

Drought Policy and Water Management: Comparative Analysis of Davis and Redding

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Abstract

The drought in California has caused policy changes to reduce water consumption and use water resources more efficiently. Policies that require groundwater management plans, water metering, and mandated conservation levels have caused cities to develop strategies for water conservation. The objective of this paper is to analyze and compare the strategies of Davis, CA and Redding, CA for meeting their mandated water levels dictated by the State Water Resources Board.

Using total water production for both cities we predicted how long it would take for each city to meet its mandated water reduction. The two cities' gpd/person will then be compared to ultimately see a difference between the two. Some limitation in our work includes assumptions made on population growth and total water usage. All were assumed to behave linearly for simplicity. Our project found that even if Redding meets their 36% water reduction. The gpd/person is still too high compared to Davis and the United States as a whole.

Introduction

With the increasing strain on water supply due to the California drought, urban water management plans are focusing on decreasing water consumption in residential areas while increasing efficiency. Urban water usage involves a higher human population density that includes indoor and outdoor water use in residential areas for bathing, washing clothes, and watering lawns typically delivered through a public supplier. There are two sources of groundwater for urban water use: surface and groundwater. The City of Davis receives their water supply from groundwater. Currently, Davis is a conservation leader, having reduced their

residential water usage by 28% from September 2014 (City of Davis, 2014). As of 2015, Davis has a water use per capita of 144 gdp/person (City of Davis, 2015). Comparatively, the city of Redding has implemented a mandatory 20% water use reduction. They have achieved a 16% water reduction since from 2013 to 2014. As of 2015, Redding has a water use per capita of 271 gdp/person (City of Redding, 2015).

By comparison with Davis, the City of Redding has two major sources of drinking water, both ground and surface. The surface water is obtained from Sacramento River and Whiskeytown Lake (City of Redding, 2010). This provides about 74% of the water they use. The remaining 26% is obtained from the Redding Groundwater Basin. Due to the water restrictions statewide, the City of Redding's was called to cut down water production by 36%, which is a tier 9 water usage (City of Redding, 2015). This large percentage has definitely caused some disputes between the city and the state. According to a letter, "State water board proposed regulatory framework", written to the state water board by Redding Mayor Francie Sullivan, he feels that it is unfair for their city to have a 36% reduction in water use. The Redding's water reduction is compensating other regions only requiring a 10% or 20% conservation. He argued that the 36% reduction is based on water use during the hottest months of Redding which isn't experienced in any other region. Nevertheless, Redding customers will rise to the call of water reduction.

Objective

The main objective of this project is to analyze and compare the indoor water usage between Davis and Redding. Some main tasks were: data collection on indoor water usages, calculation of Redding's indoor water usage, regulations or policies that explains the water usage, and possible implementations to reduce water use.

Background

As the State Water Resources Board is in charge of implementing mandatory conservation levels, the cities of Redding and Davis must develop strategies to conserve water use. Redding has a mandatory reduction level of 36% while Davis is at 28%. These levels are based on population and if cities have a higher per capita use. According to the “Redding Utilities Water Shortage Contingency Plan Fact Sheet,” Redding has implemented an ordinance to reduce water usage. The three elements in the ordinances are prohibited acts, outdoor water restrictions, and enforcement (City of Redding, 2015). In prohibited acts, restaurants are not allowed to give customers water unless they ask for it, outdoor irrigation water is not allowed to runoff onto sidewalks, potable water is not allowed onto sidewalks and driveways unless it is to protect public health or for safety reasons. Outdoor water restrictions prohibits all outdoor watering of landscapes on certain days and strict regulations on when houses can water. Anyone who violates the ordinance are punished (City of Redding, 2015).

On the other hand, Davis has been meeting a residential 28% water reduction rate since September of 2014 (City of Davis, 2014). If they continue to use strategies to limit water use in commercial and industrial areas, they may also be able to reach their overall 28% mandatory reduction level.

Hypothesis

We hypothesize that with continued water demand management, the City of Davis can reach their mandated 28% water conservation level. We also hypothesize that the city of Redding can meet their 36% state mandated goal.

Calculation/Results

We first compared gpd/person for Redding and Davis. We assumed that all factors were linear; population increased linearly and total water consumption decreased linearly. We also assumed that all water production is consumed and none is left over to carry out calculations.

| Supplier Name | Total Water Production (gallons) | | Total Water Saved (Jun-14 - Feb-15, compared to 2013) | Percent Saved (Jun-14 - Feb-15, compared to 2013) | Jul-Sep 2014 R GPCD | Tier | Conservation Standard |
|---|----------------------------------|------------------------------|---|---|------------------------|------|--------------------------|
| | 2013 (Jun - Feb) | 2014/15 (Jun-14 - Feb-15) | | | | | |
| California Water Service Company Bear Gulch | 3,623,142,017 | 3,228,861,790 | 394,280,227 | 11% | 252.5 | 9 | 36% |
| Los Banos, City of | 2,053,870,000 | 1,905,101,000 | 148,769,000 | 7% | 253.0 | 9 | 36% |
| Redding, City of | 7,109,010,000 | 5,934,100,000 | 1,174,910,000 | 17% | 253.7 | 9 | 36% |
| Riverside Highland Water Company | 971,591,200 | 889,248,544 | 82,342,656 | 8% | 253.9 | 9 | 36% |

Figure 1. Total water usage from years 2013 – 2015 for Reddings for months June-February for 2013 -2015

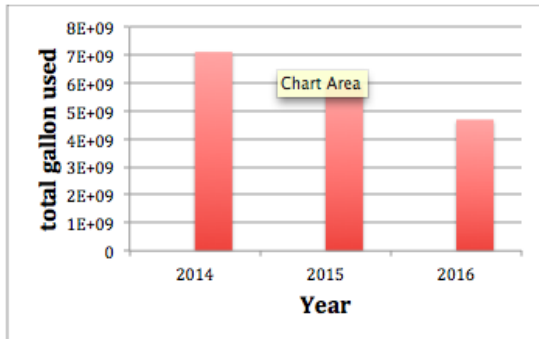


Figure 2. Total water production assumed to decrease linearly for Redding.

To calculate the gpd/person we obtained data from the state water resources control board. The gpd/person calculation for 2013-2014 (June - February) is shown below

$$\frac{gpd}{person} = 7,109,010,000 * \left(\frac{1}{240 \text{ days}}\right) * \left(\frac{1}{91,469 \text{ people}}\right) = 323.8 \frac{gpd}{person}$$

According to the United States Census Bureau the Redding population was 88,265 in 2005 and 91,119 in 2013. The population size in 2014 was estimated to be 91,469 assuming linear growth

in the population. Using the same method, the gpd/person in 2014-2015 (June-February) was estimated to be 269.53, using 5,934,100,000 as the water consumption.

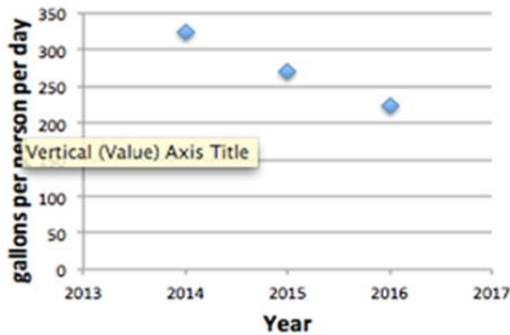


Figure 3. Gallons used per person per day projected into 2016, which is a total of 34% reduction

Now we assumed that in February 2016, there will be a 34% reduction (double of 17% from 2014 to 2015), as shown in figure 2. This came out to be 4,692,037,600 gallons, which is 212.4 gpd/person. This calculation was carried out assuming the total water consumption decreases linearly.

| | | | | | | | |
|---------------|---------------|---------------|-------------|-----|-------|---|-----|
| Davis City of | 3,023,400,000 | 2,527,400,000 | 496,000,000 | 16% | 143.9 | 7 | 28% |
|---------------|---------------|---------------|-------------|-----|-------|---|-----|

Figure 4. Total water use for Davis. This shows a 3,023,400,000 gallons of water usage in 2013-2014(June - February) and 2,527,400,000 in 2014-2015(June February)

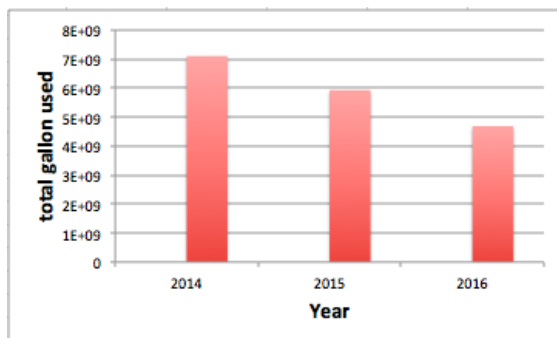


Figure 5. Total water consumption assumed to decrease linearly for Davis

Davis gpd/person was calculated the same way. The population was obtained from the Census of Bureau and estimated for 2016. This came out to be 68,164 people. The gpd/person for 2016 was calculated in a similar fashion, as shown below.

$$\frac{gpd}{person} = 2,055,912,000 \text{ gallons} * \left(\frac{1}{240 \text{ day}}\right) * \left(\frac{1}{68,164 \text{ people}}\right) = 125.67$$

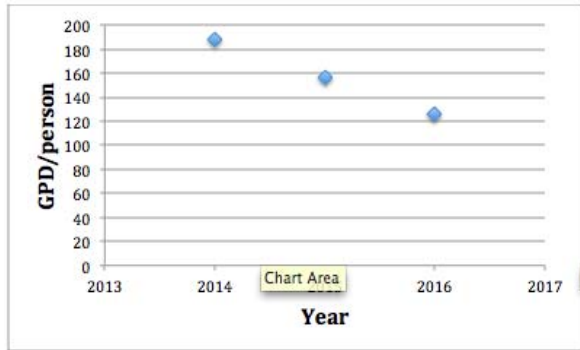


Figure 6. Gallons per day person projected into 2016, which shows a 32% reduction

From 2013-2014 (June - February) to 2014-2015 (June - February) there was a decrease of 16% in total water consumption. If this continues linearly, by 2016 they will have achieved a 32% reduction in water usage. Since Davis is required to only reduce their water consumption by 30%, it is estimated that they will meet their water reduction goal late 2015. This means the gpd/person will be roughly be about 130.

So in 2016 Redding's and Davis' gpd/person will be 212 and 126, respectively.

Assuming everything works out and both cities meet their reduction percentage, Redding still uses more water. Thus, the next step is to look at their indoor water use.

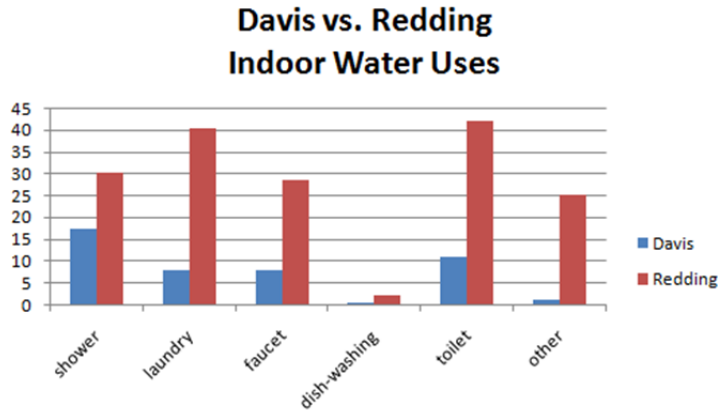


Figure 6 . GPD use of water in indoor water use

Figure 6 and 7 show indoor water usage between Redding and Davis. It is clear that the high gpd/person is clearly due to a higher indoor water usage. For example, the toilet water use is almost quadruple that of Davis'.

Conclusions

In conclusion, it was shocking to see that Redding still had the higher gpd/person even though they were projected to meet their water reduction. Comparing it to the US average gallons a person uses daily (150 gpd/person), Davis actually uses less water. Redding on the other hand has a higher usage which has influenced their higher water reduction level by the State Water Resources Board. Even though Davis accomplished a 28% reduction in residential water usage, there can be more water conservation and efficiency techniques applied to reduce the total water consumption by 28%. These include agricultural and industrial water use.

As for Redding, they will have needed to have better water conservation techniques to ultimately reduce their gpd/person below or at the average U.S gpd/person. A great technique is the city offering rebates to install water efficient technology for indoors since the indoor water use for Redding is much greater than Davis. This will create a greater incentive for residents to conserve water.

Recommendation/Limitations

Redding undoubtedly has a much higher water usage in all aspects for indoor water uses. There are many possible implementations of water conservation technologies that could result in reduced water consumption. Based on higher water indoor usage, it can be assumed that there is inefficient water usage, such as shower heads, toilets, etc. We recommend Redding to install water inefficient technology.

The most prominent challenge was the data collection, especially for Redding. Redding has an extremely limited amount of data, so projections would be not accurate in depicting the conditions within Redding. It is also important to note that each city analyzes, collects, and projects their data differently, so there may be some small error differences.

References

(2011). “City of Davis 2010 Urban Water Management Plan.” *City of Davis*.

<<http://water.cityofdavis.org/Media/PublicWorks/Documents/PDF/PW/Water/Documents/Davis-2010-UWMP-final.pdf>> (May 25, 2015).

“Redding Utilities.” *City of Redding*. (2015). <<http://www.reddingutilities.com/water.html>> (June 4, 2015).

“Redding Utilities Water Shortage Contingency Plan Fact Sheet.” (2015). *City of Redding*. <http://www.reddingutilities.com/water_183_1103229500.pdf> (June 4, 2015).

“Davis Ranked Third in California for Reducing Water Use During September.” *The City of Davis*. (2014).

<<http://public-works.cityofdavis.org/press-releases/davis-water-use-dropped-28-percent-during-september>> (May 25, 2015).

Cohen, Yoram. (2009). “Graywater - A Potential Source of Water.” *UCLA Institute of the Environment and Sustainability*.

<<http://www.environment.ucla.edu/reportcard/article4870.html>> (May 25, 2015).

<http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757> (June 4, 2015).

“Water efficient rebate program” *Solano county*

<<http://www.scwa2.com/water-conservation/water-efficient-landscape-rebate-program>> (June 4, 2015).

Population in the United States U.S Census Bureau

<https://www.google.com/publicdata/explore?ds=kf7tgg1uo9ude_&met_y=population&idim=place:0659920:0613014:0623042&hl=en&dl=en> (June 4, 2015)

State Water Resource Control Board “Urban Water Suppliers And Regulatory Framework Tiers to achieve 25% reduction”

<http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/emergency_regulations/supplier_tiers_20150428.pdf> (June 4, 2015)

Sullivan, Francie (2015). “State water board proposed regulatory framework”

<http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/comments041315/francie_sullivan.pdf> (June 4, 2014)