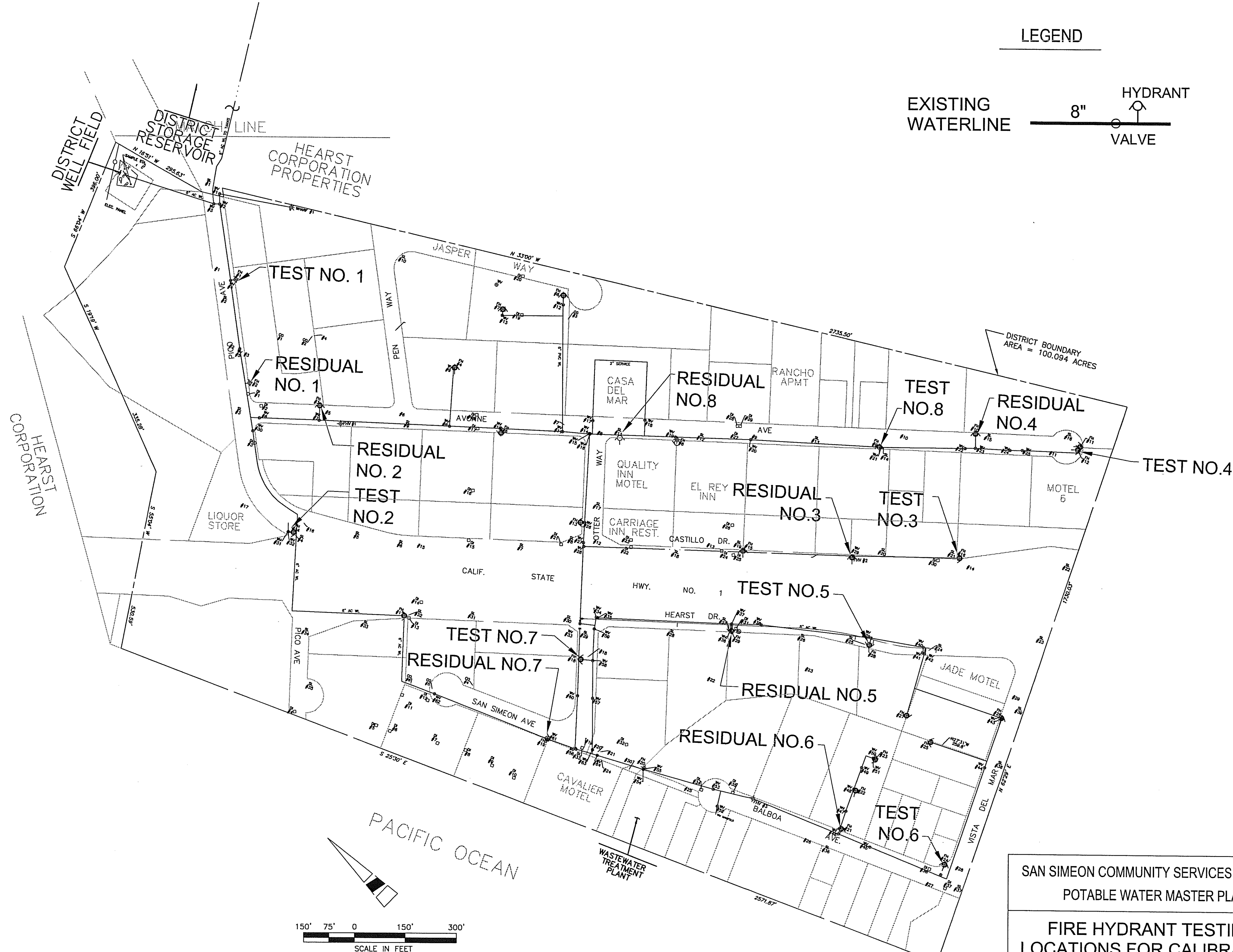

BOYLE ENGINEERING CORPORATION

SAN SIMEON COMMUNITY SERVICES DISTRICT
POTABLE WATER MASTER PLAN

FIRE HYDRANT TESTING LOCATIONS FOR CALIBRATION

NOV. 2006 | FIGURE 5-1

6.0 Design Criteria

6.1 Production Wells

At a minimum, production facilities (e.g. production wells) should be capable of providing MDD over a 24-hour period.

6.2 Storage Facilities

Storage capacity is required to provide operational, fire, and emergency storage. The following describes the criteria used to estimate the District's storage requirements:

Operational Storage

Operational storage is the volume of storage recommended to meet short-term peak daily demands that are in excess of production. An operational storage criteria of 25 percent of the maximum day demand (MDD) is recommended for San Simeon.

Emergency Storage

Emergency storage is the volume of storage recommended to ensure ongoing supply in the event of a water supply emergency. Typical emergency planning criteria assumes that water facilities will be capable of sustaining basic sanitary needs for 48 hours (using 50 gpcd as the minimum sanitary requirement for the District). Because of high transient populations, a more conservative emergency storage criteria of 50 percent of the maximum day demand (MDD) is recommended for San Simeon.

Fire Storage

Fire storage is the volume of storage recommended to provide adequate supply in the event of power outages, main breaks, or other events that may occur during a fire. The California Fire Code (CFC 903.2, 903.4.2), which is the adopted fire code for San Luis Obispo County (Title 16.10), expressly states the fire flow requirements. Hotels fall under the authority of the State Fire Marshall as an R-1 occupancy, which also uses the CFC adopted by the State Legislature. Storage requirements for San Simeon were determined by consultation with CDF/San Luis Obispo County Fire Department and the 2001 California Fire Code. It was assumed that through sprinkler installation and building size limitations, future fire flow requirements would not increase.

6.3 Distribution Pipelines

To analyze the distribution pipelines, the following criteria was used:

A. During ADD the system was assessed assuming a maximum allowable flow velocity of 5 fps during ADD and a minimum pressure of 40 psi. Maximum allowable system pressures were limited to 150 psi. Additionally, headloss was limited to 10 ft per 1,000 feet of pipe.

B. During PHD, the system was assessed assuming a maximum allowable flow velocity of 10 fps and a minimum system pressure of 30 psi.

C. During MDD +Fire Flow conditions, the system was assessed assuming a minimum pressure residual of 20 psi and maximum velocities of 15 fps.

6.4 Criteria Summary

Table 6-1 provides a summary of the analytical and design criteria used to develop the Water System Master Plan for the San Simeon CSD.

Table 6-1
Summary of Evaluation and Design Criteria

Criterion	Value
Demand Cases:	Three cases will be considered: (1) MDD + FF (2) PHD (3) ADD
Maximum Day Demand (MDD)	2.0 x ADD
Peak Hour Demand (PHD)	2.0 x MDD or 4.0 x ADD
Fire Flow (FF)	1500 gpm (residential) 2500 gpm (commercial/retail) 3 hour duration
Minimum Pressures:	40 psi for ADD 30 psi for PHD 20 psi for MDD + FF
Maximum Pressures:	150 psi
Maximum Velocity - ADD	5 fps
Maximum Velocity - PHD	10 fps
Maximum Velocity – Fire Flow	15 fps
Maximum Head Loss - ADD	10 ft / 1000 ft

Table 6-1
Summary of Evaluation and Design Criteria

Criterion	Value
Hazen-Williams Coefficients for Hydraulic Modeling	
AC pipe	120 existing
PVC	140 existing / 150 new

7.0 Ability of Existing System to Meet Existing Demands

7.1 Water Production Capacity

In June 1987, the District was granted a License for Diversion and Use of Water from the Pico Creek underflow by the State Water Resources Control Board (SWRCB).[9] This license permits a diversion of up to 140 acre-feet per calendar year at a rate of 0.27 cubic feet per second (CFS) (121 GPM) or at higher rates that do not exceed an average of 0.27 CFS during any 7-day period, provided there is no interference with other vested rights and instream beneficial uses.[10]

The well production capacity of each District well was measured at approximately 325 gpm (0.47 MGD), and the existing MDD was estimated at 133 gpm (0.19 MGD). This provides a buffer under maximum day conditions of approximately 0.28 MGD.

Table 7-1: Short-Term Production Capacity vs. Existing Demand

Existing MDD (MGD)	Single Well Pumping Capacity (MGD)[11]	Surplus Pumping Capacity (MGD)
0.19	0.47	0.28

A comprehensive evaluation of the District wellfield was completed by Boyle in October 2006. This report determined a safe yield of 120 AFY for the Pico Creek Groundwater Basin. Two District wells and two Hearst Ranch wells are the only producing wells in the basin. Allowing for an estimated annual draw of 16 AFY at the Hearst Ranch, extractions from the District should not exceed 104 AFY. Seawater intrusion episodes of relatively short duration can be expected during extended gaps between wet seasons, but although groundwater levels fluctuate in response to a combination of both production rates and precipitation, high production rates were the primary cause of lower water levels recorded between 1984 and 1989.

7.2 Existing System Deficiencies

During ADD, a minimum pressure of 40 psi and a maximum velocity of 5 fps are recommended. During PHD, a minimum pressure of 30 psi and a maximum velocity of 10 fps are recommended. All existing transmission piping is within these criteria during ADD and PHD,

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[9] State of California State Water Resources Control Board Permit 12465, License 12272 (June 16, 1987).

[10] Although the permit allows for the diversion of up to 140 AFY, the safe yield of the Pico Creek Basin has been determined to be 120 AFY (104 AFY for the District Wells and 16 AFY for a third agricultural well on Hearst property.

[11] Average well production was approximately 325 gpm during pumping test performed by Cleath and Associates in February 2006. Safe instantaneous yield of each well was estimated to be 340 gpm.

except at a few locations where the pipeline ends at a cul-de-sac. During existing ADD conditions, the east end of a 6-inch AC pipe in Avonne Avenue was calculated to be below 40 psi (38 psi). Also, a 6-inch PVC lateral between Jasper Way cul-de-sac and Avonne Avenue was below 40 psi (35 psi) during ADD. Low pressure in these areas could be improved by looping any dead end pipes.

Most of the existing pipeline deficiencies were based on the system's inability to provide the fire flow requirement while maintaining a 20 psi residual pressure. If looping is not possible, a minimum of 8-inch pipeline is recommended for a residential fire flow of 1,500 gpm to limit the velocity below 15 fps. A minimum of 10-inch pipeline is recommended for commercial areas where a fire flow requirement of 2,500 gpm is required. Most of the existing distribution system is comprised of 6-inch pipe.

Bentley Systems' WaterCAD software was used to test improvements selected to improve fire flow. Figure 7-1 shows an overview of the existing pipe sizes.

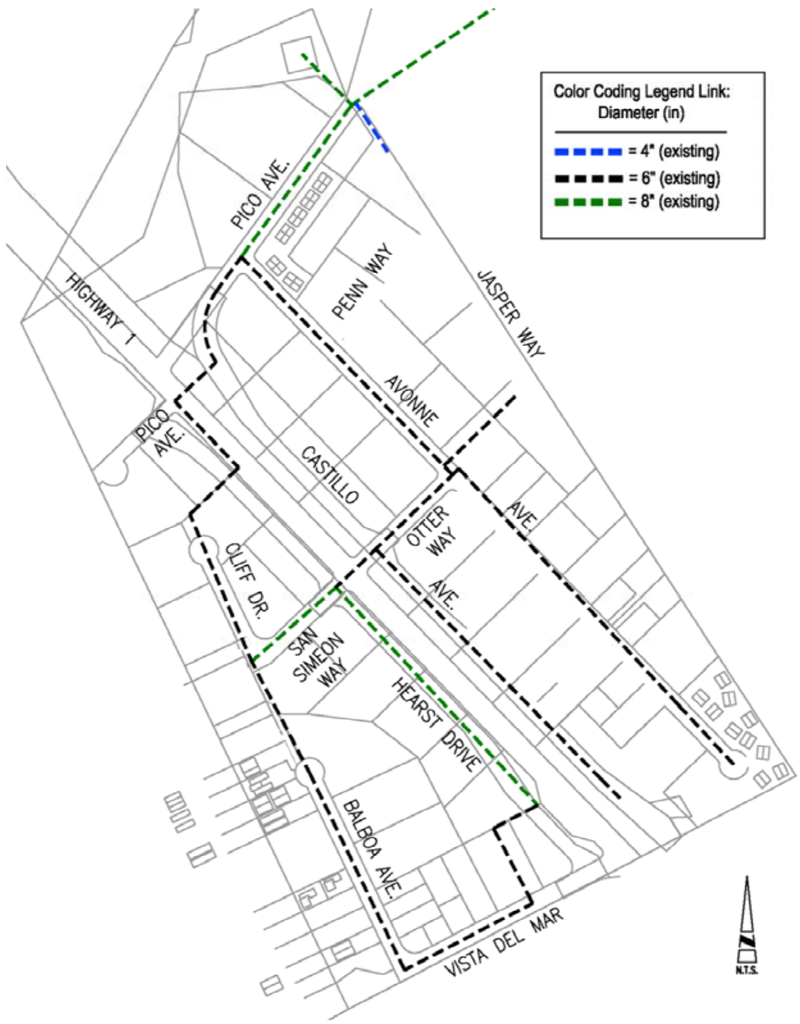


Figure 7-1: Existing Pipe Sizes

Recommended improvements have been prioritized into two categories. Priority 1 (P1) projects are defined as those necessary to meet existing fire-flow deficiencies and strengthen the "backbone" of the distribution system. Priority 2 (P2) projects are those required to satisfy existing fire-flow requirements in localized areas.

P1 projects consist of the following:

- Wellhead rehabilitation (See San Simeon Production Well Evaluation, Boyle, 2006);
- Upsize tank outlet and Pico Avenue piping between Jasper and Avonne;
- Upgrade piping in Avonne between Pico and Otter Way;
- Install new piping in Jasper Way;
- Upgrade piping in Otter Way between Avonne and Castillo;
- Upgrade piping in Castillo between Otter and Motel 6, and loop Castillo with Avonne (through Motel 6); and

P2 projects consist of the following;

- Install new highway crossing at Vista del Mar;
- Upgrade piping at end of Avonne;
- Upgrade piping in Pico between Avonne and Highway 1; and
- Replace District reservoir.
- Upgrade piping in Cliff Drive cul-de-sac.

Figure 7-2 shows the pipeline upgrades recommended to improve existing deficiencies. A summary of these projects can be seen in Table 7-2.

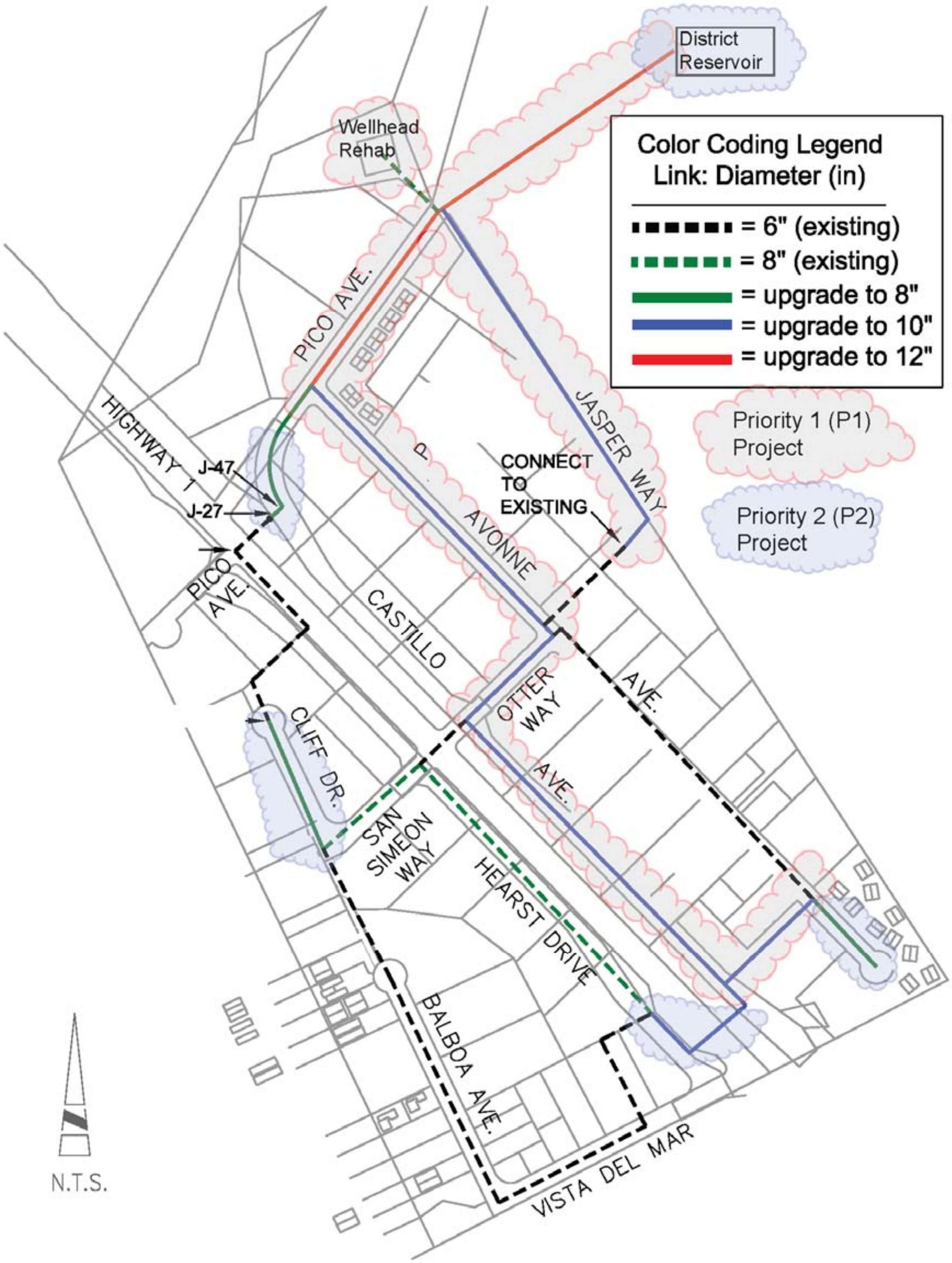


Figure 7-2: Pipeline Upgrades Recommended to Improve Existing Deficiencies

Table 7-2 Summary of Improvement Projects Required to Improve Existing Deficiencies

Priority	Project Description	Exist. Size (in)	New Size (in)	Linear Feet of Pipeline for Project (ft)
P1	Wellhead Rehabilitation	NA	NA	NA
	Tank Outlet and Pico Ave	8” ACP 8” ACP	12” PVC 12” PVC	❑ 850’ ❑ 640’
	Avonne Avenue	6” ACP	10” PVC	❑ 1,000’
	Loop from Pico through Jasper Way	none	10” PVC	❑ 1,150‘
	Otter Way	6” ACP	10” PVC	❑ 330’
	Castillo Avenue, and loop Castillo to Avonne Ave	6” ACP	10” PVC	❑ 1,110’ in Castillo Ave & 380’ loop piping
P2	Piping at south end of Avonne	6” ACP	8” ACP	❑ 270’
	Cliff Drive cul de sac	6” ACP	10” PVC	❑ 470’
	Highway crossing at Vista Del Mar	none	10” DIP with casing	❑ 300’ in casing and 400’ in Hearst and Castillo
	Pico Ave from Avonne Ave to Hwy 1	6” ACP	8” PVC	❑ 400’
	District Reservoir	150,000 gal	750,000 gal	

Table A-1 in the Appendix shows the calculated fire flows associated with these improvements.

Connecting Avonne Avenue and Jasper way through Penn Way (see Figure 7-2) was analyzed as an alternative to the recommended connection through the existing easement. According to the model, available fire flows were deficient for the existing 6-inch PVC pipeline in the easement by approximately 500 gpm. Since this 6-inch PVC pipe would also require upgrades with this layout, the easement was selected as the preferred alternative.

A record search was performed to investigate the existence of a 20” steel casing crossing Highway 1 at San Simeon Avenue. According to the CalTrans Encroachment Permit, this casing was installed at mile marker 54.34. As-built plans provided by Wallace Group show the casing extending across the highway from San Simeon Avenue, approximately 40 feet southeast of the existing 6-inch waterline crossing. We do not recommend utilizing this casing to upgrade the crossing at San Simeon Avenue. We have recommended installing a new highway crossing at Vista del Mar, while utilizing the existing 6 inch crossing at San Simeon Avenue as the most cost effective alternative.

7.3 Existing Storage Facilities

As discussed in Section 6, storage tanks are sized to provide regulatory, emergency, and fire storage. The ability of existing storage capacity to meet existing demands is shown in Table 7-3.

In a letter from Fire Marshal Robert Lewin (dated August 30, 2006), storage requirements (fire flow durations) were identified based on the size and types of existing and planned buildings. These requirements are summarized in Appendix III-A of the 2001 California Fire Code. According to a follow-up conversation with Mr. Lewin, a duration of three hours would be required for Master Planning purposes. Required fire flow (commercial/industrial) was determined to be 2,500 gpm.[12]

It is recommended the District operate wells on a 24-hr schedule. A 24 hour pumping schedule provides less operational flexibility for dealing with emergencies, system maintenance/repairs, or storage replenishment, but minimizes the operational storage requirement and thus minimizes required tank size. The District has one reservoir that provides 150,000 gallons (0.15 MG) of storage. Using a 24-hr production schedule, an additional 450,000 gallons is required to supply the recommended operational, emergency and fire storage.

Table 7-3: Ability of Existing Storage to Meet Existing Demands

Fire		MDD (gpd)	Fire Storage (gal)	Emergency Storage (gal)	Operational Storage (gal)	Total Storage Required (gal)	Recom-mended Storage (gal)[4]	Existing Tank Capacity (gal)	Existing Storage Deficit (gal)
Flow (GPM)	Duration (Hours)								
2,500	3	191,494	450,000	95,747	47,874	593,621	600,000	150,000	-450,000

Notes:
1) Assumes that existing buildings are not sprinklered
2) Recommended storage requirements are based on 24-hour well operation
3) Emergency storage based on 0.5 MDD and Operational Storage is based on 0.25 MDD

[12] Section 4.2 of the 2001 California Fire Code allows for a 75% reduction in required fire flow for buildings equipped with an approved automatic sprinkler system (to a minimum of 1500 gpm). None of the larger hotels in San Simeon have sprinkler systems. The fireflow duration requirement of these larger buildings will determine fire storage requirements for the community.

8.0 Ability of Existing System to Meet Future Demands

8.1 Water Production Capacity

The existing production rate of each District well was measured at approximately 325 gpm (0.47 MGD). In "Production Well Evaluation"(Boyle Engineering, October 2006). Boyle recommends replacing the existing well pumps with pumps capable of producing 340 gpm. Future MDD was estimated at 0.40 MGD. This provides a buffer under maximum day conditions of approximately 0.07-0.09 MGD.

Table 8-1: Production Capacity vs. Future Demand

Future MDD (MGD)	Existing Single Well Production Capacity (MGD)	Potential Single Well Production Capacity[13] (MGD)	Surplus Pumping Capacity (MGD)
0.40	0.47	0.49	0.07-0.09

The wells are only considered adequate for short-term peak demands under existing usage conditions and would not meet long-term system demands at buildout. It is assumed that the District will pursue additional sources of supply to satisfy the buildout water consumption requirement of 224 AFY. A comprehensive evaluation of the District wellfield and groundwater basin was completed by Boyle in October 2006. In this report, the safe District yield of the Pico Creek Groundwater Basin was estimated to be 104 AFY.

8.2 Future Pipeline Deficiencies

This section assumes Priority 1 and 2 Projects (from Table 7-2) have been constructed. During ADD, a minimum pressure of 40 psi and a maximum velocity of 5 fps are recommended. During PHD, a minimum pressure of 30 psi and a maximum velocity of 10 fps are recommended.

Build-out pipeline deficiencies were based on the system's inability to provide adequate fire flow while maintaining a 20 psi residual pressure. Table 8-2 identifies pipe improvements proposed to reduce fire flow deficiencies at build-out conditions (assuming P1 and P2 projects have been completed). Recommended improvements have been prioritized into two categories. Priority 3 (P3) projects are defined as those necessary to meet build-out fire-flow deficiencies. Priority 4 (P4) projects are recommended to satisfy California Department of Forestry/ County of San Luis Obispo recommendations.

[13] This assumes that the District will replace the existing well pumps with pumps capable of producing 340 gpm each as recommended in "Production Well Evaluation", Boyle, October 2006). Permit constraints may limit total groundwater withdrawal.

Table 8-2: Summary of Improvement Projects Required for Build-out Conditions

Priority	Location	Exist. Size (in)	New Size (in)	Linear Feet of Pipeline for Project (ft)
P3	Upgrade pipe from end of "Cliff Drive" cul-de-sac to Pico (this section of pipe runs along the west side of the Cavalier Inn)	6" ACP	8" PVC	❑ 650'
P4	Replace all remaining 6" water mains with minimum pipe size of 8" per CDF recommendation (Otter easement, Avonne, Balboa, Vista del Mar)	6" ACP	8" PVC	❑ 3500'

Figure 8-1 is an overview of the pipeline upgrades recommended to improve build-out deficiencies (assumes P1 and P2 projects have been completed).

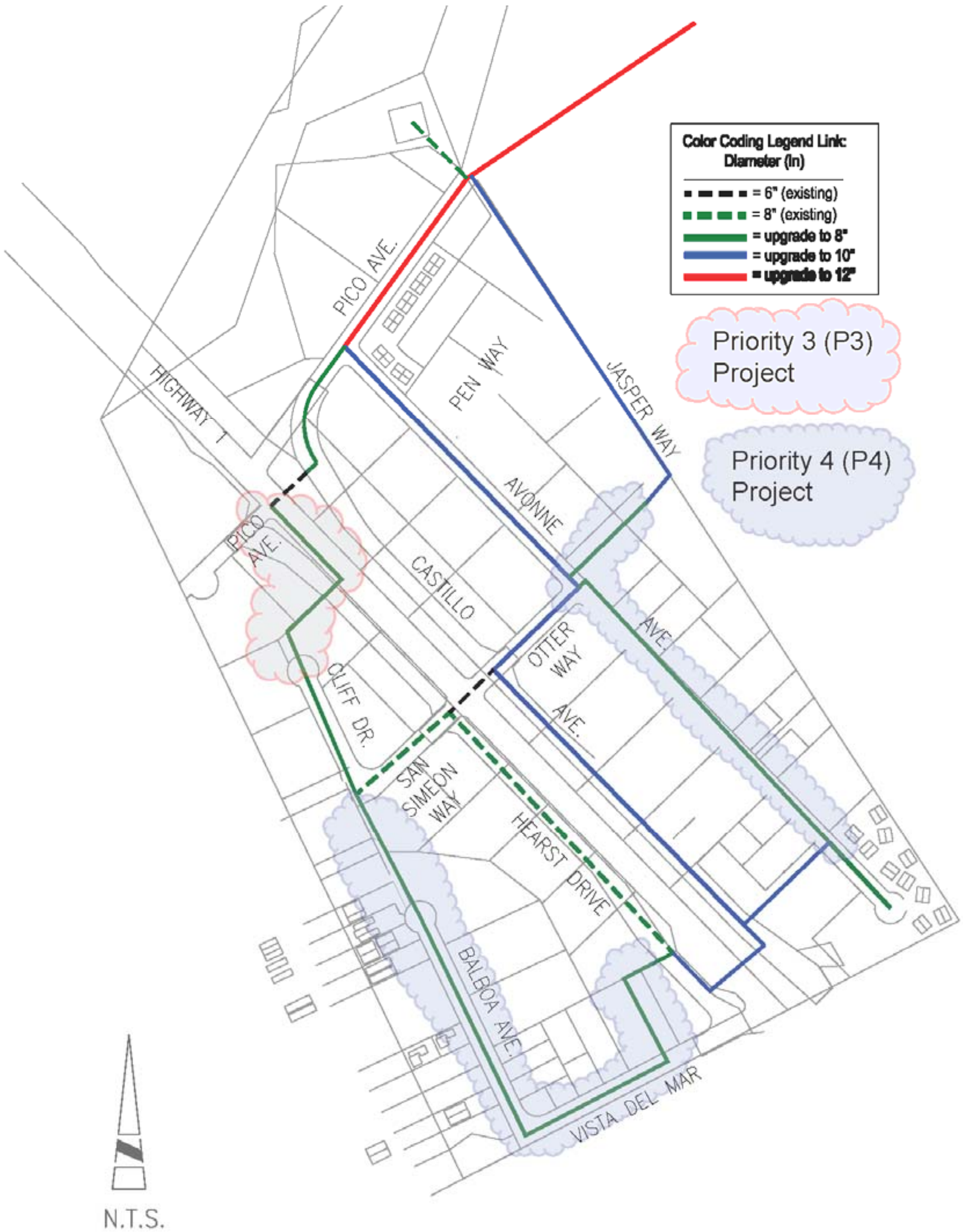


Figure 8-1: Pipeline Upgrades Recommended to Improve Build-Out Deficiencies (P3 and P4 Projects) (Assumes P1 and P2 projects are complete)

8.3 Future Storage Facilities

As discussed in Section 6, storage tanks are sized to provide regulatory, emergency, and fire storage. The ability of existing storage capacity to meet future demands is shown in Table 8-3.

It is recommended that the District operate water production facilities on a 24-hr schedule instead of sizing production and storage facilities to allow off peak pumping and storage. A 24-hour pumping schedule provides less operational flexibility for dealing with emergencies, system maintenance/repairs, or storage replenishment, but minimizes the operational storage requirement and thus minimizes required tank size. The District has one reservoir that provides 150,000 gallons (0.15 MG) of storage. Using a 24-hour production schedule, an additional 600,000 gallons is required to supply the recommended operational, emergency and fire storage.

Table 8-3: Ability of Existing Storage to Meet Future Demands

Fire		Future MDD (gpd)	Fire Storage (gal)	Emergency Storage (gal)	Operational Storage (gal)	Total Storage Required (gal)	Recom-mended Storage (gal)	Existing Tank Capacity (gal)	Future Storage Deficit (gal)
Flow (GPM)	Duration (Hours)								
2,500	3	400,000	450,000	200,000	100,000	750,000	750,000	150,000	-600,000

Notes:
1) This assumes that existing buildings do not have sprinklers.
1) Recommended storage requirements are based on a 24-hour pumping schedule
2) Emergency storage based on 0.5 MDD and Operational Storage is based on 0.25 MDD

Section 4.2 of the 2001 California Fire Code allows for a 75% reduction in required fire flow for buildings equipped with an approved automatic sprinkler system (to a minimum of 1500 gpm). If existing buildings were retrofitted with sprinklers, and all future commercial developments had sprinklers, the District may be able to significantly reduce future fire storage requirements. If all commercial buildings had a fire flow requirement of 1500 gpm (as opposed to 2500 gpm), fire storage requirements would be reduced from 450,000 gallons to 270,000 gallons (from 750,000 gallons to 570,000 gallons total storage required).

9.0 Summary of Recommendations and Opinion of Probable Cost

9.1 Operation and Maintenance

Tank Maintenance. Boyle recommends continuing the District reservoir inspection program to assess condition and identify leaks.

Valves. Valves and hydrants should be exercised yearly to ensure functionality and maintain water quality. When problems with the operation of these appurtenances are detected, then they should be scheduled for replacement.

Hydrant Spacing. Spacing of hydrants should be a maximum of 250 feet in commercial zones, and 300 feet in residential zones. Appendix III-B of the California Fire Code sets the maximum distances. The fire department must approve the location of all fire hydrants, and will require a hydraulic test at the completion of any project.

Meters. The District has an on-going meter replacement program. Regular meter replacement is recognized as an important revenue protection technique, since old meters frequently record less flow than may be consumed.

9.2 Capital Projects Summary

This section summarizes the capital improvements recommended through build-out. The program is derived from the recommendations of this report, and the opinions of probable cost.

This program and these cost opinions are based on the following assumptions:

- Except where other data are available, cost opinions are generally derived from bid prices from similar water utility projects, with adjustments for inflation, size, complexity, and location.
- Cost opinions are in 2006 dollars. When budgeting for future years, appropriate escalation factors should be applied.
- Cost opinions are "budget-level" and may not fully account for site-specific conditions that will affect the actual costs.
- Engineering, project administration, inspection, and construction management are included in the opinion of cost.
- Contingency of 30 percent has been included.

The opinions of probable cost prepared by Boyle Engineering represent our judgment and are supplied for the general guidance of the District. Since Boyle has no control over the cost of labor and material, or over competitive bidding or market conditions, Boyle does not guarantee the accuracy of such opinions as compared to contractor bids or actual costs.

9.3 Typical Lifecycle

Table 9-1 presents an estimate of expected life for certain facilities.

Table 9-1
Anticipated Facility Life

Facility	Estimated Life
Pipelines	80 years
Pump Stations (except pumps and electrical)	60 years
Electrical and control facilities at pump stations and storage facilities	20 years
Pumps	25 years
Welded steel storage tanks (except coating)	50 years
Tank coatings	12 years
Concrete reservoirs	70+ years

9.4 Project Prioritization and Engineer's Opinion of Probable Cost

Table 9-2 contains estimated unit costs for piping improvements. Pipeline costs are based on work in existing streets and include excavation, installation, backfill, pavement repair, normal appurtenances, traffic control and connection of existing service to new main.

Table 9-2
Piping Improvements Construction Cost Criteria

Item Description	Budgetary Cost
8-inch pipeline	$170/LF
10-inch pipeline	$180/LF
12-inch pipeline	$200/LF
12-inch pipeline with casing (jack and bore method)	$500/LF

Table 9-2 Piping Improvements Construction Cost Criteria	
Item Description	Budgetary Cost
Welded Steel Tanks	$0.80/gal + $0.20/gal for site work
Concrete Reservoirs	$1.00/gal + $0.25/gal for site work
Engineering and Administration	25% of construction cost
Project Contingency	30% of total project cost

Table 9-3 provides an opinion of probable construction costs for the improvements recommended to meet both existing and build-out demands. The recommended improvements have been arranged by priority.

- Priority 1 – Priority 1 improvements include critical improvements required to improve significant fire flow deficiencies in the community under existing conditions (See Section 7). It is recommended that these improvements be completed within four years.
- Priority 2 – These recommendations include important improvements needed to improve remaining fire flow deficiencies in the community under existing conditions (See Section 7). It is recommended that these improvements be completed within six years.
- Priority 3 – Priority 3 improvements are necessary to improve fire protection under the future buildout scenario (See Section 8). It is recommended that these improvements be completed within ten years.
- Priority 4 – Priority 4 projects are recommended to satisfy California Department of Forestry/ County of San Luis Obispo recommendations (See Section 8). It is recommended that these improvements be completed within ten years.

Table 9-3
Engineer's Opinion of Probable Cost for Recommended Improvements

Priority	Project	Exist. Size (in)	New Size (in)	Linear Feet of Pipeline for Project (ft)	Estimated Cost ($)
P1	Wellhead Rehabilitation	NA	NA	NA	$320,000
	Tank Outlet and Pico Ave	8" ACP 8" ACP	12" PVC 12" PVC	❑ 850' ❑ 640'	$276,000 $208,000
	Avonne Avenue	6" ACP	10" PVC	❑ 1,000'	$293,000
	Loop from Pico through Jasper Way	none	10" PVC	❑ 1,150'	$336,000
	Otter Way	6" ACP	10" PVC	❑ 330'	$97,000
	Castillo Avenue, and loop Castillo to Avonne Ave	6" ACP	10" PVC	❑ 1,110' in Castillo Ave & 380' loop piping	$325,000 $111,000 **Total $1,966,000**
P2	Piping at south end of Avonne	6" ACP	8" ACP	❑ 270'	$75,000
	Cliff Drive cul de sac	6" ACP	10" PVC	❑ 470'	$137,000
	Highway crossing at Vista Del Mar	none	10" DIP with casing	❑ 300' in casing and 400' in Hearst and Castillo	$361,000
	Pico Ave from Avonne Ave to Hwy 1	6" ACP	8" PVC	❑ 400'	$111,000
	District Reservoir	150,000 gal	750,000 gal		$1,450,000 **Total $2,134,000**
P3	Upgrade pipe from end of "Cliff Drive" cul-de-sac to Pico (this section of pipe runs along the west side of the Cavalier Inn)	6" ACP	8" PVC	❑ 650'	$180,000 **Total $180,000**
P4	Replace all remaining 6" water mains with minimum pipe size of 8" per CDF recommendation (Otter easement, Avonne, Balboa, Vista del Mar)	6" ACP	8" PVC	❑ 3500'	$967,000 **Total $967,000**

Costs include contingency, engineering, and administration

10.0 Wastewater Collection System Capacity Analysis

10.1 Background

A gravity sewer system conveys domestic wastewater to the District's Wastewater Treatment Plant. The collection system is comprised of approximately 1.6 miles of gravity sewer pipe (mostly six inches in diameter). The District also receives wastewater from the Hearst San Simeon State Historical Monument (the State).

A topographic survey and partial boundary survey of the District was performed on 11/27/06, and is included under separate cover.

A schematic of the existing wastewater collection system is shown in Figure 10-1.

LEGEND:

P-72	PIPE LABEL
6 inch	PIPE SIZE
VCP	PIPE MATERIAL
0.00711	PIPE SLOPE (ft/ft)
SSMH#16	MANHOLE NUMBER
45.69	RIM ELEVATION (ft)

BOYLE ENGINEERING CORPORATION

SAN SIMEON COMMUNITY SERVICES DISTRICT

EXISTING WASTEWATER COLLECTION SYSTEM

BEC PROJECT NO. 20020.03

FIGURE 10-1

DWG: W:\San Simeon CSD (20020.XX) \S4310007 (San Simeon Water Master Plan) \CAD\Figures\Existing Sewer (rev) .dwg USER: jfroelicher
DATE: Dec 07, 2007 8:48am XREFS: slopes lot lines IMAGES:

10.2 Scope of Work

Recommendations were based on necessary improvements identified for the collection system alone. Improvements related to the wastewater treatment plant were not considered in this study. Boyle's scope of work included the following tasks:

- Create a model of collection system based on existing information
- Review typical usage patterns from last five years
- Perform peaking factor analysis based on existing data and land use information to project future usage patterns
- Identify and recommend capital improvements for collection system
- Develop engineer's opinion of probable cost for recommended improvements to the collection system

10.3 Existing Wastewater Flows

Average Daily Flow (ADF) is defined as the average flow over the course of one year expressed in gallons per day, and is the base flow for the wastewater collection system. ADF for the District is 77,500 gpd based on flow records for 24 consecutive months from January 2004 through December 2005.

Maximum Day Flow (MDF) is the maximum daily flow rate in the period evaluated. Flow records indicate MDF was 248,060 gpd in February 2005. Since plant records indicate that, generally, winter maximum day flows are less than summer maximum day flows, inflow/infiltration (I/I) was not considered significant in this capacity analysis.

Peak Hour Flow (PHF) represents the maximum flow entering the wastewater treatment facility over a one-hour period. PHF can sometimes be derived from WWTP flow records, but if hourly flow records are not available, empirical equations must be used to estimate PHF.

A peaking factor analysis was performed in Section 10.4.

Historic flow data (ADF, MMF, and PDF) are summarized in Table 10-1.

Table 10-1: Historic WWTP Flows

Month	MDF (gpd)	ADF (gpd)
Jan-04	123,000	64,000
Feb-04	149,000	74,000
Mar-04	113,000	71,000
Apr-04	108,000	77,000
May-04	113,000	70,000
Jun-04	152,210	77,081
Jul-04	127,230	89,046
Aug-04	226,170	114,830
Sep-04	185,800	103,161
Oct-04	230,000	101,485
Nov-04	113,030	80,195
Dec-04	235,140	77,416
Jan-05	185,430	88,120
Feb-05	248,060	86,691
Mar-05	138,910	84,613
Apr-05	99,300	57,858
May-05	90,910	64,787
Jun-05	120,930	71,939
Jul-05	200,130	99,440
Aug-05	149,186	84,424
Sep-05	143,420	61,029
Oct-05	149,118	59,213
Nov-05	137,611	54,316
Dec-05	92,874	48,985
Existing ADF =		***77,526***
Existing MDF =	***248,060***	

10.4 Peaking Factor Summary

One method commonly used to estimate PHF is to multiply the ADF by a Peaking Factor (PF).

$$PHF = P.F. \times ADF$$

The following formula was used to calculate the peaking factor, where P is population (in thousands).[14]

$$P.F. = \frac{18 + P^{0.5}}{4 + P^{0.5}}$$

For San Simeon's existing population estimate of 250 persons[15], the calculated peaking factor is 4.1. Metcalf and Eddy (2003), recommends using a peaking factor of 4.0 for communities with populations less than 4,000. A peaking factor of 4.0 was used for this project.[16]

Peak hour flow is summarized in Table 10-2.

Table 10-2: Peaking Hour Flow Estimates (Existing Conditions)

Existing ADF (gpd)	Peaking Factor	Existing PHF (gpd)
77,500	4.0	310,000

Applied to the ADF of 77,500 gpd, the Peak Hour Flow was estimated to be 0.31 MGD (215 gpm). This flow correlates with reports from operators suggesting flows in the 0.30-0.35 MGD range have been observed during high tourism periods, or wet weather.

10.5 Projected Flows

Future flow conditions were estimated using plant records and projected water demands developed for the water distribution system hydraulic model.

Future ADF
Under existing conditions, the amount of water entering the collection system was approximately 81% of the amount of potable water billed.[17] Therefore, future ADF was estimated as 81% of the future potable water demand.

Future MDF
In order to estimate future MDF, future ADF was escalated by a Maximum Day Peaking Factor. This Maximum Day Peaking Factor was determined by analyzing existing plant records. It was found that under existing conditions, MDF was 3.2 times higher than

[14] Fair, G.M., and Geyer, J.C., "Water Supply and Waste-Water Disposal." 1st Ed., John Wiley & Sons, Inc., New York (1954).
15 Based on Draft Cambria and San Simeon Acres Community Plan, November 2005.
[16] Boyle installed a temporary influent flowmeter at the plant during December, 2005. The resulting diurnal patterns indicate that a design peaking factor of approximately 4.0 correlates well with existing conditions.
[17] Existing ADF (77,526 gpd) divided by existing ADD (95,747 gpd) equals 81%.

ADF.[18] This Maximum Day Peaking Factor was applied to Future ADF to estimate Future MDF.

Future PHF
In order to estimate future PHF, future ADF was escalated by a Peak Hour Peaking Factor of 4.0 (calculated in Section 10.4).

The estimated future flows are summarized in Table 10-3.

Table 10-3: Projected Flow Estimates

			Projected Flow Rate (gpd)
Future ADF	.81	x Future Water ADD (200,000 gpd)	162,000
Future MDF	3.2	x Future ADF (162,000 gpd)	518,000
Future PHF	4.0	x Future ADF (162,000 gpd)	648,000

10.6 Hydraulic Model

The wastewater collection system was analyzed for its ability to meet both existing and future demands. First, a computer spreadsheet model was developed to estimate the hydraulic capacity of the existing sewer lines. The spreadsheet model utilized Manning's equation for circular channel flow in conjunction with a published graph for d/D vs. Q/Q_{full}.[19] This graph relates the ratio of depth of flow to the diameter of pipe (d/D) and the ratio of the actual flow rate to the full capacity flow rate (Q/Q_{full}). The following evaluation criteria were used for the analysis of the sewer interceptors:

Flow Condition	**Allowable Flow Depth (d/D)**
Average Daily Flow	0.60
Peak Hourly Flow	0.75

Modeled sewer flows were distributed throughout the system using the distribution pattern developed for the water distribution system.

[18] Existing PDF (248,060 gpd) divided by existing ADF (77,526 gpd) equals 3.2.
[19] Lindeburg, Michael R., "Civil Engineering Reference Manual," 8th Ed., Professional Publications, Inc., Ca (2001) - Appendix 19.C

Through records provided by the District, it was determined that the State contributes an average of 11,700 gallons of wastewater to the District system per day (based on an average from 2001-2005). Accordingly, total flow estimates applied in the model were reduced by 11,700 gallons per day. Once the resultant flows were distributed throughout the system according to the distribution developed in the water model, the average instantaneous flow rate from the State (158 gpm) was added to the model at the connection location.[20] This flow rate was applied to the model runs for all flow scenarios. This capacity analysis assumes that the rate of wastewater contributed by the State will not increase.

For each section of pipe, estimated flows were compared to the theoretical capacity calculated by the model. Pipes with estimated flows greater than the calculated hydraulic capacity were considered for replacement. Table 10-4 shows the calculated capacity of each section of pipe (using 60% MDF and 75% PHF criteria stated above) and compares these capacities to the estimated existing and future demands.

[20] A pressure main conveys sewage from the State to the District collection system at approximately Pico Avenue and Castillo Streets. According to State staff, the maximum pumping rate of the State system is approximately 158 gpm.

Table 10-4
San Simeon Sewer Collection System Hydraulic Capacity Analysis

									Analysis During MDF Conditions			Analysis During PHF Conditions		
Pipe Label	Length (ft)	Section Size (in)	Material	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Hydraulic Capacity, 60% d/D (gpm)	Existing MDF (gpm)	Future MDF (gpm)	Hydraulic Capacity, 75% d/D (gpm)	Existing PHF (gpm)	Future PHF (gpm)
P-7	**20**	**6**	**VCP**	SSMH#21	SSMH#24	16.44	16.43	0.00050	**41**	29.1	**58.1**	**55**	36.4	**72.7**
P-3	377	6	VCP	SSMH#27	SSMH#26	25.80	25.10	0.00186	79	1.4	27.9	106	1.7	34.9
P-4	378	6	VCP	SSMH#26	SSMH#25	25.10	24.10	0.00265	94	8.9	51.6	127	11.2	64.5
P-14	368	6	VCP	SSMH#14	SSMH#15	45.80	44.70	0.00299	100	19.1	22.1	135	23.9	27.6
P-13	368	6	VCP	SSMH#13	SSMH#12	43.20	42.10	0.00299	100	29.7	44.2	135	37.1	55.2
P-20	470	6	VCP	SSMH#6	SSMH#7	55.12	53.60	0.00323	104	50.7	33.8	140	63.4	42.2
P-17	487	6	VCP	SSMH#9	SSMH#8	54.02	52.41	0.00331	105	5.9	34.5	142	7.4	43.2
P-24	203	6	PVC	SSMH#3	SSMH#4	58.41	57.70	0.00350	108	0.0	1.7	146	0.0	2.1
P-9	107	8	VCP	SSMH#24	Headworks Box	16.43	16.05	0.00355	**235**	**295.3**	**440.4**	**317**	**329.7**	**511.0**
P-74	369	6	VCP	SSMH#15	SSMH#13	44.70	43.20	0.00407	116	19.1	22.1	157	23.9	27.6
P-22	237	6	VCP	SSMH#5	SSMH#6	56.13	55.12	0.00426	119	4.0	10.4	161	5.0	13.0
P-25	37	6	PVC	SSMH#2	SSMH#3	58.60	58.41	0.00514	131	0.0	1.7	177	0.0	2.1
P-27	159	6	VCP	SSMH#17	SSMH#16	46.55	45.69	0.00541	134	0.3	0.3	181	0.4	0.4
P-23	236	6	PVC	SSMH#4	SSMH#5	57.70	56.13	0.00665	149	0.0	1.7	201	0.0	2.1
P-72	**505**	**6**	**VCP**	SSMH#16	SSMH#12	45.69	42.10	0.00711	**154**	**158.3**	**158.3**	**208**	**158.4**	**158.4**
P-8	**18**	**6**	**VCP**	SSMH#20	SSMH#24	16.60	16.43	0.00944	**177**	**266.2**	**382.3**	**239**	**293.3**	**438.3**
P-16	451	6	VCP	SSMH#10	SSMH#9	58.95	54.02	0.01093	191	5.9	23.5	258	7.4	29.4
P-6	400	6	VCP	SSMH#22	SSMH#21	21.47	16.44	0.01257	204	29.1	58.1	276	36.4	72.7
P-15	454	6	VCP	SSMH#11	SSMH#10	64.88	58.95	0.01306	208	2.9	10.1	282	3.7	12.6
P-68	117	6	VCP	CO#5	JC-5	35.50	33.00	0.02137	266	0.0	0.0	360	0.0	0.0
P-18	53	6	VCP	SSMH#7	SSMH#8	53.60	52.41	0.02245	273	53.5	46.0	369	66.9	57.5
P-67	66	6	VCP	CO#6	CO#5	37.00	35.50	0.02273	275	0.0	0.0	371	0.0	0.0
P-11	267	6	VCP	SSMH#18	SSMH#19	30.73	23.30	0.02783	304	254.9	299.5	411	279.2	334.9
P-26	224	6	VCP	SSMH#1	SSMH#2	65.04	58.60	0.02875	309	0.0	1.7	418	0.0	2.1
P-30	345	6	VCP	SSMH#8	SSMH#12	52.41	42.10	0.02988	315	59.4	80.5	426	74.2	100.6
P-2	96	6	VCP	SSMH#28	SSMH#27	28.73	25.80	0.03052	318	1.4	27.9	431	1.7	34.9
P-69	361	6	VCP	JC-5	SSMH#19	33.00	20.80	0.03380	335	11.3	82.7	453	14.1	0.0
P-12	331	6	VCP	SSMH#12	SSMH#18	42.10	30.73	0.03435	338	249.1	284.8	457	271.9	316.4
P-32	511	6	VCP	SSMH#29	SSMH#28	46.93	28.73	0.03562	344	1.4	12.5	465	1.7	15.6
P-31	285	6	VCP	SSMH#23	SSMH#22	32.97	21.47	0.04035	366	29.1	58.1	495	36.4	72.7
P-5	154	6	VCP	SSMH#25	Headworks Box	24.10	16.05	0.05227	417	8.9	51.6	563	11.2	64.5
P-71	122	6	VCP	JC-6	SSMH#1	72.00	65.04	0.05705	435	0.0	0.0	589	0.0	103.4
P-10	43	6	VCP	SSMH#19	SSMH#20	20.80	16.60	0.09767	570	266.2	382.3	770	293.3	438.3

Note 1 - Greyed cells indicate projected flows greater than estimated capacity
Note 2 - See Figure 10-1 for pipe locations

10.7 Sewer Pipeline Recommendations

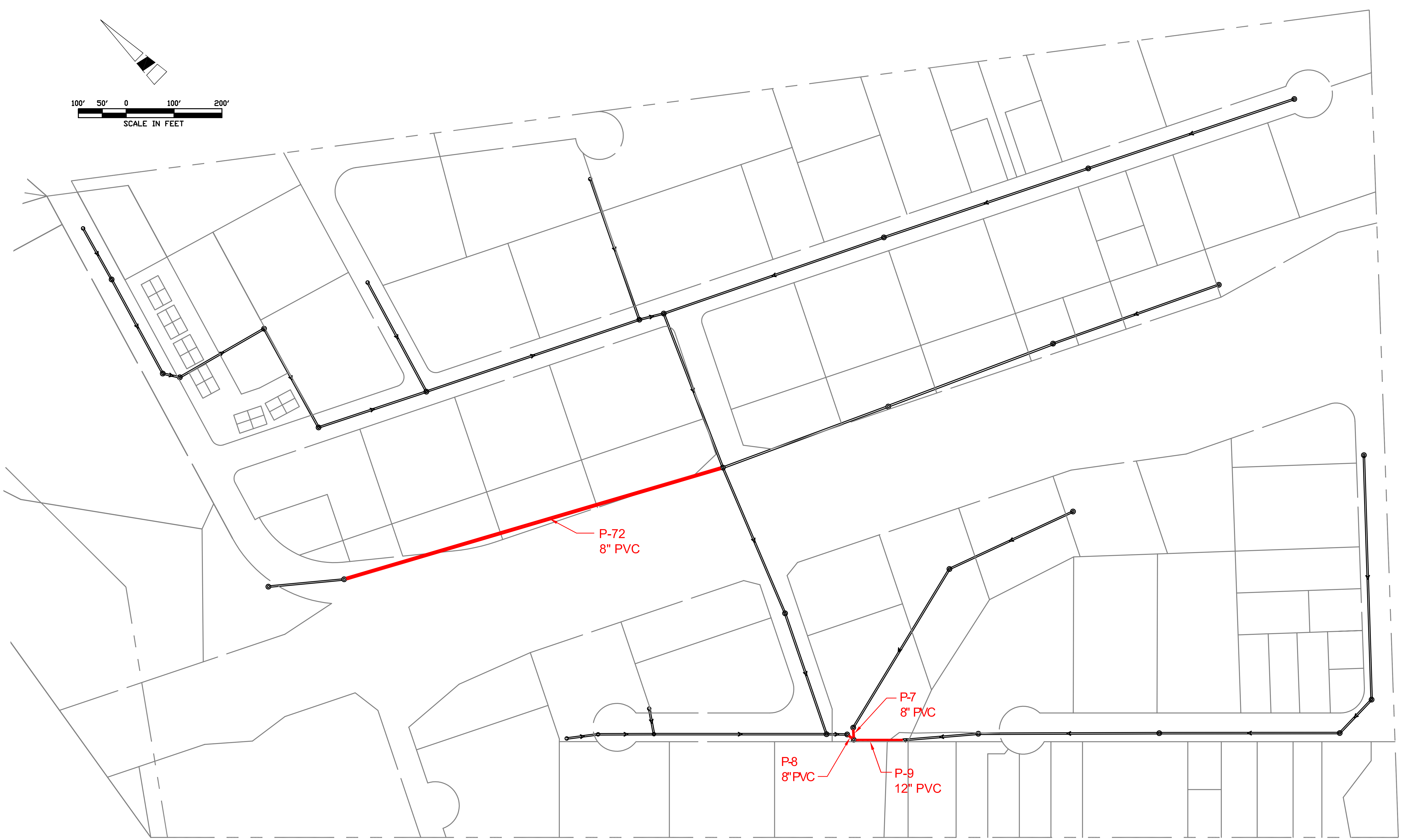
As can be seen in Table 10-4 above, the model identified four sections of pipe with inadequate capacity under existing or future conditions. Pipes number 8 and 9 failed under MDF and PHF scenarios in both existing and future conditions. Pipe number 7 failed under future conditions, and Pipe number 72 failed under PHF scenarios in both existing and future conditions.

According to the model, all pipe sizes recommended for buried pipe provide adequate capacity for existing and future scenarios. The 10-inch pipe recommended for the pipe bridge, however, provides 420 gpm of capacity (under 60% MDF criteria), and future modeled MDF was 440 gpm. It is Boyle's opinion that despite the model results, a 10-inch pipe would be adequate for future conditions, and may be a more appropriate size (compared to 12-inch) for installation on the existing pipe bridge.

Pipes recommended for replacement are summarized in Table 10-5, and are shown on Figure 10-2.

Table 10-5 – Recommended Collection System Improvements and Projected Capacity

Pipe Label	Description	Exist. Size (in)	Recommended Size (in)	Length of Pipeline (ft)	Projected Capacity (60% MDF) (gpm)	Projected Capacity (75% PHF) (gpm)
7	Located upstream of pipe bridge (west of the Wastewater Treatment Plant)	6" VCP	8" PVC	20'	89	120
8	Located upstream of pipe bridge (west of the Wastewater Treatment Plant)	6" VCP	8" PVC	18'	387	523
9	Pipe Bridge	8" VCP	10" DI	107'	420	568
72	Castillo Ave – between Pico Ave and Otter Way	6" VCP	8" PVC	505'	336	454



Legend

= 6" VCP (existing)

size" PVC = Recommended Upgrade

BOYLE ENGINEERING CORPORATION

SAN SIMEON COMMUNITY SERVICES DISTRICT

RECOMMENDED SEWER PIPELINE IMPROVEMENTS

BEC PROJECT NO. 20020.03

FIGURE 10-2

DWG: W:\San Simeon CSD (20020.XX) \S4310007 (San Simeon Water Master Plan) \CAD\Figures\SEWER IMPROVEMENTS.dwg USER: jfroelicher

DATE: Dec 07, 2007 10:13am XREFS: slopes lot lines IMAGES:

10.8 Engineer's Opinion of Probable Cost

Pipeline replacement costs were estimated to be $270/lf based on recent competitive bids for an open trench pipe replacement project in Cayucos, CA (November 2006). Construction cost criteria can be seen below in Table 10-6.

Table 10-6: Sewer Pipeline Improvements Construction Cost Criteria

Item Description	Budgetary Cost
Pipeline	$270/LF
Engineering and Administration	25% of construction cost
Project Contingency	30% of total project cost

Table 10-7: Engineer's Opinion of Probable Project Cost

Pipe Label	Description	Exist. Size (in)	Recommended Size (in)	Length of Pipeline (ft)	Estimated Cost ($)
7	Located upstream of pipe bridge (west of the Wastewater Treatment Plant)	6" VCP	8" PVC	20'	$9,000
8	Located upstream of pipe bridge (west of the Wastewater Treatment Plant)	6" VCP	8" PVC	18'	$8,000
9	Pipe Bridge	8" VCP	10" DI	107'	$47,000
72	Castillo Ave – between Pico Ave and Otter Way	6" VCP	8" PVC	505'	$222,000

Appendix

Calculated fire flows after completion of P1, P2, and P3 projects

CDF letter stating fireflow requirements

Field measurements and calculated fire flows

Table A-1 – Fire Flow Field Measurements versus Modeling Result

Scenario			Time	Date	WaterCAD model Node Number	Location		Fire Flow Test Observations						Model Results		Notes	
Test performed by	Zone	Test No.					Streets/Name	Static (psi)	Pitot Tube	Pitot (psi)	Discharge (gpm)	Residual (psi)	System Status (wells, reservoirs, etc)	Static (psi)	Residual (psi)		Static Delta (model - obs.)
City Staff	Main	1	8:53 am to 9:13 am	8/24/2006	J-45	Flow Hydrant	along Pico Ave near the ECO Resources Office		2.5"	17	650		tanks at 13.63'				
					J-46	Static/Residual	N/O intersetion of Pico Ave and Avonne Ave	46				34		45.1	36.8		-0.9
City Staff	Main	2	9:25 am to 9:29 am	8/24/2006	J-27	Flow Hydrant	intersection of Pico Ave and Castillo Dr		2.5"	16	630		tanks at 13.34'				
					J-48	Static/Residual	along Avonne Ave between Pico Ave and Pen Way	44				25.5		45.8	29.5		1.8
City Staff	Main	3	9:40 AM	8/24/2006	J-15	Flow Hydrant	east end of Castillo Dr near Motel 6		2.5"	12	550		tanks at 13.24'				
					J-49	Static/Residual	along Castillo Dr between Motel 6 and Otter Way	45.5				18		47	17.9		1.5
City Staff	Main	4	10:15 am to 10:20 am	8/24/2006	J-13	Flow Hydrant	East End of Avonne Ave		2.5"	8	450		tanks at 12.80'				
					J-41	Static/Residual	long Avonne Ave E/O Otter Way	40.5				14.5		41.4	18.7		0.9
City Staff	Main	5	10:35 AM	8/24/2006	J-42	Flow Hydrant	East end of Hearst Drive (W/O Vista Del Mar)		2.5"	16	630		tanks at 13.08'			Residual is 27.2 psi when pipe along Heart Drive is PVC with a C factor of 150	
					J-38	Static/Residual	along Hearst Dr between San Simeon Ave and adjacent to Orchid Inn	52				26		51.7	26.1		-0.3
City Staff	Main	6	10:50 AM	8/24/2006	J-39	Flow Hydrant	Corner of Balboa Ave and Vista Del Mar		2.5"	10	500		tanks at 13.01'			reducing C factor from 120 to 100 reduces residual to 27.4 psi.	
					J-20	Static/Residual	along Balboa Ave E/O cul-de-sac	54				33		57.7	36.6		3.7
City Staff	Main	7	11:00 AM	8/24/2006	J-37	Flow Hydrant	along San Simeon Ave S/O Hearst Dr		2.5"	15.5	620		tanks at 12.91'			Residual is 30.6 psi when demands are MDD instead of ADD	
					J-43	Static/Residual	at intersection of San Simeon Ave and Cliff Dr	56				31.5		57.2	34.7		1.2
City Staff	Main	8	11:30 PM	8/24/2006	J-32	Flow Hydrant	along Avonne Ave (6" ACP)		2.5"	10	500		tanks at 12.64'			More likely FH is on 6-inch line instead of 4-inch line as shown in atlas	
					J-29	Static/Residual	E/O intersection at Otter Way and Avonne Ave	44				23		44.6	24.1		0.6

Water Level assumed to be at an elevation of 160.5'

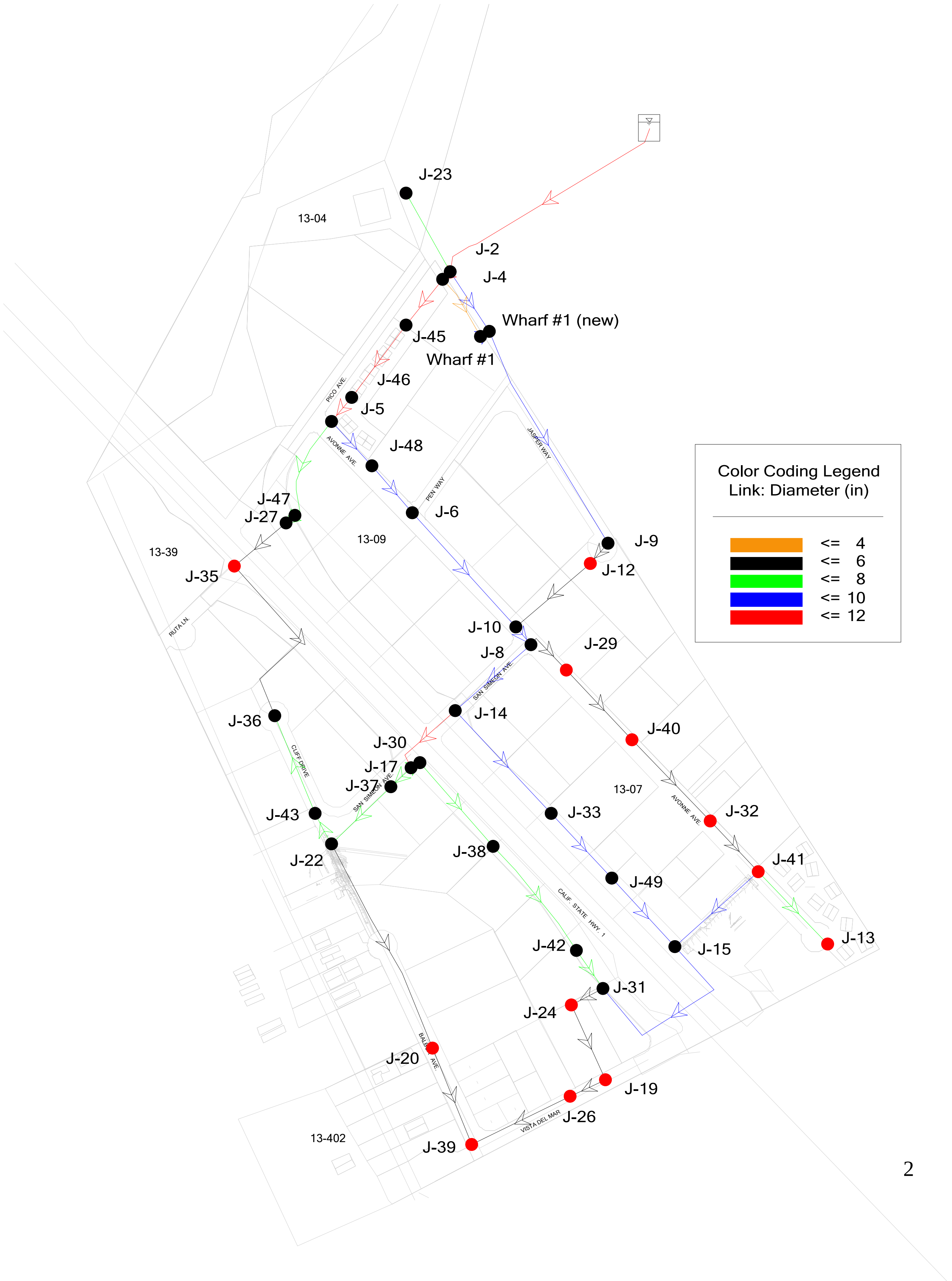
red cell = FF < 1000 gpm

pink cell = FF < 1500 gpm

yellow cell = FF < 2500 gpm

Table A-1: Improvement Scenarios

Label	**Elev (ft)**	**MDD Press (psi)**	**Req'd fire flow (gpm)**	**Existing Available fire flow at 20 psi during MDD (gpm)**	**Calculated Fire Flow After Completion of P1, P2, and P3 Projects (gpm)**
Resdential Nodes					
J-5	62	41.9	1500	505	4,338
J-6	62	41.7	1500	422	3,887
J-8	61	42.1	1500	403	3,356
J-9	83	32.6	1500	362	2,836
J-10	61	42.1	1500	401	3,458
J-12	83	32.6	1500	369	2,400
J-13	72	37.3	1500	339	2,214
J-19	52	46	1500	421	1,690
J-20	30	55.5	1500	421	1,761
J-24	51	46.4	1500	421	2,233
J-26	46	48.6	1500	421	1,671
J-29	60	42.5	1500	403	2,178
J-32	65	40.4	1500	381	1,849
J-39	30	55.5	1500	421	1,741
J-40	62.5	41.4	1500	403	1,751
J-41	67.5	39.3	1500	362	2,447
J-45	68	39.7	1500	776	4,555
J-46	59	43.3	1500	552	4,391
J-48	58	43.6	1500	465	4,134
WHARF #1	85	32.5	1500	797	3,744
Commercial Nodes					
J-2	77	35.9	2,500	1,164	4,579
J-4	77	35.9	2,500	1,137	4,572
J-14	51	46.4	2,500	413	3,110
J-15	53	45.5	2,500	413	2,666
J-17	46	48.6	2,500	421	3,070
J-22	31	55.1	2,500	421	3,184
J-23	19.5	60.8	2,500	1,164	3,768
J-27	50	47	2,500	470	3,567
J-30	46	48.6	2,500	421	3,057
J-31	52	46	2,500	421	2,781
J-33	50	46.8	2,500	413	2,876
J-35	50	47	2,500	459	2,696
J-36	31	55.1	2,500	435	3,104
J-37	36	52.9	2,500	420	3,099
J-38	44	49.4	2,500	421	2,963
J-42	50	46.8	2,500	421	2,840
J-43	31	55.1	2,500	425	3,230
J-47	50	47	2,500	472	3,643
J-49	55	44.6	2,500	413	2,767



J-23
13-04
J-2
J-4
Wharf #1 (new)
J-45
Wharf #1
J-46
PICO AVE.
J-5
J-48
AVONNE AVE.
JASPER WAY
PEN WAY
J-47
J-27
J-6
13-09
J-9
13-39
J-12
J-35
RUTA LN.
J-10
J-8
J-29
SAN SIMEON AVE.
J-14
J-36
J-40
J-30
J-17
J-37
SAN SIMEON AVE.
CLIFF DRIVE
13-07
J-33
J-32
AVONNE AVE.
J-43
J-22
J-38
J-49
J-41
CALIF. STATE HWY. 1
J-42
J-15
J-13
J-31
J-24
J-20
J-19
J-26
VISTA DEL MAR
13-402
J-39
Color Coding Legend
Link: Diameter (in)
<= 4
<= 6
<= 8
<= 10
<= 12

STORAGE: 2500 gpm @ 3 hrs

CDF/San Luis Obispo County Fire Department

635 N. Santa Rosa • San Luis Obispo • California 93405

August 30, 2006

Ms. Rosalyn Piza, Engineer
1194 Pacific Street, Suite 204
San Luis Obispo, CA 93401

Subject: San Simeon Water Master Plan

Dear Ms. Piza,

This letter is in response to your request for information regarding the fire department's recommendations for master planning for the community of San Simeon water system.

The California Fire Code (CFC 903.2, 903.4.2), which is the adopted fire code for San Luis Obispo County (Title 16.10), expressly states the fire flow requirements needed. (See attached CFC Appendix IIIA and IIIB.) In addition, the hotels also fall under the authority of the State Fire Marshal as an R-1 occupancy, which also uses the CFC adopted by the State Legislature.

Residential Development:
The **minimum** requirement for a residential development is 1000 gpm for a two hour duration at 20 to 150 psi. Spacing should be no more than 500 feet unless on a dead-end then it will be reduced by 100 feet. The maximum distance from any street or road frontage should be no more than 250 feet.

Commercial / Industrial Development:
The **minimum** flow requirements for commercial and industrial development are based on the size and type of construction of the buildings served. Flow shall not be less than 1500 gpm at 20 to 150 psi. Hydrants must be within 150 feet of the exterior of the building.

Master Planning:
Master planning for new, improving or expanding community water distribution system the following is our recommendation:

- Residential – 1,500 gpm
- Commercial/Industrial* – 2,500 gpm
- Urban Downtown Development/Heavy Industrial– 4,500 gpm
- All pipe diameters will be a minimum of 8 inch.
- Spacing of hydrants in commercial should be a minimum of 250 feet and 300 feet in residential. Appendix III-B of the California Fire Code sets the minimum distances.

* will require more fire flow for hazardous buildings

The fire department must approve the location of all fire hydrants and will require a hydraulic test at completion of the projects.

Water Storage:
To calculate the water storage and flow to individual hydrants it is necessary to know the general square footage of each building, what the construction type is and if they are sprinklered or not, for example:

> If a building is 12,000 sq. ft. and is Type V-N construction then the required fire flow required is 3000 GPM for a 3 hour duration (540,000 gallons stored). Three (3) hydrants would be required with a spacing of no more than 400 feet between hydrants. The closest one must be within 150 feet of the building.

If the building is sprinklered there is a reduction of 75% for fire flow to no less than 1500 GPM. However, the duration of 3 hours would still be required. With sprinklers the above example would require:

> 1500 GPM for 3 hours duration (270,000 gallons stored).

For residential areas the required fire flow is reduced to 1000 GPM unless the home is over 3600 sq. ft without sprinklers.

There is an obvious reduction in fire flow for sprinklered buildings. Therefore the District should consider whether retrofitting the existing buildings is feasible. Sprinklers are the most effective form of fire protection in protecting life and property.

Domestic water supply should be added to the required fire flow storage requirements; the County Health Department can assist with calculating the necessary quantities.

Please contact me at 543-4244 if I can provide any additional information.

Sincerely,

Robert Lewin, Fire Marshal
Battalion Chief

cc: Phill Veneris, Battalion Chief
Greg Pisano, Division Chief

Division III
FIRE PROTECTION
APPENDIX III-A
FIRE-FLOW REQUIREMENTS FOR BUILDINGS

(See UFC Section 903.3)

SECTION 1 — SCOPE

The procedure determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with Appendix III-A. Appendix III-A does not apply to structures other than buildings.

SECTION 2 — DEFINITIONS

For the purpose of Appendix III-A, certain terms are defined as follows:

FIRE AREA is the floor area, in square feet, used to determine the required fire flow.

FIRE FLOW is the flow rate of a water supply, measured at 20 psi (137.9 kPa) residual pressure, that is available for firefighting.

SECTION 2 — MODIFICATIONS

2.1 Decreases. Fire-flow requirements may be modified downward by the chief for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

2.2 Increases. Fire flow may be modified upward by the chief where conditions indicate an unusual susceptibility to group fires or conflagrations. An upward modification shall not be more than twice that required for the building under consideration.

SECTION 3 — FIRE AREA

3.1 General. The fire area shall be the total floor area of all floor levels except as modified in Section 4

3.2 Area Separation. Portions of buildings which are separated by one or more four-hour area separation walls constructed in accordance with the Building Code, without openings and provided with a 30-inch (762 mm) parapet, are allowed to be considered as separate fire areas.

3.3 Type I and Type II-F.R. Construction. The fire area of buildings constructed of Type I and Type II-F.R. construction shall be the area of the three largest successive floors.

SECTION 4 — FIRE-FLOW REQUIREMENTS FOR BUILDINGS

4.1 One- and Two-Family Dwellings. The minimum fire flow and flow duration requirements for one- and two-family dwellings having a fire area which does not exceed 3,600 square feet (344.5 m^2) shall be 1,000 gallons per minute (3785.4 L/min.). Fire flow and flow duration for dwellings having a fire area in excess of 3,600 square feet (344.5 m^2) shall not be less than that specified in Table A-III-A-1.

> **EXCEPTION:** A reduction in required fire flow of 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system.

4.2 Buildings other than One- and Two-Family Dwellings. The minimum fire flow and flow duration for buildings other than one- and two-family dwellings shall be as specified in Table A-III-A-1.

> **EXCEPTION:** A reduction in required fire flow of up to 75 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system. The resulting fire flow shall not be less than 1,500 gallons per minute (5677.5 L/min.).

TABLE A-III-A-1—MINIMUM REQUIRED FIRE FLOW AND FLOW DURATION FOR BUILDINGS

FIRE AREA (square feet) × 0.0929 for m²					FIRE FLOW (gallons per minute)[2]	FLOW DURATION (hours)
Type I-F.R. II-F.R.[1]	Type II One-HR. III One-HR.[1]	Type IV-H.T. V-One-HR.[1]	Type II-N III-N[1]	Type V-N[1]	× 3.785 for L/min.	
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	2
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	3
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	4
"	"	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
"	"	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
"	"	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
"	"	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
"	"	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
"	"	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
"	"	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
"	"	191,401-Greater	128,301-Greater	85,101-Greater	8,000	

[1]Types of construction are based upon the Building Code.
[2]Measured at 20 psi (137.9 kPa). See Appendix III-A, Section NO TAG.

non sprinklered

5- hour rating (stick)

FIRE HYDRANT LOCATIONS AND DISTRIBUTION

APPENDIX III-B

(See UFC Section 903.4.2)

SECTION 1 — SCOPE

Fire hydrants shall be provided in accordance with Appendix III-B for the protection of buildings, or portions of buildings, hereafter constructed.

SECTION 2 — LOCATION

Fire hydrants shall be provided along required fire apparatus access roads and adjacent public streets.

SECTION 3 — NUMBER OF FIRE HYDRANTS

The minimum number of fire hydrants available to a building shall not be less than that listed in Table A-III-B-1. The number of fire hydrants available to a complex or subdivision shall not be less than that determined by spacing requirements listed in Table A-III-B-1 when applied to fire apparatus access roads and perimeter public streets from which fire operations could be conducted.

SECTION 4 — CONSIDERATION OF EXISTING FIRE HYDRANTS

Existing fire hydrants on public streets are allowed to be considered as available. Existing fire hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extend between properties and easements are established to prevent obstruction of such roads.

SECTION 5 — DISTRIBUTION OF FIRE HYDRANTS

The average spacing between fire hydrants shall not exceed that listed in Table A-III-B-1.

EXCEPTION: The chief may accept a deficiency of up to 10 percent where existing fire hydrants provide all or a portion of the required fire hydrant service.

Regardless of the average spacing, fire hydrants shall be located such that all points on streets and access roads adjacent to a building are within the distances listed in Table A-III-B-1.

TABLE A-III-B-1—NUMBER AND DISTRIBUTION OF FIRE HYDRANTS

FIRE-FLOW REQUIREMENT (gpm)	MINIMUM NO. OF HYDRANTS	AVERAGE SPACING BETWEEN HYDRANTS[1,2,3] (feet)	MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT[4]
× 3.785 for L/min.		× 304.8 for mm	
1,750 or less	1	500	250
2,000-2,250	2	450	225
2,500	3	450	225
3,000	3	400	225
3,500-4,000	4	350	210
4,500-5,000	5	300	180
5,500	6	300	180
6,000	6	250	150
6,500-7,000	7	250	150
7,500 or more	8 or more[5]	200	120

[1]Reduce by 100 feet (30 480 mm) for dead-end streets or roads.

[2]Where streets are provided with median dividers which can be crossed by firefighters pulling hose lines, or arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet (152.4 m) on each side of the street and be arranged on an alternating basis up to a fire-flow requirement of 7,000 gallons per minute (26 495 L/min.) and 400 feet (122 m) for higher fire-flow requirements.

[3]Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000 feet (305 m) to provide for transportation hazards.

[4]Reduce by 50 feet (15 240 mm) for dead-end streets or roads.

[5]One hydrant for each 1,000 gallons per minute (3785 L/min.) or fraction thereof.