Los Angeles Department of Water & Power

Water Conservation Potential Study

September 2017

Executive Report

As an industry leader in water conservation, the Los Angeles Department of Water and Power (LADWP) has always been on the cutting edge of water use efficiency strategies. To plan for the future, LADWP needs to develop an improved understanding of current water use efficiency among its customer sectors. Developing this understanding will allow LADWP to determine the City of Los Angeles' (City) remaining water conservation potential, and effectively develop strategies to meet the long-term water resource goals established in LADWP's 2015 Urban Water Management Plan (2015 UWMP).

This Executive Report summarizes LADWP's multi-year effort to develop its comprehensive *Water Conservation Potential Study* (WCPS) for the City. The full WCPS report can be obtained from LADWP on its website at www.ladwp.com/waterconservation.

The Water Conservation
Potential Study was prepared by:

LA DWP Los Angeles Department of Water & Power

Water Resources Division

&

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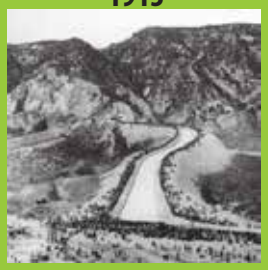
Section 1 - Introduction

Committed to providing a reliable water supply to Angelenos, LADWP has a long, proactive history of water resources management. When Los Angeles was a town of 142,000 residents back in 1902, surface water came from the Los Angeles River and groundwater from the San Fernando Basin. To address the City's rapid growth during the early 1900's, LADWP built the first Los Angeles Aqueduct (LAA) to import additional water supplies from the Eastern Sierras in 1913.

Early 1900's

LADWP Fully Meters Its Water Customers

1913



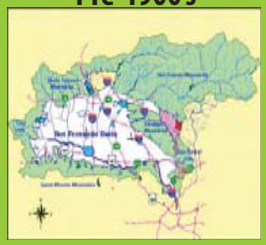
1st Los Angeles Aqueduct Completed

1930's and 1950's

In Partnership with MWD, LADWP Helped Fund the Colorado River Aqueduct and State Water Project

1900 | 1910 | 1920 | 1930 | 1940 | 1950

Pre-1900's



Pueblo Rights to San Fernando Basin Reaffirmed in 1979

1928

Founding Member of Metropolitan Water District

As the City and the Southern California region continued to grow, LADWP was instrumental in the creation of the Metropolitan Water District of Southern California (MWD), the regional wholesale water provider for Southern California. In partnership with MWD, LADWP helped fund the Colorado River Aqueduct in the early 1930's and the State Water Project in the late 1950's. The LAA's supply capacity was also expanded with the completion of the second Los Angeles Aqueduct in 1970.

But from the 1970's, as droughts became more frequent and severe, LADWP has been focusing its efforts on increasing drought-resilient local water supplies by investing in water conservation, recycled water, groundwater recovery, and stormwater capture.

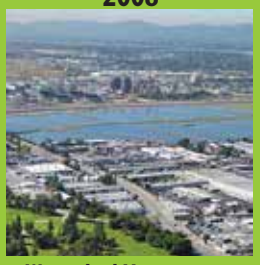
1970

2nd Los Angeles Aqueduct Completed

1979

Delivery of Recycled Water Commenced

2008



Watershed Management Group Created

2015

Urban Water Management Plan

1960 | 1970 | 1980 | 1990 | 2000 | 2010

1977

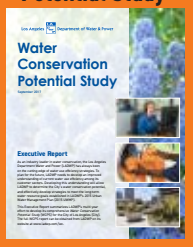
Water Conservation Program Initiated

2012-2017

Recycled Water Master Planning

Stormwater Capture Master Plan

Water Conservation Potential Study



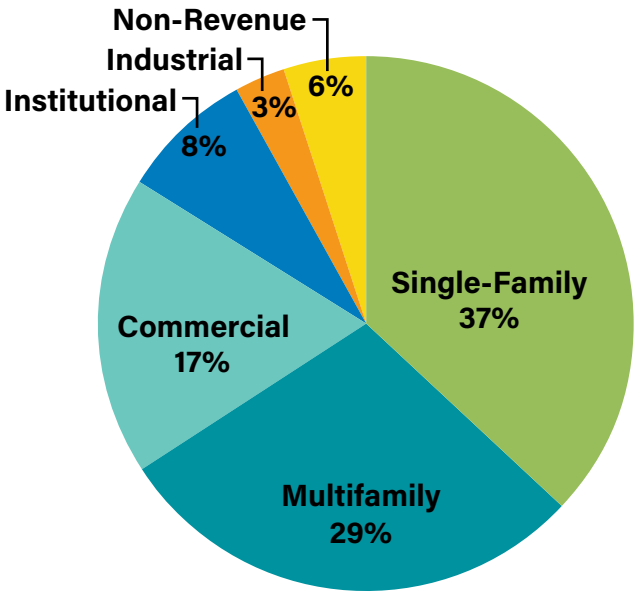
LA's Water Demand Breakdown

Water use in LADWP's service area is divided into five main customer sectors: (1) single-family residential; (2) multifamily residential; (3) commercial; (4) industrial; (5) institutional. Commercial, industrial, and institutional sectors are often referred to by LADWP and other water utilities as CII. In addition to these customer sectors, non-revenue water makes up the remainder of potable water use and consists of authorized uses such as firefighting as well as system losses. The residential sectors make up about two-thirds of the City's potable water demand.

Fun Fact: An acre-foot of water can serve 3 average-sized LA homes for a year.

Average Demand = 536,000 Acre-Feet/Year

LADWP's Water Usage by Major Sector (Fiscal Year Ending [FYE] 2012 to 2016)



LADWP's Water Conservation Program

Los Angeles has long recognized that water conservation should be at the core of multiple strategies to improve overall water supply reliability for its residents. Water conservation has numerous benefits for the City, such as reduction in costs associated with water and wastewater treatment, reduction in energy and greenhouse gas emissions, monetary savings for customers who reduce water consumption, and improved water supply reliability.

LADWP has embraced water use efficiency since our customers became fully metered back in the early 1900's. A few key milestones demonstrate LADWP's conservation leadership throughout more recent years as shown in the timeline below.

1970's — Initiates water conservation program and provides customers with conservation kits

1990's — Launches toilet rebate, exchange, and direct install programs; starts Technical Assistance Program; helps form California Urban Water Conservation Council

1991 — Implements an ascending tier, volumetrically priced rate structure to promote conservation

1993

2000's — Expands incentives for clothes washers, efficient cooling towers, high-efficiency toilets, turf replacement, and Technical Assistance Program

2009 — Implements outdoor water use restrictions (1991), creates enforcement team (A.K.A Drought Busters, 2009), and expands public education in response to severe droughts (2015)

2014 — Increases turf replacement rebate, adds rebate for rain barrels and cisterns, and expands Outreach and Education Program

2015

2016 — Implements 4-tiered rate structure, and adds Unreasonable Water Use restrictions to encourage responsible water use

LADWP's Water Conservation Program consists of three main components:

Outreach & Education **City Ordinances** **Rebates & Incentives**

Outreach & Education

LADWP employs multiple outreach and education strategies to encourage Angelenos to improve their water use efficiency and instill an understanding that water conservation is the cultural norm in Los Angeles. These strategies include:

Outreach

- **Earned Media Opportunities:** Through the distribution of regular and timely news releases, the LADWP Communications Team generates broadcast interviews and print articles in various media outlets about water conservation and available rebate and incentive programs.

- **Social Media:** Program facts, web links, reminders, videos, photos, and other water conservation relevant information shared regularly via Twitter, Instagram, Facebook, Vimeo, and YouTube.

- **Print Materials:** Branded print materials including flyers, Frequently Asked Questions, and fact sheets available for distribution at all relevant venues, such as community fairs.

- **Media Advertising Campaign:** Campaign messages broadcasted and displayed using paid advertising in television, radio, newspapers, magazines, bus tails, movie screens, and online ads.

Education

- **Los Angeles Times in Education:** In partnership with LA Times, newspapers are provided to students in grades 4-12 and lesson packages are provided for teachers on water supply sources and conservation. Students are encouraged to illustrate concepts they have learned by participating in an annual art contest.

- **"Thirsty City" Live Performances:** Plays are presented on school campuses to introduce students to water supply sources, water supply challenges, and conservation.

- **Los Angeles Outdoor Landscape Academy (LAOLA):** LAOLA is LADWP's training academy to help inform the community on how to remove turf and switch to sustainable, water efficient landscaping. A combination of classroom training and hands-on-workshops are provided to inform customers, gardeners, and design professionals on turf removal, garden design, irrigation, and garden maintenance.

City Ordinances

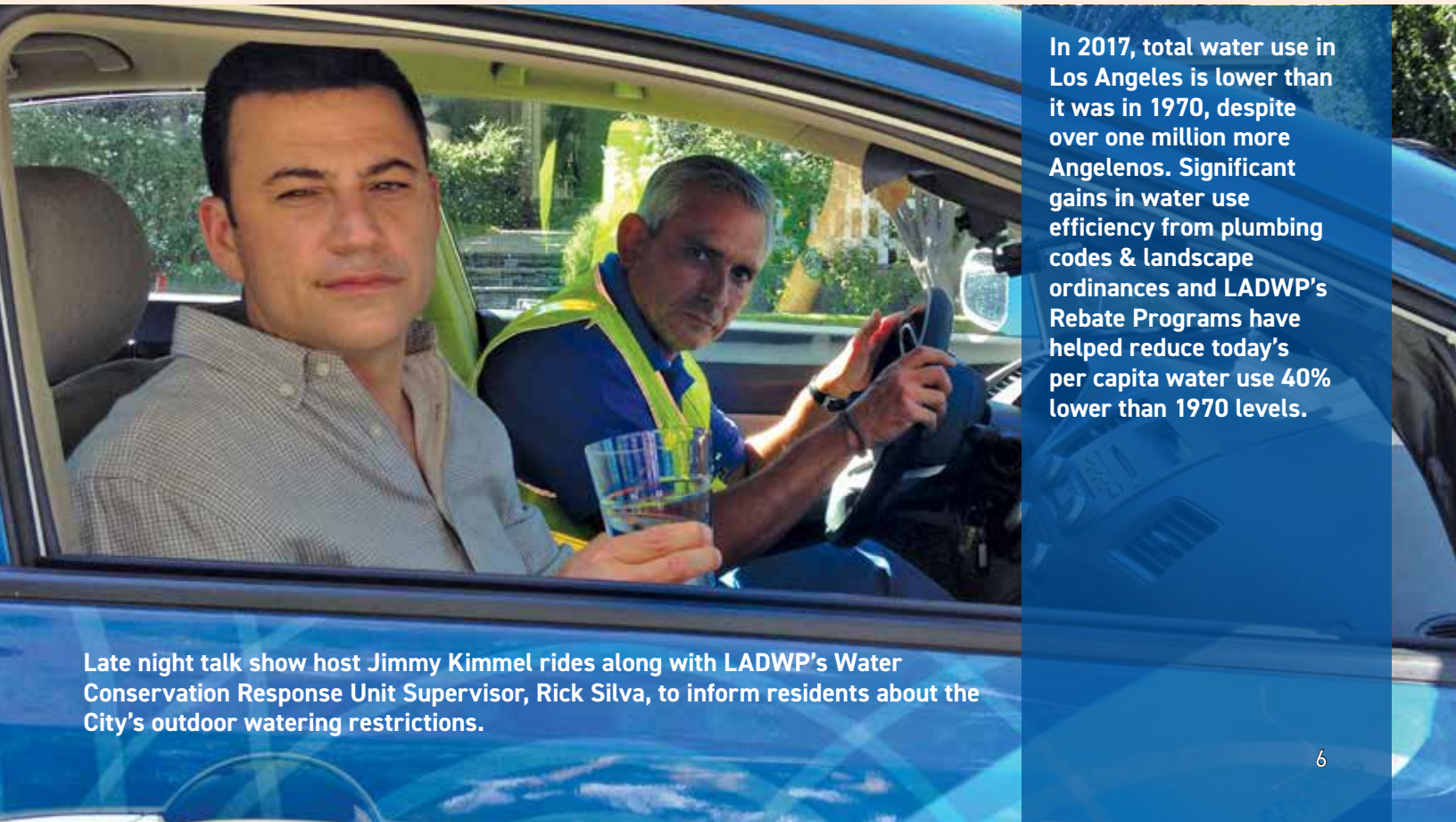
The City has been a leader in using codes and ordinances to drive conservation and has helped shape many of the state plumbing codes and landscape ordinances that are in place today. The following is a list of City Ordinances aimed to improve water use efficiency:

- **Emergency Water Conservation Plan Ordinance:** The ordinance contains six phases of water restrictions to address water shortages. Water waste prohibitions steadily increase by phase, which includes a progressive reduction in allowable outdoor watering days per week.

- **Retrofit-On-Resale Ordinance:** First adopted by the City in 1988 as its plumbing retrofit ordinance, an amendment was made in 1998 to require the installation of efficient toilets and showerheads in single-family and multifamily properties prior to close of escrow.

- **2015 State Model Water Efficiency Landscape Ordinance (MWELO):** In May 1996, the City's Landscape Ordinance was passed to improve efficiency in outdoor water use. Since then, the State has updated its landscape ordinance, setting very high efficiency standards for outdoor water use, which the City has adopted.

- **2009 Water Efficiency Requirements and 2016 Citywide Water Efficiency Standards Ordinances:** These two ordinances require installation of high efficiency plumbing fixtures in new development and major renovation projects for residential and CII customers.



Late night talk show host Jimmy Kimmel rides along with LADWP's Water Conservation Response Unit Supervisor, Rick Silva, to inform residents about the City's outdoor watering restrictions.

In 2017, total water use in Los Angeles is lower than it was in 1970, despite over one million more Angelenos. Significant gains in water use efficiency from plumbing codes & landscape ordinances and LADWP's Rebate Programs have helped reduce today's per capita water use 40% lower than 1970 levels.

Rebates & Incentives

LADWP provides its residential and CII customers with an extensive choice of rebates and incentives for installing high efficiency water fixtures that include:

- Up to $1.75 per square foot (sq. ft.) of turf removed
- $100 for premium high-efficiency toilets
- $200 for weather-based irrigation controllers
- $300 for high-efficiency clothes washers
- $500 for zero and ultra low flush urinals
- $3,000 for cooling tower pH controllers
- Up to $250,000 per CII project through LADWP's Technical Assistance Program (TAP)

In addition to partnering with MWD on water conservation rebate programs, LADWP also partners with the Southern California Gas Company and LADWP Efficiency Solutions to offer Direct Install Programs. The partnerships achieve multiple benefits by helping residential and small business customers replace fixtures to save gas, energy, and water.

Recent achievements are shown in Table 1 (Residential Rebates) and Table 2 (CII Rebates).

Since 2010, LADWP's conservation program has saved roughly 25,000 acre-feet of water per year (or 22 million gallons per day) by incentivizing Angelenos to:

- Replace over 48 million sq. feet of turf with California-Friendly landscaping (since the program started in 2009)
- Install over 400,000 high-efficiency toilets
- Install over 44,000 high-efficiency clothes washers
- Install over 55,000 high-efficiency showerheads
- Install over 95,000 faucet aerators
- Install over 4,800 zero or ultra low flush urinals
- Install over 15,000 weather-based irrigation controllers

Table 1. Residential Rebates (FY 2010/11 - 2015/16)

Device Type/Program	Devices Installed	Water Savings (Acre-Foot/Year)
Customer Rebates		
High Efficiency Toilets	124,583	3,194
High Efficiency Washing Machines	44,968	1,511
Sprinklerhead Rotating Nozzles	26,961	118
Weather Based Irrigation Controller and Soil Moisture Sensors	1,840	77
Rain Barrels and Cisterns	44,079	84
Turf Replacement (sq. ft.)	32,562,898	4,396
Residential Free Device Program		
High Efficiency Showerheads	40,182	662
Residential Faucet Aerators	65,497	183
Drip Irrigation Starter Kits	431	3
Direct Install Partnership Programs		
Home Energy Improvement Program – Showerheads	7,729	128
Home Energy Improvement Program – Faucet Aerators	9,829	27
Home Energy Improvement Program – High Efficiency Toilets	2,715	100
Total Residential Rebate Water Savings		**10,483**

Table 2. Commercial (CII) Rebates (FY 2010/11 - 2015/16)

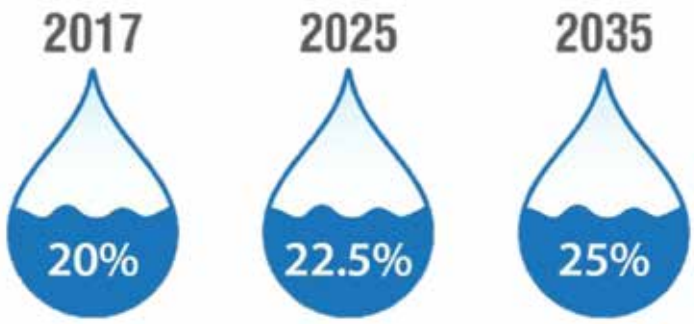
Device Type/Program	Devices Installed	Water Savings (Acre-Foot/Year)
Commercial (CII) Customer Rebates		
High Efficiency Toilets	302,967	7,450
Premium High Efficiency Toilets	56,841	1,656
Zero and Ultra Low Water Urinals	4,884	597
Cooling Tower pH Controller	96	186
Cooling Tower Conductivity Controller	30	19
Weather Based Irrigation Controller and Soil Moisture Sensors	17,931	235
Large Rotary Nozzle	1,290	46
Rotating Nozzles for Pop-up Spray Heads	44,983	198
In-stem Flow Regulator	12,911	39
Plumbing Flow Control Valve	343	3
Laminar Flow Restrictor	926	22
Technical Assistance Program	--	1,778
Turf Replacement (sq. ft.)	12,254,668	1,122
Commercial (CII) Free Device Program		
Commercial Showerheads	9,554	157
Commercial Faucet Aerators	19,754	91
Water Brooms	59	9
Pre-Rinse Spray Nozzles	296	45
Direct Install Partnership Programs		
Multifamily Direct Thermal Savings Program	149,618	1,124
Small Business Direct Install Program	6,732	94
Total Commercial (CII) Rebate Water Savings		**14,871**

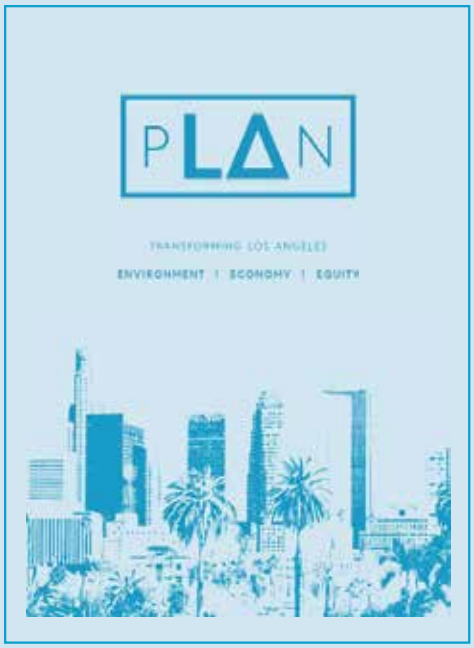
Mayor's Executive Directive No. 5 and Sustainability pLAn Goals

In October 2014, Mayor Eric Garcetti established Executive Directive No. 5: Emergency Drought Response – Creating a Water Wise City (ED5) in response to one of the most severe droughts in California's history. On April 8, 2015, the City released the Sustainable City pLAn (pLAn), which incorporates ED5's goals and adds additional long-term goals to serve as a road map towards sustainability.

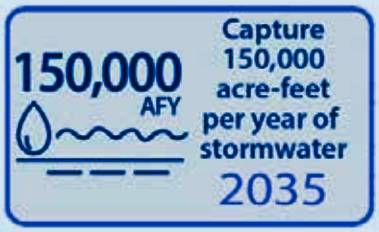
Through multiple conservation strategies implemented by LADWP and the strong conservation efforts by Angelenos, the City was able to meet the Mayor's January 1, 2017 goal by reducing per capita use to 104 gallons per capita per day, which equates to a 20 percent reduction compared to the FYE 2014 baseline. Going forward, LADWP has incorporated the remaining pLAn goals into its 2015 UWMP and has committed to meeting these goals through the development of additional water conservation, recycled water, and stormwater capture along with remediating the San Fernando Groundwater Basin.

pLAn Long-Term Per Capita Water Use Reduction Goals





Additional pLAn Water Supply Targets

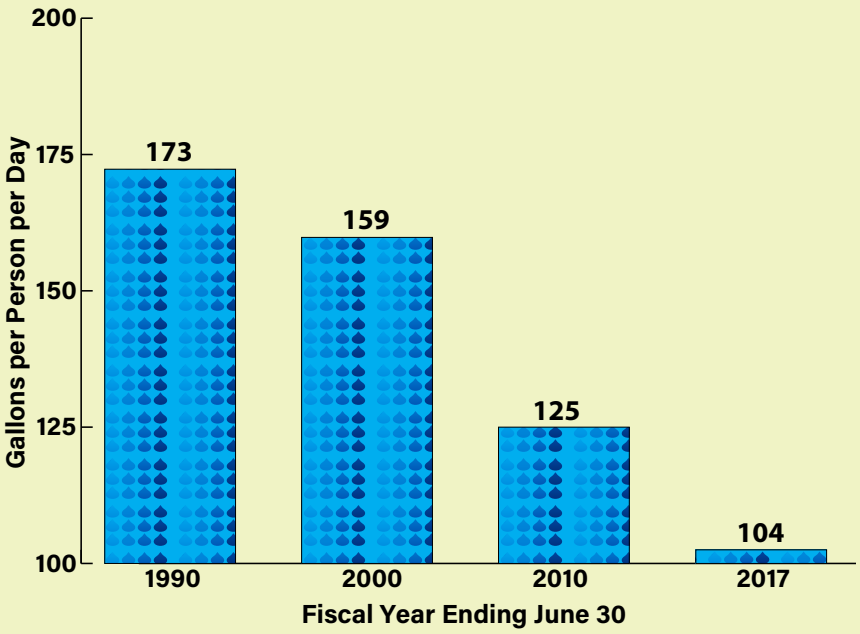


The Need to Understand the City's Remaining Conservation Potential

LADWP has made tremendous achievements in water use efficiency since its Water Conservation Program started in the late 1970's. As of FYE 2017, water savings from LADWP's rebates and incentives total over 128,000 acre-feet per year. These savings, along with water use efficiency from plumbing codes and landscape ordinances, have contributed to significant reductions in the City's per capita water use.

The historical water conservation achievements clearly demonstrate LADWP's wide influence in encouraging water efficiency upgrades by its residential and CII customers. Recognizing that a significant percentage of customers have likely already been reached, it's important for LADWP to understand the current saturation levels of fixtures and the remaining conservation potentials for LADWP's customer sectors. The results from the WCPS will help LADWP develop a long-term plan for its Water Conservation Program that cost-effectively achieves the 2025 and 2035 per capita water use reduction goals set in the 2015 UWMP.

LADWP's Per Capita Water Use



Section 2 - Water Conservation Potential Study Approach

WCPS Water Conservation Levels

The WCPS analyzes four different types of water saving levels.

Theoretical Ceiling:

This represents the water savings that could be achieved if all LADWP customers were instantaneously at the most theoretically efficient levels of water usage. This Theoretical Ceiling is **not achievable** regardless of LADWP's investment levels. While unachievable, this Theoretical Ceiling does help by setting a reference point for other conservation potentials analyzed in the WCPS.

Technical Maximum Conservation Potential:

The level of conservation achievable by going beyond voluntary customer participation and mandating efficiency through stricter codes, ordinances, and enforcement. This level of conservation potential is **logistically unenforceable**.

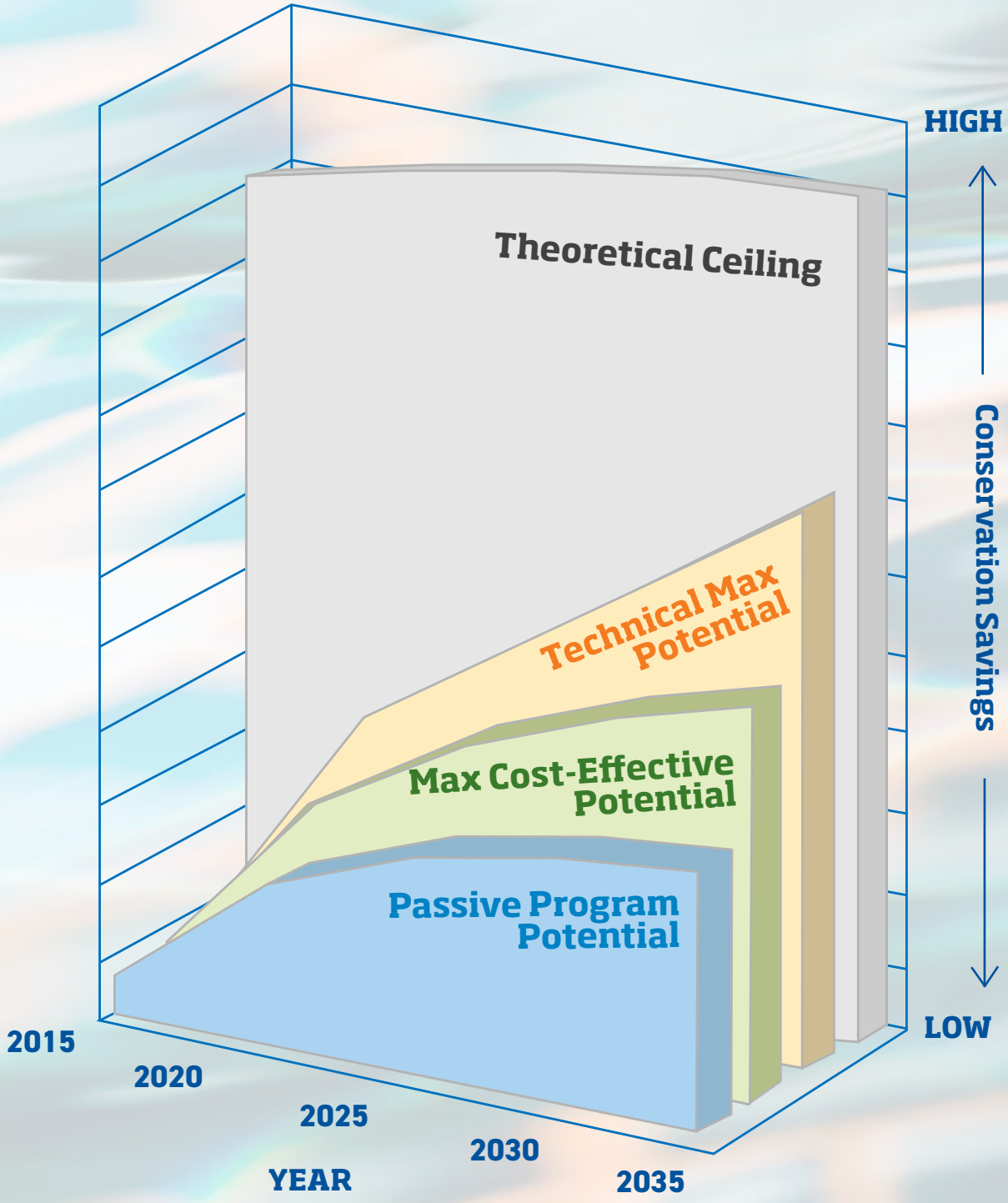
Maximum Cost-Effective Conservation Potential:

The level of conservation achievable through **cost-effective** conservation programs implemented by LADWP, although it would require greatly expanding current financial incentives in order to increase customer participation.

Passive Program Conservation Potential:

The level of conservation achievable with programs aimed at maximizing current plumbing codes and landscape ordinances, public messaging and outreach, and maintaining behavior-change savings from past customer efforts.

WCPS Water Conservation Levels





Method of Measuring Conservation Potential

For each customer sector (i.e., single-family, multifamily, CII, and City-owned Facilities), water is used for various "water end use" categories. Water end uses include: toilet flushing, showers, clothes washing, dishwashing, faucets, car washing, pools, landscape irrigation, commercial/industrial cleaning, cooling towers for commercial/industrial users, manufacturing, and many more.

To determine the different levels of water conservation potential, current and future water end uses for each measure are estimated for each customer sector using the following formula:

GPD=P x E x S x I

Where for each water end use:

GPD = Gallons per day
P = Presence
E = Efficiency Level
S = Saturation Level
I = Intensity

Over time, the water end uses change as the saturation levels shift from non-efficient to efficient. This provides the estimate of water savings for the Water Conservation Potential Study (WCPS) and forms the basis for determining cost-effectiveness.

WCPS Terms

Water End Use:
Water use isolated to a specific purpose, such as toilet flushing, landscape irrigation, and industrial cooling.

Presence (P values):
The percentage of customer properties in the City where the water end use is present.

Efficiency Level (E values):
Appliance efficiency levels for the water end use (example: toilets in the City can range from older 3.5 gallons per flush models to newer, efficient models that need less than 1.0 gallons per flush)

Saturation Level (S values):
The percentage of appliances in a customer sector at a specific efficiency level for the water end use.

Intensity (I values):
Average daily water end use habits per customer sector unit (ex: # of flushes per day per multifamily unit)

Water Savings:
Represents the gallons per day reduction in any future year's water end use as compared to the baseline.

Determining Cost-Effectiveness of Water Conservation

There are many ways to assess the cost-effectiveness of a single water conservation measure or a group of measures in a customer sector. While there are many additional benefits to increased water conservation that can be included, the WCPS focused its cost-effectiveness analysis on the cost savings from reducing purchased imported water from MWD. Cost-effectiveness for the WCPS was determined using a variety of economic metrics defined below.

Economic Metric	Definition
Present Value Cost (PV Cost)	Total future costs adjusted by the discount rate into present value costs (cost in today's dollars).
Present Value Benefit (PV Benefit)	The volume of water saved for a measure (over its replacement life) is multiplied by projected increases in MWD's treated water rate. This avoided cost in future dollars is then adjusted by the discount rate into present value benefit.
Net Present Value (NPV)	The PV Benefit minus the PV Cost. While a large NPV indicates that more benefits are produced than costs, NPV does not always indicate the relative cost-effectiveness of the investment, when compared to other investments.
Benefit-Cost Ratio (BCR)	The PV Benefit divided by the PV Cost. A BCR greater than 1.0 is deemed cost-effective, with larger BCR values indicating greater cost-effectiveness. BCR is also useful in terms of assessing the value for each dollar invested. For example, a BCR of 2.0 means that for each dollar invested, two dollars are generated as a return.
Internal Rate of Return (IRR)	The annualized effective rate of return that would make the NPV for the investment from a measure equal to zero (break even). IRR values that are greater than the discount rate used for NPV are generally considered to be good investments, with higher IRR values indicating more desirable investments.

Main Components of the Water Conservation Potential Study

The formulas for determining water end uses, water conservation savings at different potential levels, and cost-effectiveness are relatively straightforward; however, they require massive amounts of data and valid assumptions in order to be implemented. To meet this challenge, LADWP split the WCPS work into three main components.

1 Research/Data Collection

- Literature review
- Single-family telephone survey
- Single-family onsite home audits
- Multifamily owners online survey
- Interviews with CII Audit Experts
- City-owned facilities audits

2 Saturation Levels/Baseline Water Use

- 4 main water sectors
- Over 15 water end uses
- Baseline efficiency saturation levels
- Water end use calibration

3 Water Conservation Model

- Passive Program Conservation Potential
- Max Cost-Effective Conservation Potential
- Technical Max Conservation Potential
- Conservation and economic projections to 2035

Section 3 - Baseline Water End Uses

To estimate the baseline, or initial, water end uses by customer sector, a variety of approaches were utilized to collect data including conducting surveys & audits, researching past studies, and making professional engineering judgment/assumptions.

Single-Family Residential Sector

Single-family homes represent LADWP's largest customer sector with over 450,000 out of approximately 700,000 water accounts and is over one-third of overall water demand. Accordingly, it was important for LADWP to get a deeper understanding on water use and efficiency for this sector.

LADWP conducted telephone surveys in English and Spanish of a statistically representative random selection of single-family customers. Questions were asked about household characteristics, presence and efficiency levels of plumbing fixtures, landscape size and type, and irrigation systems.

LADWP Survey of Single-Family Homes

Random Telephone Surveys = 615
Onsite Audits = 72

In addition, a sub-sample of customers surveyed by telephone volunteered for an onsite home audit to help validate the results of the phone survey. The onsite home audit involved inspection and measurement of plumbing fixtures, landscapes, and irrigation systems by trained water auditors.

Onsite home audit findings were compared against the customers' phone survey responses. Phone survey responses that closely match with in-person inspections are validated as accurate survey findings.

Generally, for similar questions asked between the telephone survey respondents and onsite audit, there was good agreement between the two. Table 3 shows an example where the telephone survey and onsite audit match well in terms of types of landscaping.

Table 3. Survey Responses on Single-Family Landscape Type

Landscape Type	Telephone Survey Respondents as a Whole (615 Responses)	Telephone Survey Respondents Participating in Onsite Audit (72 Responses)	Onsite Audit (72 Responses)
Front Yard			
Mainly Turf with Trees and Shrubs	73%	71%	79%
CA Friendly/Drought Tolerant	13%	15%	15%
No Landscaping/No Plants	12%	15%	6%
Back Yard			
Mainly Turf with Trees and Shrubs	60%	68%	74%
CA Friendly/Drought Tolerant	13%	10%	16%
No Landscaping/No Plants	24%	18%	10%

There were some instances when the telephone survey and onsite audit differed, particularly when the telephone survey question was not clear enough but the onsite inspection was able to gather the correct information (see Table 4).

When compared against onsite audit findings, results showed that more than 50 percent of telephone respondents answered the high-efficiency washer question incorrectly. Since the vast majority of front loading washers are high efficiency units, the WCPS used the data on front loading washers as a good proxy for high efficiency washers.

The results of these single-family residential surveys, along with information on existing plumbing codes and ordinances,

Table 4. Survey Responses on Clothes Washer Type

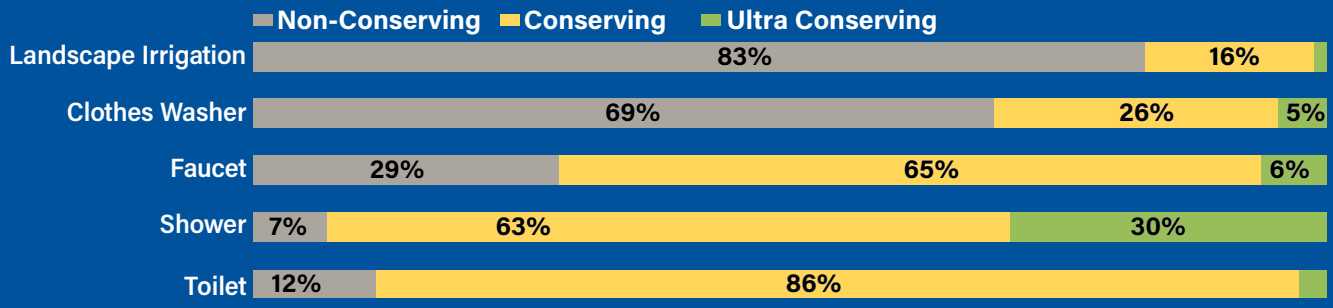
Attributes of Clothes Washer	Telephone Survey Respondents as a Whole (615 Responses)	Telephone Survey Respondents Participating in Onsite Audit (72 Responses)	Onsite Audit (72 Responses)
Percent with Clothes Washer	91%	94%	96%
Percent Front Loading Washers	36%	34%	38%
Percent High- Efficiency Washers	62%	65%	30%

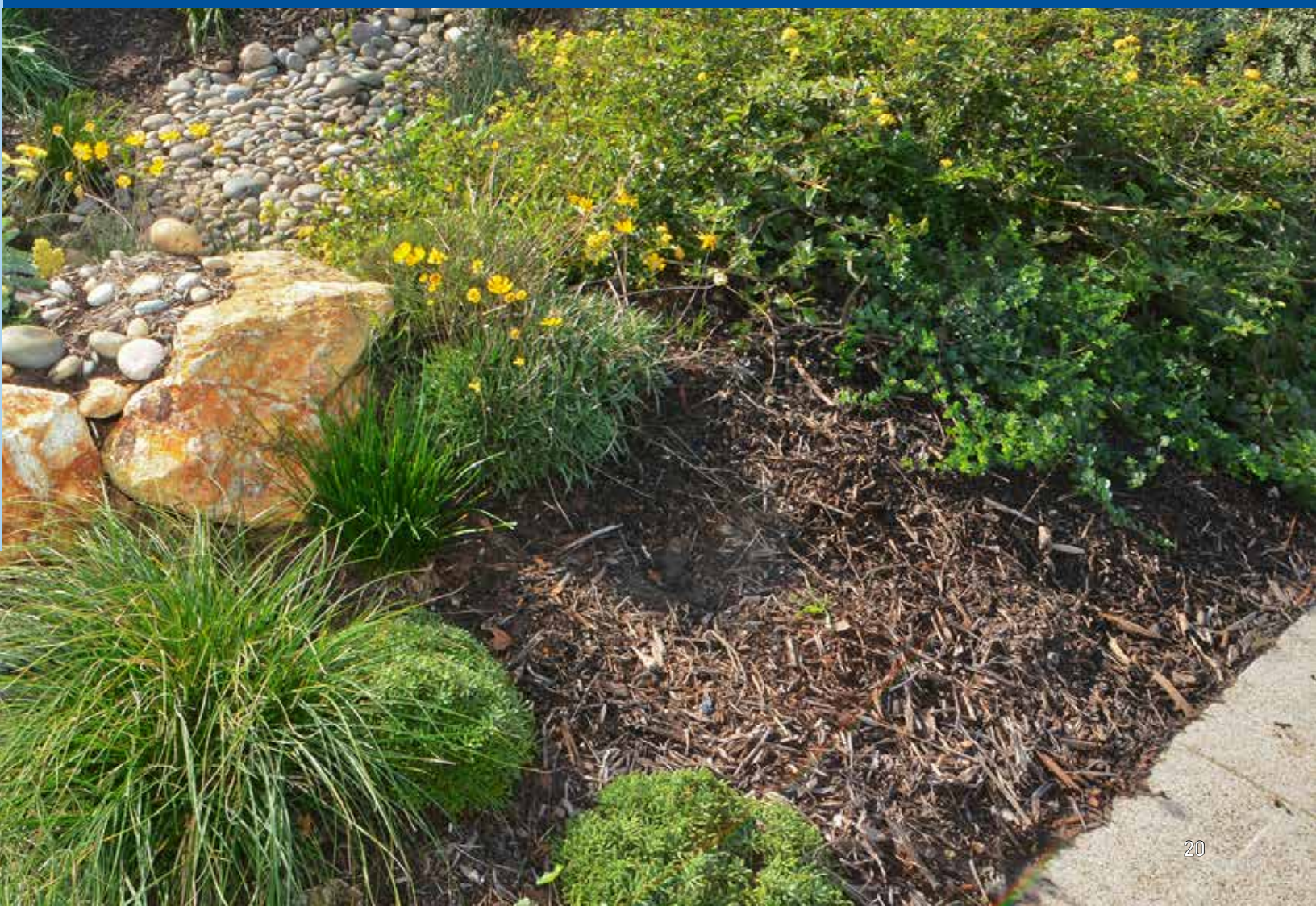
were used to determine the baseline water end uses and efficiency saturation levels.

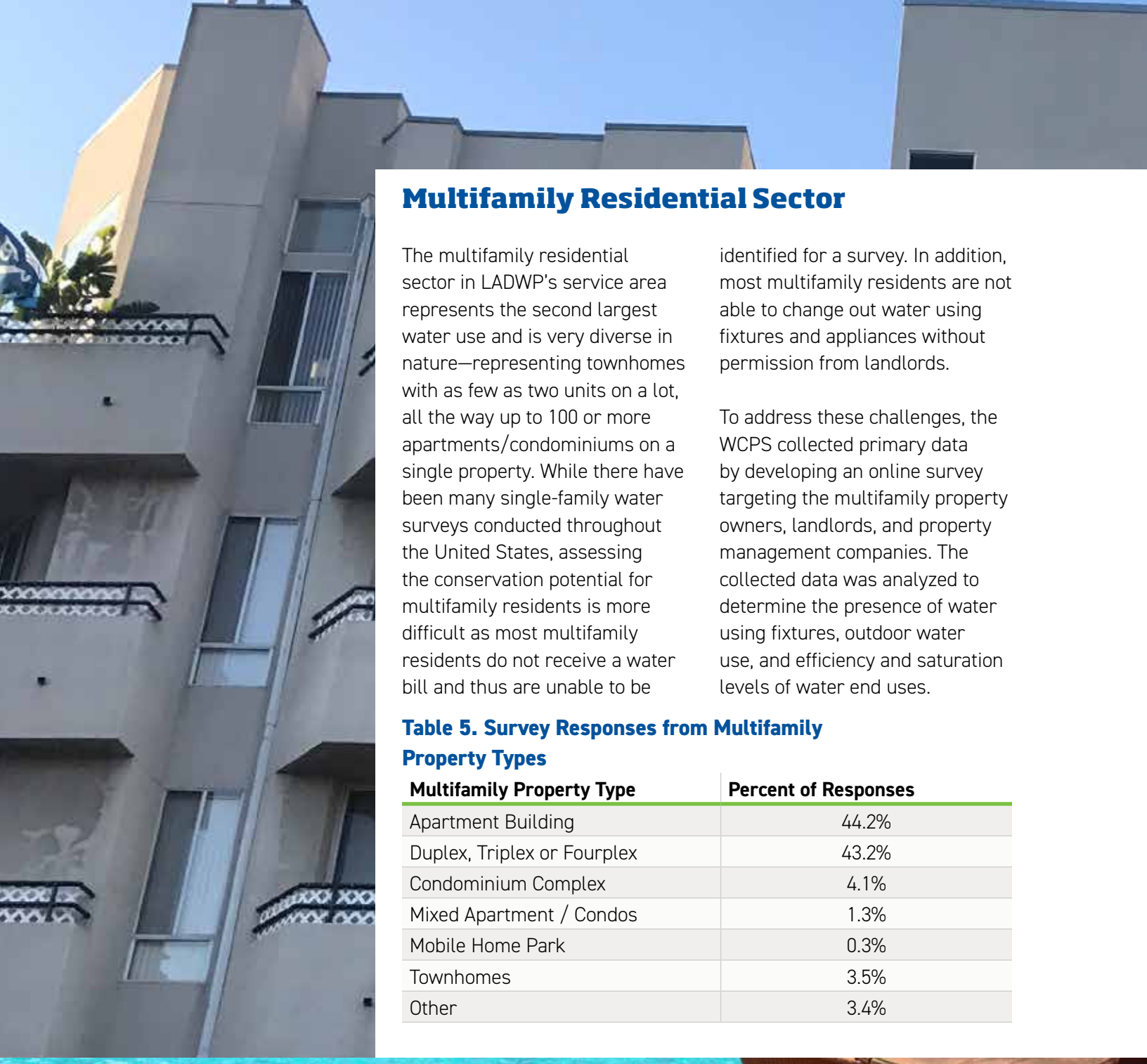
The single-family baseline water end use data reveals that the largest conservation potentials are in landscape irrigation and clothes washers, while the least potential is in bathroom fixtures.

Over 83 percent of homeowners have turf-heavy landscapes, and 69 percent of single-family washers are using more than double the amount of water compared to the efficient models that qualify for LADWP rebates.

Single-Family Residential Efficiency of End Uses







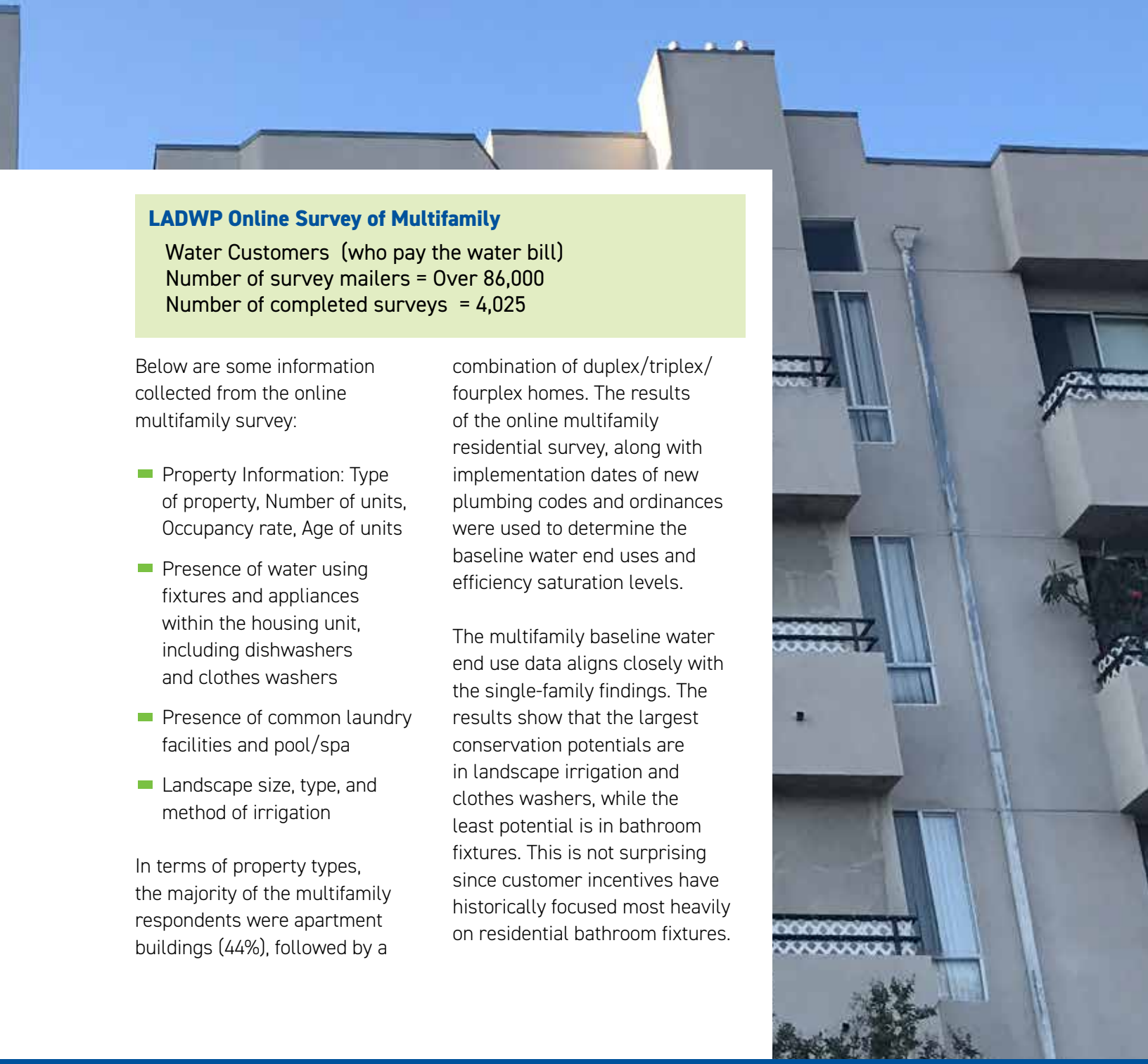
Multifamily Residential Sector

The multifamily residential sector in LADWP's service area represents the second largest water use and is very diverse in nature—representing townhomes with as few as two units on a lot, all the way up to 100 or more apartments/condominiums on a single property. While there have been many single-family water surveys conducted throughout the United States, assessing the conservation potential for multifamily residents is more difficult as most multifamily residents do not receive a water bill and thus are unable to be identified for a survey. In addition, most multifamily residents are not able to change out water using fixtures and appliances without permission from landlords.

To address these challenges, the WCPS collected primary data by developing an online survey targeting the multifamily property owners, landlords, and property management companies. The collected data was analyzed to determine the presence of water using fixtures, outdoor water use, and efficiency and saturation levels of water end uses.

Table 5. Survey Responses from Multifamily Property Types

Multifamily Property Type	Percent of Responses
Apartment Building	44.2%
Duplex, Triplex or Fourplex	43.2%
Condominium Complex	4.1%
Mixed Apartment / Condos	1.3%
Mobile Home Park	0.3%
Townhomes	3.5%
Other	3.4%



LADWP Online Survey of Multifamily

Water Customers (who pay the water bill)
Number of survey mailers = Over 86,000
Number of completed surveys = 4,025

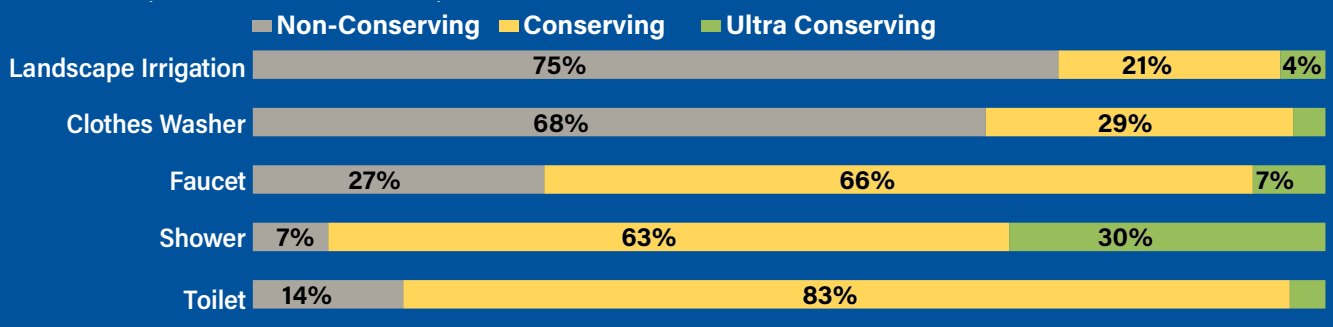
Below are some information collected from the online multifamily survey:

- Property Information: Type of property, Number of units, Occupancy rate, Age of units
- Presence of water using fixtures and appliances within the housing unit, including dishwashers and clothes washers
- Presence of common laundry facilities and pool/spa
- Landscape size, type, and method of irrigation

In terms of property types, the majority of the multifamily respondents were apartment buildings (44%), followed by a combination of duplex/triplex/fourplex homes. The results of the online multifamily residential survey, along with implementation dates of new plumbing codes and ordinances were used to determine the baseline water end uses and efficiency saturation levels.

The multifamily baseline water end use data aligns closely with the single-family findings. The results show that the largest conservation potentials are in landscape irrigation and clothes washers, while the least potential is in bathroom fixtures. This is not surprising since customer incentives have historically focused most heavily on residential bathroom fixtures.

Multifamily Residential Efficiency of End Uses



Commercial/Industrial/Institutional Sector

The commercial/industrial/institutional (CII) sector in Los Angeles is very diverse in nature with over 896 different business types in the City. Given the wide range and high variability of water uses for the CII sector, it was not feasible to gather primary data that would adequately represent the sector. Instead, the WCPS developed a methodology to estimate CII baseline water end uses by drawing from data sources.

Standard Industrial and North American Industrial Classification System

In the United States, data on commercial and industrial businesses is collected to provide information at the property level on business type and number of employees. Previously, the Standard Industrial Classification (SIC) coding system was the standard used to provide a uniform method for identifying types of businesses. In 1997, the SIC system was replaced by the North American Industrial Classification System (NAICS).

The US Census Bureau publishes its County Business Patterns database, which provides data on the number of business establishments and employees by NAICS code. In addition, LADWP's billing database maintains a field for identifying the SIC code of CII customers. The SIC code information was matched to its corresponding NAICS code, so the two databases could be used to help estimate the CII sector's baseline water end uses.

Comparing the two databases, LADWP selected the following 9 major business types in LA to represent the CII sector:

- Offices
- Restaurants
- Schools
- Hospitals
- Fitness and recreation centers
- Hotels
- Grocery stores
- Gas stations
- Industrial

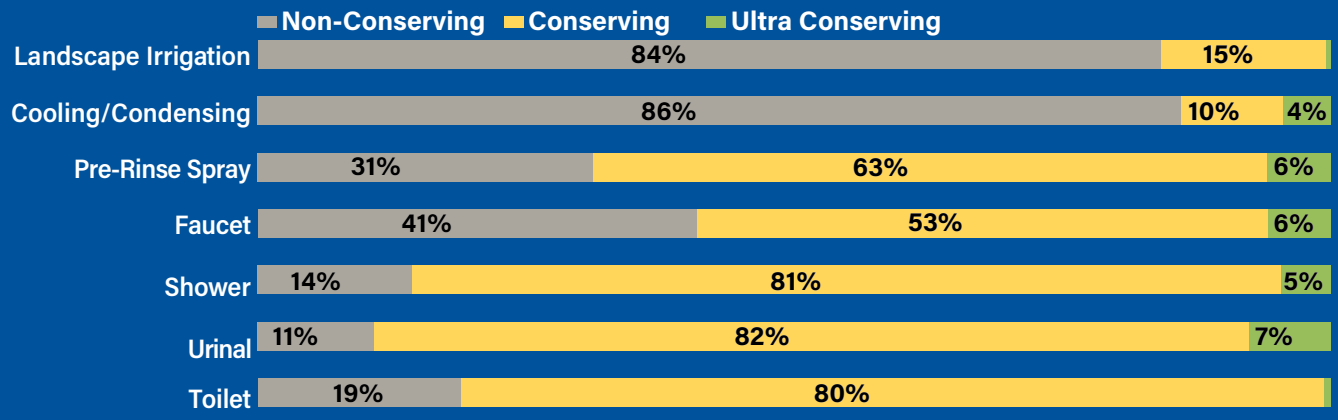
Literature Review

To understand CII water end uses, the following studies were researched:

- **American Water Works Association Research Foundation (2000):** Commercial and Institutional End Uses of Water
- **Metropolitan Water District of Southern California (2012):** Market Study Among Commercial Businesses
- **LADWP (2009):** Opportunities to Conserve Water in Los Angeles Schools
- **LADWP (2010):** Indoor Water Conservation Potential in CII Sector, which utilized data from a number of additional studies in California and other parts of the U.S.

Data from the studies and interviews with CII industry experts were used to estimate the baseline water end uses and efficiency saturation levels. The estimates suggest that the sector's highest conservation potentials are likely in cooling/condensing and landscape irrigation.

CII Efficiency of End Uses



City-Owned Sector

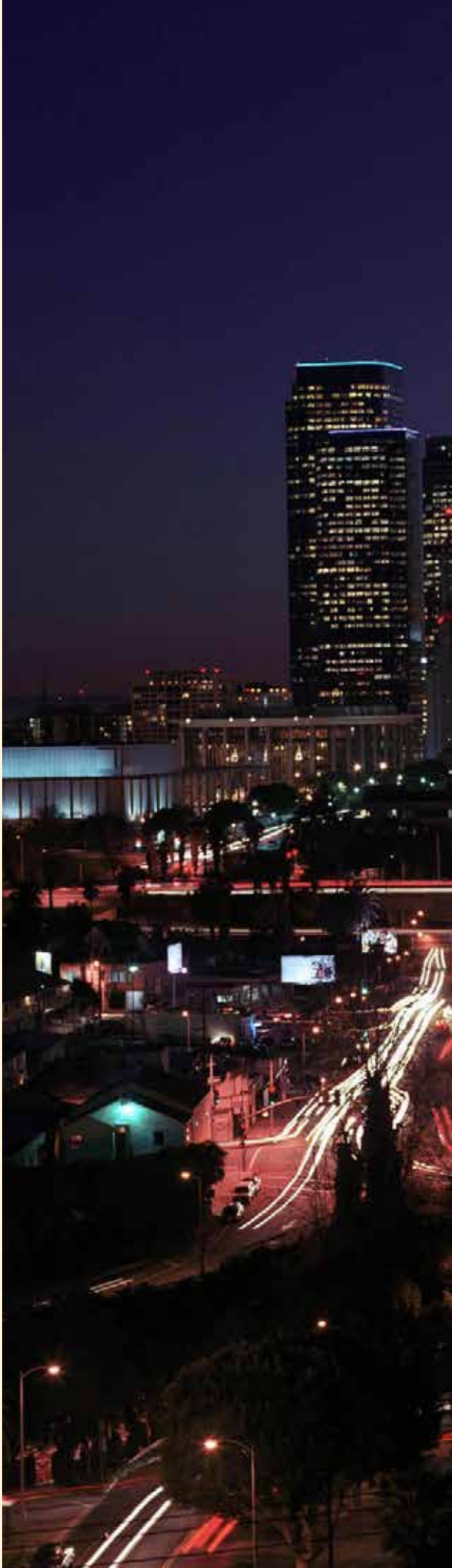
City-owned sector represents facilities that are owned and/or maintained by the City of Los Angeles. Much like the CII sector, there is a wide range of water end uses for this category making it challenging to determine a baseline water use and potential for future conservation. And while the overall water use for this sector is small compared to other water sectors in the City, it is important to the City that it leads by example when it comes to improving water use efficiency in its facilities. This is especially important given the Mayor's ED5 goals of increasing water conservation efforts for all City departments.

Therefore, robust primary data was gathered through detailed onsite water audits for a sample set of 100 facilities representing the major types of facilities in the City-owned sector. The table on the next page presents the number of onsite audits conducted by major facility type for this study.

Detailed individual audit forms were developed for each of the property categories by a professional CII water auditor. Audits were conducted through scheduled visits with building maintenance managers to assist with gathering end use information. Onsite audits examined the following:

- Bathrooms and plumbing fixtures, including flow rates
- Kitchens and breakrooms, including inspection of pre-rinse spray values, dishwashers, and food preparation
- Vehicle-washing facilities, and other areas where water is used for cleaning
- Cooling towers/condensation equipment, including inspection of tags indicating cycles of concentration
- Landscape area, landscape type, and irrigation systems
- Decorative fountains, ponds and other water features, including assessment of recirculation systems

All of the information from these detailed onsite audits were entered into a comprehensive database to determine baseline water use for the City-owned sector. The assessment of baseline City-owned water use in Los Angeles reveals that water use efficiency for restroom fixtures are saturated. This matches LADWP's initial expectations,



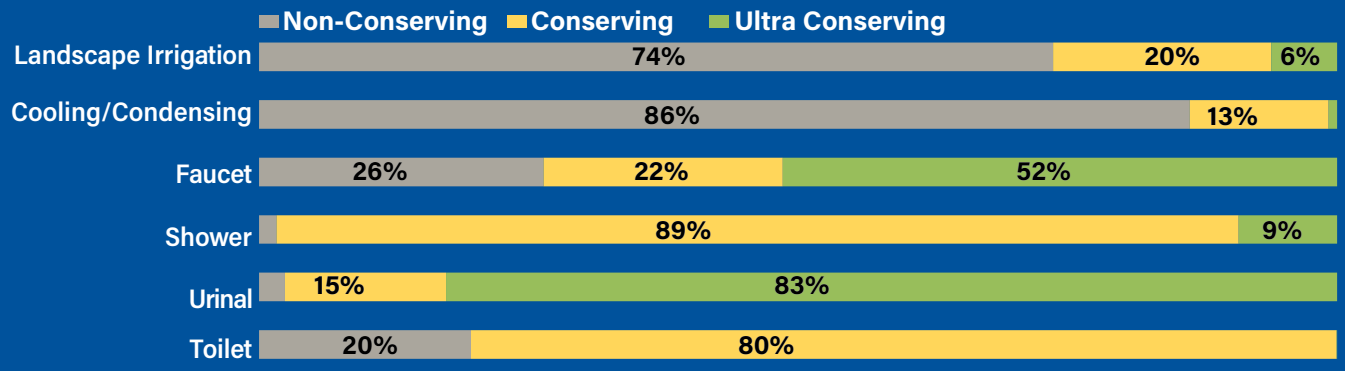
City-Owned Facility Onsite Audits

Code	Property Category	Number of Audits
AS	Animal Shelters	4
CCC	Community and Youth Centers	20
HA	Harbors, Airports	1
IND	Industrial	8
LIP	Parks and Medians	12
MS	Maintenance, Service Yards	19
OAL	Office, Admin, Libraries	19
PF	Police, Fire	13
GC	Golf Courses	4
	Total Number of Onsite Audits Completed	**100**

since a lot has been done in the past to improve restroom efficiency in City facilities.

Similar to the CII sector, the City-owned facilities baseline end use data reveals that the largest conservation potentials are in cooling/condensing and landscape irrigation. Over the last decade, City Departments have made a strong effort to retrofit its facilities with efficient bathroom fixtures. Currently, the City has refocused its efforts towards replacing turf with sustainable landscaping to improve outdoor water efficiency.

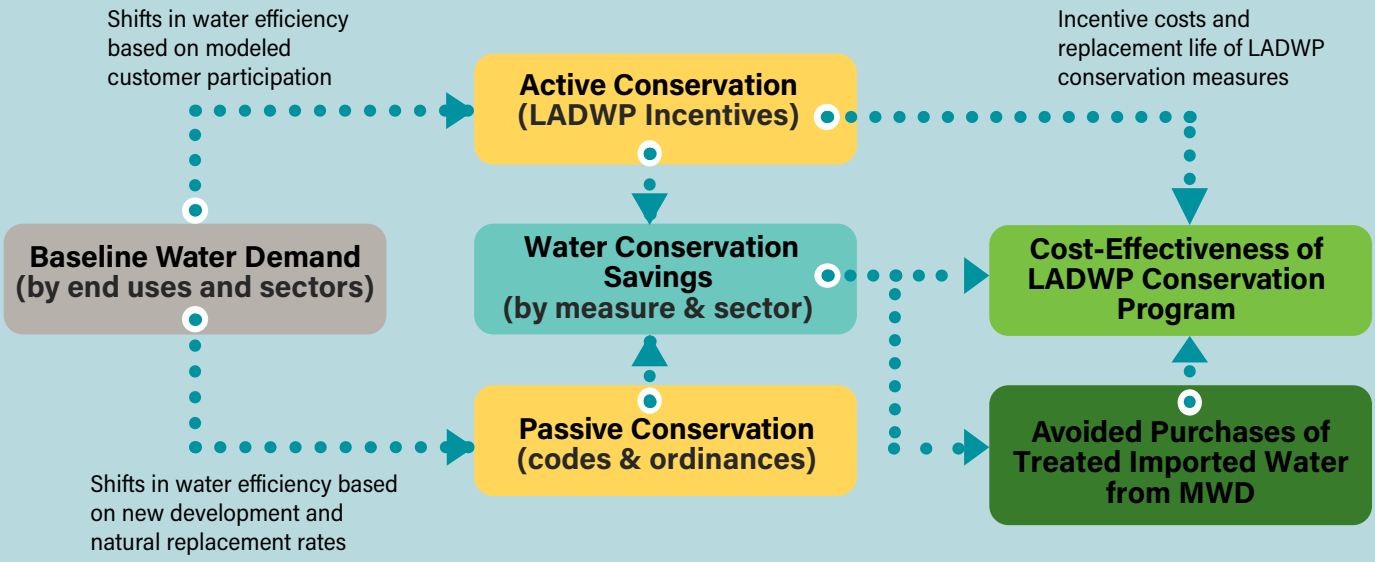
City-Owned Facilities Efficiency of End Uses



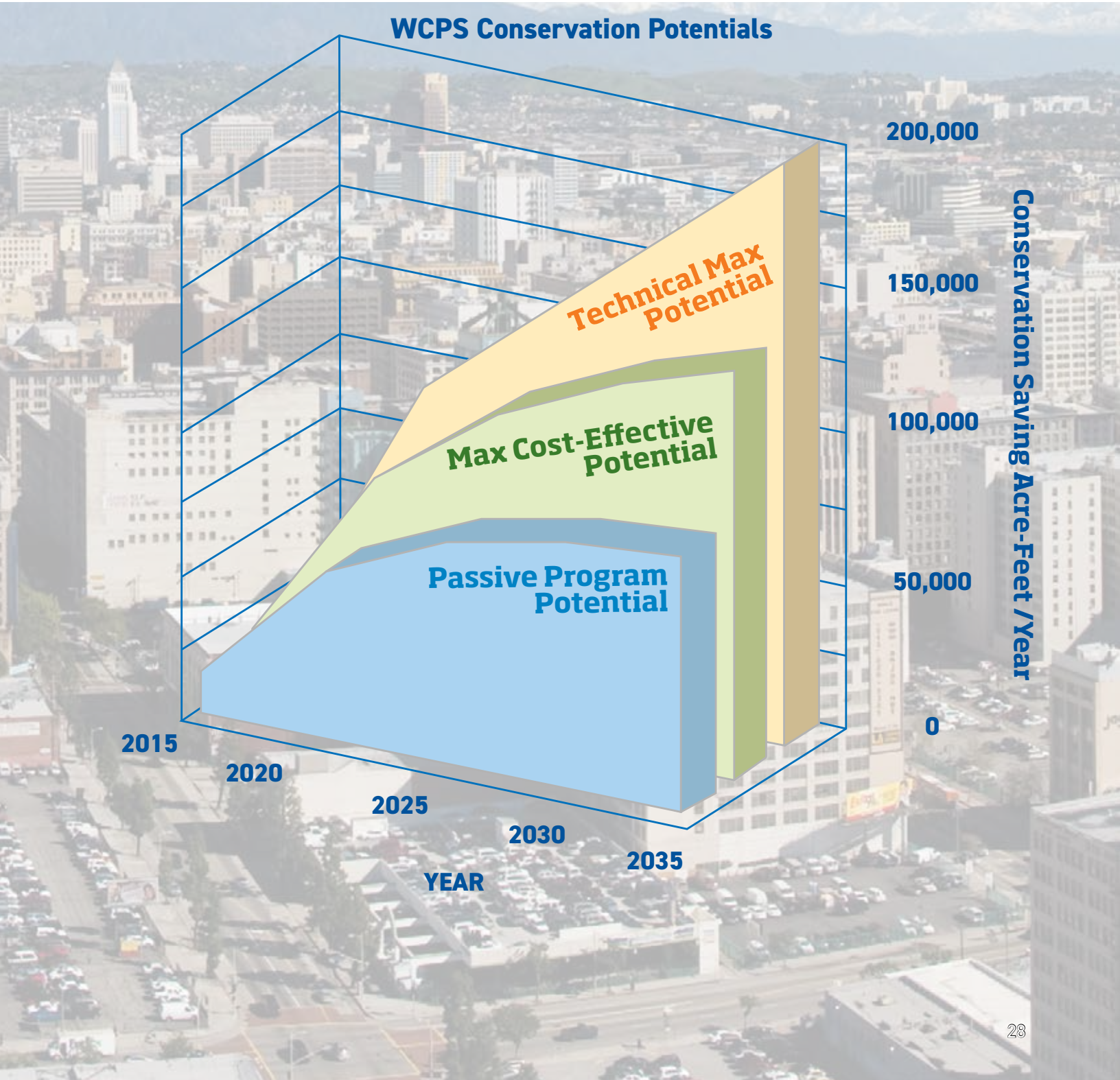
Section 4 - Water Conservation Potential

To estimate the water conservation potential and cost-effectiveness of water conservation measures, a sophisticated water conservation model was developed for the WCPS to ensure that all of the calculations were handled properly. The model estimates the shift in water use efficiency levels for each end use in the four sectors as a result of both passive conservation (driven by plumbing codes and landscape ordinances) and LADWP's active conservation (driven by LADWP's incentives). Based on the replacement life of conservation measures, the model estimates water savings and cost-effectiveness. Model results for each of the customer sectors were aggregated to determine the total remaining conservation potentials in the City.

LADWP's Water Conservation Model



	Acre-Feet / Year			
	2020	2025	2030	2035
Technical Maximum Potential	96,000	132,000	168,000	204,000
Maximum Cost-Effective Potential	77,000	107,000	127,000	140,000
Passive Program Potential	55,000	74,000	84,000	88,000



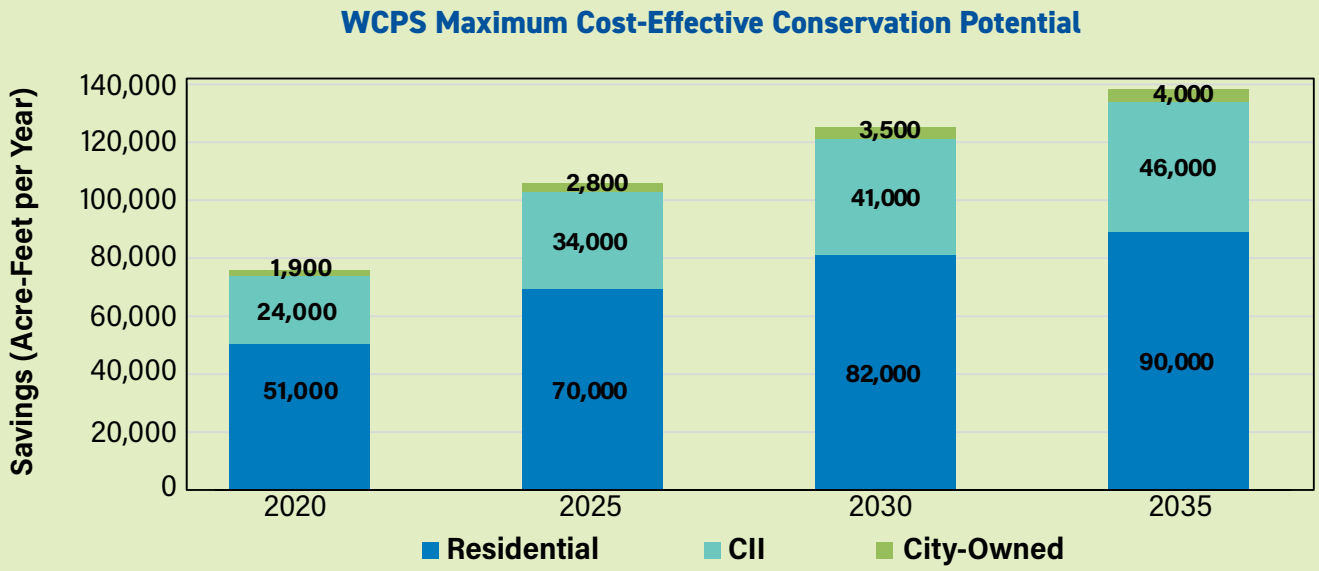
Water Conservation Savings and Cost-Effectiveness

As defined in Section 2, the Maximum Cost-Effective Conservation Potential represents the level of savings achievable through cost-effective programs implemented by LADWP. To model this potential, increased residential and CII rebate incentive levels were set. The higher investment levels represent the maximum participation levels achievable through the influence of conservation programs.

By 2035, total potential water savings are approximately 140,000 acre-feet per year for the Maximum Cost-Effective Conservation Potential. Economic assessments of the potential confirmed that all individual rebates and customer sectors were cost-effective compared to projected increases in MWD's treated water rate.

Overall Economic Analysis of Maximum Cost-Effective Conservation Potential

Sector	Net Present Value ($M)	Benefit-Cost Ratio	Internal Rate of Return
Residential	$179	1.8	11%
CII	$109	2.4	17%
City-Owned	$12	3.9	38%
Total	$300	2.0	13%


WCPS Maximum Cost-Effective Conservation Potential
Savings (Acre-Feet per Year)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1,900
24,000
51,000
2,800
34,000
70,000
3,500
41,000
82,000
4,000
46,000
90,000
2020
2025
2030
2035
Residential
CII
City-Owned

Section 5 – Study Conclusions and Next Steps

LADWP's WCPS represents one of the most comprehensive assessments of the potential for future water conservation ever taken by a municipal water utility. The WCPS conducted detailed single-family and multifamily surveys, single-family onsite verifications, completed comprehensive onsite audits of City-owned facilities, and developed a sophisticated water conservation model to project future conservation potential. The WCPS also used robust economic evaluations to determine the cost-effectiveness of the conservation measures at each of the sector levels.

2015 UWMP Long-Term Goals

As part of its 2015 UWMP, LADWP set ambitious long-term goals to reduce per capita water usage 22.5 percent by 2025 and 25 percent by 2035. These goals were adopted to secure water reliability for LA's future and will be achieved by expanding water conservation, recycled water, groundwater recovery, and stormwater capture. During the recent drought years, LADWP customers have greatly reduced their water use in response to the Mayor's call to conserve. With the help from planned local supplies and sustained water savings achieved from existing conservation measures, **LADWP has determined that there will be enough remaining conservation potential to help meet the 2025 and 2035 per capita water use reduction goals.**

Next Steps: Long-Term Water Conservation Program Planning

The WCPS Maximum Cost-Effective Conservation Potential helped determine that it will be feasible to meet the City's long-term conservation goals within cost-effective investment levels. WCPS findings also show that a large portion of the remaining conservation potential will come from new passive water savings. **Achieving these savings will depend on developing City-wide strategies to maximize water savings from ordinances, code compliance, and behavior-change.**

Diversifying investments to strike a good balance between active and passive programs will help increase the cost-effectiveness of LADWP's Conservation Program. Going forward, LADWP will use the WCPS findings and conservation model to develop a balanced long-term conservation plan that achieves the City's 2025 and 2035 water use reduction goals. **In addition, to boost customer participation, active conservation programs will require additional funding to increase existing rebates and add new incentives.**

LA DWP Los Angeles Department of Water & Power