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Efficient Urban Water Management

Understanding Your Residential Water Bill

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This publication is the first in a series on urban water management.

INTRODUCTION

According to the estimates compiled by the U.S. Geological Survey (USGS) from 2000 to 2015, water withdrawals for public supply in California dropped from 6,121 to 5,096 billion gallons per day. To put these numbers in perspective, per capita water use in California has decreased from 181 gallons per capita per day (GPCD) in 2000 to 131 GPCD in 2015. However, even with these reductions in residential water use, Californians are expected to reduce water consumption further. California's population increase from 39 million to 60 million by 2050 (Dieter and Maupin 2017), coupled with impacts of climate change (Hanak and Lund 2012), heighten the need for continued urban water conservation. To prepare for increased water scarcity and wider fluctuations in water availability, California recently enacted a conservation law that requires water agencies to reduce indoor water consumption to 52.5 gallons per person per day by 2030.

Water utilities use a variety of tools to achieve these conservation goals. These methods include conservation-based water pricing, outdoor water use restrictions, education geared toward reducing water waste through efficient irrigation practices and the planting of drought-resistant plants, rebate programs for lawn replacement, and the installation of efficient appliances. The focus of this publication is to provide information on consumption and pricing, which is one demand-side management approach that can be used to encourage water conservation (Nemati et al. 2016; Nemati and Penn 2018; Buck et al. 2016). This publication defines terms commonly used in water bills, explains various pricing structures, describes average indoor and outdoor water consumption, and directs the reader to indoor and outdoor water conservation information, including accurate plant-selection databases and available resources from UC ANR regarding landscape irrigation methods.

Understanding residential water bills can be confusing and challenging for the customers. Water utilities in California, as well as other states, use different units to measure water consumption. On top of that, water pricing methods vary according to the water utility, which makes water statements complicated and hard to understand. In order to conserve water, it is essential for customers first to know how much water they are consuming and how much they are paying for it. Single-family residential customers can use this document to better

SB 606 and AB 1668 establish guidelines for efficient water use and a framework for the implementation and oversight of the new standards, which must be in place by 2022. The two bills strengthen the state's water resiliency in the face of future droughts with provisions that include 1) establishing an indoor, per-person water use goal of 55 gallons per day until 2025, 52.5 gallons per day from 2025 to 2030, and 50 gallons per day beginning in 2030; 2) creating incentives for water suppliers to recycle water; and 3) requiring both urban and agricultural water suppliers to set annual water budgets and prepare for drought. For more information, see the California Department of Water Resources website, https://water.ca.gov/Programs/Water-Use-And-Efficiency/Making-Conservation-a-California-Way-of-Life.

understand their water usage, their water bill, and its components.

TERMS USED IN WATER BILLS

To understand water statements, it is essential to understand the various terms and acronyms used in the water statements. Below we explain some of these terms used by the water agencies in California.

Billing Cycle

A billing cycle is an interval of time from the end of one billing date to the start of the next billing date listed on your statement. Billing cycle (frequency) can range from annual to monthly. Understanding the billing cycle helps to identify opportunities to save water and money. For example, in California, the average monthly usage during the winter is a good indicator of indoor water consumption. Winter billing cycles could potentially direct more attention to indoor water use activities, and summer billing cycles direct more attention to outdoor water use activities. Between 2015 and 2017, there was a widespread transition among water agencies to billing customers every month rather than bimonthly (every 2 months), quarterly, or annual billing periods. According to the 2017 California-Nevada water rate survey by the American Water Works Association, monthly billing cycles are now used by 77 percent of the water utilities in California. Table 1 provides a few examples of public water utilities in California and their billing cycles. As indicated in this table, each water agency uses a unique water pricing structure and billing frequency.

Units of Water Measurement

Water agencies use different units to measure water consumption. The most common water consumption measurement units are the following:

Gallons (gal)

This refers to total gallons of water consumed in each billing cycle in a household.

Centum Cubic Feet (CCF)

Hundred cubic feet (HCF) is another term that water utilities use instead of CCF. A CCF or HCF represents 100 cubic feet of water. (The first "C" comes from the Roman word for hundred, "centum.") CCF is the most common unit used by water utilities. One CCF is equivalent to 748 gallons.

Acre-feet (AF)

One acre-foot equals about 325,851 gallons and can cover an acre of land (about the size of a football field) 1 foot deep. On average, households in California use between one-half and 1 acre-foot of water per year for indoor and outdoor use.

Average Gallons per Day (GPD)

This term is straightforward, meaning exactly what it sounds like: average gallons of water

Table 1. Examples of rate structure and billing frequency used by water utilities

Water service provider	Effective date	Bill frequency	Pricing structure
Alameda County Water District	3/1/2018	bimonthly	uniform
Amador Water Agency	10/1/2017	monthly	uniform
City of Bakersfield	6/1/2017	monthly	uniform
City of Beverly Hills	7/3/2017	bimonthly	tiered
City of Chino Hills	7/1/2017	monthly	budget
City of Glendora	4/1/2017	bimonthly	tiered
City of Grover Beach	8/1/2017	monthly	uniform
City of Indio	1/1/2018	monthly	budget
City of Livermore	1/1/2017	monthly	tiered
East Bay Municipal Utility District	7/12/2017	bimonthly	tiered
Glenbrook Water Cooperative	1/1/2016	annually	tiered

Note: *For a more extensive list of water utilities, see the California-Nevada Water Rate Survey (American Water Workers Association 2017).*

used per day. This term can be calculated by dividing total gallons of water consumed in a household by the number of days in the billing cycle.

Average Gallons Per Capita Per Day (GPCD)

The only difference between this term and GPD is that GPCD measures average water consumption for an individual rather than for each household. GPCD can be calculated by dividing total gallons of water consumed in a household by the number of people living in the household and then by the number of days in a billing cycle.

WATER RATES

Service Charge

Based on the 2017 California-Nevada water rate survey results, households in California, on average, paid $75 per month for their water bills. Usually, bills consist of two main parts: a fixed service charge and a volumetric commodity charge. The service charge is a monthly (or bimonthly) charge applied to all customers, regardless of how much water they consumed. The service charge is commonly used by all water utilities. The service charge varies depending on the customer's meter size, but it is not a meter charge or fee to rent or pay for the meter itself. The service charge is designed to recover costs that do not vary with consumption (known as fixed cost). For example, the service charge represents costs for meter readings and billing, maintanance and replacement of meters, and maintenance of service lines across the distribution system, to name a few. Approximately 43 percent of the average water bill consists of the service charge.

Other portions of the total bill, besides the volumetric portion, include a fixed fee (service charge). In addition, if a water utility provides sewer services, you would see a sewer service fee, which is for the collection, treatment, and disposal of wastewater.

Volumetric Charge

Water utilities usually use one of the following pricing structures for calculating the volumetric portion of the customer's monthly bills. The most common pricing structures are uniform volumetric, tiered (also referred to as inclining block rates, conservation rates, conservation-oriented rates, or demand-management pricing), and budget (also referred to as conservation rates, conservation-oriented rates, or demand management pricing). Each of these pricing structures, along with an example of water agencies that use these structures, is described below.

Uniform Volumetric

A uniform volumetric rate is a single charge per unit of consumption. The charge remains constant for all metered consumption of water, usually on a year-round basis. A customer's water bill increases by a uniform amount for each additional unit of water consumed. The Alameda County Water District (ACWD), for example, is one among many districts that use this type of pricing structure. ACWD uses bimonthly billings and charges $4.419 per 100 cubic feet (748 gallons) for residents inside the water district service area and $5.081 for residents outside of the service area. Note that 100 cubic feet is equal to one CCF (or HCF), or 748 gallons. Figure 1 illustrates how this rate structure works. Effective indoor or outdoor water conservation practices can help to save money in each billing cycle. For example, in this illustration, conservation can reduce the water bill by $4.419 or $5.081 per CCF conserved (748 gallons of reduced usage) in each billing cycle.

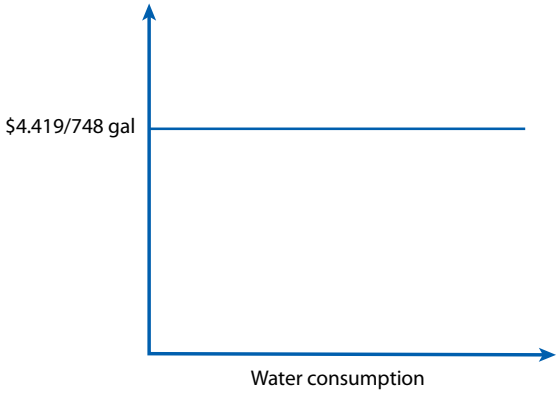

Figure 1. Uniform rate structure used by the Alameda County Water District in 2019.

As an example, assume that a household inside the ACWD service area consumes 15,000 gallons of water in 2 months (equal to 20 CCF). This household water bill would be (20.05 × $4.419) = $86.60 plus the fixed water service charge. ACWD charges $54.43 bimonthly water service charges, which makes total water cost for this household $141.03 ($86.60 + $54.43) for the 2-month billing

period. If this household reduces consumption from 20.05 CCF to 15.00 CCF, the water bill in 2 months reduces to (15.00 × $4.419) = $66.28, where the monetary savings would be ($86.60 - $66.28) = $20.31 per billing cycle. The City of Newport Beach, the City of Sacramento, and the City of San Bernardino are examples of other water districts that use the uniform rate structure.

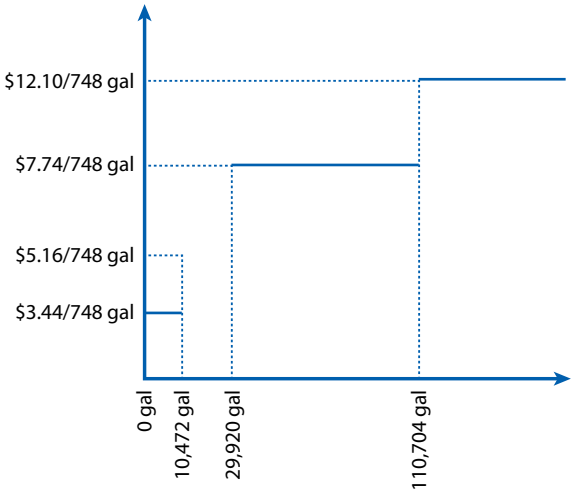

Figure 2. Tier rate structure used by the City of Santa Monica in 2019.

Tiered

A tiered water rate structure is the most common water pricing method that water utilities in California currently use. Tiered pricing is based on the idea that water rates increase as water consumption increases. In a tiered pricing structure, the rate charged for water consumption resembles a set of stairs (fig. 2), which are called tiers or blocks. Water used within the first tier is the least expensive. If a customer's water use exceeds the limit of the first tier, subsequent water use is charged at a higher, second-tier rate. As consumption continues climbing into higher tiers, the price for water consumed continues to rise. Typically, the perception among researchers and water agencies is that the more dramatic the rise in cost, the higher the incentive to conserve water.

An illustration of an increasing block rate structure is the four-block structure employed by the City of Santa Monica. The City of Santa Monica is using a 4-tier pricing structure in 2019-2020 with bimonthly billing cycle. Customers pay $3.44 for 748 gallons (1 CCF) of water up to a limit of 10,472 gallons (14 CCF) per household per month. The same household is charged $5.16 for each additional 748 gallons more than 10,472 gallons per month up to 29,920 gallons (40 CCF). Each additional 748 gallons used would cost $7.74 until an upper limit of 110,704 gallons (148 CCF) is reached. Households exceeding 110,704 gallons per month have to pay $12.10 for each additional 748 gallons.

To illustrate how much a resident in the City of Santa Monica water service area pays for water, assume a household in this service area consumes 15,000 gallons of water in a billing cycle, i.e., 2 months (equal to 20 CCF). The volumetric portion of this household water bill would be (14 × $3.44) + (6.05 × 5.16) = $79.38 plus water service fixed charge. Tiered structure tends to provide more incentive for water conservation than a uniform volumetric pricing structure, especially for reducing outdoor usage (anything beyond tier 1). In this example, if this water user could reduce their usage from 20.05 to 15.00 CCF, they could save $25.17. The savings potential is even higher if a water user is using water in even higher tiers. The East Bay Municipal Utility District, the City of Glendora, and the City of Beverly Hills are other water districts that use tier-based water pricing structure, to name a few.

Budget-Based

Another water pricing structure is the water budget-based rate structure, which is also referred to as a goal system, allocated system, or customer-specific water rate. Water utilities determine a budget for indoor and outdoor water consumption based on variables such as square footage of landscape, daily weather and climate, and season of the year, as well as the size of the household. Customers are charged based on how much water their household uses above or below the estimated budget for their property. Eastern Municipal Water District (EMWD) and Western Municipal Water District (WMWD) in Riverside County are two examples of water utilities in California that use this type of pricing structure. One of the main goals of this type of water pricing structure is to encourage water conservation

through prices but also provide water at the affordable rate for necessary daily requirements (e.g., showering and cooking).

We use EMWD to illustrate this pricing structure. As shown in table 2, EMWD uses four blocks in their increasing block budget-based rates. The block size is different for each household and is calculated mainly based on the household size, drought conditions, and specific climate factors (microclimate) of the household location. In 2019, for a household with three members, EMWD allocated 5,236 gallons (7 CCF) for indoor use and 5,984 gallons (8 CCF) for outdoor usage. Customers pay a relatively higher rate for water they use beyond the indoor and outdoor budgeted amount. In most cases, the indoor budget is based on the household size, and the outdoor budget is based on the lot size and microclimate conditions. The microclimate is usually calculated by municipalities as a percent of reference evapotranspiration (ETref).

Table 2. Tier rate structure used by the Eastern-Municipal Water District (EMWD) in 2019

Tier	Price per 748 gallons
tier 1 (indoor)	$1.07
tier 2 (outdoor)	$3.43
tier 3 (excessive)	$5.67
tier 4 (wasteful)	$11.59

WATER USE BREAKDOWN AND ADDITIONAL INFORMATION

How Much and Where We Are Using Water in Our Homes

On average, each Californian used 131 gallons per day in 2015. Overall, single-family residential water consumption has two main components: indoor and outdoor water use. Water use for outdoor purposes (e.g., watering lawns) is estimated at 54 percent of total single-family residential water use. Regarding indoor water use, a recent survey of 23 water agencies across the United States shows that four main activities account for 80 percent of indoor water consumption, including toilet (24%), shower (20%), faucet (19%), and clothes washer (17%), respectively. Figure 3 illustrates

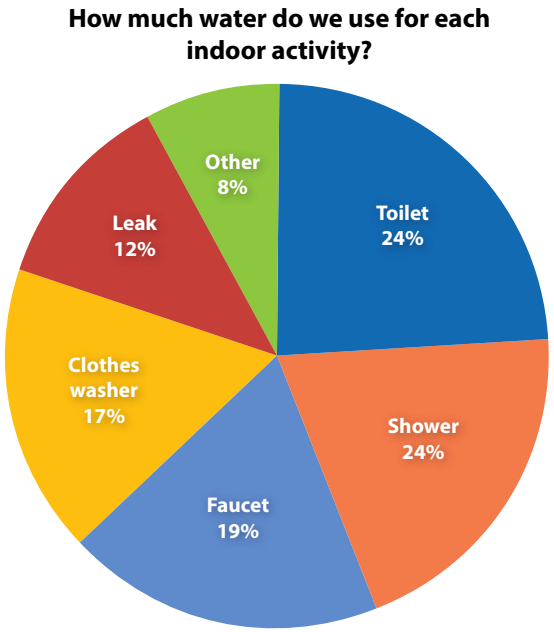

Figure 3. Indoor water use breakdown by activity.

Source: Residential End Use of Water, Version 2. 2016. Water Research Foundation. For more information, see the Water Research Foundation website, https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf.

indoor water consumption by activity, based on the survey of 23 agencies across the country (Water Research Foundation 2016).

Where to Find More Information

Below is a list of searchable plant-selection databases that allow California residents to select plants based on climate zone, water use, size, function, and several other factors. Note that while these databases are useful tools, they do not represent exhaustive research-based experimental data, which takes many years to compile.

SelecTree

A tree-selection guide is a searchable database that is maintained by the Urban Forest Ecosystems Institute at California Polytechnic State University, San Luis Obispo. Users may search multiple criteria to select trees based on climate zone, ultimate height and width, above and below ground space requirements, root damage potential, water requirement, flower characteristics, disease, insect susceptibility, and other criteria. For more information, see the SelecTree: A Tree Selection Guide website, http://selectree.calpoly.edu.

Water Use Classification of Landscape Species IV

This is a searchable database that classifies over 3,500 woody and herbaceous landscape plants into very low, low, medium, and high water-use categories. Water-use categories are based on the observations of regional committees consisting of knowledgeable horticulturists combined with research-based data when available. For more information, see the Water Use Classification of Landscape Species (WUCOLS) website, http://ucanr.edu/sites/WUCOLS/.

CalScape

Maintained by the California Native Plant Society, this is a database that includes thousands of woody and herbaceous plants searchable by city and other criteria such as plant type, flower color and season, water use, ease of care, use, and nursery availability. For more information, see the Calscape website, https://calscape.org/.

UC ANR Publications

The following free, downloadable UC ANR publications are another source of useful information on developing sustainable, drought-resistant landscape plantings.

- *Sustainable Landscaping in California*. UC ANR Publication 8504 (https://anrcatalog.ucanr.edu/pdf/8504.pdf)
- *Use of Graywater in Urban Landscapes in California*. UC ANR Publication 8536 (https://anrcatalog.ucanr.edu/pdf/8536.pdf)
- *Keeping Plants Alive under Drought or Water Restrictions*. UC ANR Publication 8553 (https://anrcatalog.ucanr.edu/pdf/8553.pdf)
- *Top Indoor and Outdoor Water Conservation Tips* (https://ucanr.edu/sites/ccmg/files/198039.pdf)

Conserve H2O

Conserve H2O, a Regional Water Providers Consortium, serves as a collaborative and coordinating organization to improve the planning and management of municipal water supplies in the greater metropolitan region of Portland, Oregon. They provide tips and illustrations for conserving indoor water use as well as signs for finding leaks and broken appliances. For more information, see the Conserveh2o website, https://www.conserveh2o.org/indoor-water-conservation-tips.

Water Consumption Calculator

This calculator is designed to help households calculate water use according to the appliance, both indoors and outdoors. The final calculation could provide information on daily, monthly, and yearly water use in gallons. For more information, see the CSGNetwork.com website, http://www.csgnetwork.com/waterusagecalc.html.

Los Angeles County Public Works

This website provides tips to reduce indoor water consumption according to type of use, such as that found in the bathroom, kitchen, and laundry. For more information, see the Los Angeles County Department of Public Works website, http://ladpw.org/WWD/ConservationTip/Page_01.cfm.

Below are more technical resources for readers interested in a more in-depth overview of what drives evapotranspiration and more quantifiable approaches to irrigation.

CIMIS

The California Irrigation Management Information System (CIMIS), developed in 1982, consists of a statewide network of over 145 automated weather stations in California that are being used to measure weather parameters necessary to estimate ETref (reference crop evapotranspiration). Spatial CIMIS was developed later in 2009 to produce more accurate maps of ETref, using a combination of remotely sensed satellite data and traditional CIMIS stations. For more information, see the California Irrigation Management Information System (CIMIS) website, https://cimis.water.ca.gov/.

MWELO

Model Water Efficiency Landscape Ordinance (MWELO), originally developed in 1992 by California's Department of Water Resources (DWR) and updated in 2009 and 2015, articulates a quantitative approach to calculating maximum applied water allowance for landscape irrigation in urban settings.

MWELO provides information to estimate landscape irrigation water required to meet the physiological needs of plants while maximizing the irrigation water use efficiency. For more information, see the California Department of Water Resources website, https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance.

CONCLUDING REMARKS

Understanding how to read your water bill, how much water you are using, and what actions you can take to ensure that your water use remains in lower tiers or water budgets are three important ways to help you manage your water consumption and establish a benchmark for future water saving actions. As explained in this publication, the main measurement units for water consumption that residents see in their water bills are gallons (gal), centum cubic feet (CCF) or hundred cubic feet (HCF), and acre-feet (AF).

1 CCF (or HCF) = 748 gallons
1 AF = 325,851 gallons

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