



# Using Smart Water Meters to Promote Residential Water Conservation

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Presented at BECC 2015

In Sacramento CA



Which is the heaviest  
neutrino? p. 1555

Changing goals of nature  
conservation p. 1559

Epigenetic roles in immune cell  
development pp. 1578, 1579, & 1580

# Science

\$10  
26 SEPTEMBER 2014  
sciencemag.org

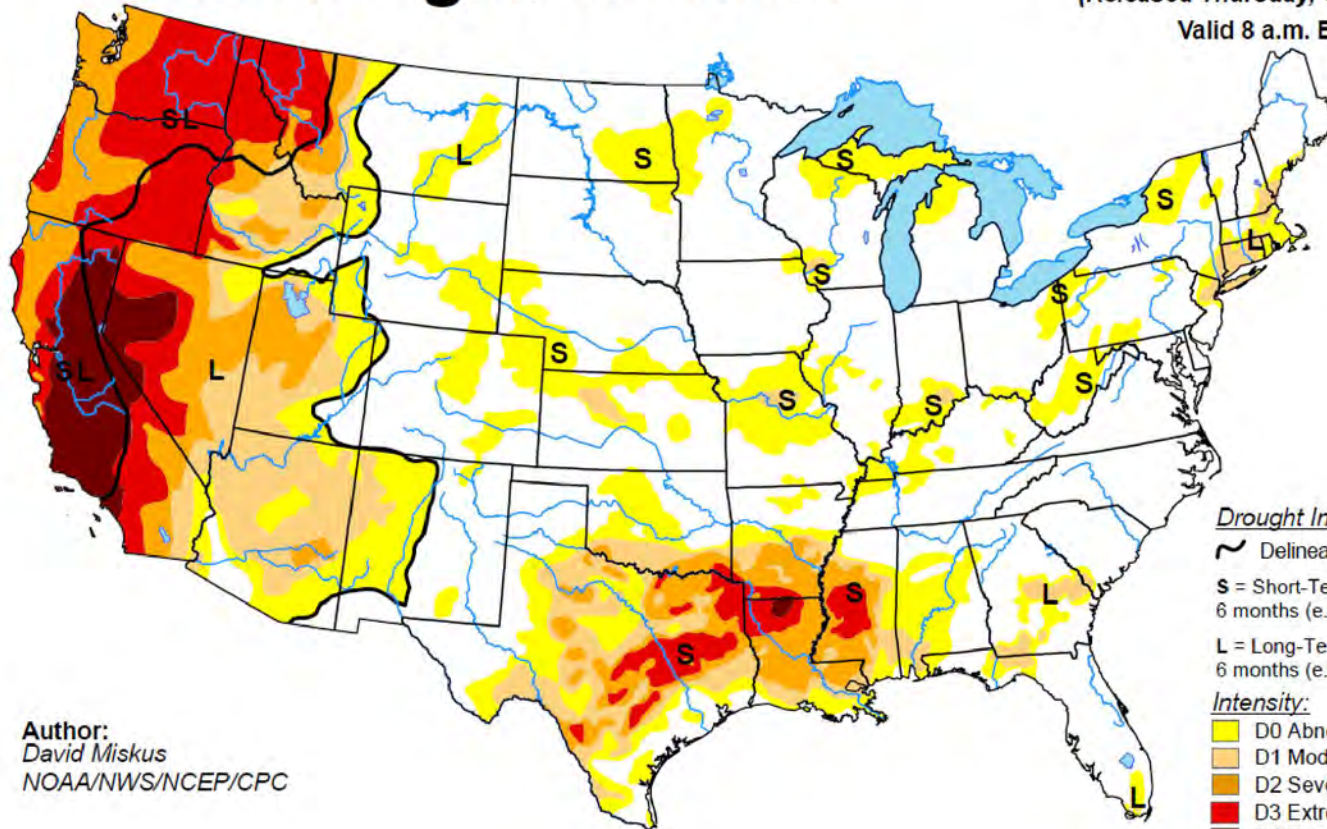
AAAS

## *The drought you can't see*

Geophysical methods detect changes  
in water storage pp. 1543 & 1587

# U.S. Drought Monitor

October 6, 2015  
 (Released Thursday, Oct. 8, 2015)  
 Valid 8 a.m. EDT



Author:  
 David Miskus  
 NOAA/NWS/NCEP/CPC

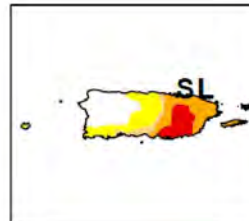
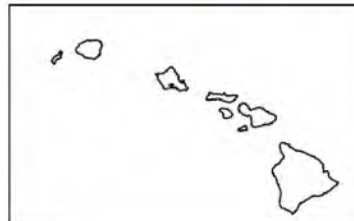
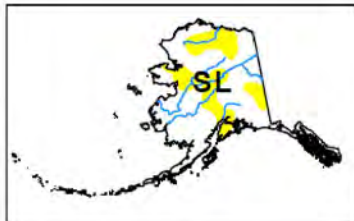
**Drought Impact Types:**

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

**Intensity:**

- Yellow: D0 Abnormally Dry
- Light Orange: D1 Moderate Drought
- Orange: D2 Severe Drought
- Red: D3 Extreme Drought
- Dark Red: D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>



## Conservation Means Behavior

P. WESLEY SCHULTZ

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Most instances of deteriorating environmental conditions are caused by human behavior. Although there are certainly instances of such environmental conditions developing from natural processes, most are largely the result of human activity. Drivers of phenomena such as climate change, loss of species' habitats, and ocean acidification rarely are the result of malicious intent, but rather the consequence of the lifestyles of billions of humans. Accordingly, efforts to promote conservation must change behavior (Burlich & Kennedy 2005; Schultz & Kaiser 2012).

This fundamental link between conservation and behavior has been noted in a number of recent publications. Mascia et al. (2003) state that "Biodiversity conservation is a human endeavor: initiated by humans, designed by humans, and intended to modify human behavior. ..." Cowling (2005) calls this realization "an epiphany for... natural scientists." And Balmford and Cowling (2006) note that "conservation is primarily not about biology but about

and support for environmental protection (Leiserowitz et al. 2005). Yet despite these high levels of awareness, there have not been dramatic changes in personal actions or widespread patterns of behavior (Moore 2002; Crompton 2008). Consequently, individuals in industrialized nations around the world continue to consume high levels of resources and to live in unsustainable ways.

In this essay, I highlight four research findings that illustrate the challenges of changing behavior:

- (1) education does not typically result in increases in conservation behavior;
- (2) human thinking is biased and promotes short-sighted responses to environmental threats;
- (3) individuals generally perceive themselves as separate from nature; and
- (4) social norms guide behavior.

First, results of psychological studies have shown con-

# San Diego County Water Authority

## Conservation Video



# Changing Behavior

## 6 Tips for Saving Water

Just six of the many ways we can all conserve and protect our water.



Drink water from faucets and drinking fountains, and use reusable water bottles instead of buying bottled water.



Keep the water clean/  
don't litter/ do recycle



Save water in the garden - Plant native plants/ don't overwater/  
water early or late, not the hottest part of the day



Use water saving devices -  
low flow shower head/ hose sprayer/ faucet aerators



Be a water detective - Get leaks fixed inside and out

How to check your toilet for leaks:

Lift off the toilet tank lid.

Place one dye strip/tablet (or 5-10 drops of food coloring) in the toilet tank.  
(Use a dark color such as blue or red instead of yellow.)

Wait 30 minutes.

If water in the bowl turns that color, you have a toilet leak.



Whenever you're not using the faucet,  
remember to turn it off

## Tiered prices

The city of San Juan Capistrano's 2010 water rate schedule, which a group of residents is challenging in court.

(Cost per 748 gallons)

Tier 1

\$2.47

Tier 2

\$3.29

Tier 3

\$4.94

Tier 4

\$9.05

Source: city of San Juan Capistrano

@lalimesgraphics



Knowledge

Awareness

Economic

# Traditional Approaches

## Knowledge

*If people know what to do, they will do it.*

*Knowledge ≠ Behavior Change*

## Awareness

*If people know the severity of it, they will change.*

*Attitude ≠ Behavior Change*

## Economic

*If it is in their financial best interest, they will do it*

*Enlightenment ≠ Behavior Change*



Badger Meter Approach

**EYE ON WATER**





# Printed Home Water Reports



City of Sunnyvale  
Utility Billing Division  
650 W. Olive Ave  
Sunnyvale, CA 94085  
(408) 730-7400

John Smith  
123 Main Street  
Sunnyvale, CA 94087

Your Household Water Report  
May 1, 2014 – June 1, 2014



Your household used **12% more water** per day than similar households in Sunnyvale.

#### How Does Your Home Compare?

Here's how your average daily water usage stacked up against households like yours in the past month:



#### Take Action!

Follow these steps, and you'll be on your way to using water more efficiently.



#### 1. Install aerators.

When you screw an aerator onto a faucet, you add air to the water. You'll use 30% less water anytime the faucet's on (And you'll hardly notice the difference).



#### 2. Take shorter showers.

A typical shower uses 5 gallons of water per minute. Reducing your shower by 1 minute per day can save 150 gallons per month.



#### 3. Stop that leaky toilet.

Even a small leak can waste 30 gallons per day. That's over 10,000 gallons per year. Yikes.

#### Rebate Offer: High-Efficiency Toilets

Save up to \$125 on a high-efficiency toilet (HET).

Visit [valleywater.org](http://valleywater.org) to learn about and redeem rebates on eligible devices.

Sunnyvale Water customers are eligible for a rebate of up to \$125 per toilet for replacing old, high water-use toilets that use 3.5 gallons per flush or more, with a new HET from the approved list of qualifying models.

#### A Message From Sunnyvale

Save more than 3,000 gallons a week and up to \$50 a month by installing a smart irrigation controller.

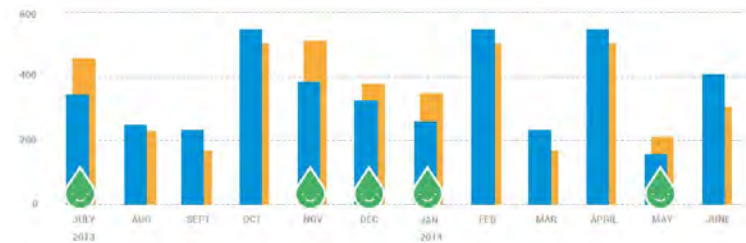
Use 10 fewer gallons every time you turn on the hot water. How? By installing a demand-driven recirculation pump that delivers hot water instantly.

Save at least 20 gallons a day when you install a high-efficiency toilet.

#### Water Usage Over Time<sup>2</sup>

Your average daily water usage compared to similar households in Sunnyvale over the past year.

● You ● Similar Households



Average Daily Water Usage Per Month in Gallons.

You now have online access to your hourly water usage information.

Visit [sunnyvale.eyeonwater.com](http://sunnyvale.eyeonwater.com) and enter your account number to register.

Account # 785923423

Questions? Contact the City of Sunnyvale Utility Billing Division at (408) 730-7400.



#### Get the EyeOnWater App

Download the EyeOnWater App to keep an eye on your water usage, track historical trends, monitor your home for leaks, and more. It's free.

Download on the App Store

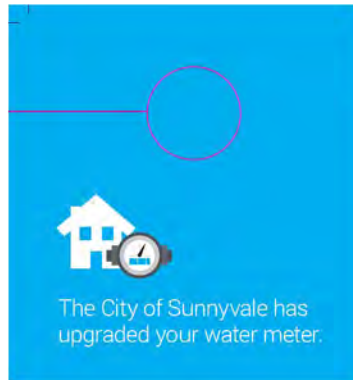
<sup>1</sup> In this comparison, "similar households" are determined by the average water use over the same period from approximately 500 single-family homes in your area.

<sup>2</sup> Monthly average values are calculated based on your billing records.

# Web Portal



# Door Hanger Notification



Dear Resident of Sunnyvale,

As part of our ongoing efforts to improve services to our customers, the City of Sunnyvale has upgraded your water meter. With these new meters, **you now have online access to your hourly water usage information.** You will also receive monthly reports in the mail that show your average monthly water usage and compare your usage over the same period to approximately 500 single-family homes in your area.

We encourage you to use this information to monitor your water usage, look for ways to reduce the amount of water you use, and make informed decisions about water efficiency in your home.

To access your personalized online portal visit:  
[sunnyvale.eyewater.com](http://sunnyvale.eyewater.com)

You can also **download the EyeOnWater App** on your iPhone to keep an eye on your water usage, track historical trends, and monitor your home for leaks.



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Action Research

# **EVALUATION PLAN**



# Sample

- ❑ Single Family Homes
  - ❑ 410
- ❑ Four Conditions
  - ❑ Random Assignment
    - ❑ Mail Only
    - ❑ Mail + Web
    - ❑ Mail + Web + Door
    - ❑ Control



# Data

- ❑ Water Consumption
  - ❑ Average Weekly
    - ❑ Historical
    - ❑ Post intervention
- ❑ Web Platform Signups
- ❑ Customer Engagement Survey
  - ❑ Knowledge
  - ❑ Usage
  - ❑ Water Saving Activities
  - ❑ Customer Satisfaction
  - ❑ Mailed Reports
  - ❑ Web Platform





Action Research

# RESULTS



# Participants

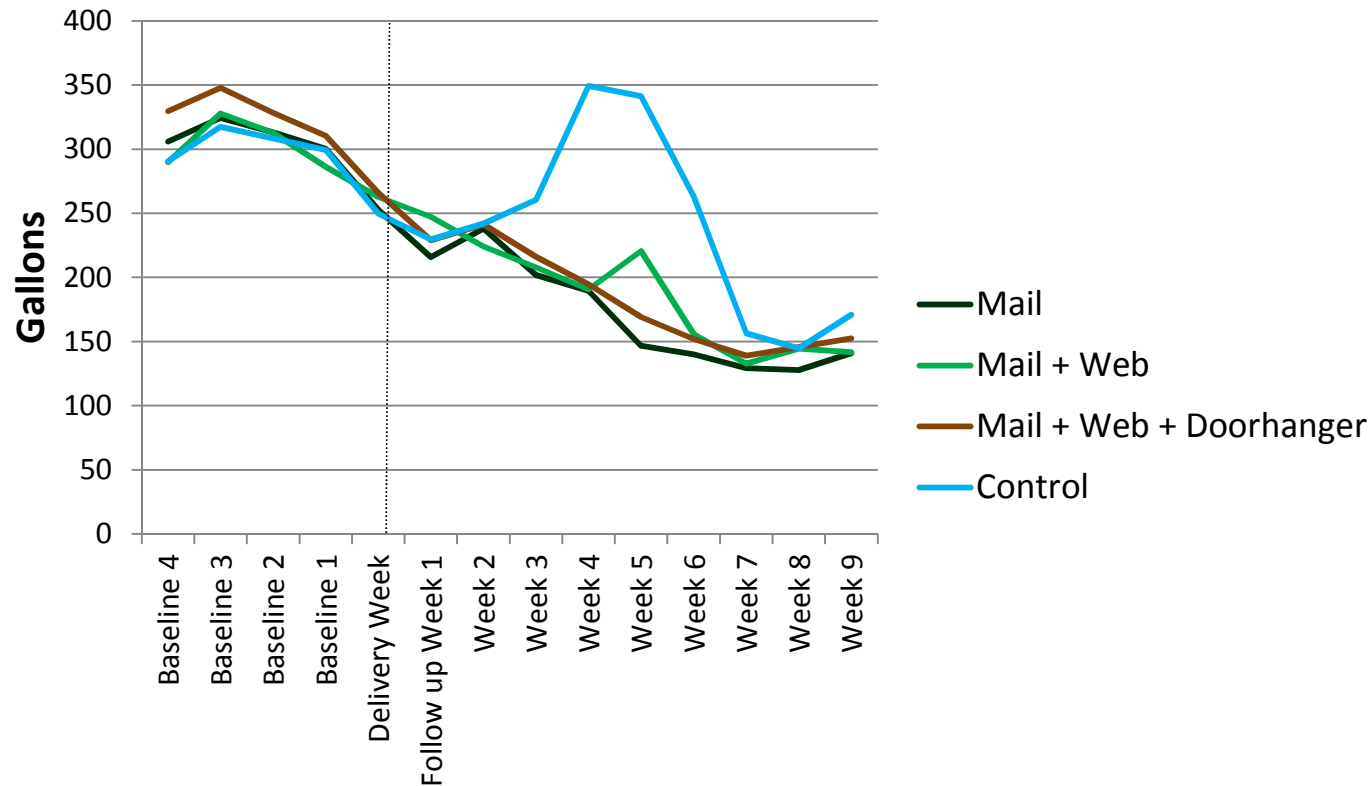
Condition	Number	Surveys Returned	Accounts Created
Mail	105	68	N/A
Mail + Web	98	63	16 (16%)
Mail + Web + Door	104	66	19 (18%)
Control	103	77	N/A
<b>Total</b>	<b>410</b>	<b>274 (67%)</b>	



# Average Daily Gallons Consumed per Week

## Raw Scores

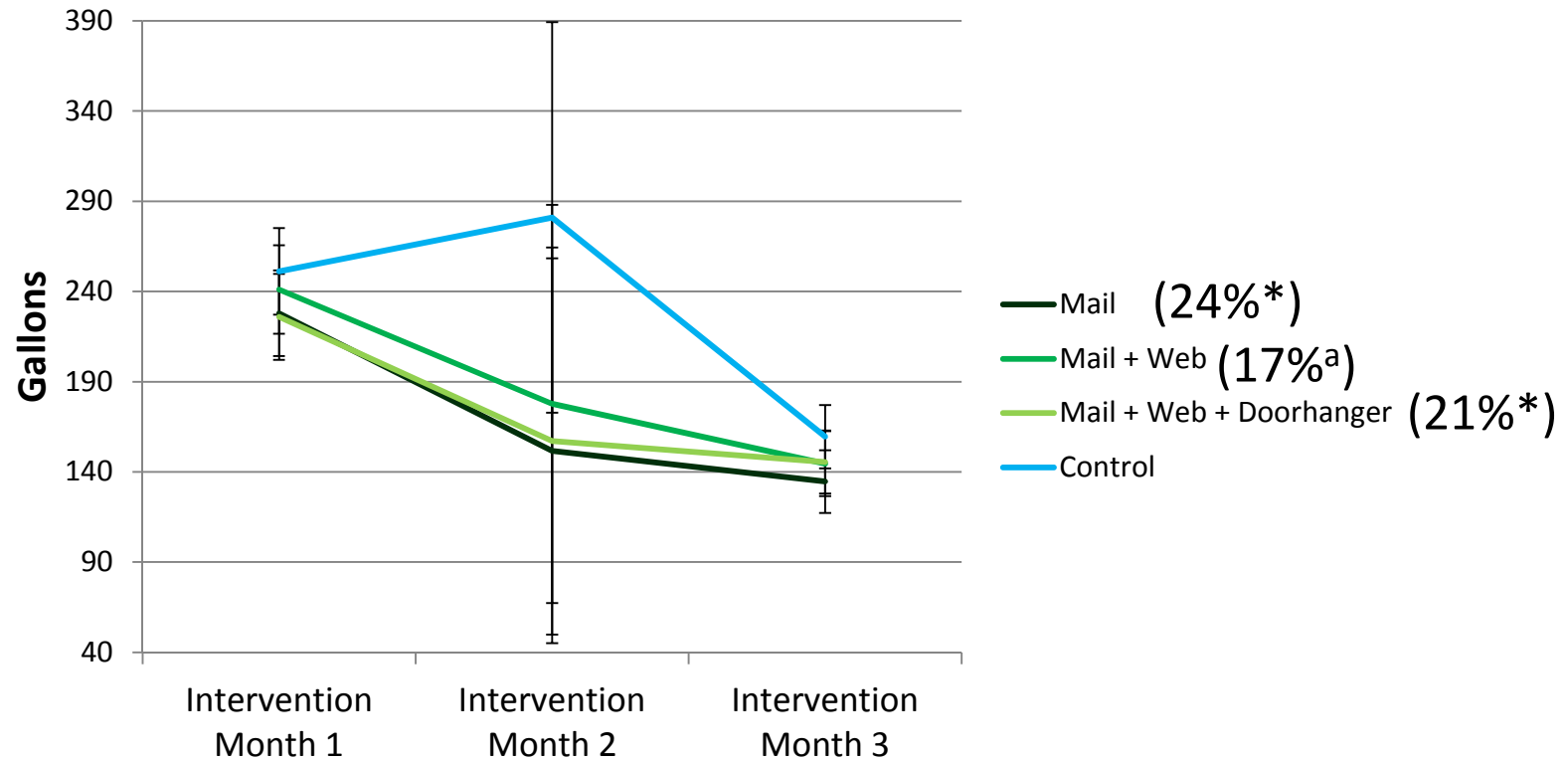
- Four weeks prior to the pilot
- Ten weeks following the launch



# Average Daily Gallons Consumed per Month

## Raw Scores

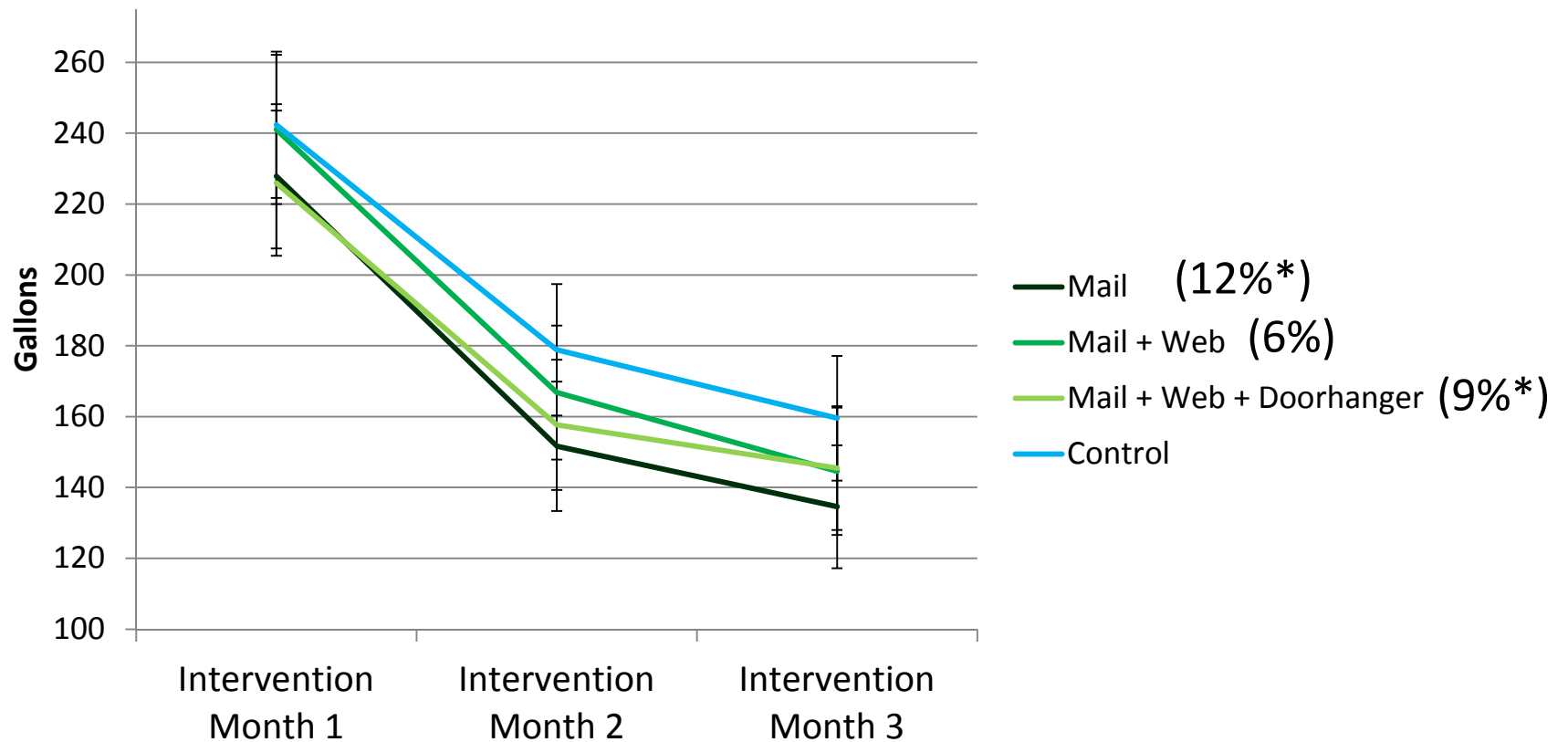
- Baseline consumption as a covariate



# Average Daily Gallons Consumed per Month

## Reduced Outliers

- Baseline consumption as a covariate



# Customer Engagement Survey

## Sunnyvale Water Survey

**1. This first set of questions is about water use in general.**

Using a scale from 1 to 7, where 1 is "Very Little" and 7 is "A Great Deal," how much do you know about...

	Very Little						A Great Deal
a. water use in your home?	1	2	3	4	5	6	7
b. the cost of water use in your home?	1	2	3	4	5	6	7
c. how water use in your home compares to water use in similar households?	1	2	3	4	5	6	7
d. how much water is used by the different things you do in your home?	1	2	3	4	5	6	7

**2. These questions are about general water-use in your home.**

a. Do you have a pool?  Yes  No

b. In the past month, approximately how many times have you washed cars or other vehicles at home? \_\_\_\_\_ times

c. In a typical week, approximately how many loads of laundry are washed in your home washing machine? \_\_\_\_\_ loads

d. During the past three months, how frequently have you discovered a water leak in your home?  
 Never  
 Once  
 Two or more times → How did you discover the leak? \_\_\_\_\_

e. During the Summer months, what days of the week does your yard typically get watered? (Please circle all that apply)  
 Sun Mon Tue Wed Thu Fri Sat  I do not have a yard [Skip to Section 3]

f. During the Summer months, what time of day does your yard typically get watered? (Please circle all that apply)  
 Before 6am 6am to 10am 10am to 2pm 2pm to 5pm 5pm to 8pm After 8pm  I do not have a yard

**3. This section is about water saving activities that you may or may not have done in your household.**

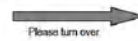
In the past three months, have you done any of the following water saving activities? If you did an activity more than three months ago, please check "Previously." If an activity does not apply to you, check "N/A."

	Yes	No	Previously	N/A
a. Water your lawn only when it needs it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Install a low-flow toilet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Stop a leaky toilet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Repair dripping faucets by replacing washers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Make sure every tap in your home has an aerator.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Take shorter showers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Install a low-flow shower head.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Insulate your water pipes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Choose and use your clothes washer wisely.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Set up a rain barrel.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Cover your pool.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**4. The following section asks your opinions of the City of Sunnyvale Water Utility.**

Using a scale from 1 to 7, where 1 is "Strongly Disagree" and 7 is "Strongly Agree," please rate the following statements as they relate to the City of Sunnyvale Water Department.

	Strongly Disagree						Strongly Agree
a. The Water Utility is looking for innovative ways to save me money.	1	2	3	4	5	6	7
b. The Water Utility sends me useful information on saving water.	1	2	3	4	5	6	7
c. The Water Utility wastes money by sending me things I don't need.	1	2	3	4	5	6	7
d. Overall, I am satisfied with the City of Sunnyvale Water Utility.	1	2	3	4	5	6	7



**5. Over the past three months, you should have received three water reports in the mail. These next questions are about those reports.**

Using a scale from 1 to 7, where 1 is "Strongly Disagree" and 7 is "Strongly Agree," please rate the following statements as they relate to the reports you received.

	Strongly Disagree						Strongly Agree
a. I remember receiving the reports.	1	2	3	4	5	6	7
b. I liked receiving the reports.	1	2	3	4	5	6	7
c. The reports were easy to understand.	1	2	3	4	5	6	7
d. The reports motivated me to use less water.	1	2	3	4	5	6	7

What did you do with the mailed reports?  
 Read and discarded them  Read and posted them in a common area (Where did you post them? \_\_\_\_\_)  
 Ignored / Discarded them without reading  Other \_\_\_\_\_

The City of Sunnyvale Water Utility is considering sending more of these reports in the future. How often do you think these reports should be mailed?  
 Once a month  
 Every two months  
 Every three months  
 Every six months  
 Once a year  
 Never

**6. This next set of questions is about the website that was available to access the information from your upgraded water meter.**

What information on the website was most valuable to you? (check all that apply)  
 Hourly water use  Week over week comparison  
 Occurrence of a leak  Other \_\_\_\_\_  
 I did not know about the website [Skip to Section 7]

How did you typically access the website?  Computer  Mobile (android, ios, etc...)  Other \_\_\_\_\_

The City of Sunnyvale Water Utility is considering making the website features available to more customers in the future. Using a scale from 1 to 7, where 1 is "Strongly Disagree" and 7 is "Strongly Agree," how much do you agree that this data is useful to other customers?

	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7

**7. The questions in this final section are for classification purposes only.**

How long have you lived at your current address? \_\_\_\_\_ years  
 Including yourself, how many people live in your household? \_\_\_\_\_ How many are children under 18? \_\_\_\_\_

**8. Optional opportunity to participate in future interviews or focus groups.**

The City of Sunnyvale Water Utility is continuing to improve our services to customers. Occasionally, we ask residents like you for feedback. If you would be willing to be contacted for future interviews or focus groups about our new water meter services please provide your contact information below.

Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Email: \_\_\_\_\_

Thank you for your time and participation!

# General Knowledge

Using a scale from 1 to 7, where 1 is “Very Little” and 7 is “A Great Deal,” how much do you know about...

Item	Mail	Web	Door	Control	Sig	%+
water use in your home?	5.24	5.24	4.82	4.85	.18	64.5
the cost of water use in your home?	5.31	5.18	4.79	5	.24	64
how water use in your home compares to water use in similar households?	4.39	4.75	4.25	3.26	<.001	40.7
how much water is used by the different things you do in your home?	4.34	4.61	4.32	4.16	.44	47.5

# Mailed Report

Using a scale from 1 to 7, where 1 is “Strongly Disagree” and 7 is “Strongly Agree,” please rate the following statements as they relate to the reports you received.

Item	Mail	Web	Door	Sig	%+
I remember receiving the water reports in the mail.	5.82	6.23	5.94	.31	87.6
I liked receiving the water reports.	5.55	5.85	5.83	.56	82.1
The water reports were easy to understand.	5.65	5.86	5.79	.69	82.9
The water reports motivated me to use less water.	5.27	5.16	5.19	.94	68.3

# Future Reports

How often do you think these reports should be mailed?

- 99% - At least once a year
- 85% - At least quarterly

Timeframe	Number	Percentage
Once a month	66	35.9
Every two months	44	23.9
Every three months	46	25
Every six months	17	9.2
Once a year	9	4.9
Never	2	1.1

# Conclusions

- ❑ Clear evidence for reductions in consumption
  - ❑ Printed reports produced 12% reduction in water consumption over 3-month period
- ❑ No evidence that online access promoted conservation
  - ❑ Likely because most motivated created accounts
- ❑ Consider adding leak detection to the printed reports
- ❑ Customers liked the printed reports (99%)
- ❑ Improved knowledge about water consumption in similar households



# Contact

## Action Research

California: 3630 Ocean Ranch Blvd. | Oceanside, CA 92056

New York: 13 East 37th St., Suite 7F | New York, NY 10016

**phone:** 760.722.4012 | **email:** [schmitt@action3630.com](mailto:schmitt@action3630.com)

[www.action3630.com](http://www.action3630.com)

