CITY OF SEBASTOPOL

WATER MASTER PLAN

September 2005

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List of Abbreviations

ADD	Average Daily Demand
DHS	Department of Health Services
DIP	Ductile Iron Pipe
ft	Feet
FSRS	Fire Suppression Rating Service
gpcd	Gallons per capita per day
gpd	Gallons per day
gpm	Gallons per minute
LAFCO	Local Agency Formation Commission
lf	Linear feet
ISO	Insurance Services Office
LOS	Level of Service
MDD	Maximum Daily Demand
Mgal	Millions of Gallons
MHD	Maximum Hour Demand
MtBE	Methyl-tert-butyl ether
P2K	Pipe 2000 water modeling program
PCE	perchloroethylene
PRV	Pressure reducing valve
psi	Pounds per square inch
PVC	polyvinyl chloride
RWMP	North Coast Regional Water Management Plan
sf	Square feet
SMWS	Sebastopol Municipal Water System
SOI	Sphere of Influence
UFC	Uniform Fire Code

Executive Summary

Coastland Civil Engineering was hired by the City of Sebastopol to complete a *Water System Master Plan*. The Master Plan consists of:

- A study of the existing service area and land use plans;
- An assessment of existing water sources, storage, water quality and distribution;
- An assessment of existing and future water demands;
- The development of a hydraulic computer model of the existing and future water distribution system;
- An explanation of water system evaluation criteria;
- An evaluation of the existing and future water distribution, storage and fire protection system;
- A recommendation for water system improvements;
- An estimation of water system improvement costs.

This *Water System Master Plan* is intended as an instrument for planning water system improvements necessary to comply with current City zoning ordinances, City Standard Details and Specifications, and federal fire regulations.

Given these criterion, the hydraulic model was developed using water production and usage statistics from 1981 to 2003, the General Plan, the Growth Management Ordinance, Level of Service reports and communication with Public Works and Planning Department staff. The hydraulic model was loaded based on land use densities and adjusted to reflect the City's most recent yearly production data.

The model indicates that for current conditions there are a few areas in the City with low water pressures and low fire flows. Not all of these areas can be brought up to standards by increasing line size, but most of the area can be brought up to standards and all areas can be improved. The report recommends eight line replacement projects to increase service pressures and fire flows. Estimates for each of these projects are also provided. The report also includes an estimate for replacing substandard fire hydrants not associated with other projects. These projects are summarized below. With the exception of replacing the fire hydrants, which can be done in sections, the projects are listed in priority order.

1. Install a 14" main to loop and parallel the existing distribution main from the intersection of Lynch Road and Pleasant Hill Road along Meadowlark Drive, Jewell Avenue, First Street, Robinson Road and within Bodega Avenue to the intersection of the 8" DIP main that services the condominiums at 8100 to 8130 Bodega Ave.

2. Replace the existing 6" main in McKinley Street with 8" DIP from Brown Street to Sebastopol Avenue. Replace the existing 8" main in Morris Street with 10" DIP from Sebastopol Avenue to the intersection with the existing 8" DIP south of hydrant 2-9. Replace the existing 8" main in Sebastopol Avenue with 10" DIP from Petaluma Avenue to Morris Street. Replace the existing 6" main in Sebastopol Avenue with 8" DIP from Morris Street, west to the existing blow off.

3. Replace the existing 8" main in Gravenstein Hwy South with 10" DIP from Palm Avenue to Fircrest and a 12” DIP from Fircrest to Holiday Inn Entrance Highway 116.

4. Replace the 6" main in West Hills Circle with 8" DIP.

5. Replace the existing 4" main servicing the Pleasant Hill Condominiums with 6" DIP.

6. Replace the 6" main in Abbott Ave with 8" DIP.

7. Replace the existing 4" main in Edman Way with 6" DIP.

8. Replace the existing 4" main in Lillian Way with 6" DIP.

9. Replace substandard fire hydrants not included in other projects; a total of 101 Type II hydrants and 58 Type I hydrants.

The estimated costs of these projects are shown in the table below. The table includes estimated construction costs and total project costs including, design, environmental, administration and construction management.

Table ES-1: Estimated Costs of Projects to Bring Water System Up to Standards Current Conditions

No.	Description	Construction Cost	Project Cost
1	14" DIP Loop Pleasant Hill to Bodega Ave	$1,727,990	$2,246,387
2	Northeast Area	$700,419	$910,545
3	Gravenstein Hwy South	$770,086	$1,001,112
4	West Hills Circle	$195,960	$254,748
5	Pleasant Hill Condominiums	$57,235	$74,406
6	Abbott Avenue	$104,673	$136,075
7	Edman Way	$76,716	$99,731
8	Lillian Way	$87,342	$113,545
9	Replace substandard fire hydrants	$857,555	$943,310
	Total	**$4,577,976**	**$5,779,857**

Future water needs were established based on the Modified General Plan, The City Growth Ordinance and discussions with City Planning and Engineering Departments. Growth in the City includes projects currently in planning and the Northeast Specific Plan Option B. Growth also includes annexation of the a few areas in the sphere of influence, including the Gravenstein Highway South Study Area and Belmont Terrace.

Given the growth assumed in the report water supply and storage needs are adequate. Three additional pipeline replacement projects are recommended to maintain adequate service pressures and fire flows. These projects are summarized below.

1. Replace the existing 6" main in Teresa Court with 8" DIP.

2. Replace the existing 6" main servicing 699 Gravenstein Hwy North apartments with 8" DIP.

These projects should be completed as development in the area around the line increases. Estimates are provided for each of these projects as summarized below:

Table ES-2: Estimated Costs of Projects to Bring Water System Up to Standards Future Build-out Conditions

No.	Description	Construction Cost	Project Cost
1	Teresa Court	$165,830	$215,579
2	Gravenstein Hwy North	$519,961	$675,949
	Total	**$685,791**	**$891,528**

Maps are included in the report that show the proposed construction areas and those areas that will be below City Standards after construction. Areas that will remain below City Standards are primarily in three areas: High elevation areas in Zone 2, North Gravenstein Highway and South Gravenstein Highway. The first of these suffers from low service pressures and fire flows, primarily due to high elevation. The latter two have slightly substandard fire flows, primarily due to being at the far end of single service lines. Fire flows slightly less than the standard have been determined to be acceptable by City Engineering and the Fire Department.

Along with the Master Plan a new electronic Base Map was developed as part of this project. It includes updated information consolidated from several sources and can be overlaid on a digital photo delivered as part of this project.

Section 1: Introduction

This report presents a comprehensive study of the City of Sebastopol's water supply, storage and distribution system. It is one of a three-part master plan study of the City's water, sanitary sewer and storm drain utilities. It represents the latest in a series of studies conducted to establish the effects of existing and long-range demands on the system. The following sub-sections provide a modified history of the water system and background information regarding development of this report.

Background

The City of Sebastopol has owned, operated and maintained its water supply and distribution system since approximately 1915. From that time until 1967, a few improvements were made to the distribution system to keep up with demands created by population growth. In 1967[£] and again in 1978[¥] two studies were undertaken to determine the future water requirements of the City and its Sphere of Influence (SOI), and to set criterion for how this was to occur. As a result of the 1967 report, many of the older and undersized water mains were upgraded and extended. The 1978 study re-evaluated the original report, and provided alternatives for additional improvements to the system to meet fire flow requirements and to service the growing community.

As the City is close to reaching its ultimate build-out potential, a detailed study of existing reports, maps and records of the water storage, supply and distribution systems is again in order, along with a plan for improvements based on the current Modified General Plan and future growth patterns.

1.1 Objectives

The objective of this study is to evaluate the water supply sources, storage capabilities and distribution capacity of the water system that the City of Sebastopol owns and maintains for domestic use, commercial use and fire fighting. This study identifies system deficiencies and outlines existing and future system improvements necessary to meet current and projected demands. From this information improvement projects, costs and construction phasing is addressed.

1.2 Scope of Services

The scope of Services of this phase of the master plan study is as follows:

- Update the current Master Water Plan.
- Model the City's water system.
- Analyze and identify solutions to remedy current system deficiencies.

[£] M.C. Yoder Associates Consulting Engineers, "A Study Regarding Water Supply and Distribution", Report to The City of Sebastopol, Sonoma County, California, May 1967.

[¥] Hogan, Schoch and Associates, Inc., "A Study Regarding Water Supply and Distribution; A current Analysis and Review of the 1967 Water Report by Yoder and Assoc.", Report to the City of Sebastopol, Sonoma County, California, January 1978.

- Analyze future demands, treatment, storage needs and distribution modifications to support build-out of the City.
- Provide cost estimates for all improvement projects identified.

1.3 Conduct of Study

The information developed in this report is based on existing demand, production, and population figures, reports, as-built drawings, maps, utility information, fire flow testing and improvement plans provided by various agencies including the City Engineering Department, the Public Works Department, the City Fire Department and the Environmental Protection Agency. The Public Works Department staff identified problem areas within the water system that required attention, and allowed fine tuning of the base map.

Orthographic photography with airborne GPS control generated a digital orthographic surface from which photomaps with two foot contours were created. Surface elevations were obtained from these maps and transferred to the hydraulic modeling program.

The Modified 1998 General Plan, Growth Ordinance and Planning figures were used to determine the projected population densities of the areas within the City and the projected water needs for the land uses. The projected water requirements and flows were evaluated to determine the adequacy of water main sizes, pump station sizes, storage facilities and wells for current conditions and build-out. Hydraulic modeling of the distribution system was performed for each of the two pressure zones based on peak hour fire flows. Fire flow criteria were based on land use designation as outlined in the City Zoning Ordinance.

Facility improvement projects with implementation plans required to meet current and future storage and production needs are recommended. The capital costs required for these improvements are presented as part of this report.

Sections 2, 3 and 4 of this report discuss the study area, the existing water supply, storage and distribution system, the development of projected water demands and the generation of the computer model analysis. Sections 5, 6 and 7 discuss the results of the hydraulic modeling, recommended system improvements, costs and phasing.

Section 2: Study Area and Existing Water System

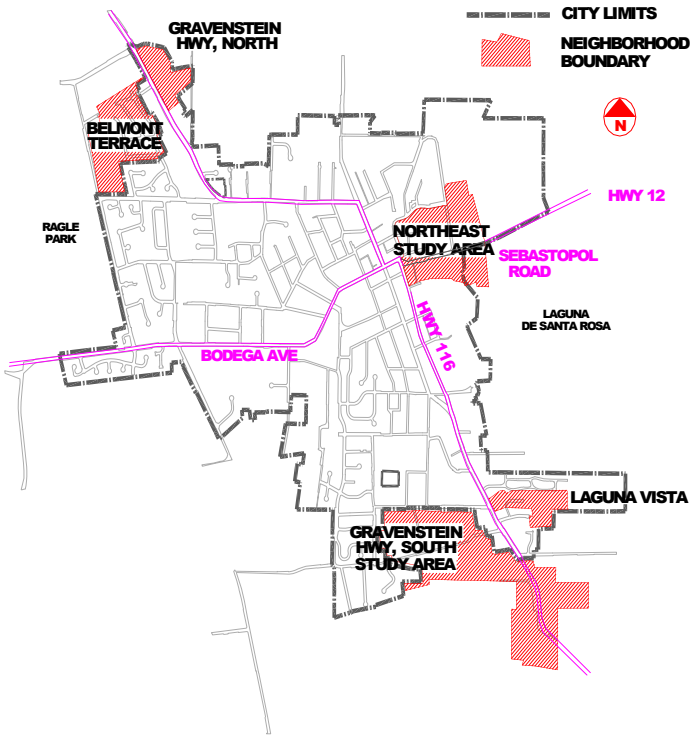
This section describes the Sebastopol Municipal Water System (SMWS) service area, the status of land use planning for the area, and the SMWS distribution system.

2.1 Existing Service Area and Land Use Plans

Sebastopol is a semi-urban incorporated community located in western Sonoma County approximately 50 miles north of San Francisco and 7 miles west of Santa Rosa. The area is bounded by the Laguna De Santa Rosa to the west and Atascadero Creek to the east. Highway 12 and Bodega Avenue is the main transportation corridor and bisects the community into north-south quadrants. Highway 116 bisects the community in east-west quadrants.

Figure 2-1 shows neighborhood areas and landmarks that may be referenced on occasion within the report. The commercial areas are generally located along the Hwy 116 corridor, with the majority of commercial and industrial space in the northeast quadrant of the City. The remaining areas are primarily residential with a scattering of parks and institutional land use for schools.

FIGURE 2-1
SEBASTOPOL NEIGHBORHOODS AND LANDMARKS



The City of Sebastopol owns, operates and maintains the SMWS under permit from the State of California, Department of Health Services (DHS). The City's sole source of drinking water comes from three wells that distribute water to two pressure zones. A fourth well failed in January 2005 and is not now in service. A fifth well remains offline at this time due to detected amounts of soil contamination from perchloroethylene (PCE).

2.1.1 Status of Area Land Use Plans

Land use planning for the service area is performed under the auspices of the City's Planning Commission, the Design Review Board, citizen committees and the Sonoma County Local Agency Formation Commission (LAFCO), as detailed in the General Plan.

The officially recognized General Plan was adopted in 1994 with updates in 1995, 1996, 1998 and 2003. Consistent with the goals outlined in the General Plan, the City has adopted measures to limit urban sprawl by reducing the City's Sphere of Influence (SOI) and by encouraging infill, a means of concentrating new development within the City limits. The community, in agreement with these ideals, adopted the Urban Growth Boundary (UGB) Measure (Measure O) in 1996. In essence, Measure O prohibits additions to the SOI by the City Council for a period of 20 years unless they are endorsed by voter approval.

In keeping with the General Plan, the City adopted a Growth Management Ordinance which establishes maximum allowable growth rates based on the community's ability to provide key resources (water, wastewater, roads, and school, for example). Moreover, this ordinance limits the number of new residential units to 25 per year. If the annual limit is not met, the unused allocations become available for future years for a limited time period.

The General Plan establishes level of service (LOS) standards for all utilities including the water system. Each year the City publishes a LOS report that includes annual statistics for water usage and outlines studies and improvements to the system.

2.1.2 Zoning and General Plan Land Use Designation

As mentioned in the previous section, the City of Sebastopol General Plan establishes land use designations for all areas within the SOI. These designations establish the City's zoning regulations as is described in the Zoning Ordinance and as illustrated in the Land Use Designations Map. The map in Appendix A reflects current zoning within the City's SOI. The 12 zones identified on this map include Open Space, Parks, Community Facilities, Very Low Density Residential, Medium Density Residential, High Density Residential, General Commercial, Office, Downtown Core, Light Industrial and Office/Light Industrial.

2.1.3 Ultimate Build-out Development Methodology

The City of Sebastopol Growth Ordinance limits the net increase in residences to 576 over the life of the Plan. Second units, commonly known as "Granny Units" are not included in this total. The City has also completed studies for development of the Northeast area of the City and believes commercial growth will also occur in the north and south ends of Gravenstein Highway.

As of December 2004, 335 of these 576 residential units in the growth ordinance had been constructed or were under construction. The methodology for determining the ultimate growth inside the existing City boundaries for this Utility Master Plan is as follows:

- Allow construction of 576 new residential housing units beginning in 1994. Use the existing residential units in 2004 and the planned units in 2004. Fill the remaining units using Alternative B of the Northeast Area Alternative Plan.

- Allow the addition of 100 new second units beginning in 2005. Disperse these throughout the low and medium density housing land use areas.
- Assume the commercial expansion from Alternative B in the Draft Northeast Area Alternative Report.
- Assume an increase of 100,000 sf of commercial space along Gravenstein Highway North.
- Assume any remaining capacity to reach the limits of the sewer capacity as outlined in the City Growth Ordinance, to be taken up by growth in the commercial zone in Gravenstein Highway South.

The City also recognizes that there may be some expansion of the existing City boundaries to include some areas inside the sphere of influence. These areas include the area south of the City along Gravenstein Highway. In 2000, the City completed a "Gravenstein Highway South Study Area Utility Needs Study" which has been used in this report. Another significant area inside the SOI that may be annexed into the City is the Belmont Terrace Area. This consists of about 90 residential homes. In addition to these two major areas the City planners envision about 50 residential units will ask to be annexed into the City at various points along the present City boundary and within the SOI.

Consistent with the vision of Urban Growth Boundary measure, future build out development projects will shift and concentrate land use designations within the City limits, and annex the remaining areas within the SOI. Table 2-1 lists locations where this expansion is estimated by City planners to occur.

Because the success of these build out projects rests partially on the City's ability to supply, among other services, sufficient quantities of water to these areas, an evaluation of the effects of the new development on the existing water supply, storage and distribution system will be visited later in this report.

2.2 Existing Water System

To map a course for future improvements to the City's water system it is vital to evaluate the development and level of service of the existing system, determine existing deficiencies, and develop alternatives to remedy these deficiencies.

2.2.1 Historical Development

The first water supply for the City of Sebastopol came from Calder Creek, a tributary that transverses diagonally from the southwest corner of the City through Ives Memorial Park. Water was pumped to a reservoir that at one time resided on Parquet Hill, and it was distributed through the City water system. In 1918 the First Street reservoir, with a capacity of 1 million gallons, was constructed, and the height of the Parquet tank was increased for additional storage. By 1927 the first well was drilled as the first source of ground water supplied to the City. Well No. 2 and No. 4 went into service in 1934 and 1953, respectively, and continue operating to this day. Well No. 3 was drilled around 1950, yet succumbed to settlement shortly after commission. Well No. 5 was drilled in 1960, but is shut down because of ground water contamination.

Table 2-1: Build-out Land Use

Residential Build Out	
Location	**Residential Units**
7991 Covert Lane	20
824 Gravenstein Hwy South	4
7385 Healdsburg Avenue	12
7770 Healdsburg Avenue	4
380 Jewell Avenue	1
Laguna Vista (net)	140
840 and 860 Litchfield Avenue	13
791 Norlee Street (completed)	3
333 North Main Street	6
501 Petaluma Avenue	39
406 Pitt Avenue	2
501 South Main Street	10
7590 Washington Avenue (net)	3
Northeast Area	78
Second Units spread throughout City	100
Belmont Terrace	90
Belmont Terrace Second Units	27
Gravenstein Hwy South	117
Gravenstein Hwy South Second Units	35
Healdsburg Avenue	8
Bodega Avenue	7
First Street	7
Robinson Road	7
Zimpher Drive	7
South Main Street	7
Jewell Avenue	7

Commercial, Industrial and Community Facilities Build-out	
Location	**area (sq. ft)**
Northeast Area	
light industrial (to be demolished)	150,000
commercial	350,000
community facilities	65,000
Gravenstein Hwy North (in City limits)	
commercial	100,000
Gravenstein Hwy South (in City limits)	
commercial	25,000
Gravenstein Hwy South (in SOI)	
light industrial	939,154
commercial	74,575
Downtown	
commercial	50,000

2.2.2 Existing Water Demands

From the memorandum entitled, “Sewer Flows and Water Usage Statistics for Annual Level of Service Report” by Sebastopol’s Engineering Director dated February 9, 2005, average total water sales for the years 1996 through 2003 was 400 million gallons (Mgal). This amount takes into account residential water usage, commercial water usage, industrial usage and system losses. System losses are discussed further in Section 3 of this report. Average residential water usage during this period was 105 gallons per capita per day (gpcd). To more closely reflect existing domestic demands, a water usage of 115.5 gpcd (2000 to 2003) is used in this analysis. An examination of the number of existing residential lots, based on the number of homes constructed, a 1994 General Plan Background report, and U.S. Census figures, suggests that there are approximately 3,360 residential units within the City. Given the average occupancy of 2.33 persons per residential unit, the average residential use is 270 gpd per unit.

Commercial water usage during the eight year span of 1996 to 2003 averages 362,000 gpd. In this study, the term “commercial” has been genericized for the sake of brevity to include commercial, office and institutional facilities.

Planning future water consumption based on current water use patterns requires making engineering assumptions. These assumptions include evaluating calculated versus reported consumption, changing demographics and conservation efforts. In regards to water conservation, Sebastopol has instituted measures to limit interior water use that include retrofitting restrooms with low-flow toilets.

To evaluate future water usage and required system upgrades, seasonal peaking factors and fire flow demands are applied to average water usage. Further discussion on these issues is discussed in Section 3.

2.2.3 Existing Water Sources

The City of Sebastopol obtains all its drinking water from four wells that pump ground water from depths ranging from depths of 530 feet to 690 feet below ground level. These wells are located approximately one quarter mile west of the Laguna de Santa Rosa, a tributary of the Russian River. The principal recharge area for the City wells comes from the Wilson Grove Formation located in the hills west of the City, with some additional recharge from the east. Chlorine is added to the water at each well site to maintain protective residual levels of chlorine in the distribution system and prevent contamination.

The combined rated capacity of all three wells is 2950 gpm. A fourth well failed in early 2005 and will be reconstructed in the future. This fourth well had a capacity of about 500 gpm, but the replacement well is expected have a different capacity. A fifth well, Well No. 5, remains offline at present due to detected quantities of PCE exceeding maximum standards established by California Code of Regulations. Well data is outlined in Table 2-2.

The SMWS supplies water to two separate pressure zones, a description of which will be addressed in the next sub-section. Two of the wells, No. 4 and No. 7, pump water to the First Street reservoir, which supplies water by means of gravity to the customers in Zone 1. Wells No. 2 and No. 6 pump water to the Pleasant Hill Reservoir, which supplies water by means of gravity to the distribution system of Zone 2.

The City's only source of water is that supplied from the four functioning wells, thus it is necessary to track the status of ground water levels over time. If water levels are found to decline, it could indicate a decrease in aquifer supply.

Table 2-2: Well Data

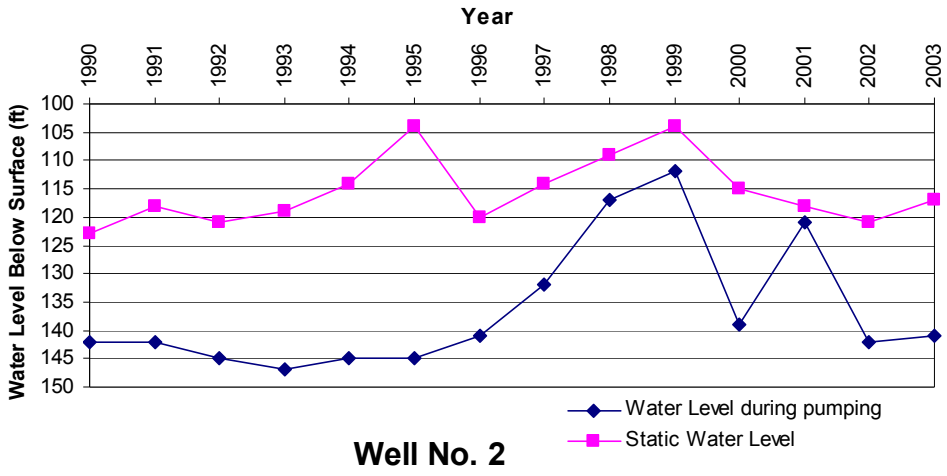
	Well Number	Diameter (inches)	Depth (feet)	Avg. Water Level from Top (feet)	Rated Capacity (gpm)	Location	Year of Construction
zone 2	2	10*	600		Failed	Calder Ave. and Jewel Ave.	1934
	6	14	570	90	1200	Near Fircrest Mobile Home Park	1968
zone 1	4	14	776	69	1000	Petaluma Ave. and Palm Ave.	1953
	7	8	690	129	750	Cooper Rd and Village Way	1996

* Diameter is 10" to a depth of 200' then 14" thereafter.

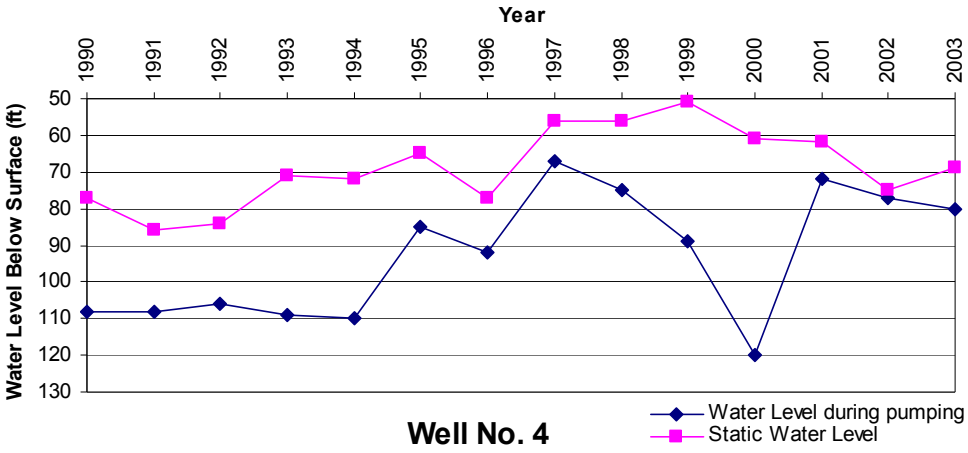
Drawdown levels, a measurement of the change in ground water levels during pumping, are recorded to check for possible declines in ground water levels.

Figure 2-2 illustrates the water level at each of the existing wells under actual pumping conditions from data supplied by the City.

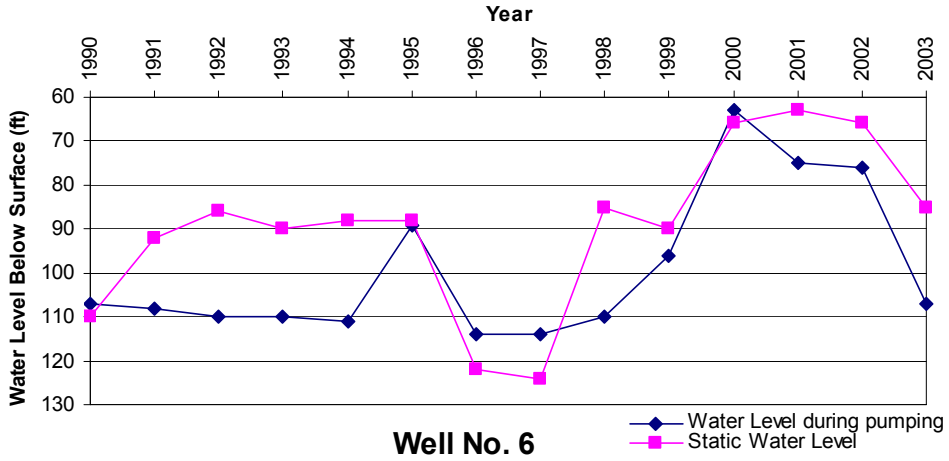
Figure 2-2: Well Levels During Pumping



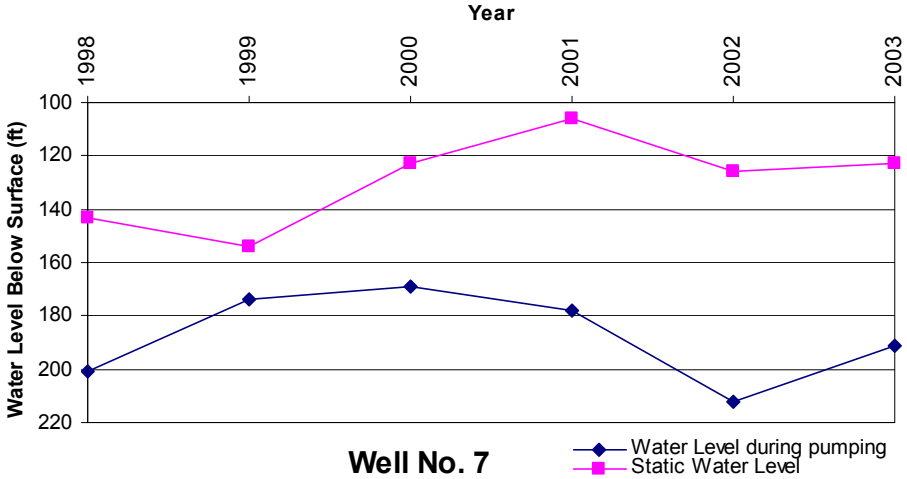
Well No. 2



Well No. 4

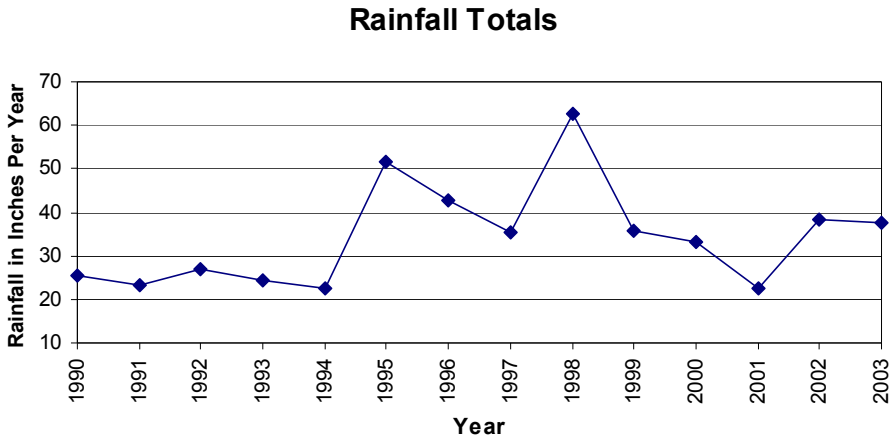


Well No. 6



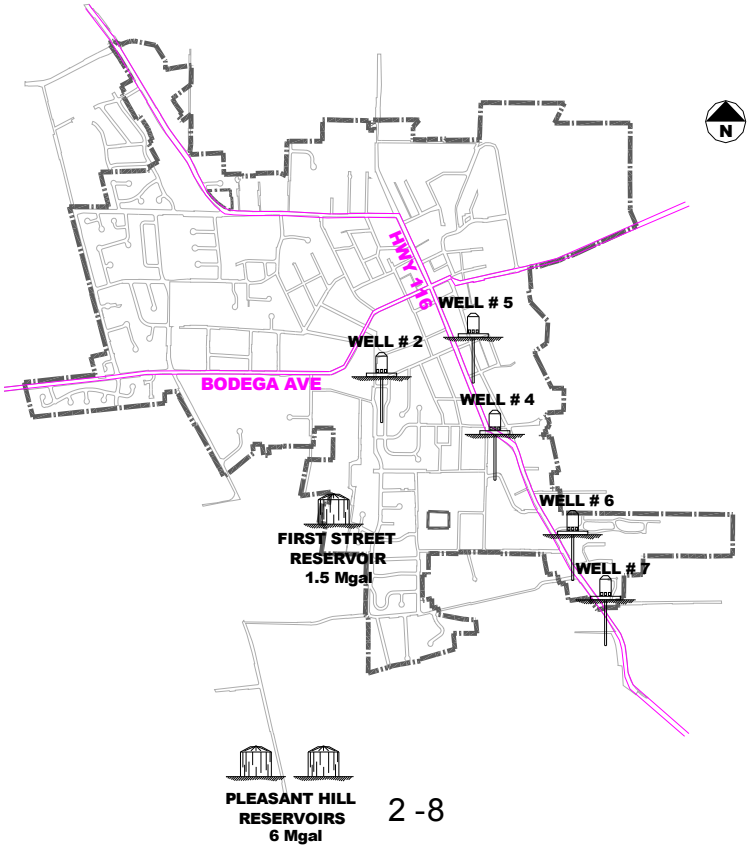
Well No. 7

Figure 2-3: Rainfall Totals



The static water level is also shown to illustrate the deviation of actual pumping levels from the periods when the pump is turned off. The graph indicates that the water table is stable at each well site for the amount of water pumped. Figure 2-3 shows the rainfall which occurred during the same period of time. This data indicates that groundwater is recharged sufficiently to maintain the City water supply. There is no reason to suspect that groundwater recharge is insufficient for the build-out construction described in this report. A map of the well and reservoir locations is shown on Figure 2-4.

FIGURE 2-4
EXISTING WATER SUPPLY AND RESERVOIRS



The City is participating in the Santa Rosa Plain Basin-wide Groundwater Study and Groundwater Ambient Monitoring and Assessment initiated by the United States Geological Survey (USGS) in 2004. Data from this report will aid the City's Groundwater Management / Wellhead Protection Planning objectives necessary for defining the City's limits of groundwater supply.

2.2.4 Raw Water Quality

To satisfy state drinking water criterion identified in Title 22 of the California Code of Regulations for domestic water quality, the City of Sebastopol regularly assesses the state of the community's raw water supply. A part of the assessment involves the assistance of various governmental agencies in long-term water quality monitoring programs. Overall, the City's source water is good. However, contaminants are present in some wells. With assistance from the North Coast Regional Water Management Plan (RWMP), Sebastopol has identified projects that would aid the City's efforts in assuring a long-term and dependable community water supply. Table 2-3 describes these projects.

Table 2-3: Water Source Issues and Studies

Project	Course of Action	Status
Well No. 4 Treatment Facility	1,2-DCA and MtBE contamination remediation	In design process
Well No. 2 and No. 6 Arsenic Investigations	Arsenic testing and remediation	Ongoing
Well No. 5 Treatment Facility	Carbon adsorption treatment for PCE removal	City staff investigation grant funding
Pressure Zone Intertie	Booster pump installation for emergency use	City staff investigation grant funding
Groundwater Management / Wellhead Protection	USGS groundwater availability study	In progress

2.2.5 Existing Transmission and Distribution System

The SMWS distribution system network is comprised of over 37 miles of pipe in sizes up to 24 inches in diameter. Pipe types include asbestos cement, ductile iron, cast iron, and polyvinyl chloride (PVC). The existing distribution facilities are shown on the Water System Map in Appendix B, and an inventory of the distribution system is tabulated in Table 2-4 and 2-5. Pipe lines are listed according to material and size and by material and year constructed.

Table 2-4: Pipe Lengths by Type

Pipe Material / length (ft)	Pipe Diameter (inches) 2	4	6	8	10	12	14	16	18	24	Total length (ft)
Asbestos Cement	1,596	6,023	45,411	30,076	21,126	24,706		896			129,834
Cast Iron		1,442	1,511		3,347						6,299
Ductile Iron	851	1,436	10,891	23,864	3,164	1,875	1,980	3,949	189	1,989	50,189
Polyvinyl Chloride			3,837	1,877	627	854					7,194
total length by diameter (feet)	2,447	8,900	61,650	55,817	28,265	27,435	1,980	4,845	189	1,989	193,517

[£]Table 2-5: Pipe Lengths by Year

Year	Pipe Diameter (inches) 2	4	6	8	10	12	14	16	18	24	Total Length (ft)
1965			2007								2007
1966			598								598
1967		167	878	2749	3826	424					8044
1968		294	1023		2575	8951					12843
1969			434								434
1970	64	208	9895	1450	6360						17977
1971				256							256
1972			1121	2040							3161
1973	277	440		713							1431
1974	171	1545	4253	5100	4815						15885
1975		920	4291	3672	2914						11796
1976			736	883		396					2016
1977	254		3626	519							4398
1978	829	2302	8912	4968	3198	4556					24766
1979		186	3814	2406		4281		3019		1989	15695
1980			1001								1001
1981			909								909
1982		767	1198	1016		1905					4886
1983			76	365							441
1984				3187		991					4178
1985	336	152	4384	536	1863	810					8081
1986		1262	4363	1055	340	2769					9789
1987	308		3073	1671	712	735		1826			8326
1988			1248	1571							2819
1989			216	1472	56						1744
1990	207	564	814	7195	1605	1617					12002
1991		93	100	2645			1980		189		4818
1992			76	4318							4394
1997			1324	260							1584
1998				866							866
1999			1020	251							1271
2001			210	621							832
2003			48	4030							4079

[£] If installation dates were unknown, they were approximated based on the pipe's proximity to other pipes of similar ages.

In 1968, the SMWS pipeline system was separated into two pressure zones. Pressure Zone 1 customers are located in the eastern portion of the City and consist mostly of commercial users. Zone 2 customers reside at elevations exceeding approximately 130 ft above sea level.

The two distribution systems are separated by four pressure regulating valves that serve as inter-ties between the two zones. In addition, there is one direct valve connection at Bodega and Washington. These usually remain closed unless it becomes necessary to divert water from one zone to the other.

Three storage reservoirs serve the City's two water pressure zones. They serve to provide water storage for emergencies, to meet peak demand during maximum demand periods (usually July or August) and to maintain hydraulic stability. The total capacity of these tanks is 7.5 Mgal, which is distributed as follows:

T 2-6: Existing Reservoirs

Name of Facility	Number of Tanks	Floor Elevation	Fire Zones Served	Volume (Mgal)	Total Volume (Mgal)
First Street Reservoir	1		1,2,3,4,7,9	1.5	1.5
Pleasant Hill Reservoirs	2	305.08	3,4,5,6,7,8,9,10	3	6

The First Street reservoir, located on First Street, was constructed in 1918 as part of improvements to the original supply from the SMWS. It is an epoxy-coated, steel-welded tank, with a concrete slab-on grade foundation and a capacity of 1.5 Mgal.

The Pleasant Hill reservoirs are located southwest of the City and were installed in 1979 and 1987. They have a combined capacity of 6 Mgal. Like the First Street reservoir, these are also steel-welded tanks. The older reservoir has a tar-coated interior; the newer reservoir is epoxy-coated.

Section 3: Water Demand Projections

This section discusses existing and projected water demands used in the water system model analysis to evaluate reservoir capacities, source supply and fire flow capacity. Maximum month, day and hour peaking factors, based on historical water production and use statistics provided by the City, are also discussed.

3.1 Water Demand Conditions

Demand criteria were developed for the following events:

- Average Hourly Demands
- Maximum Hourly Demands as a percentage of Average Hourly Demands (existing and future)
- Average Daily Demands
- Maximum Daily Demands as a percentage of Average Daily Demands (existing and future)

3.2 Average Demands – Existing Conditions

1982 to 2003, Billed vs. Production: Statistics provided by the City regarding water production and usage during the years 1981 to 2003, show that average daily water production by the City has averaged 1.1 Mgal per day (production from 2000 to 2003 has been steady at 1.3 Mgal per day). These same statistics show that over the same course of time, total annual production data exceeds total annual reported use (billed and unbilled use) by an average of 14%, or 66 Mgal. This unaccounted for water can stem from poorly functioning meters, unmetered services, theft and distribution system leaks. The same document indicated that the total reported use during this time span has steadily increased on a per capita basis from 0.05 Mgal/capita in 1982 to 0.06 Mgal/capita in 2002.

Residential Water Use by residential units: Using the 1994 General Plan Background Report, the 1990 census, the 2000 census and the count of homes built since 1994, we estimate that there exist

- 2,021 single family primary dwellings
- 259 second units
- 58 mobile homes
- 1,022 multiple family dwelling units.

This provides a total of 3,360 residential units. This value is adjusted down to 3,068 residential units to account for the larger residential water customers who will be evaluated on their actual water consumption during 2004. Appendix C includes these customers and their water usage in gallons per day (gpd). Assuming an average of 2.33 persons per household, the 115.5 gpcd equates to an average of 825,645 gallons of domestic water use per day for the standard water users. The larger residential water customers use about 52,024 gpd, totaling domestic water use to approximately 877,669 gpd, not including the larger residential irrigation use.

Commercial Water Use: Documented commercial water use is about 10.81 million gallons per month or 362,000 gallons per day. The top twenty commercial users (including the top commercial irrigation water usage), consume an average of 114,150 gpd, totaling 32% of the total commercial use. These figures are listed in Appendix D.

3.3 Peaking Factors

Water use varies by season, by certain days within the season, and time of day. To account for these variations, peaking factors are commonly used to evaluate water system operating characteristics. Peaking factors are multipliers applied to average water usage, based on data accumulated from historical patterns. City staff has records of water production for each fiscal year since 1981. Average and peak use statistics have been recorded for 1981 through 1991. Although, this data is not recent, it is consistent over the recorded time period, and considered for the purpose of this study to remain consistent to this date.

The maximum day demand (MDD) peaking factor is used for analyzing the water supply capacity of a distribution system and for designing for water supply needs. It is expressed as the ratio of the highest daily water use rate during a year to the average daily demand (ADD). This data allows for storage capacity evaluations.

The maximum hour demand (MHD) is the highest hourly water use rate during the year. The MHD peaking factor is the ratio of MHD to ADD. MHD data is used for evaluating areas where service pressures fail to meet minimum requirements. MHD data is also used with fire flow demands for evaluating the capacity of the distribution system during fires. Table 3-1 lists peaking factors used in this study, based on data gathered from City records.

Table 3-1: Peaking Factors

	Residential Use	Commercial Use	Industrial Use
Maximum Day Peaking Factor	2.0	2.1	2.2
Maximum Hour Peaking Factor	5.0	5.0	5.0

3.4 Additional Demands – Build-out Conditions

Based on the 1994 General Plan Background Report, the Gravenstein Highway South Study Area Utility Needs Study and the Northeast Area Alternatives Report, the City uses the following projections for future water use for new construction:

- 320 gpd per new residential unit
- 0.26 gpd per square foot of commercial and institutional property
- 0.42 gpd per square foot of industrial property

Additional construction and growth assumed for the build-out condition was discussed in Section 2 of this report. New construction throughout the City and the SOI resulted in the following, the following usage is added to existing demands:

- 241,280 gpd additional residential water use
- 172,790 gpd additional commercial water use
- 394,445 gpd additional industrial water use

In addition to growth listed in Section 2, Section 2 also stated that that 150,000 sf of industrial use in the northeast area would be removed as part of the Northeast redevelopment.

Section 4: Development of the Water System Model

The SMWS model was created based on the water system base map generated by Coastland Civil Engineering. Utilizing hydraulic modeling software, the base map data was used to model peak hour flows for the existing water system and for future system development. The Public Works and Engineering departments reviewed the base map and provided additional data, corrections and fire flow data to aid in the model calibration. With this information, the model was developed based on the following criteria:

- Model calibration was achieved by adjusting pipe friction factors (C-factors) associated with each material type, and allowing the computer to estimate pipe friction based on pipe age.

- Model node junctions were placed at the intersections of pipelines and next to fire hydrants.

- Pressure regulating valves at pressure zone intersections were turned off to isolate the two zones.

- Nodes were assigned the following attributes:

    - Elevations obtained from orthogonal photographic data, with accuracy to the nearest foot

- Pipes were assigned the following attributes:

    - Diameter
    - Length
    - Year constructed
    - Material type
    - Rating (pipe capacity)
    - Hazen Williams friction factor

- Supply was modeled as:

    - An average flow of 750 gpm to the node at Well No. 7.
    - Tanks with levels at half full.

- Use was modeled as:

    - Specific domestic, commercial and irrigation peak hour demands associated with the 39 biggest water consumers were applied to nodes

- Industrial peak hour demands allocated by acreage were applied to nodes.
- Residential meter connections associated with demands based on an average peak hour flow per residential unit were applied to pipes

It is important to note that pressures in this report were modeled at near ground level. Significant vertical construction in the City such as high rise construction or multi-use projects could result in reduced pressures at higher constructed elevations.

Pressures and flows modeled for master plan purposes as NOT appropriate for direct use in development or construction projects. Each project should be evaluated on a case-by-case basis using good engineering judgment and sound engineering principals.

Section 5: Results of Water System Analyses

This section describes the criteria used in the analyses of the SMWS to determine the adequacy of the system as it exists and for future build-out conditions. This section details the results of the analyses based on the criteria, and discovered system deficiencies.

5.1 Evaluation Criteria

Criteria for evaluating SMWS's supply, storage, and distribution systems are based on industry standards and are described in the following sections.

5.1.1 Distribution Pipelines

Pipe capacity depends upon ranges of pressure, velocity and flow specific to pipe types and sizes. Low service pressures experienced by customers usually indicates high service elevations relative to tank levels within a pressure zone. Low service pressures can also be a result of bottlenecks, non-looped mains, and leaks within the system.

High pressures during low demand conditions can be usually occur in areas where customer service connections are located at low elevations. The City of Sebastopol Standard Specifications for the Construction of Water Mains (July, 1998) states that all water mains shall be ductile iron, and rated at a 150 psi minimum working pressure. However, this value includes a factor of safety for pipe longevity; working pressures at service connections should not exceed 100 psi. Customers with service connections that tie into water mains carrying high pressures are fitted with pressure reducing valves to prevent the possibility of rupture.

The following is a list of pipe criteria used in this analysis, based on the National Fire Codes, the California Plumbing Code and City Standards:

Desired Minimum Pressure at Peak Hour Demand with tanks half full	40 psi
Desired Minimum Pressure at Peak Hour Fire Flow with tanks half full	20 psi
Desired Maximum Service Pressure with tanks full and no demand	100 psi

5.1.2 Fire Protection

The City's fire flow requirements and fire hydrant spacing are set based on the current edition of the National Fire Codes as published by the National Fire Protection Association, with amendments and additions by the 2001 edition of the California Fire Code. These codes establish a required municipal water supply for fire protection in compliance the latest edition of the publication, "Guide for Determination of Required Fire Flow" published by the Insurance Services Office (I.S.O.). The I.S.O.'s Fire Suppression Rating Schedule (FSRS) allows one to calculate the amount of water necessary for providing fire protection at selected locations throughout a community based on building structure type, size occupancy and exposure.

Based on the FSRS, the City has established that fire hydrants are nominally spaced at 500 feet in residential districts, and 300 feet in commercial districts. For streets divided by medians, hydrants are staggered on both sides of the street.

Table 5-1 lists minimum flows and durations of flows for fire protection, based on state and national codes, and on land use designation as described in the latest edition of the City of Sebastopol Municipal Code:

Table 5-1: Minimum Flows for Fire Protection Requirements

Land Use	Minimum Flow (gpm)	Duration (hrs)	Minimum Residual Pressure (psi)
Residential	1000	2	20
Commercial	1500	2	20
Industrial	2500	3	20

5.1.3 Water Storage Reservoirs

Water storage facilities for a municipal water supply system serve the following purposes:

- Reserve of treated water in the event of plant equipment or pump failure
- Maintain minimum desired pressures
- Reserve for fire fighting
- Reduce necessity for large distribution mains
- Allow pumps to operate at average and not peak flow rates.

The total volume necessary to meet these requirements can be split into three separate components. These are summarized by pressure zone in Table 5-2 and explained below:

5.1.3.1 Operational Storage

Operational storage is the volume difference required to maintain storage requirements when the supply source pumps are turned off. Operational storage is typically 100% of the average daily consumption. Average daily consumption in Sebastopol (2000-2003) totals 1.3 Mgal for the combined pressure zones.

5.1.3.2 Equalization Storage

Equalization storage is the volume sufficient to meet demands in excess of maximum daily demands. It is the storage required to meet water system demands that exceed that which the supply source pumping capacity. Typical equalization storage requirements are 25% of the maximum daily use.

5.1.3.3 Fire Storage

Fire storage is the volume of water required to meet fire flow demands and durations for each pressure zone that exceed maximum daily demands. Fire storage volume is determined by multiplying fire flow rates by durations. Table 5-1 lists the minimum required fire flows by land use. The maximum required storage is amount required for industrial fire fighting; 2500 gpm at 3 hours is 450,000 gallons.

Table 5-2: Water Storage Requirements

Pressure Zone	Classification			
	Operational Storage (gal)	Equalization Storage (gal)	Fire Storage (gal)	Zone Total (gal)
Zone 1	486,729	239,739	450,000	1,176,468
Zone 2	813,271	392,642	450,000	1,655,912

5.2 Analyses of the Existing Water System

Hydraulic analyses of SMWS's water system were performed using the model development described in Section 4. In-field fire flow tests provided data necessary to calibrate the pipe C-factors. Minor variations between field fire flow test and model fire flow test pressures are anticipated and result from varying demands between actual conditions and modeled conditions. Tanks were modeled at half capacity, and pressure zones were analyzed separately as PRV's between the two zones normally remain closed. The following subsections describe the results of the analyses for the existing system.

5.2.1 Working Service Pressures during Peak Hour Demands

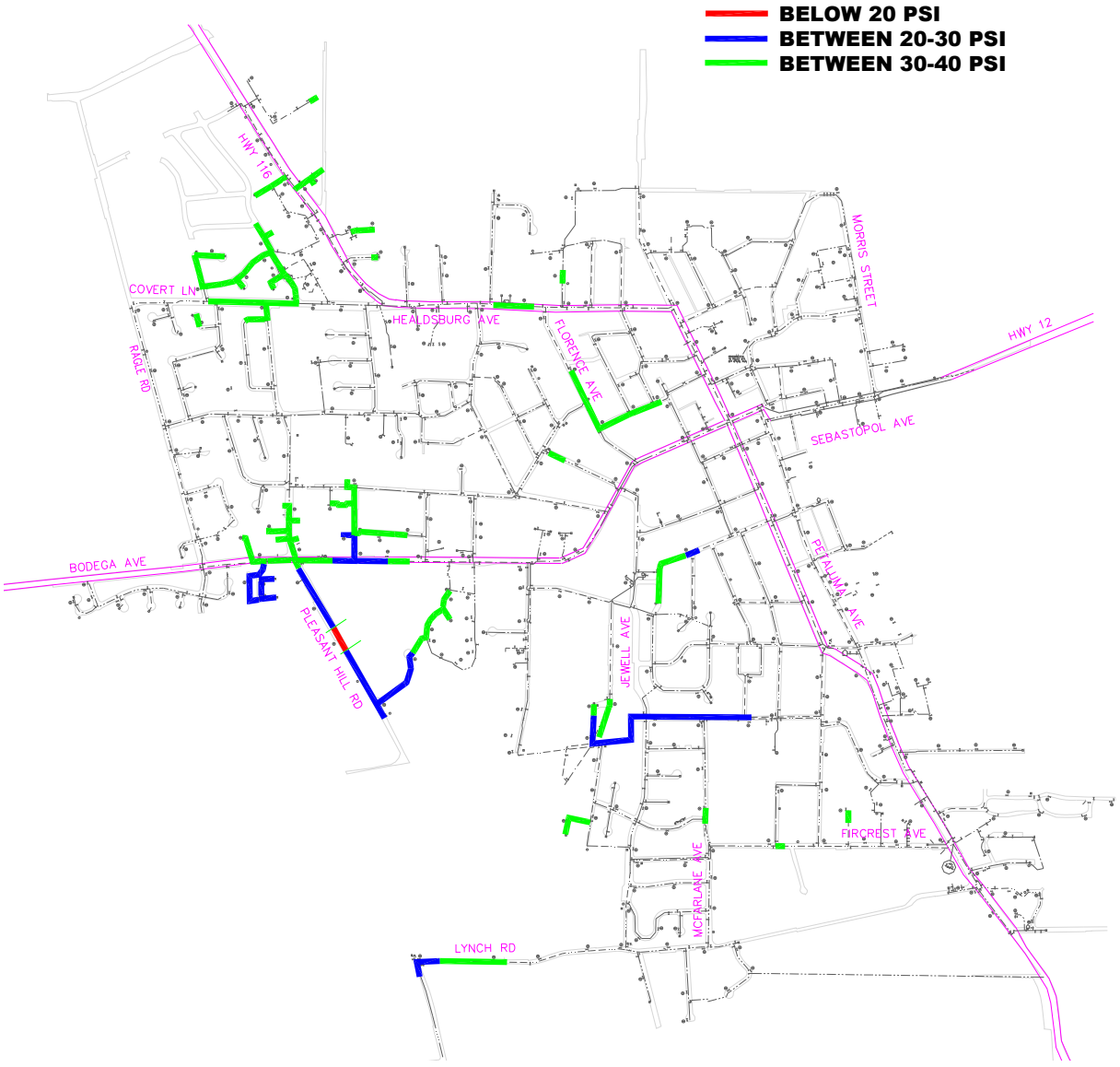
As stated in the previous section, the pressure differential between the water supply and the customer connections must remain in a range between 40 psi to 100 psi, or 92.4 ft to 231 ft of pressure head. Pressures below this range are not sufficient for use. Although the City has required the installation of ductile iron pipe rated at 150 psi since 1986, about 67% of the systems pipes are between 19 to 38 years old and consist of asbestos cement. Since this material tends to become brittle over time, asbestos cement pipe should not be exposed to working pressures exceeding 100 psi during periods with low demands[£]. Figure 5-1 illustrates areas of the distribution system in both zones where service pressures fail to reach 40 psi.

[£] When modeling the existing and future water systems, two locations in pressure zone 1 slightly exceeded a 100 psi service pressure: near the First Street Reservoir and at the end of Hazel Cotter Court. The first location does not service customers. The second location is modeled as a main terminus, although conversations with Public Works indicated that this main was looped to the main in Corline Court by a private party.

5.2.2 Fire Protection

Several aspects of the water system analyses are involved in evaluating the adequacy of the existing fire protection capabilities. Proper pipe sizing, hydrant spacing, hydrant sizing, and residual pressures are all crucial components to achieving operational fire flows. The results of these analyses are described in this section.

FIGURE 5-1
EXISTING LOCATIONS WITH LOW SERVICE PRESSURES DURING PEAK HOUR USE



5.2.2.1 Fire Flows

Fire flow tests were modeled at each hydrant in the distribution system. These tests revealed the hydrants with inadequate flows at residual pressures of 20 psi. Many of the hydrants with inadequate pressures are clustered in locations near the terminus of primary water mains. In Section 6, several scenarios are explored to establish remedies to insufficient fire flows, and all of these involved either looping or upsizing existing mains.

The following sections locate these hydrant clusters, the minimum required water flow for fire protection according to land use designation, and the modeled fire flows based on a residual pressure reserve of 20 psi at the fire engine.

Figure 5-2: Gravenstein Hwy North Hydrants

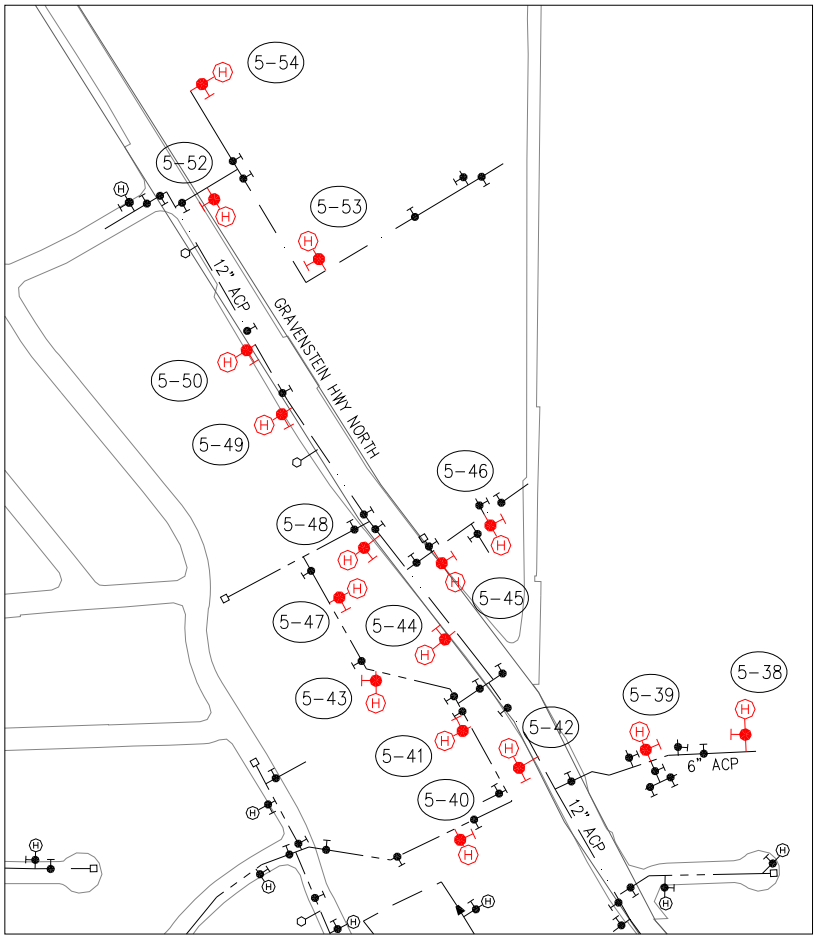


Table 5-3: Gravenstein Hwy North Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
5-38	723.8	Residential	1000
5-39	874.7	Residential	1000
5-40	1260.3	Commercial	1500
5-41	1318.9	Commercial	1500
5-42	1416	Commercial	1500
5-43	1224.3	Commercial	1500
5-44	1289.3	Commercial	1500
5-45	1238.9	Commercial	1500
5-46	1154.3	Commercial	1500
5-47	1213.7	Commercial	1500
5-48	1251.9	Commercial	1500
5-49	1354.3	Commercial	1500
5-50	1371.8	Commercial	1500
5-52	1393.7	Industrial	2500
5-53	1197.6	Industrial	2500
5-54	1338.1	Industrial	2500

Figure 5-3: Northwest Area Hydrants

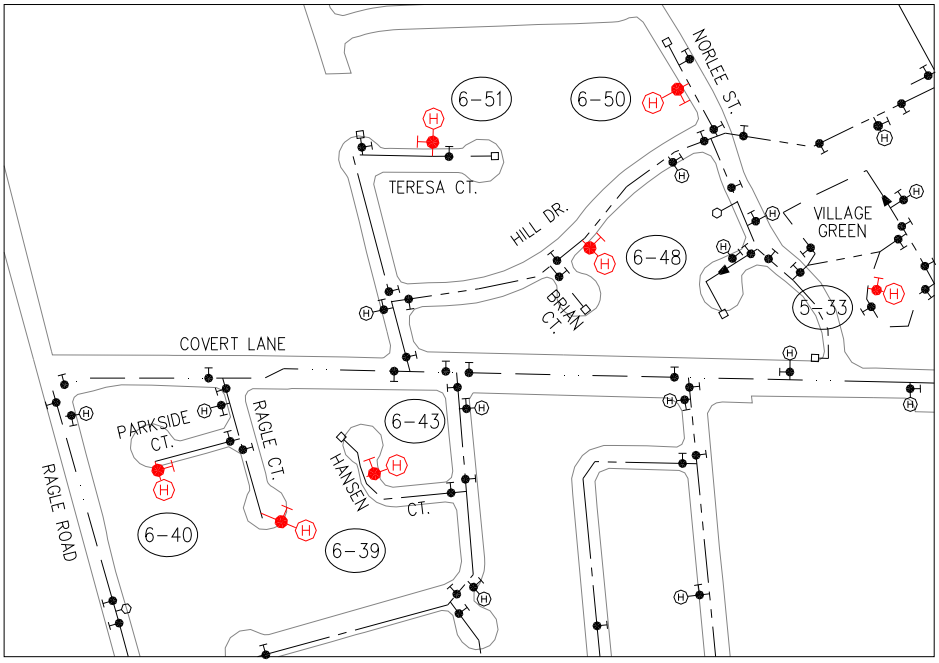


Table 5-4: Northwest Area Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
5-33	962.4	Residential	1000
6-39	918.5	Residential	1000
6-40	940.7	Residential	1000
6-43	813.9	Residential	1000
6-48	952.5	Residential	1000
6-50	980.5	Residential	1000
6-51	711.5	Residential	1000

Figure 5-4: Valentine Avenue Area Hydrants

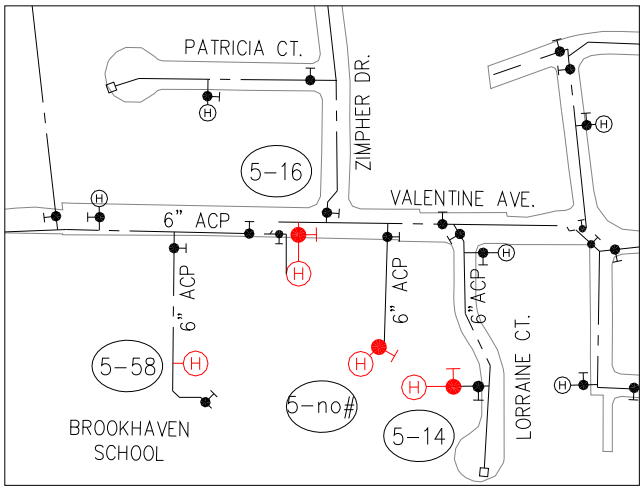


Table 5-5: Valentine Avenue Area Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
H 5-no #	1175.9	Commercial	1500
H 5-14	993	Residential	1000
H 5-16	1486	Commercial	1500
H 5-58	1092.7	Commercial	1500

Figure 5-5: Swartz Avenue Area Hydrants

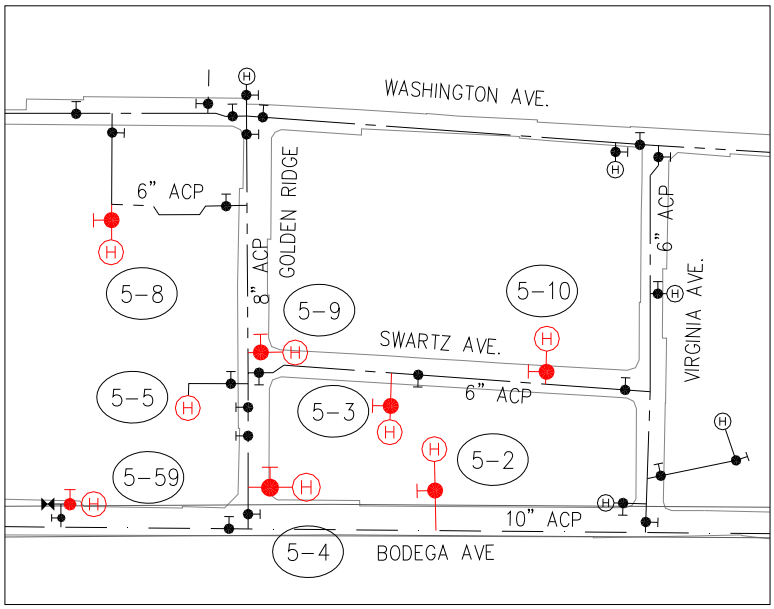


Table 5-6: Swartz Avenue Area Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
5-2	744.8	Residential	1000
5-3	841.6	Residential	1000
5-4	532.5	Residential	1000
5-5	585.2	Residential	1000
5-8	897.9	Residential	1000
5-9	768.7	Residential	1000
5-10	895.2	Residential	1000
5-59	590.8	Residential	1000

Figure 5-6: West Area Hydrants

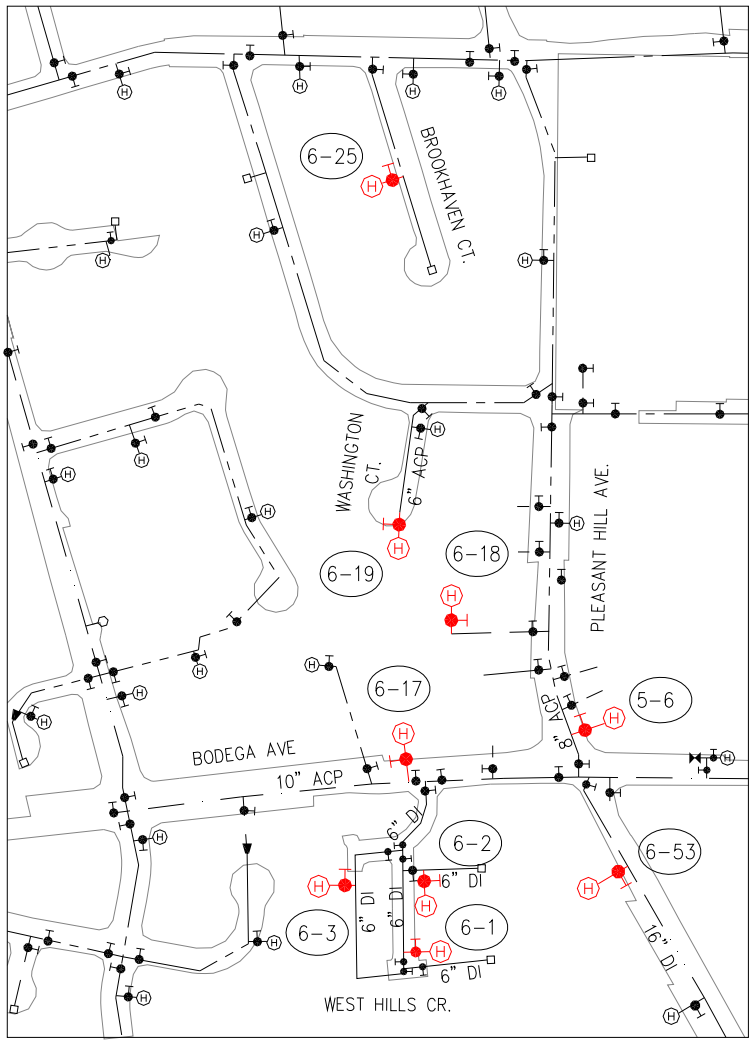


Table 5-7: West Area Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
5-6	878.3	Commercial	1500
6-1	239.5	Residential	1000
6-2	499.4	Residential	1000
6-3	450.3	Residential	1000
6-17	799.2	Commercial	1500
6-18	465.3	Residential	1000
6-19	929.7	Residential	1000
6-25	978.5	Residential	1000
6-53	584.3	Residential	1000

Figure 5-7: Pleasant Hill Road Area Hydrants

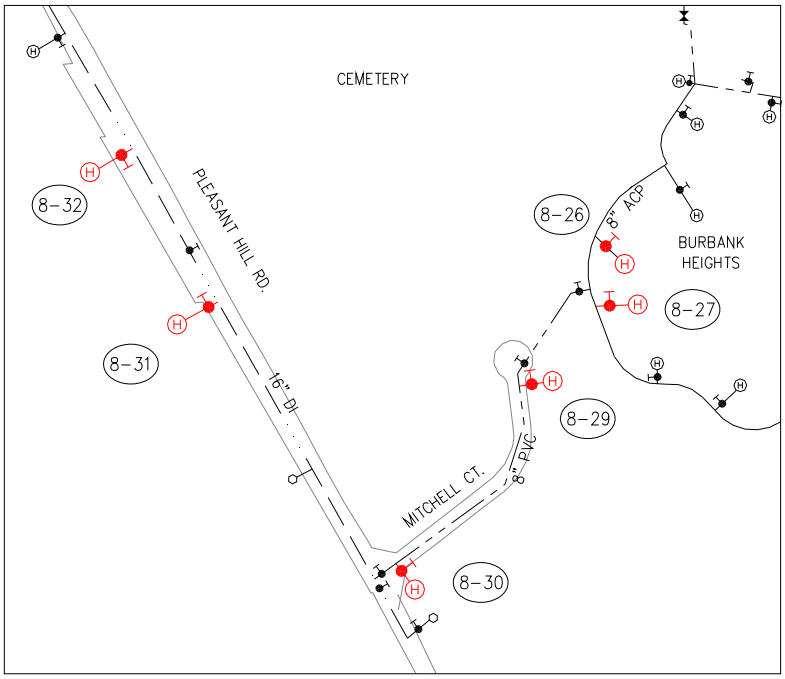


Table 5-8: Pleasant Hill Road Area Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
8-26	932.9	Residential	1000
8-27	835.3	Residential	1000
8-29	603.7	Residential	1000
8-30	244.8	Residential	1000
8-31	-319.9	Residential	1000
8-32	314.2	Residential	1000

Figure 5-8: Edman Way Hydrant

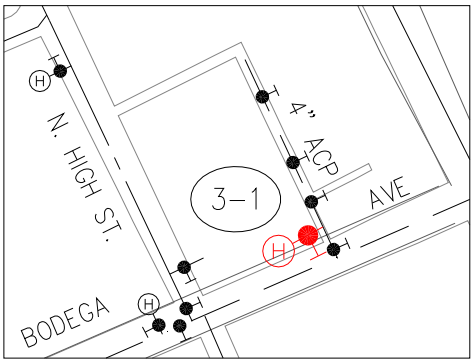


Table 5-9: Edman Way Hydrant

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
3-1	1453.9	Commercial	1500

Figure 5-9: East Area Hydrants

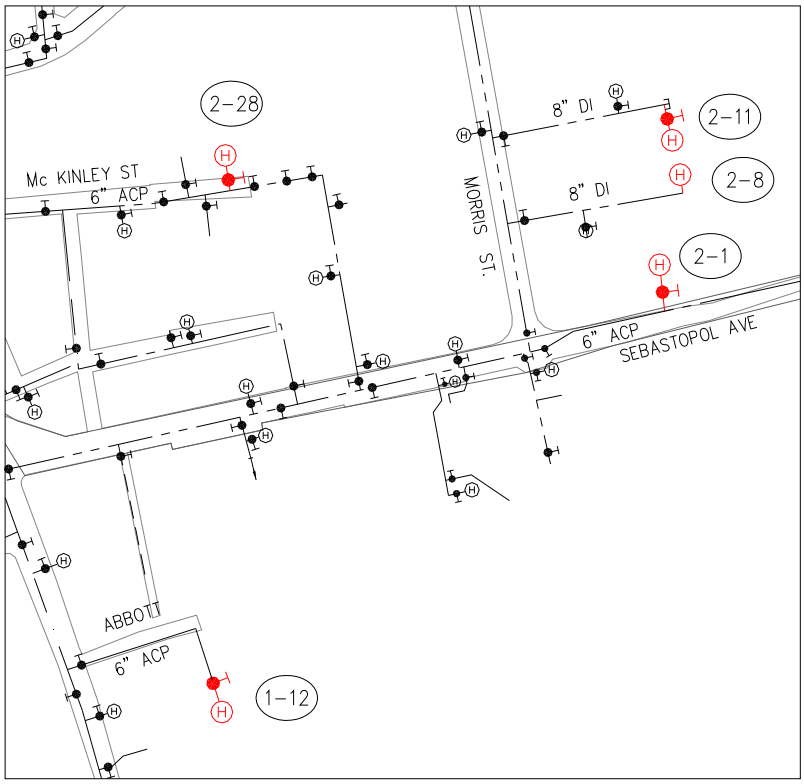


Table 5-10: East Area Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
1-12	1938.6	Industrial	2500
2-1	1755.3	Industrial	2500
2-8	2411.1	Industrial	2500
2-11	2429.6	Industrial	2500
2-28	2451.8	Industrial	2500

Figure 5-10: South Area Hydrants

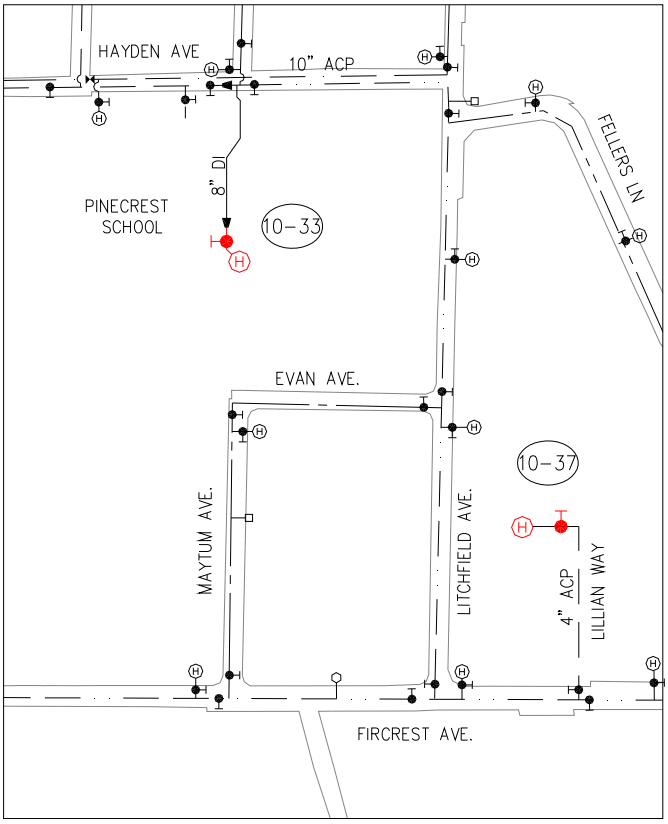


Table 5-11: South Area Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
10-33	325.8	Commercial	1500
10-37	447.8	Residential	1000

Figure 5-11: Gravenstein Hwy South Hydrants

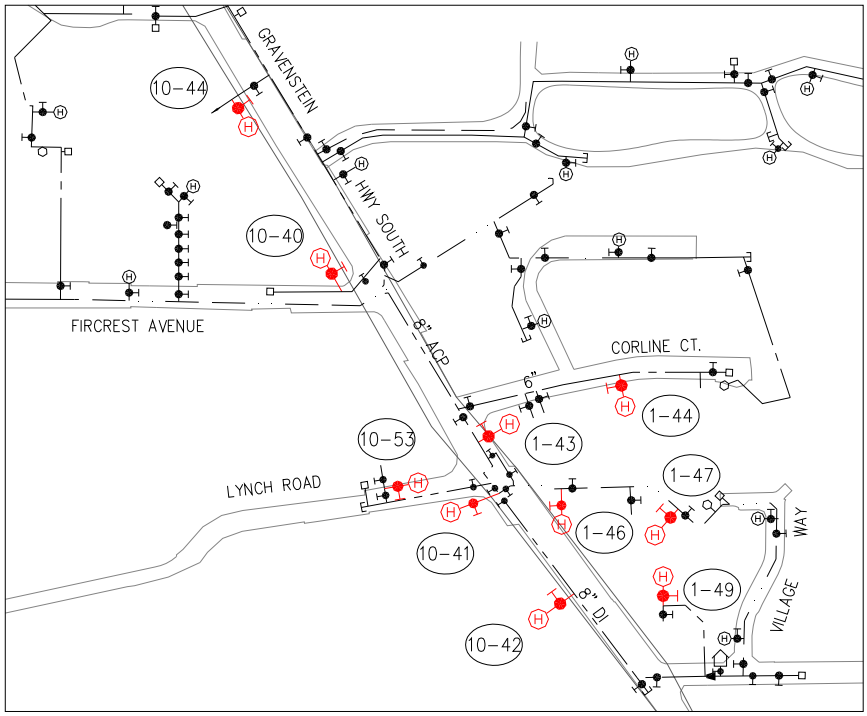


Table 5-12: Gravenstein Hwy South Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
1-43	1491	Commercial	1500
1-44	1044.8	Commercial	1500
1-46	1400.7	Commercial	1500
1-47	1209.7	Commercial	1500
1-49	1261.9	Commercial	1500
10-40	1385	Commercial	1500
10-41	1432.8	Commercial	1500
10-42	1445.6	Commercial	1500
10-44	1486.7	Commercial	1500
10-53	1316.5	Commercial	1500

5.2.2.2 Hydrant Sizing and Spacing

The City of Sebastopol currently maintains 416 fire hydrants spread throughout ten fire zones located in the two pressure zones. The system has four types of hydrants that differ by outlet size:

- Type I – one 2 ½" outlet and one 4 ½" outlet
- Type II – one 2 ½" outlet and two 4 ½" outlets
- Type III – two 2 ½" outlets
- Type IV – two 2 ½" outlets and one 4 ½" outlet

The City's Standard Specifications for Water Mains dated July 1998 identifies two types of suitable hydrants for installation: Type I and Type II. Hydrant types are chosen based on land use designation as indicated in the City Standard Construction Specifications. Type I hydrants are designated for residential areas and Type II hydrants are designated for the commercial and industrial districts. The City owns 58 of the Type III hydrants. Fire Chief John Zanzi expressed that the hydrants with 21/2" outlets are becoming less practicable for use with updated fire fighting equipment and will require replacing with Type II hydrants in the future. In 2004, the fire department inspected several hydrants throughout the City to determine performance and identify problems. Appendix E lists locations of these hydrants according to fire zone number, identification number, location, manufacturer and required improvement to meet current safety standards. At this time, hydrant spacing meets the standards described in Section 5.1.2.

5.2.3 Reservoirs

As explained in Section 5.1.2, reservoirs must be capable of storing enough water to account for average daily consumption, demands in excess of pumping capacity, and fire fighting. The volume required for each pressure zone necessary to satisfy the evaluation criteria, and the actual reservoir capacities are listed in Table 5-4:

Table 5-13: Reservoir Capacities vs. Storage Requirements

Pressure Zones	Total Storage Requirement (gal)	Reservoir Capacities (gal)
Zone 1	1,176,468	1,500,000
Zone 2	1,655,912	3,000,000

This data indicates that for existing land use and population densities, the reservoir capacities exceed the storage requirements for both pressure zones.

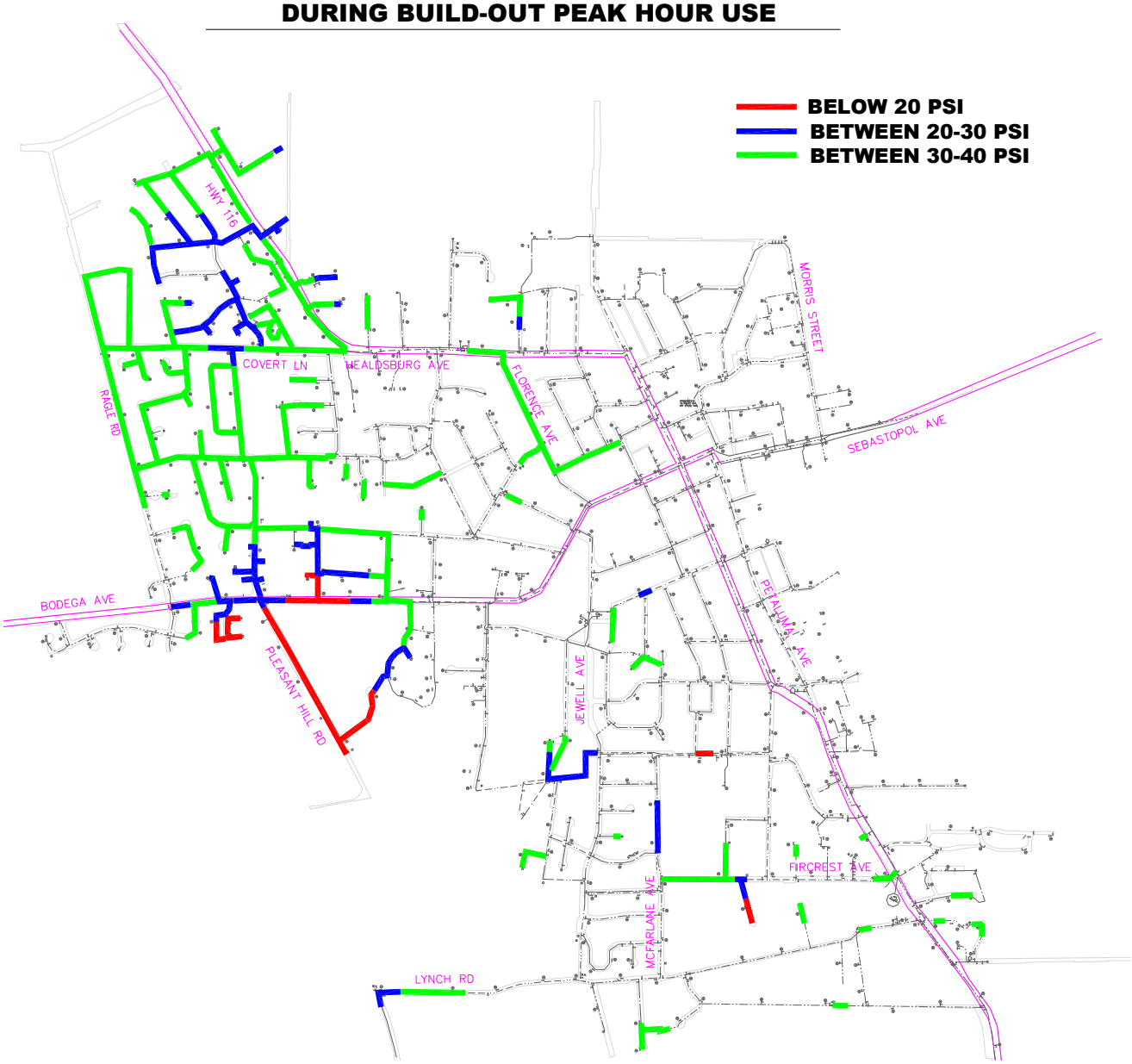
5.3 Analysis of the Water System at Build-out Conditions

Hydraulic analyses of SMWS's water system at build-out conditions were performed using the model development described in Section 4 and repeated in Section 5-2. Refer to Section 2.1.3, "Ultimate Build-out Development Methodology" and Table 2-1, "Build-out Land Use" for the locations and descriptions of future developments and annexations within the SOI. Areas to include water main improvements are Belmont Terrace, the Gravenstein Hwy South area and Walker Avenue between South Main Street and Petaluma Avenue.

5.3.1 Working Service Pressures

Figure 5-13 illustrates areas of the distribution system in both pressure zones during build-out conditions, where service pressures either fail to reach 40 psi.

FIGURE 5-12
AREAS WITH PRESSURES BELOW STANDARDS
DURING BUILD-OUT PEAK HOUR USE



5.3.2 Fire Protection

Fire flow tests were modeled at each hydrant in the distribution system for the build-out scenario. There are approximately 70 hydrants in addition to those listed in Section 5.2.2.1 that fail to meet standards during build-out conditions. The following sections locate these additional hydrants, the minimum required water flow for fire protection according to land use designation, and the modeled fire flows based on a residual pressure reserve of 20 psi at the fire engine.

Figure 5-13: Gravenstein Hwy North

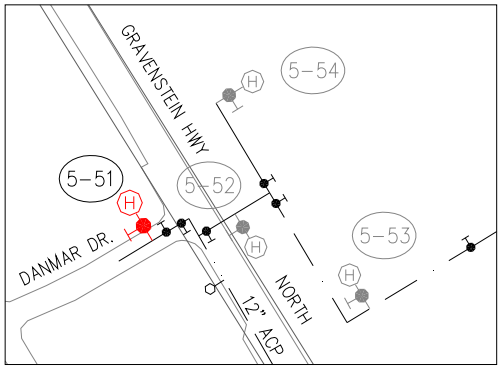


Table 5-14: Gravenstein Hwy North Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
5-51	812.2	Residential	1000

Figure 5-14: Northwest Area

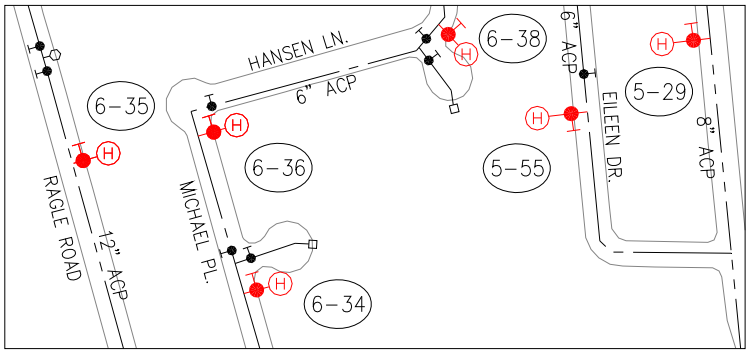


Table 5-15: Northwest Area Hydrants

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
5-29	770.1	Residential	1000
5-55	684.7	Residential	1000
6-34	687.3	Residential	1000
6-35	780.7	Residential	1000
6-36	601.9	Residential	1000
6-38	614.5	Residential	1000

Figure 5-15: Northwest Area, Continued

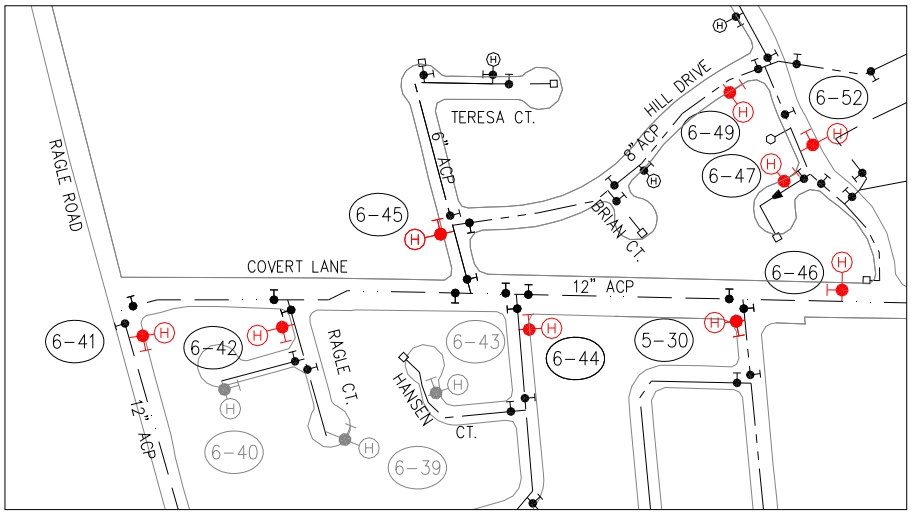


Table 5-16: Northwest Area Hydrants, Continued

Hydrant Number	Flow at 20psi residual pressure (gpm)	Land Use	Minimum Required Flow (gpm)
5-30	589.7	Residential	1000
6-41	877.3	Residential	1000
6-42	716	Residential	1000
6-44	607.7	Residential	1000
6-45	610	Residential	1000
6-46	538.5	Residential	1000
6-47	464.2	Residential	1000
6-49	418.5	Residential	1000
6-52	469.1	Residential	1000

Figure 5-16: Northwest Area, Continued

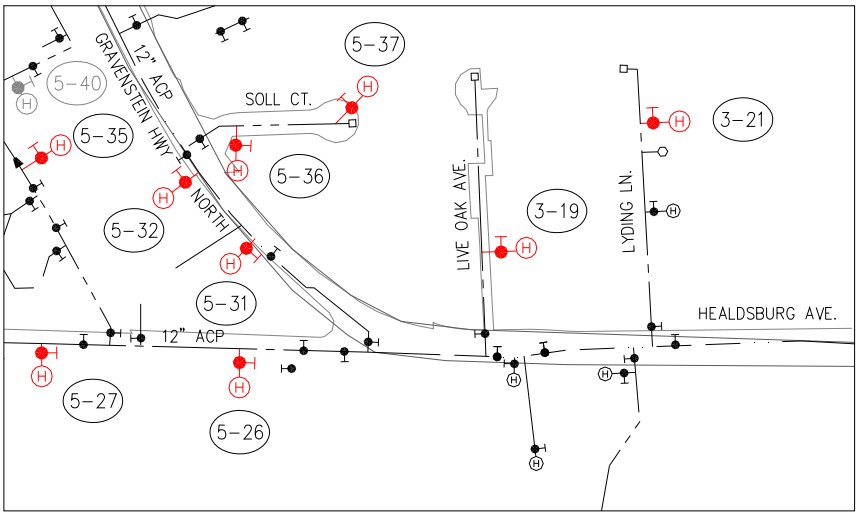


Table 5-17: Northwest Area Hydrants, Continued			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
3-19	856.6	Residential	1000
3-21	854.2	Residential	1000
5-26	854.8	Residential	1000
5-27	724.1	Residential	1000
5-31	885.8	Commercial	1500
5-32	875.4	Commercial	1500
5-35	719.6	Residential	1000
5-36	757.3	Residential	1000

Figure 5-17: Valentine Avenue Area

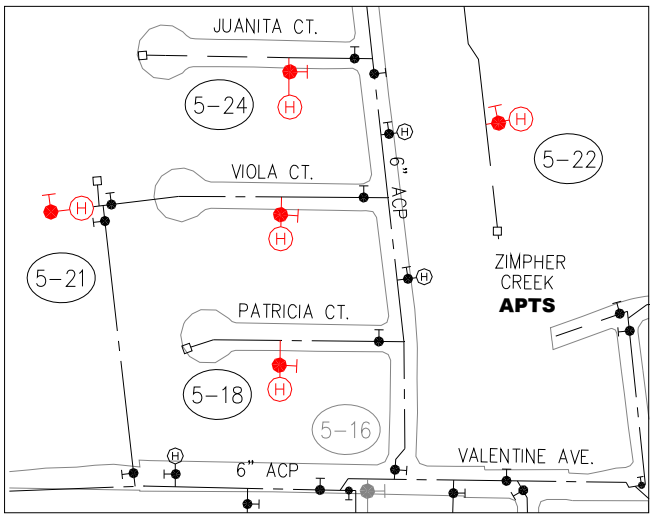


Table 5-18: Valentine Avenue Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
5-18	886.9	Residential	1000
5-21	775.9	Residential	1000
5-22	989.4	Residential	1000
5-24	872	Residential	1000

Figure 5-18: Swartz Avenue Area

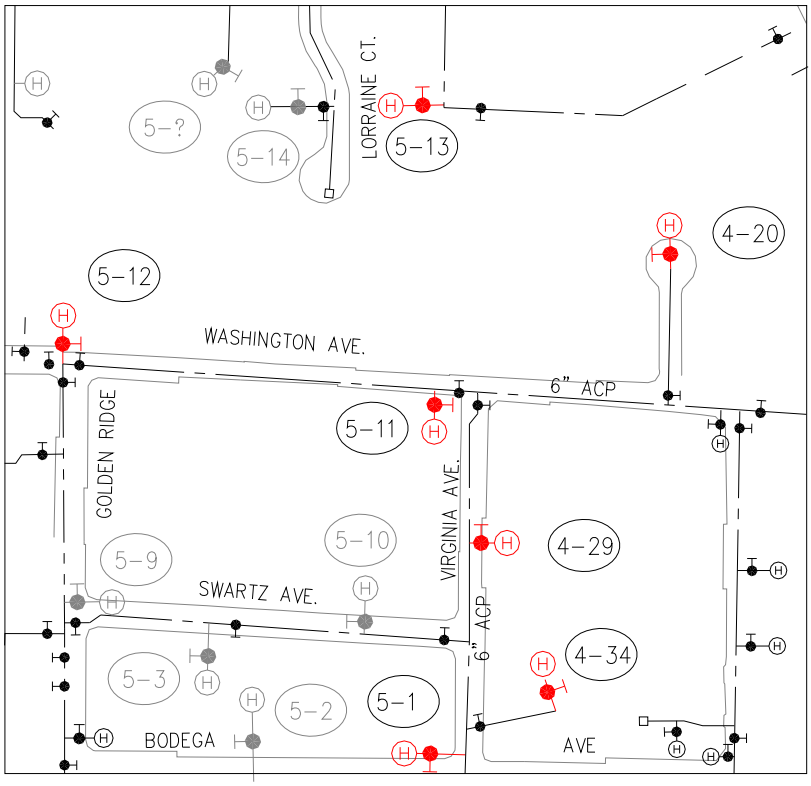


Table 5-19: Swartz Avenue Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
4-20	855.1	Residential	1000
4-29	781.5	Residential	1000
4-34	882.6	Residential	1000
5-01	762.4	Residential	1000
5-11	950.5	Residential	1000
5-12	487.6	Residential	1000
5-13	999.2	Residential	1000

Figure 5-19: West Area

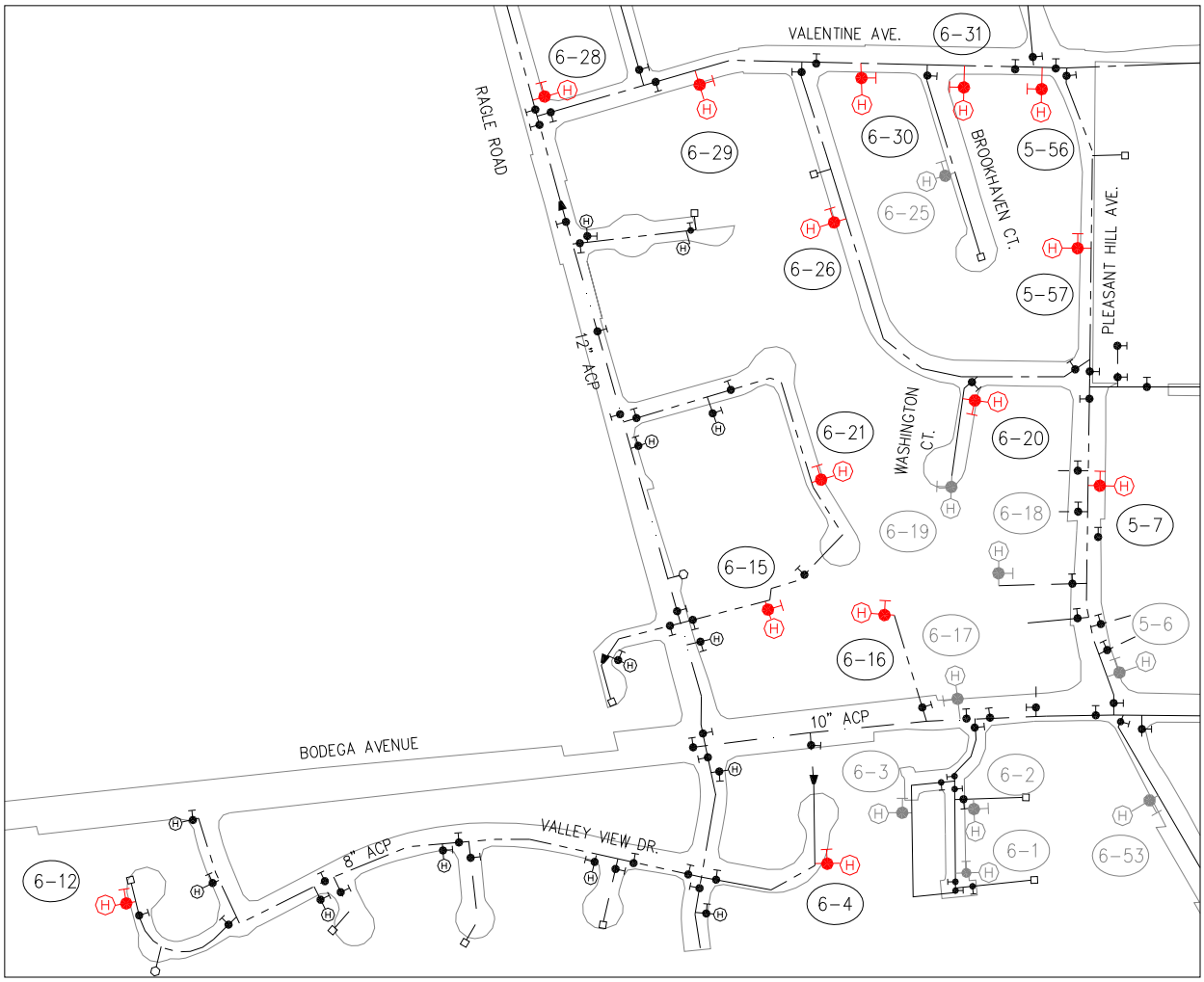

VALENTINE AVE.
6-31
6-28
RAGLE ROAD
6-29
6-30
BROOKHAVEN CT.
5-56
6-25
6-26
PLEASANT HILL AVE.
5-57
12" ACP
WASHINGTON CT.
6-21
6-20
6-18
6-19
5-7
6-15
6-17
5-6
6-16
10" ACP
BODEGA AVENUE
6-3
6-2
VALLEY VIEW DR.
8" ACP
6-1
6-53
6-12
6-4

Table 5-20: West Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
5-07	711.9	Residential	1000
5-56	947.1	Residential	1000
5-57	996.5	Commercial	1500
6-04	647.5	Residential	1000
6-12	988.6	Residential	1000
6-15	966.8	Residential	1000
6-16	546.8	Residential	1000
6-20	776.8	Residential	1000
6-21	815.3	Residential	1000
6-26	858.1	Residential	1000
6-28	935.1	Residential	1000
6-29	809	Residential	1000
6-30	841.6	Residential	1000
6-31	784.3	Residential	1000

Figure 5-20: Healdsburg Avenue Area

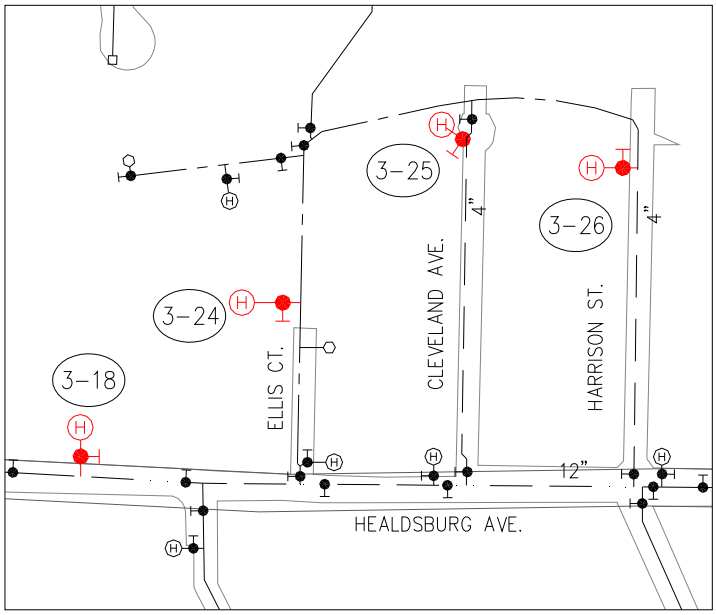


Table 5-21: Healdsburg Avenue Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
3-18	1399.4	Commercial	1500
3-24	869.1	Residential	1000
3-25	907.4	Residential	1000
3-26	978.9	Residential	1000

Figure 5-21: North Main Street Area

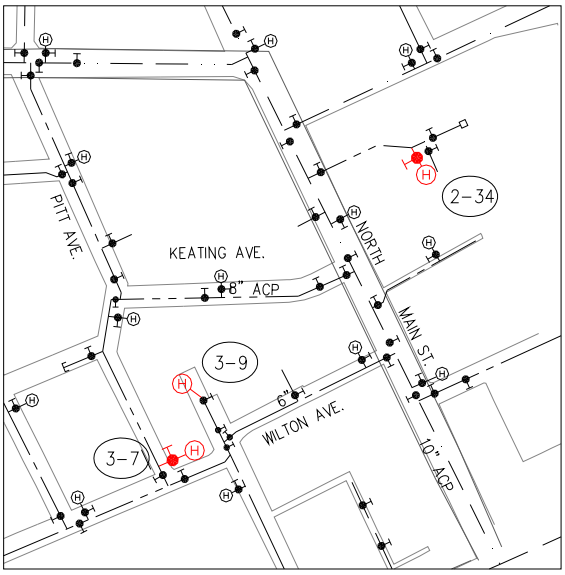


Table 5-22: North Main Street Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
2-34	1354.3	Commercial	1500
3-07	1390.5	Commercial	1500
3-09	1381.3	Commercial	1500

Figure 5-22: Pleasant Hill Road Area

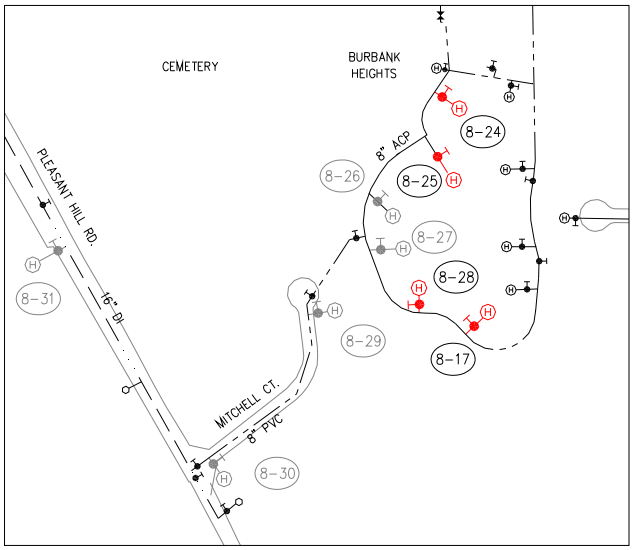


Table 5-23: Pleasant Hill Road Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
8-17	539.2	Residential	1000
8-24	740.8	Residential	1000
8-25	385.3	Residential	1000
8-28	315.1	Residential	1000

Figure 5-23: Calder Avenue Area

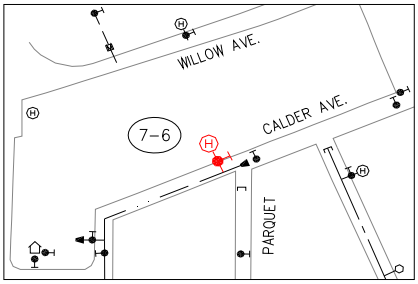


Table 5-24: Calder Avenue Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
7-06	594.1	Residential	1000

Figure 5-24: East Area

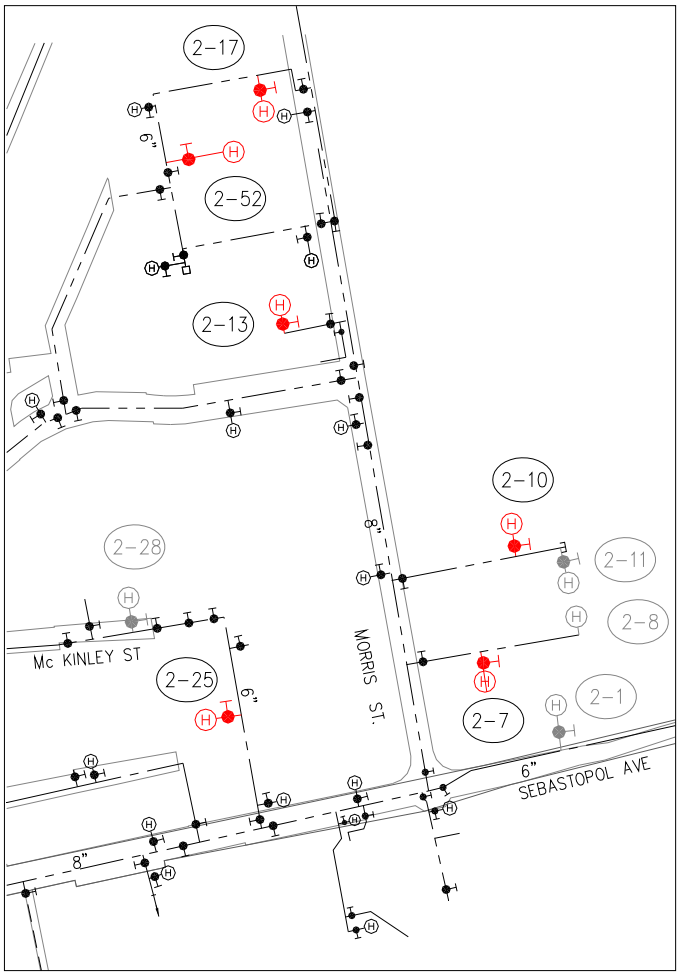


Table 5-25: East Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
2-07	2316.7	Industrial	2500
2-10	2254.8	Industrial	2500
2-13	2366.4	Industrial	2500
2-17	2454.8	Industrial	2500
2-25	2275.5	Industrial	2500
2-52	2414.4	Industrial	2500

Figure 5-25: Gravenstein Hwy South Area

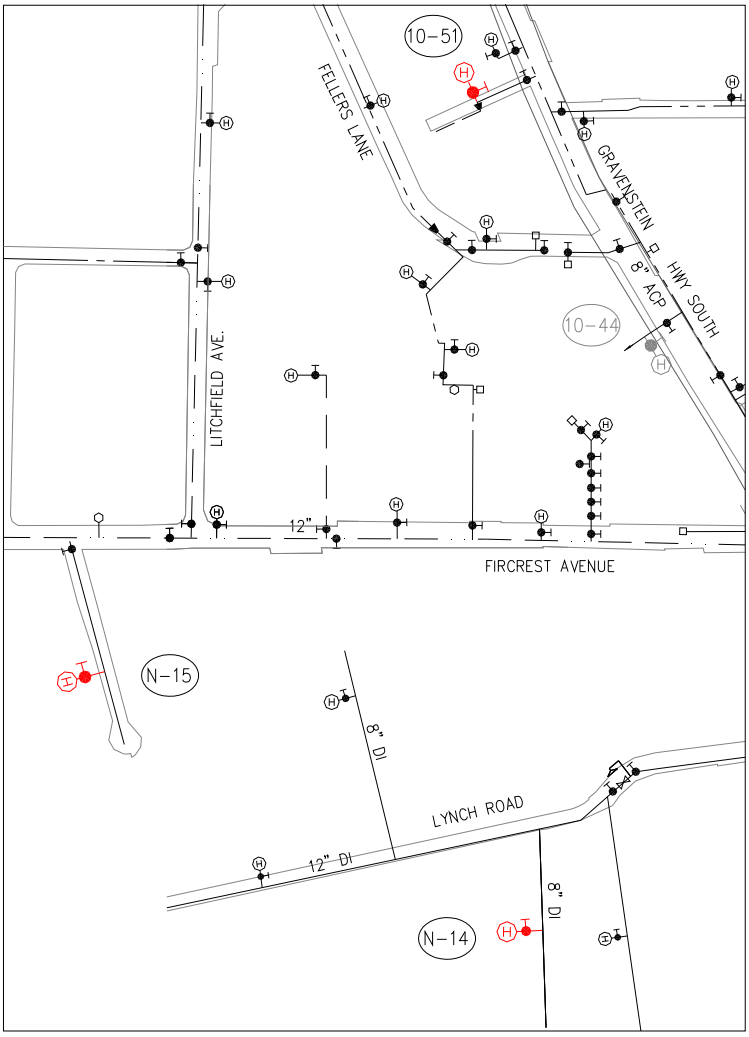


Table 5-26:Gravenstein Hwy South Area Hydrants			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
10-51	1464.3	Commercial	1500
N-14	854.8	Residential	1000
N-15	-495.4	Residential	1000

Figure 5-26: Gravenstein Hwy South Area, Continued

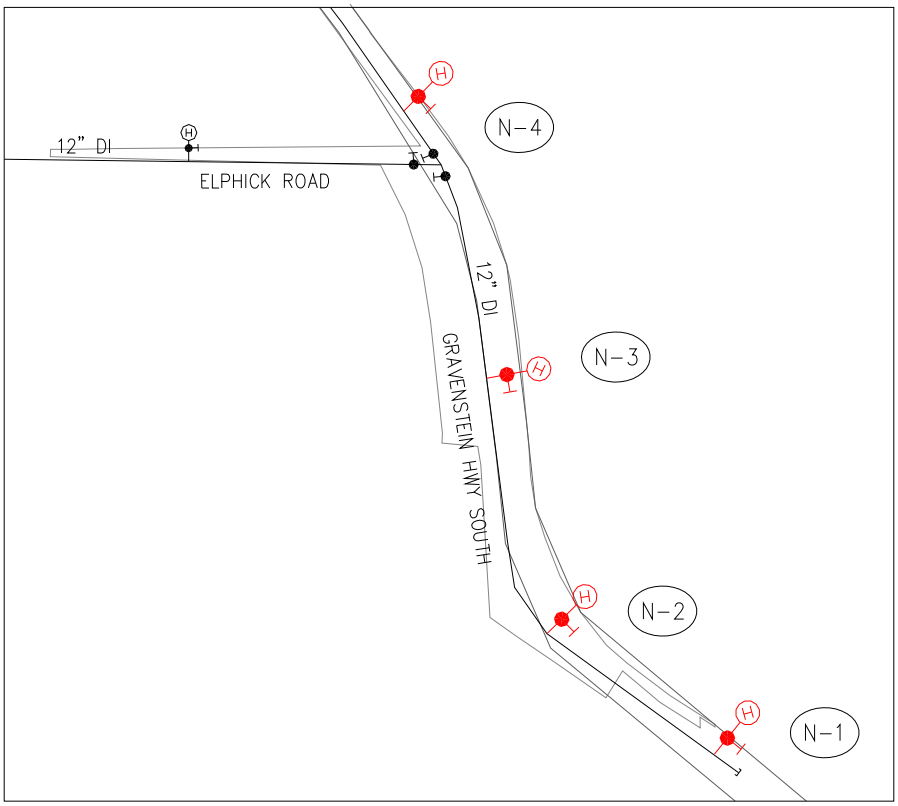


Table 5-27:Gravenstein Hwy South Area Hydrants, Continued			
Hydrant Number	**Flow at 20psi residual pressure (gpm)**	**Land Use**	**Minimum Required Flow (gpm)**
N-01	1537.3	Industrial	2500
N-02	1598	Industrial	2500
N-03	1608.1	Industrial	2500
N-04	1610.7	Industrial	2500

5.3.3 Reservoirs

The volume required for each pressure zone necessary to satisfy the evaluation criteria for build-out conditions, and the actual reservoir capacities are listed in Table 5-4:

Table 5-28: Reservoir Capacities vs. Storage Requirements

Pressure Zones	Total Storage Requirement (gal)	Reservoir Capacities (gal)	Additional Required Storage (gal)
Zone 1	2,188,885	1,500,000	688,885
Zone 2	1,867,779	3,000,000	0

This data indicates that for build-out land use and population densities, the demand during maximum day use exceeds the reservoir capacity of pressure zone 1 by 45%. The total storage in the City is sufficient for the City as a whole and interties are available to allow water to flow from Zone 2 to Zone 1.

Section 6: Recommended Water System Improvements

The hydraulic analyses of the Sebastopol's water system presented in the Section 5 revealed various deficiencies that would intensify as demands increase with build-out land use and population density projections. The following sections discuss a sequence of water system improvement recommendations based on the deficiencies found in the existing system, and those at build-out.

6.1 Water System Recommended Improvements: Existing Conditions

The analysis of Sebastopol's existing water system revealed deficiencies in the distribution systems when modeled with current densities during periods of high demands. Although storage capacities for both pressure zones are sufficient during these periods, the infrastructure proves inadequate at providing pressures and flows required to meet current standards.

As indicated in Section 5.1.1, the desired minimum pressure at the service connection is 40 psi during peak hour demands and with tank levels half full. Figure 5-1 shows areas in the existing system where service pressures failed to meet this standard. Furthermore, Section 5.2.2 sited 68 fire hydrants that failed to achieve required flows at residual pressures of 20 psi when modeled at flows during peak hour demands.

Many of the problems encountered can be remedied by upgrades. However, there are a few areas of low pressures and low fire flows where upgrades to the existing system are not functionally practical. In some cases, service connections are physically located too high in elevation relative to the tanks to receive sufficient working pressures. In other cases, hydrants are located too close to a terminus in the system to draw proper demands. Upsizing the pipes in these areas prove to be ineffective.

The following sections list the recommended improvements and locate remaining problem areas.

6.1.1 Water Distribution System Pipeline Improvements

The following table lists the distribution main construction and replacement required to boost residual pressures and service pressures in both zones. Projects are listed in the order of priority. Generally, higher priority projects will provide the benefits to larger areas of the City

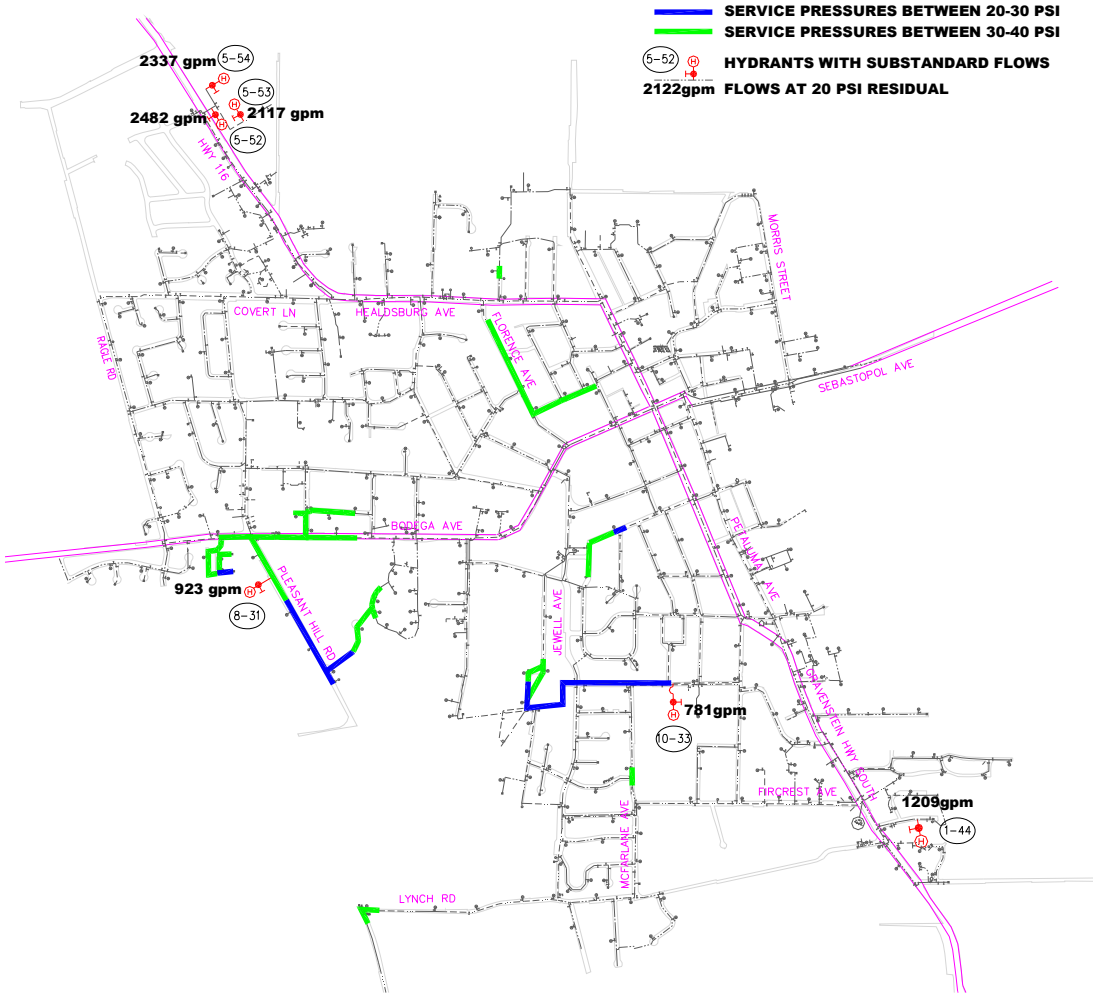
Table 6-1: Prioritized Recommended Distribution Main Improvements

Priority	Zone	Area	Description
1	2	14 inch DIP Loop	Install a 14" main to loop and parallel the existing distribution main from the intersection of Lynch Road and Pleasant Hill Road along Meadowlark Drive, Jewell Avenue, First Street, Robinson Road and within Bodega Avenue to the intersection of the 8" DI main that services the condominiums at 8100 to 8130 Bodega Ave.
2	1	Northeast Area	Replace the existing 6" main in McKinley Street with 8" DI from Brown Street to Sebastopol Avenue. Replace the existing 8" main in Morris Street with 10" DI from Sebastopol Avenue to the intersection with the existing 8" DI south of hydrant 2-9. Replace the existing 8" main in Sebastopol Avenue with 10" DI from Petaluma Avenue to Morris Street. Replace the existing 6" main in Sebastopol Avenue with 8" DI from Morris Street, west to the existing blow off.
3	1	Gravenstein Highway South	Replace the existing 8" main in Gravenstein Hwy South with 10" DI from Palm Avenue to Fircrest and a 12" DI from Fircrest to Cooper Road.
4	2	West Hills	Replace the 6" main in West Hills Circle with 8" DI.
5	2	Pleasant Hill Condos	Replace the existing 4" main servicing the Pleasant Hill Condominiums with 6" DI.
6	1	Abbot Avenue	Replace the existing 6" main in Abbott Avenue with 8" DI.
7	1	Edman Way	Replace the existing 4" main in Edman Way with 6" DI.
8	1	Lillian Way	Replace the existing 4" main in Lillian Way with 6" DI.

6.1.2 Remaining Areas of Low Fire Flows and Pressures

Figure 6-1 represents a snapshot of remaining problem areas in both pressure zones:

FIGURE 6-1
EXISTING SYSTEM POST IMPROVEMENTS:
AREAS WITH PRESSURES AND FIRE FLOWS BELOW STANDARDS



6.1.3 Fire Hydrant Replacement

There are numerous fire hydrants that do not meet the current City Standards and need to be replaced. A list of these is provided in Appendix E. In addition to the construction recommended above, about 101 Fire Hydrants need to be upgraded to Type II Fire Hydrants and about 58 Fire Hydrants need to be upgraded to Type I Fire Hydrants.

6.2 Water System Recommended Improvements: Build-out

The analysis of Sebastopol's water system at build-out revealed deficiencies in the distribution systems during periods of high demand. Figures 5-12 through 5-26 illustrate areas where the distribution system and fire hydrants fail to meet standard minimum pressures and fire flows, respectively. Many of the system improvements required to remedy the system for existing conditions also resolve those at build-out, with some additional improvements necessary. As with the existing system, there remain a few areas in the future system that fail to achieve

standard minimum pressures and fire flows because their elevations reside high relative to the reservoirs, and upsizing mains in these cases proves impracticable.

Because of large demands on the system in pressure zone 1 during build-out densities and land use amendments, the water volume required for operational, equalization and fire storage exceeds the capacity of the First Street Reservoir. However, the combined capacity of the reservoirs in both pressure zones exceeds the storage required during build-out.

The following sections describe the recommended upgrades to the water system during build-out and detail remaining problems in the distribution and storage systems.

6.2.1 Water Distribution System Pipeline Improvements

The following tables list the additional distribution main remedies required to boost residual pressures and service pressures in both zones:

Table T-6-3: Zone 2 Distribution Main Improvements

1.	Replace the existing 6" main in Teresa Court with 8" DI.
2.	Replace the existing 6" main servicing 699 Gravenstein Hwy North apartments with 8" DI.

6.2.2 Remaining Areas of Low Fire Flows and Pressures

Figure 6-2 represents a snapshot of remaining problem areas in both pressure zones during build-out conditions:

FIGURE 6-2
BUILD-OUT SYSTEM POST IMPROVEMENTS:
AREAS WITH PRESSURES AND FIRE FLOWS BELOW STANDARDS

6.2.3 Reservoir Capacities at Build-out Conditions

Table 6-3 lists the storage volumes by pressure zone, required storage, and total capacity:

Table 6-3: Build-out Storage Requirements vs. Capacity

Pressure Zone	Operational Storage (gal)	Equalization Storage (gal)	Fire Storage (gal)	Total Required Storage (gal)	Reservoir Capacity (gal)
Zone 1	1,146,316	592,569	450,000	2,188,885	1,500,000
Zone 2	954,083	463,696	450,000	1,867,779	3,000,000
			Total:	4,056,664	4,500,000

During build-out densities, the City has sufficient storage for the combined pressure zones. Although Zone1 will not have sufficient storage by itself, existing cross connections with PRVs will allow water to go from Zone 2 to Zone 1 when pressures in Zone 1 become low. The City Fire Department understands and accepts that flow through the interties will only occur when pressures in Zone 1 drop to a point where fire flows may be impaired.

Section 7: Estimated Cost of Recommended Improvements

This section provides the estimated costs for the recommended improvement projects required to meet current and future needs. Estimated costs were averaged from a number of actual bid projects from 2003 to 2005, adjusted for inflation. These were compared with other master plan figures adjusted for inflation. Future use of this cost data must be adjusted accordingly.

Each project estimate is based on the lineal feet of pipe, the number of main connections into the pipe, the number of hydrants replaced, blow-offs and air release valves (ARV). Materials are selected based on the City of Sebastopol Standard Details and Specifications, dated July, 1998. The standard cost for a pipe line includes the estimated cost of trenching, shoring, backfilling, paving, valves and connections to water and fire services. In low density areas the isolation valves are assumed to be placed every 1,000 feet and services are assumed to be every 100 feet on each side. In higher density areas, the isolation valves are assumed to be placed every 500 feet and services are assumed to be every 60 feet on each side. Additional costs are added for mobilization, for traffic control and for miscellaneous work. An additional factor of 10% is included for small jobs.

Each project estimate includes estimated construction cost and a 15% construction contingency and a 30% mark-up for legal, environmental, engineering, inspection and administration. Estimates do not include land acquisition or right-of-way costs.

These cost estimates are provided at a preliminary planning level of accuracy and do not guarantee that a bid price will be received at or below estimates, as price bids are subject to numerous and changing variables.

7.1 Cost Estimates

Table 7-1: ***EXISTING SYSTEM IMPROVEMENTS: Gravenstein Hwy South***

Task	Replace the existing 8" main in Gravenstein Hwy South with 10" DIP from Palm Avenue to Cooper Road.	**Quantity**	**Units**	**Unit Cost**	**Total**
Item No.	**Bid Item**				
1	Traffic Control	1	L.S.	$10,000	$10,000
2	Install 10" DIP	2810	L.F.	$164	460,840
3	Install 12" DIP	550	L.F.	$172	$94,600
4	Reconnect Existing Blow-off	1	Each	$2,000	$2,000
5	Replace Existing Hydrant with Type II Hydrant Assembly	8	Each	$5,500	$44,000
6	Water Main Tie-In	16	Each	$2,700	$43,200
7	Miscellaneous Work	1	L.S.	$5,000	$5,000
8	Mobilization	1	L.S.	$10,000	$10,000
				Sub Total	$665,240
				15% Construction Contingency	$100,466
				Construction Sub Total	$770,086

30% Mark-up for Professional Fees	$231,026
Total	**$1,001,112**

Table 7-2: ***EXISTING SYSTEM IMPROVEMENTS: Northeast Area***

Task	Replace the existing 6" main in McKinley Avenue with 8" DIP from Brown Street to Sebastopol Avenue. Replace the existing 8" main in Morris Street with 10" DIP from Sebastopol Avenue to the intersection with the existing 8" DIP south of hydrant 2-9.Replace the existing 8" main in Sebastopol Avenue with 10" DIP from Petaluma Avenue to Morris Street. Replace the existing 6" main in Sebastopol Avenue with 8" DIP from Morris Street, west to the existing blow off.	**Quantity**	**Units**	**Unit Cost**	**Total**
Item No.	**Bid Item**				
1	Traffic Control	1	L.S.	$10,000	$10,000
2	10" DIP Water Main	1690	L.F.	$164	$277,160
3	8" DIP Water Main	1540	L.F.	$155	$238,700
4	Replace Existing Hydrant with Type II Hydrant Assembly	7	Each	$5,500	$38,500
5	Water Main Tie-In	11	Each	$2,700	$29,700
6	Miscellaneous Work	1	L.S.	$5,000	$5,000
7	Mobilization	1	L.S.	$10,000	$10,000
				Sub Total	$609,060
				15% Construction Contingency	$91,359
				Construction Sub Total	$700,419
				30% Mark-up for Professional Fees	$210,125
				Total	**$910,544**

Table 7-3: ***EXISTING SYSTEM IMPROVEMENTS: West Hills Circle***

Task	Replace the 6" main in West Hills Circle with 8" DIP.	**Quantity**	**Units**	**Unit Cost**	**Total**
Item No.	**Bid Item**				
1	Traffic Control	1	L.S.	$10,000	$10,000
2	8" DIP Water Main	860	L.F.	$155	$133,300
3	Reconnect Existing Hydrant	2	Each	$2,000	$4,000
4	Water Main Tie-In	3	Each	$2,700	$8,100
5	Miscellaneous Work	1	L.S.	$5,000	$5,000
6	Mobilization	1	L.S.	$10,000	$10,000
				Sub Total	$170,400
				15% Construction Contingency	$25,560
				Construction Sub Total	$195,960
				30% Mark-up for Professional Fees	$58,788
				Total	**$254,748**

Table 7-4: *EXISTING SYSTEM IMPROVEMENTS: Abbott Avenue*

Task	Replace the 6" main in Abbott Ave with 8" DIP.	Quantity	Units	Unit Cost	Total
Item No.	Bid Item				
1	Traffic Control	1	L.S.	$3,000	$3,000
2	8" DIP Water Main	400	L.F.	$155	$62,000
3	Replace Existing Hydrant with Type II Hydrant Assembly	1	Each	$5,500	$5,500
4	Water Main Tie-In	1	Each	$2,700	$2,700
5	Miscellaneous Work	1	L.S.	$5,000	$5,000
6	10% Mark-up for Minor Project	1	L.S.	$7,820	$7,820
7	Mobilization	1	L.S.	$5,000	$5,000
				Sub Total	$91,020
				15% Construction Contingency	$13,653
				Construction Sub Total	$104,673
				30% Mark-up for Professional Fees	$31,401
				Total	**$136,074**

Table 7-5: *EXISTING SYSTEM IMPROVEMENTS: Pleasant Hill Condos*

Task	Replace the existing 4" main servicing the Pleasant Hill Condominiums with 6" DIP.	Quantity	Units	Unit Cost	Total
Item No.	Bid Item				
1	Traffic Control	1	L.S.	$3,000	$3,000
2	6" DIP Water Main	200	L.F.	$140	$28,000
3	Reconnect Existing Hydrant	1	Each	$2,000	$2,000
4	Water Main Tie-In	1	Each	$2,700	$2,700
5	Miscellaneous Work	1	L.S.	$5,000	$5,000
6	10% Mark-up for Minor Project Costs	1	L.S.	$4,070	$4,070
7	Mobilization	1	L.S.	$5,000	$5,000
				Sub Total	$49,770
				15% Construction Contingency	$7,465
				Construction Sub Total	$57,235
				30% Mark-up for Professional Fees	$17,170
				Total	**$74,406**

Table 7-6: *EXISTING SYSTEM IMPROVEMENTS: Edman Way*

Task	Replace the existing 4" main in Edman Way with 6" DIP.	Quantity	Units	Unit Cost	Total
Item No.	Bid Item				
1	Traffic Control	1	L.S.	$3,000	$3,000
2	6" DIP Water Main	310	L.F.	$140	$43,400
3	Reconnect Existing Hydrant	1	Each	$2,000	$2,000
4	Water Main Tie-In	1	Each	$2,700	$2,700
5	Miscellaneous Work	1	L.S.	$5,000	$5,000
6	10% Mark-up for Minor Project Costs	1	L.S.	$5,610	$5,610
7	Mobilization	1	L.S.	$5,000	$5,000
				Sub Total	$66,710
				15% Construction Contingency	$10,006
				Construction Sub Total	$76,716

30% Mark-up for Professional Fees	$23,014
Total	**$99,731**

Table 7-7: ***EXISTING SYSTEM IMPROVEMENTS: Lillian Way***

Task	Replace the existing 4" main in Lillian Way with 6" DIP.	**Quantity**	**Units**	**Unit Cost**	**Total**
Item No.	**Bid Item**				
1	Traffic Control	1	L.S.	$3,000	$3,000
2	6" DIP Water Main	370	L.F.	$140	$51,800
3	Reconnect Existing Hydrant	1	Each	$2,000	$2,000
4	Water Main Tie-In	1	Each	$2,700	$2,700
5	Miscellaneous Work	1	L.S.	$5,000	$5,000
6	10% Mark-up for Minor Project Costs	1	L.S.	$6,450	$6,450
7	Mobilization	1	L.S.	$5,000	$5,000
				Sub Total	$75,950
				15% Construction Contingency	$11,392
				Construction Sub Total	$87,342
				30% Mark-up for Professional Fees	$26,202
				Total	**$113,545**

Table 7-8: ***EXISTING SYSTEM IMPROVEMENTS: 14" DIP Loop***

Task	Install a 14" main to loop and parallel the existing distribution main from the intersection of Lynch Road and Pleasant Hill Road along Meadowlark Drive, Jewell Avenue, First Street, Robinson Road and within Bodega Avenue to the intersection of the 8" DIP main that services the condominiums at 8100 to 8130 Bodega Ave.	**Quantity**	**Units**	**Unit Cost**	**Total**
Item No.	**Bid Item**				
1	Traffic Control	1	L.S.	$10,000	$10,000
2	14" DIP Water Main	10300	L.F.	$140	$1,442,000
3	Water Main Tie-In	2	Each	$2,700	$5,400
4	Install Blow-off	6	Each	$2,700	$16,200
5	Install ARV	2	Each	$2,000	$4,000
6	Miscellaneous Work	1	L.S.	$10,000	$10,000
7	Mobilization	1	L.S.	$15,000	$15,000
				Sub Total	$1,502,600
				15% Construction Contingency	$225,390
				Construction Sub Total	$1,727,990
				30% Mark-up for Professional Fees	$518,397
				Total	**$2,246,387**

Table 7-9: ***EXISTING SYSTEM IMPROVEMENTS: Fire Hydrants***

Task	Replace substandard fire hydrants not included in other projects	**Quantity**	**Units**	**Unit Cost**	**Total**
Item No.	**Bid Item**				
1	New Type I Fire Hydrant	58	Each	$1,500	$87,000
2	New Type II Fire Hydrant	101	Each	$1,400	$141,400
7	Mobilization	1	L.S.	$10,000	$238,000
				Total	**$745,700**
				15% Construction Contingency	$111,815
				Construction Sub Total	$857,555

10% Mark-up for Professional Fees	$85,755
Total	**$943,310**

Table 7-10: ***FUTURE SYSTEM IMPROVMENTS: Teresa Court***

Task	Replace the existing 6" main in Teresa Court with 8" DIP.	**Quantity**	**Units**	**Unit Cost**	**Total**
Item No.	**Bid Item**				
1	Traffic Control	1	L.S.	$3,000	$3,000
2	8" DIP Water Main	760	L.F.	$155	$117,800
3	Reconnect Existing Hydrant	2	Each	$2,000	$4,000
4	Water Main Tie-In	2	Each	$2,700	$5,400
5	Reconnect Blow-off	2	Each	$2,000	$4,000
6	Miscellaneous Work	1	L.S.	$5,000	$5,000
7	Mobilization	1	L.S.	$5,000	$5,000
				Sub Total	$144,200
				15% Construction Contingency	$21,630
				Construction Sub Total	$165,830
				30% Mark-up for Professional Fees	$49,749
				Total	**$215,579**

Table 7-11: ***FUTURE SYSTEM IMPROVMENTS: Gravenstein Hwy North Apartments***

Task	Replace the existing 6" main servicing 699 Gravenstein Hwy North apartments with 8" DIP.	**Quantity**	**Units**	**Unit Cost**	**Total**
Item No.	**Bid Item**				
1	Traffic Control	1	L.S.	$3,000	3,000
2	8" DIP Water Main	480	L.F.	$140	$67,200
3	Reconnect Existing Hydrant	2	Each	$2,000	$4,000
4	Water Main Tie-In	1	Each	$2,700	$2,700
5	Miscellaneous Work	1	L.S.	$5,000	$5,000
6	10% Mark-up for Minor Project Costs	1	L.S.	$8,190	$8,190
7	Mobilization	1	L.S.	$5,000	$5,000
				Sub Total	$95,090
				15% Construction Contingency	$14,263
				Construction Sub Total	$109,353
				30% Mark-up for Professional Fees	$32,806
				Total	**$142,159**

Appendix A

EXISTING AND FUTURE LAND USE DESIGNATIONS MAP

Appendix B

EXISTING WATER SYSTEM MAP

Appendix C

TOP RESIDENTIAL WATER USERS

TOP RESIDENTIAL WATER USERS

#	Account	Address	Calendar Year 2004 Water Usage Units (x100 cuft or 748 gal)	Water Usage in gal/day	Zone
1	Burbank Heights & Orchards	7777 Bodega Avenue	7754	15890	2
2	Colonial Manor	7771 Healdsburg Avenue	758	1553	2
3	Fircrest Mobile Home Park	965 Gravenstein Hwy So	4879	9999	1
4	Gravenstein North Apartments	699 Gravenstein Hwy No	5422	11111	2
5	Quail Hill Apartments	385 Murphy Avenue	1359	2785	2
6	Redwood Grove Apartments	7001- 7065 Fellers Lane	2050	4201	2
7	Sebastopol Garden Apartments	7940 Bodega Avenue	1359	2785	2
8	7725 Bodega Ave. Apartments	7725 Bodega Avenue	1805	3699	2
		Total Both Zones	25386	52024	

Appendix D

TOP COMMERCIAL WATER USERS

TOP COMMERCIAL WATER USERS

#	Account	Address	Calendar Year 2004 Water Usage Units (x100 cuft or 748 gal)	Total Water Usage in (gpd)	Zone
1	Albertson's	776 Gravenstein Hwy No	1057	2166	2
2	Analy High School	6950 Analy Ave	4205	8617	1
3	Apple Valley Convalescent	1035 Gravenstein Hwy So	3431	7031	1
4	Community Center	390 Morris Street	850	1742	1
5	Fircrest Convalescent	7025 Corline Court	2009	4117	1
6	Hi-Tide Laundromat	992 Gravenstein Hwy So	1707	3498	1
7	Holiday Inn Express	1101 Gravenstein Hwy So	3045	6240	1
8	Libby Park	Pleasant Hill Avenue No	5950	12193	2
9	Palm Drive Hospital	501 Petaluma Avenue	4483	9187	1
10	Parkside School	7450 Bodega Avenue	748	1533	2
11	Pinecreek Property	6775/6793 McKinley Street	1225	2510	1
12	Pinecrest Medical Plaza	7064 Corline Court	1098	2250	1
13	Pinecrest School	7285 Hayden Avenue	537	1100	2
14	Ragle Park	Ragle Road	1106	2267	2
15	Rotten Robbie's Gas Station & Car Wash	7200 Healdsburg Avenue	2072	4246	1
16	Safeway	406 No Main Street	2828	5795	1
17	Sebastopol Convalescent	501 Petaluma Avenue	1361	2789	1
18	Sebastopol Health Care Professionals	6800 Palm Avenue	1938	3972	1
19	Sebastopol Inn	6751 Sebastopol Avenue	1017	2084	1
20	Super Suds Laundromat	736 Gravenstein Hwy No	1321	2707	2
21	Whole Foods Market	6910 McKinley Street	3906	8005	1
		Total Both Zones	45894	94051	

Appendix E

FIRE HYDRANTS REQUIRING REPLACEMENT TO MEET EXISTING STANDARDS

FIRE HYDRANTS REQUIRING REPLACEMENT TO MEET EXISTING STANDARDS

Hydrant # Fire Zone - Hydrant		Location	Number and Size of Connections		Upgrades Required
			2-1/2"	4-1/2"	
1	1	Petaluma Ave. cross Pellini Chevrolet	2	1	Upgrade to Type II hydrant
1	2	Petaluma Ave. East of Frizell Enos	2	1	Upgrade to Type II hydrant
1	4	435 Petaluma Ave.	2	1	Upgrade to Type II hydrant
1	5	Palm Ave. in front of Dr. Holmes	2	1	Upgrade to Type II hydrant
1	6	Petaluma Ave. (Entrance to Palm Drive Hospital	2	1	Upgrade to Type II hydrant
1	7	Petaluma Ave. @ south entrance to Palm Drive Hospital	2	2	Upgrade to Type II hydrant
1	8	Palm Drive Hospital Near Fuel Tank	2	1	Upgrade to Type II hydrant
1	9	Palm Drive Hospital (Rear) near Cell Tower	2	1	Upgrade to Type II hydrant
1	10	Palm Drive Hospital E. R.	2	1	Upgrade to Type II hydrant
1	11	Sebastopol Ave. in front of Benedetti Tire	2	1	Upgrade to Type II hydrant
1	12	Abbott Ave.	2	1	Upgrade to Type II hydrant
1	15	End of Walker Ave.	2	0	Upgrade to Type I hydrant
1	16	Palm Ave. @ Eye Center	1	1	Upgrade to Type II hydrant
1	17	6800 Palm Ave. in complex	2	1	Upgrade to Type II hydrant
1	19	Palm Ave. @ Mini Storage	2	1	Upgrade to Type II hydrant
1	20	Near 755 Gravenstein Hwy S.	2	1	Upgrade to Type II hydrant
1	21	Southpoint Storage Western most Bldgs.	2	1	Upgrade to Type II hydrant
1	22	Southpoint Storage in front of space 320	2	1	Upgrade to Type II hydrant
1	23	Southpoint Storage in front of space 810	2	1	Upgrade to Type II hydrant
1	24	Southpoint Storage in front of space 931 & 932	2	1	Upgrade to Type II hydrant
1	25	Gravenstein Hwy. S./Southpoint	2	1	Upgrade to Type II hydrant
1	26	Southpoint Storage next to space 329	2	1	Upgrade to Type II hydrant
1	27	Southpoint storage south side	2	1	Upgrade to Type II hydrant
1	28	Corner of Southpoint	2	1	Upgrade to Type II hydrant
1	29	Southpoint Storage across from space 1061	2	1	Upgrade to Type II hydrant
1	30	Gravenstein Hwy. S./Hutchins	2	1	Upgrade to Type II hydrant
1	35	Highway 116 S.	2	1	Upgrade to Type II hydrant
1	36	Redwood Ave.	2	1	Upgrade to Type II hydrant
1	43	Corline Ct. & Gravenstein Hwy S. next to Apple Valley Conv.	2	1	Upgrade to Type II hydrant

1	44	Corline Ct. east end of Apple Valley Conv.	2	1	Upgrade to Type II hydrant
1	46	North side of Holiday Inn Express next to Gravenstein Hwy. S.	2	1	Upgrade to Type II hydrant
1	47	Gravenstein Hwy S. back of Holiday Inn Express next to pool	2	1	Upgrade to Type II hydrant
1	49	Gravenstein Hwy. S. south side of Holiday Inn Express	2	1	Upgrade to Type II hydrant
1	52	Sebastopol Ave. Entrance to Bradley Video	2	1	Upgrade to Type II hydrant
1	54	Southpoint Storage inside complex next to gate	2	1	Upgrade to Type II hydrant
1	55	Southpoint Storage south end	2	1	Upgrade to Type II hydrant
2	1	Sebastopol Ave. across from Village Park	2	1	Upgrade to Type II hydrant
2	2	Sebastopol Ave./Morris	2	1	Upgrade to Type II hydrant
2	3	Sebastopol Ave. @ Barlow Entrance West lot	2	1	Upgrade to Type II hydrant
2	4	Sebastopol Ave.	2	1	Upgrade to Type II hydrant
2	7	101 Morris St. NE Corner near London Pool & Spa	2	1	Upgrade to Type II hydrant
2	8	105 Morris St. NE Corner of Caldwell Banker	2	1	Upgrade to Type II hydrant
2	9	Morris St. in front of the Old Barlow Co.	2	1	Upgrade to Type II hydrant
2	10	121 Morris St. North of R's Auto.	2	1	Upgrade to Type II hydrant
2	11	111 Morris St.NE of R's Auto.	2	1	Upgrade to Type II hydrant
2	12	200 Morris St. & Laguna Parkway	1	1	Upgrade to Type II hydrant
2	13	Morris St @ 250 Morris St.	2	1	Upgrade to Type II hydrant
2	14	Morris St. @ rear of 380 Morris	2	1	Upgrade to Type II hydrant
2	15	Morris St. in front of 380 Morris St.	1	1	Upgrade to Type II hydrant
2	16	Morris St.	2	1	Upgrade to Type II hydrant
2	17	Morris St. @ 400 Morris St. north side of building	2	1	Upgrade to Type II hydrant and place blue pavement marker
2	18	Morris St. @ rear of 400 "D" Morris St. north side corner	2	1	Upgrade to Type II hydrant and place blue pavement marker
2	19	Morris St.	1	1	Upgrade to Type II hydrant
2	20	Morris St.	2	0	Upgrade to Type II hydrant
2	21	Weeks Way @ Rear of Plaza	2	1	Upgrade to Type II hydrant
2	22	Weeks Way & McKinley St.	2	1	Upgrade to Type II hydrant
2	24	Depot St.	2	1	Upgrade to Type II hydrant
2	25	Barlows lot west side across from 6786 Sebastopol Ave.	2	1	Upgrade to Type II hydrant
2	27	Laguna Parkway @ McKinley	2	1	Upgrade to Type II hydrant
2	28	McKinley Ave. across from 6760 McKinley	2	1	Upgrade to Type II hydrant
2	29	Laguna Parkway in front of Police Dept.	2	1	Upgrade to Type II hydrant

2	30	Johnson St. & Laguna Parkway	2	1	Upgrade to Type II hydrant
2	31	Flynn & Laguna Parkway	2	1	Upgrade to Type II hydrant
2	32	Laguna Parkway (East end)	2	1	Upgrade to Type II hydrant
2	34	Berry Lane	2	1	Upgrade to Type II hydrant and trim vegetation
2	35	N. Main St./Keating	2	1	Upgrade to Type II hydrant
2	36	N. Main St. behind #373	2	1	Upgrade to Type II hydrant and trim vegetation
2	39	Wallace St @ Taft St.	1	1	Upgrade to Type II hydrant
2	42	Bonnardel Ave @ Analy Ave.	2	1	Upgrade to Type II hydrant
2	43	Sunset Ave. @ Taft St.	2	1	Upgrade to Type II hydrant
2	44	Sunset Avenue	1	1	Upgrade to Type II hydrant
2	46	High School Rd/Analy Ave.	2	1	Upgrade to Type II hydrant
2	47	High School Rd. just after curve by sw classroom	2	1	Upgrade to Type II hydrant
2	48	High School Rd. /Eddie Lane	2	1	Upgrade to Type II hydrant
2	49	Analy High School @ Quad	2	1	Upgrade to Type II hydrant
2	50	Analy High School near gym & track	2	1	Upgrade to Type II hydrant
2	51	McKinley Ave. across from 6760 McKinley	2	1	Upgrade to Type II hydrant
2	52	Morris St. @ 400 Morris St.	2	1	Upgrade to Type II hydrant and place blue pavement marker
2	53	445 Taft St. @ Laguna High School in faculty parking lot south side of building	2	1	Upgrade to Type II hydrant and place blue pavement marker
3	2	Bodega Ave. /High St.	2	1	Upgrade to Type II hydrant
3	3	North High St. @ Wilton Ave.	2	0	Upgrade to Type I hydrant
3	8	Wilton Ave. @ North Main St.	2	1	Upgrade to Type II hydrant
3	9	231 North High St.	1	1	Upgrade to Type II hydrant
3	10	Pitt Ave. @ Keating Ave.	2	0	Upgrade to Type II hydrant
3	11	7121 Keating Ave.	2	1	Upgrade to Type II hydrant
3	15	Harrison/Healdsburg Ave.	2	1	Upgrade to Type II hydrant
3	16	Healdsburg Ave./Cleveland Ave.	2	1	Upgrade to Type II hydrant
3	17	Healdsburg Ave./Ellis Ct.	2	1	Upgrade to Type II hydrant
3	18	Next to 7440 Healdsburg Ave.	2	1	Upgrade to Type II hydrant
3	19	Live Oak Ave.	2	0	Upgrade to Type I hydrant
3	20	565 Lyding Lane	2	0	Upgrade to Type I hydrant
3	24	Ellis Ct. west side of street	2	0	Upgrade to Type I hydrant and trim vegetation
3	26	Harrison St. west side behind telephone pole	2	0	Upgrade to Type I hydrant and relocate clear from telephone pole
4	2	7771 Healdsburg Ave. - Colonial Manor Driveway	1	1	Upgrade to Type II hydrant
4	7	Healdsburg Ave. @ corner of Murphy	2	1	Upgrade to Type II hydrant

4	10	385 Murphy Ave. between Bately Ct. and Quail Hill Apartments	2	0	Upgrade to Type I hydrant
4	26	7801 Washington Ave. @ Nelson	2	0	Upgrade to Type I hydrant
4	27	7594 Washington Ave. between Bodega Ave. and Huntley	2	0	Upgrade to Type I hydrant
5	2	7908 Bodega Ave. Between Virginia Ave. and Golden Ridge Ave.	2	0	Upgrade to Type I hydrant
5	13	Springdale @ Anthony St.	2	0	Upgrade to Type I hydrant
5	16	7905 Valentine Ave. & Zimpher	2	1	Upgrade to Type II hydrant
5	17	Valentine Ave. between Zimpher & Pleasant Hill Ave. N.	2	0	Upgrade to Type I hydrant
5	21	Valentine Ave. @ rear of St. Sebastians	2	0	Upgrade to Type I hydrant and trim vegetation
5	28	Pleasant Hill Ave. N. cross of Valentine	2	0	Upgrade to Type I hydrant
5	29	456 Pleasant Hill Ave. North , Cross of Covert Lane	1	1	Upgrade to Type II hydrant
5	31	Gravenstein Hwy. N. in front of the Farmhouse Restaurant	2	1	Upgrade to Type II hydrant
5	32	550 Gravenstein Hwy. N. opposite Soll Ct.	2	1	Upgrade to Type II hydrant
5	41	Gravenstein Hwy. N. Albertson's parking lot near Burger King	2	1	Upgrade to Type II hydrant and trim vegetation
5	43	780 Gravenstein Hwy. N. in Albertson's parking lot	2	1	Upgrade to Type II hydrant and trim vegetation
5	44	Gravenstein Hwy. N. @ Redwood Market Place Entrance	2	1	Upgrade to Type II hydrant
5	45	825 Gravenstein Hwy. N.	2	1	Upgrade to Type II hydrant
5	46	760 Hurlbut & Gravenstein N.	2	1	Upgrade to Type II hydrant and trim vegetation
5	47	Redwood Market Place in front of Mary's Pizza	2	1	Upgrade to Type II hydrant
5	48	Gravenstein Hwy. N. in front of bank	2	1	Upgrade to Type II hydrant
5	49	868 Gravenstein Hwy N.	2	1	Upgrade to Type II hydrant
5	50	900 Gravenstein Hwy. N.	2	1	Upgrade to Type II hydrant
5	56	384 Pleasant Hill Ave. Across from Libby Park	2	0	Upgrade to Type I hydrant
5	57		2	0	Upgrade to Type I hydrant
6	4	Valley View between 8141 & 8143	2	0	Upgrade to Type I hydrant
6	5	203 S. Ragle	2	0	Upgrade to Type I hydrant
6	6	S. Ragle & Bodega Ave.	2	0	Upgrade to Type I hydrant
6	7	8247 Valley View Dr.	2	0	Upgrade to Type I hydrant
6	20	279 Washington Ct. - Corner of Washington Ct. & Washington Ave.	2	0	Upgrade to Type I hydrant
6	24	320 Pleasant Hill Ave N. - across from Libby Park	2	0	Upgrade to Type I hydrant
6	25	West Side at 352 Brookhaven Ct.	2	0	Upgrade to Type I hydrant
6	26	8058 Washington Ave.	2	0	Upgrade to Type I hydrant

6	28	N. Corner of Valentine Ave. & Ragle Rd.	2	0	Upgrade to Type I hydrant
6	29	Front of 8123 Valentine Ave.	2	0	Upgrade to Type I hydrant
6	30	South side of street across from 8090 Valentine Ave.	2	0	Upgrade to Type I hydrant
6	34	Corner of Michael Pl. & Kathleen Ct	2	0	Upgrade to Type I hydrant
6	35	441 Ragle Rd.	2	0	Upgrade to Type I hydrant
6	36	Corner of Hansen Ln. & Michael Pl.	2	0	Upgrade to Type I hydrant
7	1	472 Jewell Ave.	2	0	Upgrade to Type I hydrant
7	2	311 Jewell Ave.	2	0	Upgrade to Type I hydrant
7	3	Jewell (back of firehouse parking lot)	2	1	Upgrade to Type II hydrant
7	4	Willow St. in front of Ives Pool	1	1	Upgrade to Type II hydrant
7	5	High St. in front of Vets Bldg.	2	1	Upgrade to Type II hydrant
7	7	Corner of High St. & Willow St.	2	0	Upgrade to Type I hydrant
7	8	Corner of High St. and Calder Ave.	2	0	Upgrade to Type I hydrant
7	9	S. Main St. across from Calder Ave.	2	1	Upgrade to Type II hydrant
7	11	Burnett St.	2	1	Upgrade to Type II hydrant
7	12	Petaluma Ave./Bodega Ave.	2	1	Upgrade to Type II hydrant
7	14	High St./Burnett St.	2	1	Upgrade to Type II hydrant
8	1	Leland St.	2	0	Upgrade to Type I hydrant
8	2	Leland St.	2	0	Upgrade to Type I hydrant
8	9	First St. @ S jog	2	0	Upgrade to Type I hydrant
8	13	Bodega Ave. @ Robinson Rd.	2	0	Upgrade to Type I hydrant
8	14	Robinson Rd. @ Leland St.	2	0	Upgrade to Type I hydrant
8	15	Across from 605 Robinson Rd.	2	0	Upgrade to Type I hydrant
9	1	In front of 698 Petaluma Ave.	2	1	Upgrade to Type II hydrant
9	2	Palm Ave. & Petaluma Ave.	2	1	Upgrade to Type II hydrant
9	3	S. Main St./Palm Ave.	2	1	Upgrade to Type II hydrant
9	4	S. Main St. across from Maple Ave.	2	1	Upgrade to Type II hydrant
9	5	Petaluma Ave. @ Walker	2	1	Upgrade to Type II hydrant
9	6	S. Main St./Walker Ave.	2	1	Upgrade to Type II hydrant
9	7	High Street	2	0	Upgrade to Type I hydrant
9	8	Corner of High St. & Maple Ave.	2	0	Upgrade to Type I hydrant
9	9	Corner of High St. & Palm Ave.	2	0	Upgrade to Type I hydrant
9	13	Corner of Pinecrest Ave. & Eastside Ave.	2	0	Upgrade to Type I hydrant
9	15	Corner of Maple Ave. & Vine Ave.	2	0	Upgrade to Type I hydrant
9	17	Parquet St.	2	0	Upgrade to Type I hydrant
10	13	Lynch @ McFarlane Ave.	2	0	Upgrade to Type I hydrant
10	14	Lynch Rd. between Enos and Jean	2	0	Upgrade to Type I hydrant
10	16	Meadowlark @ McFarlane Ave.	2	0	Upgrade to Type I hydrant
10	20	Belleview Ave. just west of McFarlane	2	0	Upgrade to Type I hydrant
10	21	Fircrest Ave. @ McFarlane Ave.	2	0	Upgrade to Type I hydrant
10	24	Fircrest Ave. @ Maytum	2	0	Upgrade to Type I hydrant
10	25	McFarlane Ave. just north of Woodland	1	1	Replace existing hydrant with Type I hydrant
10	34	Maytum Ave. @ Evan	2	0	Upgrade to Type I hydrant
10	36	Fircrest @ Litchfield	2	0	Upgrade to Type I hydrant

10	37	End of Lillian Way	2	0	Upgrade to Type I hydrant
10	38	Fircrest just east of Lillian Way	2	0	Upgrade to Type I hydrant
10	40	Gravenstein Hwy S./Fircrest Ave.	2	1	Upgrade to Type II hydrant
10	41	Gravenstein Hwy S./Lynch Rd.	2	1	Upgrade to Type II hydrant and trim vegetation
10	42	Gravenstein Hwy S. near Vern's Liquors	2	0	Upgrade to Type II hydrant
10	47	Fellers Lane in front of Redwood Grove Apts.	2	0	Upgrade to Type I hydrant
10	51	Foster Lane in Victorian Square parking lot	2	1	Upgrade to Type II hydrant
10	52	Gravenstein Hwy. S.	2	1	Upgrade to Type II hydrant
10	54	McFarlane Ave. @ Dowd	2	0	Upgrade to Type I hydrant

Appendix F

RECOMMENDED WATER SYSTEM IMPROVEMENTS MAP