CITY OF SONOMA
WATER MASTER PLAN

MARCH, 2011

Prepared for:

City of Sonoma
Public Works
Sonoma, CA

Prepared by:

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WATER MASTER PLAN
CITY OF SONOMA

Job No. 02418-10-019

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EXECUTIVE SUMMARY

Winzler & Kelly was retained by the City to provide a Water Master Plan (WMP) that would identify and incorporate proposed water system improvement projects into the City's 2010 Capital Improvement Program (CIP). The previous Water System Improvement Study was completed in 1999 (amended 2002). Since that time, the City has substantially increased the number of customer s served and implemented several water system projects, facilitating the need to update its water improvement program.

The goal of this WMP is to identify projects necessary to strengthen the City's ability to reliably supply potable water based on current and anticipated planned demand. The 2010 CIP water projects were established by identifying operational deficiencies and required maintenance of major water system components. These projects augment those defined in the J. Nelson 2010 Rate Study Report.

ES-1 Project Demand and Supply

Most of the City's water is supplied via connection to the Sonoma County Water Agency (SCWA) system. Total water allocated annually to the City under its agreement with SCWA is fixed through 2035. Any additional water made available to the City will result from increased pumping of municipal wells (existing and future). Table ES-1.1 shows a current summary of available water supply for the City.

TABLE ES-1.1 Available Water Supply

Current Water Source	Amount (AF/Y)
SCWA Contractual Entitlement[1]	3,000
Well No. 1[2]	156
Well No. 3[2]	13
Well No. 4[2]	33
Well No. 6[2]	56

[1] Amount does not include reduction of 356 AF/Y due to allocation change adopted by SCWA in April, 2006.
[2] Assumes wells are run during summer periods only and allows for recovery time.

Assuming a capital planning horizon of year 2020, overall demand is projected to be relatively flat based on a slight increase in projected population combined with recent decreases in per capita consumption. Table ES-1.2 provides current average daily demand vs. projected daily demand at buildout. Peaking factors of 2 and 3 were used to estimate peak day demand and peak hour demand, respectively.

TABLE ES-1.2 Current vs. Future Demand

Year 2006-2008 (avg. mgd)	Buildout – Year 2020 (mgd)
2.02	2.06

ES-2 Model Development and Calibration

The City's water system was modeled using Bentley's WaterCAD v8i software platform. Constructed model elements include pipes, junctions, tanks and pumping stations. Demands were based on 2006-2008 City billing data. Billing records were geocoded to individual parcels using street address information. Calibration was performed by comparing predicted model pressures in the model to hydrant pressure/flow data (provided by City staff). Additional modifications were applied to the water model based on field notes gathered by Winzler & Kelly/City staff.

ES-3 Capital Improvement Program

A summary of the water system capital improvement projects that are recommended to address capacity and system deficiencies under existing/future conditions are listed in Table ES-3.

TABLE ES-3 CIP Cost Summary

Project ID No.	CIP Year(s)	Project Description	Estimated Construction Cost	Estimated CIP Cost
1	2015-2017	Zone 1-2 Intertie	$ 487,000	$ 672,500
2	2011-2012	Zone 3 Expansion	$ 99,500	$ 137,000
3	2012-2013	Tank Mixing	$ 220,000	$ 303,500
4	2012-2014	Napa St. Tank/Pump Station Upgrade	$ 371,500	$ 513,000
5	2014-2015	Well No. 3 Replacement	$ 693,500	$ 929,500
6	2011-2014	New Well No. 8	$ 827,500	$1,169,000

ES-4 Additional Recommendations

In addition to recommended CIP projects, the following sections provide recommendations for projects that will improve operability and maintenance of the City's water system, as well as provide better planning tools for future projects and capital allocation.

- Comprehensive Maintenance Plan – Utilizing GIS Asset Management, this type of plan will help the City establish maintenance priorities within the system. It will also provide the town with written policies and procedures for identifying maintenance and field staffing needs.
- Billing Segregation – By separating irrigation billing data into Irrigation-Commercial vs. Irrigation-Residential vs. Irrigation-Parks, the City can plan with greater accuracy during future planning efforts.
- Hydrant/Valve ID Program – The City has access to Hydrant Manager software which includes the ability to track routine required maintenance and control required inventory of hydrants, valves and meters.

1.0 INTRODUCTION

The City of Sonoma is currently in the process of updating the capital improvement program for their potable water system. The last time this was done was in November 2002 when the City prepared an addendum to the previous improvement program, which was completed in 1999. The City has completed several water system projects since that time, so it is necessary to reevaluate the system and update the improvement program.

Approximately 5.5 million gallons of storage are available in City-owned tanks, and the City's distribution system is hydraulically connected to two Sonoma County Water Agency (SCWA) tanks totaling 10 million gallons. The SCWA connection provides the majority of the City's water supply with municipal wells making up the balance. The City maintains 56.5 miles of water main, ranging in diameter from 1-inch to 14-inches.

The City currently provides potable water to approximately 4,600 connections within their service area. Historically, most of the City's water has been provided by the Sonoma County Water Agency (SCWA), with the balance provided by City-owned wells. The service area currently comprises approximately 1,546 acres, and is anticipated to grow an additional 167 acres at buildout (year 2020). The City limits and additional water service areas are shown in Figure 1-1.

1.1 Purpose

The purpose of this Master Plan is to establish a CIP program for the City's water system infrastructure by analyzing water supply vs. current/projected water demands, and entering this information in the water distribution system model to identify operational deficiencies and required improvements. Specifically, the Plan identifies the following existing infrastructure:

- Storage tanks;
- Distribution piping arrangement; and
- Water supplies.

This document also includes:

- Estimates of current and future demands;
- Analysis of supply capacity;
- Analysis of delivery pressures;
- Analysis of storage; and a
- Capital improvement program.

1.2 Objectives and Scope

The objective of the work is to define water system improvements necessary to ensure a reliable and efficient water system by documenting and analyzing key elements of the City's existing potable water facilities. Technical memoranda (TM) were previously prepared and submitted to the City. These TM's form the basis for this Master Plan. The TM's included were:

- TM 1 – System Overview
- TM 2 – Demand Analysis
- TM 3 – Fire Flow
- TM 4 – Model Calibration
- TM 5 – System Performance Summary
- TM 6 – Supply Analysis
- TM 7 – Capital Improvement Program

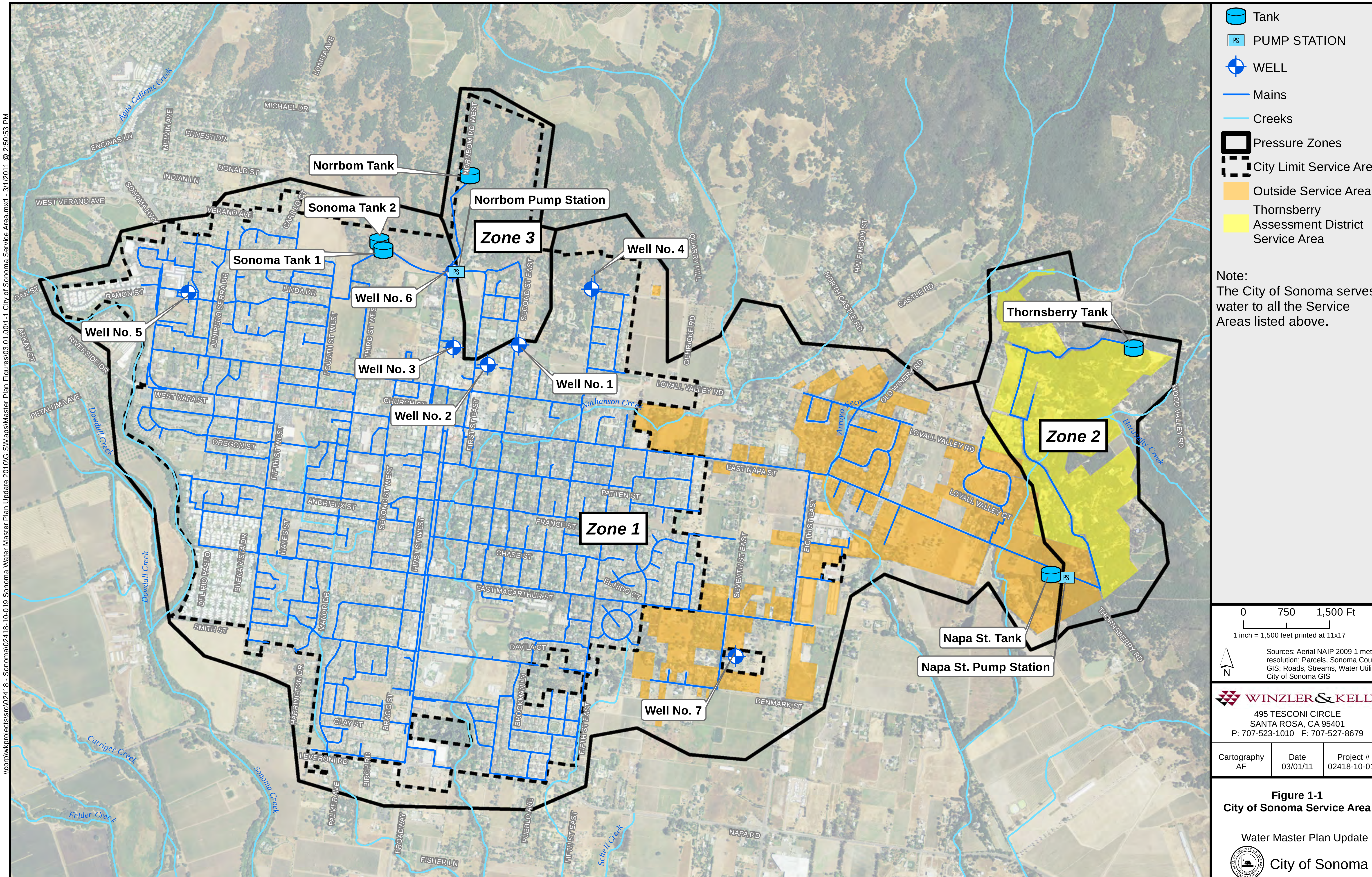


Figure 1-1
City of Sonoma Service Area

2.0 SUMMARY OF EXISTING POTABLE WATER FACILITIES

2.1 Existing Storage Facilities

Each of the three zones in the City's distribution system is served by a City-owned storage tank. A summary of the City's tanks is provided in Table 2-1 below.

TABLE 2-1 Existing City-Owned Storage Facilities

Tank Name	Capacity [Mgal]	Overflow Elevation [ft]	Floor Elevation [ft]	Year Built	Type	Zone Served
Napa Street	2.0	230	198	1990	Welded steel	1
Thornsberry	0.5	547.7	517.7	1971	Welded steel	2
Norrbom	3.0	314.5	285	2002	Welded steel	1 & 3

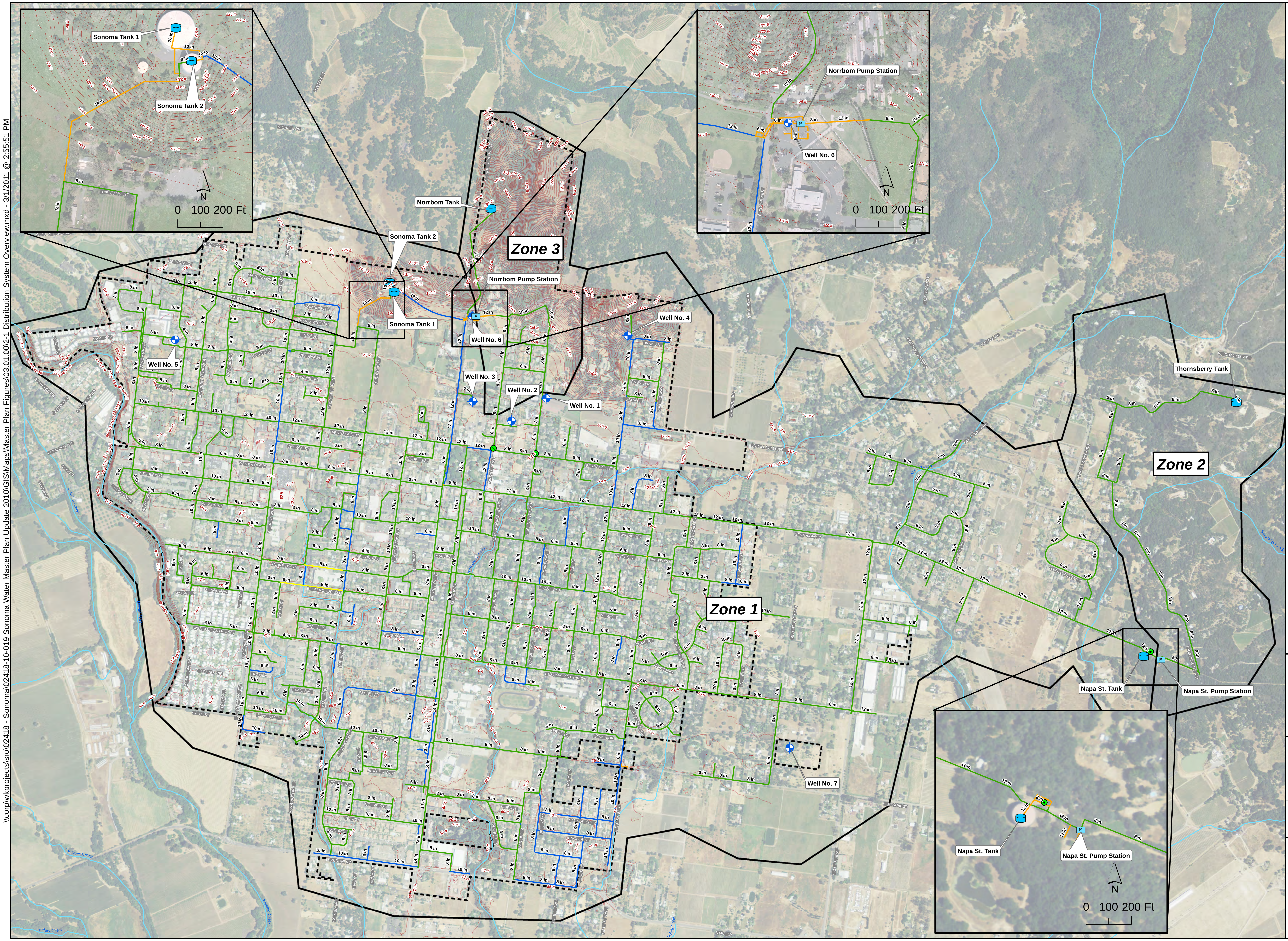
In addition to the three tanks listed above, the City owns an existing 50,000 gallon wood-stave tank that was constructed in 1984. However, this tank has essentially been abandoned because it is lower (overflow elevation of 233') than the normal hydraulic grade line for Zone 1 (230' – 260'), and would require a dedicated booster pump to move water from the tank back into the distribution system.

The Norrbom tank serves both zone Nos. 1 and 3 through pressure reducing valves.

2.2 Distribution system

The water system consists of three pressure zones that are each served by one or more storage tanks. Most of the system is contained within Zone 1, which operates at a hydraulic grade between elevations 260' – 212'. Potable water from SCWA is fed directly to Zone 1 via a 16-inch aqueduct, which is also used to fill the two SCWA tanks in the northwest corner of the distribution system. The distribution system is shown on Figure 2-1. A full-size version (22"x34") of this figure is provided at the end of this document.

\\corp\wkprojects\sro\02418 - Sonoma\02418-10-019 Sonoma Water Master Plan Update 2010\GIS\Maps\Master Plan Figures\03.01.00\2-1 Distribution System Overview.mxd - 3/1/2011 @ 2:55:51 PM



Tank

PUMP STATION

WELL

Normally Closed Zone Valve

Motor Operated Valve

Water Pipe Material & Size

ACP

DI

PVC

Unknown

Creeks

Contours

Pressure Zones

City Limits & Limits of Topographic Data

0 700 1,400 Ft

1 inch = 700 feet printed at 22x34

N

Sources: Aerial NAIP 2009 1 meter resolution; Parcels, Sonoma County GIS; Roads, Streams, Water Utility, City of Sonoma GIS

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Cartography	Date	Project #
AF	03/01/11	02418-10-019

Figure 2-1
Distribution System Overview

Water Master Plan Update

City of Sonoma

Water mains are either asbestos-cement (AC) or polyvinylchloride (PVC) with sizes that range between ¾-inch up to 16-inch. Table 2-2 below provides a breakdown of the different pipe sizes.

TABLE 2-2 Pipe Summary

Nominal Diameter [inches]	Total Length [ft]
0.75	19
1	435
1.5	996
2	1,424
4	5,915
6	59,994
8	154,430
10	38,556
12	26,855
14	8,265
16	1,212

Detailed information regarding the locations of each pipe material were not available for this effort.

2.3 Water Supplies

Most of the City's water is supplied from the Sonoma County Water Agency (SCWA) via two storage tanks. The tanks, totaling 10 million gallons of capacity, are located in the northwest corner of the City. Water surface elevations in the tank can range between elevation 211.6' (floor elevation) to 260.6' (overflow elevation). SCWA typically regulates the level in the tanks to an average of 30-ft in the winter, and 44-ft in the summer.

In addition to the SCWA connection, the City also owns six potable water wells. A summary of the well information is provided in Table 2-3 below.

TABLE 2-3 Well Summary

Well No.	Nominal Capacity [gpm]	Current Status
1	500	Active
2	180	Inactive, pending reactivation
3	145	Active
4	112	Pump is operated at reduced speed to prevent excessive drawdown
5	190	Inactive standby, poor water quality, no sanitary seal
6	155	Active

The total estimated capacity of the City's wells is approximately 1,300 gpm. However, for practical purposes the capacity of Well No. 5 should not be counted for purposes of estimating the reliable capacity of the well system. In addition, the capacity of the largest single unit (Well No. 1) should be deducted from the total for purposes of establishing the firm-capacity of the well system (590 gpm).

Except for Well No. 2, the above-grade equipment at each of the well sites is in good condition. The chlorination equipment at Well No. 2 is non-operational due to parts being scavenged for repairs at other City owned chlorination systems.

The wells are started and stopped manually by the operations staff.

3.0 DEMAND ANALYSIS

The purpose of this section is to establish the potable water demand for current and future (2020) conditions. These flows are used to establish the basis for analyzing the City's potable water infrastructure.

3.1 Current Conditions

Public water system statistics for 2006, 2007 and 2008 were used to establish the current average daily demand. Since daily flow totals were not available for this study, maximum-day demands were estimated by applying a peaking factor of 2.0 to the average daily demands. This peaking factor was established in a previous study that was published in 1999, and was based on an analysis of daily flowmeter data recorded at the SCWA turnouts. A summary of the historical demand data is presented in Table 3-1.1.

TABLE 3-1.1 Summary of Historical Demands

	2006	2007	2008	totals
SCWA [acre-ft]	2253.448	2,239.534	2,270.794	6,763.776
Wells [acre-ft]	64.500	73.307	104.920	242.727
total [acre-ft]	2,317.948	2,312.841	2,375.714	7,006.503
equivalent average daily demand [mgd]	2.07	2.06	2.12	2.08
SCWA	97%	97%	96%	97%
Wells	3%	3%	4%	3%
estimated maximum-day demand [mgd]	4.14	4.13	4.24	4.17

Annual potable water consumption has not changed significantly over the last ten or more years; the average-day demand was 2.01 mgd in 1996, and 2.14 mgd in 1997[1]. The demand per capita has decreased, however. In 1997 the per capita demand was 216 gpd, and in 2008 it was 187 gpd, which is a 14% reduction[2].

Potable water demand data for 2007, 2008 and 2009 was obtained from the City's billing records.[3] The zoning for each billing record was obtained by geocoding each record to the Assessor's Parcel Map using GIS software. The land-use designation for each parcel was obtained from the City's General Plan land-use map. This process allows unit-demand factors to be calculated for each land use category based on actual consumption data as summarized in Table 3-1.2 below.

[1] Water System Improvement Plan, Brelje and Race, January, 1999.

[2] Per capita demands were obtained by dividing the total water consumption, including non-residential uses, by the population.

3 A scaling factor was applied to 2009 data since 2009 was a water rationing year. The adjusted data reflects demand during the 2006-2008 period.

TABLE 3-1.2 Unit-Demand Factors for 2007 – 2009 (inside City limits)

Land Use/Zoning	Normalized Unit Flow (gpd/acre)
Agriculture	368
Commercial	3,271
Commercial-Gateway	697
Mixed Use	902
Public Facility	1,042
Park	1,301
High Density	3,465
Hillside Residential	228
Low Density Residential	1,557
Medium Density Residential	2,712
Housing Opportunity	1,961
Mobile Home Park	255
Rural Residential	401
Sonoma Residential	2,620
Wine Production	164

A map showing the spatial distribution of demand is provided in Figure 3-1, which is attached to this document.

Average daily demand for connections outside the City limits was 115,600 gallons/day for 2007, 2008 and 2009. Dividing the daily consumption by 796 people (population estimate for area outside the City limits in 2009) yields an average demand of 145 gallons per day per capita.

3.2 Potable Water Demand at Buildout (2020)

The planning horizon for this study ends at the year 2020, which corresponds to the horizon used for the City's last General Plan update. The General Plan identifies the baseline (2005) developed acreage for each land-use category within the City limits. The document also lists the 2020 build-out potential for the same categories. The differences between the 2005 and 2020 acreages were used to identify the incremental growth for each land-use category as summarized in Table 3-2.1 below.

TABLE 3-2.1 General Plan Land-Use Projections

Land-Use Category	2005 [acres]	2020 [acres]	change [acres]
hillside residential	43.7	50.3	6.60
rural residential	69.3	77.4	8.10
Sonoma residential	74.0	109.3	35.30
low-density residential	457.2	485	27.80
medium-density residential	190.9	196.6	5.70
high-density residential	6.2	6.2	-
housing opportunity	1.4	8.8	7.40
mobile home	54.8	54.8	-
commercial	106.1	107	0.90
gateway commercial	51.6	82.2	30.60
mixed use	78.9	87.1	8.20
public facility	210.5	210.5	-
park	163.4	199.5	36.10
agriculture	25.4	25.4	-
wine production	12.7	12.7	-
	1,546	1,713	167

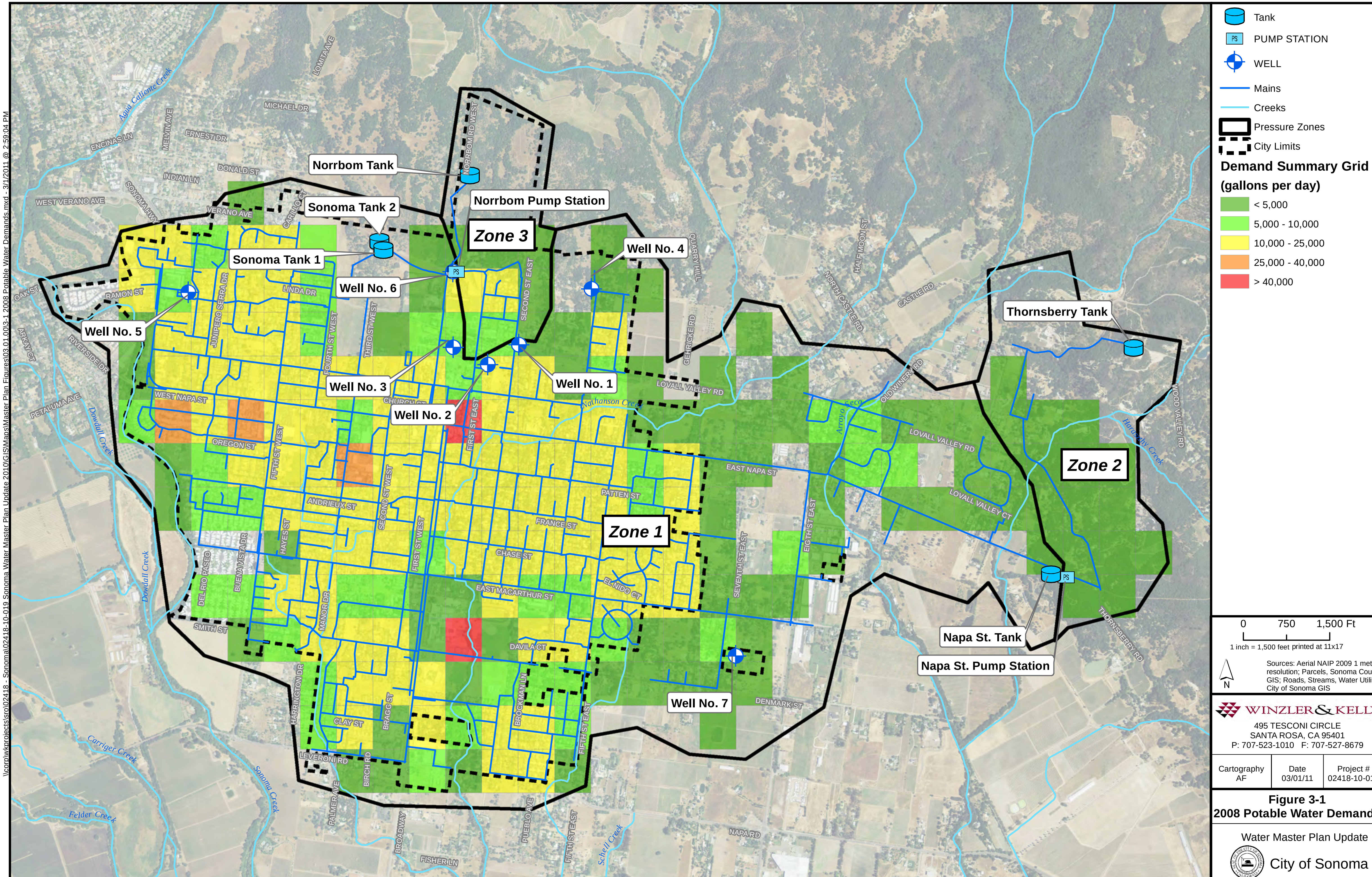


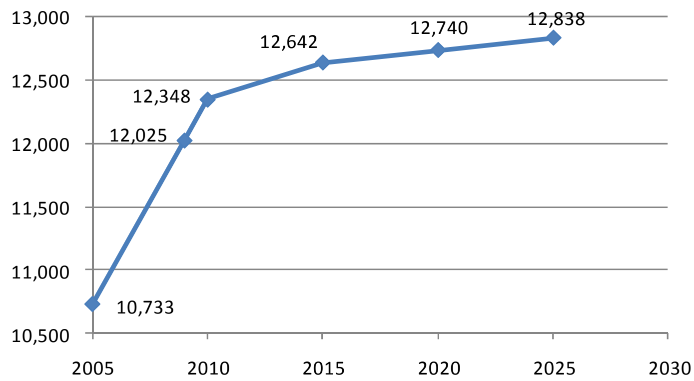
Figure 3-1
2008 Potable Water Demands

Water Master Plan Update

City of Sonoma

Presumably, some of the development anticipated in the 2006 General Plan has already occurred by 2009, which is the baseline year of this study. Thus, the incremental growth potential between 2009 and 2020 was estimated by prorating the 15-year growth (2005 to 2020) based on population data for 2005, 2009, and projections for 2020. Population data used for this analysis is presented in Figure 3-2 below.

Figure 3-2 General Plan Population Projections



The estimated incremental growth in potable water demand for each land-use category was obtained by multiplying the change in developed acreage by the unit demand factors obtained from the billing data. The results are summarized in Table 3-2.2 below.

TABLE 3-2.2 Incremental Growth in Potable Water Demand inside the City Limits

Land-Use Category	2009 [acres]	2020 [acres]	change [acres]	unit demand [gal/day/acre]	incremental demand [gal/day]
hillside residential	49.0	50.3	1.32	230	304
rural residential	75.8	77.4	1.62	400	648
Sonoma residential	102.2	109.3	7.06	2,600	18,356
low-density residential	479.4	485	5.56	1,600	8,896
medium-density residential	195.5	196.6	1.14	2,700	3,078
high-density residential	6.2	6.2	-	3,500	-
housing opportunity	7.3	8.8	1.48	2,000	2,960
mobile home	54.8	54.8	-	260	-
commercial	106.8	107	0.18	3,300	594
gateway commercial	76.1	82.2	6.12	700	4,284
mixed use	85.5	87.1	1.64	900	1,476
public facility	210.5	210.5	-	1,000	-
park	192.3	199.5	7.22	1,300	9,386
agriculture	25.4	25.4	-	370	-
wine production	12.7	12.7	-	160	-
	1,679	1,713	33		49,982

Thus, potable water demand inside the City limits is expected to increase by approximately 50,000 gallons per day by the year 2020.

Population projections were used to estimate demand growth for the area outside the City limits. According to the City's estimates this area is expected to grow from 796 people in 2009 to 813 people in 2020. This is equivalent to an additional 2,470 gallons per day (+17 people * 145 gpd/person). Taken together with the area inside the City limits, average daily demand for the entire service area is expected to grow by 52,000 gallons per day.

From this analysis the average day demand in the year 2020 will be approximately 2.06 mgd (2.01 mgd + 52,000 gpd). Applying a peaking factor of 2.0 to the average-day demand yields an estimated maximum-day demand of 4.12 mgd.

Historical potable water consumption data shows a 14% decrease in the per capita demand between 1997 and 2008. This fact, combined with modest population growth, results in fairly flat growth in potable water demand through the year 2020, assuming the trend continues for the next ten years.

4.0 WATER SUPPLY ANALYSIS

The water supply planning projections are evaluated in five-year increments beginning with the existing supply in year 2010 and continuing with projected supplies through year 2035. This is consistent with the planning horizon for the City's 2010 Urban Water Management Plan (2010 UWMP). This section was prepared in coordination with John Nelson for consistency with water supply documents being prepared for the City (namely the 2010 Water Rate Study and the 2010 Urban Water Management Plan).

The City's primary water supply (approximately 95 percent) is purchased from the Sonoma County Water Agency (SCWA). The majority of the SCWA water supply is comprised of surface water from the Russian River and a small contributing source is derived from groundwater wells owned by SCWA and located outside of the City's groundwater basin. In addition to the City's primary water supply (SCWA water), the City uses local groundwater supply from five municipal wells located within City limits (local supply wells). Prior to the first water supply master agreement with SCWA and other water contractors in 1974, the City used local groundwater as the primary water supply for the City's demands. These local supply wells provided the City with up to 600 acre feet per year (AF/Y) of water.

The City's current water strategy is to meet the water demands using purchased SCWA water and use local groundwater supplies to supplement water demand needs during peak periods and also during periods of drought and/or SCWA water shortages and shortfalls. The City's local groundwater supply is a key element of its drought contingency plan and it is expected to remain as such throughout the planning horizon of the 2010 UWMP.

4.1 Summary of Current and Planned Water Supply Sources

Figure 4-1 shows the general location of the City's SCWA turnout, the five active local supply wells and the potential, future connection point from the Sonoma Valley County Sanitation District (SVCSD) for recycled water. The projected normal water year supply for each source is shown in Table 4-1.1 and is based on the City's conjunctive use practice of using SCWA water supply during normal and wet water years.

TABLE 4-1.1 Current and Planned Water Supplies – AF/Y

Water Supply Sources	2010	2015	2020	2025	2030	2035
SCWA Contractual Entitlement [(a)]	3,000	3,000	3,000	3,000	3,000	3,000
Less SCWA Delivery Constraints [(a)]	(356)	(356)	(356)	(356)	(356)	(356)
Local Supply Wells [(b)]	60	70	80	90	90	90
SDC [(c)]	0	0	0	0	0	0
Recycled Water (SVCSD)	0	0	0	0	0	0
Total	2,704	2,714	2,724	2,734	2,734	2,734

Notes:

(a) The City's entitlement under its current water supply agreement with SCWA is 3,000 acre-feet per year (AF/Y). However, due to SCWA's recent action of failing to meet its long term contractual obligation by dropping its petition to increase its water diversion permit from its current 75,000 AF/Y to 101,000 AF/Y, the City's planned SCWA water supply assumes a resultant reduction of 356 AF/Y based on the allocation methodology adopted by the SCWA Board on April 4, 2006.

(b) Existing groundwater sources are based on the City's water strategy of using SCWA supply source during normal and wet years and only using local supply wells for meeting peak demands during summer months, as needed. Therefore, normal and wet year pumpage is significantly lower than well field production capacity. Future supplies based on up to three new local supply wells and/or replacement of existing wells to increase pumping capacity.

(c) This is a planned new water supply source for delivery of water during dry and water shortage years.

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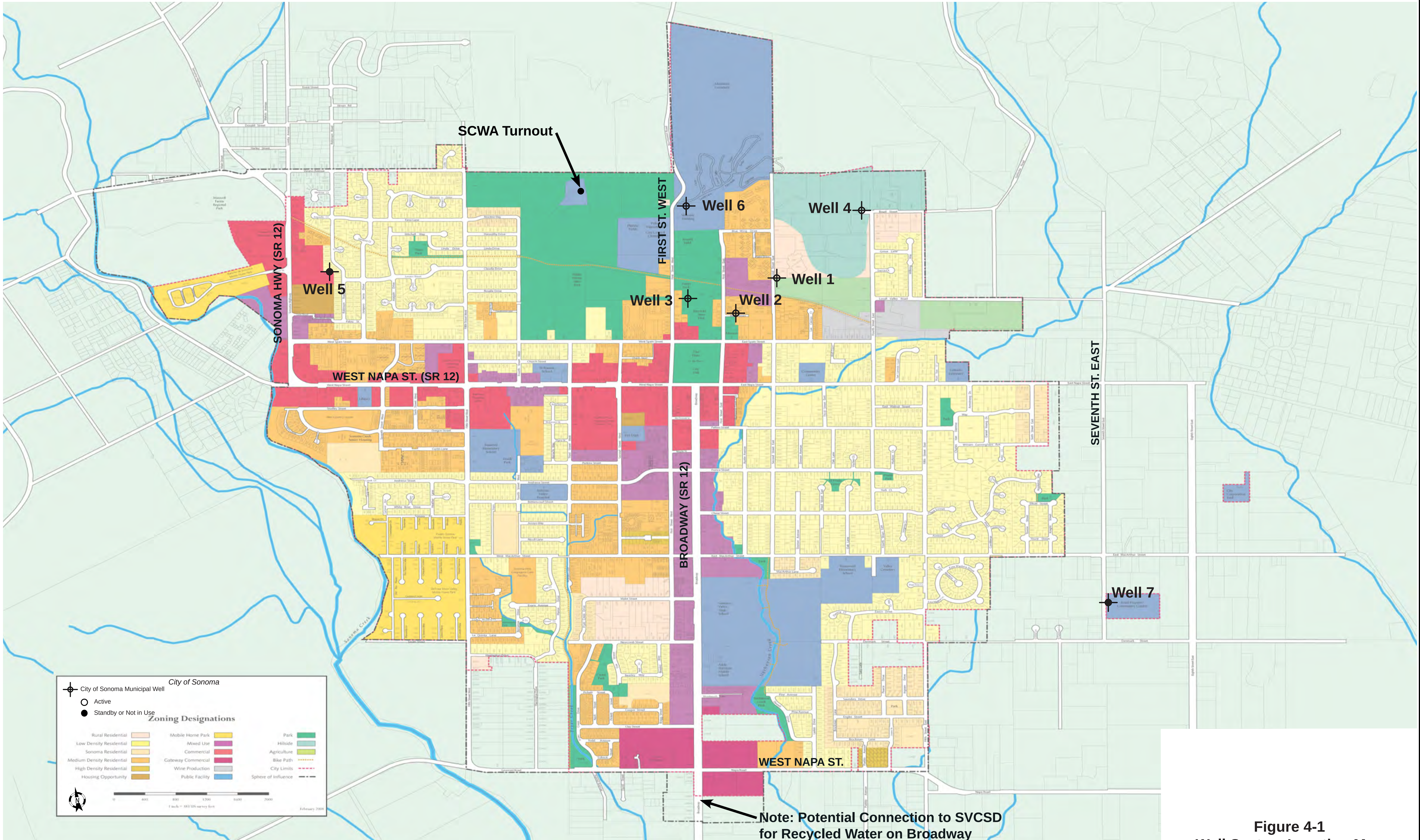

Figure 4-1
Well System Location Map
City of Sonoma, CA

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The maximum water supply is greater than the supply projected under normal and wet years because the local supply wells can be pumped more frequently if needed to meet temporary demand during the summer and fall high water use periods. Table 4-1.2 below identifies the maximum water supplies, based on the City's entitlement under its water supply contract with the SCWA and the maximum pumpage capacity for the City's local supply wells.

TABLE 4-1.2 Maximum Available Water Supplies – AF/Y

Water Supply Sources	2010	2015	2020	2025	2030	2035
SCWA Contractual Entitlement [a]	3,000	3,000	3,000	3,000	3,000	3,000
Less SCWA Delivery Constraints [a]	(356)	(356)	(356)	(356)	(356)	(356)
Local Supply Wells [b]	271	391	451	451	451	451
SDC [c]	0	0	0	0	0	0
Recycled Water (SVCSD)	0	0	0	0	0	0
Total	2,930	3,050	3,110	3,110	3,110	3,110

Notes:

(a) The City's entitlement under its current water supply agreement with SCWA is 3,000 acre-feet per year (AF/Y). However, due to SCWA's recent action of failing to meet its long term contractual obligation by dropping its petition to increase its water diversion permit from its current 75,000 AF/Y to 101,000 AF/Y, the City's planned SCWA water supply assumes a resultant reduction of 356 AF/Y based on the allocation methodology adopted by the SCWA Board on April 4, 2006.

(b) Existing maximum pumpage capacity for Wells 1, 2, 3, 4, and 6 is 271 AF/Y. By 2015 two planned wells; Wells 8 and 9 will be on-line. These new wells are projected to supply an additional 60 AF/Y each. By 2020, one addition planned well, Well 10, will be drilled and in full production.

(c) This is a planned new water supply source for delivery of water during dry and water shortage years with the Sonoma Development Center (SDC). At the writing of this document, there has not yet been a formal or informal agreement on this supply, therefore, it is shown on this table as "zero."

4.2 SCWA Water Supply Source

4.2.1 Description of SCWA Water Supply and Transmission System

Water is delivered to the city from a turnout from the Sonoma Tank located on First Street West in the in the northern end of the city. The SCWA transmission system prior to this turnout is described in the paragraphs that follow.

The SCWA aqueduct system is a surface water supply from the natural flow of the Russian River; water stored in winter for later release from Lake Sonoma; and, water stored in winter and other times of the year for later release from Lake Mendocino. Lake Sonoma is created by Warm Springs Dam and Coyote Dam creates Lake Mendocino. These dams are federal projects under the jurisdiction of the U.S. Army Corps of Engineers. The SCWA contracts with the Corps for water stored and released from the water supply pool of each dam. The water supply pool of Lake Sonoma is 212,000 AF and Lake Mendocino is 70,000 AF. Figure 4-2.1 shows a general location map of the SCWA system.

Lake Mendocino also benefits from water released into Potter Valley by Pacific Gas and Electric Company (PG&E). PG&E operates a hydropower generation station at the head of Potter Valley. Water for the power station is diverted through a tunnel from the South Fork of the Eel River via the Cape Horn Dam regulation facility. Power production is optimized by the storage

THE RUSSIAN RIVER WATER SYSTEM

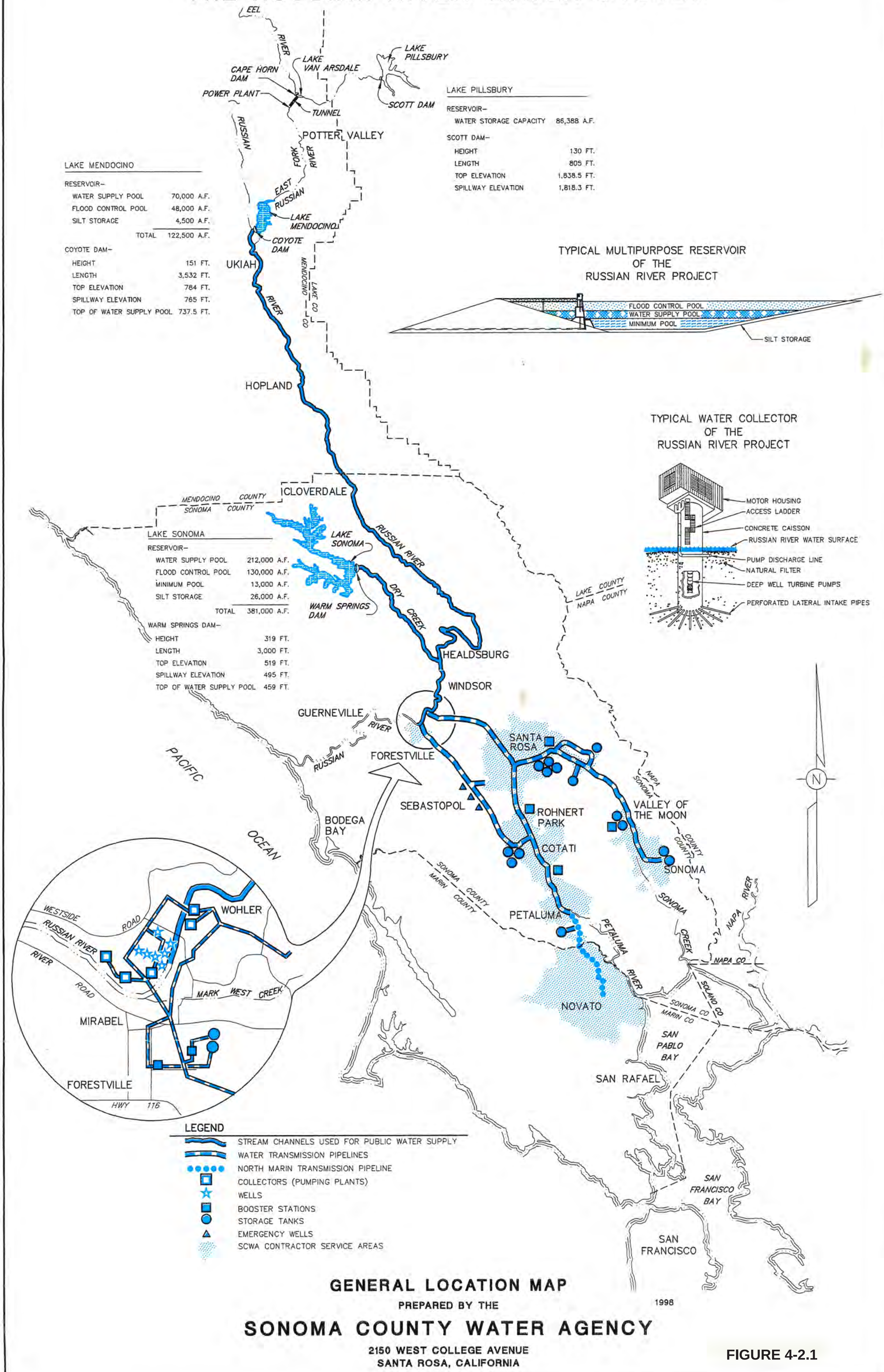


FIGURE 4-2.1

of water in Lake Pillsbury (created by Scott Dam) on the South Fork of the Eel River. The water storage capacity of Lake Pillsbury is 86,400 AF. The Eel River facilities are all owned by PG&E. After a long drawn out re-licensing process, a new license for operation was obtained from the Federal Energy and Regulatory Commission. Conditions of the new license require PG&E to divert about 30 percent less water.

Using the natural channel of Dry Creek and the Russian River, SCWA diverts water from the river near Wholer Bridge via six Ranney Collectors. Each collector is fitted with a motor housing about 40 ft above streambed which pumps water into the aqueduct system. The collectors extract water from a depth of about 90 ft through an array of perforated laterals extending 140 ft horizontally in a spoke-like pattern from the bottom of each well. Water reaching the collector has therefore percolated through about 90 ft of natural sand and gravel making up the streambed of the river. The water is highly polished (has exceptionally low turbidity) and only needs the addition of chlorine to meet California Department of Public Health (CDPH) water quality criteria for a potable supply. In order to minimize corrosion, aqueduct water pH is balanced by addition of sodium hydroxide. A system of aqueducts, booster pumps and tanks then distribute the water to the various Water Contractors. The system was designed and planned to meet peak day demands of its customers.

The existing Sonoma Aqueduct Facilities serving the City of Sonoma and Valley of the Moon Water District (VOMWD) are listed in Table 4-2.1 and shown in Figure 4-2.2. The main booster pumping station (BST) for the Sonoma Aqueduct is called the Sonoma BST and is located on the east side of Spring Lake (see Figure 4-2.2). Another booster pumping station is located near Glen Ellen called the Eldridge BST. Practice has shown this station to be of little use in increasing flow to the terminal end of the aqueduct, however, and it is generally left off-line. Finished water storage in above ground water tanks is located near Oakmont - Annadel No. 1, and Annadel No. 2 (the latter is also known as Los Guilicos Tank), Eldridge, and Sonoma near First Street West where the aqueduct terminates in two tanks having total storage of 10 MG. It is important to note that nearly all of the capacity of the Sonoma tanks is available to the City, given the location of VOM's upstream demands and turnouts from the Sonoma Aqueduct. This increases "local" storage directly available to the City's distribution system to a total pf about 15.5 million gallons or 3,633 gallons per active connection. This well exceeds the typical storage per connection commonly found in most municipal distribution systems.

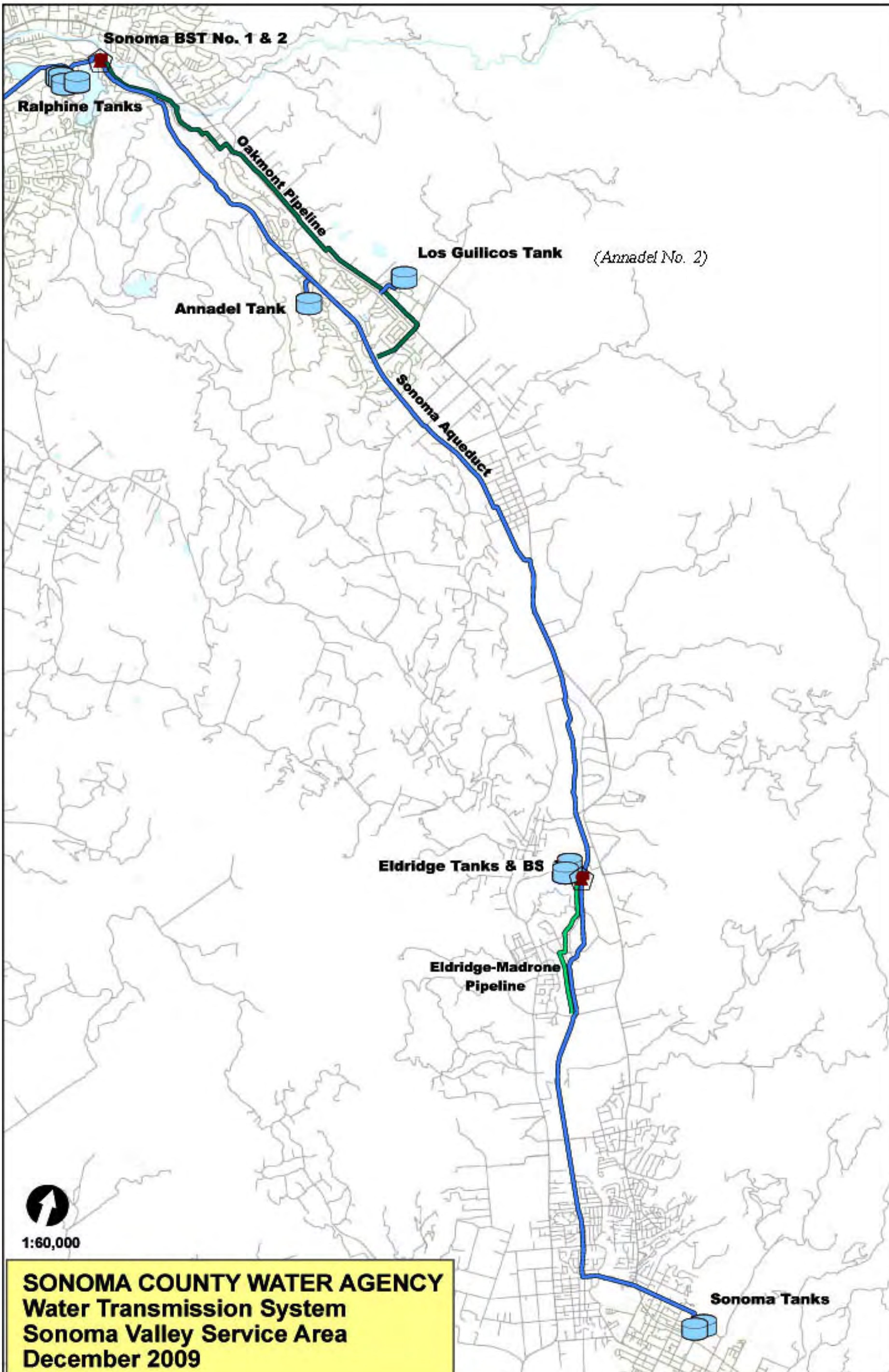


FIGURE 4-2.2
SONOMA AQUEDUCT FACILITIES

TABLE 4-2.1 Sonoma Aqueduct Facilities

Description	Install Date	Size	Length (feet)
Aqueducts (Diameter, inches)			
Santa Rosa Aqueduct: Raphine Tank to Sonoma Booster Station [(a)]	1959	27 in.	2,183
Sonoma Aqueduct: Sonoma Booster Station to Eldridge Tanks [(b)]	1963	20 in.	57,300
Sonoma Aqueduct Reach 2: Eldridge Tanks to Sonoma Tanks [(c)]	1963	16 in.	31,225
Oakmont Pipeline: Sonoma booster Station to Oakmont [(d)]	1989	24 in.	27,607
Eldridge-Madrone Pipeline: Eldridge to Madrone Road [(e)]	2006	27 in.	8,623
Tanks (Million Gallons, MG)			
Oakmont Tank (Annadel No. 1)	1963	2.5 MG	
Los Guillicos Tank (Annadel No. 2)	1994	3.0 MG	
Eldridge Tank 1 (Sonoma Valley Park)	1963	2.0 MG	N/A
Eldridge Tank 2 (Sonoma Valley Park)	1973	6.0 MG	
Sonoma Tank 1 (First Street West, Sonoma)	1963	2.0 MG	
Sonoma Tank 2 (First Street West, Sonoma)	1993	8.0 MG	
Booster Pumps (Horsepower, Hp)			
Sonoma No. 1 (3 pumps)		900 Hp	
Sonoma No. 2 (1 pump)		250 Hp	N/A
Eldridge		75 Hp	

Notes:
(a) Owned and operated by SCWA, constructed initially by City of Santa Rosa. Restructured Agreement defines this segment and the 20-inch segment as Reach 1.
(b) The Sonoma Booster Station is located on the east side of Spring Lake.
(c) There are segments of this aqueduct where the coating is 1-inch thick. These segments are covered with a 1/8-inch coal tar coating.
(d) The Oakmont pipeline is the first parallel segment of the Aqueduct system serving the City of Sonoma.
(e) The Eldridge-Madrone pipeline is the second parallel segment of the Aqueduct system serving the City of Sonoma.

4.2.2 SCWA Water Supply Agreement

The SCWA water supply is provided for under the terms of the Restructured Water Supply Agreement on June 23, 2006. The water supply agreement providing the City's primary supply has been amended 11 times and was subsequent replaced by the Restructured Agreement of June 23, 2006 for Water Supply (Restructured Agreement). A copy of the agreement is available at the City Public Works Department. The Restructured Agreement and the Eleventh Amended Agreement both were based on the SCWA providing a water supply of 139.9 million gallons per day (mgd) during the average day of the peak month of the year. The agreements were also based on a plan whereby the SCWA would petition and obtain diversion rights from the Russian River from existing rights of 75,000 AF/Y to a total of 101,000 AF/Y. The eight signatories to the Restructured Agreement with the SCWA comprise the "Water Contractors" and are shown in Table 4-2.2 along with other SCWA customers. This table also includes the average daily rate of flow during any month (for an "all customer" total of 139.9 mgd) as well as the voting weight under the terms of the Restructured Agreement.

TABLE 4-2.2 Water Contractors and Customers of the SCWA Restructured Agreement

Customer of SCWA	Avg. Daily Rate of Flow During any month, mgd	Voting Weight (Percent)
Water Contractors		
Cotati	*3.8*	2.80
Petaluma	*21.8*	16.30
Rohnert Park	*15*	11.20
Santa Rosa	*56.6*	42.40

Customer of SCWA	Avg. Daily Rate of Flow During any month, mgd	Voting Weight (Percent)
Sonoma	*6.3*	4.70
Windsor	*1.5*	1.10
North Marin Water District	*19.9*	14.90
Valley of the Moon Water District	*8.5*	6.40
Total for Water Contractors	133.4	100.00
Other Agency Customers	2.7	--
Marin Municipal Water District	3.8	--
Surplus Customers	0	--
Total – All Customers	139.9	--

Note: A detailed description of the voting power of each Water Contractor and how voting weight is determined can be found in the Restructured Agreement (see Appendix A).

A brief description and chronology of the most current agreements are shown in Table 4-2.3.

TABLE 4-2.3 SCWA Water Supply Agreements Summary

Date	Agreement	Key Provisions	Status
6/23/06	Restructured Agreement	Same provisions as Eleventh Amended Agreement and allocated up to 3,000 AF/Y and 6.3 mgd peak month average daily rate; new elements include water conservation requirements, watershed planning and restoration; new governance for Water Advisory Committee (WAC)	In effect until 1/30/40
8/24/05	Extended Temporary Impairment MOU	Due to SCWA system constraints, limited the City's average day peak month flow rate from 2006 to 2008.	Expired 9/30/08
1/26/01	Eleventh Amended Agreement	Allocated up to 3,000 AF/Y and a maximum delivery of 6.3 mgd peak month average daily rate; provided for transmission system cost allocation	Terminated and replaced with Restructured Agreement
3/31/01	Temporary Impairment MOU	Due to SCWA system constraints, limited the City's average day peak month flow rate from 2006 to 2008.	Expired 9/30/05

4.3 Groundwater Supply Source

The City has seven local supply wells (Wells No. 1-7), with five of them active (Wells No. 1, 2 (pending), 3, 4 and 6). Well No. 5 is on Standby status due to poor water quality and no sanitary seal, while Well No. 7 is on Inactive status due to poor water quality and unfinished permitting.

Drawdown pumping tests and well analyses were conducted for Wells No. 1, 3, 4 and 6 in 2009 where the pumping capacity for each well was evaluated. The evaluation was conducted to identify pumping rate constraints on each well. These constraints considered the well construction, pumping equipment and well interference between the City's active supply wells.

Based on historical groundwater elevation data, the aquifer recharges fully during the winter months and historic operation of the City's supply wells has not caused a condition of sustained aquifer overdraft. In the future it is expected that the increased frequency of use of the City's supply wells could result in localized depression of the groundwater elevation in the pumping area during the four month pumping season but water levels should recover during the winter months.

In normal and wet years, the total volume of pumping is expected to be small, on the order of 60 to 90 AF/Y. During periods of draught or under conditions where SCWA is unable to meet there water deliveries, higher pumpage from the City's supply wells is planned. Some of the City's wells are located relatively close together and if they are pumped simultaneously then they extract groundwater from the same portion of the aquifer which induces larger depressions in groundwater elevation. In order to efficiently extract groundwater from the aquifer, it is best to stager the operation of some of the wells to provide for rest periods and to avoid operation wells that a close together at the same time. The maximum pumpage for the 4-month high demand season is summarized in Table 4-3.1.

TABLE 4-3.1 City Well Capacity

Well Identification	**Pump Flow Rate into Distribution (gpm)** (1)	**Maximum 4-Month Well Pumpage With Well Resting Periods(AF/Y)** (2) (3)	**Well Installation Date**	**Notes**
No. 1, Second Street East	460	171	1959 Rehabilitated in 2010	Well 1 should not be run with Wells No. 2 and 3.
No. 2, Mission Terrace	140	13	1944, Pending Active 2010	No pumping test completed, sustainable pumpage estimated. Well 2 should not be run with Wells No. 1 and 3.
No. 3, Depot Park	140	13	1947; Relined in 2001	Well 3 should not be run with Wells No. 1 and 2.
No. 4, Brazil/Fourth Street East	90	33	1959; Relined in 2001	
No. 5, Sonoma Bowl Well	0	0	1960	Standby due to poor water quality and no sanitary seal. 150 gpm flow rate.
No. 6, First Street West, near Veteran's Building	150	56	1956; relined in 1999	Should not be run longer than 2 weeks at a time.
No. 7, Seventh Street East at Community Garden	0	0	2002	No pump currently in well, 100 gpm test flow, inactive due to poor water quality.
Totals	980gpm	286 (1)		

Notes:

[1] Notwithstanding a peak daily capacity of 980 gpm (1.41 MGD) identified during field tests by Winzler & Kelly in summer of 2009 and with new well pump in Well 1, the wells should not be relied upon for more than 286 ac-ft/year for a 4-month pumping season.
[2] Pumpage is predicated on the assumption the wells will only be run during the summer season (June-Sept) and not year-round thus providing adequate recovery time for groundwater recharge during the rainy season.
[3] Drawdown studies indicate that Wells 1, 2 and 3 should not be operated at the same time in order to avoid large interference between the three wells. Efficient operation of the system requires rest periods for wells during the pumping season to allow for groundwater recharge.

Two changes occurred in 2010 to increase the pumpage from the City's supply wells. Well No. 1 received a new pump and well rehabilitation in May of 2010. The pump capacity of Well No. 1 has increased from 350 gpm to 420 gpm. Well No. 2 will be used on a limited basis for peak flow demand. Well No. 2 normal pumpage is assumed to be the capacity of the pump because no pumping tests have been completed and it is assumed that the well can operate for short periods of time without restriction. As noted in Table 5, Wells No. 2 and No. 3 are best operated when Well No. 1 is off to avoid large drawdown in the local water level.

The total normal pumpage of the existing active municipal wells is 286 AF/Y, and was calculated based on efficiently extracting groundwater from the aquifer using the City's existing local supply wells. Because of well interference (overlapping radii of influence from wells located near each other), an estimated pumping schedule that includes rotating operation to allow for resting of the wells and water level recovery was created (Table 6). This pumping schedule cycles through the wells every 6 weeks. The annual value for "maximum well pumpage" is this six week schedule of operation implemented continuously for the four month pumping season of peak use.

There are a number of operational adjustments that can be implemented that will efficiently extract the groundwater and the sample operational schedule below can be varied. This example accommodates the operational constraints of the individual wells to avoid large localized draw downs in the well caused by overlapping radii of pumping influence. The daily average shown below is between 1.02 AFD and 3.10AFD, but the average is 2.27AFD. Under normal operation all the wells should not be used at the same time to avoid drawing the groundwater level down below the screen of the well or to levels for which the pump is not designed to operate. Table 4-3.2 below indicates a sample of the well output for peak seasonal use for 18 weeks during a drought or condition of limited SCWA deliveries.

TABLE 4-3.2 Sustainable Maximum Use of Municipal Wells Sample Schedule in AF/Week for Seasonal Peak Use

Active Well No.	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Total for 6 Weeks	Total for 4 Month Peak Seasonal Use (18 weeks)
	Acre-Feet per Week						AF/6 weeks	AF/Y
Well 1	14.24	14.24		14.24	14.24		56.97	171
Well 2						4.33	4.33	13
Well 3			4.33				4.33	13
Well 4		2.79	2.79		2.79	2.79	11.16	13
Well 6	4.64	4.64		4.64	4.64		18.56	56
Totals	18.89	21.68	7.12	18.89	21.68	7.12	95.38	286

Active Well No.	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Total for 6 Weeks	Total for 4 Month Peak Seasonal Use (18 weeks)
	Acre-Feet per Week						AF/6 weeks	AF/Y
Daily Average (AFD)	2.70	3.10	1.02	2.70	3.10	1.02	Daily Average = 2.27	
Daily Average (MGD)	0.88	1.01	0.33	0.88	1.01	0.33	Daily Average = 0.74	

Note: Weekly Acre Foot Calculations are based on =GPM*60*24*7 and converted to AF.

Based on the recommendation of Winzler & Kelly Engineers, the City is moving forward with siting studies for construction of several new wells and a plan for replacement of some of the existing wells that are over 50 years old,. This would supplement water demands during water shortages frequently encountered due to environmental constraints with the SCWA water supply. Scheduling of improvements is subject to further revision as more detailed information is developed and studies are completed this year. For planning purposes, it is assumed there would be three new wells, each yielding the average amount available from the existing active wells, which is about 60 AF/Y per well or 180 AF/Y total (each well operating at approximately 140 gpm for the 18 week pumping peak season). Some of the existing supply wells are operating at pumping rates that are lower than when they were first installed. This reduction is due to age and modifications that were made to the wells in order to extend the operational life of the wells. These modifications resulted in a reduction of the pumping efficiency of the well and a lower total extraction rate. An evaluation of the options available for the existing wells is currently being performed.

Groundwater banking would also increase the availability of groundwater for the City. Groundwater banking accelerates the recovery of groundwater in storage and allows for greater surety of supply when natural recharge is insufficient or too slow to fully recharge the aquifer during the rainy season. This process allows for the extraction of groundwater during peak season demand and the recharge of the aquifer when water is available during the rainy season. At the time this Technical Memorandum writing, the feasibility and cost of groundwater banking was unknown but being investigated, so maximum pumpage is based on historical use of the wells during the peak season and evaluations of the well interference (overlapping radii of influence) of supply wells.

4.4 Sonoma Development Center Water Supply Source

A water supply project that provides increased reliability of customer service to all parties is a project which utilizes surplus capacity in the Valley of the Moon Water District (VOMWD) and Sonoma Developmental Center (SDC) water systems and captures and makes beneficial use of off-peak water (wintertime water) available in the Russian River and off-peak capacity available in SCWA's Water Supply and Transmission System. This project increases the water supply to the City of Sonoma during water shortages, and, during critical hot spells, increases flows available in the south end of the Sonoma Aqueduct that serve VOMWD's Aqueduct Zone customers and SCWA's Sonoma tanks, and reduces competition among SCWA's Water Contractors for summertime deliveries from the Russian River. Implementation of the plan would require an agreement between the SDC, VOMWD, and City of Sonoma and the cooperation of the SCWA pursuant to provisions contained in the existing Restructured Agreement for Water Supply. Specifically the following water system components having surplus capacity would be optimized:

SCWA System:

- Surplus water available for diversion from the Russian River in the off-peak period (February through April).
- Surplus off-peak capacity in the SCWA Water Supply and Transmission System from the intakes at the Russian River near Wohler Bridge to the metered turnout from the Sonoma Aqueduct serving SDC.

SDC System:

- Storage space in local lakes that does not fill with water in dry years.
- Surplus treatment plant capacity.

VOMWD System:

- Surplus transmission capacity available in VOM's Arnold Drive Pipeline which parallels the Sonoma Aqueduct from Glen Ellen south to the southern terminus of Madrone Road.

At this time, the City has not been actively engaged in this project with SDC and VOMWD but it is anticipated that the discussions will become more formal and frequent in the upcoming year. Because there has not been a letter of understanding or even an informal agreement amongst the parties at the time of the writing of this document, this water supply source is not included on Table 1 or Table 1.1.

4.5 Recycled Water Supply Source

In 2005, the SCWA, on behalf of the Sonoma Valley County Sanitation District (SVCSD), Valley of the Moon Water District (VOMWD) and City of Sonoma, prepared a feasibility study on use of recycled water for valley vineyards, dairies, pastures, wetland restoration sites and urban irrigation sites[1] and shortly thereafter an EIR[2]. The reports showed that a recycled project could increase use of recycled water from the "no project" level of 1,000 to 1,200 acre-feet per year (AF/Y) (primarily irrigation of pasture and use in wetland restoration) to a total of 2.750 AF/Y. The primary users would be agriculture but the project would include pipeline segments that would also distribute water to urban irrigation sites in the City and VOMWD service areas. The feasibility study identified 86 AF/Y for the City and 60 AF/Y for VOMWD or 146 AF/Y of potential potable water offset. This represents 3% and 2% respectively of the City and VOM's large irrigation customer demand. Increased recycled use envisioned in the project EIR was 1,500 AF/Y. Recycled use by large customers in the City and VOMWD make up 10% of this amount. Key to implementation of the project, therefore, clearly depended on the support of

1 Sonoma Valley Recycled Water Feasibility Study, Prepared by SCWA on Behalf of Sonoma Valley County Sanitation District, Valley of the Moon Water District, and City of Sonoma, December 2005
2 Sonoma Valley Recycled Water Project Draft EIR, Prepared for Sonoma County Valley Sanitation District, September 2006

agriculture, mainly vineyards. Some controversy surrounds the use of recycled water on vineyards, notwithstanding that clear authorization to do so is provided by CDPH standards.

Subsequently, additional studies have been undertaken as part of a regional effort under the auspices of the North Bay Water Reuse Authority in concert with the US Bureau of Reclamation. Several phases were studied and a final EIR was completed in November 2009[3]. Phase 1 studies identified 1,972 AF/Y for the lower Sonoma Valley area. Out of that total, the City's potential recycled water use is estimated at 130 AF/Y with the City establishing a maximum amount of 80 AF/Y with the full project beyond the planning horizon of this document.

3 North Bay Water Recycling Program, EIR/EIS, SCH# 2008072098, November 2009

5.0 HYDRAULIC MODEL CALIBRATION

The purpose of this section is to explain how the hydraulic model was developed for the City's potable water distribution system, and present a summary of the calibration results. The model was developed utilizing Bentley's WaterCAD v8i software platform, and was calibrated by comparing modeled predictions of pressures with field measurements taken by City staff. These results are summarized in the following sections.

5.1 Model Development

The City provided a GIS data set that mapped all known water mains within the City's potable water service area. This data set was imported into the hydraulic model. Tank and pump station piping was modified according to field notes gathered by Winzler & Kelly and City staff. The hydraulic model was then used to compare static and residual pressures within the model to a series of fire hydrant test flow data provided by the City.

Once model elements such as pipes, junctions, tanks, and pump stations were entered into the hydraulic model, junction demands were entered based on 2007-2009 fiscal year City water billing data. Individual billing records were geocoded to individual parcels using street addresses. Three years of billing data were then aggregated for each parcel and assigned to a node in the computational model. Since 2009 was a water rationing year, a factor was applied to 2009 data to instead represent 2006 data.

5.2 Model Calibration

Model calibration was achieved using fire hydrant test flow data provided by the City. A total of 7 test data sheets were utilized in the calibration of Zone 1. Flow test data was not available for Zones 2 and 3. However, these zones comprise less than 6% of the City's total water demand. Figure 5-1 shows the location of the hydrants used in the model calibration.

The following table provides a summary of observed static and residual pressures at the test hydrants along with the corresponding hydraulic model static and residual pressures. The hydrant flow test numbers in the table also correspond to Figure 5-1.

TABLE 5-1 Summary of Hydraulic Model Calibration Results.

Hydrant Flow Test No.	Hydrant Location	Model Junction ID No.	Recorded Flow (gpm)	Recorded Static Pressure (psi)	Recorded Residual Pressure (psi)	Tank Level (ft)	Model Static Pressure (psi)	Model Residual Pressure (psi)
1	West MacArthur & 2nd St W	J-389	1111.5	80	78	40.4	77.5	74
2	862 Towne St	J-569	1101	74	64	39	71.4	65.4
3	2nd St E & E Napa St	J-874	1020	76	71	42.5	69.5	66.8
4	693 Austin Ave	J-331	1020	70	67	30	70	67.9
5	19190 Sonoma Hwy	J-1134	925	64	60	48 [1]	63	59.1

Hydrant Flow Test No.	Hydrant Location	Model Junction ID No.	Recorded Flow (gpm)	Recorded Static Pressure (psi)	Recorded Residual Pressure (psi)	Tank Level (ft)	Model Static Pressure (psi)	Model Residual Pressure (psi)
6	201 W Napa St	J-1792	1020	75	70	48 [1]	75.1	71.9
7	492 Patten St	J-1095	1075	68	65	48 [1]	68.3	63.6

The calibration results shown above deviated between -6% and +3% when comparing model residual pressures to recorded residual pressures at the fire hydrants. This is considered to be a suitable calibration given the accuracy of the hydraulic model and the pressure gages used during the flow testing. Hazen-Williams roughness coefficients were uniformly adjusted to attain calibration with the flow test data, and a roughness coefficient of C=130 was used to achieve the results shown in the table above.

The calibrated hydraulic model is acceptable for use in evaluating the City's sources of supply, storage and distribution piping under current and future conditions.

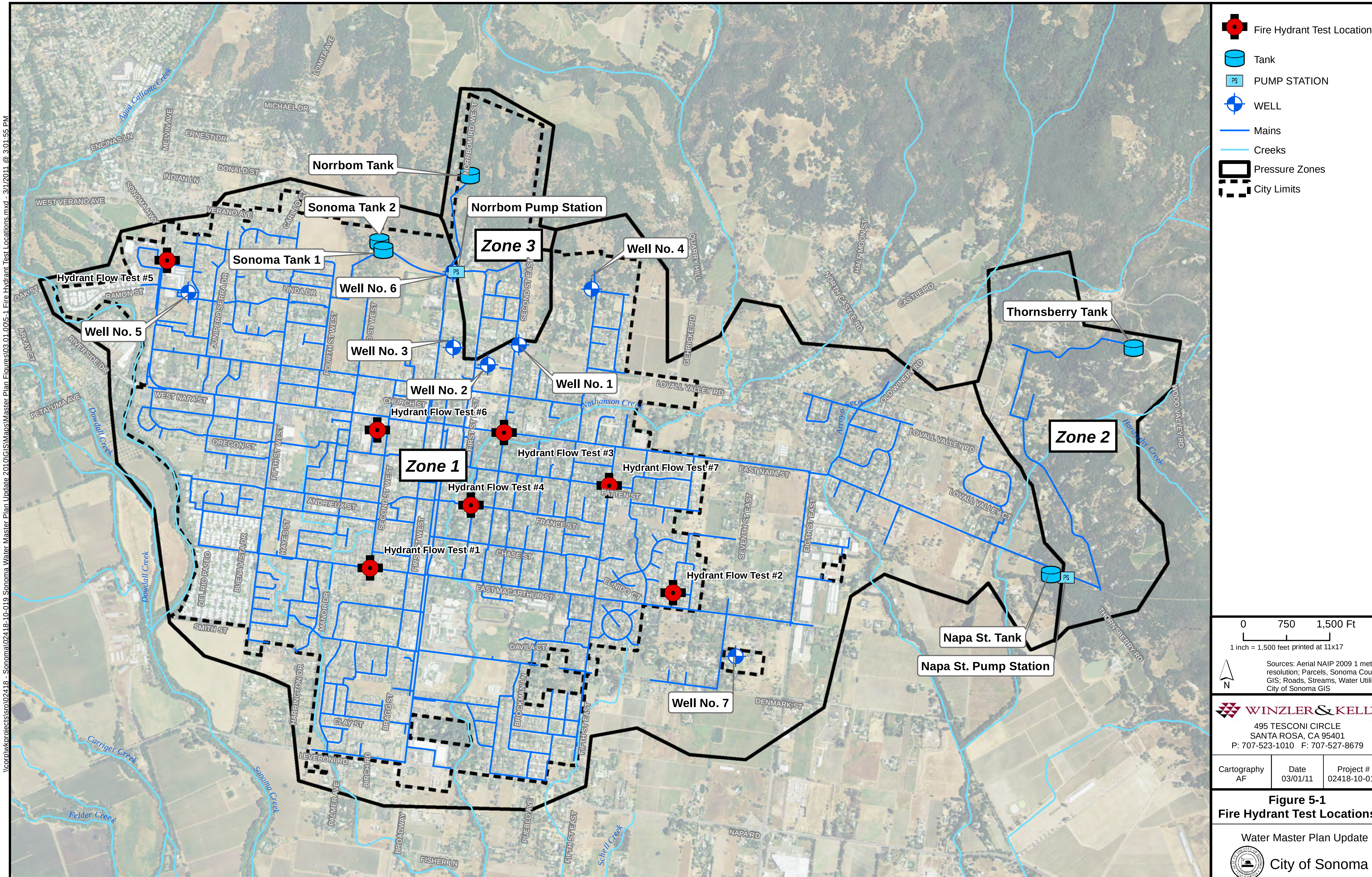


Figure 5-1
Fire Hydrant Test Locations

6.0 SYSTEM PERFORMANCE SUMMARY

The purpose of this section is to summarize the analyses run to evaluate the City's water system including sources of supply, storage, and distribution piping. The analyses were run to identify bottlenecks and pressure deficiencies within the City's water system. A total of four demand scenarios were analyzed using the calibrated hydraulic model:

1) Current (2008) peak hour,
2) Future (2020) peak hour,
3) Current (2008) maximum day with fire flow, and
4) Future (2020) maximum day with fire flow.

In addition to the four scenarios listed above, a desktop water age analysis was used to evaluate water quality in the City's water tanks. The results of these analyses are described in the following sections.

6.1 Peak Hour Analysis

Peak hour demands were input into the calibrated hydraulic model to assess bottlenecks and identify locations of low pressure within the distribution system. Peak hour demands were established for both current and future conditions, input into the calibrated hydraulic model and run, and results analyzed for deficient pressures caused by either high velocities within the system or elevation limitations.

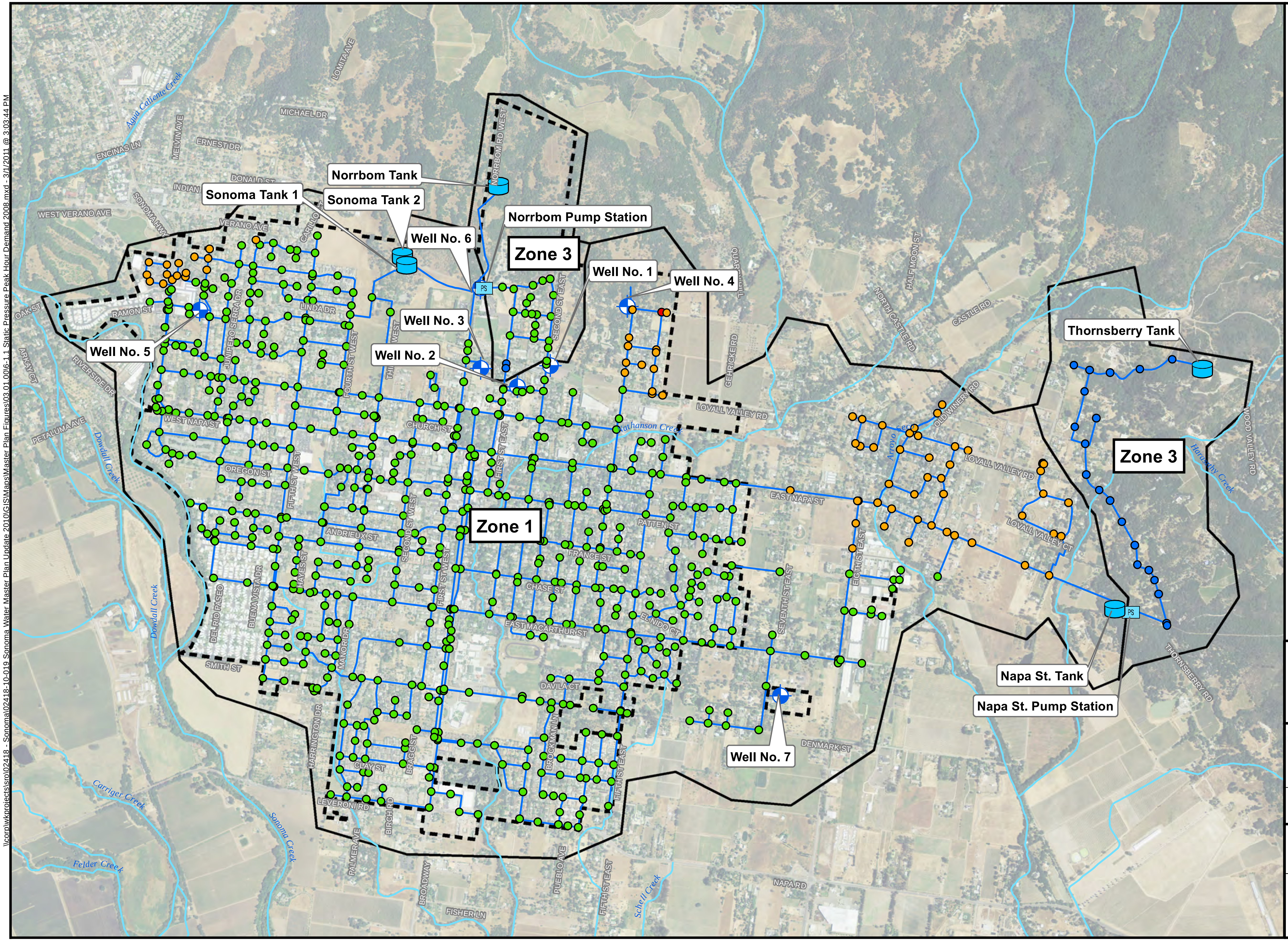
A peaking factor of 3.0, as identified in Section 3.0 Demand Analysis, was applied to the estimated current average day demand of 2.01 million gallons per day (MGD), to arrive at a current peak hour demand of 6.03 MGD, or approximately 4,187 gallons per minute (gpm). Future peak hour demands were determined by incorporating the additional 52,000 gallons per day (gpd) to current average day demands and then applying the peaking factor of 3.0 to arrive at a future peak hour demand of 6.18 MGD, or 4,291 gpm.

For the peak hour hydraulic simulations, all storage tanks within the City system, including the two SCWA tanks, were assumed to contain 1 foot of storage. This conservative assumption was used to verify that the water system provides acceptable pressure independent of water levels in the tanks. All pumps were also assumed to be off during the simulation, and the pressure reducing valve (PRV) in between Zone 3 and Zone 1 was simulated as closed. This latter assumption requires all Zone 1 demands to be supplied exclusively from the SCWA tanks.

Figures 6-1.1 and 6-1.2 illustrate model results (current and future) for the peak-hour demand analyses. The figures show that the minimum pressure criteria are satisfied in most areas of the distribution system. In addition, model results indicate that there is very little difference between current and future conditions due to the fact that the City is effectively built out.

Only one junction location within the entire City water system was determined to have a pressure of less than 20 psi under the peak-hour demand scenarios. This occurred at the highest elevation of Zone 1 on Brazil Street east of 4th Street East and Well No. 4.

Several zones within the system were found to have pressures between 20 psi and 40 psi. These include:



Tank
PUMP STATION
WELL
Mains
Creeks
Pressure Zones
City Limits

Static Pressure

- < 20 psi
- 20 - 40 psi
- 40 - 80 psi
- > 80 psi

0 750 1,500 Ft

1 inch = 1,500 feet printed at 11x17

N

Sources: Aerial NAIP 2009 1 meter resolution; Parcels, Sonoma County GIS; Roads, Streams, Water Utility, City of Sonoma GIS

WINZLER & KELLY
495 TESCONI CIRCLE
SANTA ROSA, CA 95401
P: 707-523-1010 F: 707-527-8679

Cartography	Date	Project #
AF	01/21/11	02418-10-019

Figure 6-1.1 – Static Pressures at Peak Hour Demand (6 MGD) Current Conditions (2008)

Water Master Plan Update

City of Sonoma

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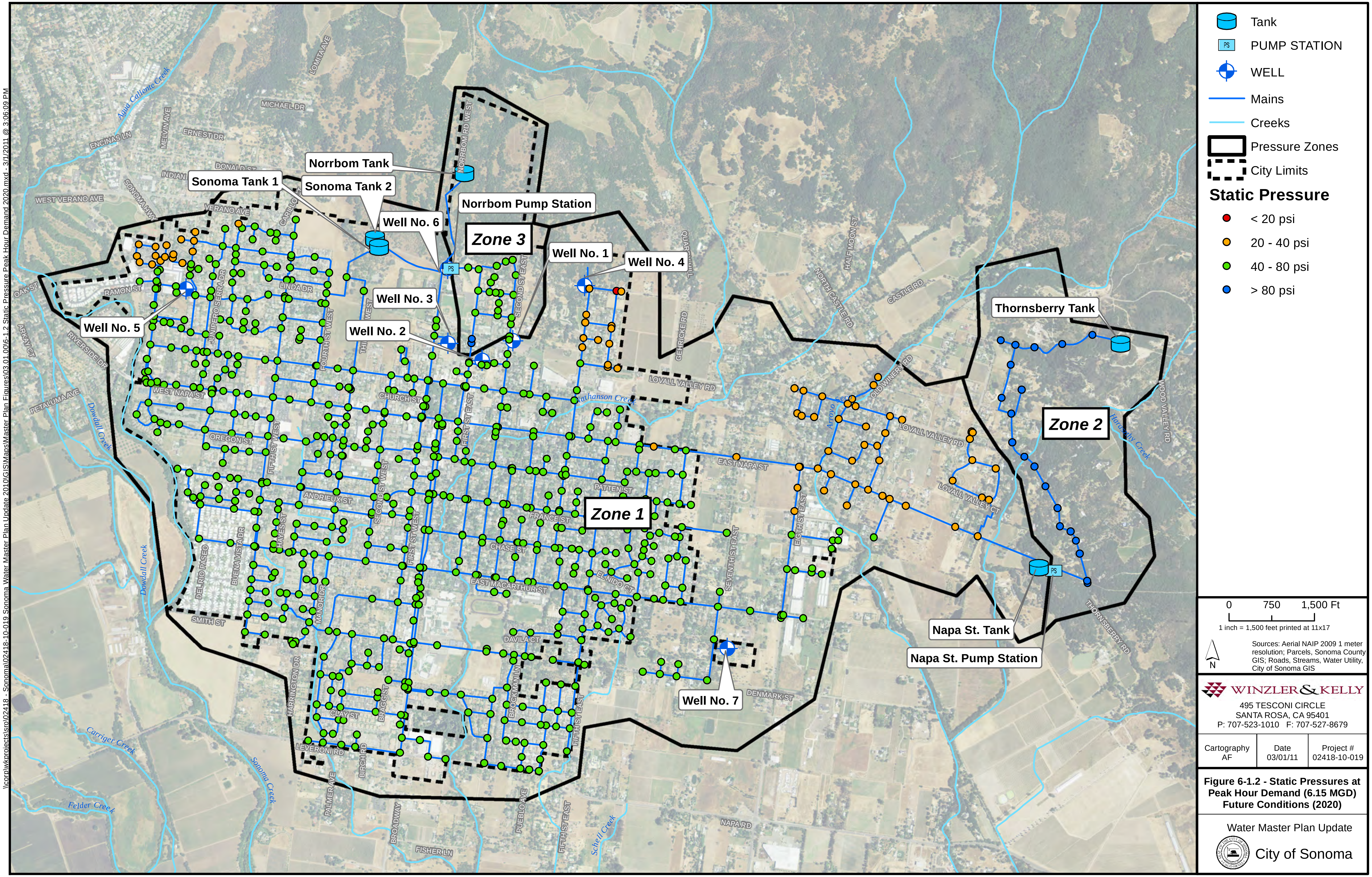

WINZLER & KELLY
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P: 707-523-1010 F: 707-527-8679

Cartography	Date	Project #
AF	03/01/11	02418-10-019

Figure 6-1.2 - Static Pressures at Peak Hour Demand (6.15 MGD) Future Conditions (2020)

Water Master Plan Update

City of Sonoma

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1) The high elevation region (100 – 150 ft) at the northern end of 4th Street East north of Lovall Valley Road,
2) Another high elevation region (110-140 ft) at the eastern end of Sonoma located around the intersection of East Napa Street and Old Winery Road,
3) The northwestern part of Sonoma near Highway 12 and Maxwell Farms Regional Park

While this satisfies the minimum statutory requirements for existing public water systems, pressures less than 40 psi are not allowed for new water systems under peak-hour demand conditions.

The remainder of Zone 1 was found to have pressures between 40 – 80 psi. The low pressure portions of Zone 1 listed above are due to high elevation of the parcels served and would not be improved significantly with larger pipes. The pipes feeding each of these low pressure zones were verified to have low velocities of less than 1 foot per second (fps), so undersized pipes are not the cause of the low pressures.

Zone 2 delivers water at high pressures (greater than 80 psi) throughout the zone due to the elevation of the Thornsberry tank.

Zone 3 contains mostly pressures of between 40 – 80 psi with the lowest portion of Zone 3 seeing pressures greater than 80 psi.

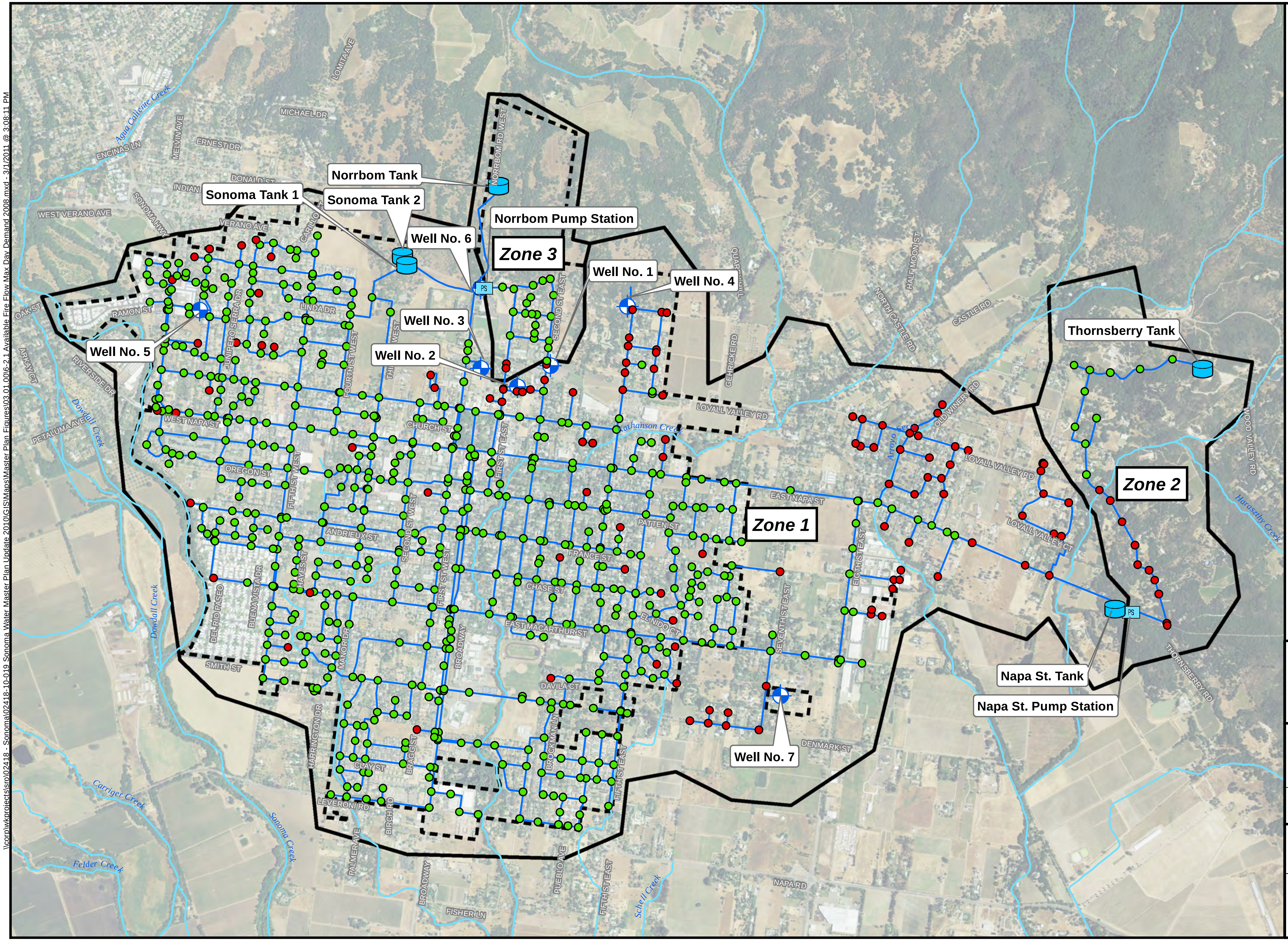
6.2 Fire Flow Analysis

The calibrated hydraulic model was also used to assess two fire flow scenarios under both current and future maximum day demands. Current and future maximum day demands were estimated at 4.02 MGD and 4.12 MGD respectively, using a peaking factor of 2.0 as presented in Technical Memorandum No. 2 – Demand Analysis.

Fire flow requirements were assigned to junctions within the hydraulic model consistent with the requirements of 1,500 gpm for residential areas within City limits and 2,000 gpm for all other land-use categories and residential areas outside of City limits presented in Section 7.0 Fire Flow Requirements. The fire flow analysis was performed in the hydraulic model by assigning the corresponding fire flow iteratively to each junction within the model in addition to maximum day demands occurring throughout the system. The system is either capable of meeting the fire flow requirement while maintaining a 20 psi residual pressure at a fire flow junction, or is unable to maintain the required 20 psi residual pressure in which case the model determines the available fire flow while still meeting the pressure constraint.

Similar to the peak hour demand scenario, all storage tanks within the City system, including the two SCWA tanks, were assumed to contain only 1 foot of storage for satisfying maximum day demands and fire flow requirements. This assumption was made to ensure the City is capable of providing fire flows at adequate pressures throughout the system under worst case storage conditions. All pumps were also assumed to be off during the simulation, and the pressure reducing valve (PRV) in between Zone 3 and Zone 1 was simulated as closed. This latter assumption requires all Zone 1 demand to be fed off of the SCWA tanks.

Figures 6-2.1 and 6-2.2 present the results of the fire flow analyses under current and future maximum day demands.



Tank

PUMP STATION

WELL

Mains

Creeks

Pressure Zones

City Limits

Available Fire Flow

Yes

No

0 750 1,500 Ft

1 inch = 1,500 feet printed at 11x17

N

Sources: Aerial NAIP 2009 1 meter resolution; Parcels, Sonoma County GIS; Roads, Streams, Water Utility, City of Sonoma GIS

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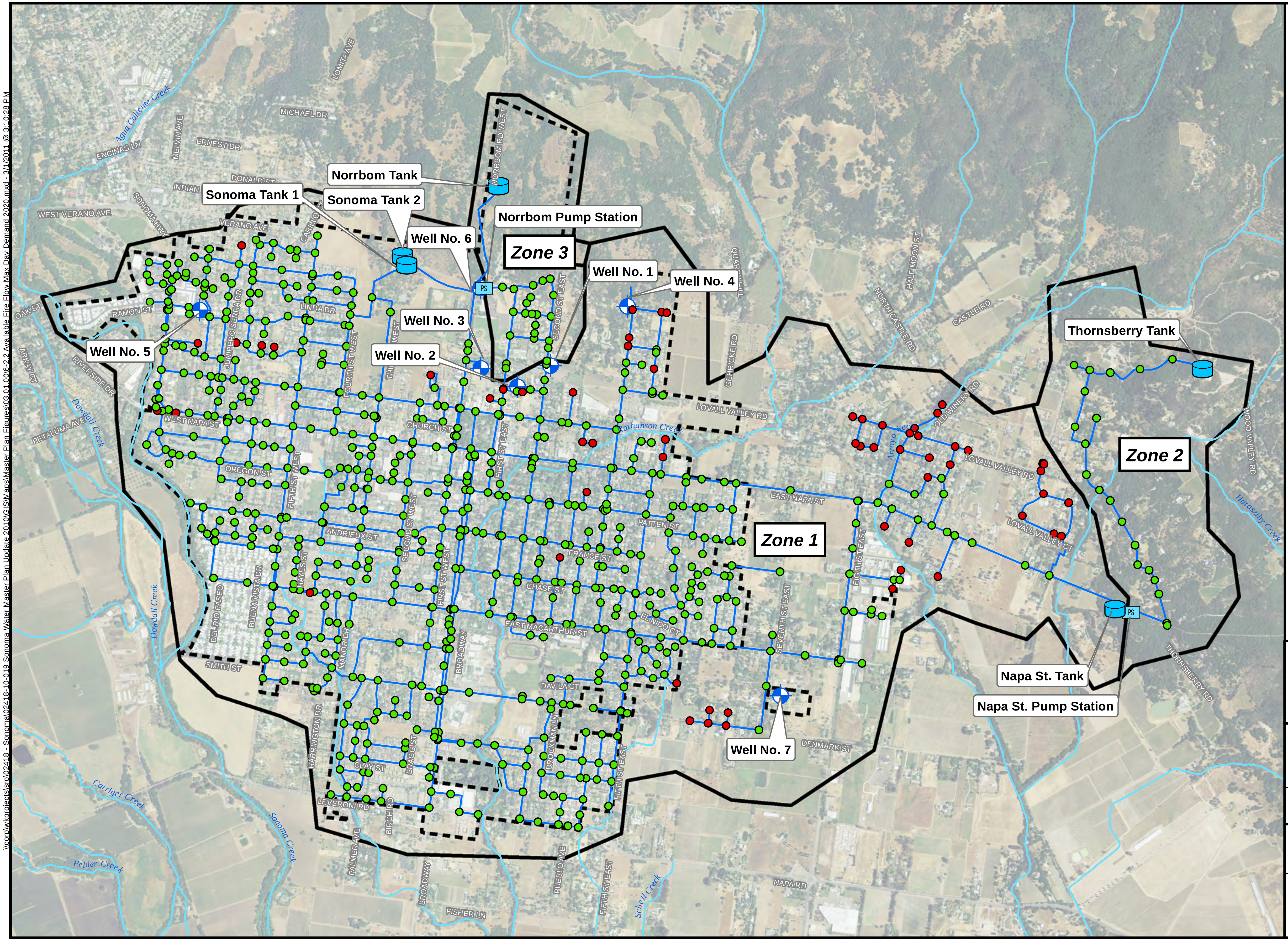
Cartography	Date	Project #
AF	03/01/11	02418-10-019

Figure 6-2.1 - Available Fire Flow @ 20 psi Max Day Demand (4 MGD) Current Conditions (2008)

Water Master Plan Update

City of Sonoma

\\corp\wkprojects\sro\02418 - Sonoma\02418-10-019 Sonoma Water Master Plan Update 2010\GIS\Maps\Master Plan Figures\03.01\06-2.1 Available Fire Flow Max Day Demand 2008.mxd - 3/1/2011 @ 3:08:11 PM



Tank
PUMP STATION
WELL
Mains
Creeks
Pressure Zones
City Limits

Available Fire Flow

Yes
No

0 750 1,500 Ft
1 inch = 1,500 feet printed at 11x17

Sources: Aerial NAIP 2009 1 meter resolution; Parcels, Sonoma County GIS; Roads, Streams, Water Utility, City of Sonoma GIS

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Cartography	Date	Project #
AF	03/01/11	02418-10-019

Figure 6-2.2 - Available Fire Flow @ 20 psi Max Day Demand (4.1 MGD) Future Conditions (2020)

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City of Sonoma

As the figures show, adequate fire flows are available throughout Zones 2 and 3. In contrast, two of the regions in Zone 1 found to have had low pressure under the peak hour demand simulations are also found to not meet fire flow requirements at most locations. These include the high elevation region at the northern end of 4th Street East north of Lovall Valley Road, and the region at the eastern end of Sonoma located north of the intersection of East Napa Street and Old Winery Road. Just east of this latter area is Lovall Valley Court, which is also unable to satisfy fire flow requirements. All other junctions failing to meet fire flow requirements within Zone 1 occur within unlooped areas or on dead-end branches within the system. Figures 6-2.1 and 6-2.2 clearly show unlooped areas and dead-end branches are the main reason for fire flow requirements not being met within Zone 1.

6.3 Water Age Analysis

A desktop water age analysis was also performed to estimate flow and turnover requirements for Zone 2 and Zone 3. As a general rule of thumb, residual chlorine in potable water dissipates over a period of approximately four days. Water entering Zone 1 via the SCWA tanks is assumed to be “fresh” with a water age of zero.

Zones 2 and 3 are fed by the Thornsberry Tank and Norrbom Tank respectively; however, the Napa Street Tank within Zone 1 in its current plumbing configuration does not normally provide water to Zone 1. Under most circumstances, water that enters the Napa Street Tank from Zone 1 is consumed within Zone 2. Thus, Zone 2 has an effective storage volume of 2.5 million gallons. For the purposes of this water age analysis, the following storage volumes and resulting turnover requirements were determined for Zones 2 and 3.

TABLE 6-1 Water Age Analysis for Zones 2 and 3.

Parameter	Zone 2	Zone 3
Storage Tanks	Thornsberry and Napa St. Tanks	Norrbom Tank
Total Storage Volume (MG)	2.5	3
Turnover Criteria (days)	4	4
Flowrate Requirement (mgd)	0.63	0.75
Flowrate Requirement (gpm)	430	520
Current Average Day Demand (gpm)	12	39

As shown in Table 1, in order to satisfy the four-day turnover criteria, Zone 2 and Zone 3 would have to continuously consume 430 gpm and 520 gpm, respectively. These flow rates are much greater than the current average day demands of 12 gpm and 39 gpm. Thus, without any means to increase circulation through the tanks, chlorine residuals at the tanks may drop below minimum acceptable concentrations.

To mitigate the low rates of turnover in the tanks, the City diverts water from Zone 3 into Zone 1 via a pressure reducing valve (PRV) that is located inside the Norrbom pump station building. This valve is opened and closed via a preprogrammed schedule that is programmed into the City’s SCADA system. Every seven days the valve opens for two days to allow water to drain from the Norrbom tank into Zone 1. City staff noted, however, that under some conditions the PRV does not open during the scheduled time periods. This is most likely caused by the PRV pressure setting being too low. Increasing setpoint pressure for the PRV, and the duration that the valve is open, should improve water age within the distribution system.

Similarly, a portable engine driven pump (which can also be used for emergency pumping) located at the Napa Street pump station, is used to periodically move water from the Napa tank back into Zone 1. This operation is performed manually by City operations staff.

7.0 FIRE FLOW REQUIREMENTS

The purpose of this section is to establish the minimum allowable fire-flow requirements for each area of the distribution system. The fire-flow requirement will be used together with the maximum-day demands to model the performance of the distribution system.

For purposes of this document, the term "fire-flow" is defined as the flow rate of water, measured at 20 psig residual pressure, which is available for fire fighting. The minimum fire-flow requirement for a given area is stipulated in Appendix B of the Uniform Fire Code, and is a function of the following variables:

- Size of the building (square footage);
- Presence of automatic fire sprinklers (reduces fire-flow requirement by 50% or more);
- Type of construction (as defined in the California Building Code); and
- Building occupancy.

7.1 Fire Flow Requirements

In the context of evaluating an entire municipal water distribution system, it is impractical to identify a unique fire-flow for each building based on the variables listed above. Therefore, for purposes of this study the City's fire marshal has divided the City's fire-flow requirements into two broad categories:

- Single and two-family homes (1,500 gallons per minute * 2 hrs); and
- All other construction (2,000 gallons per minute * 2 hrs).

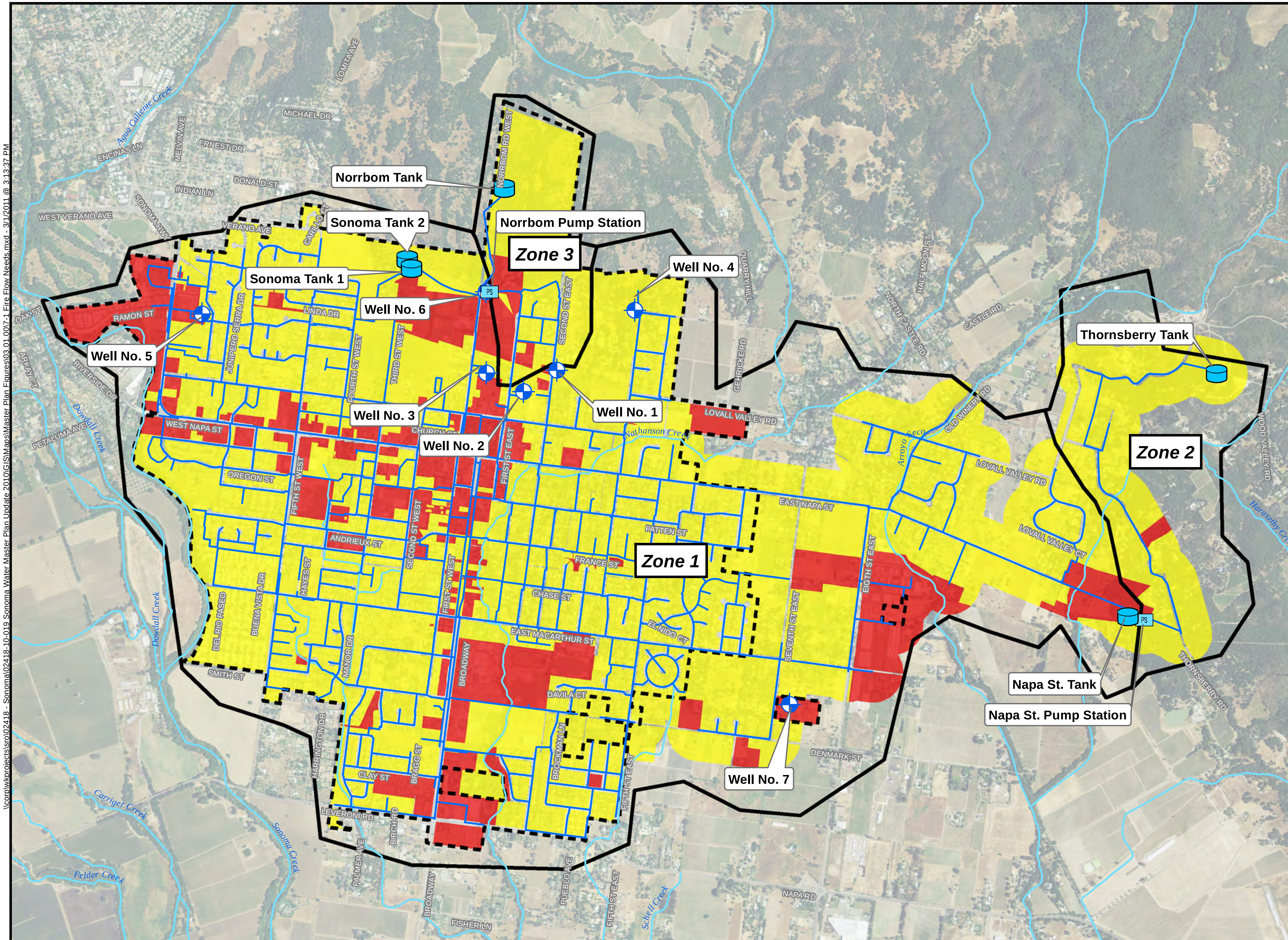
These criteria are suitable for six to eight hose streams of 250 gpm each, and are expected to adequately cover most buildings within the City's service area.

For purposes of determining the City's fire-flow requirements, the following land-use categories are assigned a fire-flow of 1,500 gpm:

- Low-density Residential; and
- Medium-density Residential.

All other land-use categories are assigned a fire-flow requirement of 2,000 gpm. A map showing the fire-flow requirement for each parcel in the service area is provided in Figure 7-1 attached. For the area outside the City limits, a fire-flow of 1,500 gpm was used to reflect the additional hazard caused by hilly terrain and chaparral ground cover.

For purposes of identifying the volume of water that should be stored for fire fighting, the flow rate of 2,000 gpm is multiplied by a duration of 2 hours to obtain a minimum volume of 240,000 gallons. This is the minimum volume that should be reserved, in each pressure zone, for fire fighting.



Tank
PUMP STATION
WELL
Mains
Creeks
Pressure Zones
City Limits

Fire Flow Needs (gpm)

- 1,500
- 2,000

0 750 1,500 Ft

1 inch = 1,500 feet printed at 11x17

N

Sources: Aerial NAIP 2009 1 meter resolution; Parcels, Sonoma County GIS; Roads, Streams, Water Utility, City of Sonoma GIS

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Cartography	Date	Project #
AF	03/01/11	02418-10-019

Figure 7-1
Fire Flow Needs Map

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\\corp\wkprojects\sro\02418 - Sonoma\02418-10-019 Sonoma Water Master Plan Update 2010\GIS\Maps\Master Plan Figures\03.01.007-1 Fire Flow Needs.mxd - 3/1/2011 @ 3:13:37 PM

8.0 CAPITAL IMPROVEMENT PROGRAM

This section provides the City with a list of capital improvement projects necessary to maintain reliability within the City's potable water distribution, supply and storage systems. Previous updates to the City's CIP were completed in 1999 and more recently in 2002. For the current effort, a working, calibrated hydraulic model was developed to analyze performance of the distribution system under current and future demand conditions, including fire-flow requirements. Information provided by City staff was also incorporated into the system analysis.

Under separate contract with Winzler & Kelly, an analysis of existing City wells was conducted to assess their condition and productivity. Projects that were recommended in the well study were incorporated into the CIP, presented in this document. In addition, CIP projects from a separate study, prepared by others, were also incorporated into this document. This section describes by location each deficiency that was identified during the modeling effort and site visits with City staff. A description of the recommended project is provided after each problem statement.

8.1 Water CIP No. 1 (Zone 1/2Intertie)

Deficiency:

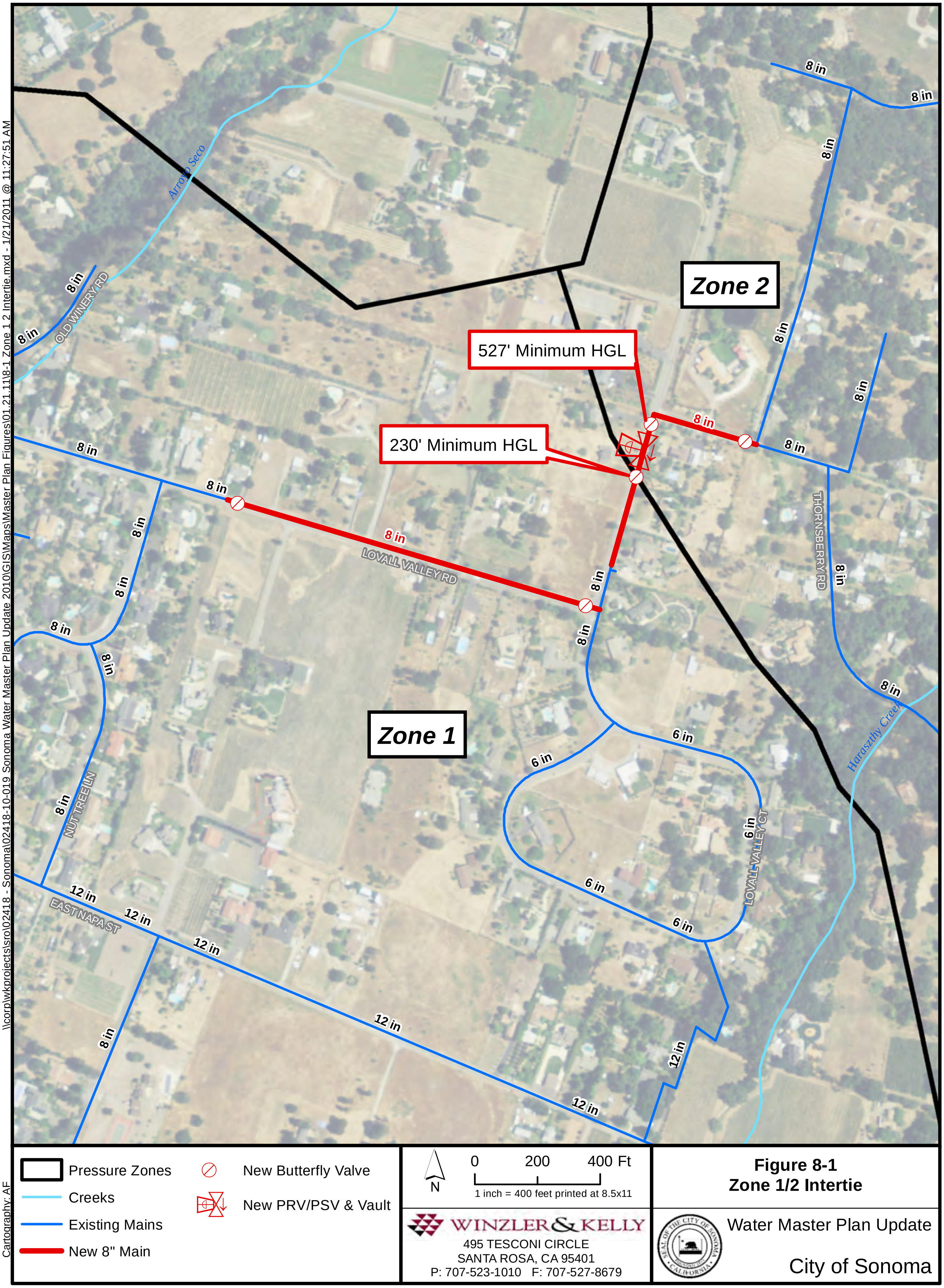
Water system static pressures range from 20-40 psi during current peak hour demand in portions of the northeast section of Zone 1. Fire flows of 1,500-2,000 gpm cannot be met (while maintaining 20 psi minimum residual pressure) during periods of max day demand. The California Department of Public Health (CDPH) mandates a minimum distribution system pressure of 20 psi at all times (§64602).

Additionally, City staff report that it is difficult to maintain minimum chlorine residual in the Napa Street and Thornsberry storage tanks due to low demands in the small Zone 2 system. CDPH states water delivered to the distribution system shall not contain a disinfectant residual of less than 0.2 mg/l for more than four hours in any 24-hour period (§64654).

Project:

A new 8-inch pipeline intertie (along Lovall Valley Road) connecting Zone 2 (higher pressure system) to Zone 1 (lower pressure system) would have multiple benefits, including increased pressures in Zone 1 during periods of high demand, as well as improved water quality resulting from greater turnover in the Napa St. and Thornsberry storage tanks. See Figure 8-1. Zone 2 pressures are substantially higher than the pressures in the affected region of Zone 1. Therefore, a combination pressure-reducing/pressure-sustaining valve (PRV-PSV) must be installed in the new section of water main that connects the two zones.

The PRV-PSV performs two functions: it maintains a minimum downstream pressure (Zone 1) regardless of fluctuating demand; this valve also sustains the upstream pressure (Zone 2) to a pre-determined minimum.



\\corp\wkprojects\sro\02418 - Sonoma\02418-10-019 Sonoma Water Master Plan Update 2010\GIS\Maps\Master Plan Figures\01.21.11\8-1 Zone 1 2 Intertie.mxd - 1/21/2011 @ 11:27:51 AM

Cartography: AF

Figure 8-1
Zone 1/2 Intertie

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City of Sonoma

The PRV should be set to regulate a downstream HGL elevation of 230 ft. This elevation represents the average Zone 1 system pressure when the SCWA tanks are approximately half full. The PSV function should be set to maintain a minimum upstream HGL elevation of 527 feet, consistent with pressures in Zone 2 when the Thornsberry tank is 1/3rd full (assumes operational and emergency storage in the Thornsberry tank have been depleted). Installation of this type of valve will increase pressures in Zone 1 without over-pressurization, while at the same time preventing Zone 2 pressures from falling too low. The valve is hydraulically actuated and does not require electrical connections. The design engineer should consider providing a bypass with associated isolation valves to facilitate removal of the PRV-PSV for maintenance. Table 1 presents item descriptions and associated budgetary level costs for a complete project including design, construction and construction management.

8.2 Water CIP No. 2 (Zone 3 Expansion)

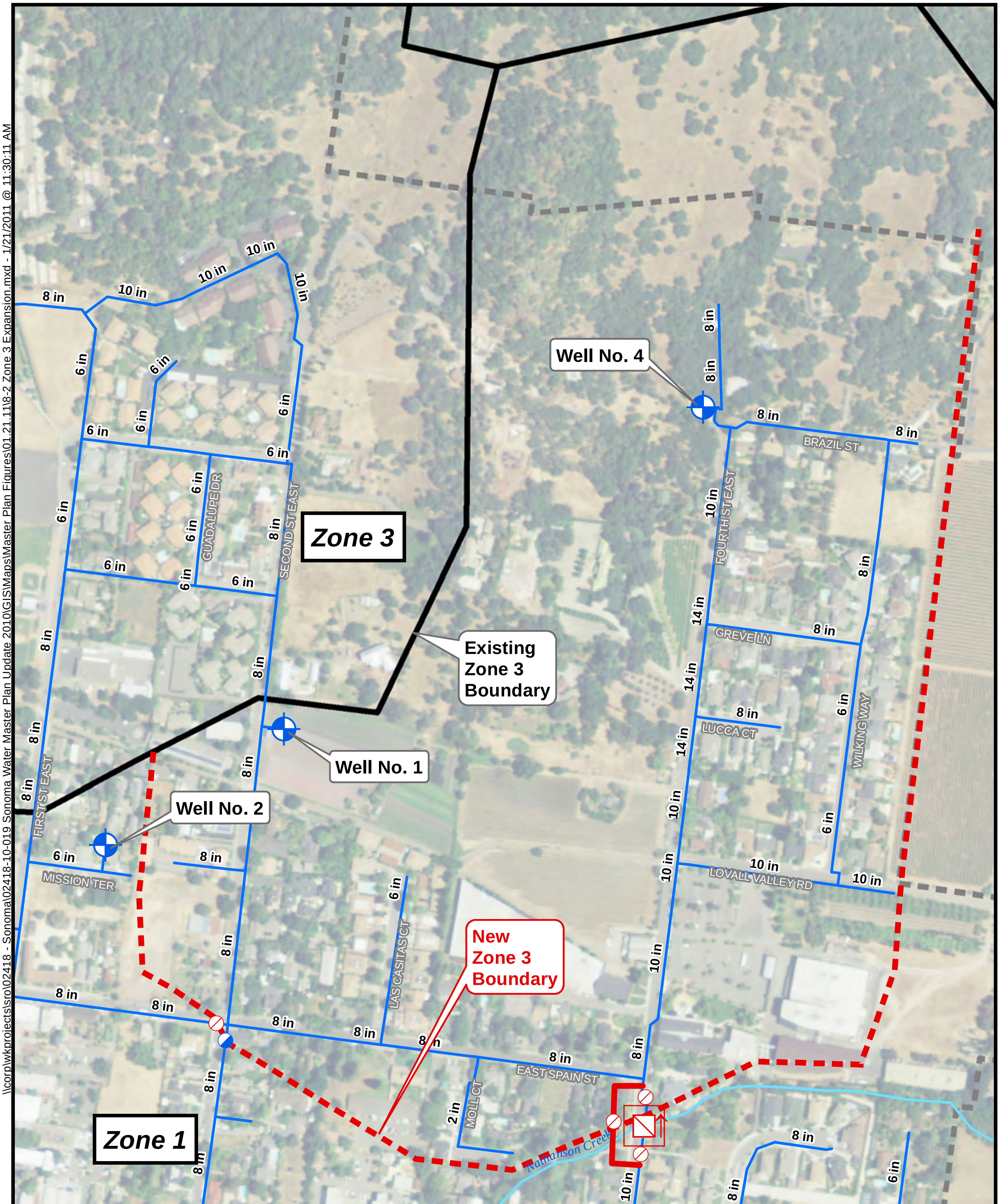
Deficiency:

Portions of the central-northern section of Zone 1 (residential area near Well No. 4) experience pressures less than 20 psi during current peak hour demand conditions. Additionally, fire flows of 2,000 gpm cannot be met (while maintaining 20 psi minimum residual pressure) during periods of max day demand. The California Department of Public Health (CDPH) mandates a minimum distribution system pressure of 20 psi at all times (§64602).

Project:

Zone 3 can be expanded to include residential customers in the vicinity of Wilking Way and Brazil Street (See Figure 8-2) by selectively installing/opening/closing specific isolation valves in the Zone 1 system. Static pressures in this area are expected to increase by approximately 23 psi. In order to accommodate fire flow demands while still maintaining 20 psi minimum pressures, a 10-inch check valve should be installed in 4th Street East. This valve (which will be closed under normal demand conditions) will open during high fire flow demands and allow water to flow from Zone 1 into Zone 3. There are two PRV's (3-inch and 8-inch) at the Norrbom pump station which regulate downstream pressures in Zone 3. The 3-inch PRV should be set at HGL 285 feet (equal to Norrbom tank floor elevation). This setting will produce maximum system pressures of approximately 80 psi in the southern portion of the Zone 3 expanded area. The larger 8-inch PRV should be set at HGL 275 feet. The majority of the time, only the 3-inch PRV will be open. When fire flow demands occur in Zone 3, pressures will fall below the 285-foot set point of the smaller PRV. Once the HGL at the pump station reaches 275-feet, the larger 8-inch PRV will open to provide additional flow into Zone 3.

The head requirements for the pumps will increase commensurate with the increase in system pressure of 23 psi with the inclusion of Well No.'s 1 and 4 into Zone 3. Settings on the variable frequency drives for the Well No. 4 pump should be adjusted accordingly to run at reduced speeds in order to accommodate increased system pressures and to prevent excessive drawdown in the well. The output for Well No. 1 is expected to decrease somewhat from the higher HGL of Zone 3. Table 2 presents item descriptions and associated budgetary level costs for a complete project including design, construction and construction management.



City Limits
Pressure Zones
Existing Mains
Creeks
New Zone 3 Boundary
Close Existing Butterfly Valve
New Butterfly Valve
Check Valve & Vault

N
0 200 400 Ft
1 inch = 400 feet printed at 8.5x11

Figure 8-2
Zone 3 Expansion

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8.3 Water CIP No. 3

8.3.1 Tank Mixing (Napa Norrbom and Thornsberry Tanks)

Background:
The City has experienced periods of low or undetectable chlorine residual in the Napa Street and Thornsberry tanks. Since normal (non-fire flow) demand in Zone 2 is low, turnover in these tanks is not frequent enough to promote a consistent chlorine residual required for proper disinfection. To address this issue an automatic valve is programmed to open the 8-inch PRV to Zone 1 in order to increase turnover rates in the Norrbom tank in an effort to improve water quality in that tank. CDPH states water delivered to the distribution system shall not contain a disinfectant residual of less than 0.2 mg/l for more than four hours in any 24-hour period (§64654).

Project:

Tank mixing can be accomplished using various methodologies. The simplest method requires manual addition of chlorine tablets in a strainer basket in combination with internal tank mixing equipment. Multiple equipment options exist for internal tank mixing. The mixing units can run via grid power or can be solar-powered. Both types of units can be installed without dewatering the tank. Other options such as constructing new pipes (requires tank penetrations) and valves for tank mixing exist, but the capital cost and energy costs from associated pumping preclude their selection as a viable alternative for tank mixing. The addition of chlorine tablets to the tanks will need to be included on the routine maintenance schedule of the City's Water Department staff. Table 8-3 (attached) presents item descriptions and associated budgetary level costs for a complete project including design, construction and construction management.

8.4 Water CIP No. 4

8.4.1 Napa Street Tank/Zone 1-2 Pump Station Upgrade

Background:

The Napa Street tank currently has a single combined inlet/outlet which hinders the ability to internally mix water. This piping arrangement, combined with low demand in Zone 2, causes low chlorine residual in the tank. The tank lining was recently evaluated (2010, Aquatech) and found to be in good condition. However, the tank requires new exterior coating and rehabilitation of the existing cathodic protection system.

The Napa Street pump station includes a hydropneumatic tank, which protects the water mains from a potentially dangerous surge pressures. The proper air/water ratio must be maintained in the hydropneumatic tank in order for it to work properly. However, for this to occur it is necessary to provide a source of compressed air and level instrumentation for the hydropneumatic tank. The air supply for the tank should be controlled from the existing PLC with process feedback and alarm status transmitted to the central SCADA system.

Project:

There are multiple upgrades to the storage tank and pump station feeding Zones 1-2 that can be implemented to enhance system performance and reliability. An air pressure lubricated compressor with receiver should be installed to add air to the hydropneumatic tank. This tank should also be retrofitted with a site gauge to provide visual confirmation of water level inside.

By installing a level indicating transmitter on the hydropneumatic tank and connecting it to an enclosed programmable logic controller (PLC), the compressor can automatically add air to the hydropneumatic tank to optimize system efficiency and provide protection from water surge related damage. Installing a pressure indicating transmitter with associated air piping, solenoid valves, and isolation valving to the hydropneumatic tank provides an added ability to monitor and adjust tank levels and pressure. The storage tank requires re-coating and rehabilitation of the existing cathodic protection system to minimize the potential for tank corrosion and extend lifespan. See Figure 8-3.

Circulation inside the storage tank (promotes enhanced water quality) can be improved by installing a dedicated tank outlet on the opposite side of the tank from the inlet. The outlet piping requires a slanting-disc check valve with isolation valves. Table 8-4 (attached) presents item descriptions and associated budgetary level costs for a complete project including design, construction and construction management.

8.5 Water CIP No. 5

8.5.1 Well No. 3 Replacement

Background:

Well No. 3 is currently (2010) operational at a flow rate of 140 gpm but the pumping efficiency of the well, as measured by the wells specific capacity, has significantly degraded in comparison to the original installation in 1947. The specific capacity (well flow rate divided by the corresponding drop in water level within the well; units of gpm/ft) of the well degraded nearly 40% between 1976 and 1990. An additional reduction in specific capacity occurred when the well was relined with a smaller diameter well screen in 2001. A new well pump was also installed in 2001.

In 2010, Well No. 3 operated at a specific capacity of approximately 1.5 gpm/ft. This is only 35% of the specific capacity recorded in 1976 (4.32 gpm/ft) and 30% of the specific capacity recorded in 1961 (4.95 gpm/ft). When installed in 1947, the specific capacity of Well No. 3 was not recorded but was likely even higher than the 4.95 gpm/ft recorded in 1961. A replacement of Well No. 3 at this location could yield significantly higher flow rates (approximately 300 gpm or better), based on the higher historic specific capacity of Well No. 3 and nearby Wells No. 1 (currently 420 gpm) No. 2 (historically 290 gpm). Well No. 3 Replacement project is also required to provide additional pumping capacity to supplement/replace supply from Well No. 1. Although Well No. 1 is currently the highest producing well in the system, it is old and unavoidable declines in the production capacity of the well are expected during the 10-year planning period.

Project:

Replacing Well No. 3 involves identifying a nearby location for the installation of the new well. The existing location in Depot Park has open areas that can be used to stage equipment and supplies needed during installation. The location of the replacement well should be at least 30 feet away from the existing well location to minimize the possibility of drilling across or pushing drilling fluids into the existing well. Some of the exiting water disinfection equipment could be reused. But if existing Well No. 3 is left intact it can serve as a backup well adding needed redundancy to the system. Redundancy in pumping capability is important because the primary purpose of the wells is to augment supply during drought conditions. The inability to supply groundwater during summer drought conditions could result in a shortfall in service.

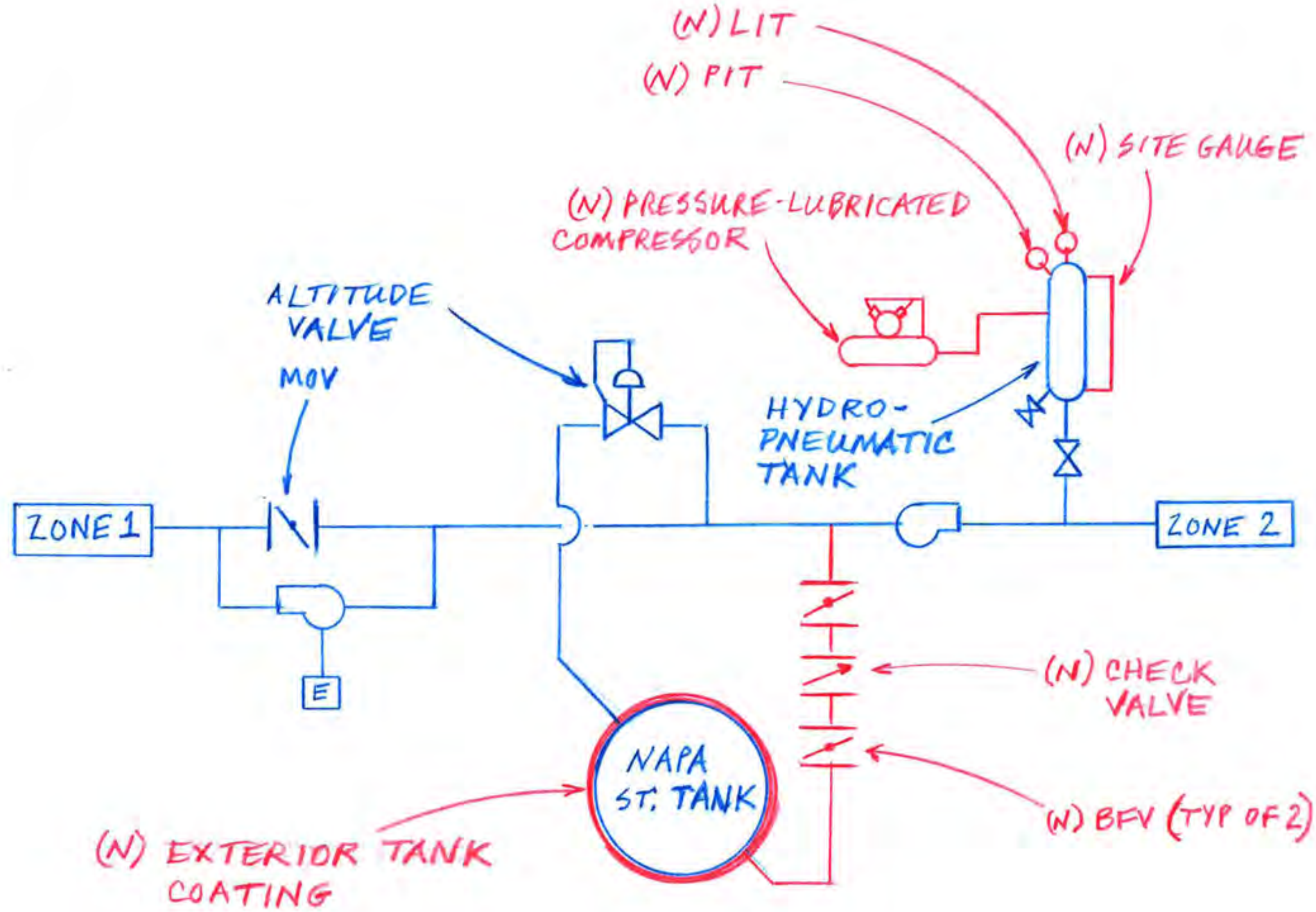

Figure 8-3
Napa St. Pump Station Upgrades

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City of Sonoma

Well No. 3 Replacement should be installed into the underlying Sonoma Volcanic Formation requiring mud rotary drilling techniques. This method is common in the area and there are a number of local contractors who can support this work. Well head protection should be provided for Well No. 3 Replacement in the form of a perimeter fence around the well site and small (10 ft X 10 ft) building for the disinfection equipment. A larger building with a removable roof may be required if the well was located inside the equipment building. A sewer connection is also needed to receive the discharge of water generated during maintenance activities. Table 8-5 (attached) presents item descriptions and associated budgetary level costs for a complete project including design, construction and construction management.

8.6 Water CIP No. 6

8.6.1 New Well Source (Well No. 8)

Background:

Groundwater is a critical component in meeting short-term emergency supply disruptions and longer-term shortages that may arise due to drought and availability of purchased water. The City owns seven wells of which six are permitted as Active (unrestricted use), Pending Active (use with special sampling) or Standby (short term use only). The seventh well in the distribution system (Well No. 7) has poor yield and poor water quality and has not been incorporated into the system. The six wells which are available for pumping were installed between 1944 and 1960. All of the wells have experienced declines in production due to age. Three have been relined to prevent well collapse or to provide a more robust well seal against contamination. Relining was necessary to continue using the wells but it resulted in an unavoidable reduction in total pumping capacity. In 2010, only one well was producing water at a rate near its historic capacity (Well No. 1). Due to the combined effects of well age and relining, the system no longer efficiently extracts groundwater from the underlying aquifer. In addition, the well system (defined as wells 1-4 and 6) does not have the excess pumping capacity to provide redundancy in the event that a well unexpectedly must be taken out of service. An additional well is required to provide increased groundwater water supply and system redundancy in the event an existing well must be taken out of service.

Project:

The most likely area for a new well is in the area north of West Spain Street, west of 1st Street West and east of 5th Street West. This area was used in the past by the City during the 1950's and 1960's as a groundwater source when the City operated the Vallejo Home Wells; Well No. 1 and Well No. 2.

Based on the available data from wells within 1,000 feet of the Study Area, a specific capacity of 3 to 6 gpm/ft can be expected in the area. Seasonal static water level varies between a depth of 50 and 100 feet. At a flow rate of 400 gpm with a specific capacity of 4.5 gpm/ft (average of 3 and 6 gpm/ft), approximately 111 feet of drawdown can be expected in the well. Therefore the well screen should be roughly 221 feet below grade to avoid exposing the screen to cascading water in the well. The well should be constructed with a minimum 10-inch casing to allow for flexibility in pump selection. The depth of the well should allow for a sufficient length of screen in the aquifer to intersect water bearing fractures and to allow for sediment to settle in the bottom of the well over time. Based on City well data, much of the flow comes from a small section of screen. It is inferred that these are areas where the well intersects fractures. Because of this the gravel pack should be extended to the bottom of the annular seal which is installed to a depth of 100 feet. This will maximize the opportunity of the well to intersect fractures in the upper part of the Sonoma Volcanic Formation. Summing the depths discussed above, a well approximately 500-600 feet deep is anticipated. These depths of construction are similar to Well No. 4 and Well No. 5.

Water quality in this area is expected to be good with treatment only for disinfection. Table 8-6 (attached) presents item descriptions and associated budgetary level costs for a complete project including design, construction and construction management.

Table 8-1 02418-10-019 March-11

City of Sonoma - Water CIP

Project No. 1 - Zone 1-2 Intertie ENR CCI 8864.72 July-10

ITEM DESCRIPTION	QUANTITY No.	Unit	COST Material	Labor	Total	TOTAL COST
General						
Temporary Traffic Controls Systems	1	LS	$2,500	$2,500	$5,000	$5,000
Potholing	1	LS	$0	$2,000	$2,000	$2,000
Survey Monument Replacement	1	EA	$200	$800	$1,000	$1,000
8-inch Pressure Reducing/Sustaining Valve	1	EA	$7,500	$2,500	$10,000	$10,000
8-inch Butterfly Valve	3	EA	$1,250	$1,750	$3,000	$9,000
Valve Vault	1	EA	$1,250	$1,500	$2,750	$2,750
8-inch Magmeter w/ Totalizer	1	EA	$4,000	$2,000	$6,000	$6,000
8-inch PVC pipe	2,110	LF	$25	$55	$80	$168,800
Joint Restraint - 8-inch PVC	6	EA	$650	$500	$1,150	$6,900
Air Release Valve Assembly	2	EA	$800	$1,200	$2,000	$4,000
Tie-In Lovall Valley Rd.	3	EA	$1,500	$5,000	$6,500	$19,500
Tie-In Thornsberry Rd.	1	EA	$1,500	$5,000	$6,500	$6,500
Underground Detection Tape	2,110	LF	$0.50	$0.50	$1	$2,110
Underground Tracer Wire	2,110	LF	$1	$0.50	$1.50	$3,165
Compaction Testing and Inspection	1	LS	$0	$5,000	$5,000	$5,000
Pressure Testing and Disinfection	1	LS	$1,000	$5,000	$6,000	$6,000
Pavement Marking and Striping	1	LS	$500	$1,000	$1,500	$1,500
Water Sampling Station	1	EA	$1,500	$1,800	$3,300	$3,300
6-inch Fire Hydrant Service	4	EA	$2,250	$2,500	$4,750	$19,000
Trench Repair Paving	4,220	SF	$2	$3	$5	$21,100
Temporary Construction Easement (County)	1	LS	$0	$500	$500	$500
Subtotal Materials	--	--	$107,055	--		
9% Sales Tax Materials						$9,635
Construction Subtotal						$312,760
Mobilization/Demobilization (4%)						$12,125
Contractor's Bonds and Insurance (3%)						$9,094
Contractor's Overhead and Profit (15%)						$45,469
Estimated Bid Price						$379,447
Construction Contingency (30%)						$113,834
Total Estimate of Probable Construction Cost						$493,282
Engineering/CM						
- Pre-Design (6%)	1	LS				$29,597
- Contract Documents (14%)	1	LS				$69,059
- Engineering Support During Construction - Office (4%)	1	LS				$19,731
- Construction Management - Field (14%)	1	LS				$69,059
Grand Total						**$680,729**

Table 8-2 02418-10-019 March-11
City of Sonoma - Water CIP
Project No. 2 - Zone 3 expansion

ENR CCI 8864.72 July-10

ITEM DESCRIPTION	QUANTITY		COST			TOTAL COST
	No.	Unit	Material	Labor	Total	
General						
Temporary Traffic Controls Systems	1	LS	$500	$1,500	$2,000	$2,000
10-inch Check Valve	1	EA	$1,750	$5,250	$7,000	$7,000
10-inch Isolation Valve	2	EA	$1,350	$3,300	$4,650	$9,300
Valve Vault	1	EA	$900	$3,750	$4,650	$4,650
6-inch Bypass Piping	1	EA	$500	$2,000	$2,500	$2,500
Joint Restraint - 6-inch PVC	6	EA	$550	$2,500	$3,050	$18,300
Tie-In	2	EA	$1,500	$5,000	$6,500	$13,000
Compaction Testing and Inspection	1	LS	$0	$1,000	$1,000	$1,000
Pressure Testing and Disinfection	1	LS	$500	$750	$1,250	$1,250
Pavement Marking and Striping	1	LS	$250	$500	$750	$750
Trench Repair Paving	1	LS	$750	$750	$1,500	$1,500
Temporary Construction Easement (County)	1	LS	$0	$500	$500	$500
Subtotal Materials	--	--	$14,150	--		
9% Sales Tax Materials						$1,274
Construction Subtotal						$63,024
Mobilization/Demobilization (4%)						$2,470
Contractor's Bonds and Insurance (3%)						$1,853
Contractor's Overhead and Profit (15%)						$9,263
Estimated Bid Price						$76,609
Construction Contingency (30%)						$22,983
Total Estimate of Probable Construction Cost						$99,591
Engineering/CM						
- Pre-Design (6%)	1	LS				$5,975
- Contract Documents (14%)	1	LS				$13,943
- Engineering Support During Construction - Office (4%)	1	LS				$3,984
- Construction Management - Field (14%)	1	LS				$13,943
Grand Total						**$137,436**

Table 8-3 02418-10-019 March-11

City of Sonoma - Water CIP

Project No. 3 - Tank Mixing and Chlorine Augmentation ENR CCI 8864.72 July-10

	QUANTITY		COST			
ITEM DESCRIPTION	No.	Unit	Material	Labor	Total	TOTAL COST
General						
Tank Mixer - Thornsberry Tank*	1	EA	$19,000	$10,000	$29,000	$29,000
Tank Mixer - Napa Street Tank*	1	EA	$29,000	$14,000	$43,000	$43,000
Tank Mixer - Norrbom Tank*	1	EA	$29,000	$14,000	$43,000	$43,000
Stainless Steel Strainer Basket	1	EA	$1,250	$250	$1,500	$1,500
Trenching/Conduit/Panel/SCADA integration	3	EA	$2,000	$4,000	$6,000	$18,000
Subtotal Materials	--	--	$77,000	--		
9% Sales Tax Materials						$6,930
Construction Subtotal						$141,430
Mobilization/Demobilization (4%)						$5,380
Contractor's Bonds and Insurance (3%)						$4,035
Contractor's Overhead and Profit (15%)						$20,175
Estimated Bid Price						$171,020
Construction Contingency (30%)						$51,306
Total Estimate of Probable Construction Cost						$222,326
Engineering/CM						
- Pre-Design (6%)	1	LS				$13,340
- Contract Documents (14%)	1	LS				$31,126
- Engineering Support During Construction - Office (4%)	1	LS				$8,893
- Construction Management - Field (14%)	1	LS				$31,126
Grand Total						**$306,810**

* Pricing for PAX mixing systems is comparable to the Solarbee units.

Table 8-4 02418-10-019 March-11

City of Sonoma - Water CIP

Project No. 4 - Napa Street Tank/Zone 1-2 Pump Station Upgrade ENR CCI 8864.72 July-10

	QUANTITY		COST			
ITEM DESCRIPTION	No.	Unit	Material	Labor	Total	TOTAL COST
General						
Storage Tank Coating	1	LS	$75,000	$90,000	$165,000	$165,000
Rehab Cathodic Protection System	1	LS	$8,000	$4,000	$12,000	$12,000
Level Indicating Transmitter	1	LS	$2,000	$1,500	$3,500	$3,500
Presssure Indication Transmitter	1	LS	$2,500	$1,500	$4,000	$4,000
PLC with Enclosure	1	LS	$400	$1,750	$2,150	$2,150
Site Gauge	1	EA	$1,500	$1,250	$2,750	$2,750
5-hp Pressure Lubricated Compressor w/ Filter and Regulator	1	EA	$13,000	$2,500	$15,500	$15,500
Retrofit New Tank Nozzle	1	EA	$1,500	$2,500	$4,000	$4,000
12-inch Check Valve	1	EA	$2,500	$1,500	$4,000	$4,000
12-inch Butterfly Valve	2	EA	$1,650	$1,500	$3,150	$6,300
12-inch PVC Pipe and Restrained Fittings	1	LS	$2,000	$1,250	$3,250	$3,250
12-inch Steel Pipe and Restrained Fittings	1	LS	$2,500	$1,500	$4,000	$4,000
Tie-In to Existing 12-inch Pipe	1	EA	$1,500	$2,000	$3,500	$3,500
Subtotal Materials	--	--	$115,700	--		
9% Sales Tax Materials						$10,413
Construction Subtotal						$240,363
Mobilization/Demobilization (4%)						$9,198
Contractor's Bonds and Insurance (3%)						$6,899
Contractor's Overhead and Profit (15%)						$34,493
Estimated Bid Price						$290,952
Construction Contingency (30%)						$87,286
Total Estimate of Probable Construction Cost						$378,238
Engineering/CM						
- Pre-Design (6%)	1	LS				$22,694
- Contract Documents (14%)	1	LS				$52,953
- Engineering Support During Construction - Office (4%)	1	LS				$15,130
- Construction Management - Field (14%)	1	LS				$52,953
Grand Total						**$521,968**

Table 8-5 02418-10-019 March-11

City of Sonoma - Water CIP

Project No. 5 - Well No. 3 Replacement

ENR CCI 8864.72 July-10

	QUANTITY		COST			
ITEM DESCRIPTION	**No.**	**Unit**	**Material**	**Labor**	**Total**	**TOTAL COST**
General						
Phase 1 – Site Preparation						
Survey	1	LS	$0	$5,000	$5,000	$5,000
Geotechnical	1	LS	$0	$8,000	$8,000	$8,000
Phase 2 – Pilot Hole, Water Quality Analysis and Estimate of Yield						
Pilot Boring and Monitoring Well Permitting by PRMD	1	LS	$0	$1,800	$1,800	$1,800
Drill Pilot Boring to 600 feet	600	LF	$0	$35	$35	$21,000
Water Sampling During Drilling	1	LS	$0	$17,000	$17,000	$17,000
E-logging	1	LS	$0	$3,500	$3,500	$3,500
Phase 3 - Conceptual Design for Well Site						
Monitoring well construction in pilot boring to 600 feet.	600	LF	$0	$25	$25	$15,000
Monitoring well construction, develop and CDPH water quality sampli	1	LS	$0	$16,000	$16,000	$16,000
CDPH permitting and well head protection evaluation	1	LS	$0	$3,000	$3,000	$3,000
Phase 4 - Well Installation, Pilot Treatment Test and Aquifer Testing						
CDPH, City, USA, Disposal Facilities & Noise Mitigation	1	LS	$1,500	$5,000	$6,500	$6,500
Replacement Well Drilling to 600 feet/Casing and Development	600	LF	$0	$200	$200	$120,000
Aquifer Testing, Title 22 Analysis and CDPH Meeting	1	LS	$0	$20,000	$20,000	$20,000
Site Cleanup and Disposal of Fluids, Clays and Soil	1	LS	$0	$18,000	$18,000	$18,000
Phase 5 - Pump and Disinfection Installation, Aquifer Testing						
Power, piping and pad	1	LS	$30,000	$35,000	$65,000	$65,000
Disinfection system enclosure	1	LS	$5,000	$3,000	$8,000	$8,000
Pump and colume pipe	1	LS	$60,000	$15,000	$75,000	$75,000
Water level recorder	1	LS	$5,000	$2,500	$7,500	$7,500
Well Testing / Aquifer Testing	1	LS	$5,000	$8,000	$13,000	$13,000
Sampling	1	LS	$3,000	$3,000	$6,000	$6,000
Subtotal Materials	--	--	$109,500	--		
9% Sales Tax Materials						$9,855
Construction Subtotal						$439,155
Mobilization/Demobilization (4%)						$17,172
Contractor's Bonds and Insurance (3%)						$12,879
Contractor's Overhead and Profit (15%)						$64,395
Estimated Bid Price						$533,601
Construction Contingency (30%)						$160,080
Total Estimate of Probable Construction Cost						$693,681
Engineering/CM						
- Pre-Design (5%)	1	LS				$34,684
- Contract Documents (11%)	1	LS				$76,305
- Engineering Support During Construction - Office (4%)	1	LS				$27,747
- Construction Management - Field (14%)	1	LS				$97,115
Grand Total						**$929,533**

Table 8-6 02418-10-019 March-11
City of Sonoma - Water CIP
Project No. 6 - New Well (No.8) ENR CCI 8864.72 July-10

ITEM DESCRIPTION	QUANTITY		COST			TOTAL COST
	No.	**Unit**	**Material**	**Labor**	**Total**	
General						
Phase 1 – Site Selection						
Testing/water quality analysis of existing well on target property	1	LS	$0	$20,000	$20,000	$20,000
Acquisition assistance	1	LS	$0	$15,000	$15,000	$15,000
CEQA	1	LS	$0	$15,000	$15,000	$15,000
CDPH permitting process initiation	1	LS	$0	$10,000	$10,000	$10,000
Phase 2 – Site Preparation						
Survey	1	LS	$0	$10,000	$10,000	$10,000
Geotechnical	1	LS	$0	$15,000	$15,000	$15,000
Phase 3 – Pilot Hole, Water Quality Analysis and Estimate of Yield						
Pilot Boring and Monitoring Well Permitting by PRMD	1	LS	$0	$1,800	$1,800	$1,800
Drill Pilot Boring to 600 feet	600	LF	$0	$35	$35	$21,000
Water Sampling During Drilling	1	LS	$0	$17,000	$17,000	$17,000
E-logging	1	LS	$0	$3,500	$3,500	$3,500
Phase 4 - Conceptual Design for Well Site						
Monitoring well construction in pilot boring to 600 feet.	600	LF	$0	$25	$25	$15,000
Monitoring well construction, develop and CDPH water quality sampli	1	LS	$0	$16,000	$16,000	$16,000
CDPH permitting and well head protection evaluation	1	LS	$0	$3,000	$3,000	$3,000
Phase 5 - Well Installation, Pilot Treatment Test and Aquifer Testing						
CDPH, City, USA, Disposal Facilities & Noise Mitigation	1	LS	$1,500	$5,000	$6,500	$6,500
Replacement Well Drilling to 600 feet/Casing and Development	600	LF	$0	$200	$200	$120,000
Aquifer Testing, Title 22 Analysis and CDPH Meeting	1	LS	$0	$20,000	$20,000	$20,000
Site Cleanup and Disposal of Fluids, Clays and Soil	1	LS	$0	$18,000	$18,000	$18,000
Phase 6 - Pump and Disinfection Installation, Aquifer Testing						
Power, piping and pad	1	LS	$60,000	$50,000	$110,000	$110,000
Disinfection system enclosure	1	LS	$5,000	$3,000	$8,000	$8,000
Controls	1	LS	$5,000	$20,000	$25,000	$25,000
Pump and colume pipe	1	LS	$60,000	$15,000	$75,000	$75,000
Water level recorder	1	LS	$5,000	$2,500	$7,500	$7,500
Well Testing / Aquifer Testing	1	LS	$5,000	$8,000	$13,000	$13,000
Sampling	1	LS	$3,000	$3,000	$6,000	$6,000
Subtotal Materials	--	--	$144,500	--		
9% Sales Tax Materials						$13,005
Construction Subtotal						$524,305
Mobilization/Demobilization (4%)						$20,452
Contractor's Bonds and Insurance (3%)						$15,339
Contractor's Overhead and Profit (15%)						$76,695
Estimated Bid Price						$636,791
Construction Contingency (30%)						$191,037
Total Estimate of Probable Construction Cost						$827,828
Engineering/CM						
- Pre-Design (5%)	1	LS				$101,391.42
- Contract Documents (11%)	1	LS				$91,061
- Engineering Support During Construction - Office (4%)	1	LS				$33,113
- Construction Management - Field (14%)	1	LS				$115,896
Grand Total						**$1,169,290**

Appendix A
10-Year Water Capital Improvement Program
FY 2010-2020

City of Sonoma

10-Year Water Capital Improvement Program - FY 2010 - 2020 (all costs shown in 2010 dollars) Sep-10

ID #	Description	Notes	Ft	Svcs	FY 10-11	FY 11-12	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	FY 17-18	FY 18-19	FY 19-20	Totals
	Additional Recommended Capital Improvement Projects														
1	Zone 1-2 Intertie									125,000	547,503				$ 672,503
2	Zone 3 Expansion					137,436									$ 137,436
3	Tank Mixing (3 tanks)						303,257								$ 303,257
4	2.0 mg Napa St. Tank/Zone 1-2 Pump Station Upgrade						125,000	237,951							$ 362,951
5	Well No. 3 Replacement (see ID #46)								250,000						$ 250,000
6	New Well No. 8 (see ID #49)					250,000	750,000	169,290							$ 1,169,290
	Sub-Total				**-**	**387,436**	**1,178,257**	**407,241**	**250,000**	**125,000**	**547,503**	**-**	**-**	**-**	**$ 2,895,437**
	City's Current CIP (from J. Nelson 2010 Rate Study Report)														
		Notes	**Ft**	**Svcs**											
	Water Mains	1													
7	Napa Road Waterline Extension (Broadway-Larkin)		1200												$ -
8	5th St West & Napa (abandon)[14]		90			65,000									$ 65,000
9	Denmark Seventh to 5th East		900	5				450,000							$ 450,000
	Sub-Total - Water mains				**0**	**65,000**	**0**	**450,000**	**0**	**0**	**0**	**0**	**0**		**$ 515,000**
	Service Lines	1,2													-
10	Fano Lane and Bettencourt Area			142	240,000										$ 240,000
11	Citywide Water Replacement Proj #0908			109	480,000										$ 480,000
12	El Nido Ct			8				31,200							$ 31,200
13	Hwy 12, Napa St West, 1st St West to City Limit			160		300,000	324000								$ 624,000
14	Wilking Way			27				105,300							$ 105,300
15	Este Madera Dr.	3		52					202,800						$ 202,800
16	Ave Del Oro - 5th West to Cordilleras			15		58,500									$ 58,500
17	Ave Del Oro - 692 to Appleton			8		31,200									$ 31,200
18	Appleton Way			9		35,100									$ 35,100
19	Cobblestone			17					66,300						$ 66,300
20	Padre			3					11,700						$ 11,700
21	Guadalupe			8					31,200						$ 31,200
22	Seventh St. East			15					58,500						$ 58,500
23	Louise Court			4					15,600						$ 15,600
24	St. Germain Ct			4					15,600						$ 15,600
25	Las Casitas Court			35					136,500						$ 136,500
26	Creek Lane			11					42,900						$ 42,900
27	Park Lane			19					74,100						$ 74,100
28	Nathanson Creek			10					39,000						$ 39,000
29	Marcy Ct			16						62,400					$ 62,400
30	Oregon			40						156,000					$ 156,000
31	Gregory Circle			24							93,600				$ 93,600
32	Anthony Court			11							42,900				$ 42,900
33	Curtin Lane			28								109,200			$ 109,200
34	Alley North of Banchero			2							7,800				$ 7,800
35	End of Perkins/Robinson St.			4							15,600				$ 15,600
36	Perkins @ 2nd West to 3rd West			11						42,900					$ 42,900
37	Misc. Service Line Replacements	4		46	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000		$ 180,000
	Sub-Total Service Lines			**856**	**740,000**	**444,800**	**344,000**	**156,500**	**714,200**	**281,300**	**179,900**	**129,200**	**20,000**		**$ 3,009,900**
	Tanks, Pumps, Wells and Other Improvements	1													
38	Feasibility Study/CEQA doc./Construct VOM/SDC CU Proj.				30,000	40,000	200,000	385,004							$ 655,004
39	New 0.5 mill gallon tank @4th and Brazil									1,000,000	1,000,000				$ 2,000,000

						FY 10-11	FY 11-12	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	FY 17-18	FY 18-19	FY 19-20	Totals
40		2.0 mill gallon Tank Interior / exterior Recoat				300,000										$ 300,000
41		3.0 mill gallon Tank Exterior Recoat											50,000	700,000		$ 750,000
42		0.5 mill gallon Tank Exterior Recoat										315,000				$ 315,000
43		New Booster Pump Station Zone 1											650,000			$ 650,000
44		Pump Replacements Zone 2								70,000						$ 70,000
45		Pump Replacements and Upgrade Zone 3								90,000						$ 90,000
46		Well #3 Replacement (note: in-lieu of Well #1 Replacement)							250,000	679,533						$ 929,533
47	*Note	Well Replacements/Water Quality and Control Improvements (Well #1)														$ -
48		General Well Improvements				125,000										$ 125,000
49	*Note	Study, Construct, Test and Equip New Well #8	5			200,000	800,000									$ 1,000,000
50	*Note	Study, Construct, Test and Equip New Well #9	5													$ -
51		Study, Construct, Test and Equip New Well #10	5													$ -
52		Feasibility Study/Improvements	6													$ -
53		Local Ground Water Source Assessment Study														$ -
54		Aerial Mapping for CIP Projects														$ -
55		Telemetry Upgrade & Improvements*						13,000			16,000					$ 29,000
56		Other System Replacement/Improvements*				70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000		$ 630,000
57		Water Conservation Program*	7			175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000		$ 1,575,000
58		Subsurface Leak Detection Services*				12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000		$ 108,000
59		Valve Replace./Repair & Pump Maint & Repair*	8			30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000		$ 270,000
60		Street Resurfacing*	9			150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000		$ 1,350,000
61		Misc. Equipment for CIP Projects*				15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000		$ 135,000
62		Water System Master Plan*				80,000						80,000				$ 160,000
63		General Consulting on CIP Projects and Periodic Rat	10			15,000	15,000	15,000	15,000	40,000	15,000	15,000	15,000	15,000		$ 160,000
		Tanks, Pumps, Wells and Other Improvements Sub-Total				**1,157,000**	**1,907,000**	**680,000**	**952,004**	**1,552,000**	**1,483,000**	**1,862,000**	**1,167,000**	**1,167,000**	**1,000,000**	**$ 12,927,004**
		SUBTOTAL - CITY'S CURRENT CIP				**1,897,000**	**2,416,800**	**1,024,000**	**1,558,504**	**2,266,200**	**1,764,300**	**2,041,900**	**1,296,200**	**1,187,000**	**1,000,000**	**$ 19,347,341**
		TOTAL - "MASTER" CIP Δ				**1,897,000**	**2,804,236**	**2,202,257**	**1,965,745**	**2,516,200**	**1,889,300**	**2,589,403**	**1,296,200**	**1,187,000**	**1,000,000**	**22,242,778**

Notes:

1 Does not include construction of new main extensions or service laterals or other facilities that may be required to serve a new connector to the water system.

2 Mainly spent on Polybutylene (PB) service line failures. PB lines account for 80% of service line failures.

3 Included in Citywide Lateral Replacement item

4 Number of service lines is estimated. Avg. cost of service line replacement from FYE 2005-FYE 2009 =

5 Local Supply expansion program.

6 Study to determine if Well #5 should be rehabilitated or abandoned and new well drilled in the immediate vicinity.

7 Does not include conservation installed or paid for by new development (i.e. conservation on-site due to plumbing code or NDS) but does include conservation programs that new Cons. Offset Charge would contribute too.

8 Replace main line valves & pumps throughout the systems and other system components as they age and are identified by system operation.

9 These funds are transferred to the Gas Tax Fund for expenditure on street resurfacing caused by maintenance, repair and upgrade of water system.

10 Outside consulting services required on CIP projects from time to time, including periodic. Includes funds for Rate Study every 5 years.

11 It is the accounting practice of the City to include items marked with an asterisk in the Operations Budget or, in some cases in the Inter-City Transfer Budget. They are included here to obtain an appropriate tally of capital project related expense. Because these items are also imbedded in the Operations Expense forecast in the Rate Model, adjustments must be made to avoid double counting these expenses.

12 Adjustment for Capacity + Cons. Offset Charge Financed Capital Expense Included in Operation Budget

13 Adjustment for Water Rate Financed Capital Expense Included in Operation Budget

14 May not include costs to reconnect 5-7 services.

* Note: Modified from J. Nelson report based on new information

Δ Note: Costs do not include conversions required at Sonoma Market Place and Maxwell Village