Los Angeles: Water Demand and Water Quality - An Overview

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Abstract

By 2050, the urban population is expected to increase worldwide. In addition to being the second largest city in the United States, Los Angeles has unique water needs. In this study, the Los Angeles Department of Power and Water examined historical water demand by residential and other uses, predicted residential population growth in the LADWP service area, and estimated residential potable water demand by 2050. The association between low-income households and communities with high levels of contaminated drinking water was also examined. This study used public databases and simple equations to calculate these predictions. There is a higher consumption of potable water by residents within the LADWP service area than by other industries. The population of the LADWP service area and the demand for potable water will both rise by 25% by the year of 2050, and more low-income households live in areas that have a higher level of drinking water contamination than households above low income. Using more advanced statistical methods and analyses can improve this study, since it is limited by simple mathematical models.

Introduction

As of 2018, 55% of the world's population lives in urban areas, and that percentage is expected to reach 68% by 2050.[1] As a result, urban water suppliers should plan ahead for projected changes in population and water demand in their service areas. Los Angeles (LA) has unique water needs, as it is the second largest city in the United States with a population of approximately 3.9 million, has low precipitation with an average annual rainfall of 11.72 inches, and has limited access to local water supplies.[2,3] As the population in urban areas is expected to increase, the city of Los Angeles is faced with the challenge of predicting water demand.

The Los Angeles Department of Water and Power (LADWP) provides water to the city of Los Angeles as well as areas outside the city limits, including West Hollywood, Culver City, and smaller parts of Los Angeles County.[4] In addition to local groundwater, LADWP gets most of its water supplies from outside sources including the Colorado River, northern areas of the state via the California Aqueduct, and Owens River via the Los Angeles Aqueduct.[4] The LADWP is the second largest municipal water utility in the United States, serving more than 4 million people in its service area.[4] As mentioned earlier, the LADWP service area population is expected to increase, making it important to estimate the water demand for the future.

Water supply and demand is not the only concern for Los Angeles. The city's drinking water quality is also an issue. Arsenic, chromium, haloacetic acids, lead, nitrate, tetrachloroethylene (PCE), trichloroethylene (TCE), Trichloropropabe (TCP), and other contaminants can be found in drinking water for Los Angeles.[5] Drinking water with elevated levels of contaminants can lead to health problems including digestive issues, nervous system and reproductive issues, as well as cancer.[6] From research, it has been found that low-income communities tend to have water with poorer quality and higher concentrations of toxic contaminants than wealthier communities.[6] As access to safe drinking water is essential for life and well-being, LA needs to be concerned about their water quality as well as their water demand.

Objective

The primary objective of this project is to examine water demand and water quality in the city of Los Angeles.

The goals I wish to achieve including:

- Look at trends in residential and other industries (commercial, industrial, institutional) consumption of potable water within the LADWP service area

- Estimate the population growth of the Los Angeles Department of Water and Power service area by the year 2050
- Estimate future demand for potable water by residential use in the LADWP service area by the year 2050
- To establish whether low-income is associated with poor water quality in the city of Los Angeles

Hypothesis

I It is expected that the population growth for the LADWP will increase drastically, resulting in excess water demand that may not be manageable or sustainable. In addition, I will hypothesize that low-income areas will have more water contamination than wealthier ones.

Data Sources

- LADWP current and future potable water demands for residential use and other industries
  - California Water Boards: Urban Water Supplier Reports[8]
  - LADWP Urban Water Management Plan 2020[9]
- Correlating median household income with drinking water quality
  - CalEnviroScreen 4.0: Drinking Water Percentile[5]
  - US Census Data: Median Household Income[10]

Methods and Assumption

In order to examine trends for potable water usage by residential and other (commercial, industrial, institutional), I downloaded the California Water Boards' Urban Water Supplier Monthly Reports for the period June 2014-March 2022. With the supplier name filtered out by Los Angeles Department of Water and Power (LADWP), I was left with data for total potable water production, percent residential use, and percent commercial, industrial, and institutional use. The data was reported monthly. As 2014 and 2022 did not have complete years, I excluded them from the findings. For each year from 2015-2021, I totaled potable water production and separated it by yearly average usage for residential use and other uses. In this database, I also found information about the total population they served each year, which I used to compare my population growth projections with historical data.

In order to calculate the population growth for the LADWP service area by year, I used an equation based on the LADWP Urban Water Management Plan (UWMP) 2020. According to their report, the LADWP service area is expected to grow at a rate of 0.64 percent annually. I calculated the projected population

growth from 2015 to 2050 in Excel. The equation was: [(2015 population) + (2015 population * 0.0064)] which was then estimated until the year 2050.

LADWP's potable water demand for residential use was also projected until 2050. In its monthly report, LADWP presented historical residential water demand data from 2015 to 2021. From 2022-2050, the projected water demand was calculated by multiplying the estimated population by 70 gallons per day per person (gpd/person). The 70 gallons/person was provided by the LADWP UWMP 2020 as the current average gallons consumed per person in the LADWP service area. This was then converted to gallons per year and then to acre-feet per year.

The US Census Bureau and the CalEnviroScreen 4.0 Indicator Maps were used to correlate drinking water contaminants with median household income. CalEnviroScreen 4.0 Indicator Maps provide information by census tract. Drinking water contamination is reported as a percentile, which represents the percentile of how the census tract compares with other census tracts. For example, a census tract has a contaminant violation percentile of 94, which means it is higher than 94% of the census tracts in California. My next step was to download the US census tract data on median household income. I then matched the drinking water contamination data with household income by the census tracts. Census tracts with incomes less than 80 percent of the statewide figure are considered low-income, which in 2020 it was $62,938. A community with high drinking water contamination was identified as having a percentile above 75. Thirteen of the 996 census tracts in the LA were excluded due to missing drinking water contaminants or median household income information. Using simple algebraic equations, we calculated the percentage of the population considered low-income, the percentage of the population living in communities with high water contamination, the percentage of people considered low-income living in communities with high water contamination, and the percentage of people living above the low income value living in communities with high contamination.

Results

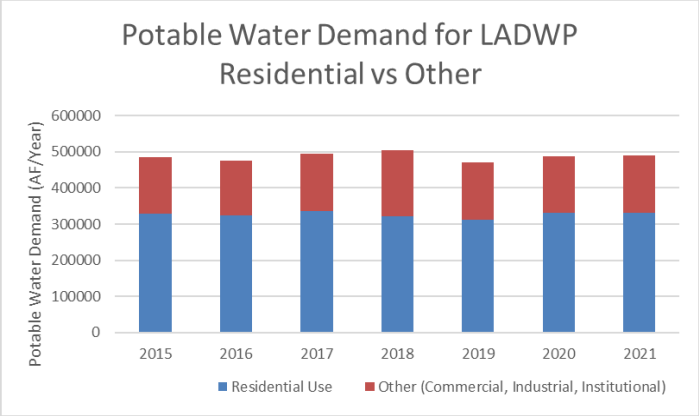

Figure 1: Potable water demand for LADWP by residential use and other (commercial, industrial, institutional).

LADWP's historical data on potable water demand shows that residential users consume more potable water than other industries combined, including commercial, industrial, and institutional.

The residential water demand for 2015-2021 is approximately 310,000-340,000 AF/year. Water demand for other (commercial, industrial, and institutional) uses ranged between 150,000 and 280,000 AF/year.

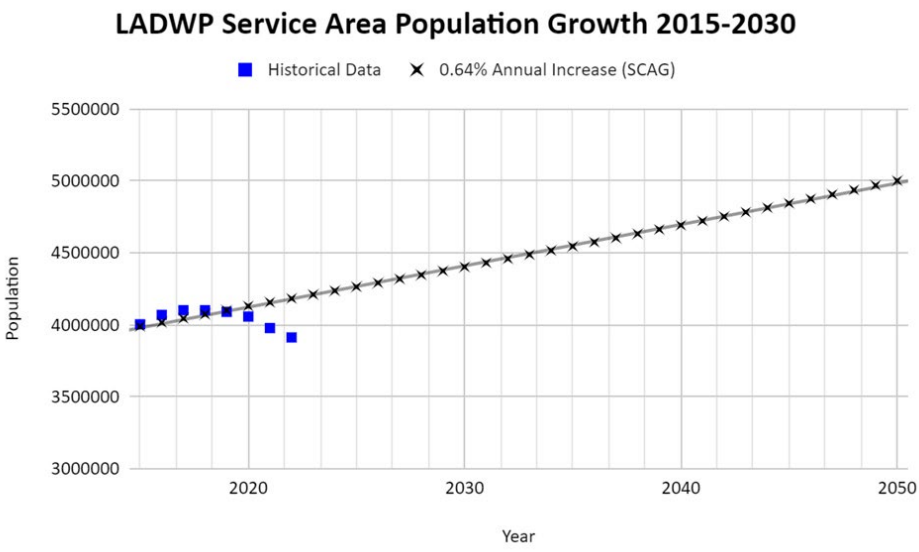

Figure 2: LADWP service area population growth from 2015 to 2030.

From 2015 to 2019, service area population growth increased, but decreased from 2020 to 2022. As a result of the pandemic, people may have moved out of Los Angeles city. We did not explore this possibility. Based on the prediction model, a population of approximately 5 million is predicted by the year 2050 in the service area, an increase from 4 million in

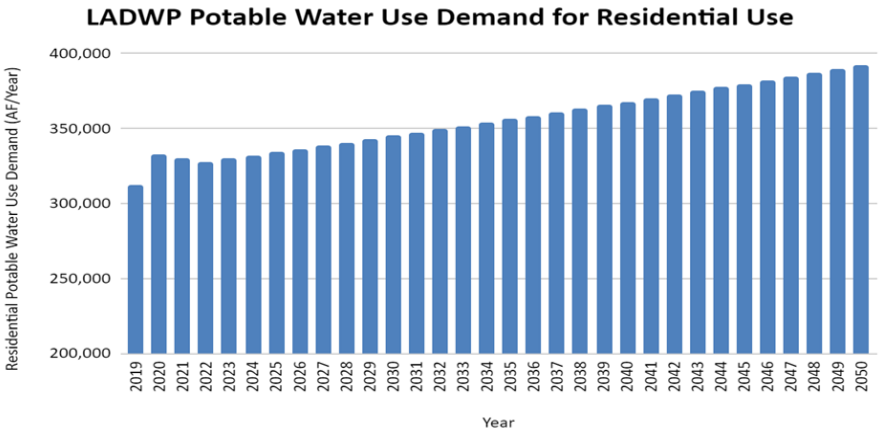

Figure 3: LADWP potable water use demand for residential use from 2019-2050.

By the year 2050, the demand for potable water for residential use is expected to reach approximately 400,000 AF/year. The water demand use has increased from 320,000 AF/year in 2015. The model estimates that residential potable water demand is expected to increase by 80,000 AF/Year by 2050. It is a significant increase of 25 percent from current demands.

Category	**Population**	**Percentage**
Low Income	2305257	58.6%
Above Low Income	1629744	41.4%
Total	3935001	

	Population	**Percentage**
Communities with High Water Contamination	3129864	79.5%
Total	3935001	

Low Income Households in Communities with High Drinking Water Contamination	**Total Low Income Households**	
1973350	2305257	85.6%

Low Income Households in Communities with High Drinking Water Contamination	**Total Low Income Households**	
1156514	1629744	71.0%

In LA, 58.6 percent of the city's population lives in low-income households. Also, 79.5 percent of the population lives in a community with high water contamination. Of the low-income population, 85.6 percent live in communities with high water contamination. Of the population above low-income, 71.0 percent live in communities with high water contamination.

Conclusions

In Los Angeles, household water consumption outpaces that of commercial, industrial, and institutional uses. By 2050, LADWP's service area is projected to have a population of 5,000,000 and a 25% increase in population. Consequently, potable water demand is expected to increase by 80,000 AF/year, which represents a 25% increase. According to these projections, access to potable or safe dirnking water in Los Angeles will be a serious problem in the next 28 years. Despite climate change and a long-term drought in California, water demand will increase. California may not be able to meet these demands. The water usage habits may have to change in order to reach a sustainable level. Additionally, 14.6% more low-income households live in areas with high water contamination than households above low-income. This is a crucial issue of environmental justice that calls for policy and advocacy to address this and restore social and economic justice in the city of Los Angeles.

Recommendation/Limitations

Due to a lack of data, this study is unable to predict potable water demands for the other industries within the LADWP service area. Because of this limitation, a full picture of the future potable water demand in LADWP's service area cannot be predicted. Another limitation is the methods used to associate low-income households with communities with high water contamination. The analysis was very simple. A more complex statistical analysis, such as a linear regression model, can be performed to estimate the correlation between these two variables.

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