Demand Side Management Least Cost Planning Decision Support System Model - DSS

Modeling and Forecasting Working Group Workshop

January 7, 2015

Facilitated by:

Bill and Lisa Maddaus,
Maddaus Water Management, Inc.
Toby Goddard,
City of Santa Cruz

Today's Workshop Agenda

- Workshop Goals
- Background on Maddaus Water Management and City's Historical Conservation Program
- Overview of DSS Model and How it Works
- Results to Date
- Next Steps
- Open Discussion
- Summary

Workshop Goals

- Understand where the City is on Conservation
- Appreciate the Expertise Available
- Understand the Conservation Planning Tool Being Used
  - Methodology
  - Assumptions
  - Input/Output
  - Results To-Date
  - Model Demo
- Interface with other Models
- Next Steps

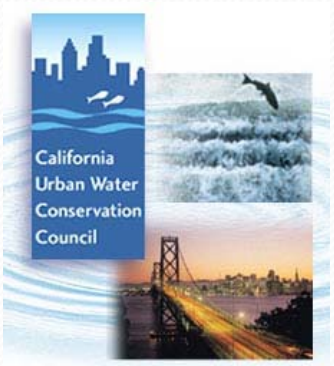
History of City's Conservation Program

- 1976-77 drought response
- Early 1980's – school, customer education
- 1986 – first dedicated Water Conservation staff
- Late 1980s to early 1990s: drought response
- 1995 – initial programs and plan development
- 2000 Long-term water conservation plan as part of IWP
- 2000-2010 plan implementation, drought response
- 2001 City becomes signatory to CUWCC
- 2011-13 Baseline survey completed, WCMP initiated

City's Current Conservation Efforts

Five categories:

- Utility operations programs
- Public information and education programs
- Residential
- Commercial, industrial, institutional (CII)
- Landscape

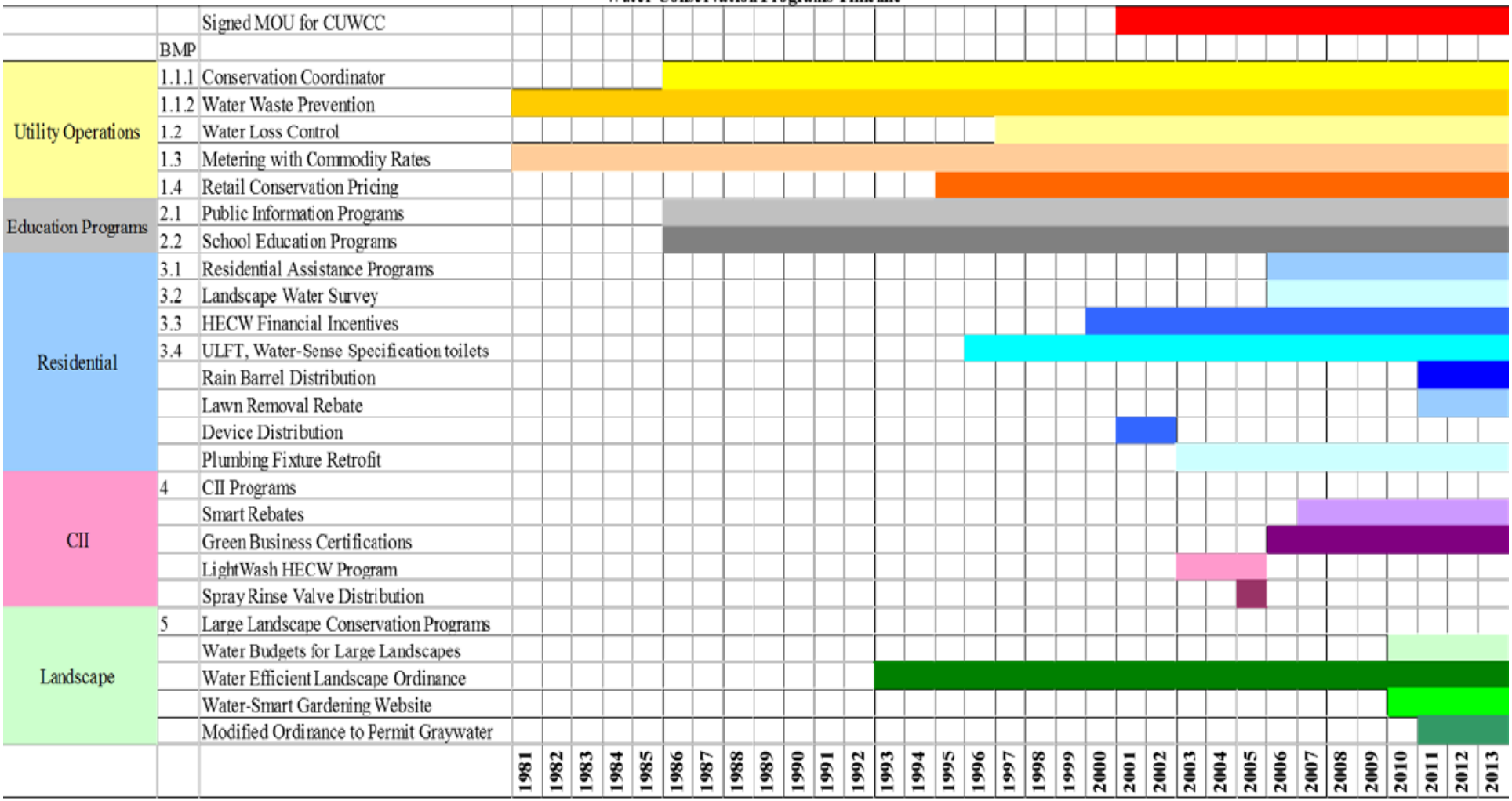


MADDAUS WATER MANAGEMENT

CITY OF SANTA CRUZ

Conservation Program Timeline

Figure 1. Water Conservation Program Timeline

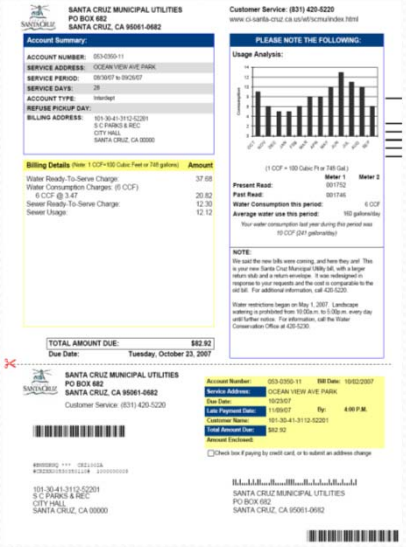


Utility Operations Programs

- Water waste prevention (1981)
  - Existing customers
  - New development
- Water loss control (1997)
- Metering with commodity rates
- Water conservation-oriented pricing (1995, 2004)

Water Waste Restrictions - In Effect at All Times:

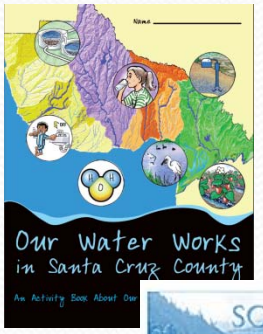
1. **No Excessive Irrigation:** Irrigating in a manner that causes or allows potable water to run off property onto sidewalks, gutters, streets, ditches, or storm drains is prohibited.
2. **Uncorrected Plumbing Leaks.** By law, a reasonable effort must be made to repair, or make arrangements for fixing, a plumbing leak within 24 hours of finding it.
3. **Hose Nozzle Required for Vehicle Washing.** Vehicles may be washed at a commercial car wash or by using a hose equipped with a shut-off nozzle.
4. **Other:** The indiscriminant running of water which is wasteful and without reasonable purpose is prohibited.

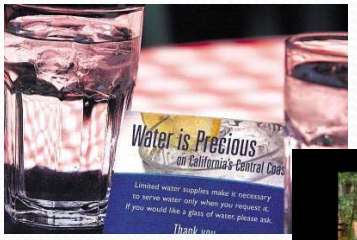


Public Information and Education

Various methods:

- Utility newsletter
- Website
- Literature
- Advertising and bill inserts
- Information on utility bills
- Distribution of free devices
- Workshops
- Regional events



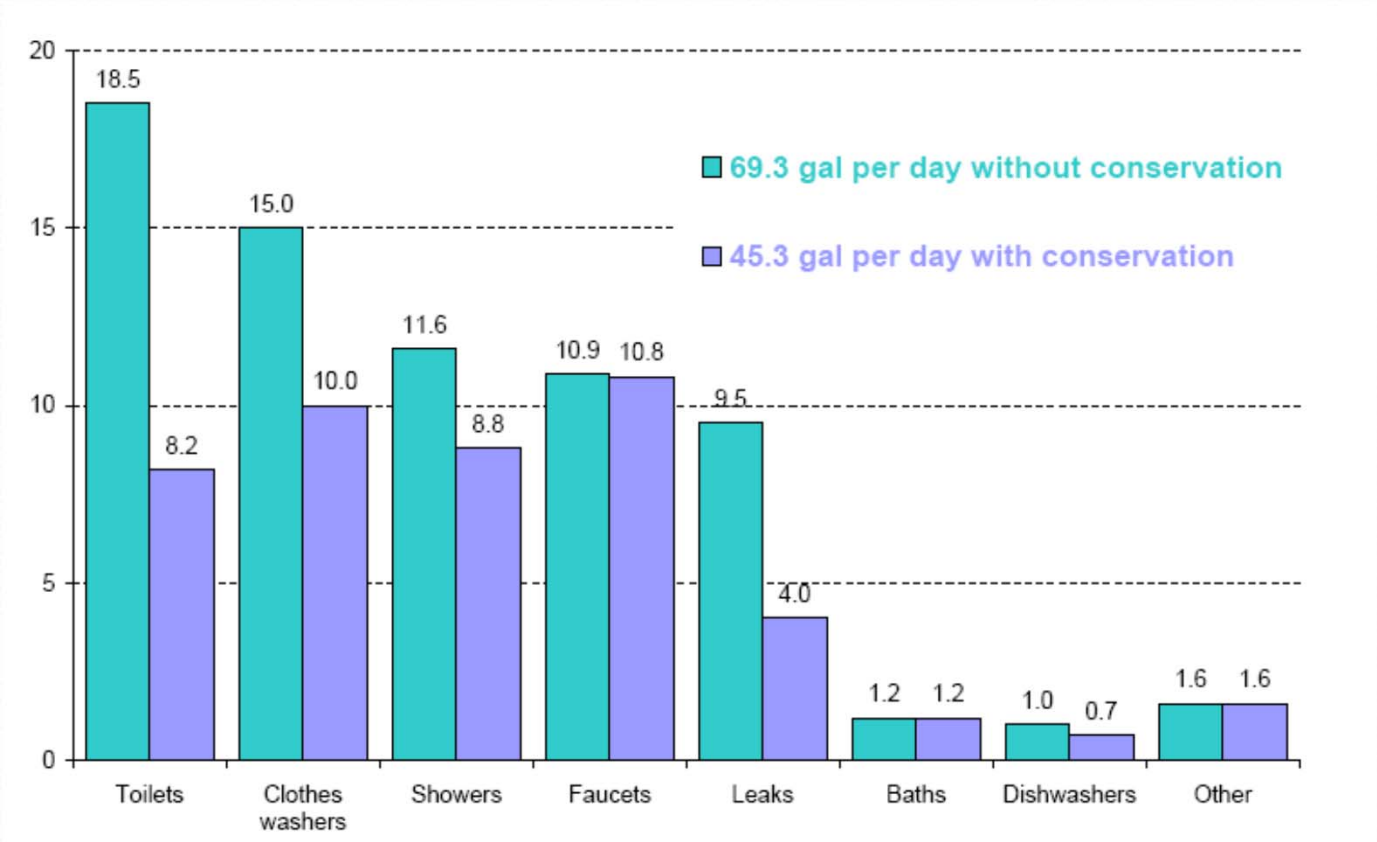


Residential Programs

- High efficiency toilet rebates (1995)
- High efficiency clothes washer rebates (2000)
- Home water audits or "surveys" for high use customers (2006)
- Plumbing fixture retrofit regulations (2003)
- Distribution of water conservation devices (2001, ongoing)

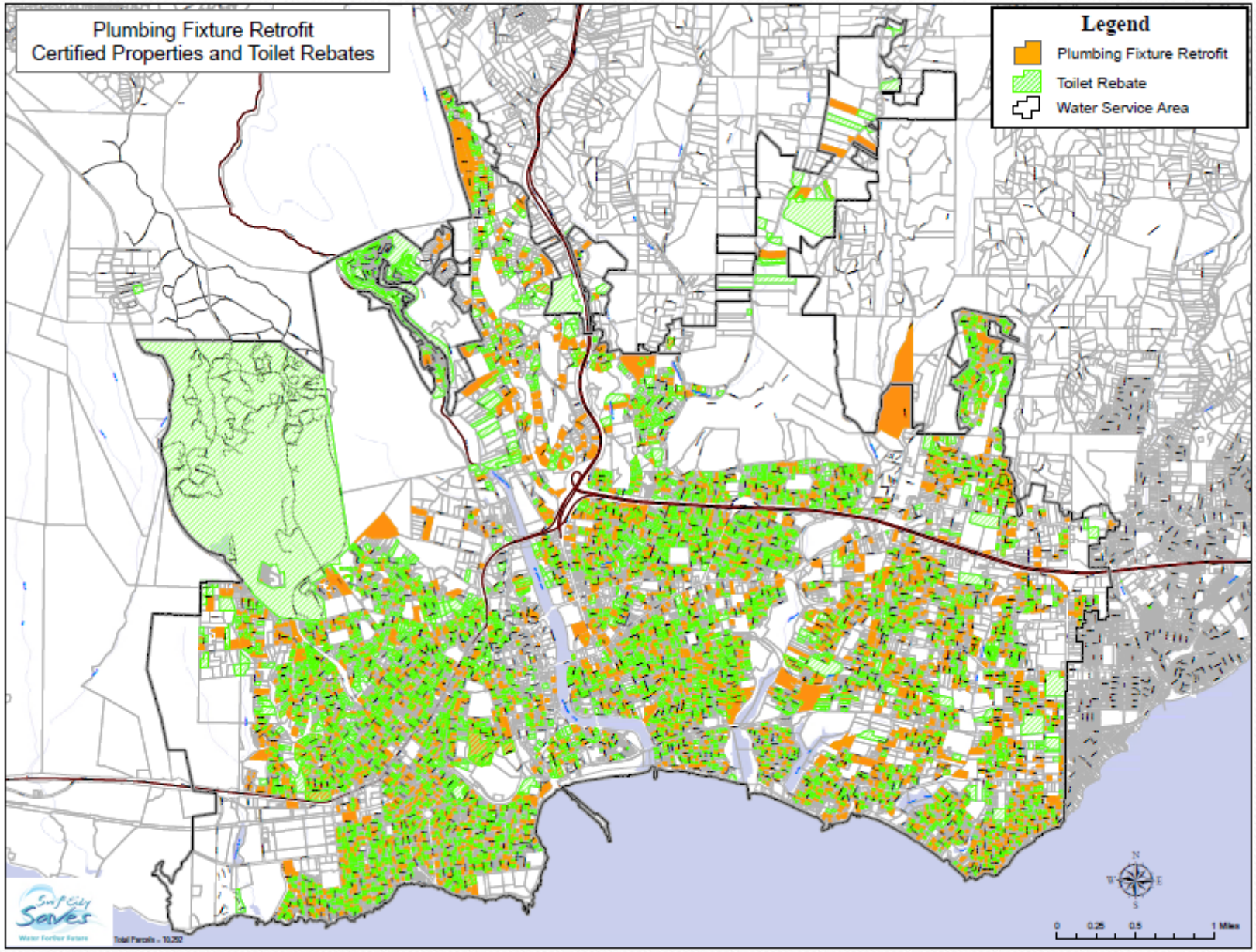
Residential Programs

Residential indoor water use (gallons/person/day):



MADDAUS WATER MANAGEMENT

CITY OF SANTA CRUZ



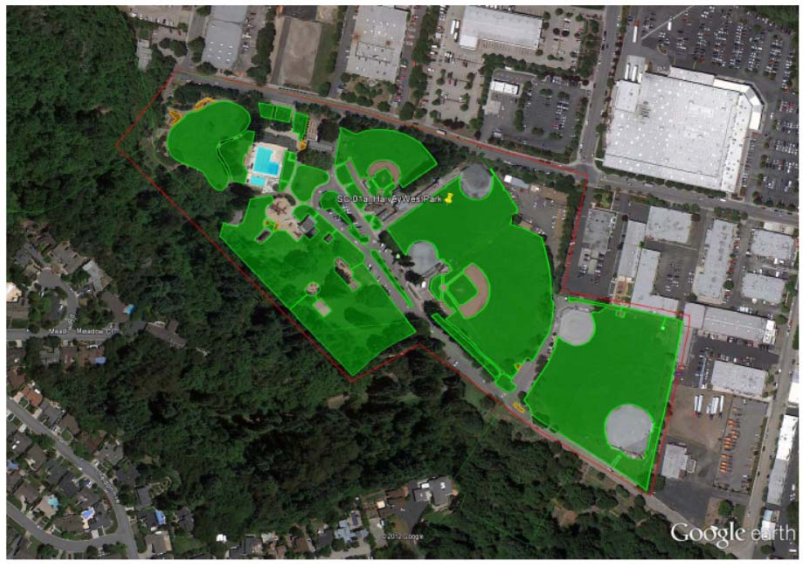
Commercial, Industrial, and Institutional Programs

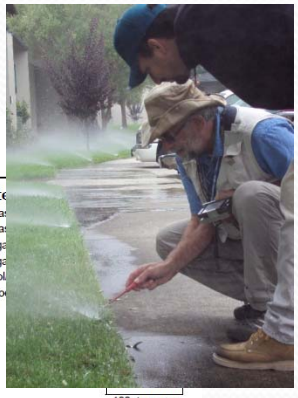
- Fixture and appliance rebate programs (1995)
- Facility audits (2006)
- Retrofit regulations (2003)
- Smart Rinse (2005)
- Light Wash (2003)
- UC Santa Cruz

Landscape Programs

- Landscape standards for new development (1993, 2010)
- Water-Smart Gardening (2009)
- Workshops/certification
- Water budgets and large landscape water audits (2010)
- Rain barrel sales (2011)
- Updated gray water standards
- Lawn removal rebates (2010)

Landscape Programs





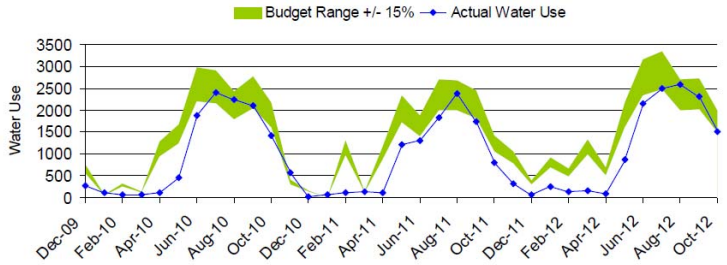
Landscape Water Use Report

Prepared For:
Site Name: HarveyWestPark
Main Contact: Meta Rhodeos
Landscape Firm:
Other Contacts: Dave Rosener

Acct# and Service Address:
027-02950-011; 0 Harvey West @ Dubois
027-02999-001; 300 Evergreen St
027-03400-011; 0 Harvey West Annex
027-03500-011; 0 Evergreen St
027-03505-011; 0 Harvey West Park
027-03520-011; 0 Harvey West Lit Lge

CITY OF SANTA CRUZ
HARVEY WEST PARK
809 CENTER ST RM 101
SANTA CRUZ CA 95060-3826

Water Use History

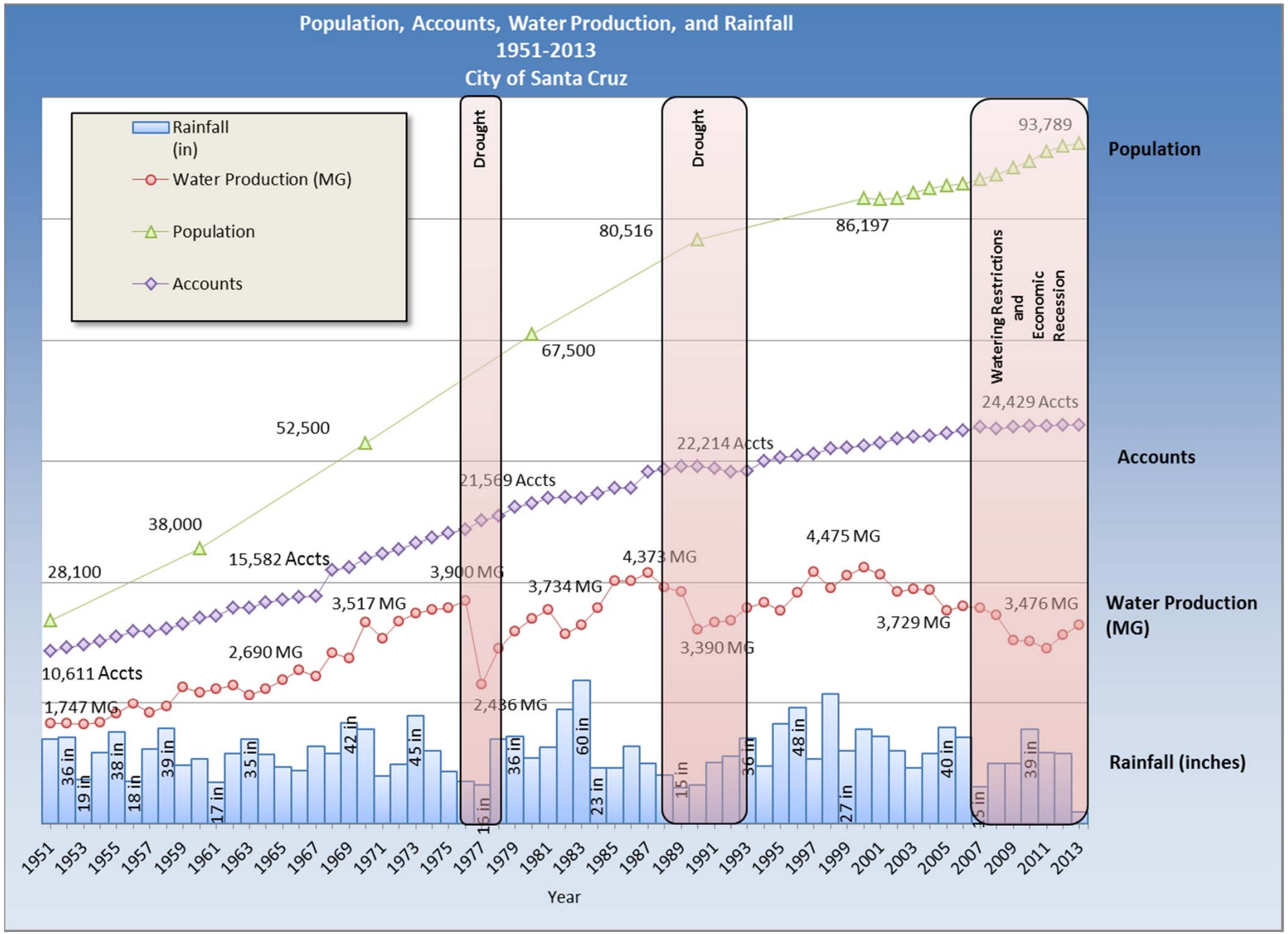


Savings Potential	Last Month	Last 12 Months	Last 24 Months	Last 36 Months
Over Water Ccf	0	244	614	805
Over Water %	0%	2%	3%	2%
Dollars Lost $	$0	$975	$2,458	$3,219

Read Date	Actual Water Ccf	Budget Water Ccf	Over Water Ccf	Over Water %	Weather ETo-Rain Inches
10/9/2012	1,502	1,739	0	0%	3.48
9/10/2012	2,317	2,373	0	0%	4.75
8/10/2012	2,592	2,348	244	9%	4.70
7/11/2012	2,486	2,898	0	0%	5.80
6/11/2012	2,158	2,743	0	0%	5.49
5/11/2012	865	1,881	0	0%	3.77
4/11/2012	96	591	0	0%	1.19
3/13/2012	161	1,153	0	0%	2.31
2/10/2012	135	572	0	0%	1.15
1/11/2012	253	799	0	0%	1.60
12/12/2011	74	347	0	0%	0.70
11/10/2011	324	908	0	0%	1.82

Messages

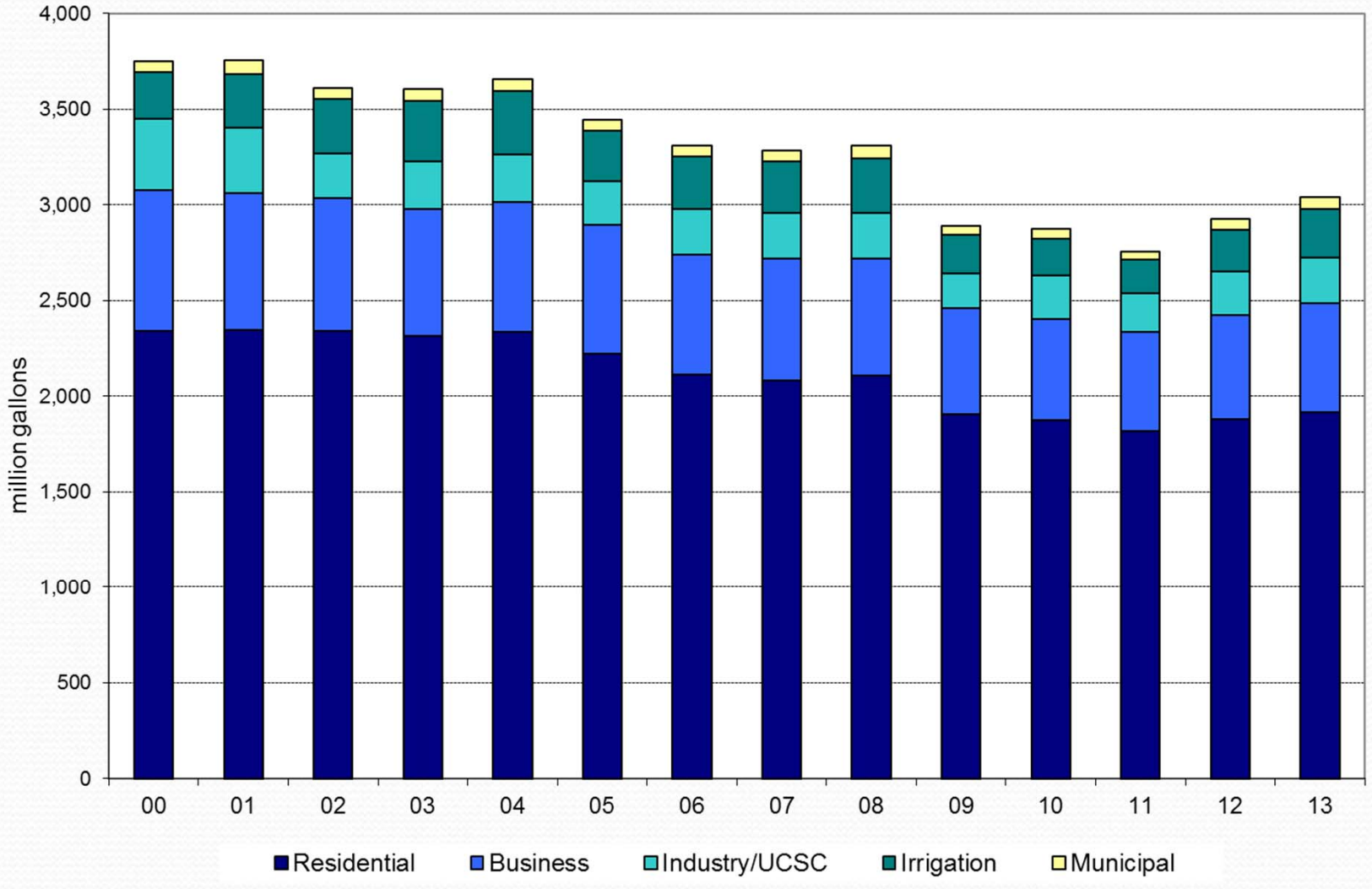
- 181 sites
- 16.5 million sq. ft.
- 265 million gallons/yr


Population, Accounts, Water Production, and Rainfall
1951-2013
City of Santa Cruz
Rainfall (in)
Water Production (MG)
Population
Accounts
Drought
Drought
Watering Restrictions and Economic Recession
93,789
86,197
80,516
67,500
52,500
38,000
28,100
24,429 Accts
22,214 Accts
21,569 Accts
15,582 Accts
10,611 Accts
4,475 MG
4,373 MG
3,900 MG
3,734 MG
3,517 MG
3,476 MG
3,729 MG
3,390 MG
2,690 MG
2,436 MG
1,747 MG
Population
Accounts
Water Production (MG)
Rainfall (inches)
Year

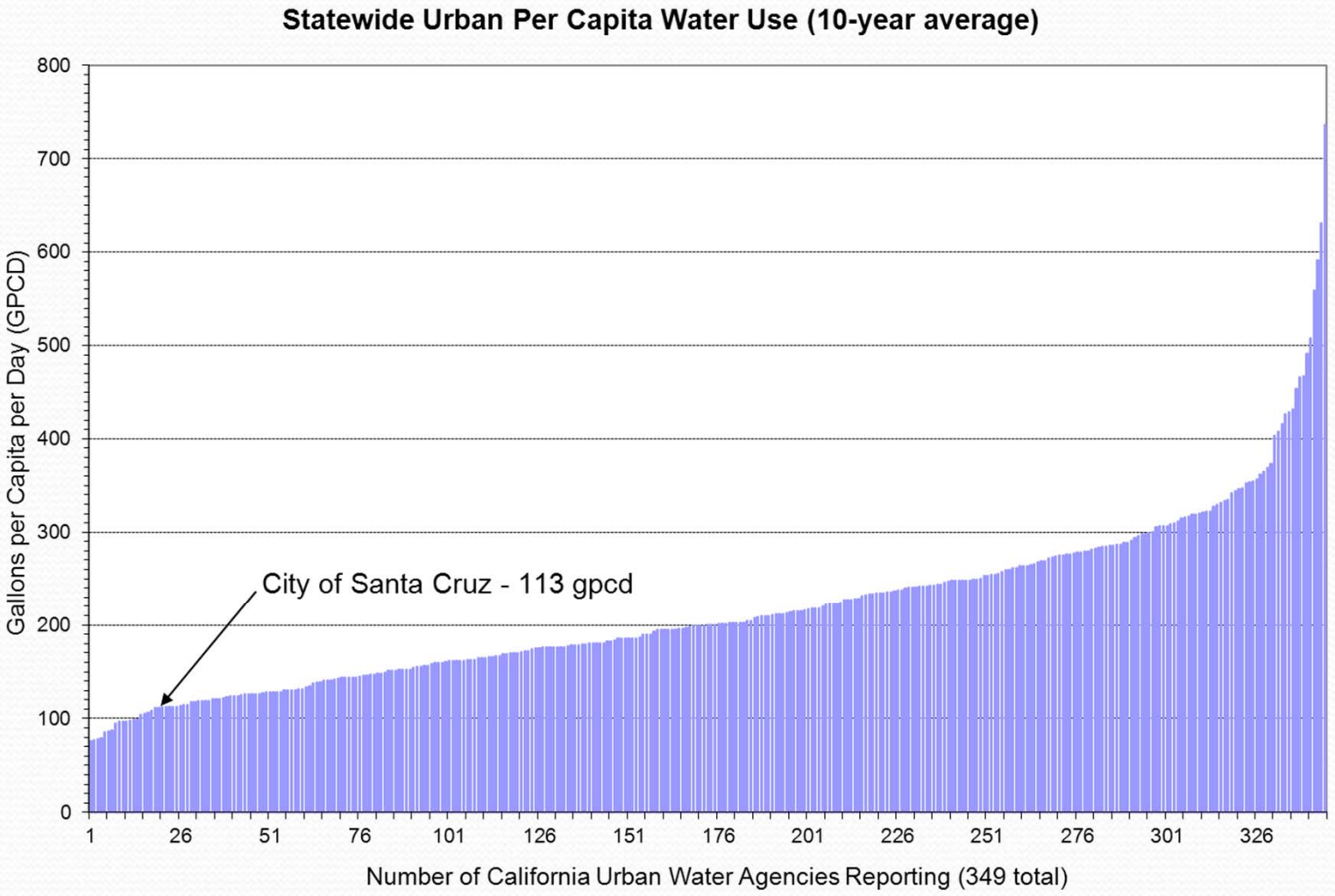
MADDAUS WATER MANAGEMENT

CITY OF SANTA CRUZ

Recent Water Use Trends



Per Capita Water Use

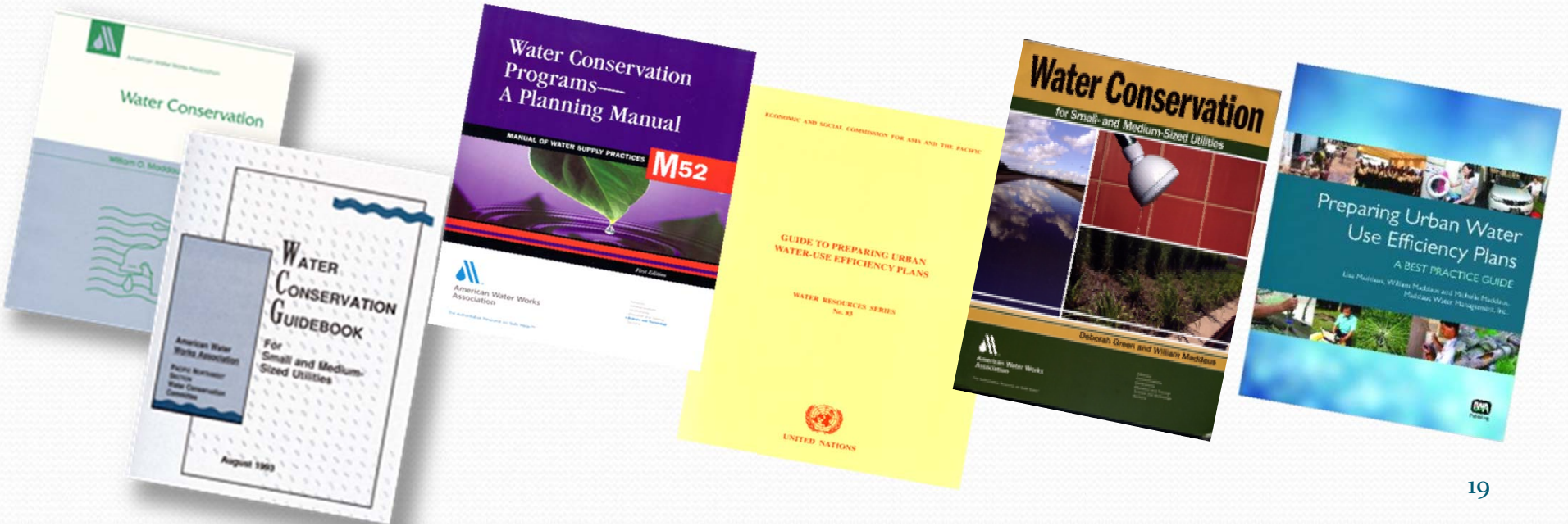


How much potential remains in the residential, commercial, and landscape sectors?

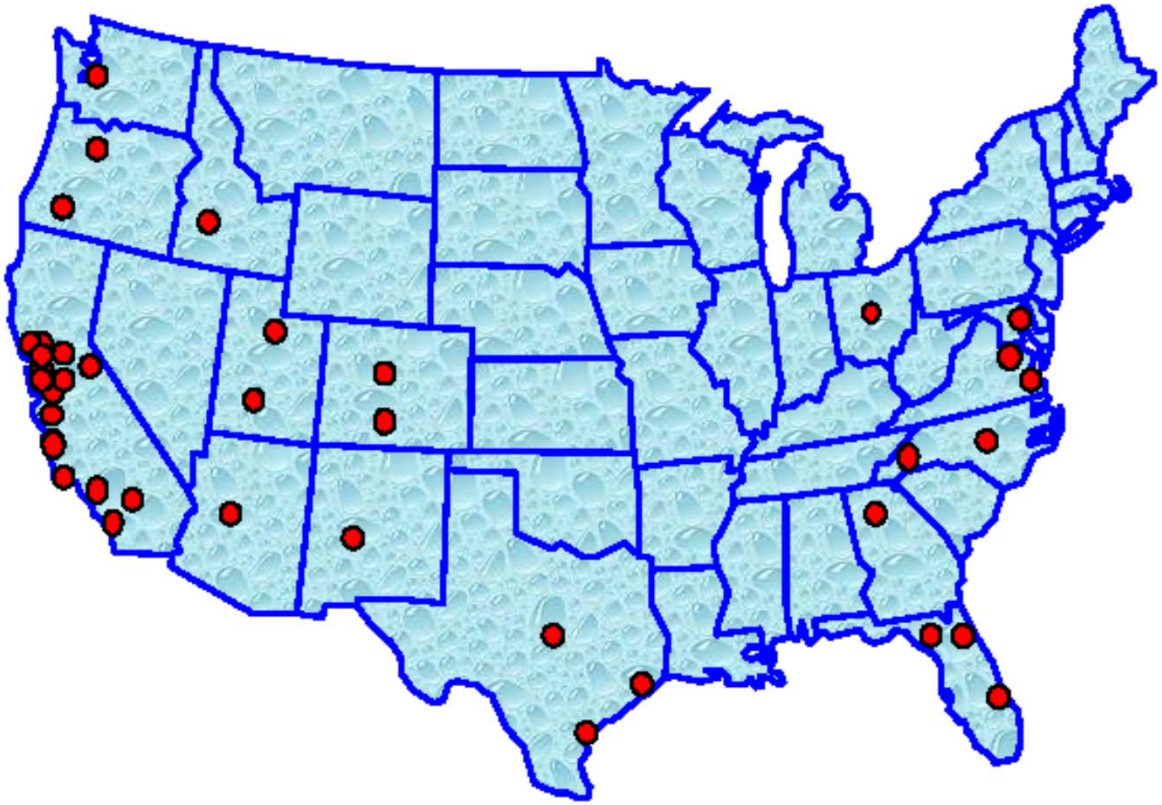
Preliminary Results Water Use Baseline Survey		
	SFR	MFR
Toilets	90%	91%
Showerheads	92%	98%
Bathroom Faucets	90%	82%
Kitchen Faucets	71%	82%
Clothes Washers	63%	46%

Maddaus Water Management, Inc.

- Hired MWM, whom has written nearly all the hallmark conservation planning guidance over the past three decades
- MWM has completed more than 250 Water Conservation Plans in the past 20 years.



Location of Maddaus' Conservation Plans



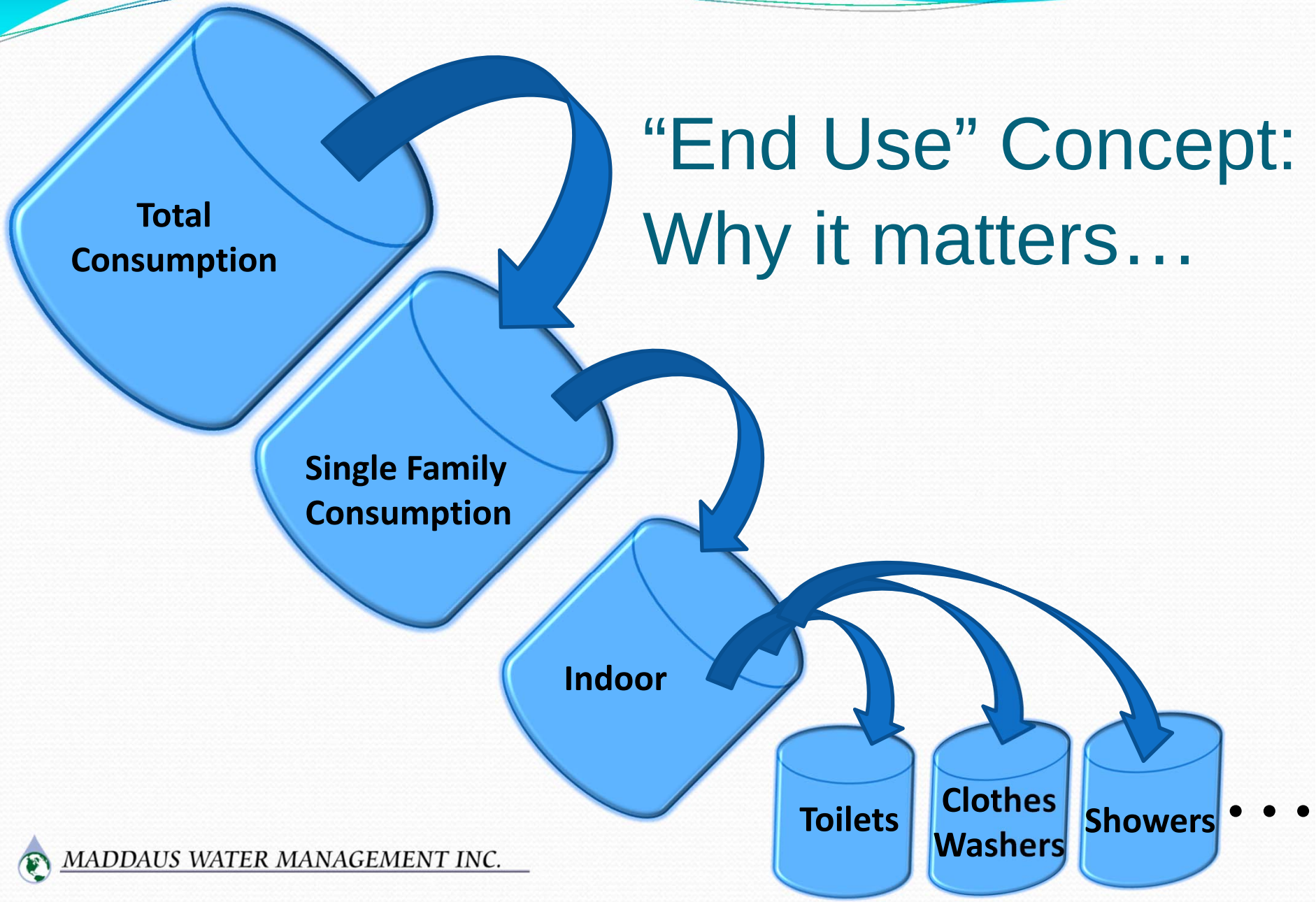
MWM's Staff

- Bill Maddaus
  - Founded MWM in 1995 as a family business
  - Trained as a Civil Engineer (Water Resources) at Cal and MIT
  - Working in field for 40 years, longer than anyone else in the US and possibly the world
- Lisa and Michelle Maddaus
  - Also Civil Engineers with a Combined 30 years Experience in Water Conservation
  - Serve on California Urban Water Conservation Council Board and California State Legislative Committees
- Chris Matyas and Tess Kretschmann
  - Responsible for the software we use & modeling efforts

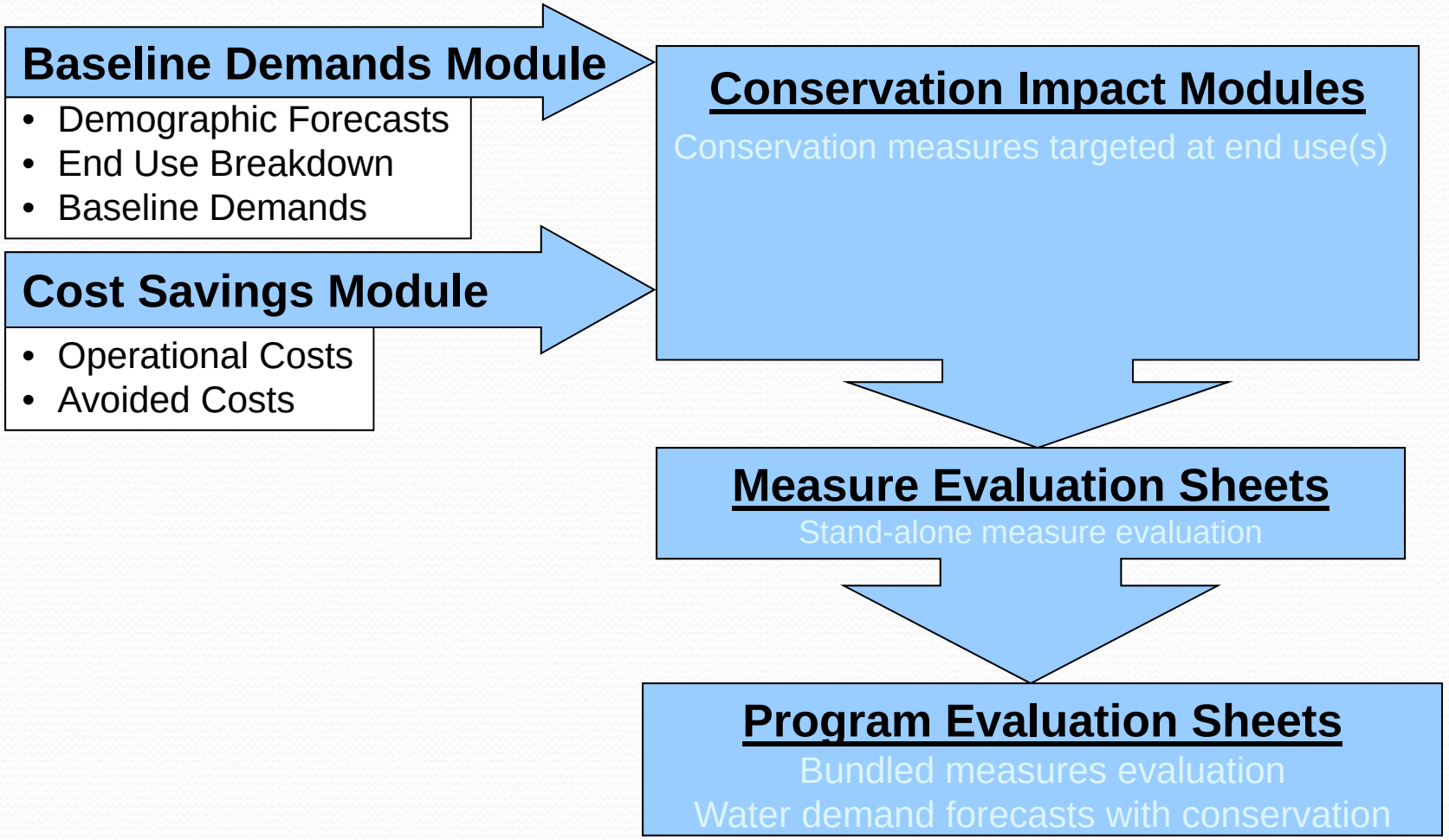
What is the "DSS Model"?

- "DSS Model" stands for:
  - Demand Side Management Least Cost Planning Decision Support System Model
- Developed in 1999 rewritten in 2013
- Endorsed by the CUWCC in 2004
- 200+ applications nation-wide & internationally
- Model Provides:
  - 2012-2035 Year Water Demand Forecasts
  - 2012-2035 Year Water Conservation Savings
  - 2012-2035 Year Benefit-Cost Ratios of Conservation Measures and Programs

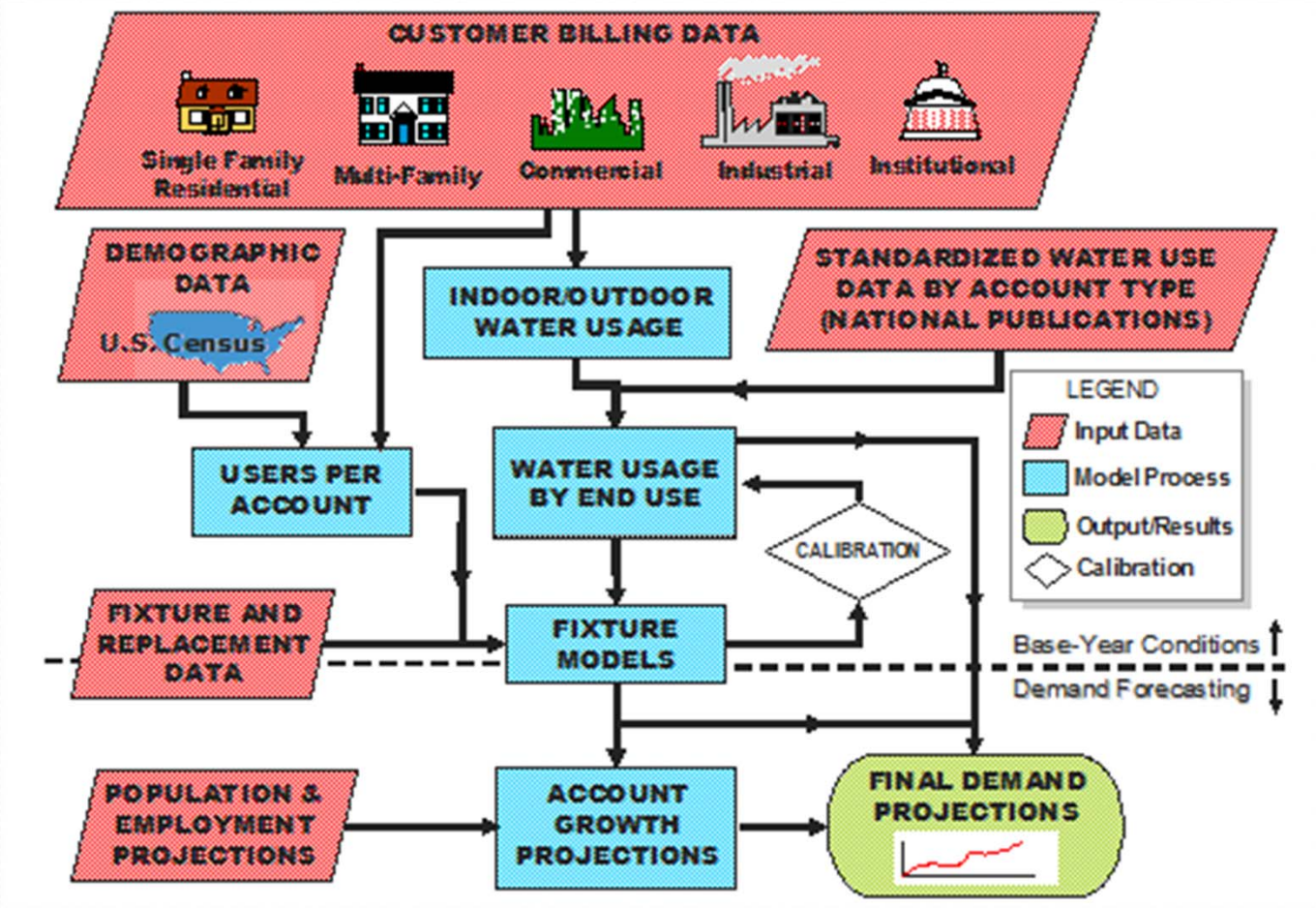
"End Use" Concept: Why it matters…



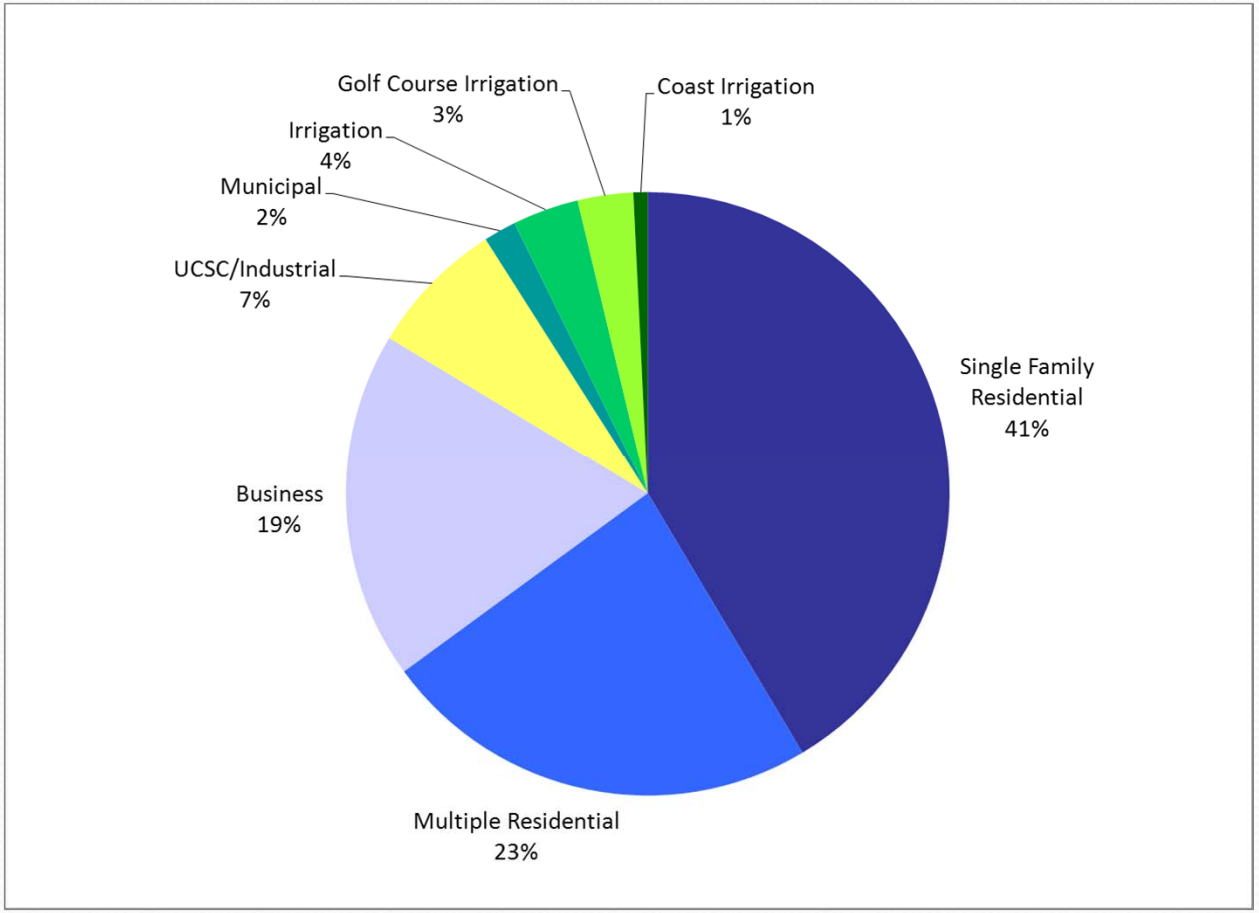
DSS Model Structure



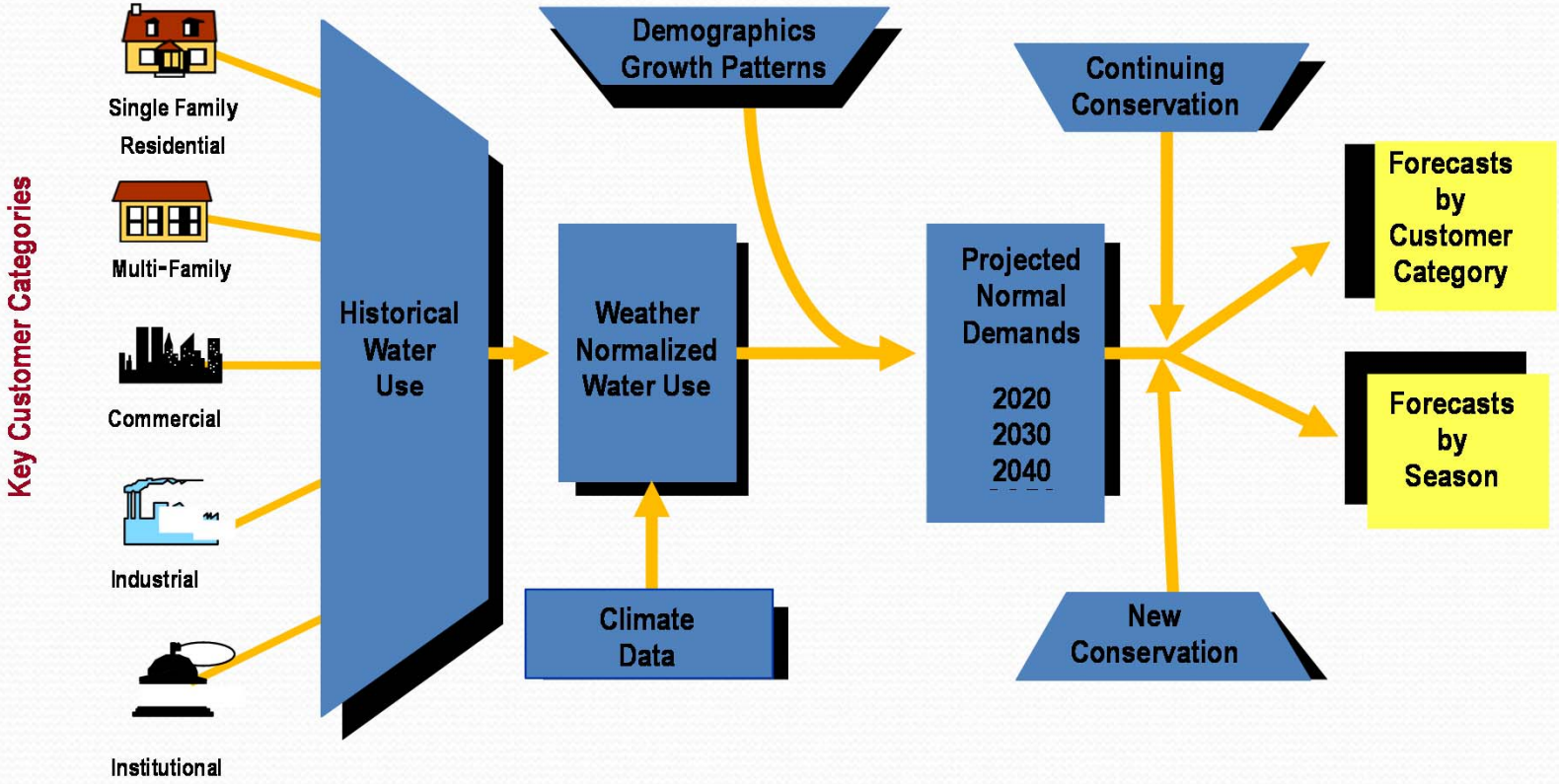
Model Calibration and Forecasting



Santa Cruz Water Use by Customer Category



Where we are in the Planning Process



Measure Screening Process

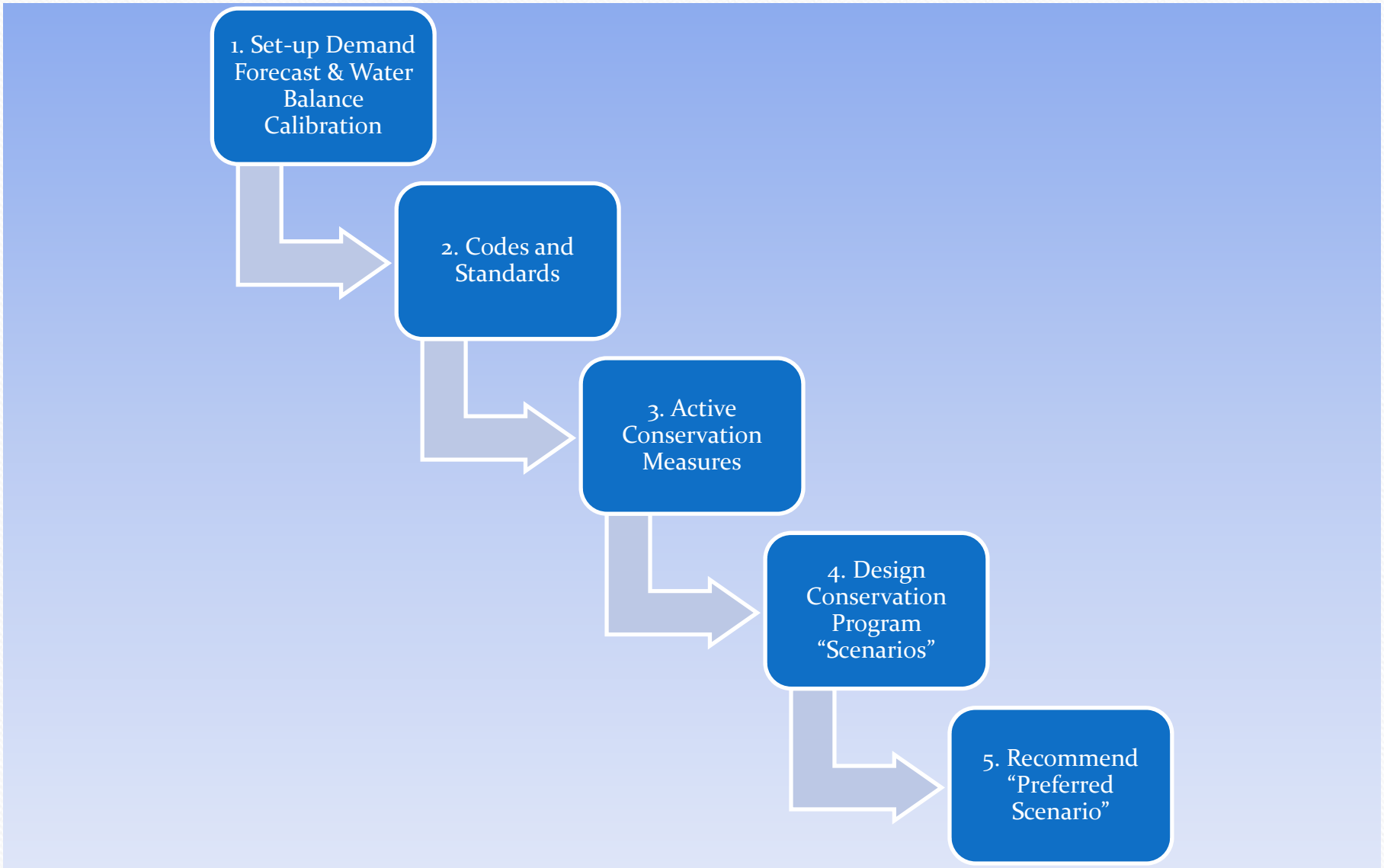
- Shared idea list
- Stakeholder input on ideas via City web site
  - Had more than 30 ideas submitted
- Master list (90 measures) organized by following measure types:
  - Foundational Best Management Practices
    - Public & School Education
    - Water Waste
    - Water Loss
    - Pricing
  - Residential
  - Commercial & Industrial
  - Large Landscape Irrigation

Measure Screening Criteria and Selection (Continued)

- Selected Screening Criteria with Water Commission
  - Water Saving Potential
  - Sustainable Water Savings
  - Quantifiable Water Savings
  - Widespread Community and Social Acceptance
  - Feasibility of Implementation/Secondary Impacts
  - Ancillary Benefits
- Performed Screening Analysis
- Developed short list (30 measures) with acceptance of Water Commission
  - (April, May 2013)
  - Eventually over 40 measures evaluated in DSS Model (see Handout)


MADDAUS WATER MANAGEMENT
DSS Water Demand & Conservation Model
Settings
Instructions
FAQ
Glossary
Agency X
Service Area Information
Show
Demand Analysis
Show
Conservation Analysis
Hide
Conservation Settings & Targets
Edit
End Uses
Edit
Avoided Costs
Edit
Conservation Measures
Edit
Program Scenarios
Edit
Final Check
Edit
Implementation Tracking
Hide
Import/Input Data
Edit
Track Measures & Savings
Edit
Results
Hide
Reports and Graphs
Edit

Outline for Overall Modeling Steps



Set-up and Calibration

- Analyze Water Billing Data to set-up a water system profile
- Breakdown in customer billing categories to "define the buckets"
- Define the water balance
- Starting Year: 2010

Code and Standard Savings

- Used the Baseline Survey to set initial fixture proportions and define plumbing and appliance code and other natural replacement savings
- Effected Fixtures/Appliances:
  - Toilets
  - Showerheads
  - Urinals
  - Clothes Washers
- Replacement vs. New Market Share

Define/Design Conservation Measures

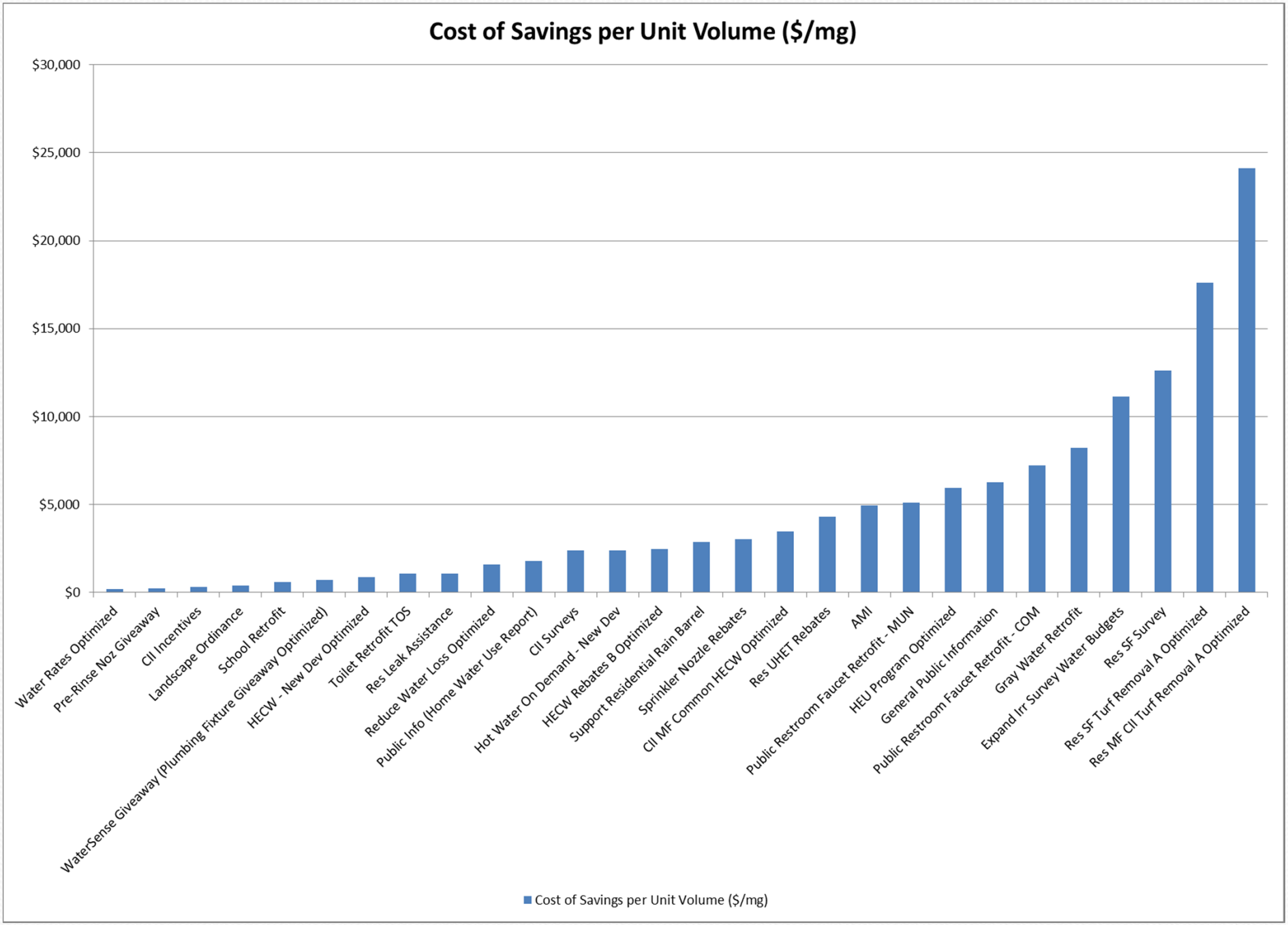
- Conceptual description, with comments
- Time frame
- Estimate utility costs and customer costs
- Water savings and measure life

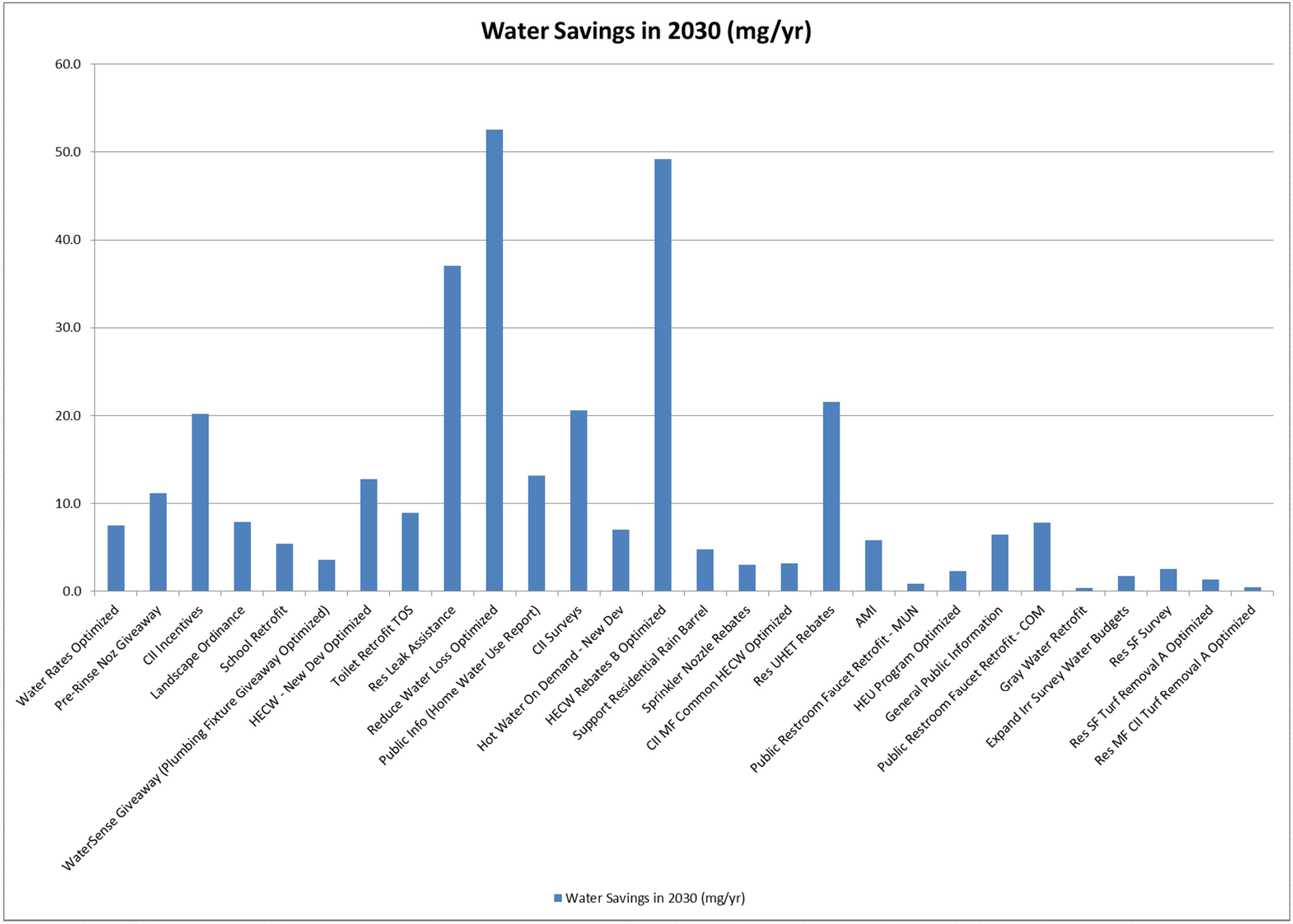
Key Model Assumptions

- Sources of estimates: contains both "literature based" and "professional judgment"
- Measure time period
- Unit savings (per account basis)
- Costs (fixture and administrative)
- Participation (target)
- Placeholder figure of $2,500/mil gallons as the "avoided cost of new supply"
- Program scenario design based on goal for savings program: "most cost effective" or "most water savings"
  - Pending new scenario "most on-peak savings"

DSS Model Demo (Part 1)

- Overview of all major functions of the model:
  - Demand Forecast
  - Generation of passive savings (code)
    - Toilet code and fixture model
  - Illustrate how new measures can be created
  - BC measures sheet


Cost of Savings per Unit Volume ($/mg)
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
Water Rates Optimized
Pre-Rinse Noz Giveaway
CII Incentives
Landscape Ordinance
School Retrofit
WaterSense Giveaway (Plumbing Fixture Giveaway Optimized)
HECW - New Dev Optimized
Toilet Retrofit TOS
Res Leak Assistance
Reduce Water Loss Optimized
Public Info (Home Water Use Report)
CII Surveys
Hot Water On Demand - New Dev
HECW Rebates B Optimized
Support Residential Rain Barrel
Sprinkler Nozzle Rebates
CII MF Common HECW Optimized
Res UHET Rebates
AMI
Public Restroom Faucet Retrofit - MUN
HEU Program Optimized
General Public Information
Public Restroom Faucet Retrofit - COM
Gray Water Retrofit
Expand Irr Survey Water Budgets
Res SF Survey
Res SF Turf Removal A Optimized
Res MF CII Turf Removal A Optimized
Cost of Savings per Unit Volume ($/mg)


Water Savings in 2030 (mg/yr)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Water Rates Optimized
Pre-Rinse Noz Giveaway
CII Incentives
Landscape Ordinance
School Retrofit
WaterSense Giveaway (Plumbing Fixture Giveaway Optimized)
HECW - New Dev Optimized
Toilet Retrofit TOS
Res Leak Assistance
Reduce Water Loss Optimized
Public Info (Home Water Use Report)
CII Surveys
Hot Water On Demand - New Dev
HECW Rebates B Optimized
Support Residential Rain Barrel
Sprinkler Nozzle Rebates
CII MF Common HECW Optimized
Res UHET Rebates
AMI
Public Restroom Faucet Retrofit - MUN
HEU Program Optimized
General Public Information
Public Restroom Faucet Retrofit - COM
Gray Water Retrofit
Expand Irr Survey Water Budgets
Res SF Survey
Res SF Turf Removal A Optimized
Res MF CII Turf Removal A Optimized
Water Savings in 2030 (mg/yr)

BREAK

Program Design Cycle

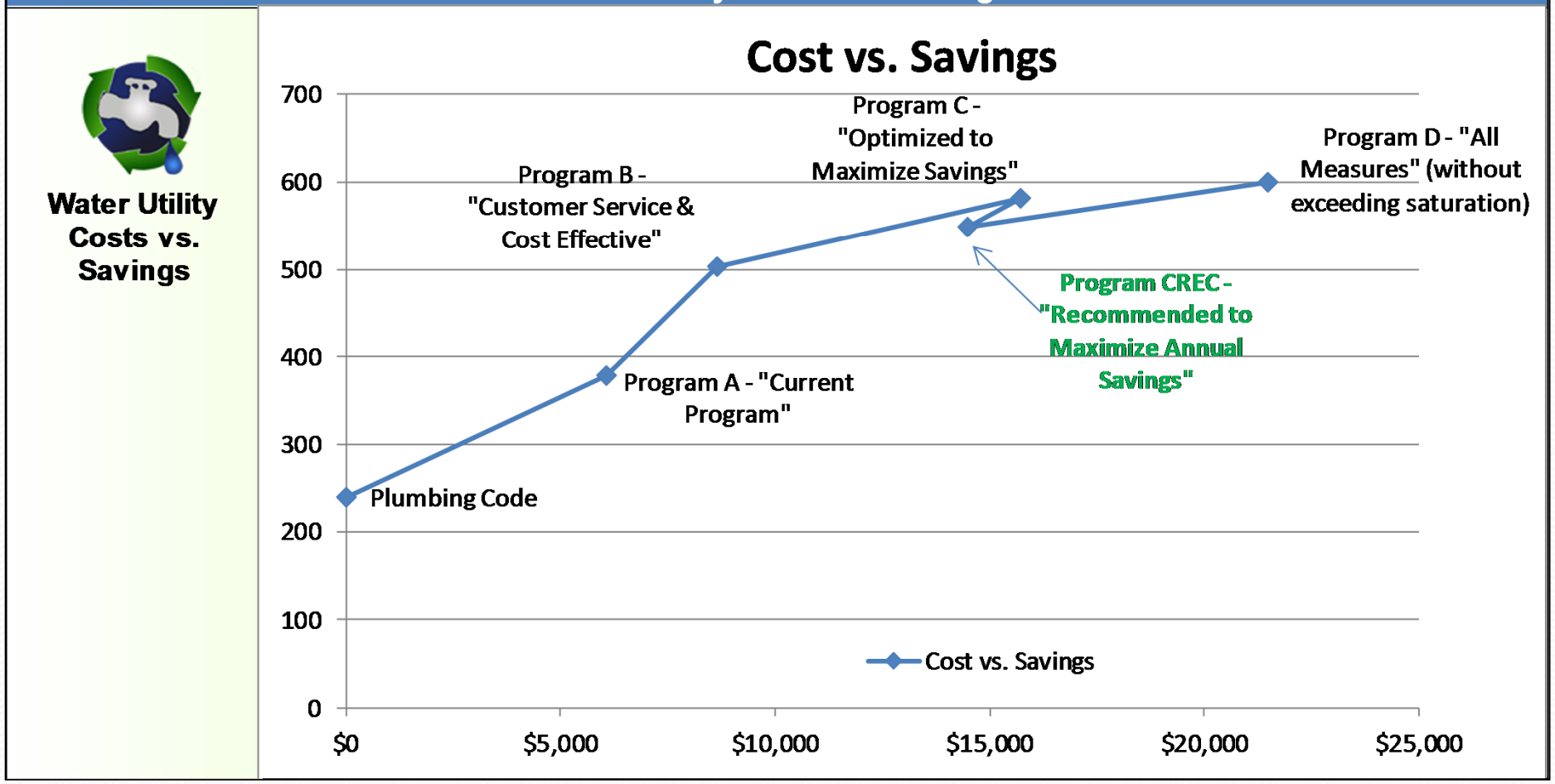
- **Review Individual Measure Details**
  - Benefit-cost ratios
  - Cost of savings per unit volume (mg)
  - Differences between "utility vs. community" perspectives
- **Build Program Scenarios**
  - Overall savings for "suites" of measures
  - Total benefit-cost ratio
  - Estimated total cost
  - Comparing Scenarios
    - Illustrating the point of diminishing returns
- **Finalize Optimal Program Design**
  - Add scenarios
  - Refine details
  - Seek feedback
  - Select Recommended Preferred Program Scenario

DSS Model Demo (Part 2)

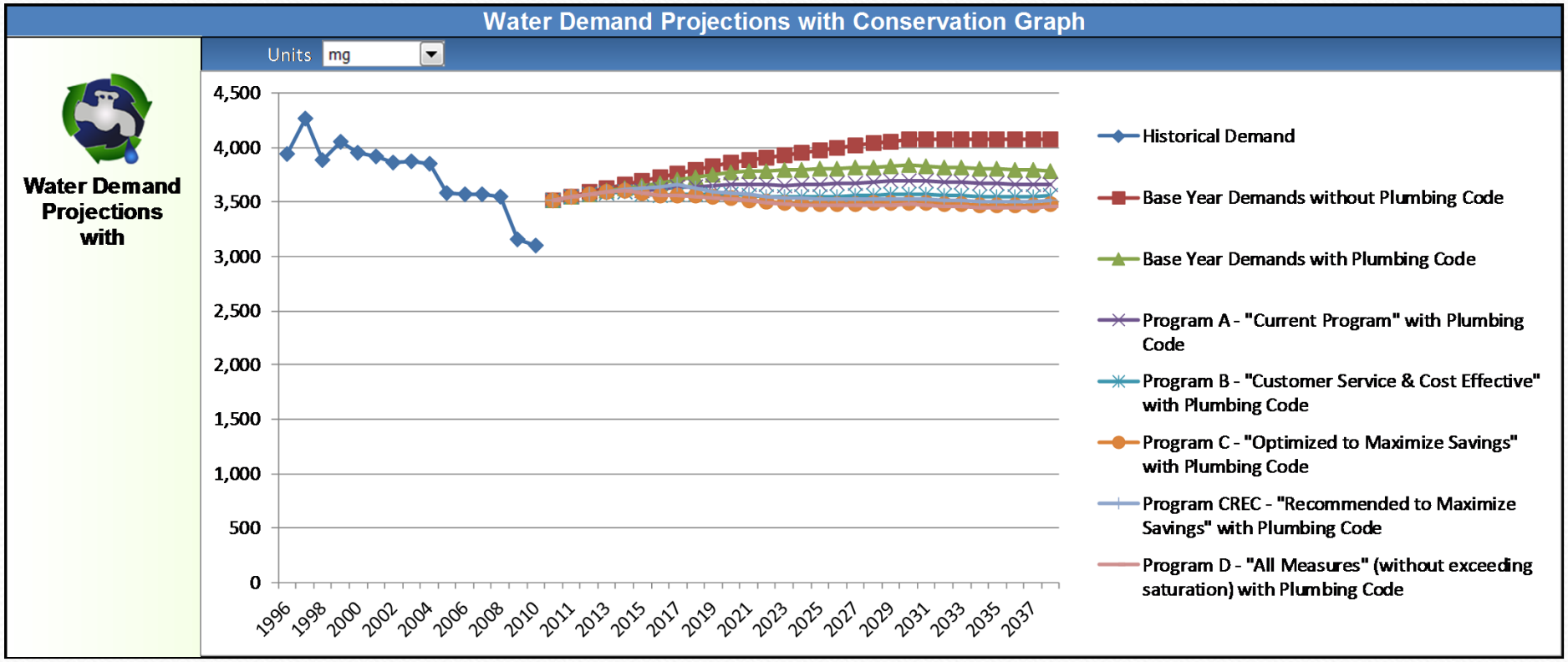
- Overview of additional major functions of the model:
  - Measure to program check list
  - Output tables and graphs

Optimization for Cost and Savings

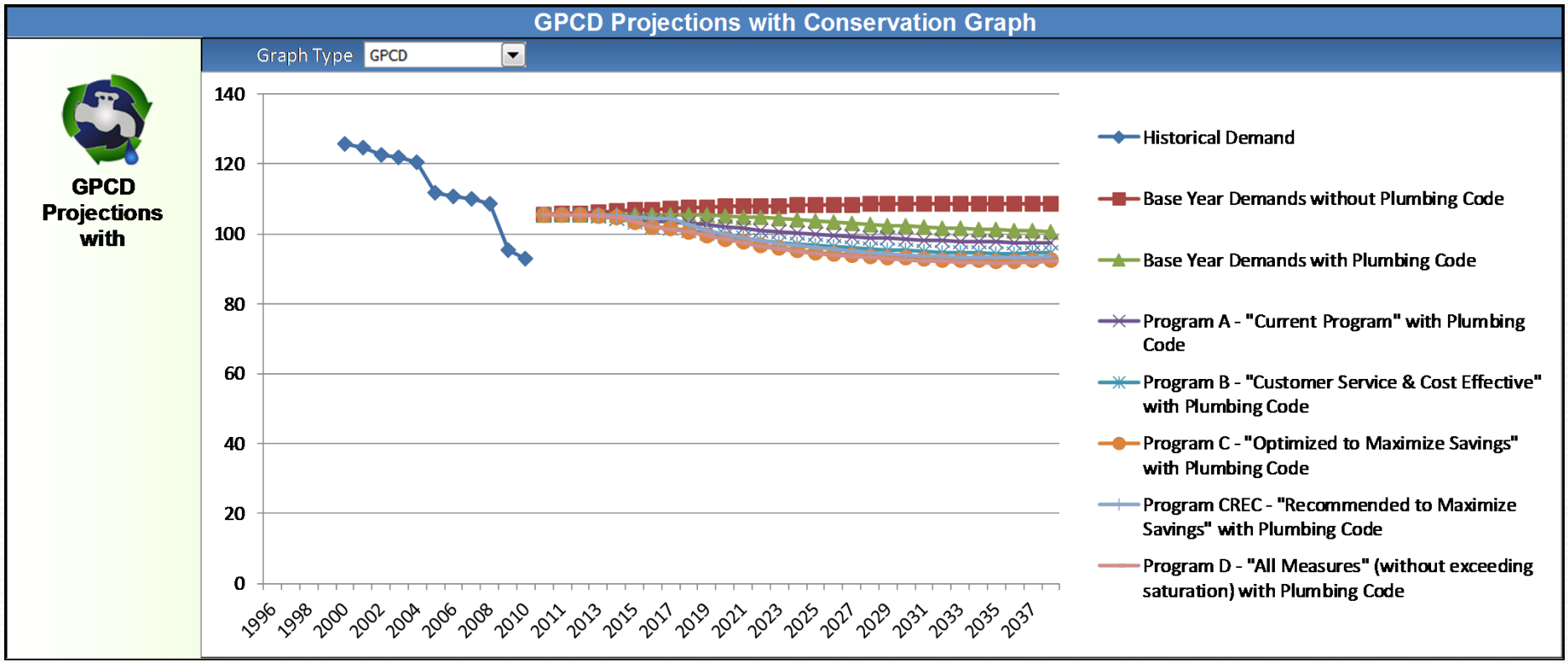
Water Utility Costs vs. Savings



Future Demands with Conservation



Average Demand by GPCD



Steps We have Taken So Far

Adopted Goals from Water Commission

Key priorities of the WCMP include:

- Capitalize on opportunities to meet the future water needs of the Santa Cruz Water Department customers through cost-effective and sustained water conservation and water use efficiency efforts;
- Demonstrate environmental stewardship and foster innovative, responsible and efficient practices;
- Commit to and implement a water conservation program that supports the health of rivers, streams and groundwater integral to the region's quality of life and economy.
- Monitor and measure performance to ensure conservation potential is being met as forecasted.

Achieving these goals will allow the Water Department to:

- Maintain and exceed the water savings already achieved by the City of Santa Cruz; identify the best path to achieve those savings and to monitor commitments to the CUWCC Memorandum of Understanding Regarding Urban Water Conservation (MOU);
- Maintain long-term plan for compliance with SB X7-7 to meet the gallons per capita per day (GPCD) target by 2020.

Results To-Date - Preliminary Recommended Program

General Measures	Residential (Indoor)	Commercial (Indoor)	Irrigation (Outdoor)
Water Loss Control Program *	Real Customer Water Loss Reduction – Leak Repair and Plumbing Emergency Assistance *	CII MF High-Efficiency Washer Rebate *	City Code Requirement for New Landscaping
Install Advance Metering Infrastructure (AMI)	Single Family Water Surveys	Promote Restaurant Spray Nozzles	Residential Single Family Landscape Conversion or Turf Removal *
Water Budget Based Billing	High Efficiency Faucet Aerator/Showerhead Giveaway *	High Efficiency Urinal Program *	Residential Multifamily and CII Landscape Conversion or Turf Removal *
Public Information Program Including Various Outreach & Education Approaches	Residential Ultra High Efficiency Toilet (UHET) Rebates	School Building Retrofit	Expand Outdoor Water Survey and Water Budgets
Customer Billing Report and Service*	Residential Washer Rebate *	Customized Top Users Incentive Program	Rotating Sprinkler Nozzle Rebates
	Require High Efficiency Clothes Washers in New Development *	CII and MF Surveys and Top Water Users Program	Residential Gray Water Retrofit*
	Require Hot Water on Demand/Structured Plumbing in New Developments	Public Restroom Faucet Retrofit*	Provide Rain Barrel Incentive
	Toilet Retrofit at Time of Sale		

Next Steps

- Consider (Evaluate) More Peak Season Measures
- Consider other Alternative Programs
- Revise and Finish Cost-Effectiveness Analysis
- Consider Changes to Current Recommended Program
- Seek Input from Water Commission
- Present to City Council for Adoption

More Information

- Water Commission Website

  http://www.cityofsantacruz.com/departments/water/city-water-commission

- Water Conservation Master Plan

  http://www.cityofsantacruz.com/departments/water/conservation/more-information/water-conservation-master-plan

Questions and Discussion?

- Feedback