CDM

Integrating Demand-Side Planning & Management into the Water Supply Planning Process

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Presented at:
Straddling the Divide: *Water Supply Planning in the Lake Michigan Region,* Chicago, Illinois

February 2005

Presentation Overview

- Review importance of demand-side planning and management (DSPM)
- Present framework for integrating DSPM into water supply planning
- Cover the basic building blocks of a DSPM plan
- Provide relevant examples

What is Demand-Side Planning & Management?

- Demand-side planning and management (DSPM) is a set of activities designed to
  - Provide a better understanding of how and why water is used
  - Forecast human demands for water supplies
  - Develop prospective water-using efficiency (demand reduction) measures
  - Evaluate the benefits and costs of efficiency measures as an alternative or complement to supply development

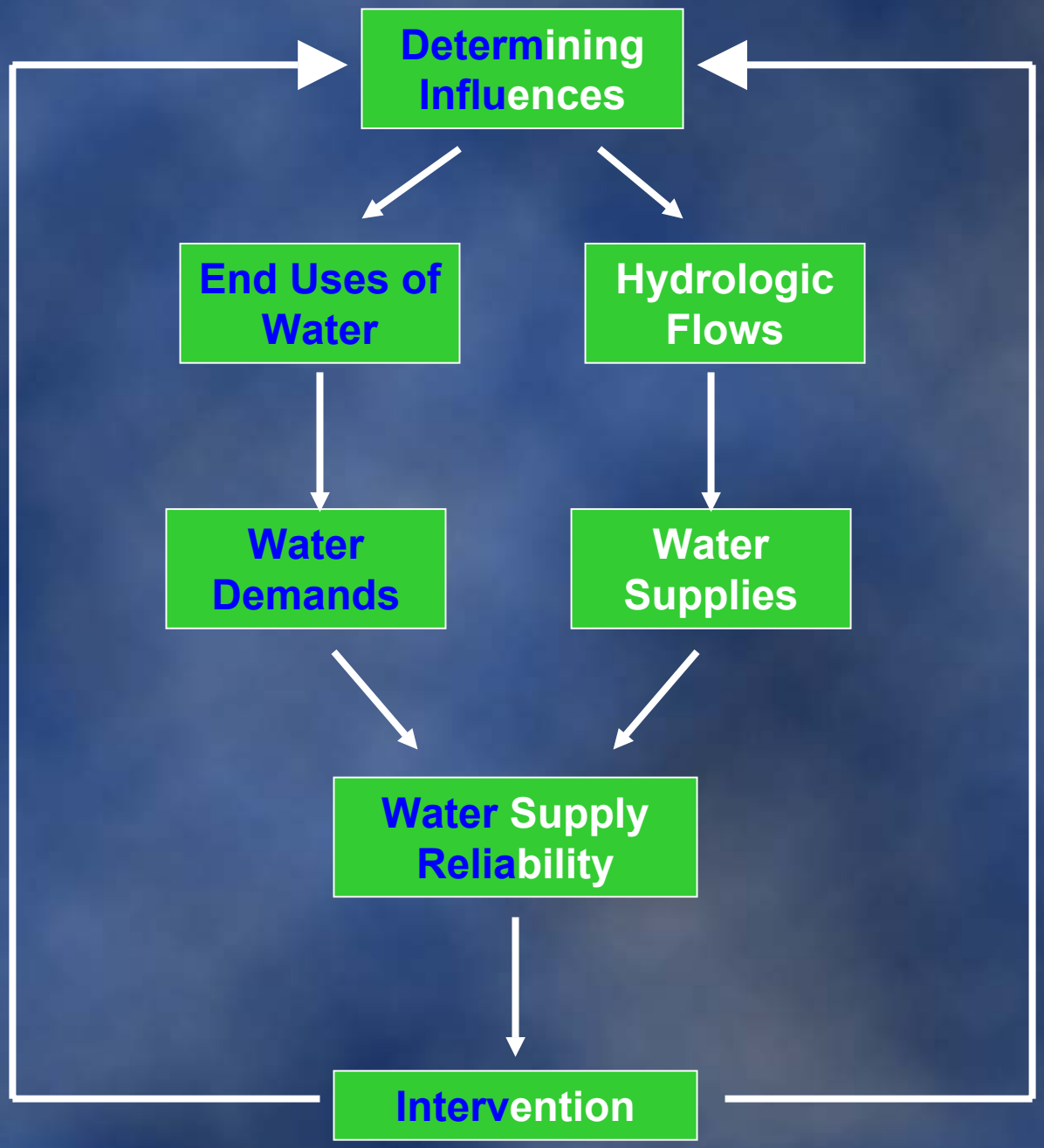
Why is DSMP Important?

- Traditional water supply planning focuses on engineering solutions with little attention to demand
- Nowadays DSMP must be considered
  - Economic costs of water supply development are rising
  - Environmental trade-off's are more important
  - Institutions and regulators require more alternatives

How does DSMP integrate?

Demand Side

- *How is water used?*
- *What are future needs?*
- *Are there beneficial measures to suppress demand?*



Supply Side

Building Blocks for DSMP

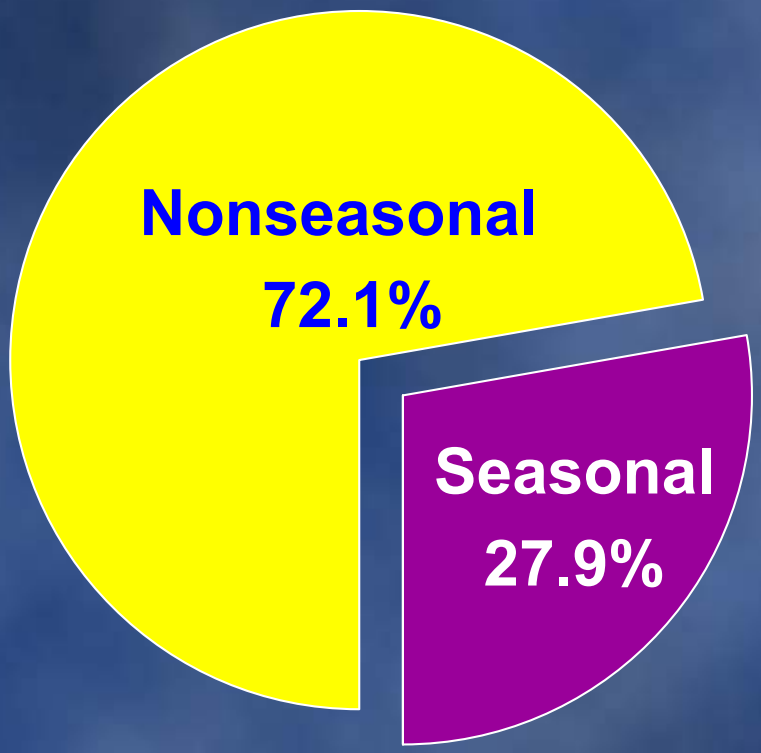
- Baseline Studies
- Water Demand Forecasts
- Programs of Conservation Measures
- Program Evaluation

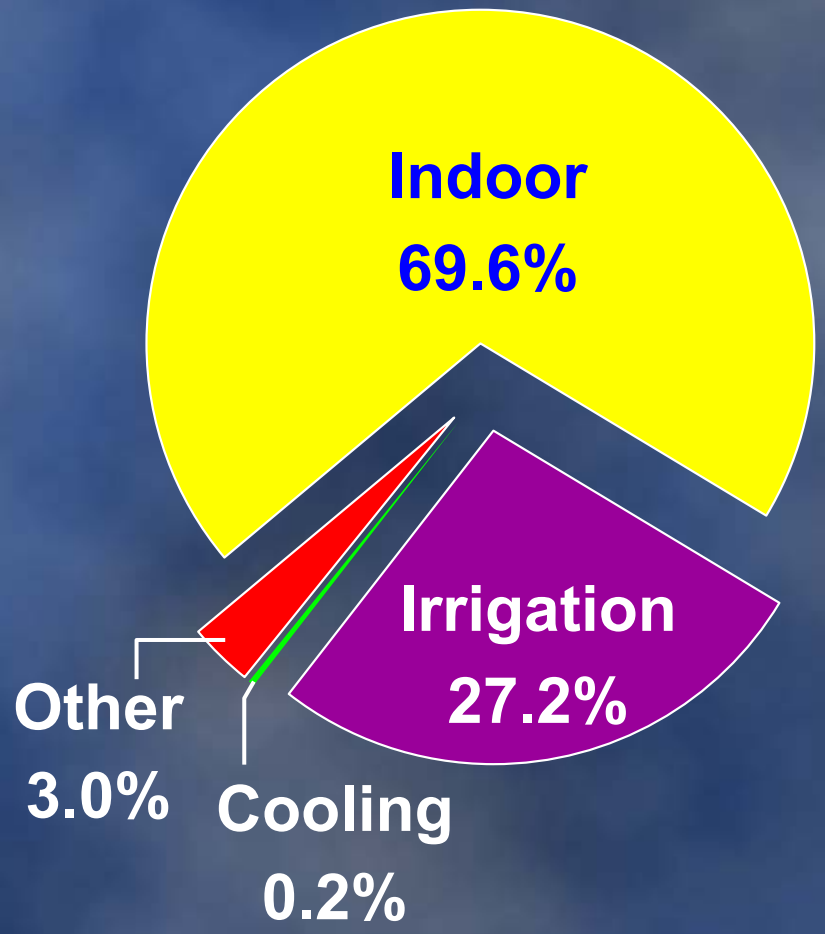
- Program Implementation
- Water Use Monitoring

Building Blocks for DSMP

- Baseline studies
  - Survey- and sampling-based method
  - Determines how water is currently used (end uses)
  - Estimates market coverage of water existing efficiency measures
  - Provides feedback on social acceptability of potential water conservation programs

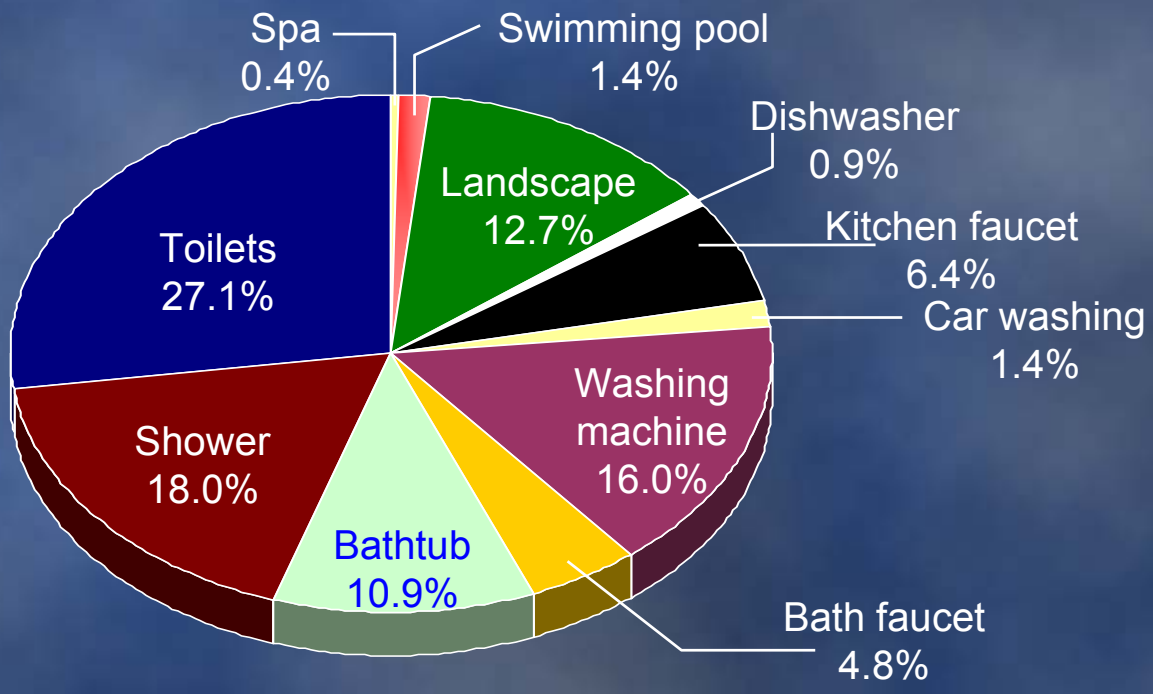
Baseline Studies—Understanding Demand





Baseline Studies—Understanding Demand

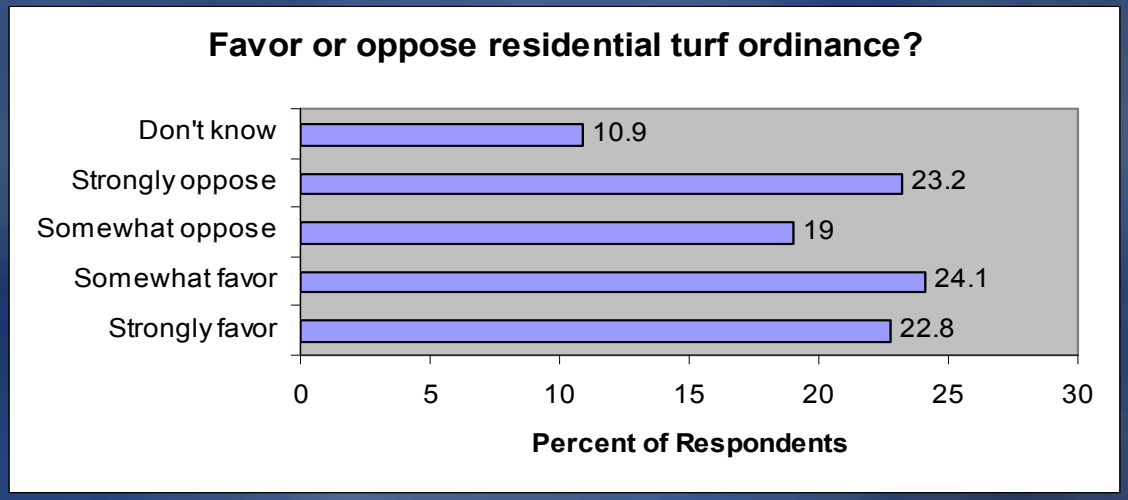
End Uses	Percent of Households with End Use
Toilets	100
Showers	100
Faucets	100
Bathtub	100
Dishwasher	75
Washing Machine	98
Water softener/treatment	15
Swimming pool	9
Irrigation	95
Other Outdoor	47
Leaks	95

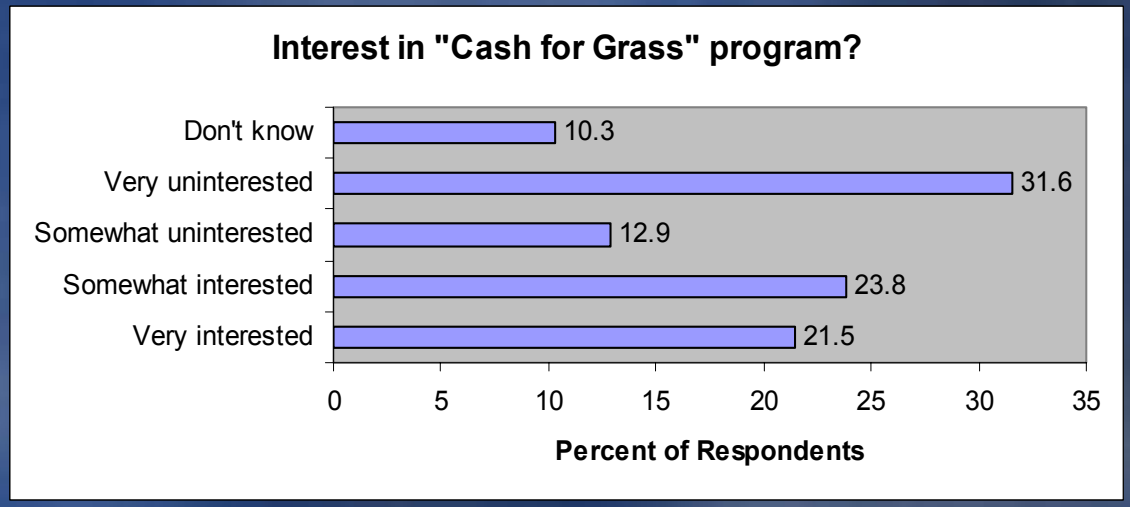


Baseline Studies—Understanding Demand

TOP FIVE OF CONSERVATION PRACTICES (SURVEY PARTICIPANTS)	
Conservation Practice	**Percent of Respondents**
Technological	
Have low-flow toilets	42.0
Have low-flow showerheads	40.7
Behavioral	
Turn off water while shaving/brushing teeth	70.7
Use dishwasher less/only full loads	69.1
Water lawn/shrubs early morning or evening	64.2

Baseline Studies—Understanding Customer Preferences

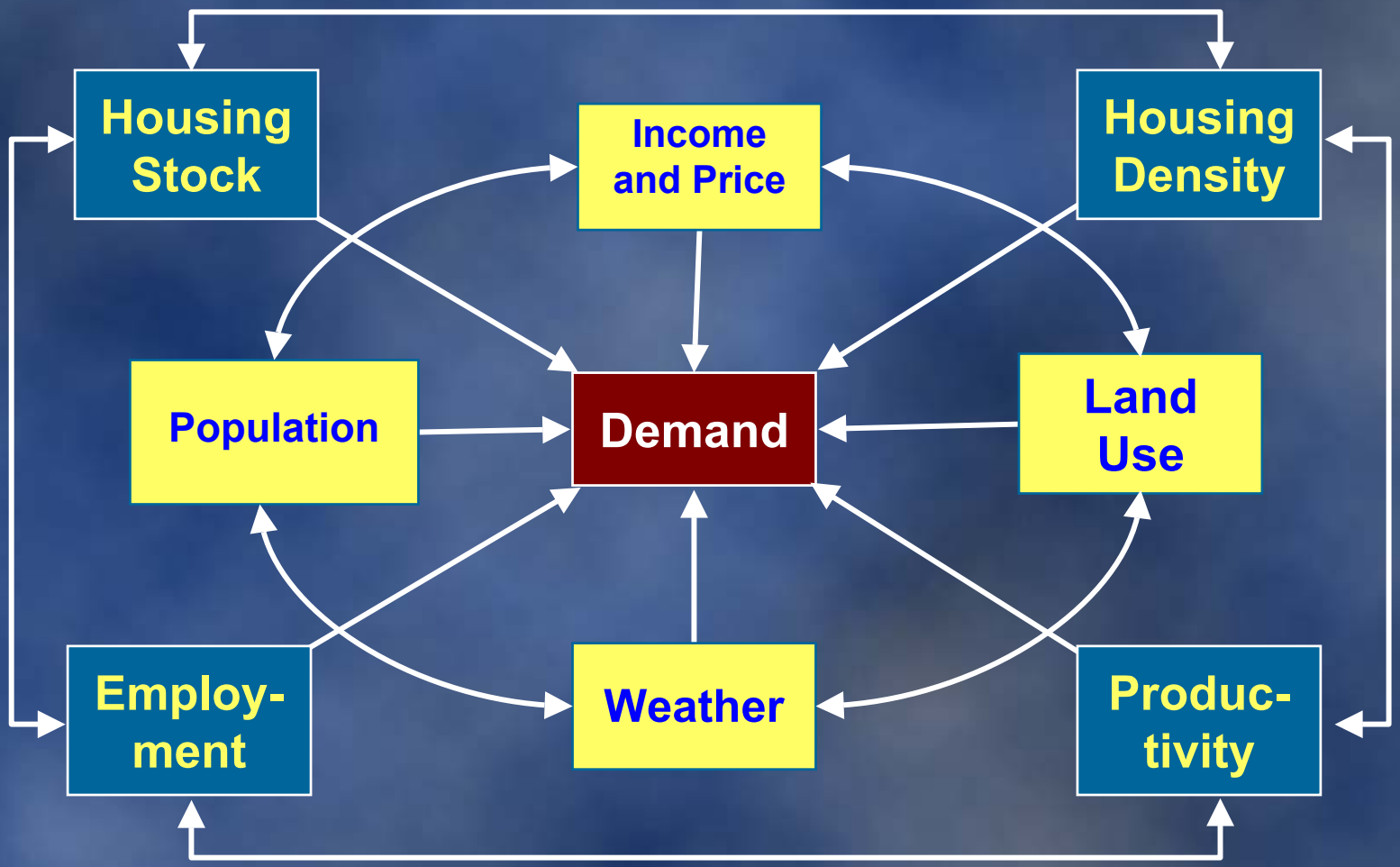




Building Blocks for DSMP

- Water Demand Forecasts
  - Projects human (household and production) needs for water
  - Establishes linkages among
    - Factors that influence water use and variation in demands
    - Water using sectors and prominent end uses
    - Geospatial trends in growth
  - Provides a (moving) baseline from which to evaluate conservation impacts

Determinants of Demand



Demand Forecasting—State of the Art

- Econometric models of demand by user sector
- Highly granular spatial units using GIS
- Risk-based demand simulations that account for uncertainty

$$
\begin{aligned}
\ln q^{SF}_{j,m,t} = {} & \alpha_{j,m} + \beta_{HS}\ln HS_{j,t} + \beta_{MP}\ln MP_{j,t} \\
& + \beta_{INC}\ln INC_{j,t} + \beta_{HD}\ln HD_{j,t} \\
& + \beta_{T}\left(\ln T_{j,m} - \overline{\ln T_{j,m}}\right) + \beta_{T1}\left(\ln T1_{j,m} - \overline{\ln T1_{j,m}}\right) \\
& + \beta_{T2}\left(\ln T2_{j,m} - \overline{\ln T2_{j,m}}\right) + \beta_{T3}\left(\ln T3_{j,m} - \overline{\ln T3_{j,m}}\right) \\
& + \beta_{R}\left(\ln R_{j,m} - \overline{\ln R_{j,m}}\right) + \beta_{R1}\left(\ln R1_{j,m} - \overline{\ln R1_{j,m}}\right) \\
& + \beta_{R2}\left(\ln R2_{j,m} - \overline{\ln R2_{j,m}}\right) + \beta_{R3}\left(\ln R3_{j,m} - \overline{\ln R3_{j,m}}\right) + \\
& + \beta_{RD01}\left(\ln RD01_{j,m} - \overline{\ln RD01_{j,m}}\right) + \beta_{RD100}\left(\ln RD100_{j,m}\right) \\
& + \beta_{FR}\ln FR_{j}
\end{aligned}
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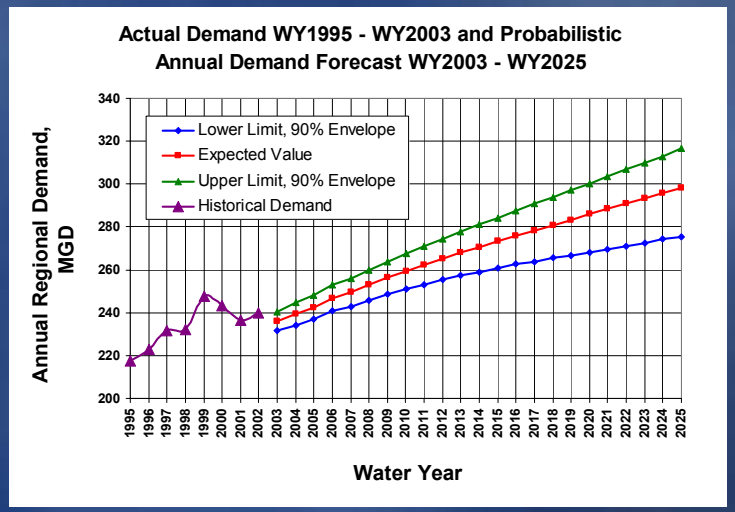
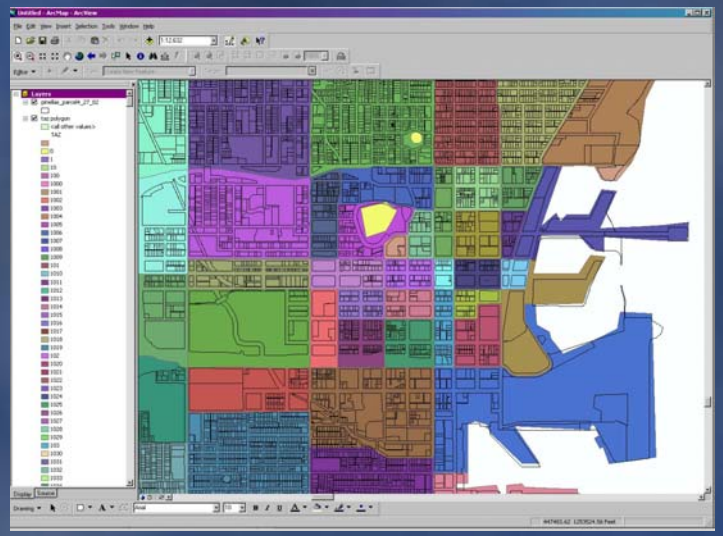
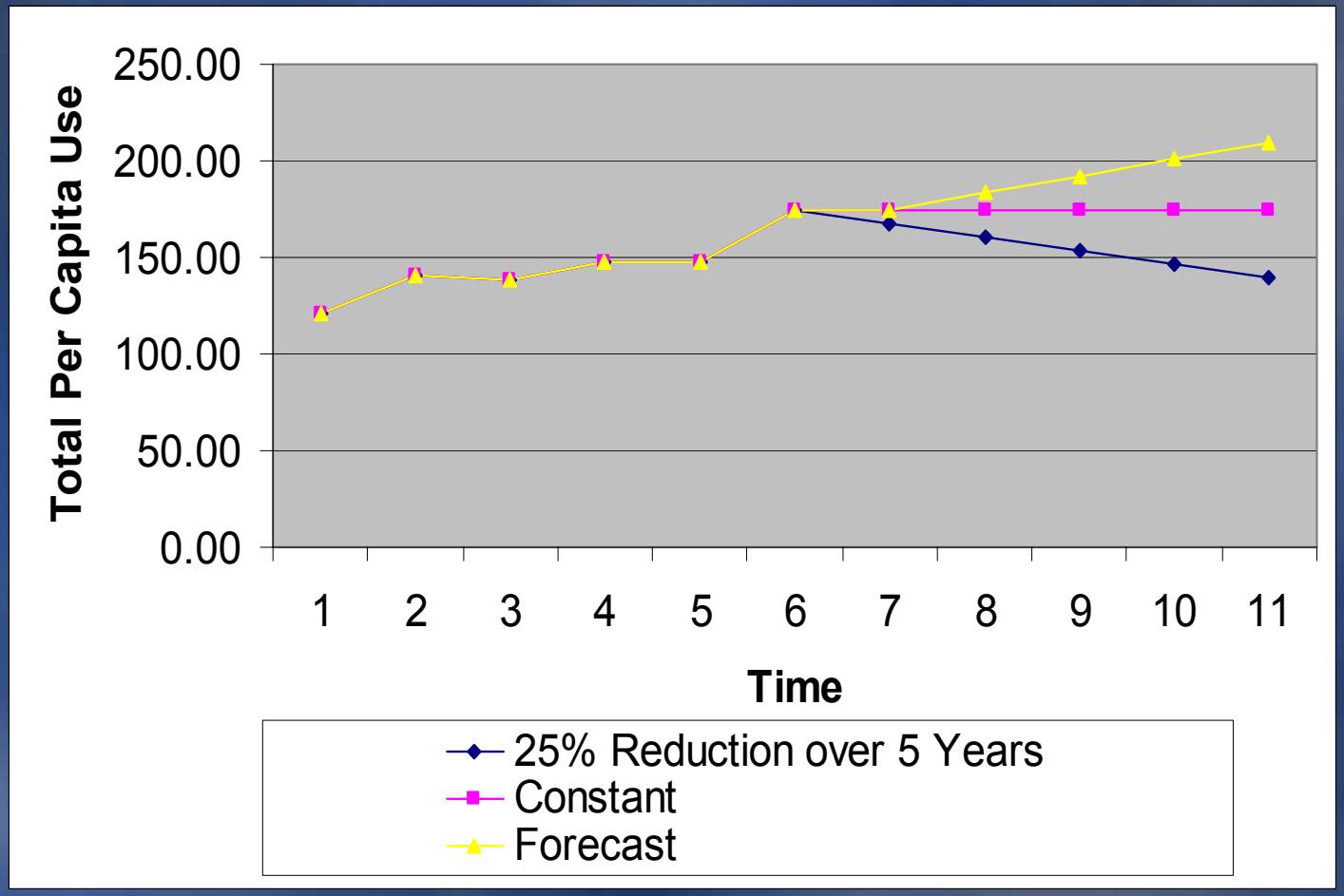




How Conservation Initiatives Can Fail: The Moving Baseline



Building Blocks for DSMP

- Programs of water efficiency measures
  - Establish technically feasible water conservation projects
  - Consider social acceptability and likely participation
  - Differentiates and accounts for passive and active measures
    - Passive: standards and self-initiated
    - Active: utility-sponsored activities
  - Defines implementation plan and targets

Programs of Water Efficiency Measures

Single-family Landscaping Workshops	
Annual costs:	$30,000
Staff:	
Coordinator	$1,9
Assistant	$3,9
Program Evaluation	$15,
	Every 4
Customer cost	$
Sector:	Single-
Participation:	0.15
Accounts per year:	52
Water Reduction:	Outdoo

Multifamily Submetering	
Staff:	
(First year only)	
Coordinator	$25,870
Assistant	$9,937
Program Evaluation	$15,000
	Every 4 years
Customer cost:	$-
Sector:	New MF
Participation:	90% new accts.
Accounts per year:	160
Water Reduction:	15% indoor and outdoor

Residential Washing Machine Rebate	
Rebate	$50
Annual costs:	
Marketing	$10,0
Staff:	
Coordinator	$10,3
Assistant	$4,96
(First year only)	
Assistant	$4,96
	$15,0
	Every 4
	$-
	All resid
	1%
	3,60
	12 gpd pe indo

Eliminate Single-Pass Cooling	
Rebate	
A:	$12,825
B:	$6,413
C:	$-
Annual costs:	
(Only through 2010)	
Marketing	$5,000
Staff:	
Coordinator	$10,348
Assistant	$9,937
Program Evaluation	$15,000
	In 4th and 8th years
Customer cost:	
A:	$12,825
B:	$19,238
C:	$25,650
Sector:	CII
Participation:	30%
Accounts per year:	312
Water Reduction:	19% indoor use

Toilet Rebate	
Rebate	$100
Annual costs:	
	$10,000
	$10,348
	$19,874
	$15,000
	years
	$-
	Accounts
	in 2000)
	2%
	1.4% existing accts
	5,450
	For 10 years
	0 gpd per acct indoor use

Screening and Formulating Programs

Program	Implementation Feasibility	Stakeholder Acceptability	Customer Acceptability	Overall Score	Overall Acceptability
Residential Information, Education and Awareness	4.88	4.73	4.81	14.42	**Good**
Property Manager Workshops	3.63	3.73	3.69	11.05	**Good**
Trade Ally Irrigation and Landscape Workshops	3.34	3.73	2.84	9.90	**Good**

Building Blocks for DSMP

- Program Evaluation
  - Estimates benefits and costs of water conservation measures
    - Implementation costs
    - Benefits from eliminated and/or deferred capital and other expenditures
  - Treats conservation measures as genuine alternatives to supply-side measures
  - Defines and applies decision-rules
    - Net economic benefits
    - Cost-effectiveness

Judging Cost-Effectiveness

Conservation Savings	vs.	Additional Supply
$ per		$ per
1000 gallon		1000 gallon

X > Y

Cost-Effective Program

Judging Cost-Effectiveness

COST-EFFECTIVENESS RANKINGS		
Project Name	**Dollars per gallon saved**	**Rank**
Toilet Leek Seekers	5.55	1
Front-Loading Washing Machine Rebate	6.71	2
Ultra-Low-Flush Toilet Replacement	7.24	3
Water Savings Kits	9.68	4
Marginal Cost per gallon of added wastewater treatment capacity = $12.17		

Judging Net Economic Benefits

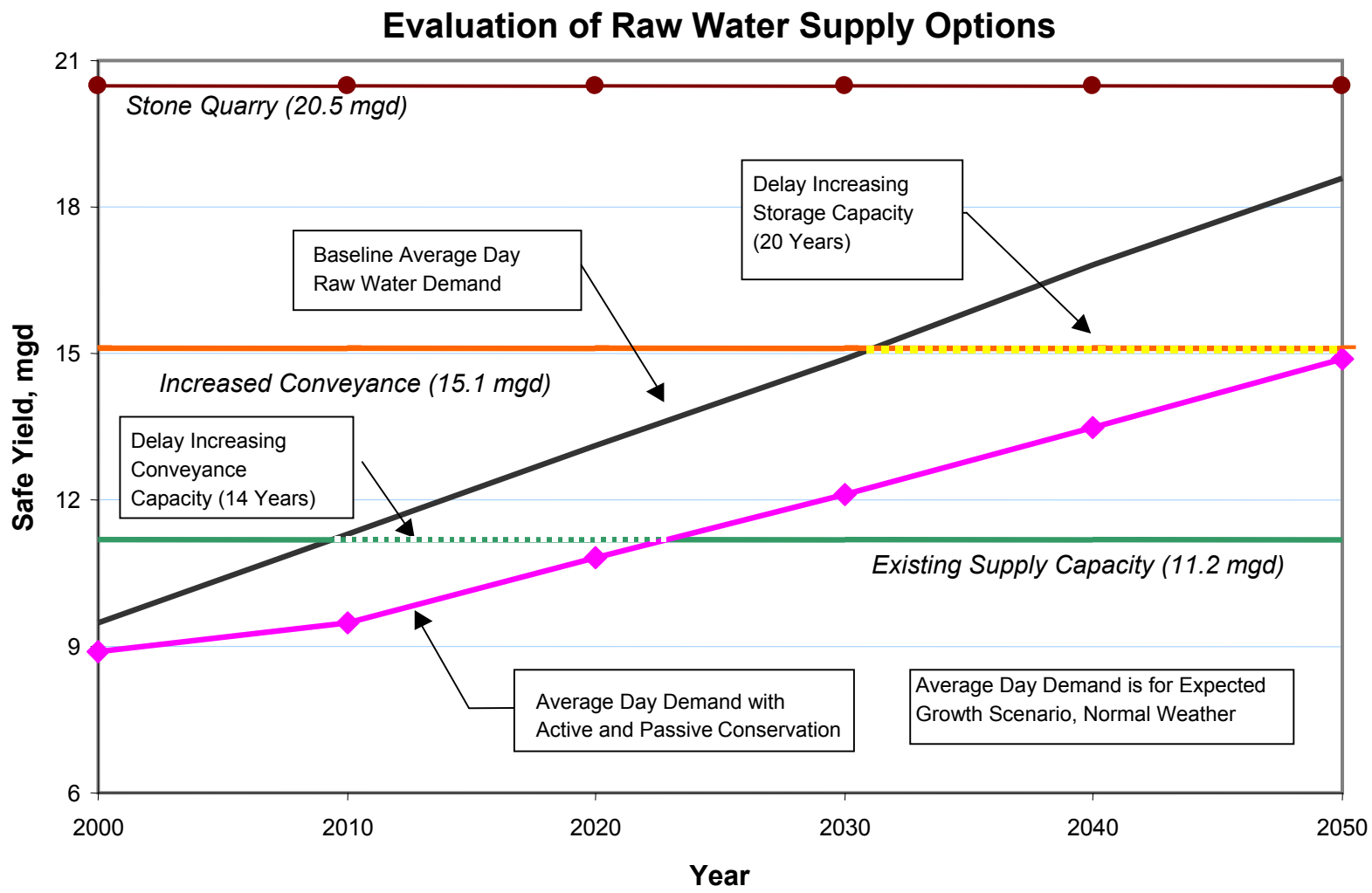
Discounted Benefits from Conservation	vs.	Discounted Costs from Conservation
•Chemical costs •Energy costs •Deferred capital costs •Other	>	•Implementation costs •Customer costs •Hardware •Labor

Net economic benefits

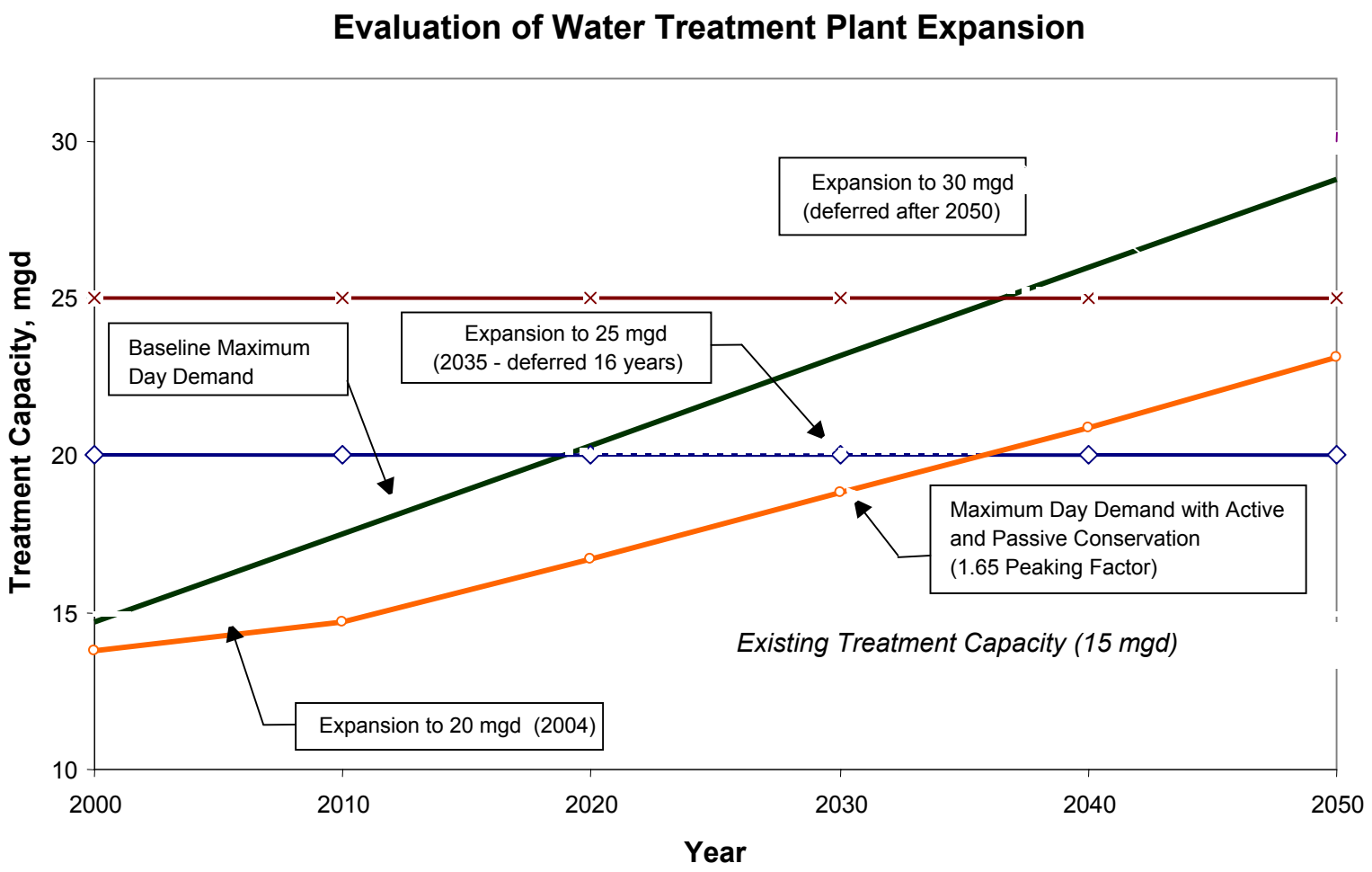
Judging Net Economic Benefits

Benefit-Cost Item	Discounted Present Worths, $1,000				
	Single Family Audit	Ultra-Low Flush Rebate	Large Landscape Audit	Industrial Audit	Government Retrofit
Cost of water treatment capacity (foregone)	57.70	57.34	26.48	21.69	17.26
Cost of water distribution capacity (foregone)	23.02	33.69	15.55	12.98	10.14
Variable cost of energy and chemicals (foregone)	42.38	36.83	17.12	14.99	12.64
Incentives for participants	—	—	—	—	—
Water heating cost reduction	1,139.08	—	—	—	25.62
Customer water/wastewater bill reduction	—	—	—	—	—
Customer hardware and installation cost	—	-436.27	—	—	—
Utility program administration cost	-99.99	-54.88	-54.82	-9.77	-4.74
Utility program implementation cost	-641.02	—	-182.98	-37.26	-12.04
Other costs to participants	-51.28	—	—	—	—
Other costs to utility	-61.54	-7.04	-28.83	—	-1.06
NET PRESENT VALUE	**408.35**	**-370.34**	**-207.49**	**2.63**	**47.83**

Benefits of Demand Management



Benefits of Demand Management

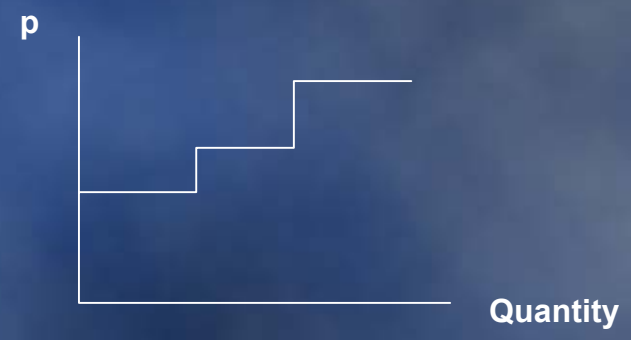


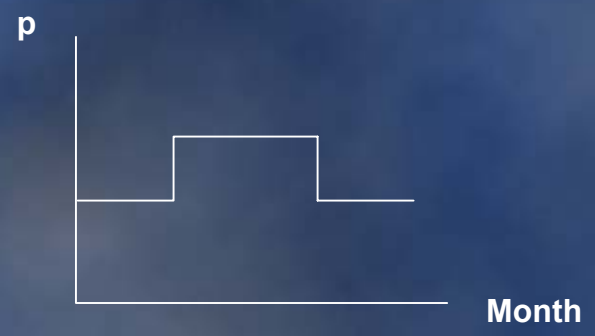
Role of Pricing in DSPM

- The price of water is a control variable for water providers
- Water use is responsive to price
- Pricing strategies can be used to provide incentives to be more efficient

Conservation-Oriented Rate Structures

- Increasing Block
- Ratchet Rates
- Seasonal Rates
- Penalty Surcharge
- Combination





Pricing Considerations

- Infinite number of ways to design a water rate structure
- Water providers tend to equate price with revenue then balance other objectives
- Economists equate price with cost
  - The “best” price is the one that is economically efficient
  - Equal to the marginal cost of water service
  - Provides incentives to use water at an economically efficient level—not necessarily at a lower level

Recommended Pricing Strategy

- Prepare a proper foundation for DSPM
  - Avoid flat rates
  - Adopt marginal cost pricing to the extent practicable
  - Reduce rate structure complexity—enhance “signal-to-noise” ratio

Closing Remarks

- Demand-side planning and management is fundamental component of water resources planning
- Understanding how water is used is critical to forecasting future water supply needs
- Conservation measures can be cost-effective and buy time for more costly capital investments
- Use pricing strategies carefully to support conservation objectives