



State of the Estuary Report 2015

Technical Appendix

PEOPLE – Conserving Water

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TECHNICAL APPENDIX: URBAN WATER USE

CONTEXT

The San Francisco Bay Area uses about 1 million acre-feet per year of water, 90% of which supports urban activities in homes, businesses, institutions, and industries. Most of this urban or municipal water¹ – about 75%- is imported, primarily from the Delta and Central Valley watersheds with smaller amounts from the Russian River and Tomales Bay. Less than 10% is supplied from local Bay-draining (non-Delta) watersheds, such as the Napa River and Alameda, Coyote, Los Gatos and San Mateo Creeks. The remaining 15% is supplied from groundwater, which is a locally significant supply source to urban users in the Santa Clara and Livermore Valleys, and in Fremont and the North Bay; some of that groundwater is derived from the recharge of imported surface water.

Using less water (conservation) and using water more efficiently by reducing the amount of water needed for any activity while still accomplishing the goals of that activity (e.g. toilet flushing, irrigation) has many actual and potential benefits for the Bay Area including:

- Reduces the demand on already-over-drawn supply sources, leaving more water to maintain the habitats, living resources, and ecological processes of the Bay and its watersheds
- Reduces the financial and energy costs of treating and transporting water
- Reduces the need to develop new supplies;
- Reduces pollutant loads from irrigating lawns, gardens and crops;
- Reduces the vulnerability of supplies to disruption by earthquakes, droughts, floods, rising sea level, and regulatory requirements to protect endangered species.

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With four straight years of low runoff from the Delta watersheds and the record low snowpack in 2015, state and local agencies have made water conservation and water efficiency both a priority and a mandate for urban residents and water suppliers.

INDICATOR

This indicator assesses the region's water use and the efficiency of that use over time by measuring total urban water use and just the residential portion with two metrics: the annual potable volume in acre-feet; and the per-person (per capita) use in gallons per capita per day (gpcd).² The period of assessment is 1986-2014, a period long enough to evaluate how the Bay Area urban use is affected over time by population growth, climate, plumbing codes, conservation measures and economic conditions. 1986 is just prior to the 1987-92 drought, the longest duration drought experienced by the Bay Area. Major plumbing code changes were also instituted in the early 1990's. From

¹ The terms "urban" and "municipal" water use are used interchangeably and refers to the use by communities that are supplied by public water districts and private water companies in contrast to the rural areas that are primarily self-supplied with groundwater.

² Measures of potable or drinkable water do not include recycled water.

2007 to 2009 the Bay Area experienced a 3-year dry period and economic downturn and since 2012 the region is in the midst of another prolonged drought.

This indicator measures the consumption of the water used inside and outside of the residences, businesses, and industries in the Bay Area. It does not measure the total water footprint, which is the volume of water that is required to produce all the goods and services that are consumed and which is many times greater than the direct consumption.³

Residential use, which includes both single family and multi-family residences, consists of indoor uses (waste elimination, washing clothes and dishes, bathing, drinking) and outdoor uses (irrigation and cleaning). Commercial users can have both an indoor and outdoor component, depending on the nature of the business while industrial users are primarily using water indoors for a manufacturing process including energy generation. Residential use is the factor most directly controlled by individuals and families, whose decisions to use water more efficiently in and around the home can collectively create large-scale benefits.

Residential per capita use is sometimes used to compare water use within and across watershed boundaries or among water agencies.⁴ Total per capita use measures, along with the residential use, different proportions of commercial, industrial, and institutional uses by the different municipalities and thus make the comparisons across boundaries and what individuals use less accurate. The total municipal per-capita use for the Bay Area, however, is a reasonable indicator of how the region as a whole is managing its water supplies over time and is also the metric that is used to assess compliance with the recently passed State legislation that establishes urban water use targets.

DATA SOURCES

All of the Bay Area municipal water suppliers measure the water use of their customers in order to bill them based upon the volume of use. The retail water suppliers separate the customers into different sectors or types of use, often distinguished by the size and type of water meter. Residential water use is normally accounted for separately from commercial, industrial, institutional and dedicated landscaping use. Residential customers are usually separated into single family and multi-family accounts and must be combined to derive the total residential use. The water suppliers generally report the water use on a monthly or bi-monthly basis in gallons or cubic feet or occasionally acre-feet. For this indicator the volume of annual water use is compiled in acre-feet per year. An acre-foot is equal to 325,851 gallons.

³ The average yearly water footprint of an American is about 655,000 gallons per year or about 18 times greater than the 36500 gallons per year or the roughly 100 gallons per day the average Bay Area resident consumes through the water supply system. Water footprints of all nations for the period 1997 - 2001 have been first reported Chapagain, A.K. and Hoekstra, A.Y. "[Water footprints of nations](#)". *Value of Water Research Report Series No. 16* (UNESCO-IHE)

⁴ This assumes that the agencies are defining the single family and multi-family residential customer class similarly, which is not always true. E.g some agencies separate mobile home parks and dedicated landscaping meters at multi-family complexes.

This indicator also requires population data in order to calculate the per-capita use. Water suppliers also report their population, which is usually derived from census data although sometimes the population is estimated based upon the number of customer accounts.

Annual water use data for the entire 1986-2014 period is available from water suppliers that serve about 93% of the 6.65 million people that reside in the municipalities in the local Bay-draining watersheds. Total municipal and residential water use and population data for the 1986-2014 period were compiled for Contra Costa Water District (CCWD), East Bay Municipal Utilities District (EBMUD), Alameda County Water District (ACWD), San Francisco Public Utilities District (SFPUC), Zone 7 Water Agency (Zone 7), Santa Clara Valley Water District (SCVWD), Bay Area Water Supply and Conservation Agencies (BAWSCA- an association of the water agencies that wholesale water from the SFPUC), Marin Municipal Water District (MMWD), and the City of Napa (Napa). Table 1 lists the agencies, the type of service provided (wholesale or retail or both), the geographic region served, population, and the sources of water. Municipalities and areas not included because data back to 1986 was not available include Novato, Petaluma, Sonoma Valley, Napa Valley communities not including City of Napa, Vallejo, American Canyon, Benicia, Fairfield, and Suisun City; the combined population of these areas in 2014 is about 450,000.

Data for the 1986-2014 period was obtained directly from the water suppliers, from reports that the suppliers produce, and the state agencies and associations to which they report their data. The specific sources include:

1. Some or all of the 1986-2014 period directly from the following suppliers: EBMUD, SFPUC, MMWD, BAWSCA, Napa, CCWD, Zone 7, SCVWD
2. 1986-2004 data compilations for the Bay Area Water Agencies Coalition (BAWAC- a coalition of the major Bay Area water agencies); some of this data was superseded by data obtained directly from suppliers)
3. Pre-2013 from Department of Water Resources Public Water System Survey (PWSS).⁵
4. 2013 and 2014 from State Water Resources Control Board Drinking Water Program database
5. California Urban Water Conservation Council (CUWCC) database
6. Urban Water Management Plans (UWMP) for selected suppliers

The water use data reported by retail suppliers to the PWSS, the Drinking Water Program and the CUWCC is not always consistent with the data for the same year contained in agency reports including the BAWAC report and their Urban Water Management Plans. These inconsistencies were brought to the attention of the suppliers who provided the water use directly to me.

METHODS AND CALCULATIONS

The average daily water use per person – gallons per capita per day (gpcd) – is calculated by converting the reported monthly, bi-monthly

⁵ The PWSS are available up through 2012. Beginning in 2013, DWR no longer requested suppliers to submit a PWSS and monthly water use data is reported by suppliers to the Drinking Water Program database housed at the State Water Resources Control Board.

or annual residential water use data into gallons, dividing by the appropriate number of days to get a daily use and then dividing that result by the population using that water to get the gallons per capita per day (gpcd). It is assumed for purposes of this calculation that only the population reported to reside within the service area of the district consumes the residential water and that visitors to the area are consuming water from non-residential accounts (i.e. commercial or institutional accounts).⁶

BENCHMARKS, TARGETS, AND REFERENCE CONDITIONS

As noted above, in order to evaluate how the Bay Area urban use is affected over time by climate, plumbing codes, conservation measures and economic conditions, water use was assessed beginning in 1986. 1986 is just prior to the 1987-92 drought, the longest drought experienced by Bay Area municipalities and prior to major plumbing code changes instituted in the early 1990's and is used as a reference condition in Table 3 from which to measure changes in total water use, population, and per-capita use.

Benchmarks used to evaluate progress on the water use efficiency metrics are based on state legislation. The Water Conservation Act of 2009, Senate Bill x7-7 (2009 Act) established a goal of reducing urban per-capita water use from a baseline usage by 20% by 2020 with an interim goal of a 10% per-capita reduction by 2015. This first legislatively-proscribed urban water use target in California provides that targets can be calculated by one of four methods. A water supplier can choose the method to establish its target, which is described in Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use, Feb 2011, available on the DWR web site <http://www.water.ca.gov/wateruseefficiency/sb7/> established for tracking the implementation of the legislation. The Method 3 target is ninety-five percent of the applicable hydrologic region target derived from the State's 20x2020 Water Conservation Plan.⁷ The benchmark for the total per-capita metric, based upon 95% of the region's target of 131 gpcd, is currently 125 gpcd for 2020 and 137 gpcd for 2015.⁸ These benchmarks are shown in Figure 2 to assess progress for the region, although they are not meant to be used to determine 2009 Act compliance.

A second benchmark to evaluate the total volume of use derives from the 2015 emergency drought regulations to reduce urban use statewide by 25% through February 2016 as result of the 4th consecutive year of low precipitation and runoff. The State Water Board translated the statewide reduction goal into specific reduction targets from the 2013 water use for each Bay Area urban water supplier separately. The required reductions range from 8% for San Francisco to 36% for Hillsborough. Population-weighting the individual supplier targets derives a Bay Area-wide reduction target of 18%. Applying this 18% reduction to the 2013 Bay Area urban water use of

⁶ It is possible that some of the visitors using the water in the municipalities are using residential water (e.g. bed and breakfasts, other short-term rentals) but that there is no way of determining that for this project. If visitors are using residential water in significant quantities then the gpcd will be somewhat higher.

⁷ The 20 by 2020 Water Conservation Plan follows from the 2008 governors executive order requiring state agencies to develop a plan to reduce statewide per capita urban water use by 20 percent by the year 2020.

⁸ The 131 gpcd regional target is reported in the 2010 UWMP for SFPUC. According to Peter Brostrom, DWR water use efficiency section chief, The SBx7-7 target for the San Francisco Bay hydrological region is not a fixed number but that for purposes of this assessment the 131 gpcd can be used (pers com, Sept 10, 2015)

946,000 results in a reduction target of about 775,000 ac-ft for a 12-month period. This value is not a compliance target but is useful as a benchmark for water use in 2015.⁹

RESULTS

Figures 1 and 2 and Table 3 document the fluctuation and eventual overall decline in total water use and per-capita use in the San Francisco Bay region in the 1986-2014 period. Total urban water use in the Bay Area is 24 percent or 266 thousand acre-feet (TAF) less in 2014 than it was 1986, a remarkable achievement given that the population has increased by 26 percent; water use so far in 2015 indicates that the decline will be around 30%. These impressive reductions are the result of requirements and incentives for more efficient water-using devices and landscapes, combined with the recent requirements for mandatory conservation because of the continuing drought. Periodic droughts over the last three decades along with greater public outreach have increased the consumer's awareness of water use, which helps increase water use efficiency. Prior to the more widespread of imposition of mandatory conservation in 2014 and 2015, total use in 2013 had declined 14% from 1986. Residential use did not decline as much percentage-wise as the total use - only 16% or 93 TAF in the 1986-2014 period- reflecting the residential growth in the region that has been greater in the hotter, lower-density inland areas. Commercial and industrial water use has also declined proportionally more due to shrinkage of water-intensive manufacturing and industry and economic incentives for the use recycled water and increased water use efficiency.

The per-capita use metrics use also demonstrates the significant increases in water use efficiency. Since 1986, the total per-capita use has declined by 40%, down to 119 gpcd, an even greater percentage reduction than the volumetric reduction because of the population increase. The per-capita residential use declined 33% to 72 gpcd during that same period.

Bay Area water agencies have collectively exceeded the legislative requirements for a 10% reduction in the per-capita use required by 2015. Furthermore the 2014 overall use exceeds the 20% reduction in per-capita use required by 2020. All of these trends have been impacted by the further reductions required by the State Board as of 2015 due to the increasing severity of the drought. Data from June, July and August of 2015 indicate that the Bay Area has reduced its outdoor water use significantly from the corresponding period in 2013. If the trend continues the region overall will achieve State Board goals although individual suppliers may not be fully compliant with their targets. However if drought restrictions are lifted, these gains could slip as evidenced that the 2013 per-capita use was just at the 2015 benchmark value of 137 gpcd.

The change in total and residential water use and per-capita use for the individual agencies is shown in Table 3. This table shows the considerable geographic variation in the water use and the trends over time around the region. The variation in water use is largely explained by the climatic differences between the cooler Bay-side versus the warmer inland areas and residential lot size differences

⁹ The emergency regulations proscribe compliance for the 9-month period from June 2015 to February 2016.

between the smaller lots in the older cities and larger lots in the newer suburbs; SFPUC and CCWD represent the two extremes with a greater than two-fold difference in the total and per-capita water use. Variations in water use are also reflective of the relative proportion of the different types of uses- residential versus non-residential uses and variations within the commercial and industrial sectors- in the region. For example Santa Clara and Contra Costa Counties have more water-using industry than Marin or Napa Counties. The water use trends over time also reflect the relative growth patterns in the region in the past 30 years. Residential growth has been proportionally much greater in the warmer inland areas of Eastern Alameda and Contra Costa Counties than in the inner Bay Area and is reflected in the increase of residential water use in the water districts serving those areas. The per-capita total and residential use, however, has decreased in all areas with the greatest reductions in the areas with higher outdoor water use.

THREATS & CHALLENGES

Responding to persisting drought will require still more efficiency, and the Bay Area faces the additional challenge of accommodating population growth. Every new person, family, or business presents increasing demand for new supply at a time when the region remains more vulnerable than ever to the warming climate. The Bay Area is still highly dependent on imports from watersheds reliant on shrinking natural snow storage. The warming climate will also increase outdoor water use, which currently represents about 40% of the total urban use in the region and offers the greatest potential for additional water savings. Efficiency improvements need to go beyond traditional conservation measures that reduce potable water use, however. Improvements must also encompass greater use of locally derived non-potable sources such as recycled wastewater and the on-site reuse of gray water, rainwater, and stormwater. The ongoing drought is also stimulating behavioral changes in how we use water. If demand stays at these reduced levels due to continued conservation or wetter conditions, the water agencies will continue to experience declining revenues and thus water rates will have to be increased to balance revenues with costs. The challenge for the agencies is how to structure rates so that users are not penalized for using less.

Whether collective action will lead to permanent reductions in urban water use and an increase in freshwater flows to the Bay and through rivers and streams, flows vital to fish and ecosystem health, remains to be seen. Current policy and upstream water management do not provide the Estuary the extra freshwater inflow that greater water use efficiency and reliance on locally sustainable sources could provide.

Table 1: Water Agencies in the San Francisco Bay Region

Agency	Type	County / region served	2014 Population	Primary sources of water
Alameda County Water District (<i>ACWD</i>)	Retail	South Alameda	340,000	SWP, SFPUC, and ground water
Bay Area Water Supply and Conservation Agencies (<i>BAWSCA</i>) ¹⁰	Association	San Mateo, north Santa Clara, south Alameda	1,745,116 (874,415) ¹¹	SFPUC, SWP, CVP, local surface and ground water
Contra Costa Water District (<i>CCWD</i>) (includes treated and wholesale service areas)	Retail and Wholesale	North, central, and east Contra Costa	471,422	CVP, and direct diversion from the Delta
East Bay Municipal Utility District (<i>EBMUD</i>)	Retail	North Alameda, north and central Contra Costa	1,379,000	Mokelumne River and local surface water
Marin Municipal Water District (<i>MMWD</i>)	Retail	South and central Marin	187,500	Lagunitas Creek, and Russian River surface water
San Francisco Public Utilities District (<i>SFPUC</i>)	Retail and Wholesale	San Francisco	848,903	Tuolumne River and local runoff in Alameda and San Mateo County
Santa Clara Valley Water District (<i>SCVWD</i>)	Wholesale	Santa Clara	1,868,558 ¹²	SFPUC, SWP, CVP, local surface and ground water
Zone 7 of the Alameda County Flood Control and Water Conservation District (<i>Zone 7</i>)	Wholesale	East Alameda	238,373	SWP, local surface and ground water
City of Napa	Retail	Napa	86,051	SWP, local surface water

¹⁰ BAWSCA does not deliver water but is an association of the 26 cities, water districts and other agencies that purchase all or a portion of their water from the City and County of San Francisco (SFPUC) Hetch Hetchy water system.

¹¹ BAWSCA includes ACWD and agencies that are part of SCVWD. The bracketed number represents the population *excluding* those entities.

¹² SCVWD population includes South County

Table 2-7 Total and Residential Water Use for the San Francisco Bay Region

	Year	Total Use			Residential Use	
		Population Served	Acre-feet	GPCD	Acre-feet	GPCD
Drought Period	1985					
	1986	4,926,783	1,095,075	198	589,835	107
	1987	4,979,501	1,115,781	200	589,065	106
	1988	5,037,887	1,054,355	187	544,857	97
	1989	5,104,278	947,070	166	514,297	90
	1990	5,161,134	981,503	170	514,416	89
	1991	5,194,112	859,548	148	450,112	77
	1992	5,248,028	876,048	149	482,453	82
	1993	5,319,206	908,995	153	514,013	86
	1994	5,363,939	957,448	159	531,947	89
	1995	5,394,104	961,710	159	542,424	90
	1996	5,450,714	1,016,822	167	572,912	94
	1997	5,522,039	1,066,884	172	600,685	97
	1998	5,598,163	1,009,597	161	563,015	90
	1999	5,668,259	1,060,497	167	596,470	94
	2000	5,750,656	1,090,438	169	612,620	95
	2001	5,817,604	1,093,009	168	621,477	95
	2002	5,849,746	1,089,017	166	619,335	95
	2003	5,869,093	1,059,250	161	634,344	96
	2004	5,922,332	1,082,049	163	641,958	97
	2005	5,950,543	1,031,193	155	612,521	92
Dry Period and Recession	2006	5,997,222	1,030,924	153	616,989	92
	2007	6,062,945	1,060,596	156	631,236	93
	2008	5,940,947	986,819	148	587,079	88
Drought	2009	5,978,758	906,759	135	534,628	80
	2010	5,987,069	864,667	129	514,350	77
	2011	6,043,490	875,742	129	509,676	75
Drought	2012	6,105,603	897,884	131	543,926	80
	2013	6,166,108	945,989	137	557,358	81
	2014	6,199,597	828,660	119	496,964	72
Percent Change (%)		26%	-24%	-40%	-16%	-33%

Table 3: Total and Residential Water Use in 2014 for Individual Agencies in the San Francisco Bay Area

Agency	Population change since 1986	2014 Water Use			Change in water use 1986-2014		Per capita water use		Change in <i>per capita</i> water use 1986-2014	
		Total (AF ¹³)	Residential (AF)	Resid. % of total ¹⁴	Total % change	Residential % change	Total (GPCD)	Resid. (GPCD)	Total % change	Residential % change
Alameda County Water District (ACWD)	+42%	40,647	26,168	64%	-10%	-13%	107	69	-37%	-39%
Bay Area Water Supply and Conservation Agencies (BAWSCA) ¹⁵	+25%	222,896 1	137,732	62%	-22%	-14%	114	70	-37%	-31%
Contra Costa Water District (CCWD)	+ 53%	104,500	55,734	53%	-21%	+16%	198	106	-49%	-24%
East Bay Municipal Utility District (EBMUD)	+21%	188,820	112,438	60%	-21%	-17%	122	73	-35%	-32%
Marin Municipal Water District (MMWD)	+12%	24,521	16,934	69%	-25%	-27%	117	81	-33%	-27%
San Francisco Public Utilities District (SFPUC)	+13%	73,696	42,672	58%	-35%	-24%	79	46	-42%	-33%
Santa Clara Valley Water District (SCVWD) ¹⁶	+31%	318,000	191,340	60%	-13%	0%	153	92	-34%	-24%
Zone 7 Alameda County (Zone 7)	+112%	36,148	23,066	60%	+34%	+28%	137	87	-36%	-39%
City of Napa	+31%	13,217	7,977	61%	+3%	-1%	137	83	-22%	-24%

¹³ Units: AF = acre-feet (325,831 US Gal., or 1233.48 m³); GPCD = gallons per capita per day

¹⁴ Residential water use as % of total water use not including recycled water

¹⁵ BAWSCA values includes ACWD and agencies that are part of SCVWD.

¹⁶ SCVWD values are for 2013; residential use estimated based upon ratio of residential use to total use given in 2010 UWMP

FIGURE 1

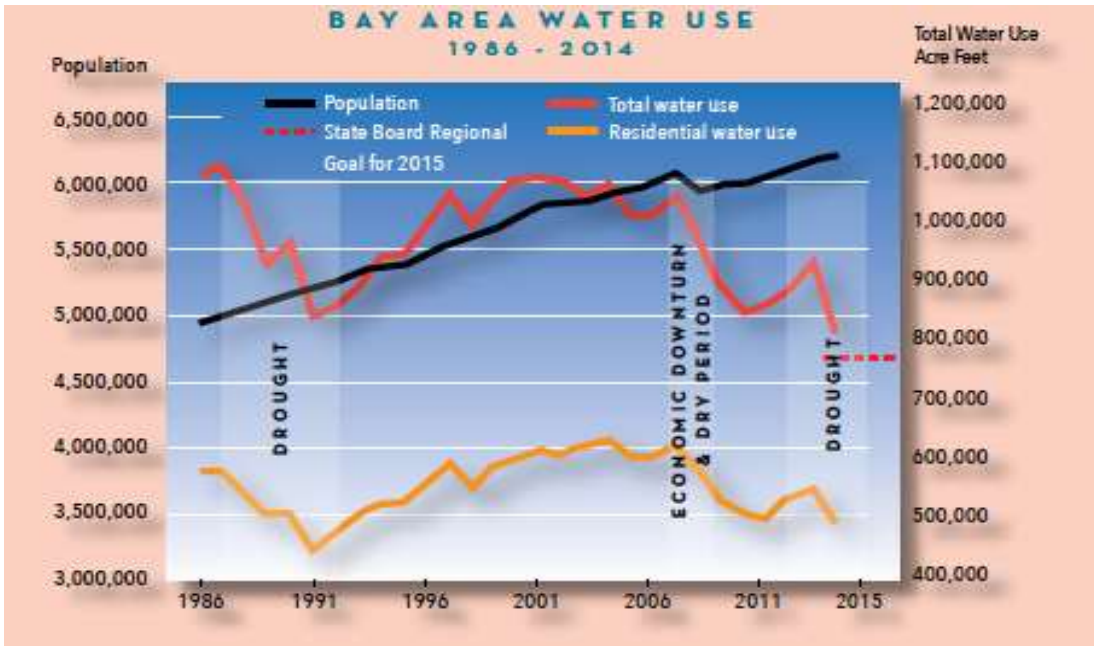


FIGURE 2

