American Water Works Association

SUSTAINABLE
Water Management Conference

2018

WRF: Water Demand Forecasting Research Overview

SESSION TUE03
March 27, 2018

Maureen Hodgins, Water Research Foundation

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Agenda

- WRF – who/what
- Research funded
- Drivers
- Research results
  - Climate
  - Economy
  - Efficiency
  - Forecasting approaches

Integrated 1/1/2018

WE&RF + WRF = WRF or The Foundation

THE Water Research FOUNDATION

The integrated organization represents the evolution of water research issues, the overlap between water and wastewater, and efficiencies to be gained through a consolidated research program.

Learn more at www.waterrf.org and www.werf.org

$700 Million in Research

2,300 Projects

1,200 Subscribers

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Research Programs

- Legacy programs more ALIKE than different!
- 2018 just like 2017
- 2019 programs TBD

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Leaders Innovation Forum for Technology - LIFT


Utility Peer Network


Technology Scans


LIFT Link


FAST Water Network

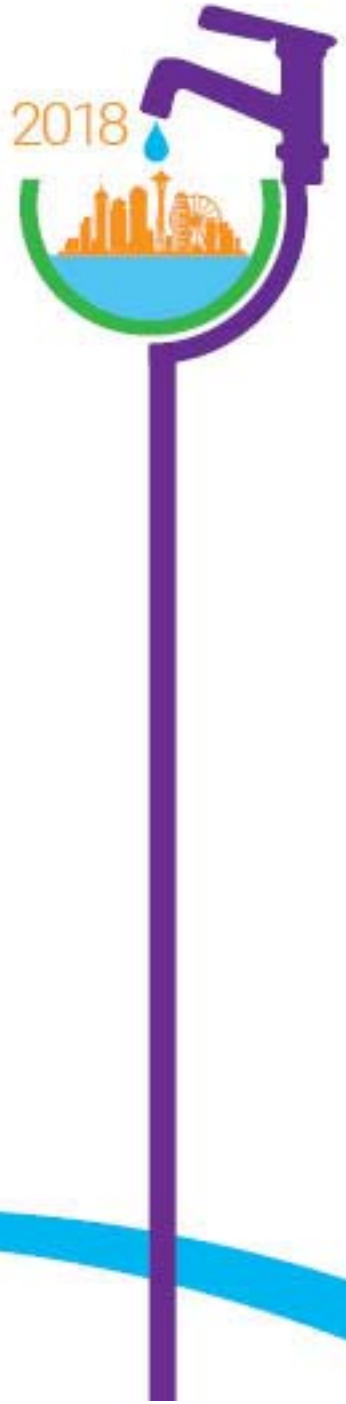

Technology Survey


SEE IT


University-Utility Partnership


Hubs, Partners, and Affiliates

- http://www.werf.org/lift
- Webcast, Mar 29, 2018, 1-2:30 ET, www.wef.org
- Drinking water input at ACE 2018



Water demand research funding 2009-2017

Idea	Funding	# Projects	WRF Cash
WRF [1, 2]	WRF	11	$2,922,836
Utilities [3]	Utility & WRF	4	558,000
Ideas pop up [4]	WRF & Partners	3	89,392
	Total	**18**	**$3,570,228**

Research Programs
1. Research Advisory Committee
2. Focus Area Program
3. Tailored Collaboration
4. Emerging Opportunity

Published: 13
Published within 6 months: 2
Ongoing: 3

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Summary on waterrf.org

2018

The Foundation | Knowledge Portals | Resources | Funding

Search... View Cart MHODGINS@WATERRF.ORG

Knowledge Portals: Water Efficiency

- Advanced Treatment
- Asset Management
- Climate Change
- Contaminants of Emerging Concern
- Disinfection By-Products
- Distribution System Management
- Energy Management
- Microbials
- Source Water Protection and Management
- Utility Finance
- Utility Management
- Water Efficiency
- Water Supply Diversification

Projects & Reports (47) Webcasts (25) Case Studies (0) Web Tools (6)

Water efficiency is the pursuit of reducing water wastage. Utilities can reduce the amount of water wasted in their systems by accurately calculating water use estimates, adopting demand management strategies, accurately forecasting future water demand, and pursuing water loss control initiatives.

Executive Tool Kit

Topic Overview

Media Library

Fact Sheets

Demand Forecasting

Potable Water Demand Management

Water Loss Control

Water Use Estimates

External Resources

Context: Trends in Urban Water Use

- Per capita water use has declined in many places
- Acute declines in some areas in the recent past
- Net revenue problems, unused capacity, stranded capital
- Case for improved water efficiency becomes harder to sell

Slide courtesy of Jack Kiefer

Example: Declining residential use

-16% over 30 yrs

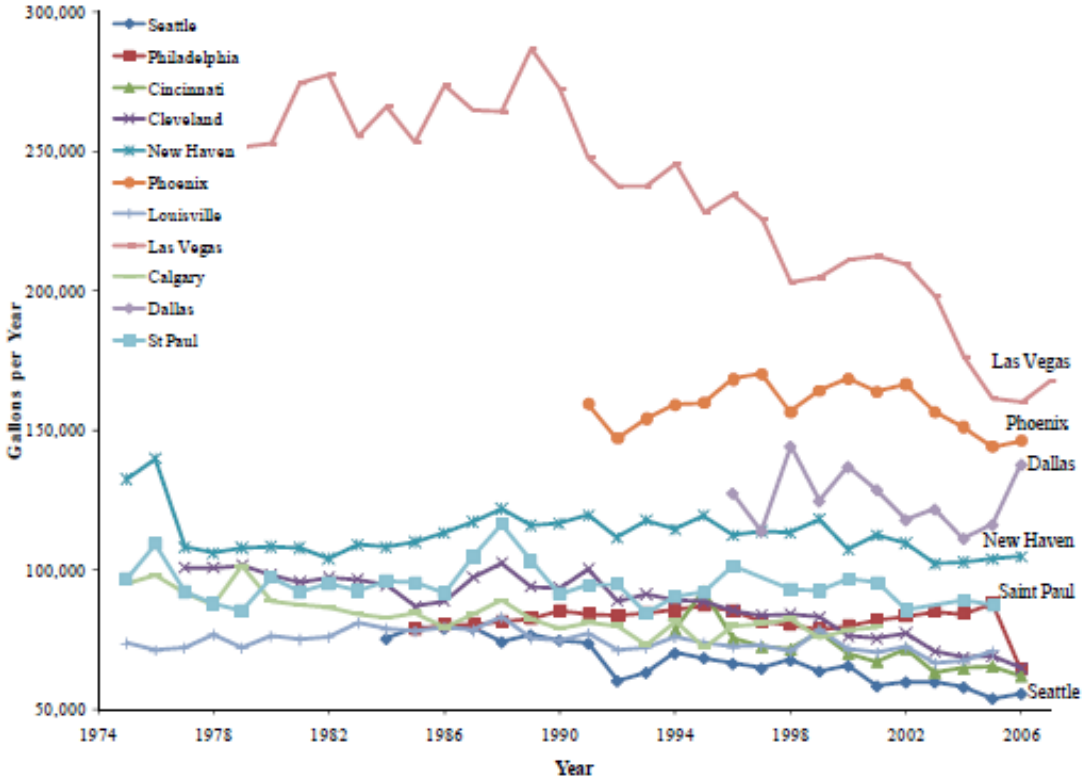
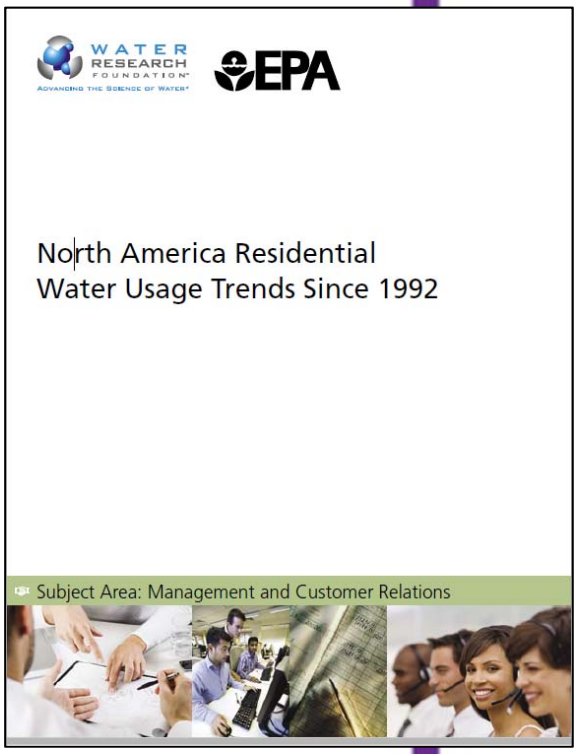


Figure ES.1. Partners' average annual water usage per residential customer, in gallons

Source: Coomes, P, T. Rockaway, J. Rivard, and B. Kornstein. 2010. North American Residential Water Usage Trends since 1992. Project #4031. Denver, Colo: Water Research Foundation



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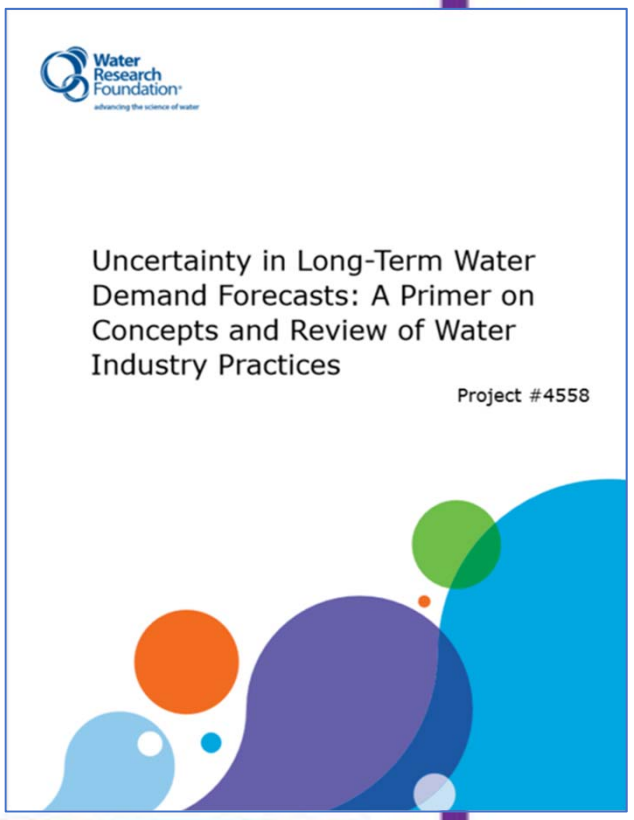
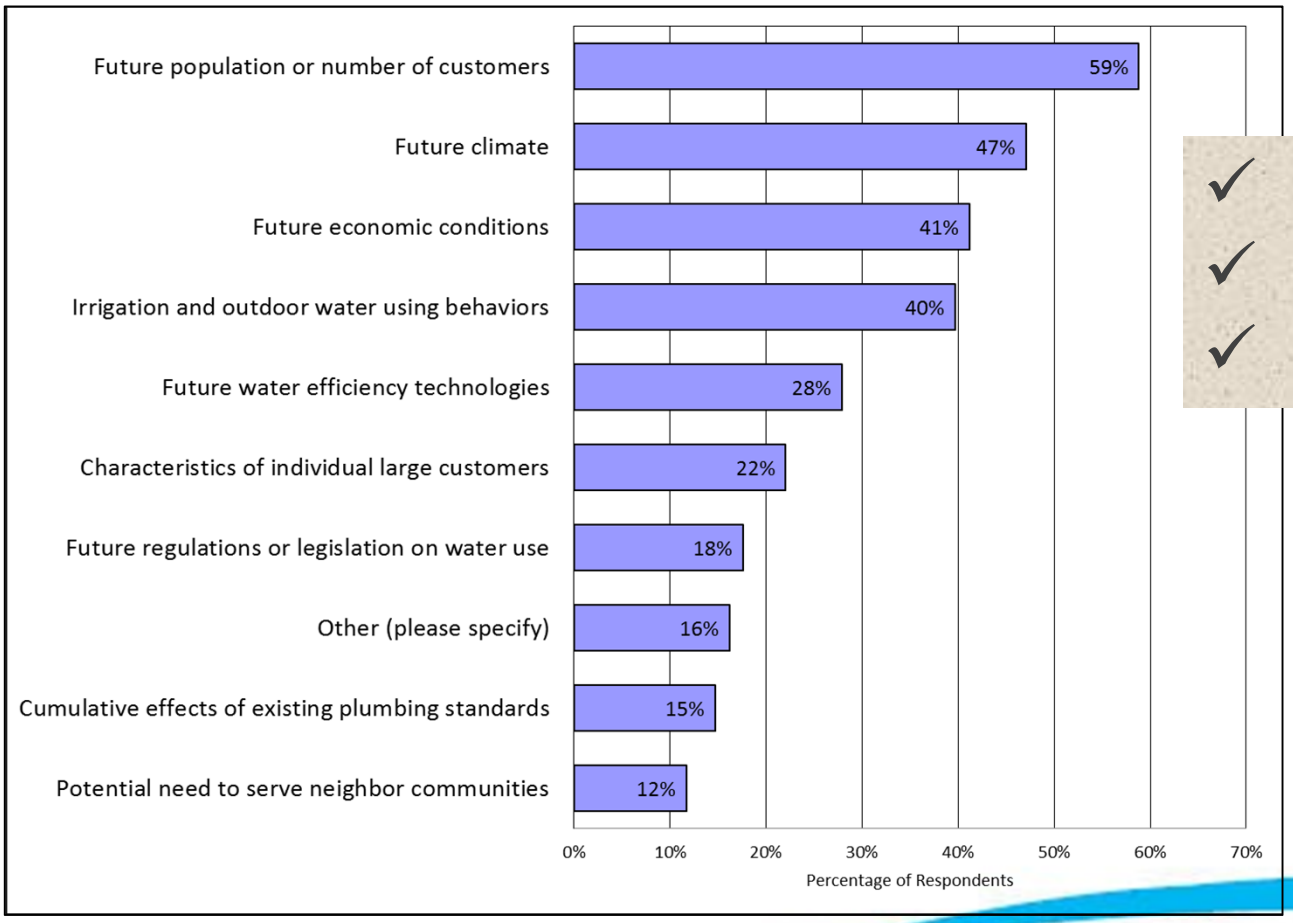
Context: Risks Tied to Water Demand Forecast Inaccuracies

- Revenue "surprises"
  - Insufficient cash flow and borrowing costs
  - Unexpected need for rate changes
  - Credit rating downgrades
- Over-sized systems
  - Unused capacity (you still have to pay for)
  - Opportunity costs (environment, financial)
- Under-sized systems
  - Chronic or more frequent shortages (economic damages)
  - Lost water sales



Slide courtesy of Jack Kiefer

What would you consider to be the 3 main drivers of uncertainty about water demands over the next 20 to 30 years?

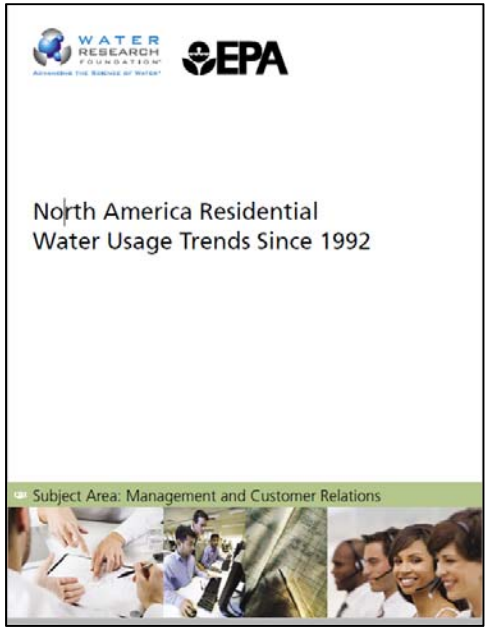


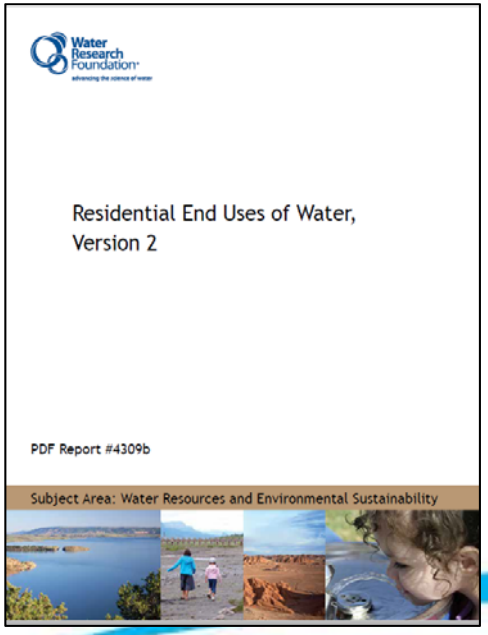
- ✓ Climate
- ✓ Economy
- ✓ Efficiency

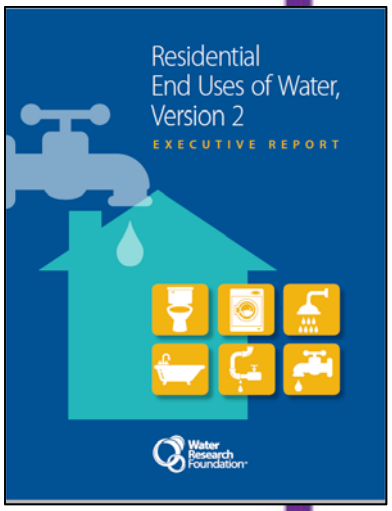
Source: Kiefer, J.C., Yoe, C., Clayton, J.M., and J.C. Leonard. 2016. *Uncertainty in Long-Term Water Demand Forecasts: A Primer on Concepts and Review of Water Industry Practices.* Denver, Colo.: Water Research Foundation.

Water Use Reflects Technology

National plumbing fixture standards have had a marked influence on residential use







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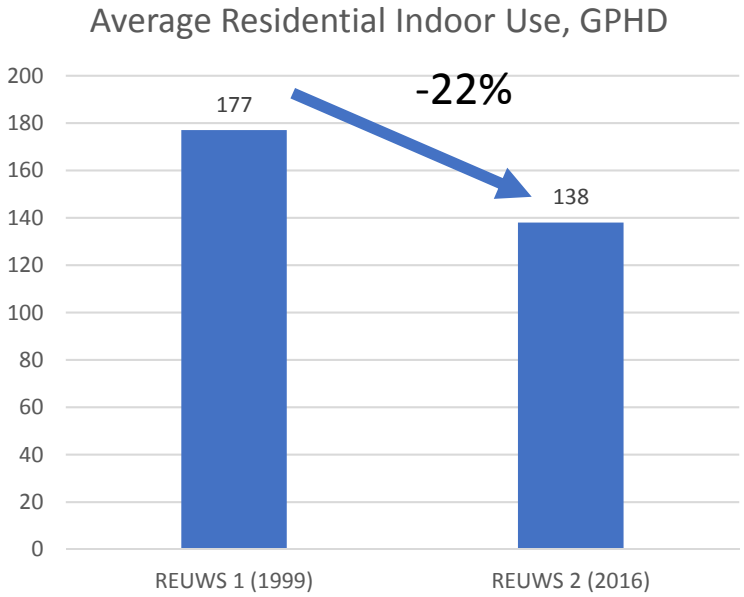
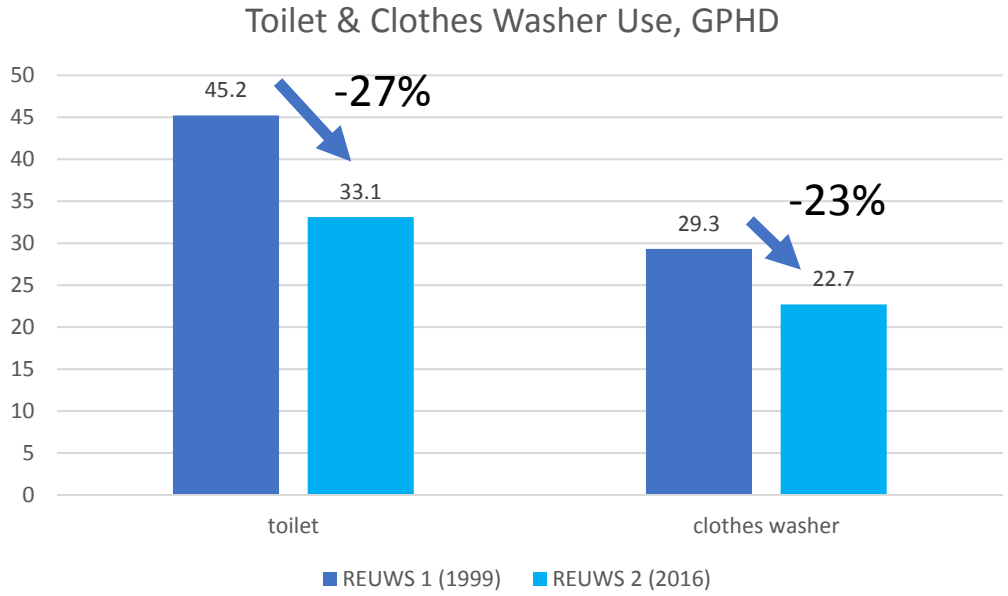
Water Use Reflects Technology





- Average behavioral aspects about the same

Source: DeOreo, W.B., P.W. Mayer, B. Dziegielewski, J.C. Kiefer, 2016. *Residential Uses of Water 2016*. Water Research Foundation. Denver, CO.

Slide courtesy of Jack Kiefer

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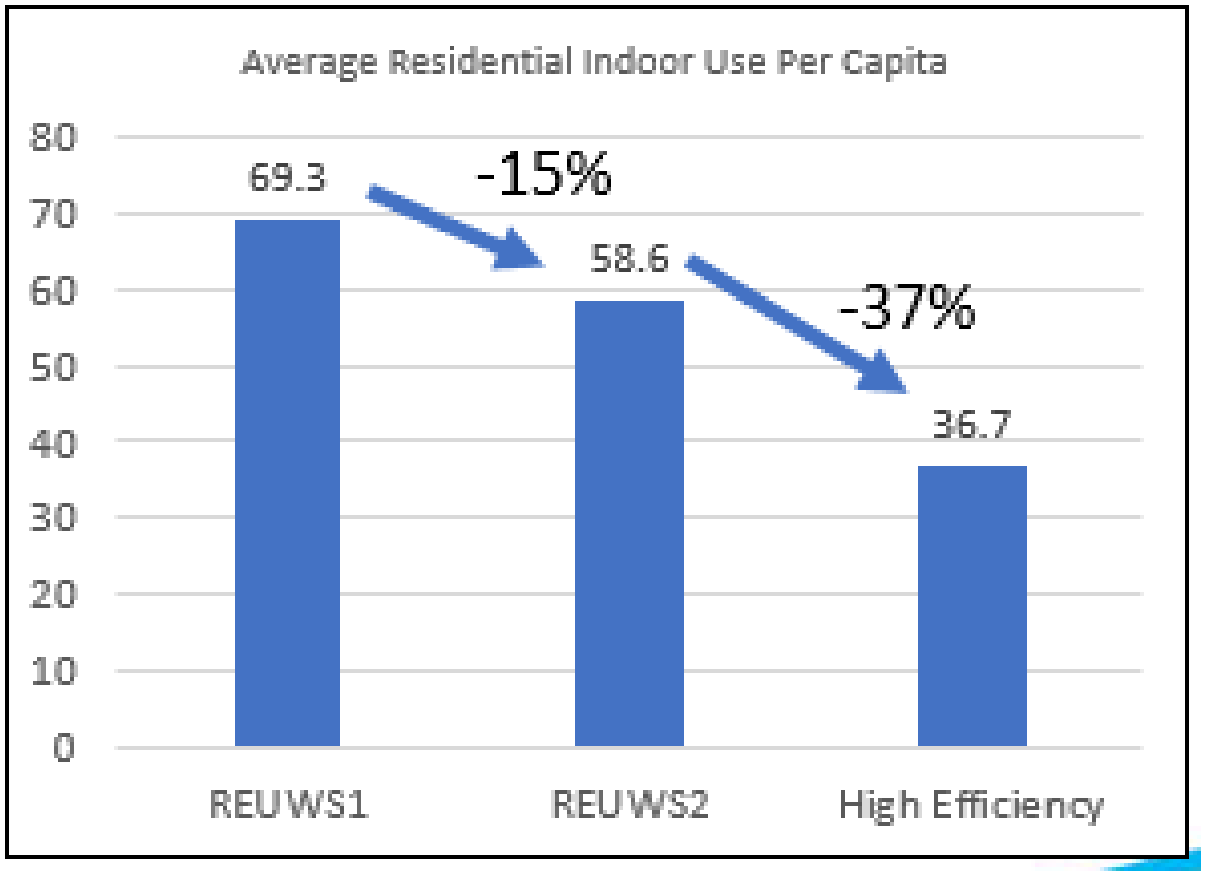
Water Use Reflects Technology



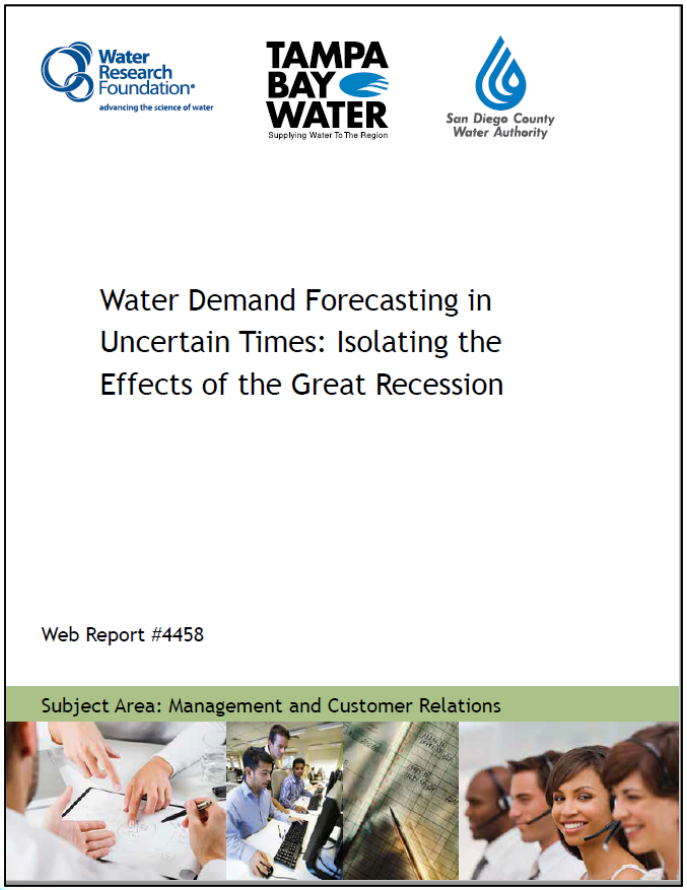
Likely -37%

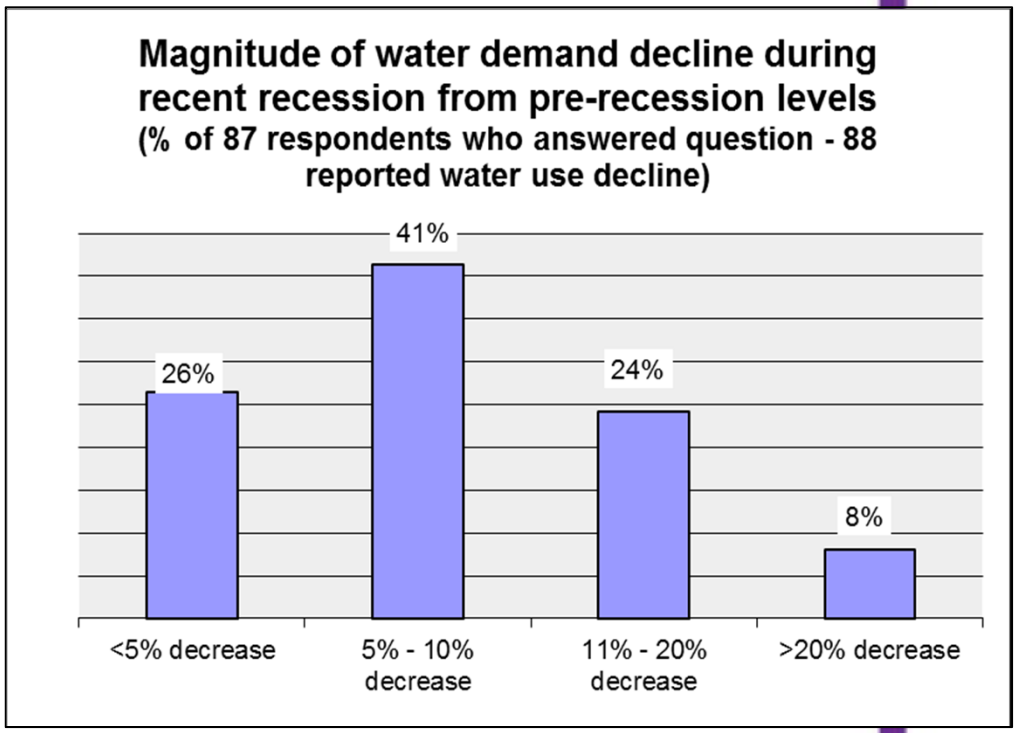
- Under existing technology
- Without change in behaviors

What next?

Source: DeOreo, W.B., P.W. Mayer, B. Dziegielewski, J.C. Kiefer, 2016. *Residential Uses of Water 2016*. Water Research Foundation. Denver, CO.

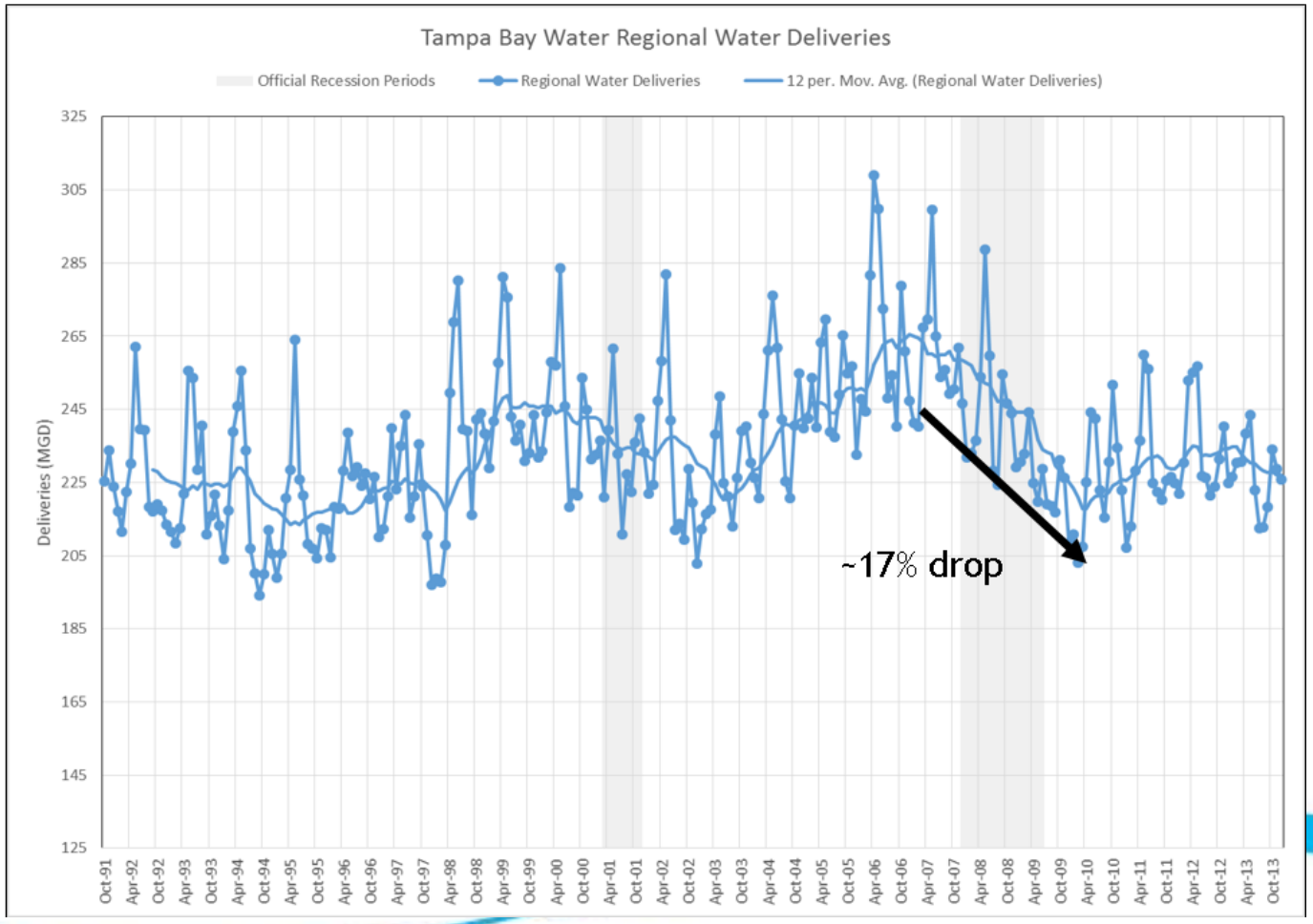
Economy: Great Recession Impacts





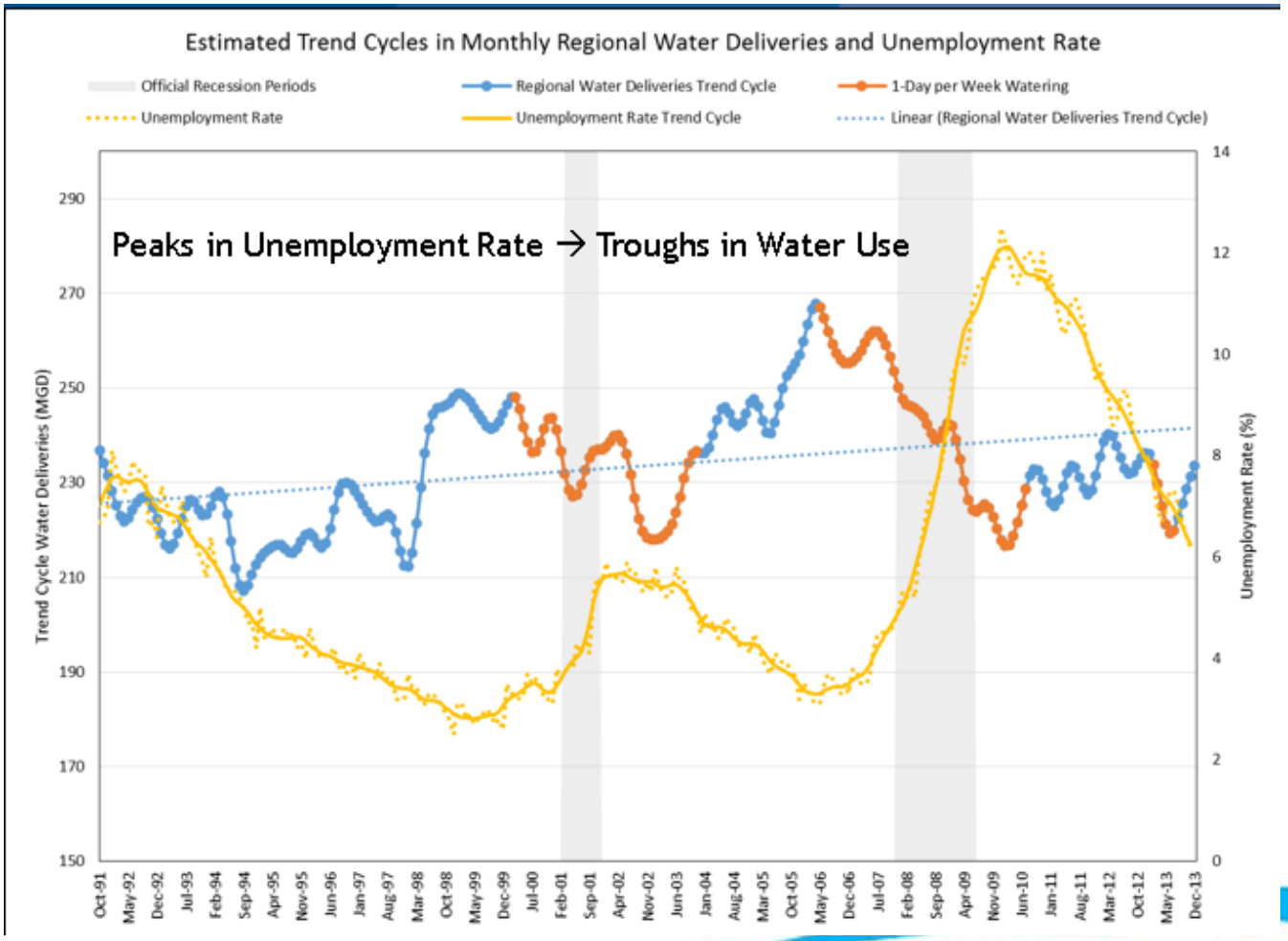
Source: Kiefer, J.C., Johns, G.M., Snaith, S.M., and B. Dziegielewski. 2016. *Water Demand Forecasting in Uncertain Times: Isolating the Effects of the Great Recession*. Denver, Colo.: Water Research Foundation.

Is water efficiency the cause of this?



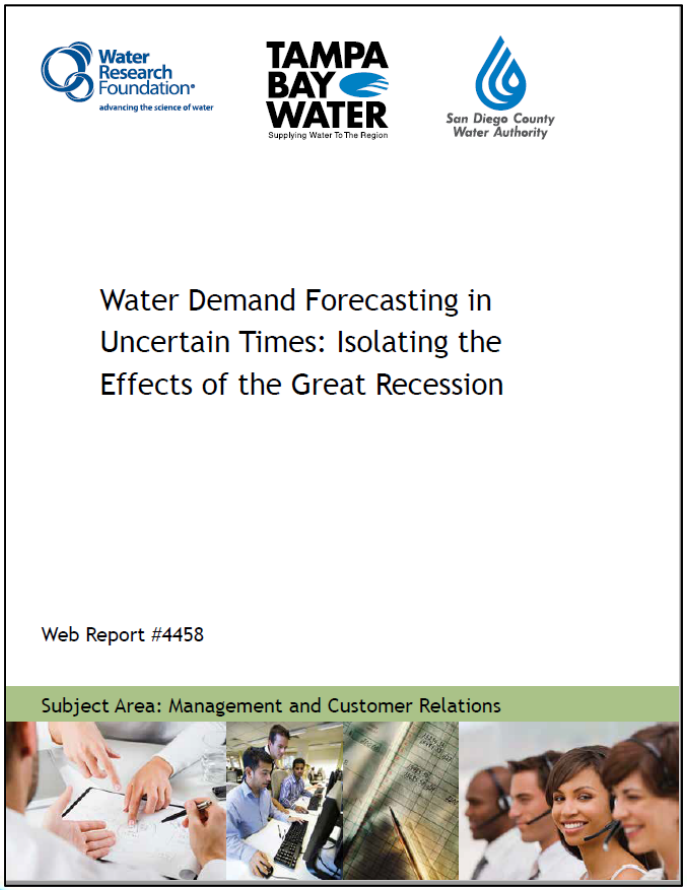
Slide courtesy of Jack Kiefer

Tampa Bay Water



Source: Kiefer, J.C., Johns, G.M., Snaith, S.M., and B. Dziegielewski. 2016. *Water Demand Forecasting in Uncertain Times: Isolating the Effects of the Great Recession*. Denver, Colo.: Water Research Foundation.

Economy: Great Recession Impacts



Case studies

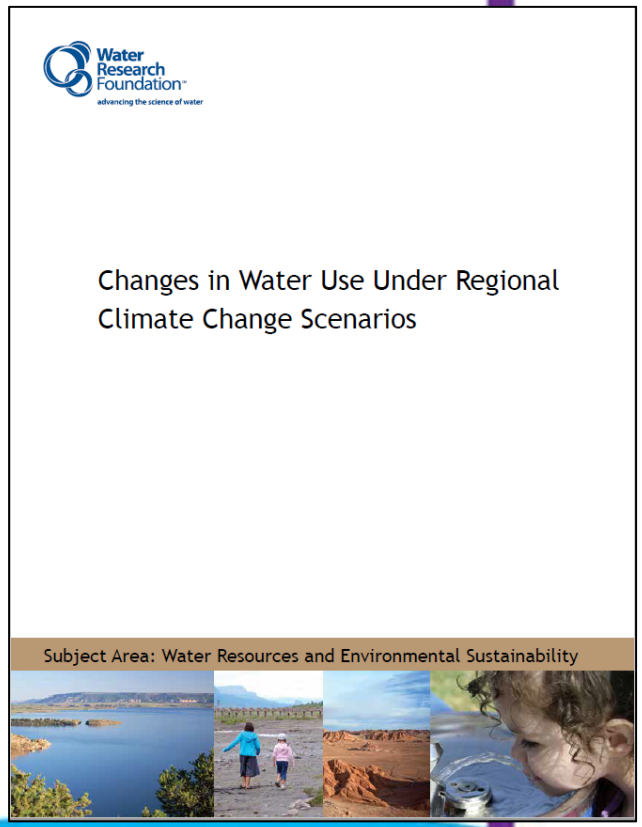
- 5-15% water use reductions
- Recessionary forces
- Lag

- Include economic data in forecasts
- Macro-economy has both short and long run effects on water use

Water Demand Varies with Climate

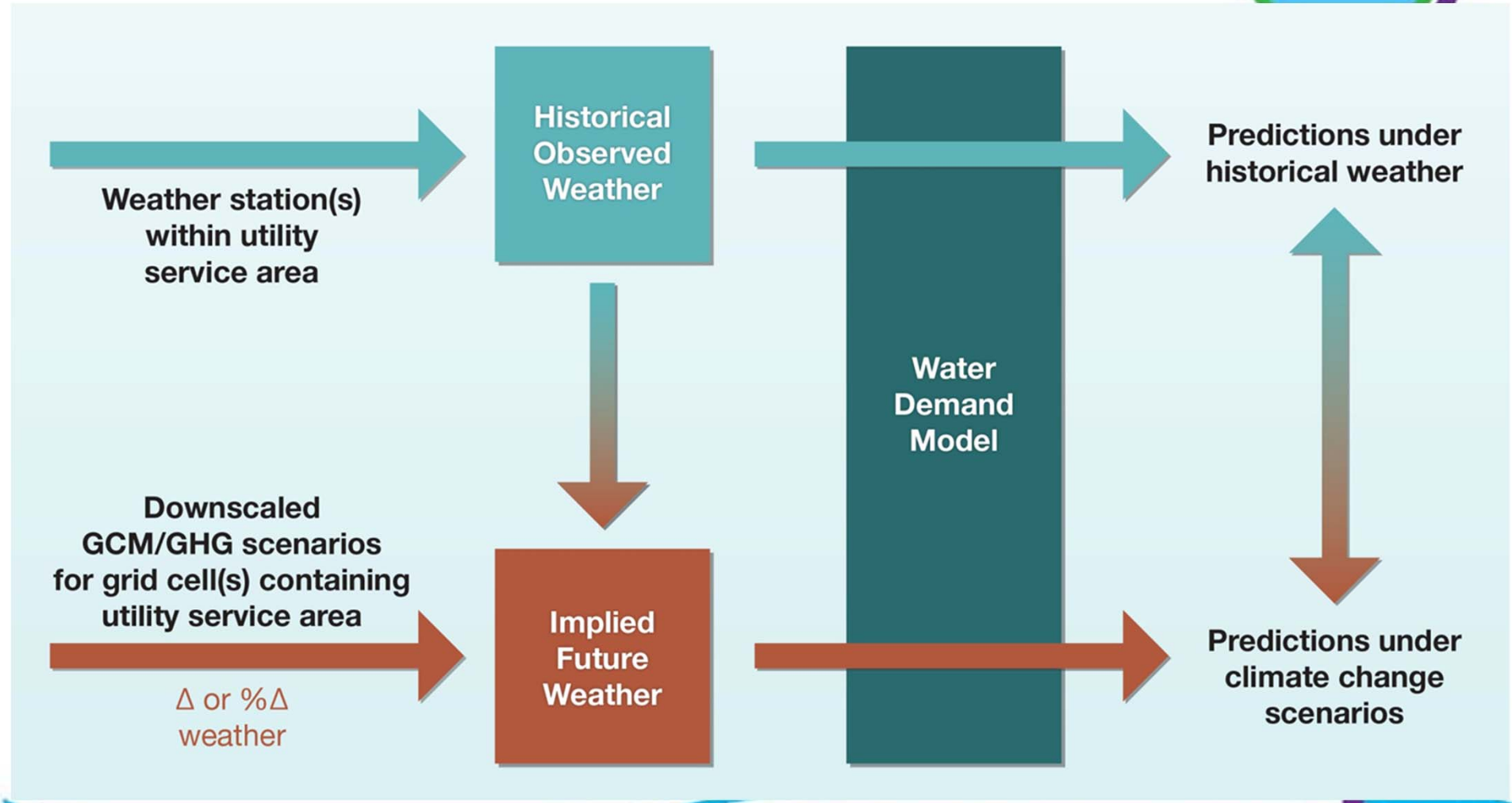
Seasonal climatic patterns explain 50% or more of inter-annual variability in demand

- Irrigation
- Cooling
- Pools
- Other



Source: Kiefer, J., Clayton, J., Dziegielewski, B., and J. Henderson. 2013. *Changes in Water Use Under Regional Climate Change Scenarios*. Denver: Water Research Foundation.

WRF 4263 Case Study Process



Source: Kiefer, J., Clayton, J., Dziegielewski, B., and J. Henderson. 2013. *Changes in Water Use Under Regional Climate Change Scenarios*. Denver: Water Research Foundation.

Summary of Mean Estimated Changes in Annual Demand

Utility	Δ Mean Estimated Demand 2055 Climate (%)		Δ Mean Estimated Demand 2090 Climate (%)	
	Min	Max	Min	Max
Colorado Springs Utilities	5.9%	23.2%	7.7%	45.0%
Durham Region (Ontario)	1.6%	4.3%	2.0%	8.3%
MWRA (Massachusetts)	1.7%	5.0%	2.5%	9.1%
SNWA (Nevada)	3.9%	9.4%	5.2%	15.5%
San Diego County	3.5%	12.7%	9.2%	23.7%
Tampa Bay Water	1.2%	5.3%	2.1%	9.9%

Source: Kiefer, J., Clayton, J., Dziegielewski, B., and J. Henderson. 2013. *Changes in Water Use Under Regional Climate Change Scenarios*. Denver: Water Research Foundation.

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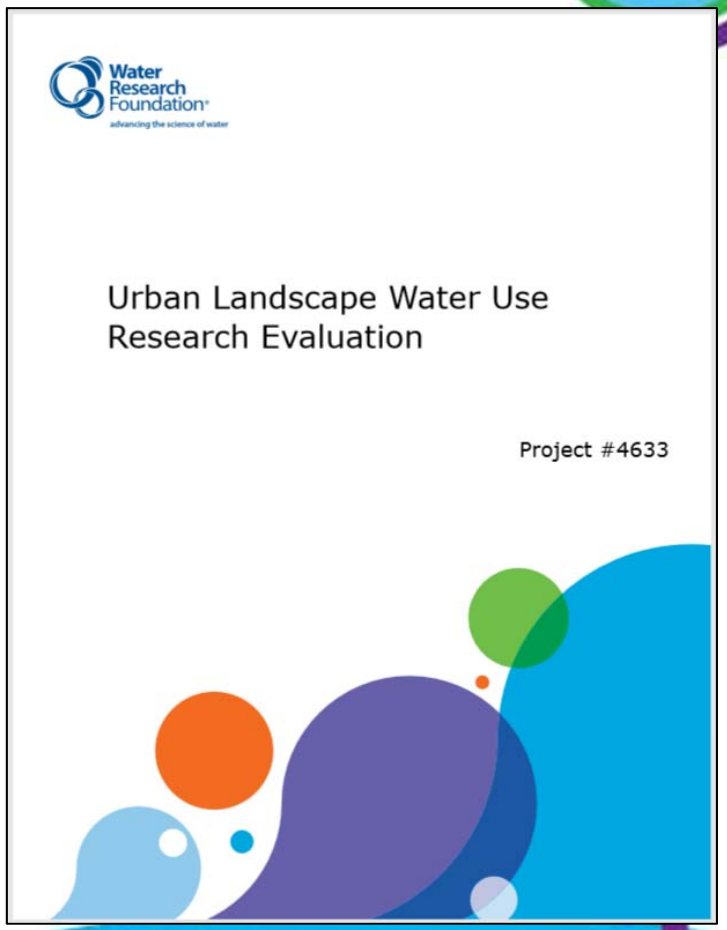
Urban Landscape Water Use

- Research needs
- Database, 650 refs tagged to 14 topics on ASU website
- Who does research, where is it published, who uses it?



sustainability.asu.edu/dcdc/publications/technical-papers/urban-landscape-water-use-research-evaluation/

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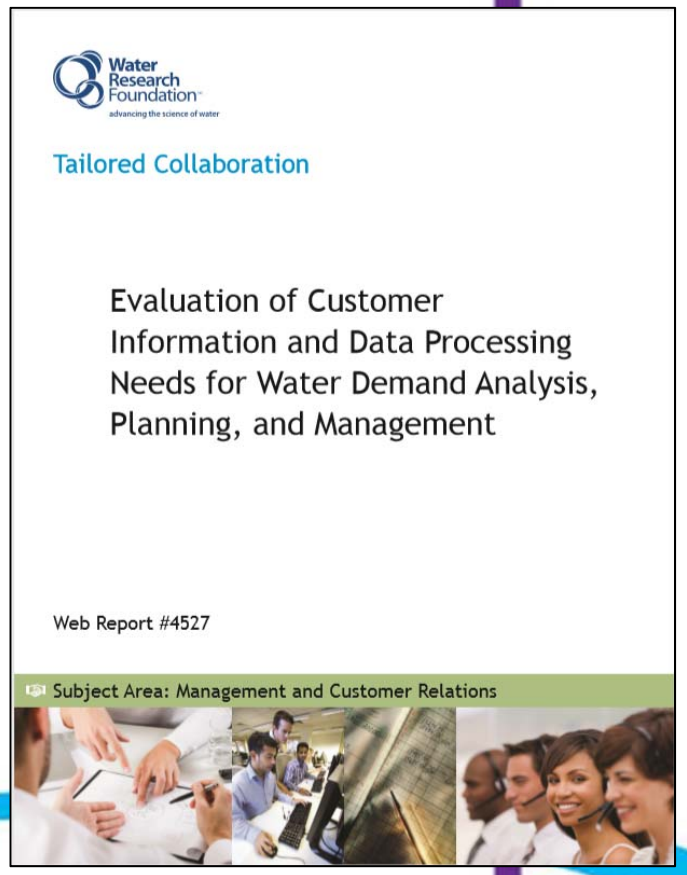
Data & Forecasting

Customer Data

Recommendations

- Develop standardized water customer classifications
- Geographically reference water customers with their unique locations.
- Historical record (10 years)



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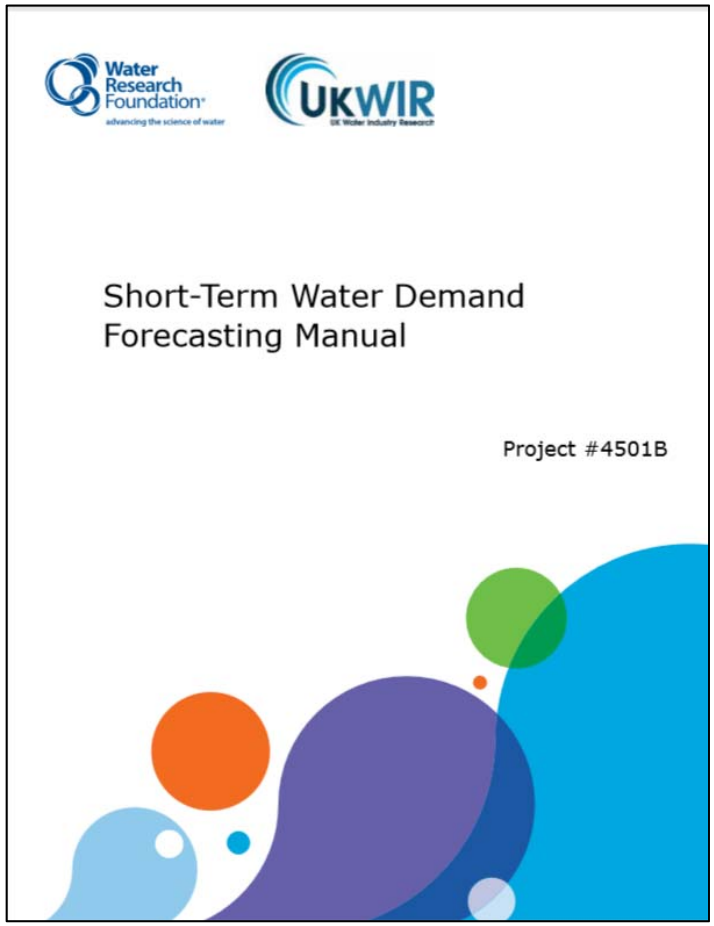
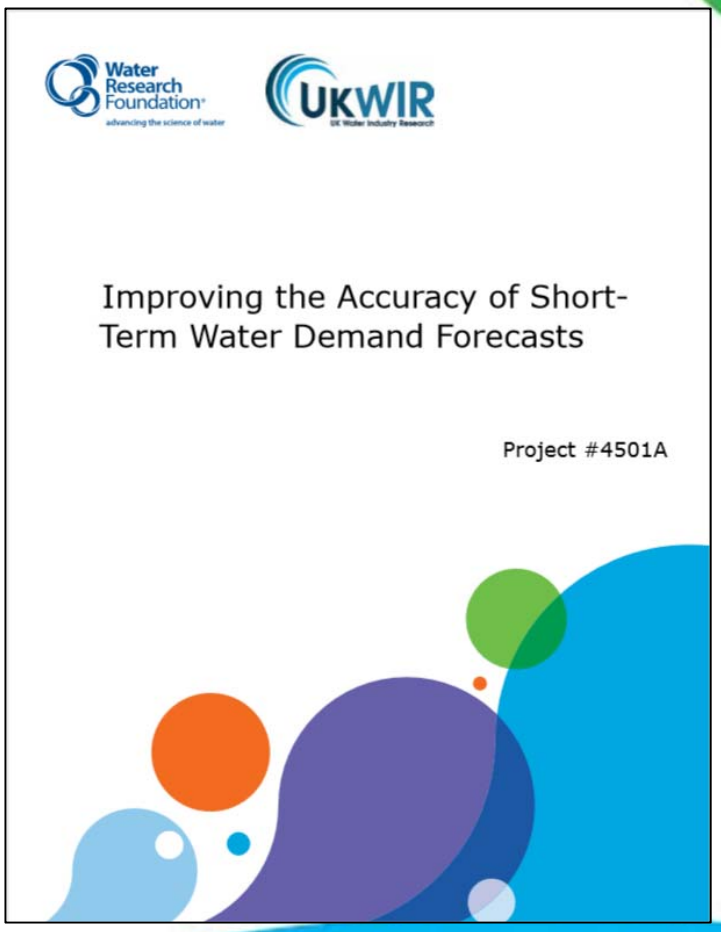
Forecasting f/ Operations & Revenue





Forecasting f/ Operations & Revenue

operational forecasting - days / weeks

- simple regression models

budgetary and revenue planning

- econometric models

Highly complex and data-intensive models not more accurate than relatively simple models

Use expert judgment, statistical techniques, good data

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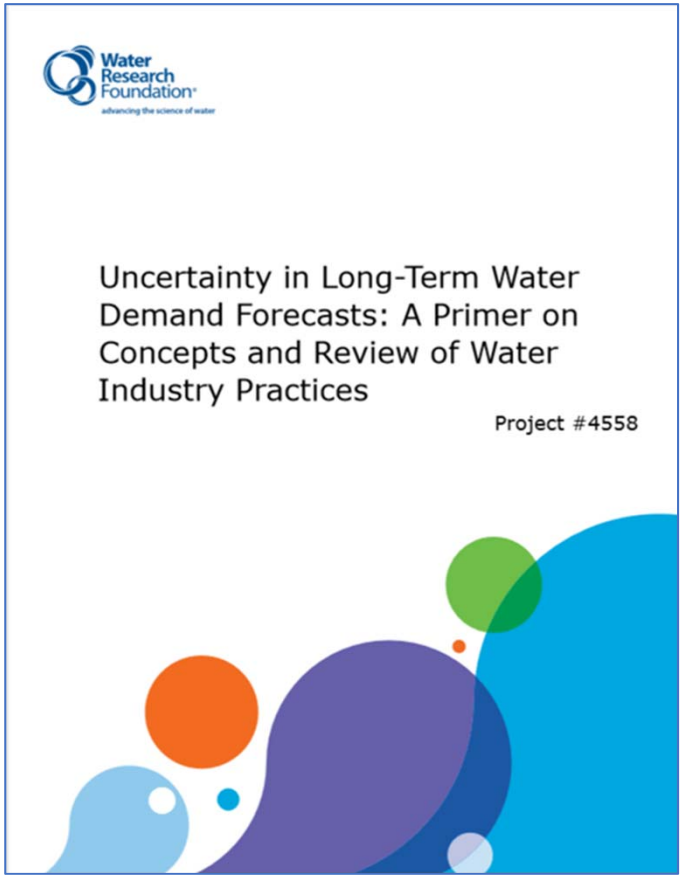
Forecasting for CIP & Supply Planning



- Scenarios
  - Capital projects - High use
  - Financial plans - Low use
- Utility actions
  - Monitor / adjust
  - Flexible projects
  - Financial innovations
- Incorporate risk
- Educate decision makers

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Forecasting – ongoing work

Long Term Water Demand Forecasting Practices for Water Resources and Infrastructure Planning - 4667

Completion Year	Research Value	Research Manager	Principal Investigator	Contractor
2020	**$345,663.00**	**Ms. Maureen Hodgins**	**Jack Kiefer**	**Hazen and Sawyer**

Probability Management for Water Finance and Resource Managers - 4742

Completion Year	Research Value	Research Manager	Principal Investigator	Contractor
2020	**$291,066.00**	**Ms. Maureen Hodgins**	**Thomas Chesnutt**	**A & N Technical Services, Inc.**

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Water Demand

Technology
Prices

Climate Change
Economic Cycles
Urban development

Slide courtesy of Jack Kiefer

Summary: Water Demand

- Improve your customer data
- Match your forecast goals to your data, resources, and approach
- Assess forecast accuracy
- Monitor water use trends & adjust
- Incorporate risk

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Use research reports

- Improve your knowledge
- Illustrate ways to analyze your own data

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