This presentation premiered at WaterSmart Innovations

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Approaches to Demand & Conservation Forecasts and Dealing with Data Gaps

Water Smart Innovations

October 5, 2017

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Agenda

- Introduction
- Background/purpose
- Case studies
- Data variables considered
- Forecasting benefits
- Concluding remarks

The Water Demand Reduction Challenge

Why are U.S. water utilities under intense pressure to reduce consumption?

- Hydrologic deficit
- Rulings by judges
- Water use reduction targets set by politicians
- Difficultly in building new supplies
- Other reasons including economics, long term changes in weather (climate) and environmental goals
- Pressure to defer expensive capital improvement projects
- State requirements for conservation planning and implementation

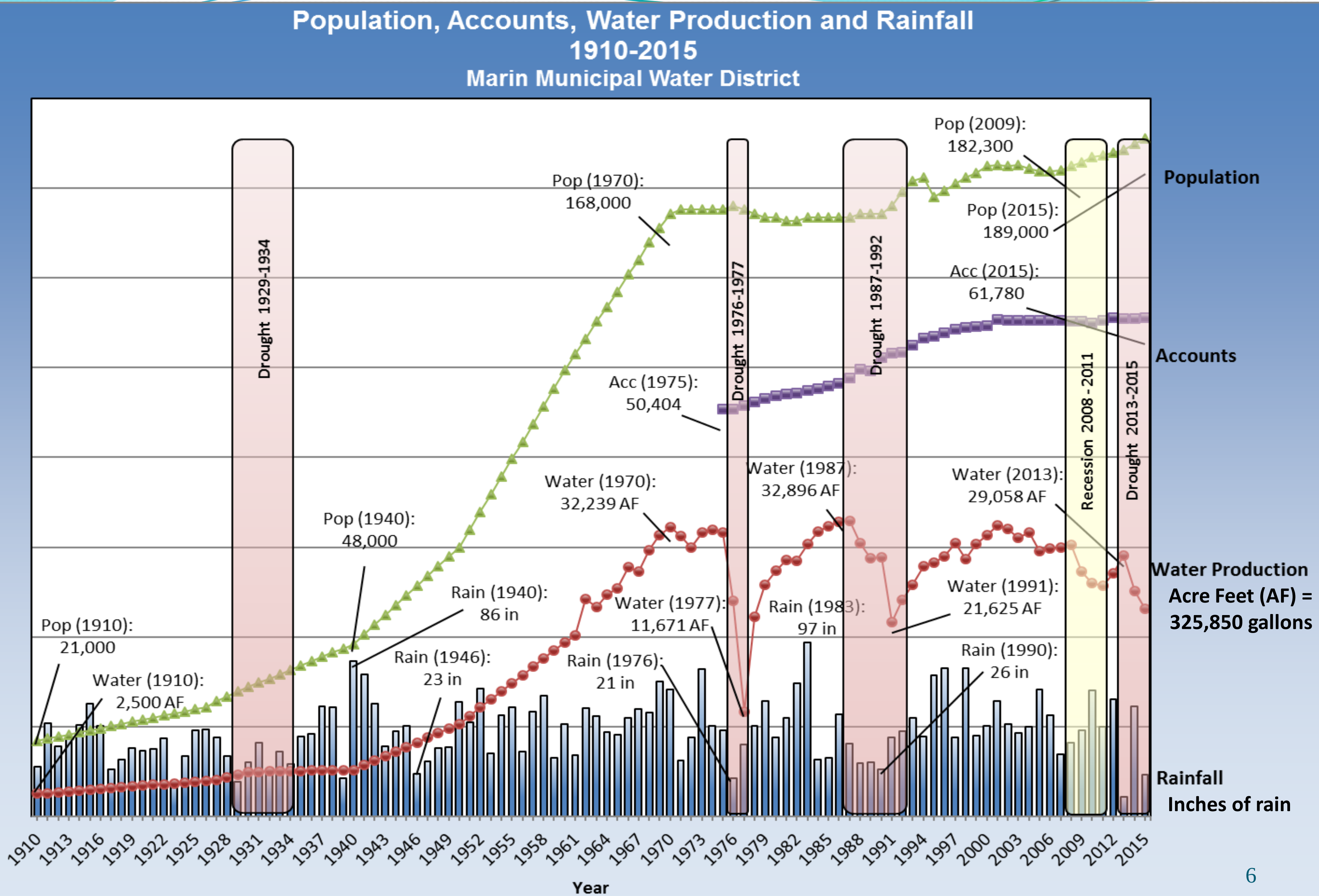
At the Same Time Dynamics in Water Demand Abound – Water Use Trends Fluctuating

- Increase or decrease in economy
- Extreme weather (droughts, floods, etc.)
- Climate change
- Water rate changes
- Water efficient devices and fixtures
- Drought restrictions and rebound
- Political changes
  - New legislation
  - Judgments/legal rulings

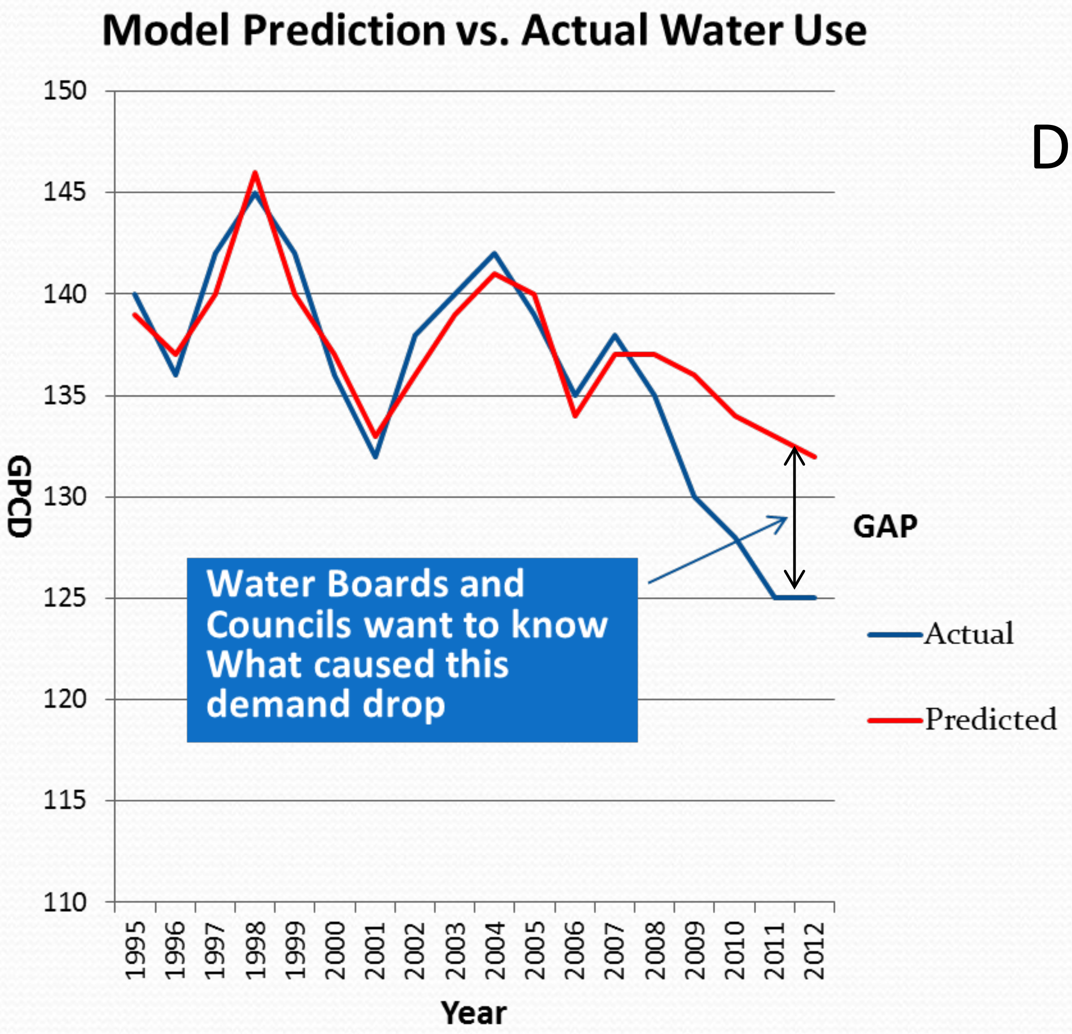
The Reality of the Last Few Years

1. Recession and/or droughts caused revenues to fall
2. Water conservation funding becomes more challenging
3. Need for creative ways to continue conservation programs
4. Need for better understanding of water demands and factors

A Look at 105 Years of Data…



Demand Forecasting: Old methods are no longer accurate



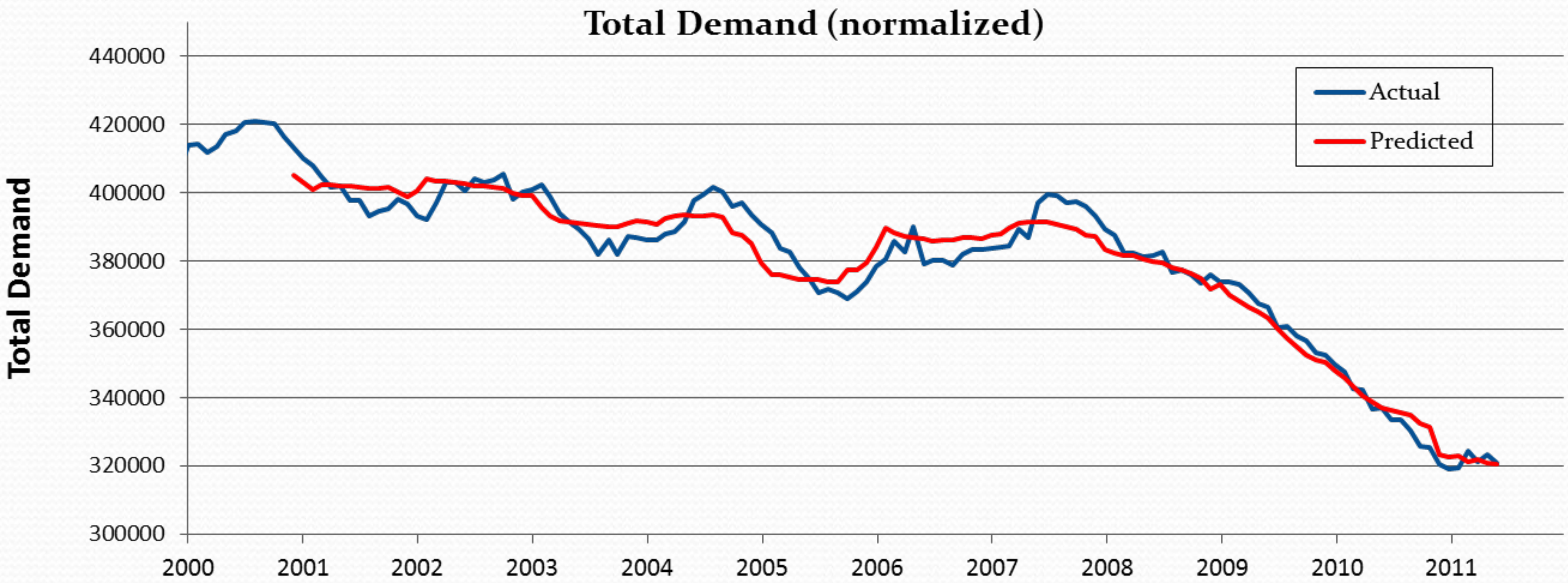
Demand Forecasting:

- Originally many forecasts were based on population or employment
- This worked well in the past, but no longer tracking water use
- Need for more detailed methods that include larger number of water demand variables

Independent Variables Evaluated in an Econometric Analysis

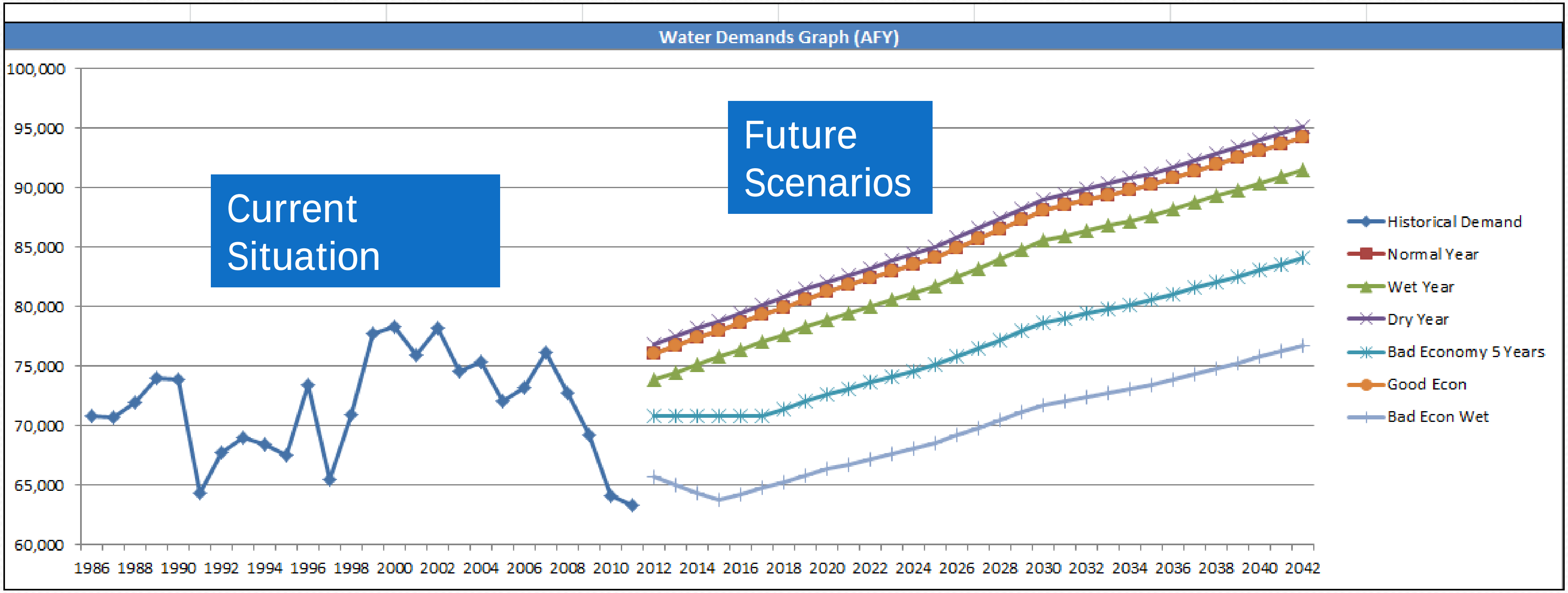
Variable Type	Variables	Units	Data Source	Comment
Weather	**Precipitation**	**Inches per month**	**NOAA Weather Data**	
Weather	**Avg Daily Max Air Temp**	**Fahrenheit**	**NOAA Weather Data**	
Weather	Avg Air Temp	Fahrenheit	NOAA Weather Data	Max temp better
Weather	Min Air Temp	Fahrenheit	NOAA Weather Data	Max temp better
Weather	Reference ETo	Inches	Not available	
Economy	# of Jobs	Jobs per capita	ABAG	Unemployment better
Economy	# of Jobs	Jobs	ABAG	Unemployment better
Economy	**Unemployment**	**Unemployment rate**	**CA EDD / BLS**	
Service Area Demographics	SF Units	Dwelling units	DOF	Insufficient variation
Service Area Demographics	MF Units	Dwelling units	DOF	Insufficient variation
Service Area Data	**Rates**	**$/HCF**	**Provided by Agencies**	
Service Area Data	**Population**	**People**	**ABAG or other selected source**	
Service Area Data	# Customers	Accounts	Agency billing data	Not favored, collinear with population
Conservation	Conservation	Conservation activity	BAWSCA WCDB	Used to convert actual GPCD to baseline GPCD

Analyzing Historical Demand w/Recession



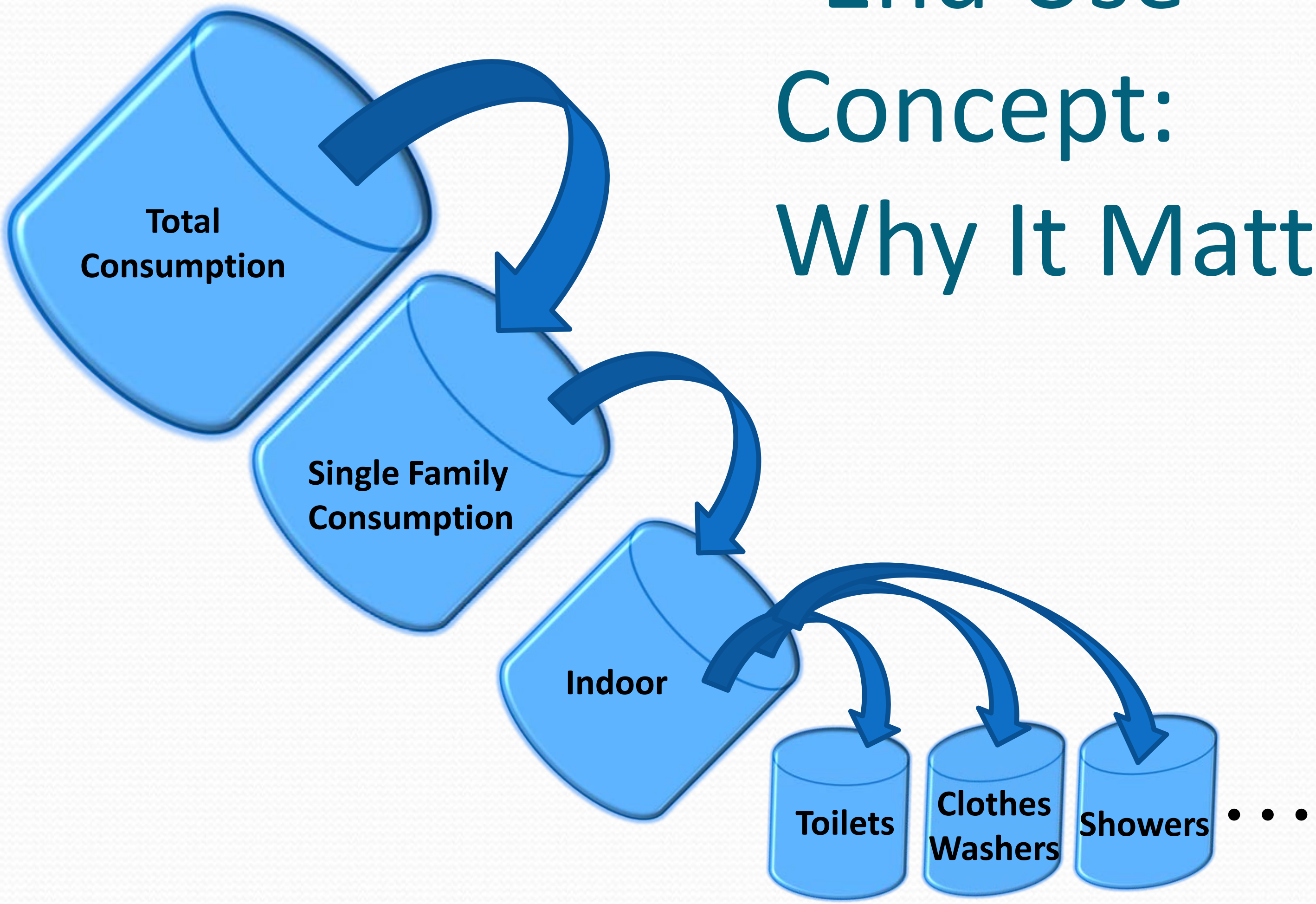
- $R^2 = 0.95$
- 13 Factors analyzed, 4 were statistically significant:
  - <u>Weather</u> – **Precipitation, Eto**, Air Temp
  - <u>Economy</u> – **Unemployment,** Employment, Household income
  - <u>Service Area Data</u> – SF/MF Housing Units, **Rates**, Population, # Accounts

Using Factors to Forecast Demand Scenarios



- Normal Year
- Wet or Dry Year
- Good or Bad Economy
- Bad Economy, Wet Year

"End Use" Concept: Why It Matters…



DSS Model – Demand & Conservation

- DSS Model created in 1999
- Updated model to make it more user friendly in 2013 and use regression data
- Used across the U.S. and internationally for hundreds of utilities
- Metric and English units
- Endorsed by the California Urban Water Conservation Council (now the California Water Efficiency Partnership)
- Based on End-Uses Verified with Billing Data

Case Studies

1. *Simplified approach*: Duck River Water Authority in Tennessee – 7 water systems for the state of Tennessee
2. *Moderate approach*: Water utilities in Utah
3. *Sophisticated approach*: Northern California utilities' econometric demand analysis (sophisticated statistics) conducted for 26 water agencies (service area population of 1.7 million people) on water demands from 1995-2013 to study the water use patterns

Tennessee Case Study – simplified approach

Duck River Water Authority in Tennessee – 7 water systems for the state of Tennessee

- **Demand forecasting trigger:** water supply becoming less reliable for region
- **Demand forecasting approach:** use recent historical water use
- **Demand drivers:** population
- **Forecasting challenges:** data gaps and inconsistency, no employment forecast
- **Benefits:** regional consensus to base regional supply infrastructure needs on
- **Next steps:**
    - data management refinement
    - conservation analysis

Duck River Watershed and Water Supply Plan Study Areas

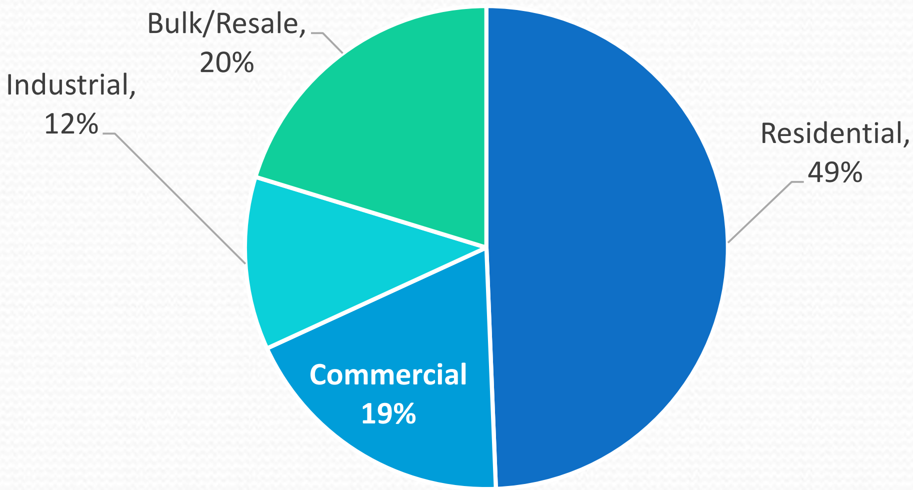
Source: O’Brien & Gere Engineers, Inc. *Duck River Comprehensive Regional Water Supply Plan*, Prepared for Tennessee Duck River Development Agency (March 25, 2011).

Data challenges – Duck River, TN

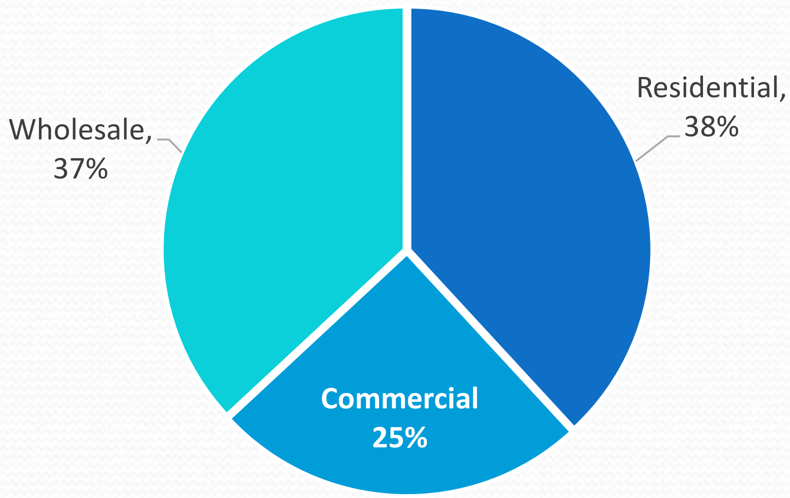
- Data challenge: water use not available by customer category for resale/bulk/wholesale categories
- Widely varying types of customers within individual customer categories.
- Minimal consistency between customer category nomenclature within region for regional planning

Challenges of Characterizing uses within Large Volume Bulk/Resale Water Categories; Duck River, Tennessee

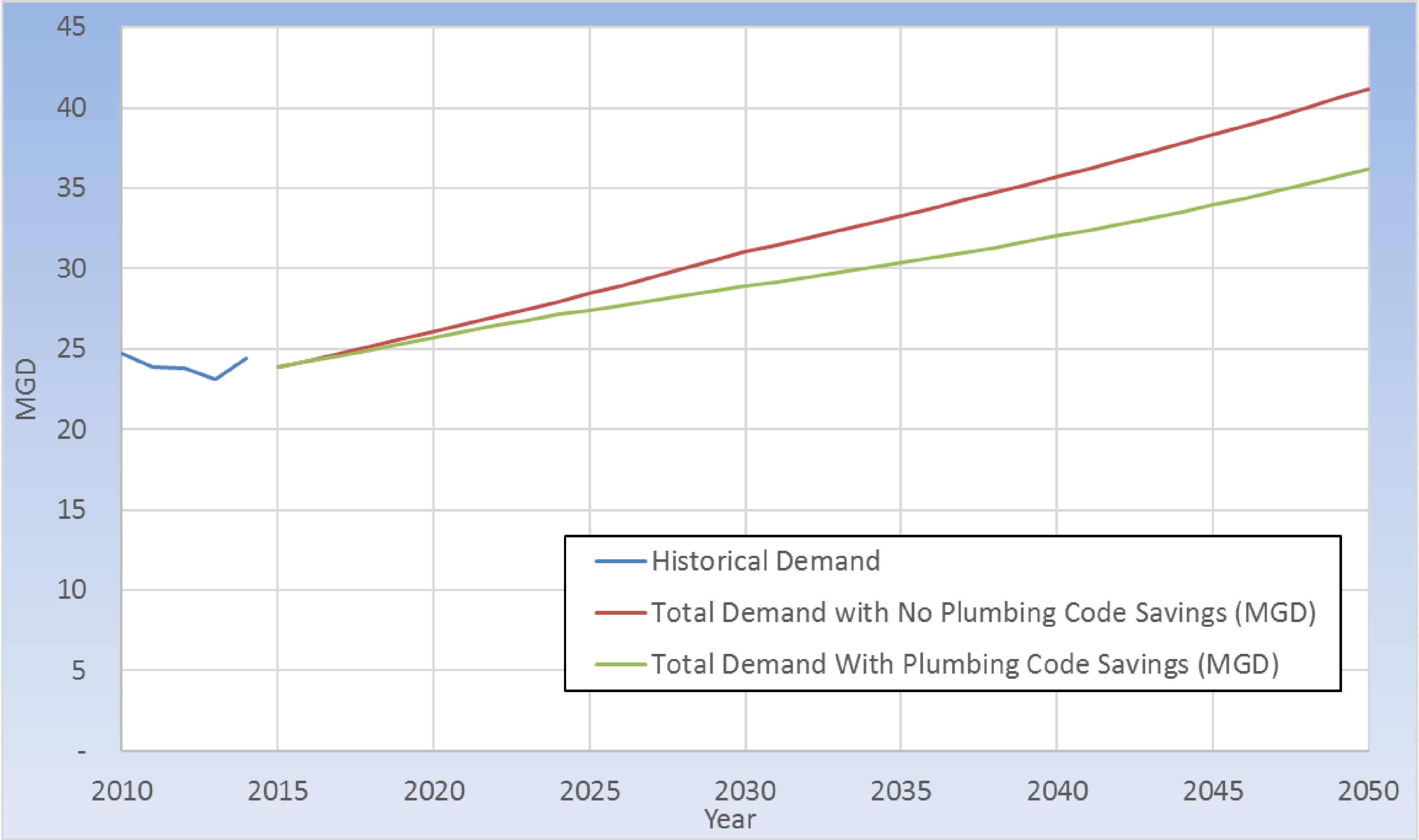
Columbia Power and Water Systems Customer Category Average Water Distribution Use Percent



Lewisburg Water and Wastewater Customer Category Average Water Distribution Use Percent



Regional Average Day Water Demands (MGD) – Duck River, TN



Utah Case Study – moderate approach

- **Demand forecasting trigger:** need to cost-effectively meet the State's goal of decreasing per capita water use 25% by 2025 and 35% by 2060
- **Demand forecasting approach:** based on continuation of recent historical per capita water use
- **Demand drivers:** population and employment
- **Forecasting challenges:** second home water use
- **Benefits:** water supply portfolio reliability
- **Next steps:**
  - customize a demand management plan and develop an implementation plan
  - foster regional cooperation
  - set budget
  - plan staffing
  - establish schedule

Project Goals and Approach – Utah

Goal – Evaluate Long-Term Water Conservation

- Consider water conservation as key part of the water supply portfolio
- How to cost-effectively meet the State's goal of saving 25% by 2025 and 35% by 2060

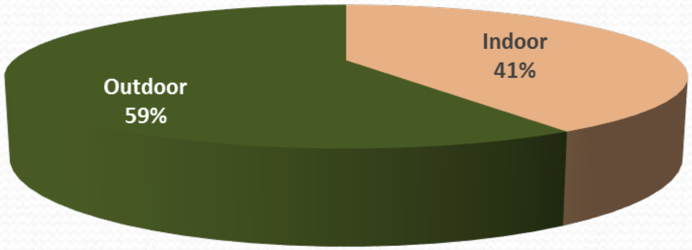
Approach

- Update and analyze historical water use data and population and demand projection forecasts
- Hold conservation measure screening to gather feedback on individual measures appropriate for the area
- Evaluate Long-Term Water Conservation Measures
  - 27 measures analyzed
  - Analyze implementation feasibility and cost effectiveness
  - Design three program options

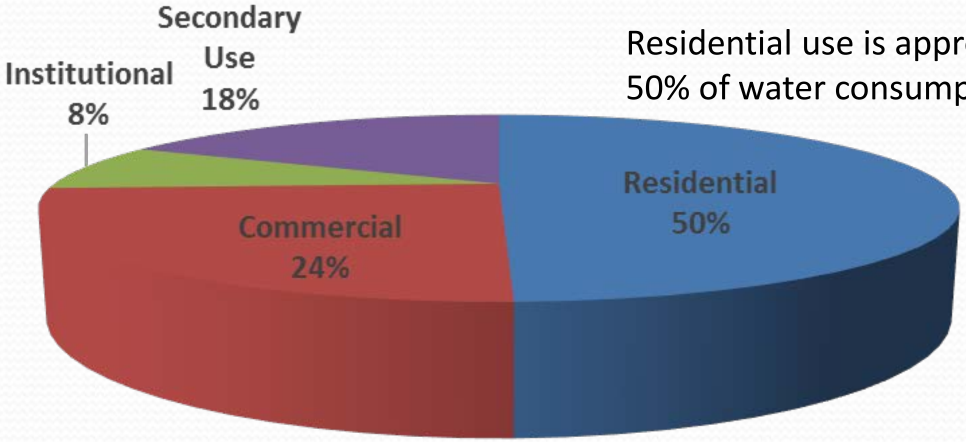
Washington County, UT Water Use – 2010

Category	Number of Accounts*	Water Consumption gpd/a	Water Consumption MGD
Single Family	32,494	589	19.13
Multifamily	1,706	1,200	2.05
Commercial	2,306	4,556	10.50
Institutional	299	11,434	3.42
Secondary Use	1	7,587,499	7.59
Total	**36,806**		**42.69**

Indoor use is approximately 41% of water consumption.



Residential use is approximately 50% of water consumption.



*Secondary use represents untreated water for outdoor irrigation use. Total value is for consumption and does not include Non-Revenue Water.

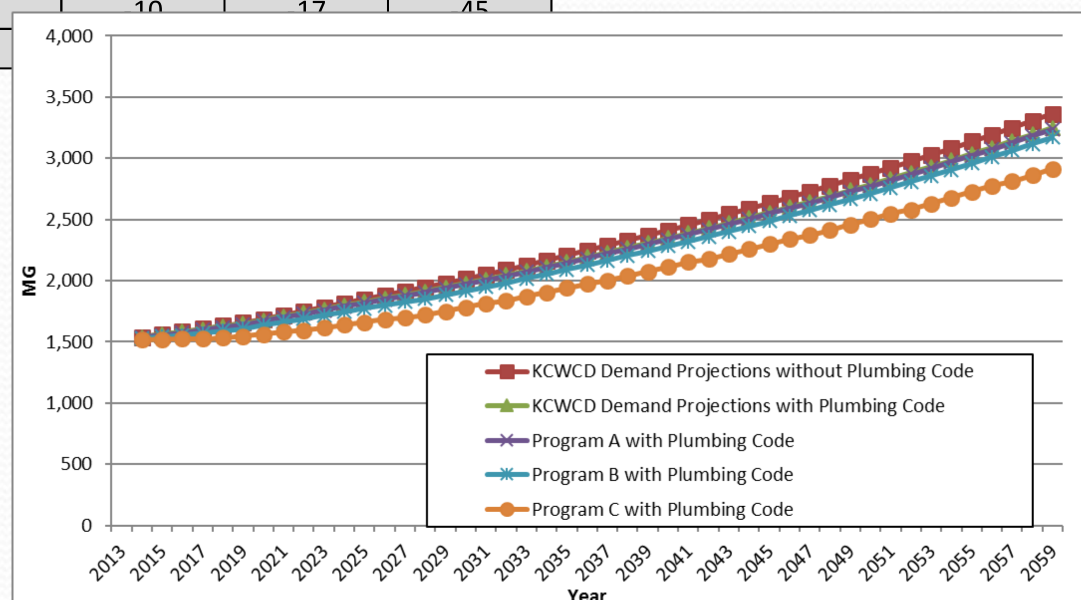
Projected GPCD Reductions & Water Demand to 2060 with Conservation

GPCD Reductions					
Year	UDWR Projections from customer category use without Plumbing Code	UDWR Projections from customer category use with Plumbing Code	Program A with Plumbing Code	Program B with Plumbing Code	Program C with Plumbing Code
2014	Baseline	Baseline	Baseline	Baseline	Baseline
2015	0	0	-1	-2	-5
2020	3	1	0	-7	-22
2025	3	-2	-2	-11	-34
2030	4	-4	-5	-14	-40
2040	4	-7	-8	-16	-43
2050	4	-9	-10	-17	-45
2060	3	-11	[illegible]	[illegible]	[illegible]

Program A = Existing program

Program B = Add additional conservation activities

Program C = All measures analyzed



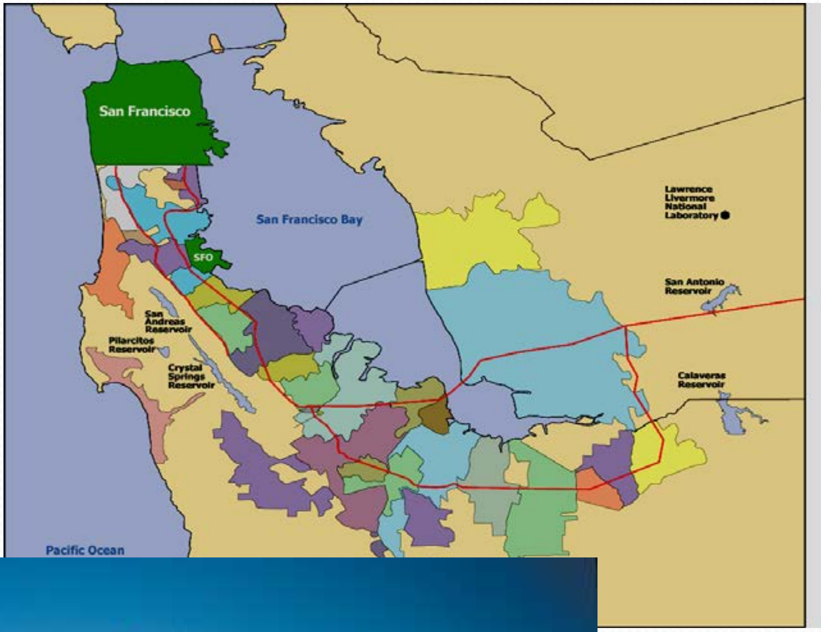
Northern California Case Study – sophisticated approach

Northern California utilities' econometric demand analysis (sophisticated statistics) conducted for 26 water agencies (service area population of 1.7 million people) on water demands from 1995-2013 to study the water use patterns.

- **Demand forecasting goal:** regional long-term water reliability
- **Demand forecasting approach:** econometric modeling
- **Demand drivers:** population and employment
- **Forecasting challenges:** multiple service areas with large change in demands due to economic downturn while active conservation and significant price increase
- **Benefits:** regional consensus with consistent methodology
- **Next steps:**
  - ongoing revisions and updates to demand forecasts - drought rebound
  - active conservation program implementation

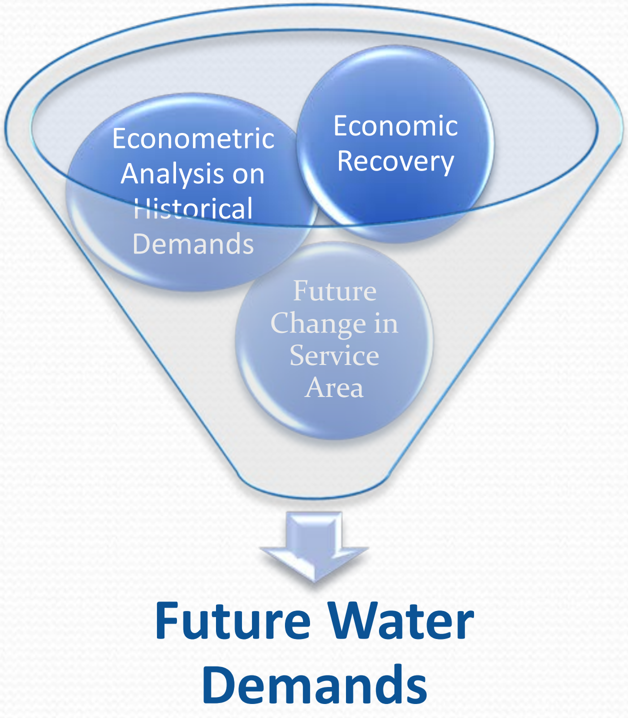
Bay Area Water Supply & Conservation Agency

- Special district representing the interests of
  - 26 cities, water districts, and water companies in San Mateo, Santa Clara, and Alameda counties
  - 1.8 million residents, over 40,000 businesses
- All rely on the San Francisco Regional Water System



Project Demand Modeling Approach

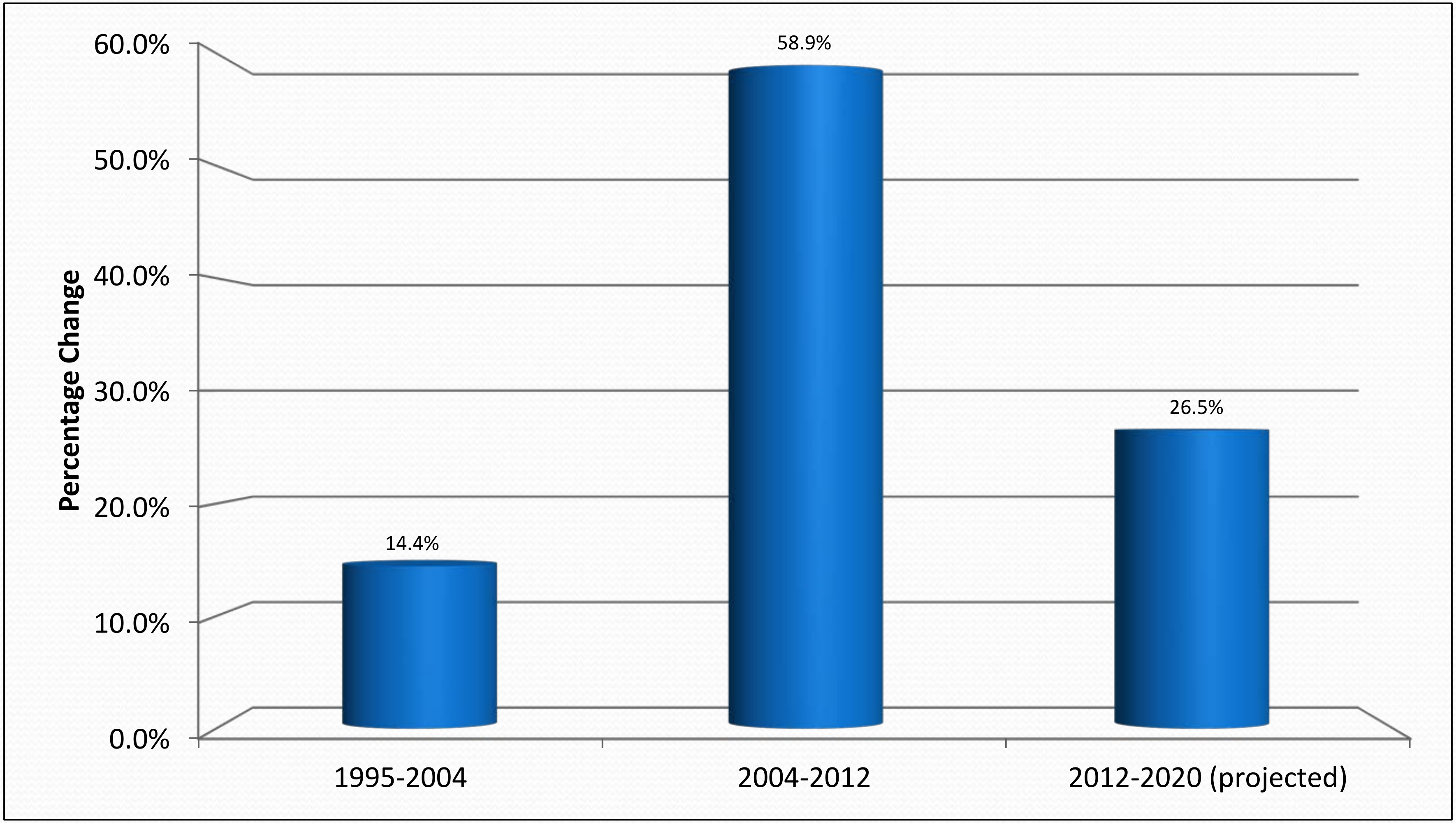
- Data was collected for 26 individual BAWSCA agencies from 1995-2013, including:
  - Water Production/Consumption
  - Pricing
  - Unemployment
  - Weather
  - Population/Employment
  - Conservation Data
- Individual model for each agency created



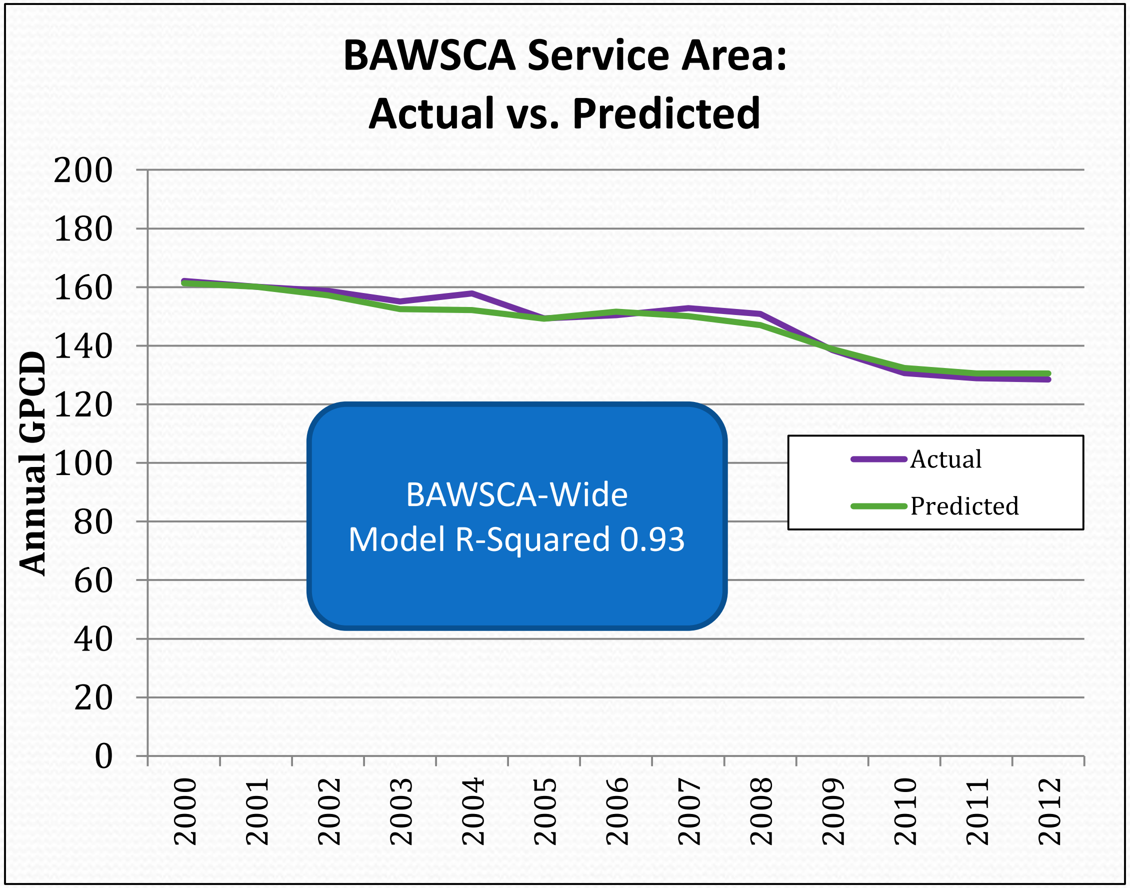
Econometric Modeling Used to Identify Factors Impacting Demands – BAWSCA

- Econometric modeling is a statistical approach used to determine the impact on water demands of factors like:
  - Economic conditions
  - Weather
  - Rates
  - Conservation
- Analysis of historical data provides helpful information for answering questions such as:
  - How much and at what rate will demand rebound as the economy expands?
  - How much will future price increases continue to depress demand?
  - How does demand respond to weather?
- R-squared: indicates the explanatory power of a statistical model
  High R-squared is good (Higher the value the better the model)

BAWSCA Econometric Models: Price Data 1995-2020

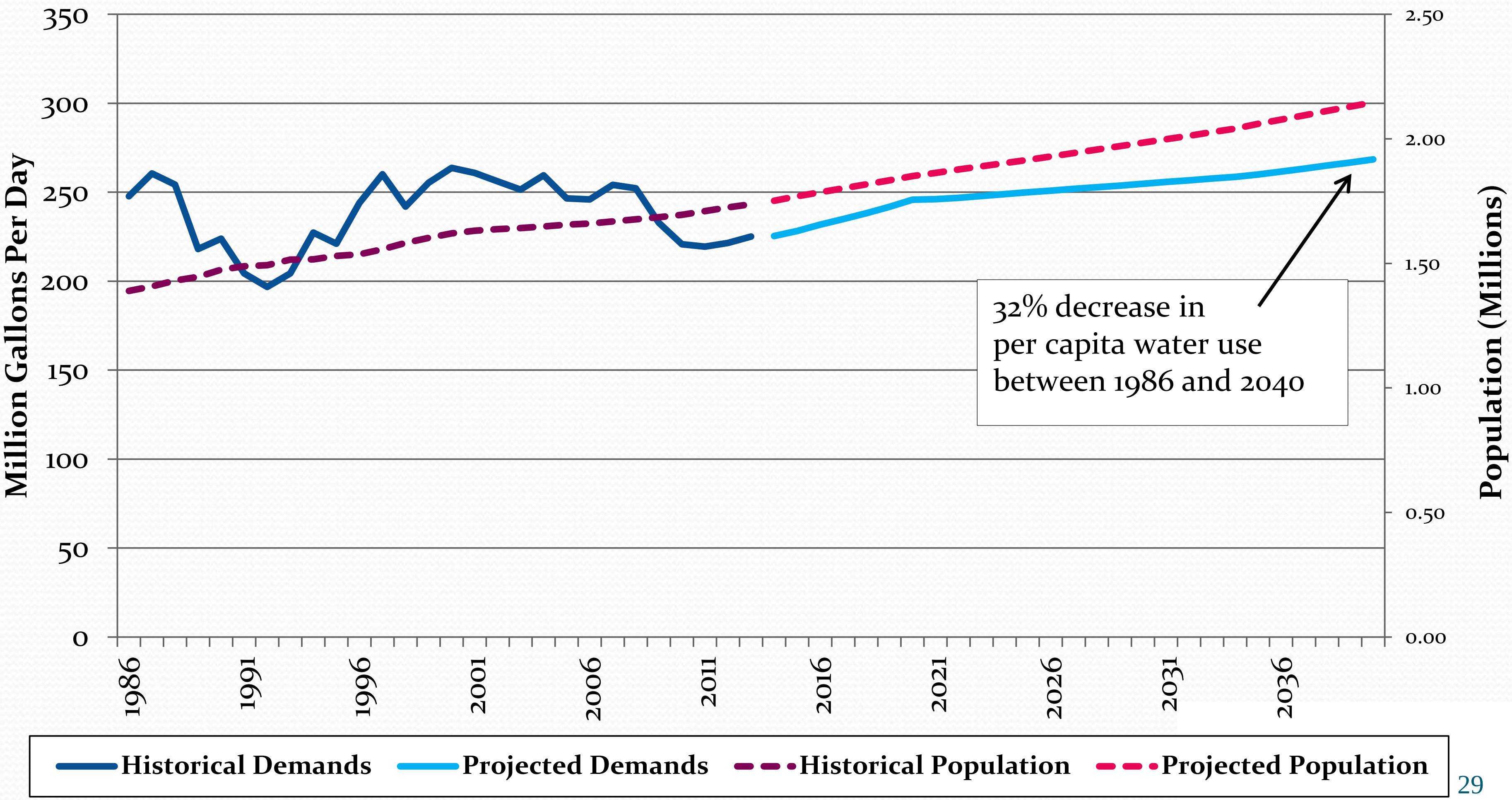


Econometric Models: BAWSCA-Wide Historical Results

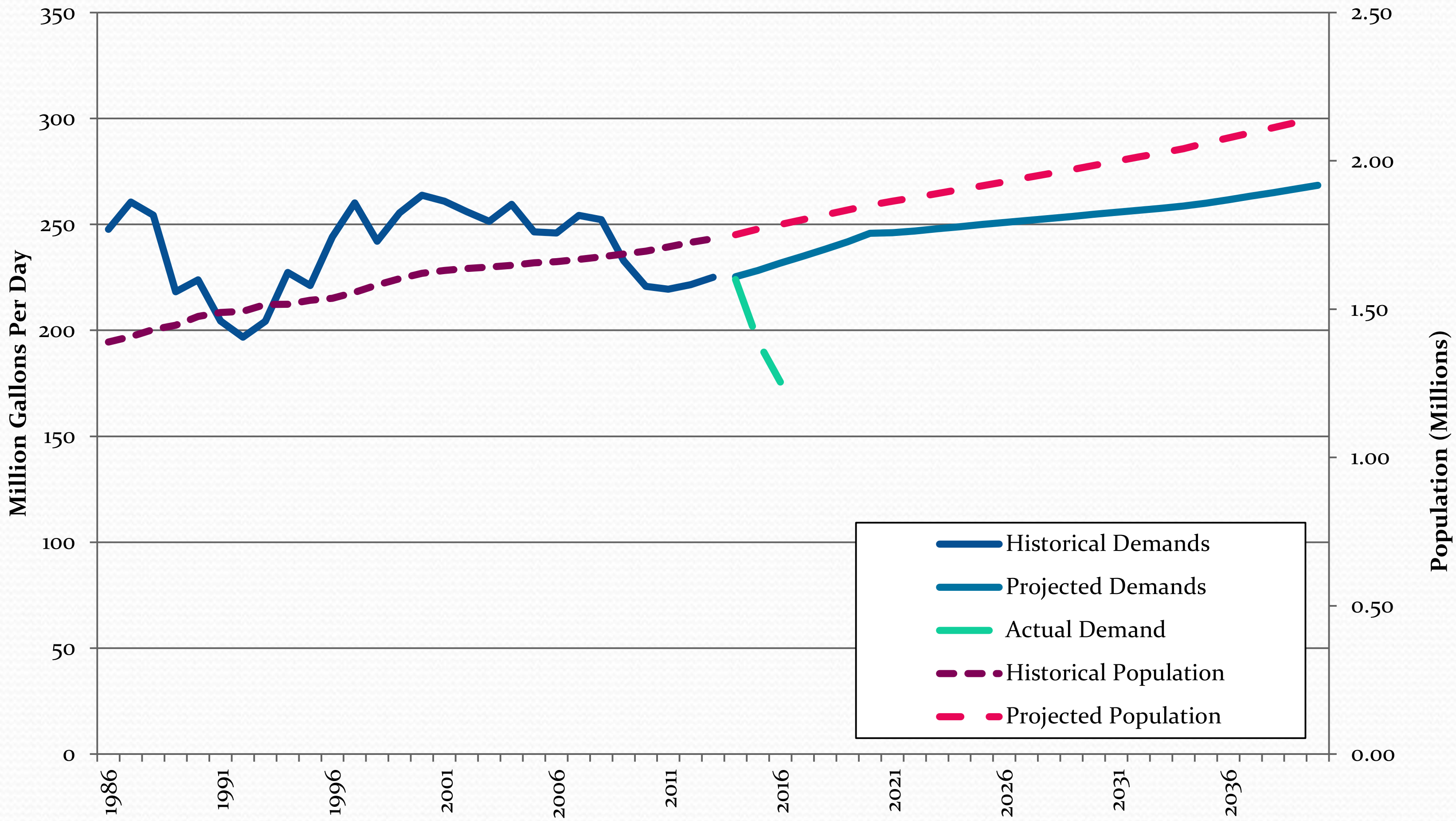


Demand Decrease from 2008-2011 BAWSCA-Wide
28% due to weather
23% due to unemployment
50% due to rates/passive/ active conservation and service area changes

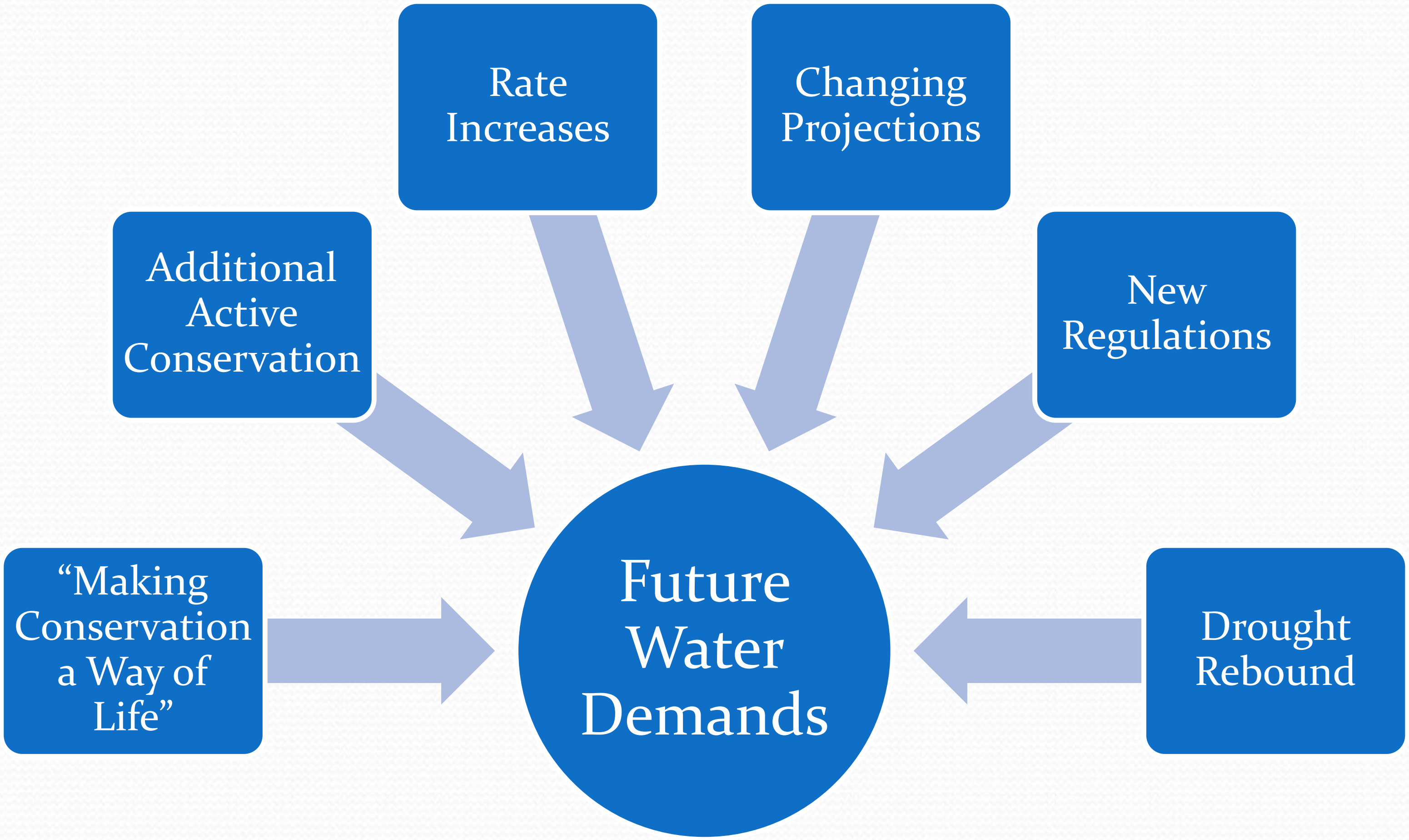
BAWSCA Projected 60% Population Increase with Only 8% Demand Increase (1986-2040)



Demand Patterns Changed Significantly During the Drought



New Considerations for BAWSCA Demand Forecasts



- Data collection underway for 2014-2017 information to be used in revised demand forecasts

Summary and Conclusions

1. New sophisticated methods are needed to deal with fluctuations in water demand and new drivers for forecasts, particularly the rebound from downturns in demands.
2. Planning and implementing programs in a declining water use and revenue environment is challenging.
3. With a good, in-depth analysis it is easier to justify spending money on conservation and hiring staff.

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