City of Brentwood

Water Master Plan

June 1, 2017

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Executive Summary

The City of Brentwood last updated the Water Master Plan in 2006. The 2006 report was an update of a previous 2003 Water Master Plan. The 2006 Water Master Plan was based upon a computerized water model with new demand allocations for the 'build out' of the City water system, up to the limits of the 2006 City General Plan. No evaluation of the existing water system was conducted at that time. The 2006 Water Model and Analysis was evaluated under the following criteria:

- A total, system-wide maximum day build out of 41 MGD based on the City's adopted 2001 General Plan
- A maximum day peaking factor of 2.1
- A peaking hour factor of 4.0 times the average day demand.

The purpose of this water model update was to conduct an existing system water model simulation, to determine immediate capital improvement needs, to analyze a future system build out to the limits of the City's General Plan and to evaluate the locations and costs for all future water system requirements.

Citing the 2006 Water Master Plan, the following recommendations and the subsequent execution of said recommendations were referenced.

Conclusions of the 2006 Water Master Plan

- Total Buildout of the water system is expected to be 41 mgd on a maximum day. Supply would be provided by the following:
    - *30 mgd from a new water treatment plant.*
    - *6 mgd from the Randall Bold Water Treatment Plan.*
    - *6 mgd from existing city wells.*
- Pumps and motors on all existing wells will need to be upgraded to provide higher flows for higher headlosses.
- Surface water storage will need to increase from 10.8 million gallons to 33.8 million gallons (+313%), an increase of 23.0 million gallons.
- New pump (booster) stations will be required at all future, at-grade water storage reservoirs.
- The City's existing water lines are adequately sized to provide service at full build-out of the water system.
- Fire flows could not be achieved at 69 locations. However, the location of these deficiencies were not provided within the report.

Conclusions of the 2017 Water Master Plan

Existing Water System:

- The current population of Brentwood is approximately 58,500 citizens.
- Recent drought prevention methodologies employed by the City reduced average, per capita consumption from a high of 228 gpcd in FY 2006 to 110 gpcd in FY 2015.
- Significant fluctuations in consumption complicates water demand projections; however, a master planning value of 180 gpcd was established for all existing and future facilities.
- The City currently has a master planned average day demand of 10.5 mgd and a master planned maximum day demand of 17 mgd. A peaking factor of 1.8 was utilized for all existing and future facilities.
- The City water system is well planned with redundant flow paths. Sufficient water supply, storage and pumping are present to serve both the current average day and maximum day demands.
- Other than a few localized pipe upgrades, the only major concern is the interconnection between the eastern and western portions of Zone 2. Without more interconnection, the northern and western portions of Zone 2 do not sufficiently benefit from Pump Station 2.3 and Reservoir 2.3.
- Fire flow simulations show no present deficiencies in providing adequate fire flows to all points in the water distribution system. As the model only analyzed 6" and larger pipe, this does not mean a problem could exist with a 4" fire lateral or partially closed water valve during a fire event.

Future (General Plan) Water System:

- The population of the City of Brentwood to approximately 92,500 citizens.
- The future average day demand will increase to 17 mgd while the future maximum day demand will increase to 31 mgd. This value is approximately 10 mgd less than the maximum day demand evaluated in the 2006 Water Master Plan.
- Overall System Improvements:
    - Phase II City of Brentwood Water Treatment Plant expansion to 30 mgd.
- Zone 1 improvements:
    - One (1) new 4 MG reservoir and 32,000 linear feet of master backbone infrastructure.
- Zone 2&3 improvements:
    - One (1) new 3 MG reservoir, a new 6.5 mgd booster pump station and 21,000 linear feet of master backbone infrastructure.

Overall, the City of Brentwood has a well designed, operated and maintained water distribution system.

Chapter 1
Background and Purpose

1.1 Background and Purpose

The City of Brentwood (City) is located in eastern Contra Costa County, approximately 50 miles east of San Francisco, California. Incorporated in 1948, the City had a 2000 census population of 23,265 and a 2010 census population of 52,193 (+224%). While population increases were dramatic at the turn of the century, growth rates over the last decade have remained relatively constant of around 1,500 to 2,000 citizens per year (see Figure1).

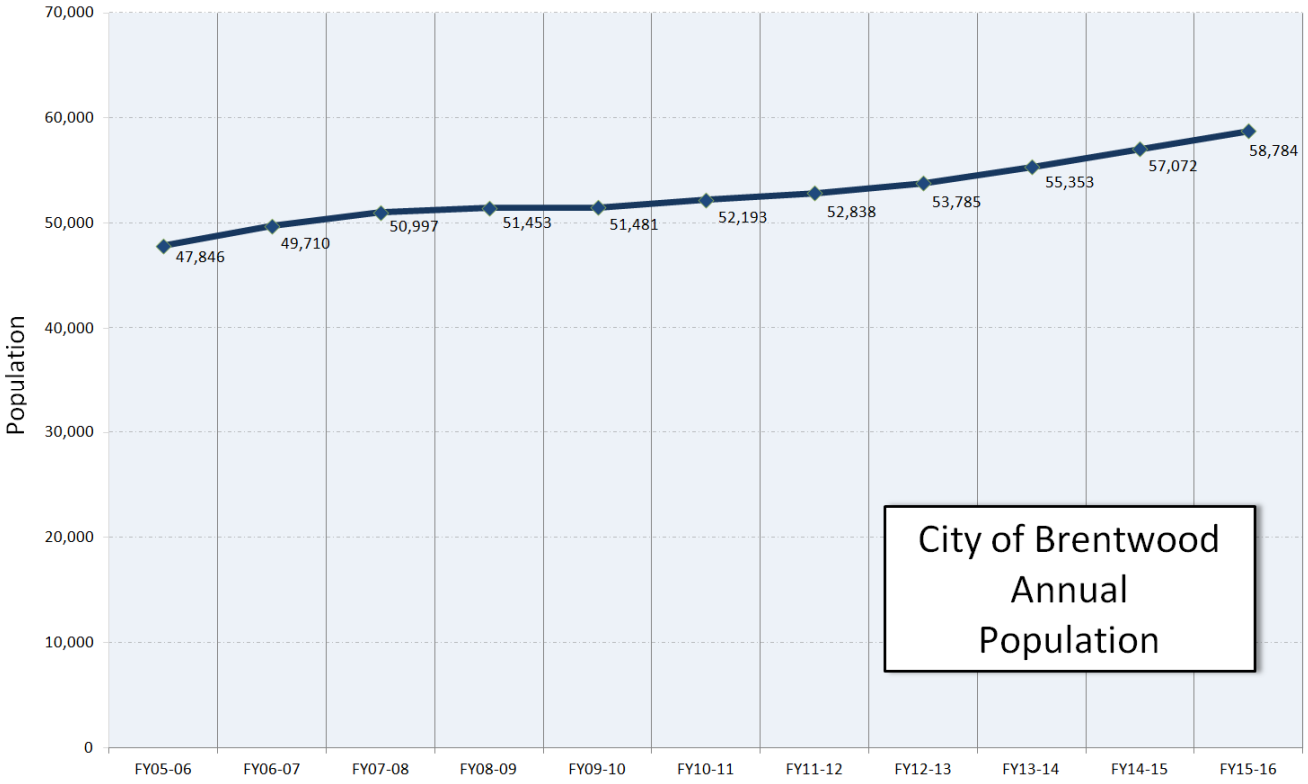


Figure 1 - City of Brentwood Population (By Year)

The purpose of the hydraulic water model and master plan is to determine the current operational condition of the existing hydraulic network and to ascertain the various water infrastructure needs in serving a 'full build' general plan that is expected to see the City grow from a present value of 6,279 acres to 12,037 acres (not taking into account an additional 12,081 acres for Agricultural Conservation or 3,012 for a new Regional Park). While the increase in developable is land is approximately +92%, the most recent general plan anticipates the city population to grow to approximately 92,500 citizens (+57%).

The goal of this master plan is to determine if any deficiencies exist in the current water distribution system and then to ascertain which facilities should be constructed as mitigation. The second goal of this master plan is to model the ultimate boundaries of the city's general plan and the determine which facilities will be required to service future growth in the years to come.

1.2 Design Criteria

The water system will be evaluated per the design criteria as provided in Table 1. Of particular note is the 'System Storage' requirement regarding emergency, fire and operational storage. This criteria was taken from the 2006 Water Master Plan and is further discussed in Section 2.1.1 and Section 4.1.1 of this report.

City of Brentwood
Water System Design Criteria

System Pressures

Minimum
- 40 psi - maximum day demand
- 20 psi - maximum day + fire flow

Fire Flow Requirements

Flow Rate and Duration

Land Use	Flow	Duration
Residential (Low to Medium)	2,000	2 hours
Residential (High), Schools	3,000	3 hours
Office, Commercial, Industrial	4,000	4 hours

Pipeline Sizing

Maximum Velocity
- 10 fps - maximum day demand

Maximum Headloss
- 10 ft/1,000 feet - maximum day demand

Storage Requirements

Operational
- 25% of maximum day demand

Fire Storage
- 4,000 gpm at 4 hours (960,000 gal)

Emergency
- 50% of maximum day demand

Total Storage = Operational + Fire + Emergency

Pumping Capacity

All Zone 1 pumps must lift the entire system maximum day demand
All Zone 2 pumps must lift all Zone 2 + Zone 3 maximum day demand
All Zone 3 pumps must lift all Zone 3 maximum day demand

Extended Period Simulation

System to be evaluated at no less than one week of Extended Period Simulations to determine system operational supply and demand

Table 1 - Water System Design Criteria

Chapter 2
System Data Collection

2.1 Existing System

The City of Brentwood water distribution network is a multi-pressure zone system. Shown in Figure 2, Zone 1 is the largest zone and is relatively flat with elevations ranging from 44' to 200' AMSL. All sources of water (8 wells + Water treatment plants) for the City are fed into Zone 1. At present, only 5 of the 8 wells are operational. Zone 2 is a pumped zone that draws the entirety of its water from Zone 1. Elevations within this zone range from range from 104' to 300' AMSL. Zone 3 is comprised of three separate pressure zones (North, Central, and South). Each of these zones is a closed pressure zone and are fed directly from Zone 2. Table 2 was created from the hydraulic computer model to illustrate the proportionality of analysis nodes within the water distribution network. Note that the majority of the water demand resides in Pressure Zone 1.

City of Brentwood
Existing Junction Nodes

Zone	Max Elevation (ft)	Min Elevation (ft)	Total Nodes	HGL	% of Total
Zone 1	200	44	2,410	228	70.1%
Zone 2	330	104	933	345	27.1%
Zone 3	336	178	94	Varies	2.7%
Total			3,437		100.0%

Table 2 - Water Model Nodes (By Pressure Zone)

2.1.1 Water Storage

Water storage consists of operational, emergency and fire demand. Zone 1 contains three (3) storage reservoirs with a combined 10.8 million gallons. Zone 2 contains three (3) storage reservoirs with a combined 8.0 million gallons. Zone 3 consists of three separate pressure zones that are pumped directly from Zone 2. There is one pump station with multiple pumps and backup power for each of the three pressure zones within Zone 3.

City of Brentwood
Existing Water Storage

Existing Max Day Demand **18.88** **mgd**

Tank ID	Zone	Volume (mg)	Low Water (ft)	High Water (ft)	Max. Water Height (ft)	Diameter (ft)	Volume @ Max. Water (gal)	Operational Storage (gal)	Emergency Storage (gal)	Fire Demand (gal)	Minimum Storage Req.	Storage Deficit
Reservoir 1.1	Zone 1	2.5	197	229	32	114	2,443,154					
Reservoir 1.2	Zone 1	4.3	197	229	32	149	4,173,627					
Reservoir 1.3	Zone 1	4.0	197	229	32	150	4,229,837					
Zone 1 Capacity		10.8						3.07	6.13	0.96	*10.16*	*0.64*
Reservoir 2.1	Zone 2	2.0	320	348	28	107	1,883,288					
Reservoir 2.2	Zone 2	2.0	320	348	28	107	1,883,288					
Reservoir 2.3	Zone 2	4.0	320	348	28	150	3,701,107					
Zone 2 Capacity		8.0						1.65	3.30	0.96	*5.92*	*2.08*
Total Storage Capacity		18.8										

Note: Zone 1 = 65% of system demand. Zone 2 + Zone 3 = 35%

Table 3 - Existing Water System Storage and Deficiency

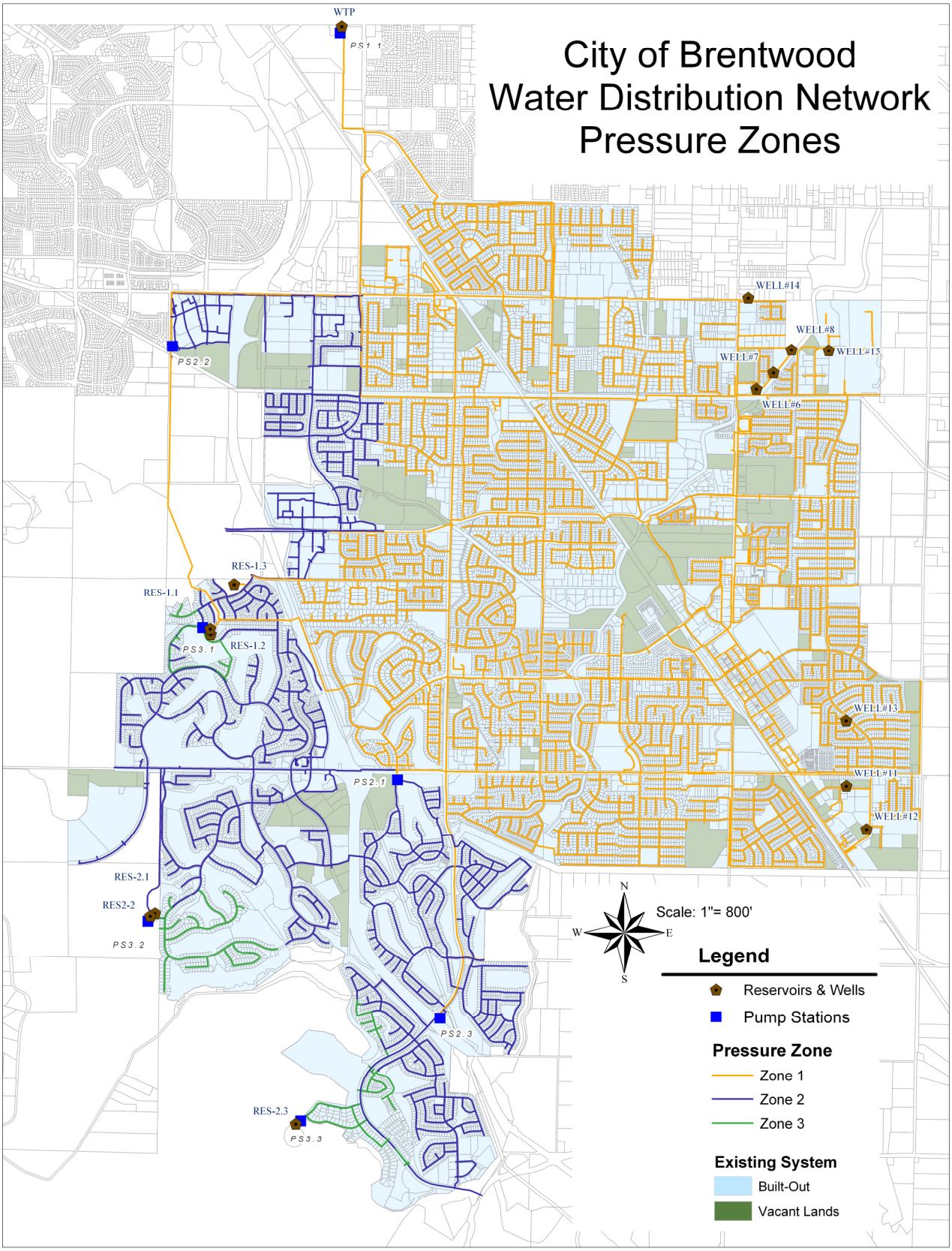


Figure 2 - City of Brentwood Pressure Zones and Vacant Land Uses

As provided in Table 3, approximately 65% of the total water system demand lies within Zone 1 while 35% resides within Zones 2 and 3. Water storage requirements for the City of Brentwood are as follows:

- Operational Storage - 25% of maximum day demand
- Emergency Storage - 50% of maximum day demand
- Fire Storage - 4 hours of 4,000 gpm (960,000 gallons)

Applying these requirements to a current Maximum Day Demand of approximately 18.9 mgd shows that Zone 1 has a surplus of 0.64 mg (10.8 provided vs. 10.16 required) while Zones 2 and 3 have a surplus of 2.08 mg (8.0 provided vs. 5.92 required). However, it is worth noting that the construction of additional storage will be required in the near future to accommodate anticipated growth within the City of Brentwood.

2.1.2 Pipe Network

Table 4 shows the overall lengths and sizes of pipe within each pressure zone. Using an effective replacement cost for each pipe diameter, the City has approximately $194 million in existing pipeline infrastructure contained within 1.3 million linear feet of pipe. Once again, note that the majority of the entire water system lies within Pressure Zone 1. Lastly (and for informational purposes only) the City has about 8 million gallons of water stored within the water distribution system at any given time.

City of Brentwood
Existing Pipe Lengths and Sizes

	Diameter (in.)	Length (ft.)	Replacement Cost/Ft	Total Capital Cost (GASB)	Existing Volume in System (gal)	Total (ft.)	% of Total
Zone 1	6	38,723	$90	$3,485,082	56,872	939,444	70.8%
	8	564,500	$110	$62,094,998	1,473,915		
	10	15,194	$140	$2,127,148	61,987		
	12	159,055	$170	$27,039,420	934,414		
	16	23,652	$200	$4,730,413	247,023		
	18	29,077	$230	$6,687,755	384,349		
	20	45,823	$250	$11,455,685	747,773		
	24	48,868	$280	$13,683,025	1,148,352		
	30	1,461	$300	$438,418	53,658		
	36	6,482	$325	$2,106,575	342,710		
	42	6,588	$350	$2,305,900	474,132		
Zone 2	6	2,195	$90	$197,552	3,224	346,513	26.1%
	8	174,637	$110	$19,210,085	455,979		
	10	2,987	$140	$418,250	12,188		
	12	82,926	$170	$14,097,454	487,173		
	14	2,046	$190	$388,703	16,359		
	16	62,347	$200	$12,469,362	651,153		
	18	1,263	$230	$290,562	16,699		
	20	12,405	$250	$3,101,285	202,437		
	24	5,695	$280	$1,594,579	133,826		
Zone 3	8	16,873	$110	$1,855,999	44,055	40,721	3.1%
	12	22,042	$170	$3,747,161	129,492		
	16	1,583	$200	$316,573	16,532		
	24	224	$280	$62,655	5,258		
				$193,904,638	8,099,562	1,326,678	100.0%

Table 4 - Existing Water Distribution Pipes (By Pressure Zone)

2.1.3 Wells and Pump Stations

The wells and pump stations provide supply for the City of Brentwood. Shown in Table 5, the overall performance of the currently operational well system is approximately 5,000 gpm (~7 mgd). Wells #11,

#12 and #13 are currently off line due to various operational issues. As this table additionally shows, system wells and pump controls are regulated by water levels in Reservoir 1.1, Reservoir 2.1 and Reservoir 2.3. The pumps at Pump Station 1.1 are controlled by the operator of the water treatment plant and will vary by time of day and season. As of the writing of this report (Spring 2017), the water treatment plant is operated during daytime hours and is used to fill all tanks in the system which have drained during the evening, night time and early morning hours.

City of Brentwood
Existing Operational Statements
Wells and Pump Stations

Zone	Pump	Pump Design Data	Pump Turns On	Pump Turns Off	Diameter	Horsepower	Operational Head	Operational Flow	Pump Curve	Comments
	PS1.1-1	3: Multiple Point Curve	Depends on treatment plant operations. Varies by season		18		155	5,800	PS1.1-1	
	PS1.1-2	3: Multiple Point Curve	Depends on treatment plant operations. Varies by season		23		155	13,000	PS1.1-2	
	PS1.1-3	3: Multiple Point Curve	Depends on treatment plant operations. Varies by season		18		155	5,800	PS1.1-1	Same model as Pump #1
	WELL#11	1: Design Point Curve	When RES1.1 below 1 ft.	When RES1.1 above 25 ft.	12					Well #11 is always OFF
	WELL#12	1: Design Point Curve	When RES1.1 below 17.5 ft.	When RES1.1 above 24 ft.	6					Well #12 is always OFF
	WELL#13	1: Design Point Curve	When RES1.1 below 1 ft.	When RES1.1 above 2 ft.	8					Well #13 is always OFF
1	WELL#14	3: Multiple Point Curve	When RES1.1 below 15.5 ft.	When RES1.1 above 24.5 ft.	10		230	1,240	WELL14	Controlled by RES1.1
	WELL#15	3: Multiple Point Curve	When RES1.1 below 15 ft.	When RES1.1 above 24 ft.	6		200	665	WELL15	Controlled by RES1.1
	WELL#6	3: Multiple Point Curve	When RES1.1 below 15.5 ft.	When RES1.1 above 24 ft.	12		215	1,025	WELL6	Controlled by RES1.1
	WELL#7	3: Multiple Point Curve	When RES1.1 below 15.5 ft.	When RES1.1 above 24 ft.	12		220	1,150	WELL7	Controlled by RES1.1
	WELL#8	3: Multiple Point Curve	When RES1.1 below 15.2 ft.	When RES1.1 above 24 ft.	10		200	875	WELL8	Controlled by RES1.1
	PS2.1-1	3: Multiple Point Curve	When RES2.1 below 13.5 ft.	When RES2.1 above 22.5 ft.	20		150	2,600	PS2.1-1	Controlled by RES2.1, LEAD
	PS2.1-2	3: Multiple Point Curve	When RES2.1 below 13 ft.	When RES2.1 above 22 ft.	12		150	2,600	PS2.1-2	Controlled by RES2.1, LAG
	PS2.2-1	3: Multiple Point Curve	When RES2.1 below 13.5 ft.	When RES2.1 above 22.5 ft.	16		140	1,110	PS2.2-1	Controlled by RES2.1, LEAD
2	PS2.2-2	3: Multiple Point Curve	When RES2.1 below 13 ft.	When RES2.1 above 22 ft.	16		140	1,110	PS2.2-2	Controlled by RES2.1, LAG
	PS2.3-1	3: Multiple Point Curve	When RES2.3 below 13 ft.	When RES2.3 above 22 ft.	12		140	2,240	PS2.3-1	Controlled by RES2.3, LEAD #1
	PS2.3-2	3: Multiple Point Curve	When RES2.3 below 13 ft.	When RES2.3 above 22 ft.	12		140	2,240	PS2.3-2	Controlled by RES2.3, LAG #1
	PS2.3-3	3: Multiple Point Curve	When RES2.3 below 12.5 ft.	When RES2.3 above 22 ft.	12		140	650	PS2.3-3	Controlled by RES2.3, LAG #2
	PS2.3-4	3: Multiple Point Curve	When RES2.3 below 11 ft.	When RES2.3 above 20 ft.	12		140	650	PS2.3-4	Controlled by RES2.3, LAG #3
	PS3.1-1	3: Multiple Point Curve	When PRES below 60 psi	When PRES above 75 psi	12		100	150	PS3.1-1	VFD Pump
	PS3.1-2	Off	When PRES below 50 psi	When PRES above 70 psi	12		(Unknown)	(Unknown)	(TBD)	Fire Backup
	PS3.2-1	3: Multiple Point Curve	When PRES below 55 psi	When PRES above 65 psi	12		160	325	PS3.2-1	Small Pump
	PS3.2-2	Off	When PRES below 50 psi	When PRES above 60 psi	12		(Unknown)	(Unknown)	PS3.2-2	Small Pump
	PS3.2-3	Off	When PRES below 30 psi	When PRES above 50 psi	12		(Unknown)	(Unknown)	PS3.2-3	Fire Backup
3	PS3.3-1	Off	Fire Flow Only		12	100	123	2,000	(TBD)	Fire Backup
	PS3.3-2	Off	Backup #2		12	20	118	450	(TBD)	Small Pump
	PS3.3-3	Off	Backup #1		12	20	118	450	(TBD)	Small Pump
	PS3.3-4	1: Design Point Curve	Service Pump is on		12	20	118	450	(TBD)	Small Pump

Table 5 - Existing Water System Logic Controls

All surface water for the system is supplied by Pump Station 1.1. This station is outfitted with three pumps with a total operational capacity of 24,600 gpm (35 mgd). The total existing water supply pumping capacity of Pump Station 1.1 plus the existing operational well field (5 wells @ 7mgd) is approximately 42 mgd.

2.1.4 Pressure Reducing Stations

The City has 6 pressure reducing stations, two (2) of which have multiple pressure reducing valves. As shown in Table 6, Stations #1 and #2 are designed to provide service flows from Zone 2 and into Zone 1 while Stations #3 through #6 were constructed as emergency pressure relief in each (North, Central, South) pumped zone of Zone 3.

The Balfour and the Sand Creek reducing stations are being used to provide optimal service pressures to the Apple Hill and the Somerset developments. Given the topography of these two developments, adequate service pressures could not be achieved solely by Zone 1. Further evaluation of the ground elevations and piping network within these two developments show that this area could become its own pressure zone. This option is further discussed in the Maximum Day Analysis section of this report.

City of Brentwood
Existing Pressure Reducing Valves

STATION	MODEL ID	Description	High Zone	Low Zone	Diameter (in)	Provided Set Pressure (psi)
1	BALFOUR #1	Balfour Rd. #1	Zone 2	Zone 1	6	50
	BALFOUR #2	Balfour Rd. #2	Zone 2	Zone 1	10	45
2	SAND CREEK #1	Sand Creek Rd. #1	Zone 2	Zone 1	6	50
	SAND CREEK #2	Sand Creek Rd. #2	Zone 2	Zone 1	12	45
3	VINEYARD	Vineyard Pkwy.	Zone 3	Zone 2	12	50
4	JULIEN	Julien St.	Zone 3	Zone 2	12	50
5	LATOUR	Latour Dr.	Zone 3	Zone 2	8	50
6	BOCCI CT.	California Train	Zone 3	Zone 2	Unk	Unk

Table 6 - Existing Water System Pressure Reducing Valves

2.1.5 Water Treatment

The City of Brentwood retains surface water rights from the Sacramento and San Joaquin Delta whereby surface water is extracted and delivered to either the City of Brentwood Water Treatment Plant and/or the Randall Bold Water Treatment Plant. The current capacities of the treatment plants are as follows:

- City of Brentwood Water Treatment Plant = 15 mgd.
- Randall Bold Water Treatment Plant = 6 mgd.

Both the City of Brentwood Water Treatment Plant and the Randall Bold Water Treatment Plant discharge treated water into a wet well, adjacent to Pump Station 1.1. The total combined supply from both treatment plants is approximately 21 mgd. The difference between the current operational capacity of Pump Station 1.1 (35 mgd) and treatment plant capacity of the two plants (21 mgd) is 14 mgd.

2.1.6 Water Supply

A total, maximum day water supply of 28.2 mgd is available to the City from both the existing well field (~7 mgd) and the surface water treatment plants (21 mgd). Using a straight line approximation for population growth against the present demand of 180 gpcd, the current source of water is theoretically sufficient to a population of approximately 82,500 citizens. Using a growth rate of 2,500 citizens per year against a present day population of 58,784 citizens, the current water supply is expected to be sufficient until the year 2027. After this time frame, the City will need to provide additional supply via an expansion of the City of Brentwood Water Treatment Plant.

2.1.7 SCADA

The City of Brentwood has constructed an advanced Supervisory Control and Data Acquisition (SCADA) system to assist in management and control of the water system. The SCADA system is capable of gathering and recording system data in order to quickly evaluate and mitigate any mechanical and/or operational malfunctions within the water distribution system. Information from the SCADA system was instrumental in the creation of this Water Master Plan.

2.2 Existing System Demands

According to SCADA and other data provided by City staff, the City of Brentwood has experienced significant swings in water consumption over the past decade. Over the last three years in particular,

proactive measures by the City due to the prolonged drought have caused daily gallon per capita per day (gpcd) consumption to plummet from roughly 190 gpcd to approximately 110 gpcd (-43%, see Table 7).

City of Brentwood
Monthly Water Demand and Population Data
(in millions of gallons)

	January	February	March	April	May	June	July	August	September	October	November	December	Total Annual Demand	Average Dally Demand	Estimated Population	GPCD (gal)
FY05-06	*144.67*	*143.24*	*135.13*	*150.96*	*367.54*	*443.32*	*453.77*	*447.53*	*390.93*	*331.43*	*241.12*	*148.24*	3,398	9.31	47,846	194.57
FY06-07	*180.81*	*166.72*	*236.81*	*298.78*	*398.38*	*464.70*	*516.16*	*513.85*	*406.92*	*344.40*	*187.87*	*151.09*	3,866	10.59	49,710	213.10
FY07-08	*137.34*	*141.00*	*237.08*	*315.48*	*411.74*	*457.41*	*496.03*	*486.69*	*416.56*	*291.01*	*233.56*	*172.06*	3,796	10.40	50,997	203.93
FY08-09	*153.47*	*120.91*	*196.44*	*357.50*	*365.57*	*464.11*	*493.50*	*480.98*	*427.40*	*353.17*	*204.04*	*320.22*	3,937	10.79	51,453	209.65
FY09-10	*128.52*	*108.58*	*166.35*	*208.90*	*347.56*	*432.20*	*493.23*	*486.37*	*449.07*	*277.87*	*222.36*	*144.80*	3,466	9.50	51,481	184.44
FY10-11	*134.66*	*135.27*	*139.57*	*245.78*	*373.88*	*346.16*	*489.97*	*474.19*	*410.85*	*324.19*	*193.71*	*134.50*	3,403	9.32	52,193	178.62
FY11-12	*177.91*	*181.25*	*188.58*	*218.02*	*398.86*	*456.71*	*450.57*	*461.26*	*419.66*	*284.00*	*193.17*	*170.23*	3,600	9.86	52,838	186.68
FY12-13	*141.27*	*158.38*	*255.39*	*301.60*	*436.04*	*461.19*	*501.34*	*498.20*	*426.00*	*336.66*	*183.94*	*140.03*	3,840	10.52	53,785	195.61
FY13-14	*214.75*	*145.29*	*203.37*	*246.72*	*396.00*	*445.23*	*518.37*	*500.44*	*430.12*	*380.53*	*260.50*	*187.42*	3,929	10.76	55,353	194.45
FY14-15	*153.02*	*142.03*	*222.85*	*246.71*	*267.31*	*263.60*	*464.52*	*422.98*	*373.64*	*325.16*	*203.52*	*133.11*	3,218	8.82	57,072	154.50
FY15-16	*119.51*	*114.79*	*127.59*	*191.58*	*257.51*	*320.63*	*287.45*	*283.00*	*259.41*	*224.13*	*157.59*	*131.10*	2,474	6.78	58,784	115.32
													3,539	9.70		184.62
												Average Day Demand		10.58		

Table 7 - Monthly, Annual and Per Capita Water Consumption

The presence of the drought, combined with the proactive measures taken by the City of Brentwood further complicate the evaluation of a 'typical' average day with regards to water demand. In looking at the data, the average day consumption (by population) began to fall between 2009 (209 gpcd) and 2010 (184 gpcd). The City appeared to stabilize water consumption to an average around 185 gpcd until 2014 where it dropped once again to a rate of 115 gpcd. This amounts to a per capita reduction of nearly 50% over a 9 year span (see Figure 3).

It is uncertain what the long term effects of the drought will have on the citizens of Brentwood. Will consumers return to their old water usage habits? Have consumers learned the valuable lesson that water is a precious resource, to be conserved accordingly? And how much longer can the City afford to sell less water at existing rates to a point where capital reserves become depleted?

History would tell us that consumers have a short term memory and that when the drought is a forgotten memory, they should return to their old habits. However, when consideration is given to continuous changes in plumbing codes and land use planning with reduced lot sizes, increased hardscaping and planting of drought tolerant vegetation, it would be safe to assume that the per capita consumption for the City of Brentwood would not return to previous levels (FY2005 - FY 2009). Therefore, for the sake of hydraulic modeling, an estimate of 180 gpcd will be used for present and future water demands (Figure 3).

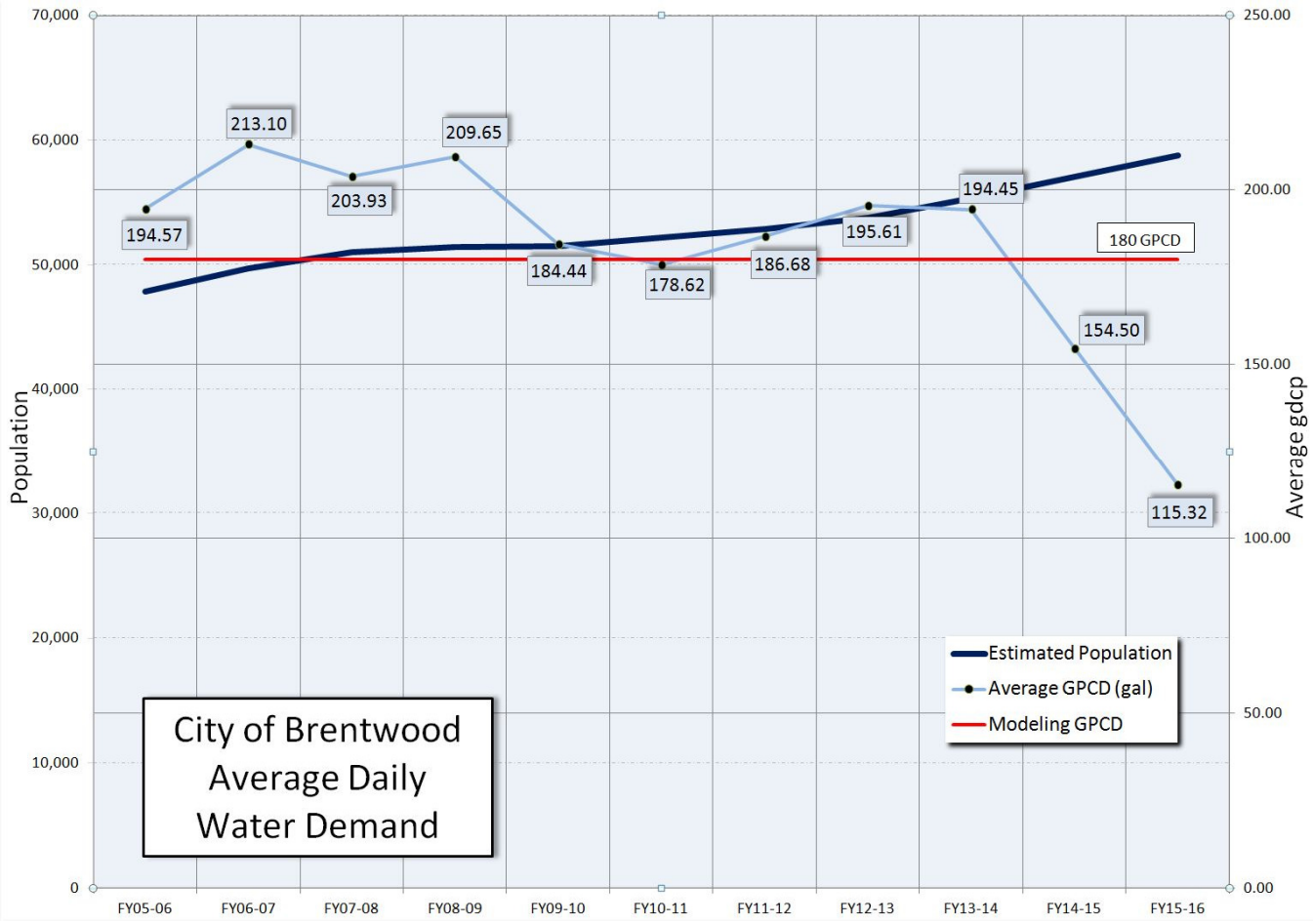


Figure 3 - Annual Average Water Demand per Capita

Chapter 3
Existing Water System Simulations

3.1 Introduction

Prior to determining future hydraulic modeling scenarios which consider the addition of new facilities to serve the ultimate growth of the General Plan, the model was calibrated to existing conditions under an average day demand. Once calibrated, the model was then placed under two operational scenarios. The first scenario was Existing-Average Day Demands while the second scenario evaluated Existing-Maximum Day Demands. Each analysis and relevant hydraulic information is provided herein.

System demands utilized in each scenario are provided in Table 8 which were derived via GIS software. Demands were allocated in the hydraulic model by using a GIS technique whereby each node in the water model inherited the attribute of the nearest land use category. System nodes were then populated with the demands generated by multiplying each land use category (by acreage) and the water duty applied to each land use category. For example, Figure 4 illustrates the geographic dispersion of water demands (red nodes) to the land use category of R-LD (Low Density Residential). Water duties were originally derived from the 2006 water model and were then adjusted accordingly to be in compliance with the Northern California Water Alliance - Land Use/Water Supply Analysis Guidebook (see Table 9). As shown in Table 8, the total average day demand applied to the model was approximately 10.5 mgd while the maximum day demand was 18.9 mgd, respectively. This average day demand relates to a population of 58,784 citizens multiplied by a per capita usage of 180 gpcd. Each model was then evaluated for an extended period simulation in which a diurnal curve provided in Figure 5 was applied.

City of Brentwood
Existing System Land Use
Water System Demand

Use Type	Description	Acres	Density (units/acre)	Water Duty (gpd/unit)	Water Duty (gpd/acre)	Water Duty (mgd/acre)	Water Duty (gpm/acre)	Average Day Demand (mgd)	Max. Day Demand (mgd)	Min. Day Demand (mgd)
BBSP	Brentwood Blvd. Specific Plan	108			2000	0.0020	1.39	0.216	0.390	0.108
BP	Business Park	78			2000	0.0020	1.39	0.156	0.280	0.078
CC	Community College	17			2000	0.0020	1.39	0.034	0.061	0.017
DSP	Downtown - Specific Plan	52			2000	0.0020	1.39	0.105	0.189	0.052
GC	Commercial - General	166			2000	0.0020	1.39	0.332	0.597	0.166
I	Industrial	22			2000	0.0020	1.39	0.044	0.079	0.022
MUPT	Mixed Use Pedestrian Transit	22	10	150	2000	0.0020	1.39	0.045	0.080	0.022
NO GP	No Designation	179			0	0.0000	0.00	0.000	0.000	0.000
P	Park	255			1000	0.0010	0.69	0.255	0.460	0.128
PD	Planned Development	11	10	350	3500	0.0035	2.43	0.038	0.069	0.019
PF	Public Facility	124			1000	0.0010	0.69	0.124	0.224	0.062
PO	Professional Office	26			2000	0.0020	1.39	0.053	0.095	0.026
P-OS	Permanent Open Space	36			0	0.0000	0.00	0.000	0.000	0.000
RC	Commercial - Regional	141			2000	0.0020	1.39	0.282	0.507	0.141
RE	Ranchette Estate	150	1	950	950	0.0010	0.66	0.142	0.256	0.071
R-VLD	Residential - Very Low Density	1,007	2	725	1450	0.0015	1.01	1.460	2.629	0.730
R-LD	Residential - Low Density	2,500	3	590	1770	0.0018	1.23	4.425	7.965	2.212
R-MD	Residential - Medium Density	388	8	450	3600	0.0036	2.50	1.398	2.516	0.699
R-HD	Residential - High Density	83	15	275	4125	0.0041	2.86	0.341	0.614	0.170
SCH	School	248			1500	0.0015	1.04	0.371	0.668	0.186
SPA 2	Special Planning Area #2	0	4	250	1000	0.0010	0.69	0.000	0.000	0.000
SPA 3	Special Planning Area #3	0	4	250	1000	0.0010	0.69	0.000	0.000	0.000
SPF	Semi-Public Facility	665			1000	0.0010	0.69	0.665	1.197	0.333
Total		**6,279**					**MGD**	**10.487**	**18.877**	**5.244**
							GPM	**7,283**	**13,109**	**3,641**

Table 8 - Existing Average and Maximum Day Demands by Land Use

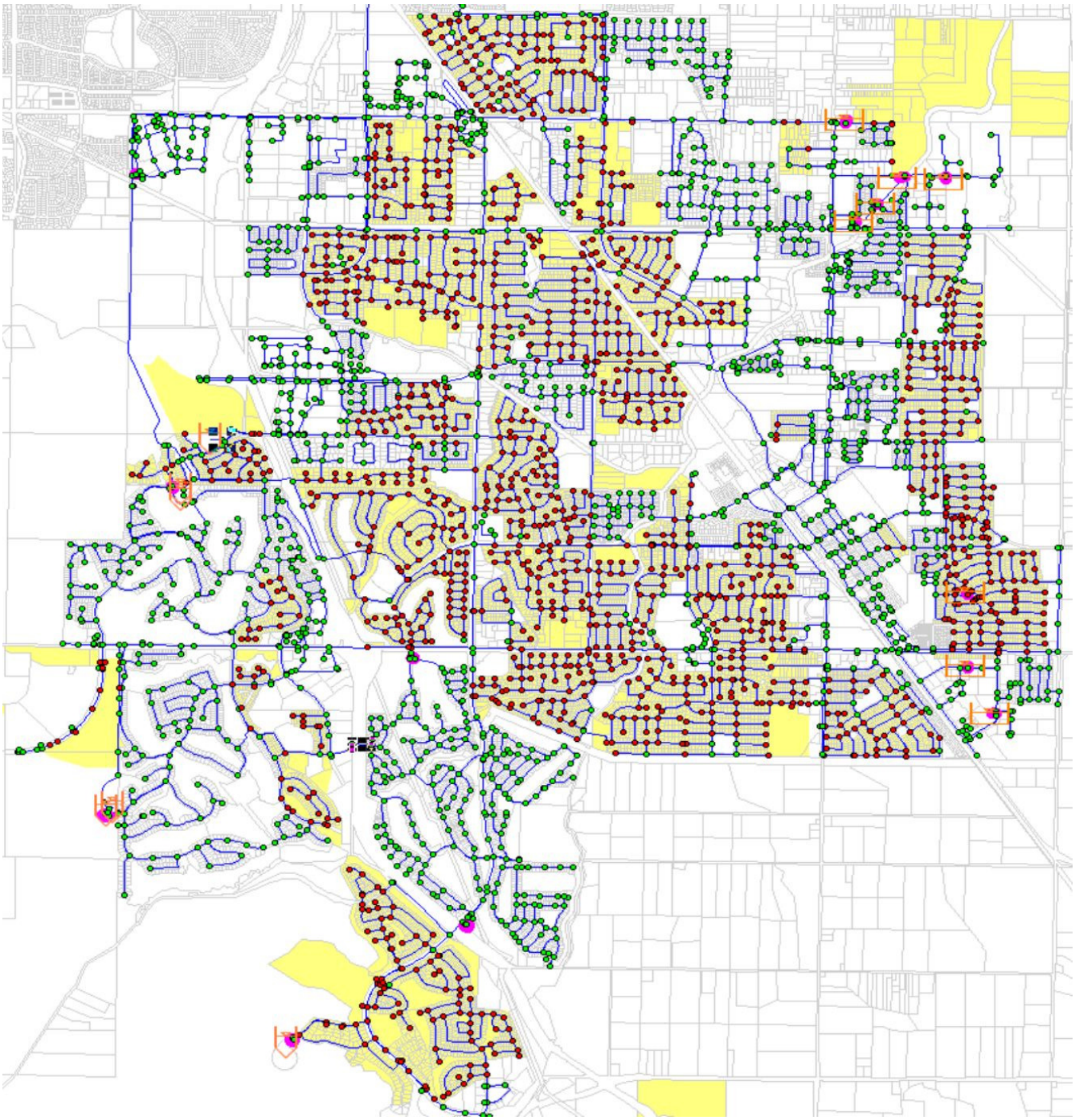


Figure 4 - Low Density Residential Water Demand Dispersion (Example Map)

Table 2-1 Residential Densities/Demand Factors Typical Ranges California – Central Valley					
Classification	**Housing Type**	**Density Ranges (du/ac)**	**Demand Factors**		
				(af/du/yr)	**(gal./du/day)**
Very-Low Density/Rural Residential	Single-family	1-3	Indoor:	0.20 – 0.30	180 – 270
			Outdoor:	0.50 – 0.80	445 – 715
			Total:	**0.70 – 1.10**	**625 – 980**
Low Density	Single-family	4-8	Indoor:	0.15 – 0.25	135 – 225
			Outdoor:	0.35 – 0.65	315 – 580
			Total:	**0.50 – 0.90**	**445 – 805**
Medium Density	Townhomes/ Condos	9-12	Indoor:	0.15 – 0.25	135 – 225
			Outdoor:	0.20 – 0.40	180 – 360
			Total:	**0.35 – 0.65**	**315 – 580**
High Density	Condos/ Apartments	13-25	Indoor:	0.15 – 0.25	135 – 225
			Outdoor:	0.10 – 0.20	90 – 180
			Total:	**0.25 – 0.45**	**225 – 405**

Table 9 - Typical Central California Water Demands by Land Use

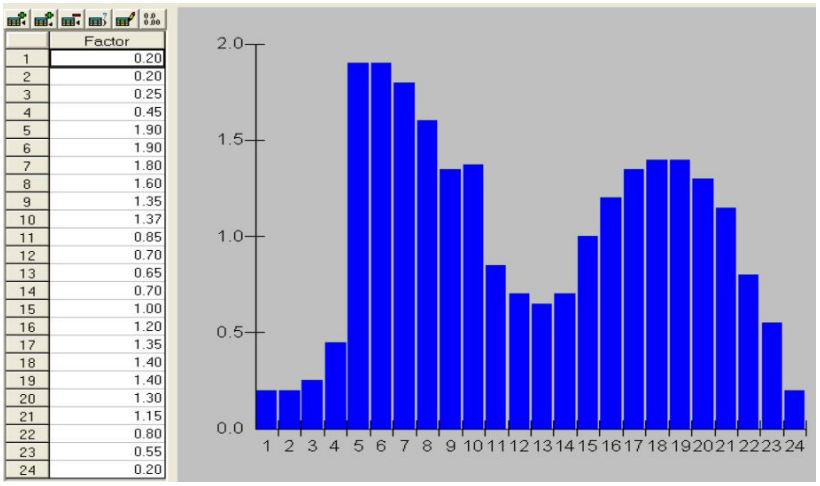


Figure 5 - City of Brentwood Diurnal Curve (Hourly Water Use)

3.2 Existing System – Average Day Analysis

The analysis of this scenario determined that the system operates efficiently under normal conditions (~7,280 gpm). Zone 1 operational pressures varied from a low of 35 psi to a high of 88 psi. Zone 2 operational pressures varied from a low of 44 psi to a high of 120 psi. Zone 3 pressures are pump station dependent and were not evaluated. Table 9 shows how demands were applied to each pressure zone within the City.

City of Brentwood
Existing Water Demand - By Pressure Zone

Pressure Zone	Avg. Day Demand (gpm)	Max. Day Demand (gpm)
Zone 1	5,061	9,110
Zone 2	2,008	3,615
Zone 3	214	385
Total	7,283	13,110

Table 10 - Existing Water Demand by Pressure Zone

Evaluation of the hydraulic model revealed the following:

3.2.1 Existing System Upgrades

- The 12" line in O'Hara Avenue between Lone Tree Way and O'Hara Lane should be upgraded to an 24" line or paralleled with a 16" line due to high flow rates.
- The 8" discharge pipe for Well #14 in Lone Tree Way should be upgraded to a 12" or paralleled with an 8" line due to high flow rates.
- The 8" pipe in Kent Drive. between Grenader Way and Tayberry Lane should be upgraded to a 12" or paralleled with an 8" line due to high flow rates.
- The 8" line in Benoni Lane between Liberty Lane and Katy Way should be upgraded to a 12" or paralleled with an 8" line due to high flow rates.
- The 16" water line on the Ventura Ave. alignment between Upton Pyne Drive and John Muir Parkway is a critical link between the east and west halves of Zone 2. Flows in this pipe are almost always one directional (east to west) and can exceed 4,200 gpm (7.5 ft/s) during an average day. In lieu of upgrading this pipe, the City should construct a 16" interconnect in John Muir Parkway as soon as possible.
- Operationally, there is an issue with Pump Station 2.3 and Reservoir 2.3 as to how much they contribute to the overall supply of Zone 2. As previously discussed, there exists insufficient interconnect piping between the eastern and western halves of Zone 2. As a result, the water levels in Reservoir 2.3 are consistently higher than the levels in Reservoir 2.1 and 2.2 (see Figure 7). Given a maximum day demand and with the Balfour and Sand Creek PRV's bleeding excessive flows into Zone 1, there could be a problem in the future with trying to keep sufficient water levels in Reservoirs 2.1 and 2.2. In other words, the headlosses and velocities in the singular 16" interconnect can only be pushed so far. Without adequate redundancy, the usefulness of both Pump Station 2.3 and in Reservoir 2.3 can become less significant during high demand days. Figure 6 provides the water level relationship between the two reservoirs during an average day demand while Figure 7 shows Pump Stations 2.1 and 2.2 working more frequently than Pump Station 2.3. Figure 8 shows the 16" interconnect as the only link between Reservoir 2.3 and the rest of Zone 2.

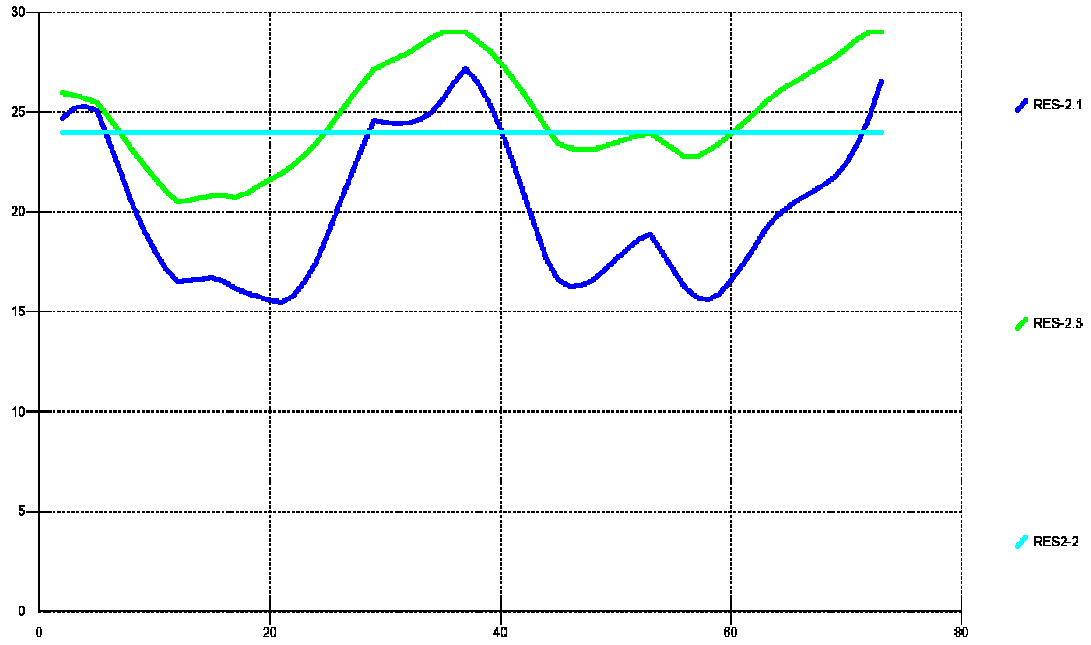


Figure 6 - Average Day Zone 2 Reservoir Levels
(Note: Tanks Res-2.1 and Res-2.2 have been combined for modeling purposes)

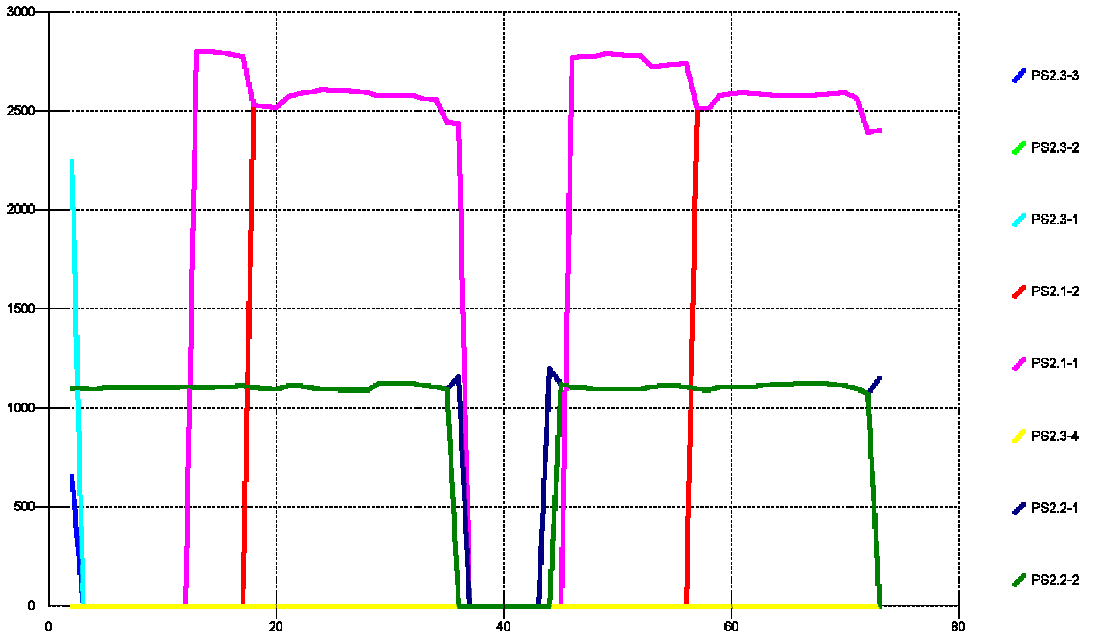


Figure 7 - Existing Zone 2 Pumping Rates and Frequency

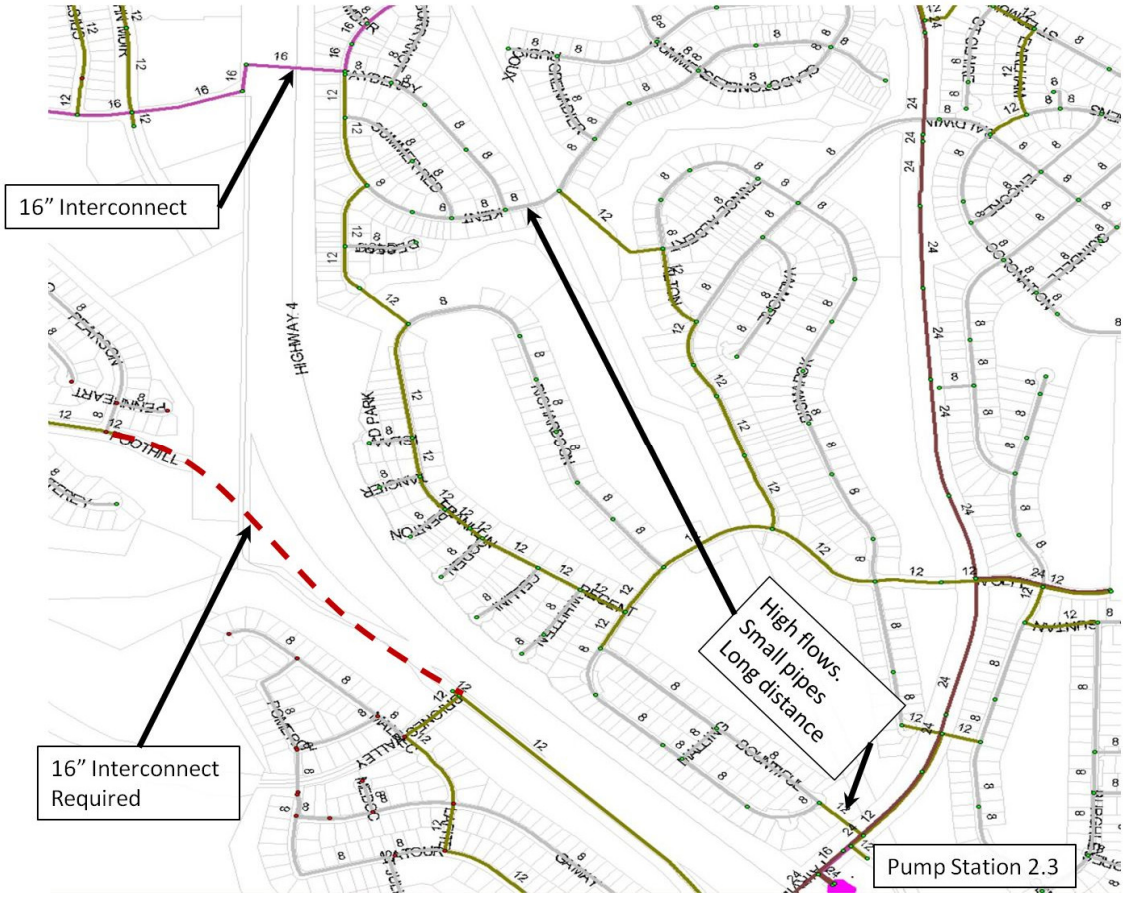


Figure 8 - Existing Zone 2 Flow Deficiencies

3.3 Existing – Maximum Day Demands

The maximum day demand represents peak water usage, most usually during the summer months. It is also during this time of year that the likelihood of fire is increased due to dry, arid conditions. Thus, while the results of a maximum day demand are informative, it is the fire flow simulation which illustrates the ability of the water system to provide for both the maximum day demand plus fire flow.

3.3.1 Maximum Day Simulation

Analyses determined that the system operates efficiently under maximum day conditions (13,110 gpm). Other than the 'Items of Interest as noted in the Average Day Demand Scenario, no significant pipe velocities or excessive pressure drops were noted during the maximum day simulation. In essence, the City of Brentwood water distribution system is well designed with sufficient redundancy for water conveyance.

However, it is worth noting that during a maximum day event, it appears that the Balfour #1 and the Sand Creek #1 PRV's continuously flow in order to provide service pressures to the Apple Hill and Somerset neighborhoods. This continuous flow is largely made available by the continuous pumping provided by Pump Stations 2.1 and 2.2, creating higher energy costs for the City. Upon further review, the City may wish to consider isolating the pipes within these neighborhoods from Zone 1 and making the area a 'Zone 2 - Reduced' pressure zone. This new zone would be serviced exclusively by the Sand Creek and Balfour pressure reducing stations, and as each reducing stations has more than one valve and

enough capacity for fire flow demands, these PRV's would only allow as much flow as is required by the residences in this area. Figure 9 has been provided to show how these two areas could be isolated to create a Zone 2 - Reduced pressure zone.

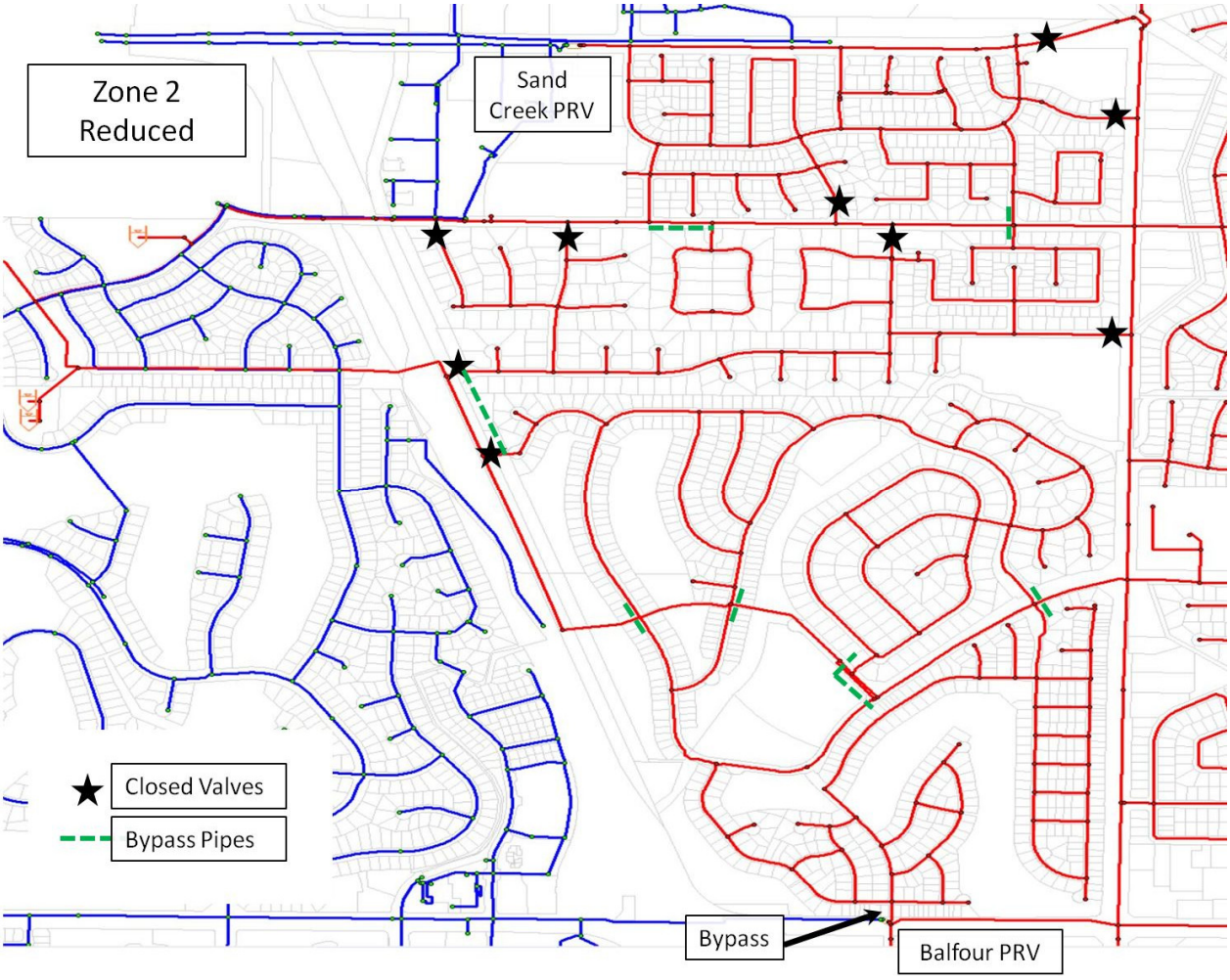


Figure 9 - Zone 2 Reduced Pressure Zone (Example)

3.3.2 Maximum Day + Fire Flow Simulation

Fire flows requirements vary from one community to another. Flow requirements are dictated by the underlying land use – which can vary from 2,000 gpm for single family residential housing unit to as high as 10,000 gpm or higher for a heavy industrial land use. Flow rates, if not determined by the local fire service provider, can be determined by the International Services Organization (ISO) or the American Water Works Association (AWWA) Manual M31 – Distribution System Requirements for Fire Protection. Table 11 represents the desired fire flows and water storage requirements for the various land uses within the City of Brentwood.

City of Brentwood
Fire Flow Requirements

Use Type	Description	Fire Flow (gpm)	Duration (hours)	Supply Req'd (gal)
BBSP	Brentwood Blvd. Specific Plan	2,000	2	240,000
BP	Business Park	4,000	4	960,000
CC	Commercial - Community	4,000	4	960,000
DSP	Downtown - Specific Plan	4,000	4	960,000
GC	Commercial - General	4,000	4	960,000
I	Industrial	4,000	4	960,000
MUPT	Mixed Use Pedestrian Transit	2,000	2	240,000
NO GP	No Designation	0	0	0
P	Park	0	0	0
PD	Planned Development	3,000	3	540,000
PF	Public Facility	3,000	3	540,000
PO	Professional Office	4,000	4	960,000
P-OS	Permanent Open Space	0	0	0
RC	Commercial - Regional	4,000	4	960,000
RE	Ranchette Estate	2,000	2	240,000
R-VLD	Residential - Very Low Density	2,000	2	240,000
R-LD	Residential - Low Density	2,000	2	240,000
R-MD	Residential - Medium Density	2,000	2	240,000
R-HD	Residential - High Density	3,000	3	540,000
SCH	School	3,000	3	540,000
SPA 2	Special Planning Area #2	3,000	3	540,000
SPA 3	Special Planning Area #3	3,000	3	540,000
SPF	Semi-Public Facility	3,000	3	540,000

Table 5 - Fire Flow Requirements (by Land Use)

The modeling software utilized in this master plan provides for a fireflow analysis. This analysis allows for each node in the water distribution system to be given a fireflow demand and modeled accordingly. The resulting analysis output report determines which nodes in the system dropped below optimal pressures when a fire demand was applied. Such an analysis is useful in the identification of system deficiencies such as undersized pipes or insufficient looping and pipe networking.

Table 6 contains the 'worst case' output of a fireflow analysis. As the data show, the City of Brentwood has an sufficient water distribution system which allows for at least 1,000 gpm at most every street intersection in the water distribution system.

City of Brentwood
Maximum Day Fire Flows - Worst Case

Node	Static Pressure	Available Flow	Residual Pressure
1514	63.68	1,138.22	20
1516	64.55	1,142.96	20
1512	64.55	1,211.81	20
1520	65.42	1,225.34	20
3092	66.28	1,239.40	20
3090	65.42	1,249.01	20
1518	65.42	1,312.52	20
3094	66.28	1,333.91	20
3130	55.12	1,383.97	20
3096	66.28	1,395.76	20
3344	61.27	1,451.10	20
3198	60.41	1,492.62	20
3624	59.58	1,555.41	20
3834	46.08	1,582.73	20

Table 6 - Maximum Day Fire Flows (Worst Case)

In nearly every instance of 'worst case' fire flows, the fire demand was applied at the end of a long, 6" dead-end pipe. As the data illustrate, the large reduction between static pressure and residual pressure can be attributed to high flows and headlosses along a long 6" water line. While these values are less than the 2,000 gpm stipulated by the City of Brentwood for residential land uses, there are always instances in any community water distribution system, particularly in older parts of town with 6" distribution mains installed in long cul-de-sac streets. Such data does not imply that a fire could not be adequately suppressed. The data simply mean that the desired flow of 2,000 gpm, in such few instances as these, is achievable.

3.3.3 Very Large Fire Demands

When fires do occur, not all required flows are achievable through a singular fire hydrant. In the case of a commercial center or industrial complex, multiple fire hydrants may be required and multiple fire engines may be dispatched. In evaluating such an circumstance, a separate simulation was conducted which placed a group of fire demands totaling 4,000 gpm at the commercial center adjacent to Pump Station 2.2. This simulation was then run for 4 hours (10 a.m. to 2 p.m.) during a maximum day scenario to evaluate the overall system performance. The results of this simulation were that the City of Brentwood water distribution network sufficiently passed this particular simulation with no significant areas of concern

In the future, this type of scenario can easily be performed by City staff for any new large scale development or industrial use that may be desired by the development community in determining fire demands and adequate water supply.

Chapter 4
Future Water System Simulations

4.1 Introduction

The primary purpose of a water model and master plan is determining future capital improvements required to serve the ultimate water system. The City of Brentwood has an approved general plan which has the city expanding from a present build-out of approximately 6,279 acres to a future build-out of approximately 15,049 acres (+240%). However, of the 15,049 acres of total build-out, approximately 3,012 is designated for a new Regional Park, located on the southern edges of town, adjacent to Zone 3 - South (see Figure 9). Deducting for this new Park acreage, the total build-out acreage of the General Plan drops to 12,037 acres (+192%). The city General Plan estimates a total population of approximately 92,500 citizens at full build out.

System demands utilized in each scenario are provided in Table 13 which were derived via GIS software. Demands were allocated in the same fashion as described in Section 3.1, excepting that new demand nodes which were digitized for the future water system and were given 'demand areas' in the GIS that were then intersected with the underlying land uses and then applied to the hydraulic model. As shown in Table 13, the total average day demand applied to the model was approximately 16.9 mgd while the maximum day demand was 30.4 mgd, respectively. Each model was then evaluated for an extended period simulation.

City of Brentwood
General Plan Land Use
Water System Demand - Full Build Out

Use Type	Description	Acres	Density (units/acre)	Water Duty (gpd/unit)	Water Duty (gpd/acre)	Water Duty (mgd/acre)	Water Duty (gpm/acre)	Average Day Demand (mg)	Max. Day Demand (mg)	Min. Day Demand (mg)
AGCON	Agricultural Conservation	12,081			0	0.0000	0.00	0.000	0.000	0.000
BBSP	Brentwood Blvd. Specific Plan	276			2000	0.0020	1.39	0.553	0.995	0.276
BP	Business Park	202			2000	0.0020	1.39	0.405	0.728	0.202
CC	Community College	17			2000	0.0020	1.39	0.034	0.061	0.017
DSP	Downtown - Specific Plan	63			2000	0.0020	1.39	0.126	0.227	0.063
GC	Commercial - General	205			2000	0.0020	1.39	0.409	0.737	0.205
I	Industrial	28			2000	0.0020	1.39	0.056	0.100	0.028
MUPT	Mixed Use Pedestrian Transit	255	10	150	2000	0.0020	1.39	0.511	0.919	0.255
NO GP	No Designation	252			0	0.0000	0.00	0.000	0.000	0.000
P	Park *	675			1000	0.0010	0.69	0.675	1.214	0.337
PD	Planned Development	126	10	350	3500	0.0035	2.43	0.442	0.796	0.221
PF	Public Facility	594			1000	0.0010	0.69	0.594	1.069	0.297
PO	Professional Office	53			2000	0.0020	1.39	0.107	0.193	0.053
P-OS	Permanent Open Space	458			0	0.0000	0.00	0.000	0.000	0.000
RC	Commercial - Regional	249			2000	0.0020	1.39	0.499	0.898	0.249
RE	Ranchette Estate	593	1	950	950	0.0010	0.66	0.563	1.013	0.282
R-VLD	Residential - Very Low Density	1,426	2	725	1450	0.0015	1.01	2.067	3.721	1.034
R-LD	Residential - Low Density	3,029	3	590	1770	0.0018	1.23	5.362	9.651	2.681
R-MD	Residential - Medium Density	476	8	450	3600	0.0036	2.50	1.714	3.084	0.857
R-HD	Residential - High Density	85	15	275	4125	0.0041	2.86	0.352	0.634	0.176
R-VHD	Residential - Very High Density	38	20	150	3000	0.0030	2.08	0.113	0.203	0.056
SCH	School	312			1500	0.0015	1.04	0.468	0.843	0.234
SPA 2	Special Planning Area #2	378	4	250	1000	0.0010	0.69	0.378	0.681	0.189
SPA 3	Special Planning Area #3	815	4	250	1000	0.0010	0.69	0.815	1.467	0.408
SPF	Semi-Public Facility	666			1000	0.0010	0.69	0.666	1.199	0.333
UR	Urban Reserve	80			0	0.0000	0.00	0.000	0.000	0.000
Total		**23,433**					**MGD**	**16.908**	**30.434**	**8.454**
Buildable Acres (Less Ag. and Reg. Park)		**11,352**					**GPM**	**11,742**	**21,135**	**5,871**

*** - Regional Park of 3,012 acres removed for determing water demands**

Table 13 - General Plan Average and Maximum Day Demands by Land Use

Figure 10 has been created by draping the City of Brentwood General Plan over Google Earth. This image has been provided to show the size and the extent of the Regional Park as well as the new growth areas on the western and northeast areas of town.

Figure 10 - City of Brentwood General Plan on Google Earth Image

4.2 Future System – Average Day Analysis

The analysis of this scenario determined that improvements will be required to ensure that the water distribution system operates efficiently. Table 14 shows the increases (by pressure zone) between the current day models and the future, master plan build-out models.

City of Brentwood
Future Water Demand - By Pressure Zone

Pressure Zone	Avg. Day Demand (gpm)	Avg. Day Increase (gpm)	Max. Day Demand (gpm)	Max. Day Increase (gpm)
Zone 1	7,094	2,033	12,769	3,659
Zone 2	3,961	1,953	7,130	3,515
Zone 3	698	484	1,256	872
Total	11,753	4,470	21,155	8,046

Table 14 - General Plan Water Demand by Pressure Zone (w/ Increase Over Existing)

As provided in Table 14, the City will require an additional 4,470 gpm of average day supply and 8,046 gpm of maximum day supply in servicing a city of 92,500 citizens. In speaking with City Staff, it is understood that all new water supply will be exclusively treated surface water and that no new well sites are to be constructed.

Further evaluating Table 14, Zone 2 pump stations will need to supply an additional 2,437 gpm (Zone 2 + Zone 3) of average day supply and 4,387 gpm of maximum day supply.

Since the City will not be constructing any new wells where additional storage capacity can be considered within the groundwater aquifer in lieu of constructing an above ground tank, Table 15 has been provided to show that Zone 1 will require an additional 4 mg of storage while Zones 2 and 3 will required another 2 mg of storage.

City of Brentwood
Future Water Storage

Future Max Day Demand **30.43** **mgd**

Tank ID	Zone	Volume (mg)	Low Water (ft)	High Water (ft)	Max. Water Height (ft)	Diameter (ft)	Volume @ Max. Water (gal)	Operational Storage (gal)	Emergency Storage (gal)	Fire Demand (gal)	Minimum Storage Req.	Storage Deficit
Reservoir 1.1	Zone 1	2.5	197	229	32	114	2,443,154					
Reservoir 1.2	Zone 1	4.3	197	229	32	149	4,173,627					
Reservoir 1.3	Zone 1	4.0	197	229	32	150	4,229,837					
Zone 1 Capacity		10.8						4.57	9.13	0.96	*14.66*	*(3.86)*
Reservoir 2.1	Zone 2	2.0	320	348	28	107	1,883,288					
Reservoir 2.2	Zone 2	2.0	320	348	28	107	1,883,288					
Reservoir 2.3	Zone 2	4.0	320	348	28	150	3,701,107					
Zone 2 Capacity		8.0						3.04	6.09	0.96	*10.09*	*(2.09)*
Total Storage Capacity		18.8										

Note: Zone 1 = 60% of system demand. Zone 2 + Zone 3 = 40%

Table 15 - General Plan Water System Storage and Deficiency

Based on the data provided in Table 13 showing that average day demands will increase to 16.9 mgd and that maximum day demands will increase to 30.4 mgd, the following capital improvements are required in the full implementation of the General Plan:

- Reservoir 1.4 - A new water storage facility, similar to Reservoir 1.1, will be required on the western limits of Zone 1, just northwest of Reservoir 1.3. The total combined capacity of this facility shall be 4 mg and shall be constructed at the same base elevation as other Zone 1 tanks.
- Pump Station 2.4 - A new pump station will be required in the vicinity of San Jose and St. Regis avenues. The new pump station should provide for approximately 4,500 gpm (~6.5 mgd) when fully operational.
- Reservoir 2.4 - A new 3 mg water storage tank will be required on the western edge of Zone 2 and shall tie into a looped American Avenue water transmission main that ties back into a new main in Balfour Road.
- Various water mains and lengths as provided in the Capital Improvement Plan found within Section 5 of this report.

4.3 Future System – Maximum Day Analysis

The analysis of this scenario determined that with the addition of the necessary capital improvements required in satisfying the future, average day demand, the City of Brentwood water system will operate at a sufficient level of service and that no other significant capital facilities are required.

During a maximum day event, Pump Station 1.1 will utilize all three pumps while delivering approximately 24 million gallons from the surface water treatment facilities. It is anticipated that the existing well field would still be providing the remaining 7 million gallons during a maximum day event.

As stated previously in this report, the existing City of Brentwood water treatment plant has an existing capacity of 15 mgd and that, based on expected growth rates, will not require expansion until the year 2027. At such time, the plant would double its capacity from 15 mgd to 30 mgd. As this is also the approximate, future maximum day water demand, the city Water Operations Manager will need to decide how much delivered water will come from the existing well field and how much will come from the Randall Bold and City of Brentwood water treatment facilities.

As of the writing of this report, the City is considering the construction of a blending facility to mix surface water and groundwater within the water distribution system. Such water chemistry decisions are beyond the scope of this water master plan; however, the city may elect to weigh the costs of this facility versus an earlier construction phasing of the City of Brentwood Water Treatment Plant and subsequently reducing the existing well field as an emergency, backup water supply. It is recommended that a new hydraulic modeling scenario be conducted prior to any such operational change to ensure that the water system does not incur any significant water supply or pressure loss.

Appendix A has been provided to illustrate the improvements required in servicing the implementation of the General Plan for the City of Brentwood.

Chapter 5
Capital Improvement Plan

5.1 Existing System Improvements

Based on the information provided in Section 3.2.1 of this report, the following improvements should be constructed within the next few years in order to improve system operation and efficiency:

City of Brentwood
Existing System - Capital Improvement Plan

	Item	Location	From	To	New or Parallel	Size	Length (ft.)
Zone 1	Pipe	O'Hara Lane	Lone Tree Way	Big Basin Dr.	Parallel	12	1,320
	Pipe	Lone Tree Way	Well #14	Brentwood Blvd.	Parallel	12	340
	Pipe	Kent Dr.*	Grenader Way	Tayberry Lane	Parallel	12	320
	Pipe	Benoni Lane*	Liberty Lane	Katy Way	Parallel	12	480
	Pipe	John Muir Pkwy	Briones Valley Rd.	Pearson Dr.	New	16	2,100
* - Improvements less required with new John Muir 16" interconnect							
Zone 2 Reduced	Multiple Locations - Construct 6 By-Pass Lines, Close 9 Valves						

Table 15 - Existing Water System Capital Improvement Plan

Note that some items may be deferred with the construction of the John Muir interconnect and that creating a Zone 2-Reduced pressure zone is a lump sum project, constructing approximately 6 by-pass lines and shuttering valves.

5.2 Future System Improvement

Implementation of the City's General Plan will require that the following master facility improvements are made to the water system.

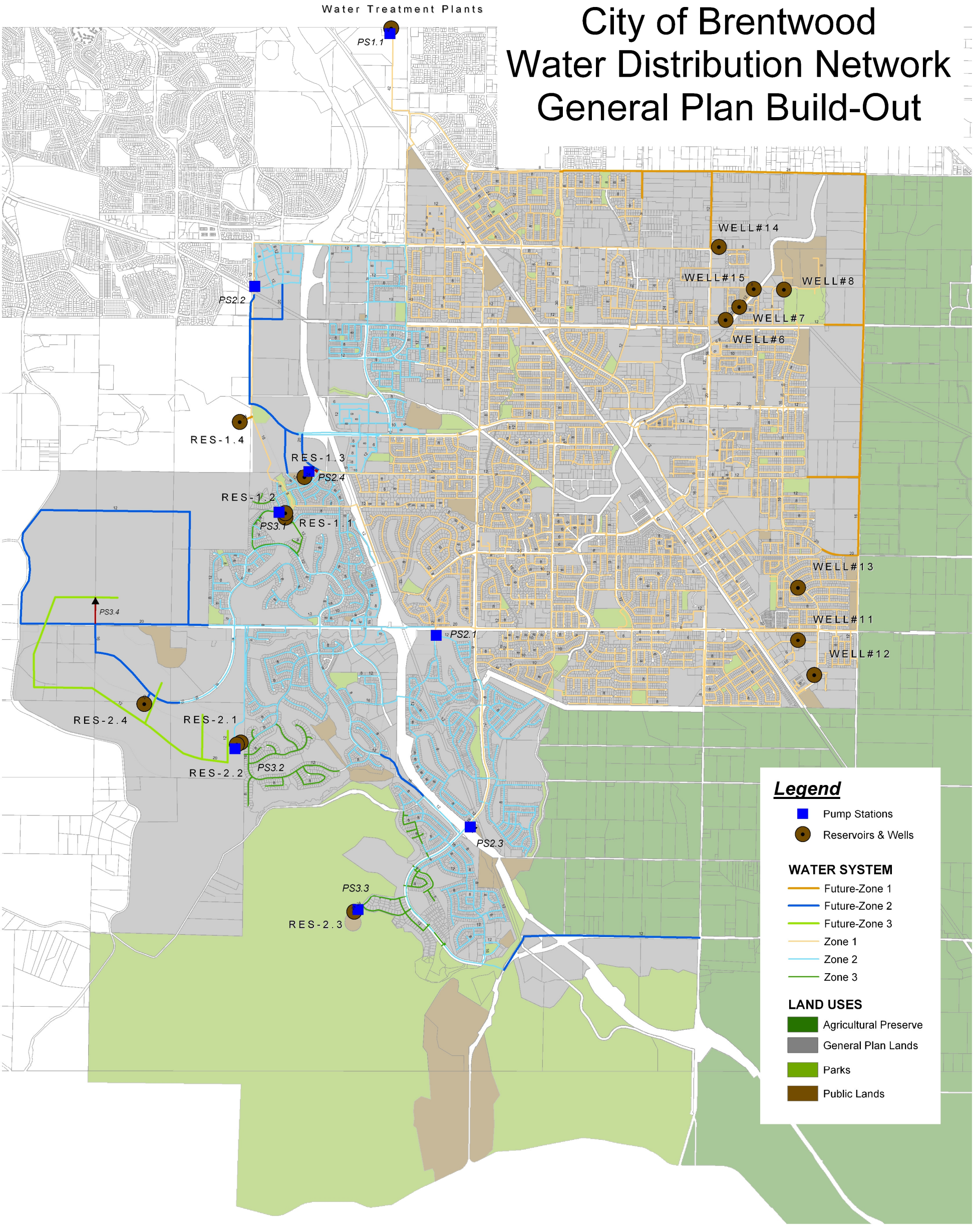
City of Brentwood
Future System - Capital Improvement Plan

	Item	Location	From	To	New or Parallel	Size	Length (ft.)
Zone 1	RES1.4	End of Sand Creek	(New Storage Reservoir)		New	4 MG	
	Neroly Loop	Neroly Rd.	O'Hara Lane	Sellers Ave.	New	24	10,600
	Sellers Loop	Neroly Rd.	Neroly Rd.	Sunset Rd.	New	24	5,200
	Sellers Loop	Sellers Ave.	Sunset Rd.	Chestnut St.	New	16	8,000
	12" Pipe	Misc	(Misc Locations - See Appendix A)		New	12	6,722
	Chestnut 20"	Chestnut St.	Oak St.	Sellers Ave.	New	20	1,232
Zone 2	RES2.4	American Ave. Loop	(New Storage Reservoir)		New	3 MG	
	PS2.4	San Jose/St. Regis	(New Booster Station)		New	6.5 MGD	
	12" Pipe	Misc	(Misc Locations - See Appendix A)		New	12	16,900
	16" Pipe	Misc	(Misc Locations - See Appendix A)		New	16	4,520

Table 16 - General Plan Water System Capital Improvement Plan

Appendix A

City of Brentwood
Water Distribution Network
General Plan Build-Out



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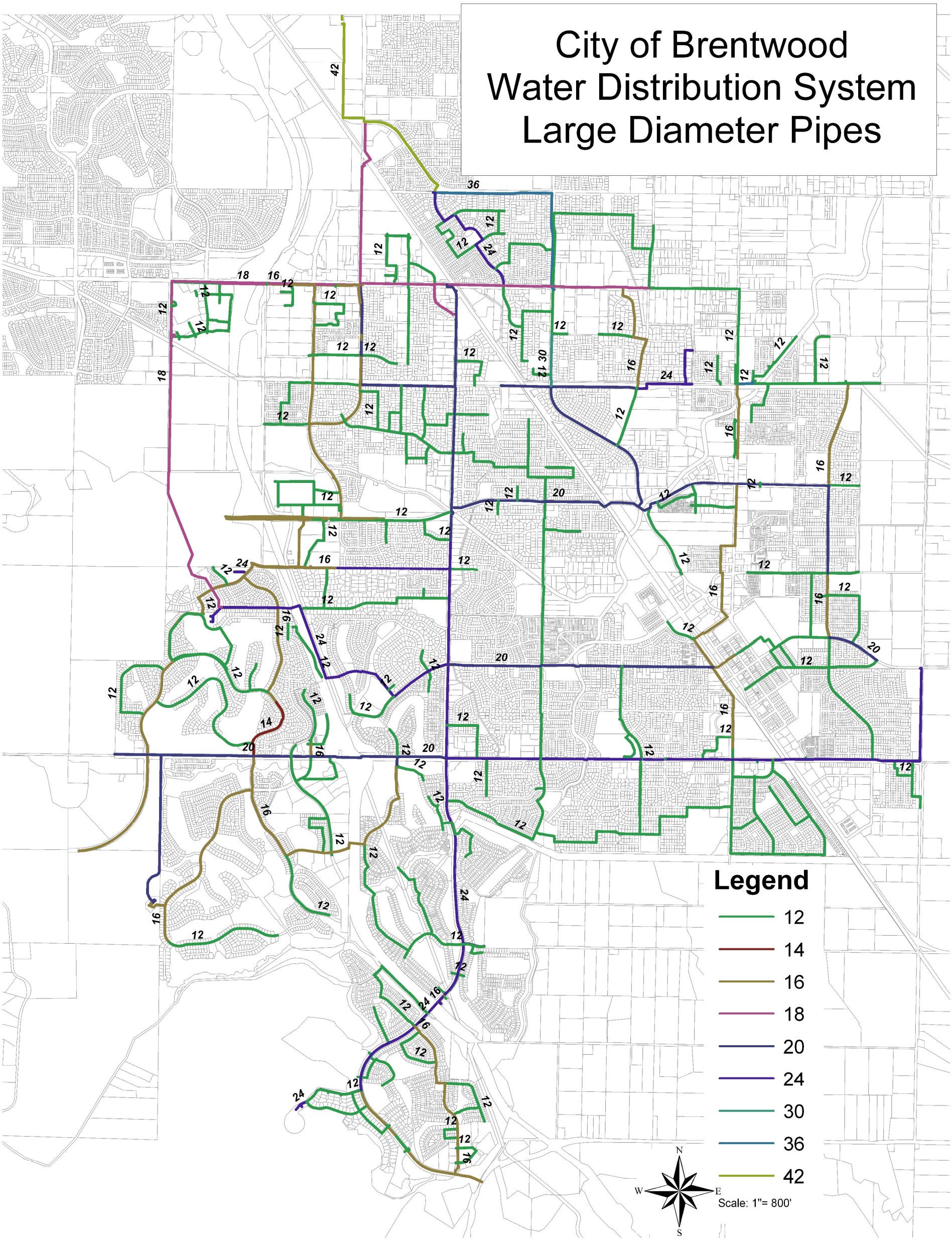
City of Brentwood
Water Distribution System
Large Diameter Pipes



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