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# *A Balanced Approach to Water Conservation: Removing Barriers and Maximizing Benefits*

*Sponsored by:*

*Water Research Foundation*

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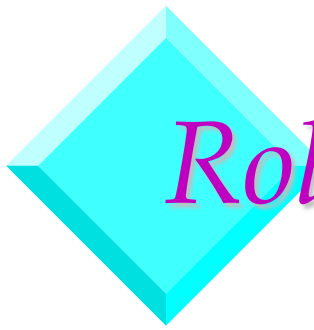
# Outline

- Role of Conservation?
  - Short Term Drought Response
  - Long Term WUE Investment
- Short Term Financial Planning
  - Drought Response Tool - Drought Pricing
- Long Term Resource Planning
- Conclusion



# *Confusion over Conservation*

- “Conservation” can mean:
  - mandatory curtailment during water supply shortage,
  - any decrease in human water consumption, or
  - water that is stored for later consumption?
- “Conservation programs” can denote
  - a public relations campaign,
  - provision of efficient plumbing devices,
  - on-site water use surveys, or
  - retrofit on resale legislation or landscape ordinances?
- Conservation as Water Use Efficiency
  - Devices/practices whose benefits exceed costs



# *Role of Conservation*

## ➤ Short Term Drought Response

- In response to shortage, customers can reduce consumption (customer shortage cost is the avoided benefit of water use)
- Utility drought management--information programs, restrictions, drought pricing – is a planning problem!

## ➤ Long Term WUE Investment

- Benefit Cost Analysis--What is the potential for WUE investment?
- Avoided Cost Analysis – What is the benefit of WUE?
- Integrated Planning – What should the portfolio of water resources look like?



# *Useful Planning Models*

- Short Term Financial and Drought Planning
  - Rate Models - Sales and Revenue
  - Drought Management – Minimizing Shortage Costs
- Long Term Resource Planning
  - Avoided Cost Model – Benefits of WUE
  - WUE Benefit Cost Model-Program Design and Tracking
  - Least Cost Planning
    - Balancing Supply Costs with Customer Shortage Costs
    - Relationship Between Avoided Costs and Shortage Costs
  - Analysis of Water Resource Portfolios



# *Short Term Planning*

- Needs to address short-term Drought Contingency Planning
  - Conservation induced by Price
  - Conservation not induced by Price
- How much can/will customers reduce consumption during a shortage event?



## *Example: SDCWA Drought Response Tool*

- An **empirical** planning tool for planning for Drought Response (consistent with Model Ordinance):
  - Model Drought Ordinance defines 4 Drought Stages
  - 4 Customer Demand Reduction Targets
  - Revenue Management and Rate Design are key
- Address **both** price-induced and non-price-induced water conservation.





# *What do we know about water conservation?*

- Price-induced Customer Conservation
  - Lots
  - More than 125 studies of price's effect on water demand
  - Specific recommendations for residential water demand
  - Short-term vs. long-term responses
- Non-Price Induced Customer Conservation
  - It depends
  - It varies



# Price-Induced Water Conservation

- Recommendation for short-term Price Elasticities:
  - Single Family Summer: -.20
    - Thus, a 100 percent increase in rates would result in a 20 percent decrease in summer water demand
  - Single Family Non-Summer: -.12
- Basis:
  - *Do Residential Water Demand Side Management Policies Measure Up? An Analysis of Eight California Water Agencies* Renwick and Green, *Journal of Environmental Economics and Management*, 2000.
  - Study empirically examines a recent drought
  - Elasticity could be higher **IF** there is a strong media campaign



# *Non-Price-Induced Water Conservation*

During drought, many things happen at once

- Drought pricing adjustments
- Public relations efforts that affect water use behaviors
- Public awareness
- Level of programmatic activity/enforcement by agencies
- Water use restrictions

During drought, there are limitations to customers' ability to cut back.

- Some water not "discretionary" (e.g., sanitary use)
- Some water exempt from restrictions (fire, erosion control)
- Some water used indoors (restrictions focus on outdoor use)



# *Savings Goals and Achievements*

**Table 3      Programs Adopted by Retail Water Suppliers during California Drought 1976-77**

<b>Supplier</b>	<b>Residential Rationing Program</b>	<b>Achievement, percent</b>
Marin Municipal Water District	Mandatory 57 percent per capita	65
East Bay Municipal Utility District	Mandatory 35 percent per household	40
Contra Costa County Water District	Mandatory 30 percent	25
San Francisco Water Department	Mandatory 25 percent	30
Los Angeles DWP	Mandatory 10 percent	16
Sunnyvale Water Department	Voluntary 25 percent	26
Santa Clara Valley Water District	Voluntary 25 percent	30
City of Pleasanton	No program	19

Source: Reproduced from “2007 Updated Edition, Draft Urban Drought Guidebook” State of California Department of Water Resources, Office of Water Use Efficiency and Transfers, August 2007



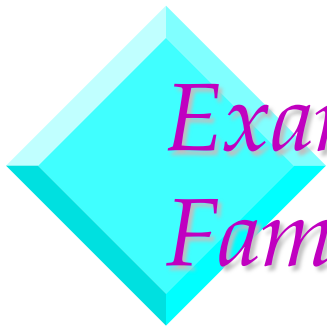
# *Non-Price Conservation Tool: Estimated Savings by Restriction*

## Model Ordinance Conservation targets:

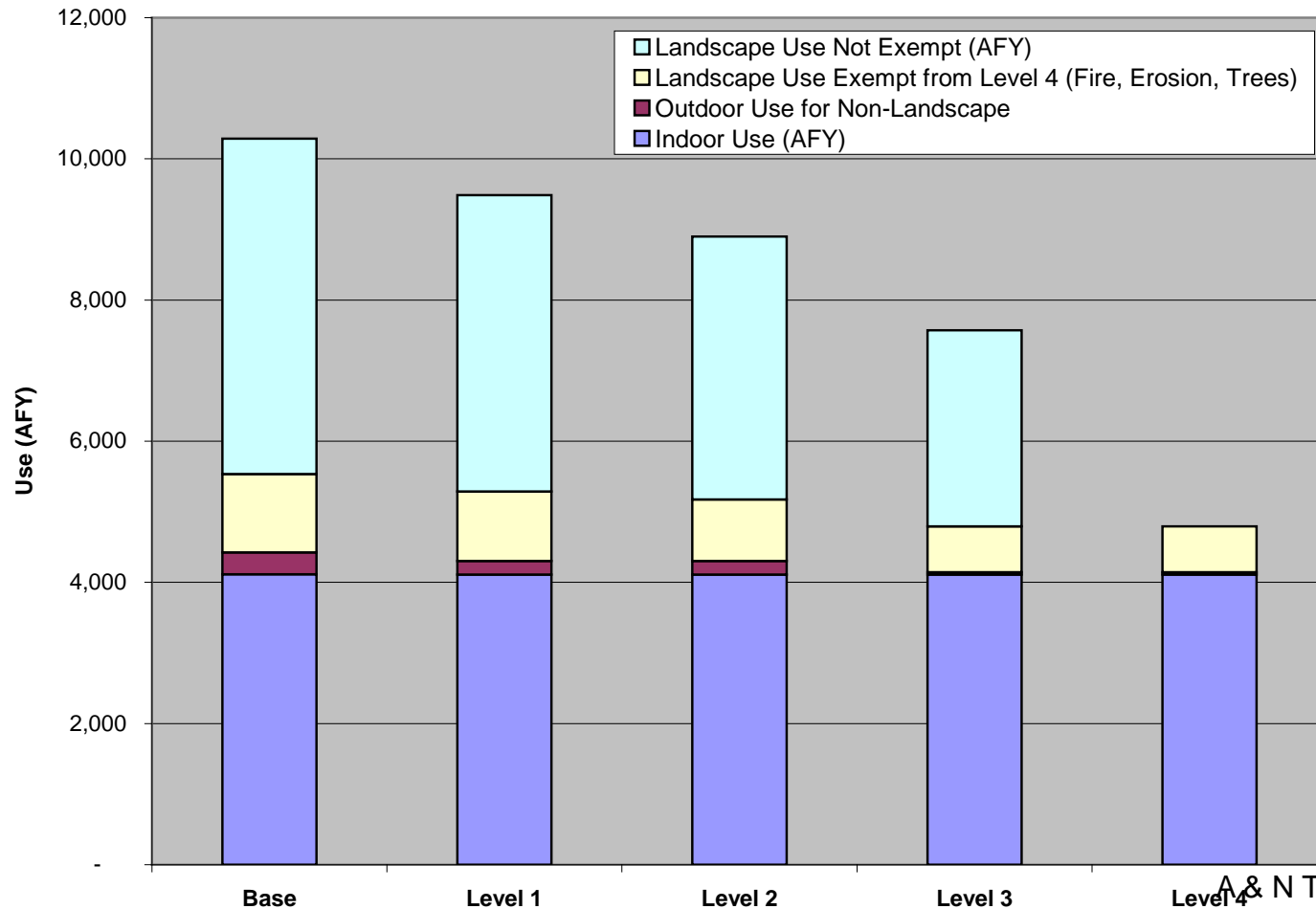
- Level 1 Up to 10%
- Level 2 Up to 20%
- Level 3 Up to 40%
- Level 4 Above 40%

## Water use restrictions (vary by Level):

- Washing paved surfaces
- Irrigation
- Fountains, Lakes, and Ponds
- Vehicle Washing
- Leak Repair
- New Connections
- Water Allocations

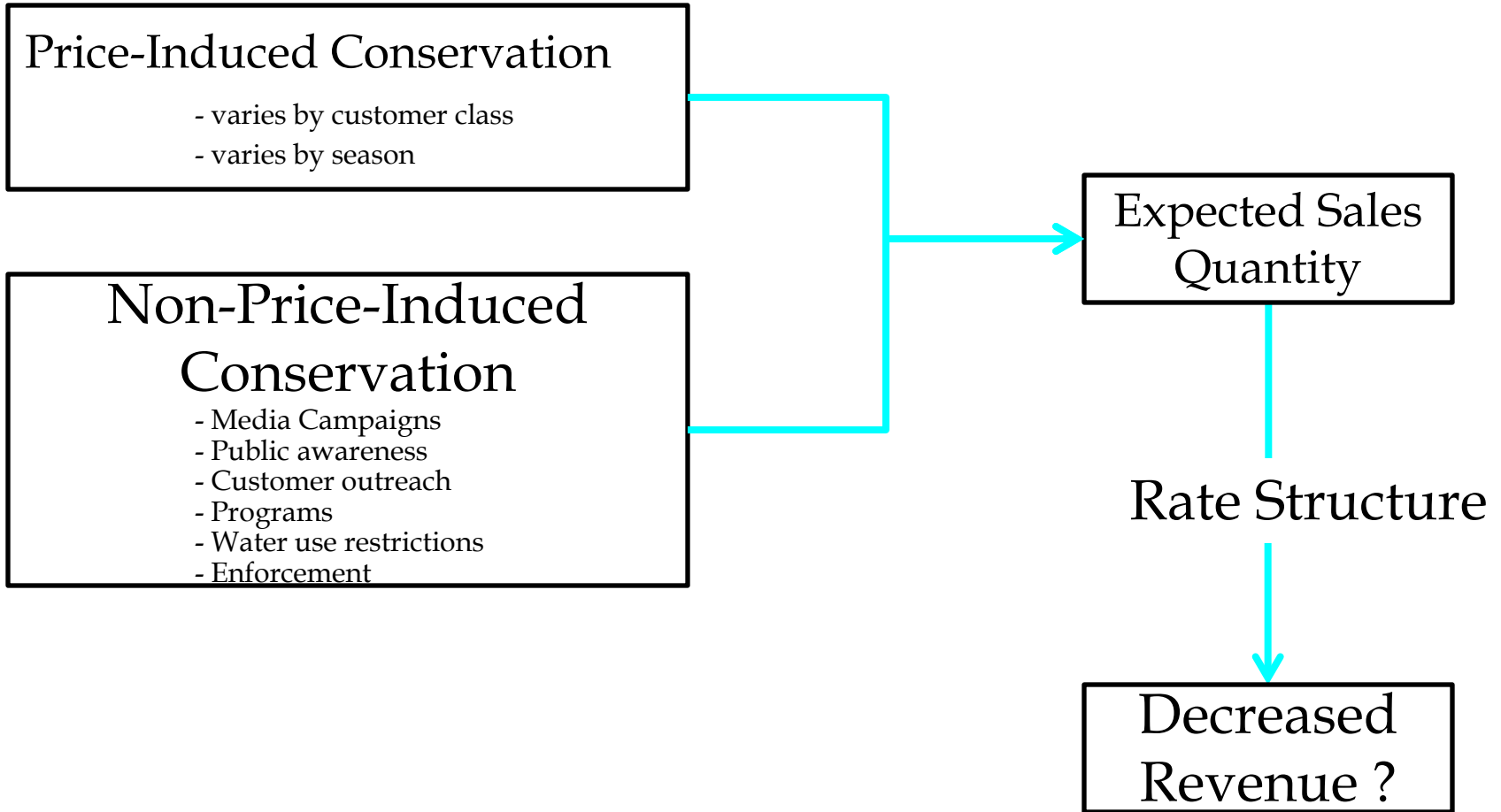


# Example: Estimating Outdoor Single Family Drought Savings Potential






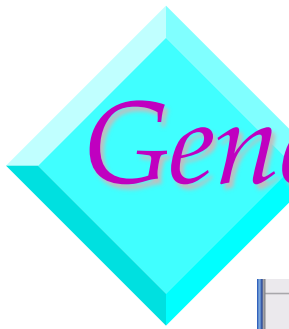
# *Drought Response Model Design*



# Look and Feel of Generic Model

	A	B	C	D	E	F	G	H	I
1	<b>Drought Response Model</b>								
2	<b>Key Policy Choices</b>								
3									
4									
5									
6									
7	<b>(a.) SUMMARY OF MODEL ORDINANCE DROUGHT RESPONSE LEVELS AND WATER-USE RESTRICTIONS</b>								
8	<b>Drought Response Levels</b>		<b>Voluntary or Mandatory Restrictions</b>	<b>Customer Conservation Targets</b>	<b>Water Authority DMP Stage</b>				
9	Level 1	Drought Watch	Voluntary	Up to 10%	Stage 1 or Stage 2				
10	Level 2	Drought Alert	Mandatory	Up to 20%	Stage 2 or Stage 3				
11	Level 3	Drought Critical	Mandatory	Up to 40%	Stage 3				
12	Level 4	Drought Emergency	Mandatory	Above 40%	Stage 3				
13									
14									
15	<b>(b.) SET NON-PRICE CONSERVATION TARGETS AND EXPECTED COMPLIANCE RATE</b>								
16	<b>Drought Response Levels</b>		<b>Non-Price Conservation (Planned)</b>	<b>Compliance Rate (Expected)</b>	<b>Net Non-Price Conservation</b>				
17	Level 1	Drought Watch	10.0%	86.0%	8.6%				
18	Level 2	Drought Alert	20.0%	86.0%	17.2%				
19	Level 3	Drought Critical	35.0%	86.0%	30.1%				
20	Level 4	Drought Emergency	40.1%	86.0%	34.5%				
21									
22									
23	<b>(c.) ENTER COSTS OF DROUGHT RESPONSE PROGRAM</b>								
24		<b>Program Units: Marketing</b>				<b>Program Units: Compliance</b>			
25	<b>Drought Response Level</b>	<b>Stuffers</b>	<b>Radio Ads</b>	<b>Newspaper Ads</b>	<b>Public Events</b>	<b>Staff Program Devt&amp;Admin</b>	<b>Site Visits</b>		
26	Level 1	10,000	100	26	4	250	50		
27	Level 2	10,000	200	52	12	500	100		
28	Level 3	20,000	300	104	12	750	150		
29	Level 4	20,000	400	156	12	1,000	200		
30	Costs/Unit	\$ 0.05	\$ 1,000.00	\$ 1,000.00	\$ 5,000.00	\$ 75.00	\$ 100.00		
31									
32		<b>Stuffers</b>	<b>Radio Ads</b>	<b>Newspaper Ads</b>	<b>Public Events</b>	<b>Staff Program Devt&amp;Admin</b>	<b>Site Visits</b>	<b>Total</b>	
33	Level 1	\$ 500	\$ 100,000	\$ 26,000	\$ 20,000	\$ 18,750	\$ 5,000	\$ 170,250	
34	Level 2	\$ 500	\$ 200,000	\$ 52,000	\$ 60,000	\$ 37,500	\$ 10,000	\$ 360,000	
35	Level 3	\$ 1,000	\$ 300,000	\$ 104,000	\$ 60,000	\$ 56,250	\$ 15,000	\$ 536,250	
36	Level 4	\$ 1,000	\$ 400,000	\$ 156,000	\$ 60,000	\$ 75,000	\$ 20,000	\$ 712,000	
37									
38									





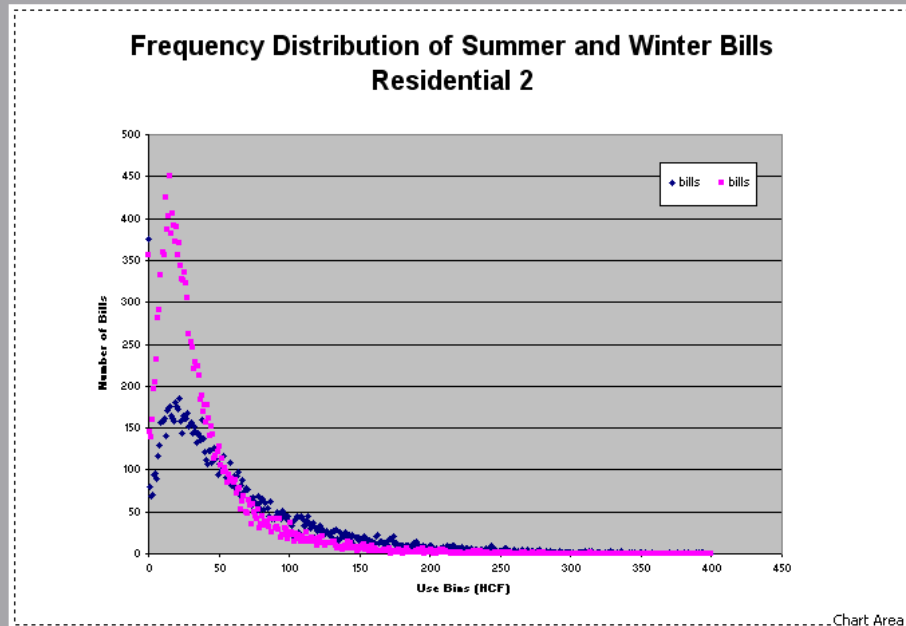
# Generic Model Outputs

	A	B	C	D	E	F	G	H	I	J	
1	<b>Drought Response Model Summary</b>										
2											
3			Test Year = 2008								
4											
5	<b>UNDER PRESENT RATES</b>										
6		<b>Rate Class</b>	<b>Seasonal Rate ?</b>	<b>Sales</b>	<b>Sales Units</b>	<b>Commodity Revenues</b>	<b>Fixed Revenue</b>	<b>Total Revenue</b>			
7		Res_1	No	2,348,180	HCF	\$ 6,344,396		\$ 6,344,396			
8		Res_2	No	1,402,861	HCF	\$ 3,779,909		\$ 3,779,909			
9		NonRes	No	404,607	HCF	\$ 1,079,339		\$ 1,079,339			
10		<b>Total</b>		<b>4,155,648</b>	<b>HCF</b>	<b>\$ 11,203,644</b>	<b>-</b>	<b>\$ 11,203,644</b>			
11											
12											
13	<b>UNDER PROPOSED RATES</b>										
14		<b>Rate Class</b>	<b>Seasonal Rate ?</b>	<b>Projected Sales</b>	<b>Sales Units</b>	<b>Commodity Revenues</b>	<b>Fixed Revenue</b>	<b>Total Revenue</b>			
15		Res_1	No	1,886,093	HCF	\$ 6,002,921		\$ 6,002,921			
16		Res_2	No	1,127,793	HCF	\$ 3,565,526		\$ 3,565,526			
17		NonRes	No	324,683	HCF	\$ 956,100		\$ 956,100			
18		<b>Total</b>		<b>3,338,570</b>	<b>HCF</b>	<b>\$ 10,524,547</b>	<b>-</b>	<b>\$ 10,524,547</b>			
19											
20											
21	<b>DIFFERENCE FROM PRESENT RATES</b>										
22		<b>Rate Class</b>		<b>Change in Sales</b>	<b>Sales Units</b>	<b>% Change in Sales</b>	<b>Change in Revenue</b>	<b>% Change in Revenue</b>			
23		Res_1		(462,087)	HCF	-19.7%	\$ (341,475)	-5.4%			
24		Res_2		(275,068)	HCF	-19.6%	\$ (214,383)	-5.7%			
25		NonRes		(79,924)	HCF	-19.8%	\$ (123,239)	-11.4%			
26		<b>Total</b>		<b>(817,078)</b>	<b>HCF</b>	<b>-19.7%</b>	<b>\$ (679,096)</b>	<b>-6.1%</b>			
27											
28											
29	<b>DIFFERENCE IN NET REVENUE</b>										
30		<b>Rate Class</b>	<b>Change in Purchase Cost</b>	<b>Change in Gross Revenue</b>	<b>Change in Net Revenue</b>		<b>Program Cost</b>	<b>Total Net Impact</b>			
31		Res_1	\$ (587,646)	\$ (341,475)	\$ 246,171						
32		Res_2	\$ (349,810)	\$ (214,383)	\$ 135,427						
33		NonRes	\$ (101,641)	\$ (123,239)	\$ (21,598)						
34		<b>Total</b>	<b>\$ (1,039,096)</b>	<b>\$ (679,096)</b>	<b>\$ 360,000</b>		<b>\$ 360,000</b>	<b>\$ 0</b>			
35											
36											
37											

Test Year
2008



# Informative Graphics



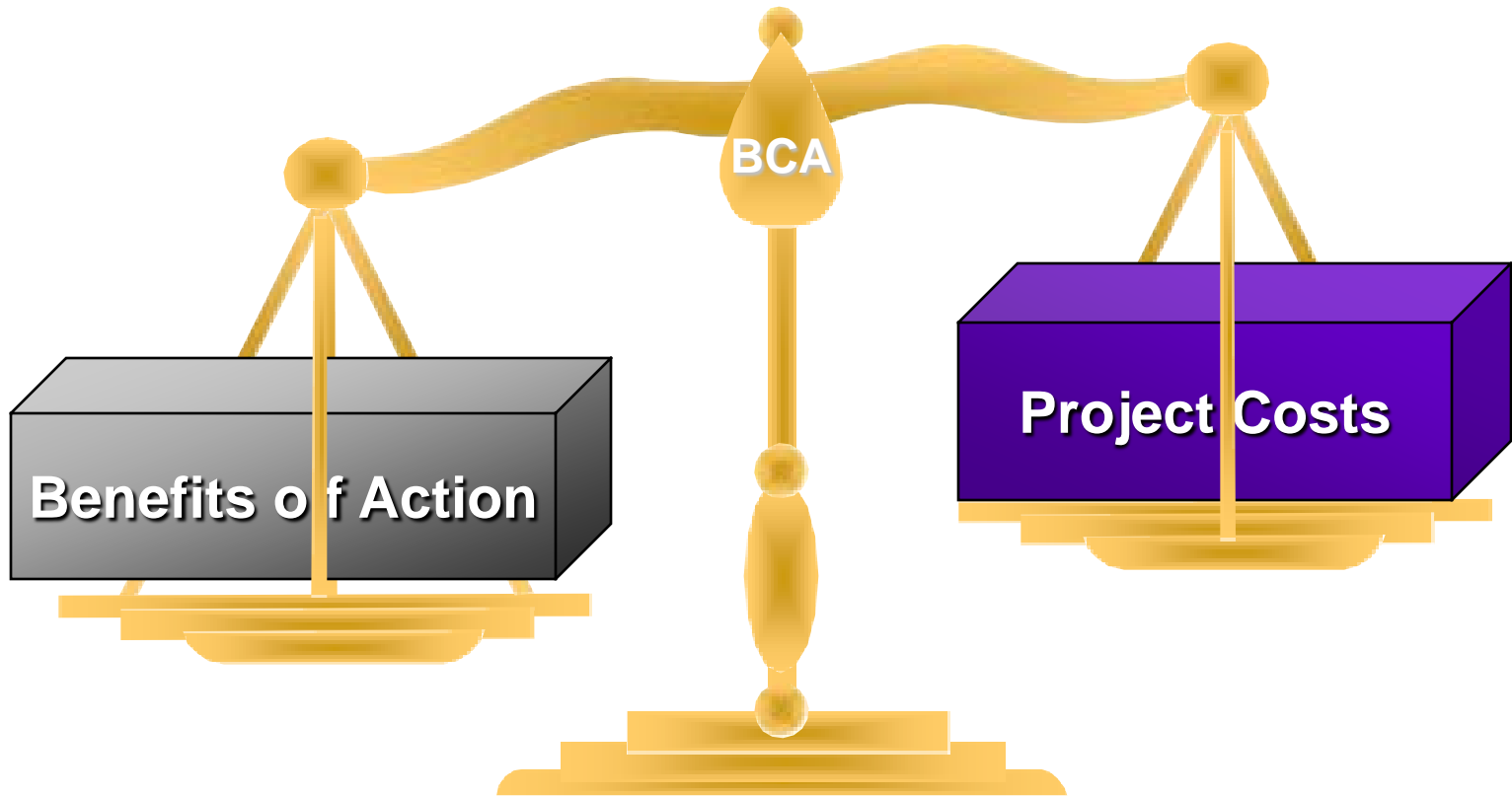


# *Long Term Resource Planning*

- Benefit-Cost Models – Program Planning and Tracking
- Avoided Cost Models – Conservation Program Benefits
- Integrated Planning Models
  - Risk, Uncertainty, and Resource Portfolios
  - Interactions Between Conservation and Supply Options

# *Why do WUE?*

Is water efficiency worth it?






# *Why WUE Matters*

(...and at no additional charge)

Water efficiency projects provide benefits.

If you understand the values produced by the effects of WUE, then better projects can be designed.


$$\text{Benefits of Action} = f(\text{WUE Impacts})$$

**Benefits of Conservation are often defined in terms of the costs avoided**



# *Avoided Cost analysis*

- The cost of alternatives can be compared to a benchmark to estimate “avoided cost” (or “net benefit”)
- The benchmark often reflects the cost associated with the typical or conventional means of producing the desired benefit



# *Integrated planning*

- Avoided-cost analysis helps place supply-side and demand-side options on a level playing field for comparison.
- Thus, avoided cost analysis plays a role in integrated resource planning and total water management.
- As in energy, the concept of avoided cost can promote consideration of conservation as a legitimate resource option.



# *Relevance of Avoided Costs*

- Avoided cost concepts can be useful to water utilities
  - Making cost consequences of alternatives explicit
  - Minimizing long term costs of providing the benefits of water supply
- Avoided costs include:
  - the costs of foregone opportunities and
  - the costs of avoided environmental degradation
- Guidance and precedence exists for their methods and use





# *The WRF/CIWCC Direct Utility Avoided Cost Model*

- Provides solid defensible estimates of avoidable costs from a utility perspective. (=potential Efficiency benefit)
- Allows costs to vary
  - By time of year (peak season)
  - By conveyance path (pumping zones, treatment or source differentials)
- Can handle costs avoided due to deferral *or* downsizing
- Also estimates bill impacts for different customer groups.

# Avoided Cost Model

Microsoft Excel - CUWCAwwaRF\_Direct Utility Avoided Cost Model Test 05-23-05.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

152%

Reply with Changes... End Review

	A	B	C	D	E
1	<b>Direct Utility Avoided Cost Estimation Model, Version 05.10.05</b>				
2	<b>Common Assumptions</b>				
3					
4					
5					
6					
7	<b>Enter Common Assumptions:</b>				
8	Planning horizon (year)		2040		
9					
10	Cost Reference Year		2005		
11					
12	Lost and Unaccounted for Water (%)		10%		
13					
14	Peak-Season Start Date ('xx/xx')		1-Jun		
15	Peak-Season End Date ('xx/xx')		31-Oct		
16					
17	Real Discount Rate		3.92%		
18					
19					
20	<b>Choose Units of Measurement</b>				
21	Measurement System				
22	<input checked="" type="radio"/> U.S. Units				
23	<input type="radio"/> Metric Units				
24					
25	U.S. System Volume Units				
26	<input checked="" type="radio"/> Million Gallons				
27	<input type="radio"/> Acre-Feet (AF)				
28					

Discount Rate Converter (Optional)	
<b>IF:</b>	
Nominal Discount Rate is:	6.00%
<b>AND</b>	
Projected Inflation Rate is:	2.00%
<b>THEN</b>	
Real Discount Rate is:	3.92%

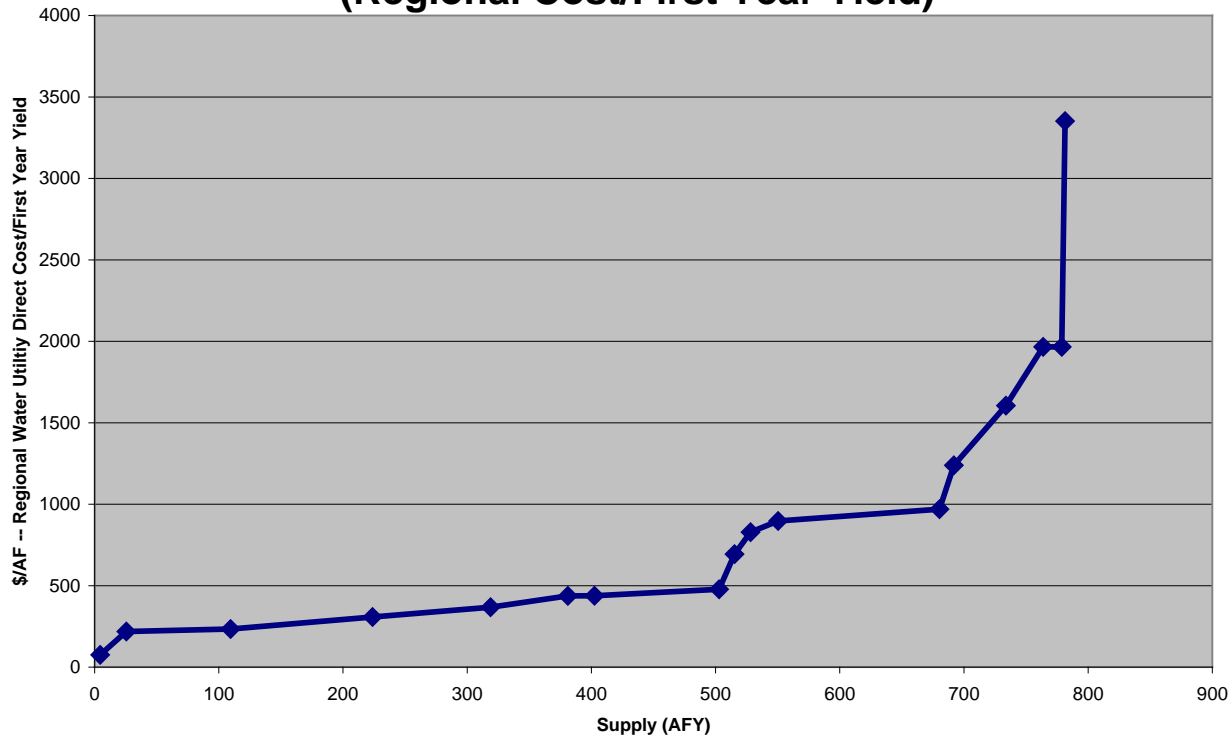
**Discount rate is used for net present value (NPV) calculations. "Real" discount rates are net-of-inflation. See converter above.**

Flow:	mgd
Volume:	mg

Cell B17 commented by T. Chesnut

# WRF Benefit-Cost Model – A Conservation Supply Curve

**Figure 7.4--Supply Curve from Conservation Programs  
(Regional Cost/First Year Yield)**

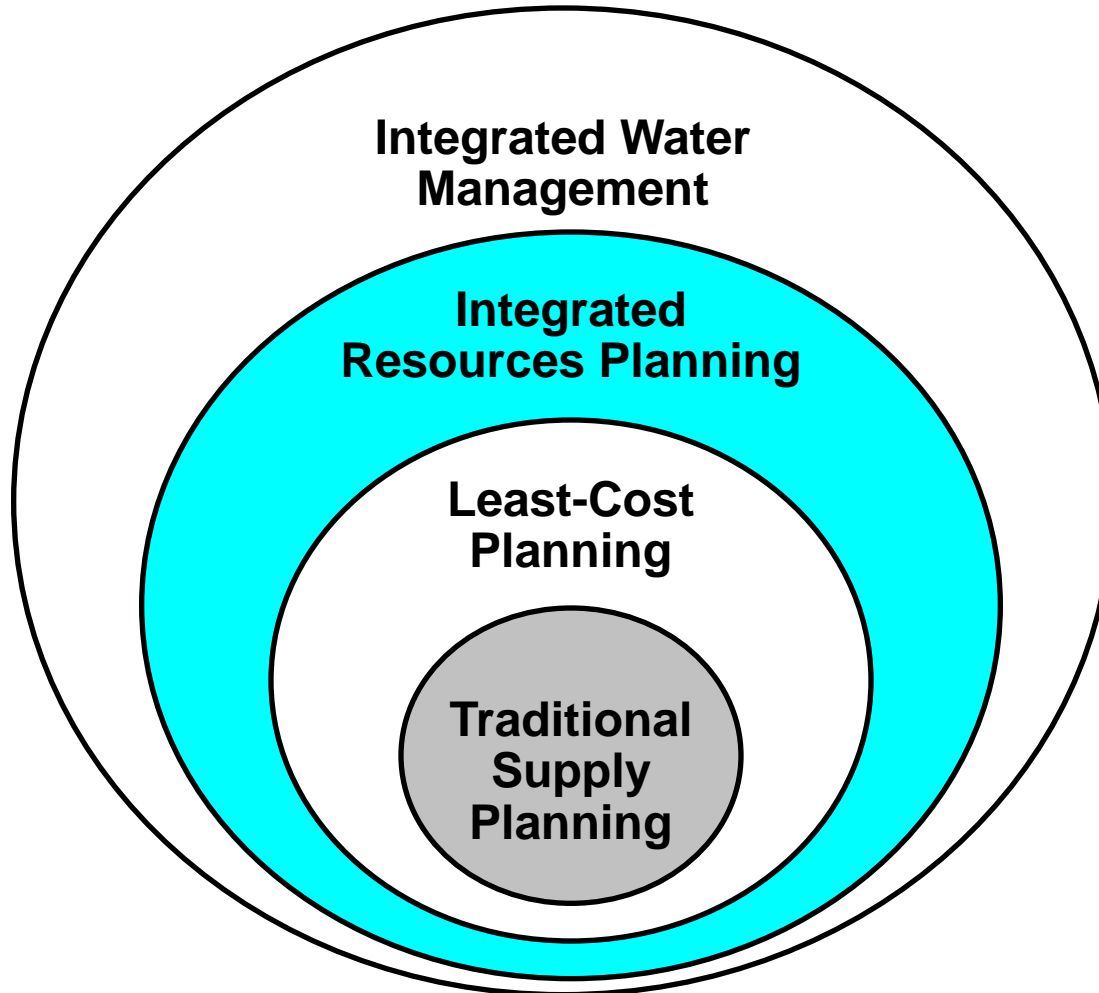




# Integrated Water Management

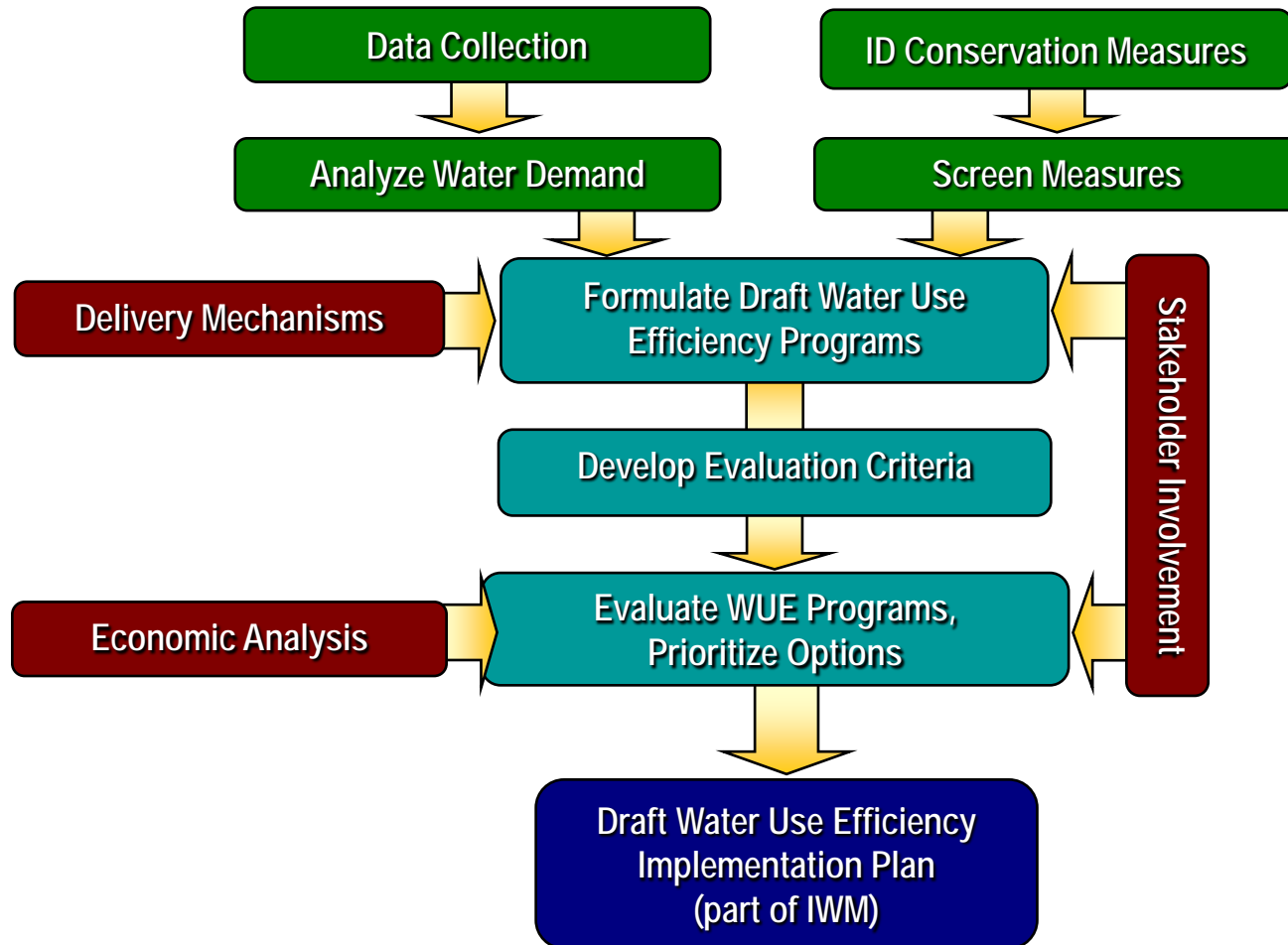
- What characterizes IWM?
  - Equal consideration to supply- and demand-side alternatives (demand can be manipulated),
  - Explicit treatment of uncertainty,
  - Integrates short and long-run planning,
  - Acknowledges a broader concept of cost,
  - Addresses sustainability,
  - Involves all institutions with a stake, and
  - Emphasizes ongoing, open, and participatory decisionmaking process.

# Integrated Planning





# Example: Water Use Efficiency Plan





# Terminology

- Conservation Measures
  - Technologies, Plumbing Fixtures, Management Practices,
  
- Delivery Mechanism
  - Education, Rebates, Incentives, Direct Install, Ordinances
  
- A Conservation Program =
  - Conservation measure(s) + delivery mechanism



# Conservation Measures

Residential	Landscape	CII
Aerators	Audits	Analyst Survey I
Flappers w/Survey	Central Controllers	Analyst Survey II
High-Efficiency Washers	Education - Mem Agy	Cooling Tower Cond Meter
Irrig Eval with Timers	ET Controllers	Engineer Survey
Irrig Eval without Timers	Irrigation Controllers	Flush Valve Kit
Multi-Family Surveys	Moisture Sensors	High-Efficiency Washers
Weather-Based Controller	Protector del Agua Class	Industrial Process Improve
Showerheads		Pre-Rinse Spray Head
Showerheads - Distributed		ULF Toilets - Dual Flush
Surveys, Single Family		ULF Toilets - Flush Valve
Surveys, Single Family-Old		ULF Toilets - Tank Type
Toilet Displacement		ULF Urinals
ULF Toilets - Distribution		Water Broom
ULF Toilets - Rebate		Water Management Study
ULF Toilets - Dual Flush		X-Ray Processor

Blue = Backed by existing or new plumbing codes.





# *Delivery Mechanisms*

---

- How can Conservation measures be delivered?
- Delivery Mechanisms include a range

**Education,  
Public  
Awareness**

**Program Marketing,  
Rebates & Incentives**


**Legislation  
Ordinances  
Regulation**



**Information**

**Incentives & Active Programs**

**Requirement**



# Measures -> Programs -> Options -> IWM

## Options

**Table 7: Summary of WUE Program Mixes Recommended for Portfolios**

WUE Option <sup>a</sup>	Estimated Savings "Yield" <sup>b</sup>	Yield over Savings Life <sup>c</sup>	Program Cost <sup>d</sup>	Present Value Unit Cost <sup>e</sup>	Considerations
<b>WUE1</b> Current Path (2007 Planned Programs) <sup>f</sup>	40 afy	632 af	\$227K	\$469/af	<ul style="list-style-type: none"> <li>• Time to implement: Ongoing</li> <li>• Not a potential emergency drought measure <sup>g</sup></li> <li>• Has project phasing potential <sup>h</sup></li> <li>• Has funding potential</li> <li>• Promotes regional coordination</li> </ul>
<b>WUE2</b> Aggressive	150 afy	1477 af	\$718K	\$597/af	<ul style="list-style-type: none"> <li>• Implementation is ongoing</li> <li>• Is a potential emergency drought measure <sup>g</sup></li> <li>• Has project phasing potential <sup>h</sup></li> <li>• Has funding potential</li> <li>• Promotes regional coordination</li> </ul>
<b>WUE3</b> Maximize Water Savings	502 afy	7,906 af	\$9,495K	\$1,583/af	<ul style="list-style-type: none"> <li>• Implementation is ongoing</li> <li>• Is a potential emergency drought measure <sup>g</sup></li> <li>• Has project phasing potential <sup>h</sup></li> <li>• Has funding potential</li> <li>• Promotes regional coordination</li> </ul>



# *Report due in 2010...*

- Conceptual Framework for Water Use Efficiency
- Institutions and Efficiency
- Planning Models and Methods
  - Short Term Financial Models
    - Adapting the Traditional Utility Finance Model to Include Conservation Pricing and WUE Programs
  - Long Term Resource Planning
    - Benefit-Cost Models – Program Planning and Tracking
    - Avoided Cost Models – Conservation Program Benefits
    - Integrated Planning Models – Risk, Uncertainty, and Planning Portfolios
- Case Studies of Utility Conservation Implementation
- Decision Support Matrix and Best Implementation Practices



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