

## Chapter 4 – Water Supply Reliability

### 4.1 Introduction

Water supply reliability depends on the City having sufficient water supplies to meet or exceed customer water demands. Several factors can affect reliability, and these factors can change over time.

One set of factors relates to failures in the water system caused by emergencies or catastrophic events, such as an earthquake. Extreme variations in weather can also impact water quality in the short-term. Since Hetch Hetchy water is not filtered at the source, it is subject to strict water quality standards set by the State DHS. As a result of weather events, turbidity levels can exceed standards which, in turn, require the Hetch Hetchy supply to be diverted to local storage or shut-off until levels drop to within regulatory standards (SFPUC, 2005). During these periods, the SFPUC's entire supply comes from the Sunol Valley Water Treatment Plant and the Harry Tracy Water Treatment Plant, both of which are supplied by local reservoirs, not Hetch Hetchy. The SFPUC's regional water system supply has experienced periodic, short-term outages as a result of these water quality events. These types of factors are managed on a case-by-case basis, using the City's emergency response plan and/or the water shortage contingency plan (described in Chapter 5) as necessary, to reduce water use to match available supplies.

Another set of factors, the focus of this chapter, relate to hydrological drought in the regional water system's watersheds (e.g., Hetch Hetchy). For the SFPUC, the 1987-1992 drought in California defined the most extreme recorded drought for SFPUC water deliveries, and established the basis for planning and modeling of future drought scenarios (SFPUC, 2005). Given the existing circumstance that the SFPUC's water supplies are less than current system demands during dry years and that increased demand is anticipated, the SFPUC and its customers must confront the challenge of an increasing gap between supplies and demand, unless and until supplies are expanded at either the regional, or individual customer level.

To quantify the hydrologic risk of Redwood City not being able to meet normal water demands with available water supplies, projections of customer water demands, passive conservation, active conservation, and sources of supply, including water recycling, must be incorporated. This chapter summarizes and integrates these inputs from other chapters and expresses reliability in probabilistic terms using the best information available. This includes scenarios of a single dry year and multiple dry years.

To begin, this chapter reviews the Interim Water Shortage Allocation Plan (IWSAP), which describes how water will be allocated among water agencies during shortages. Although the Master Water Sales Agreement and the IWSAP expire in July 2009, they do provide a current basis for quantifying risk. The next section then addresses key issues and provides an assessment of hydrologic risk to 2030.

This type of hydrological risk is important to minimize from a customers' perspective. The last section of this chapter addresses the value customers place on avoiding shortages.

## 4.2 Interim Water Shortage Allocation Plan

The City receives water from the City and County of San Francisco's regional system, operated by the SFPUC. This supply is predominantly from the Sierra Nevada, delivered through the Hetch Hetchy aqueducts, but also includes treated water produced by the SFPUC from its local facilities in Alameda and San Mateo Counties.

In 1984, the City along with 29 other Bay Area water suppliers entered into a Settlement Agreement and Master Water Sales Contract (Master Contract) with San Francisco, supplemented by an individual Water Supply Contract. These contracts, which expire in June 2009, provide for a 184 million gallon a day (mgd, expressed on an annual average basis) Supply Assurance to the SFPUC's wholesale customers collectively. The City's individual Supply Assurance is 10.93 mgd or 12,243 af/yr. Although the Master Contract and accompanying Water Supply Contract expire in 2009, the Supply Assurance (which quantified San Francisco's obligation to supply water to its individual wholesale customers) survives their expiration and continues indefinitely.

The SFPUC can meet the demands of its retail and wholesale customers in years of average and above-average precipitation. The Master Contract allows the SFPUC to reduce water deliveries during droughts, emergencies and for scheduled maintenance activities. The SFPUC and all wholesale customers adopted an Interim Water Shortage Allocation Plan (IWSAP) in 2000 to address the allocation of water between San Francisco and wholesale customers in aggregate and among individual wholesale customers during water shortages of up to 20 percent of system-wide use. This shortage plan also expires in June 2009.

The IWSAP has two components. The Tier One component of the IWSAP allocates water between San Francisco and the wholesale customer agencies collectively. The IWSAP distributes water between two customer classes based on the level of shortage as shown in Table 4-1.

<b>Level of System Wide Reduction in Water Use Required</b>	<b>Share of Available Water</b>	
	<b>SFPUC Share</b>	<b>Wholesale Customers Share</b>
5% or less	35.5%	64.5%
6% through 10%	36.0%	64.0%
11% through 15%	37.0%	63.0%
16% through 20%	37.5%	62.5%

The Tier Two component of the IWSAP allocates the collective wholesale customer share among each of the 28 wholesale customers. This allocation is based on a formula that takes three factors into account, the first two of which are fixed: 1) each agency's Supply Assurance from SFPUC, with certain exceptions; and 2) each agency's purchases from SFPUC during the three years preceding adoption of the IWSAP (FYs 1996-97, 1997-98, and 1998-99). The third factor is the agency's rolling average of

purchases of water from SFPUC during the three years immediately preceding the onset of shortage.

The IWSAP allows for voluntary transfers of shortage allocations between SFPUC and any wholesale customer and between wholesale customer agencies. Water “banked” by a wholesale customer, through reductions in usage greater than required, may also be transferred.

**4.3 Current Water Supply Reliability**

When the SFPUC declares a water shortage, Redwood City will be required to make relatively large water use cutbacks as specified by the IWSAP. Table 4-2 describes the current level of water supply reliability based on a set of operational, engineering, and hydrological assumptions. Although the City has a contractual “Supply Assurance” of 12,243 af/yr (10.93 mgd), this is not an absolute guaranteed amount. In times of shortage, the Master Contract allows the SFPUC to provide less than the assurance.

<b>Table 4-2 Current Water Supply Reliability (in mgd)</b>					
	<b>Purchase Request 2005</b>	<b>Single Dry Water Year</b>	<b>Multiple Dry Years</b>		
			<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
System-Wide Shortage %	No Shortage	10%	10%	20%	20%
BAWSCA Allocation (mgd)	177.9	157.4	157.4	136.8	136.8
Redwood City Allocation (mgd)	12.16	10.00	10.00	8.69	8.69
Redwood City Cutback %	0%	17.8%	17.8%	28.5%	28.5%
Frequency	89.2%	6.0%	6.0%	4.8% for 2 or more years	

Values based on letter sent to Peter Ingram (City) from Paula Kehoe (SFPUC) dated June 1, 2005. The frequencies are estimated on data from 1920 to 2002; 5 out of 83 (6.0%) years have 10% system-wide shortages and 4 out of 83 years (4.8%) have a 20% system-wide shortage in modeling conducted.

From a statistical perspective, current circumstances indicate there is a:

- ❑ 6 percent chance of a 10 percent Hetch Hetchy system-wide cutback next year. A 10 percent system-wide cutback equates to an 11.5 percent cutback for BAWSCA members in aggregate. An 11.5 percent cutback for BAWSCA equates to a 17.8 percent cutback for Redwood City. A 17.8 percent cutback is a “major” event requiring water rationing.
- ❑ 4.8 percent chance of a 20 percent Hetch Hetchy system-wide cutback the following year. A 20 percent system-wide cutback equates to a 23.1 percent cutback for BAWSCA members in aggregate. A 23.1 percent cutback for BAWSCA equates to a 28.5 percent cutback for Redwood City. A 28.5 percent cutback would be a “dramatic” crisis involving significant disruptions and curtailments.

The probability of a water shortage of 17.8 percent or greater in a given year is 10.8 percent (6% + 4.8%), or about one year per decade. The City would have one year of a 17.8 percent shortage before the 28.5 percent shortage.

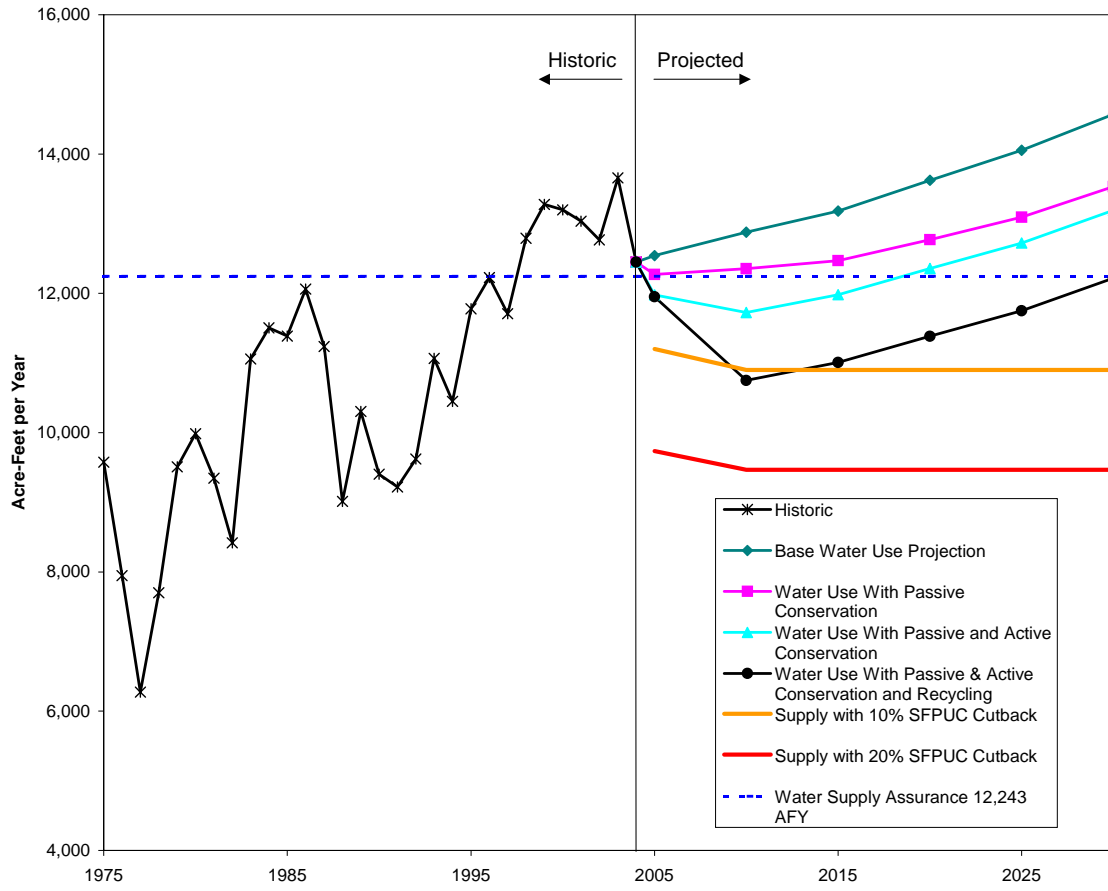
#### **4.4 Future Water Supply Reliability**

Figure 4-1 shows historic and projected water use for Redwood City between 1975 and 2030. The projections show the incremental impacts from conservation and water recycling programs, which are described elsewhere in this UWMP. Over time, the reduction in water use from these three programs progressively adds up and equals 3,374 af/yr or 25 percent of water demands in 2030.

Figure 4-1 also shows the expected SFPUC water supplies associated with the 10 percent and 20 percent system-wide cutbacks described previously. Holding all factors constant, Redwood City would be only modestly impacted by the 10 percent SFPUC cutback scenario. Regarding the 20 percent cutback scenario, the City would still be significantly impacted, needing to reduce water use by between 19.5 and 27.7 percent. Hence, conservation savings and recycled water use will greatly lessen but not entirely avoid the impacts of future droughts. Table 4-3 shows this information in tabular form.

This conclusion is predicated on current water allocation conditions. The City's proactive and relatively aggressive conservation and recycling plans will have the impact of lowering future water allocations associated with the IWSAP. Because one-third of the IWSAP allocation is based on the most recent three years of water use, as Redwood City reduces its water use, it will receive less water during a declared shortage. In effect, only two-thirds of achieved water savings via active water conservation and water recycling will benefit the City. In addition, in the future it will be more difficult to reduce water use in response to shortages. About 75 percent of conservation and recycled water reductions are associated with outdoor water use. Redwood City is effectively making itself "demand hardened." During a shortage, there will be much less discretionary water use available to cut. Hence, a 20 percent reduction will be much harder to achieve in Redwood City than in neighboring communities that are not demand hardened.

Figure 4-1. Future Water Reliability



**Table 4-3  
Future Water Reliability (af/yr)**

<b>Description</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>
<b>WATER DEMAND</b>						
Existing Customers Base Projection	12,596	12,596	12,596	12,596	12,596	12,596
New Customers	-54	283	586	1,027	1,458	1,974
Passive Conservation	-269	-523	-712	-853	-959	-1,038
Active Conservation	-294	-632	-488	-413	-373	-341
Total Water Use (Billed)	11,979	11,724	11,982	12,357	12,723	13,191
Unaccounted for Water (4%)	479	469	479	494	509	528
Total Water Demand	12,458	12,193	12,461	12,851	13,232	13,719
<b>WATER SUPPLY</b>						
Redwood City Recycled Water	30	922	1,178	1,398	1,695	1,995
Transfers / Exchanges in or out	0	0	0	0	0	0
Desalination	0	0	0	0	0	0
Redwood City Groundwater	0	0	0	0	0	0
<b>Water Needed from SFPUC</b>	<b>12,428</b>	<b>11,271</b>	<b>11,283</b>	<b>11,453</b>	<b>11,537</b>	<b>11,724</b>
Scenario with No SFPUC Cutback (Normal Year)						
SFPUC Water Supplies	12,428	11,271	11,283	11,453	11,537	11,724
Shortage	0	0	0	0	0	0
% Shortage	0%	0%	0%	0%	0%	0%
Scenario with 10% SFPUC Cutback (Single Dry Year)						
SFPUC Water Supplies <sup>(1)</sup>	11,201	10,899	10,899	10,899	10,899	10,899
Shortage	1,226	372	384	554	638	825
% Shortage	10.9%	3.4%	3.5%	5.1%	5.9%	7.6%
Scenario with 20% SFPUC Cutback (Multiple Dry Years)						
SFPUC Water Supplies <sup>(1)</sup>	9,734	9,465	9,465	9,465	9,465	9,465
Shortage	2,694	1,843	1,855	2,025	2,109	2,296
% Shortage	27.7%	19.5%	19.7%	21.5%	22.4%	24.3%
(1) The 2005 water supplies available to Redwood City are based on information contained in letter sent to Peter Ingram (City) from Paula Kehoe (SFPUC) dated June 1, 2005. The 2010 supplies are lower because the Redwood City-purchased water from SFPUC is expected to drop between 2005 and 2010. Other agencies will also be using more water, making less available for Redwood City. After 2010, the water supplies shown stay at 2010 levels. They could materially change with changes in the Master Contract and IWSAP scheduled to expire July 2009.						

### 4.5 Value of Water Reliability

A common concern for water agencies is the desire to balance improved water reliability with customers' willingness to pay for such improvements. Review of the literature of water shortages shows customers value supply reliability quite highly. In 1987, a contingent valuation study (also known as a stated preference study) of southern and northern California residential customers showed customers willing to pay between \$135 and \$421 per year to avoid stated shortage scenarios. The results from this study are summarized and applied to the City in Table 4-4. The drought avoidance scenarios defined in this study do not align with Redwood City's current shortage magnitudes and frequencies. Even assuming the total Redwood City annual aggregate willingness to pay is \$4 million to avoid any shortages, this capitalizes to \$66 million over 20 years using a 6 percent interest rate.

A similar study conducted in 1993 for the California Urban Water Agencies (Barakat and Chamberlin, Inc., 1994), found similar results. The study estimates households were willing to pay \$143 per year on average to avoid a 20 percent shortage once every 30 years. Households were willing to pay \$253 to avoid a 50 percent shortage once every 20 years.

**Table 4-4  
Willingness to Pay to Avoid Water Shortages**

<b>Avoidance Scenario</b>	<b>Estimated Household Annual Median Willingness to Pay</b>	<b>Redwood City Annual Aggregate</b>
10% to 15% shortage once every 5 years	\$135	\$4,050,000
30% to 35% shortage once out of 5 years	\$186	\$5,580,000
10% to 15% shortage twice out of every 5 years	\$248	\$7,440,000
30% to 35% shortage twice out of 5 years	\$421	\$12,630,000

Source: Based on data from *Economic Value of Reliable Water Supplies for Residential Users in the State Water Project Services Area. SWC Exhibit Number 54*. Prepared by R.T. Carson and R.C. Mitchell for the Metropolitan Water District of Southern California. 1987.  
Redwood City annual aggregate assumes 30,000 households. Values shown are in 2003 equivalent dollars.

In addition to residential customers, commercial and industrial customers are highly motivated to avoid shortages. A study of water shortages (Spectrum Economics, Inc., April 1991) shows that in response to a hypothetical 30 percent water supply reduction, about half of high-tech firms would consider locating plant expansions and new plant production facilities outside of California. This study also documented a direct link between water shortages and job and production losses.

There are other additional studies that suggest that water customers place a high value on water reliability. Each study has potential flaws and biases in its study design and estimation procedure, and address different groups of customers with different circumstances. Collectively, however, these studies support the conclusion that customers are willing to pay significant amounts for high water reliability.