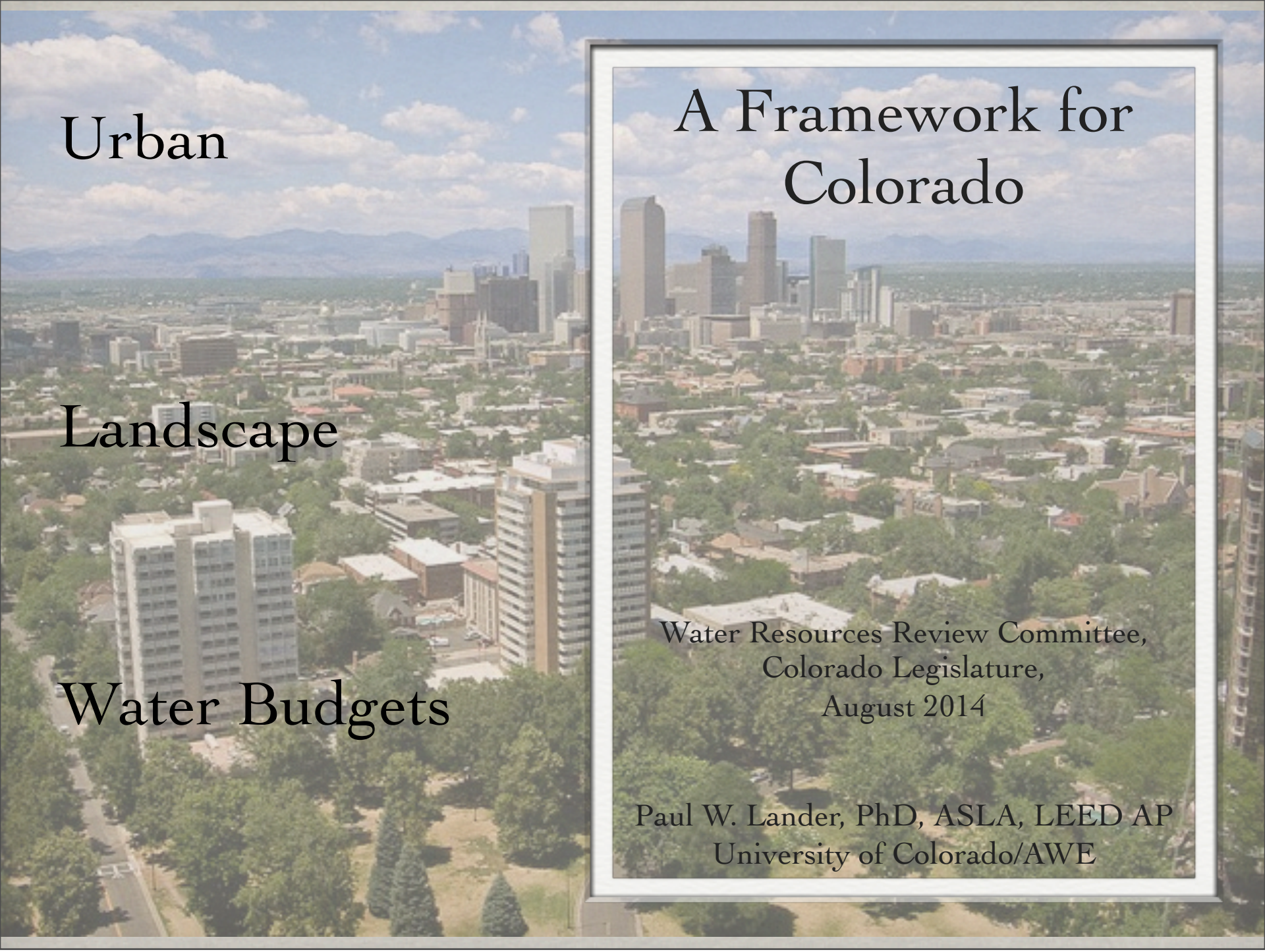
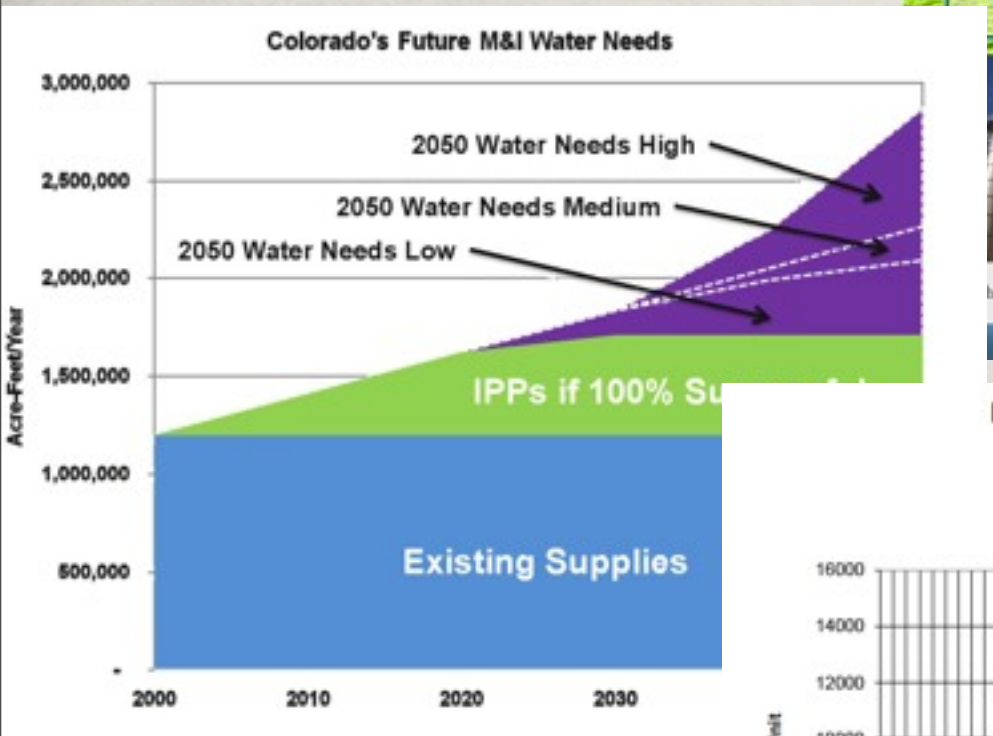

Urban
Landscape
Water Budgets
A Framework for Colorado
Water Resources Review Committee,
Colorado Legislature,
August 2014
Paul W. Lander, PhD, ASLA, LEED AP
University of Colorado/AWE

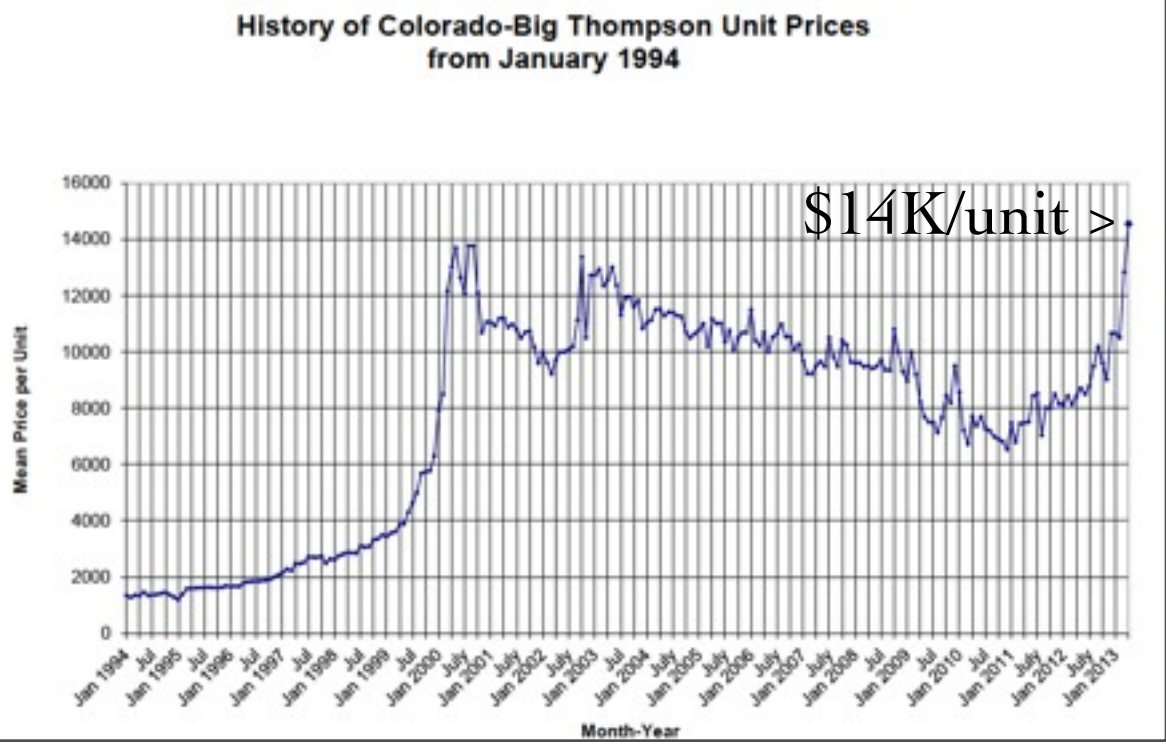

Urban : Growing Influence in Western Water
Landscape
Water Budgets :

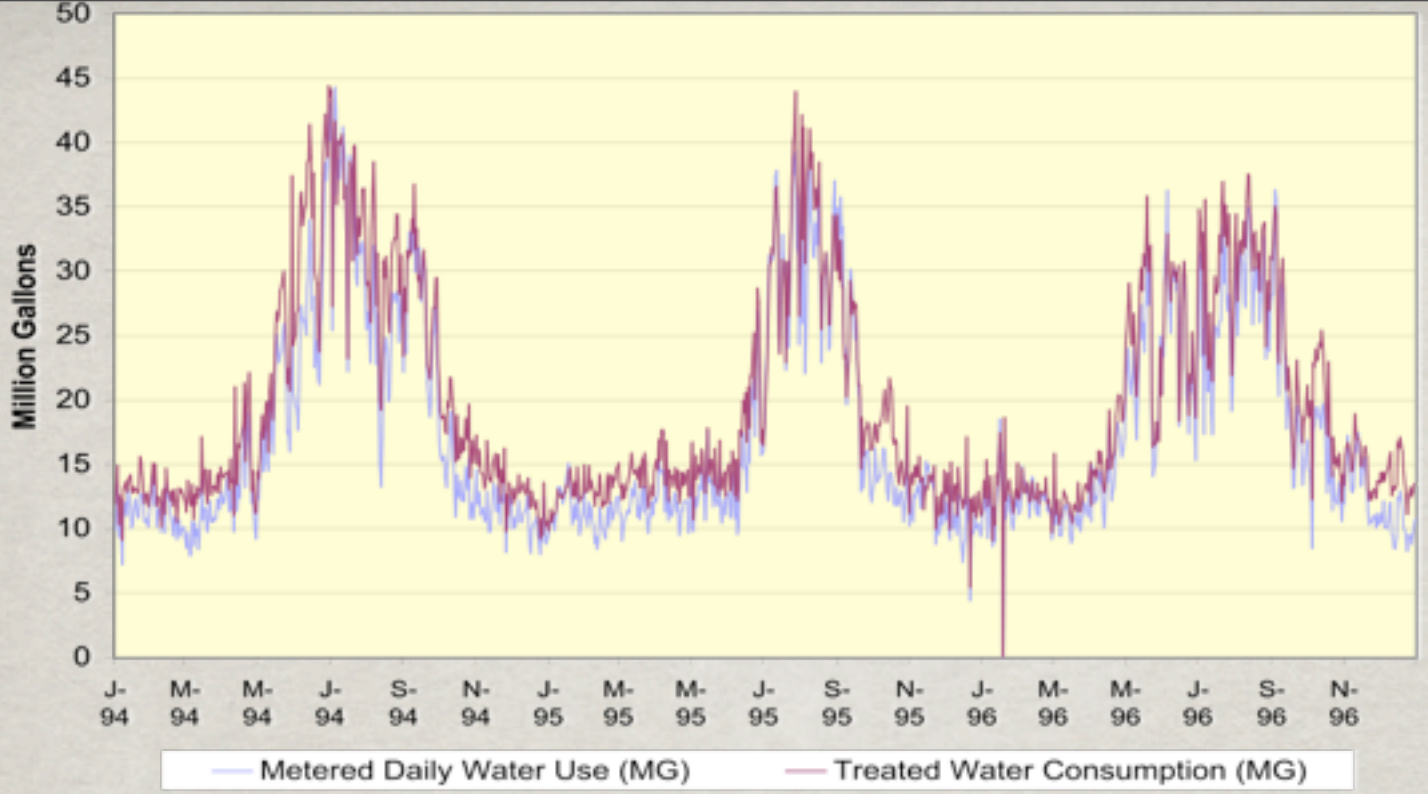

Urban : Growing Influence in Western Water
Landscape : Largest Demand, Most Potential
Community Assets
Water Budgets :


Urban : Growing Influence in Western Water
Landscape : Largest Demand, Most Potential
Community Assets
Water Budgets : Definable Goals,
Measurable Results

the Future = Re-Allocation







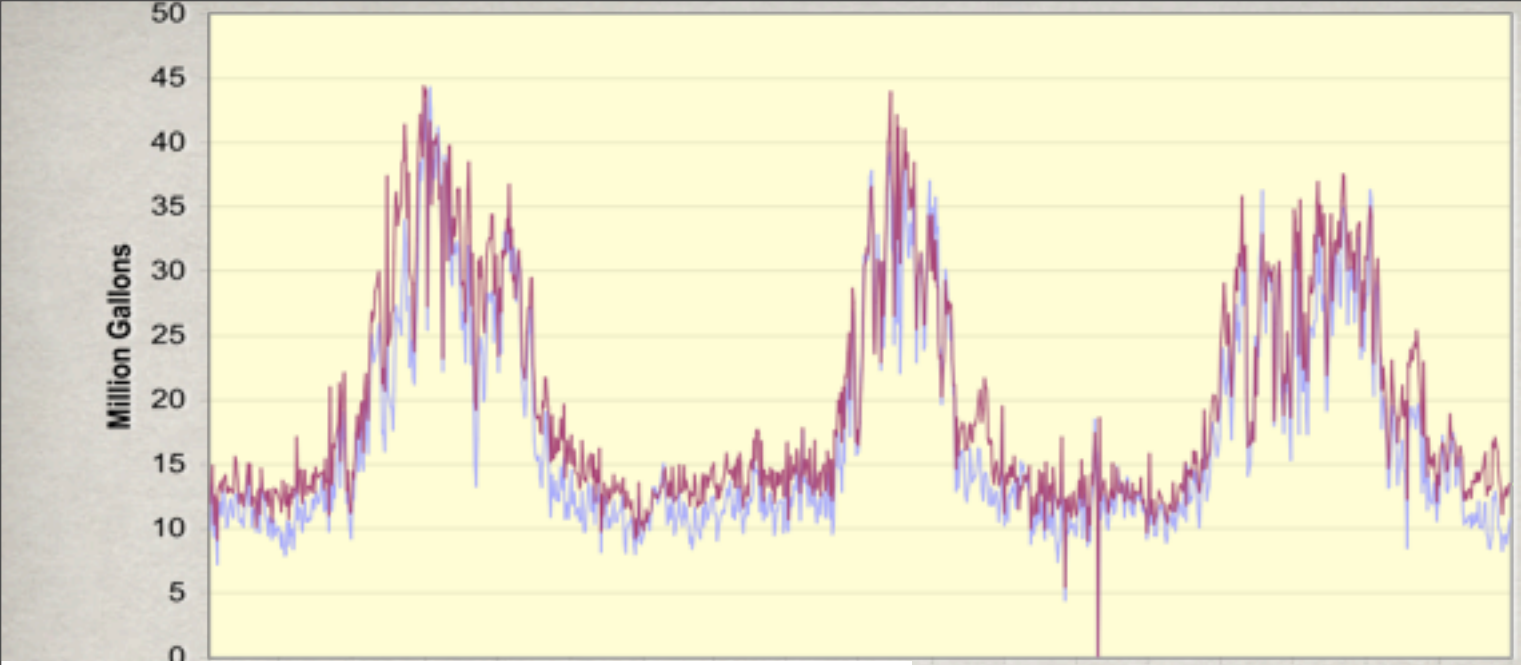
City of Boulder,
1994-1996

Cities Usage Patterns:

~95% Treated Drinking Water

Peak Demand from Outdoor Use

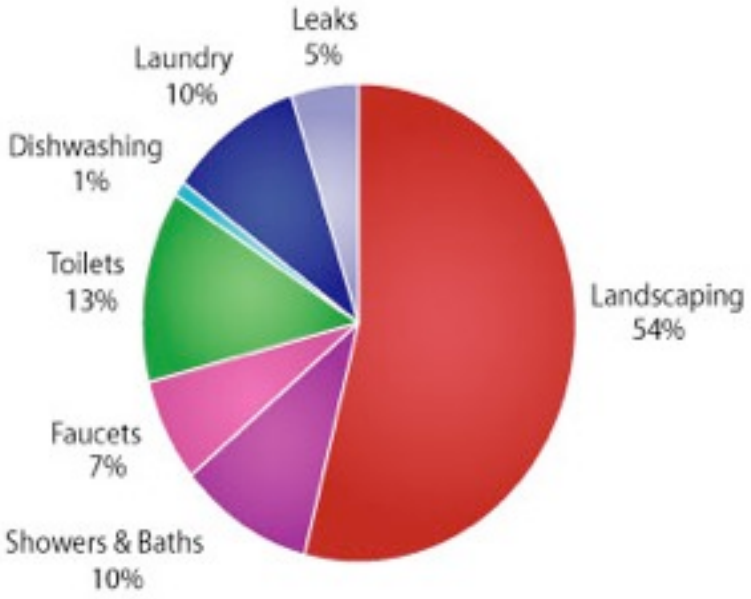
Residential ~ 65% of Total Demand



City of Boulder, 1994-1996

Single Family Residential Water Use

100% Drinking Water (EPA Standards) <5% consumed



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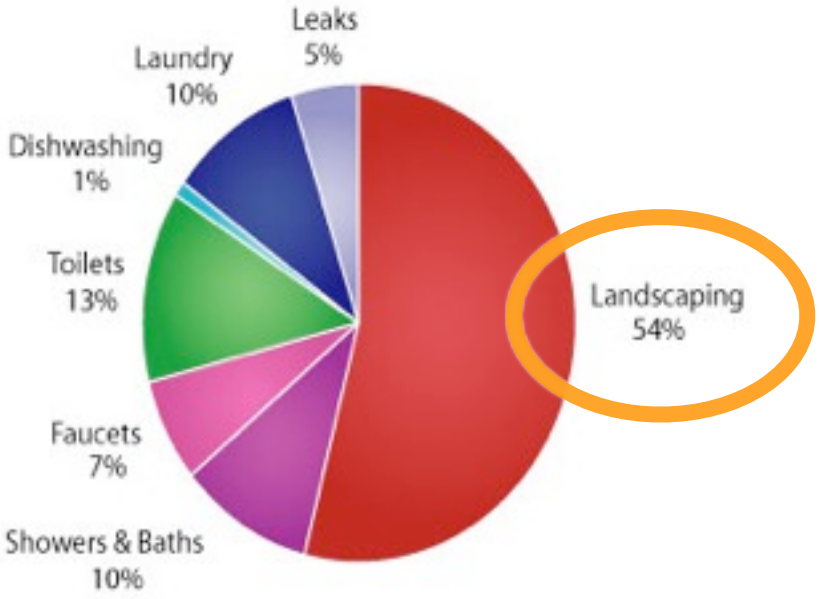


Cities Usage Patterns:

~95% Treated Drinking Water

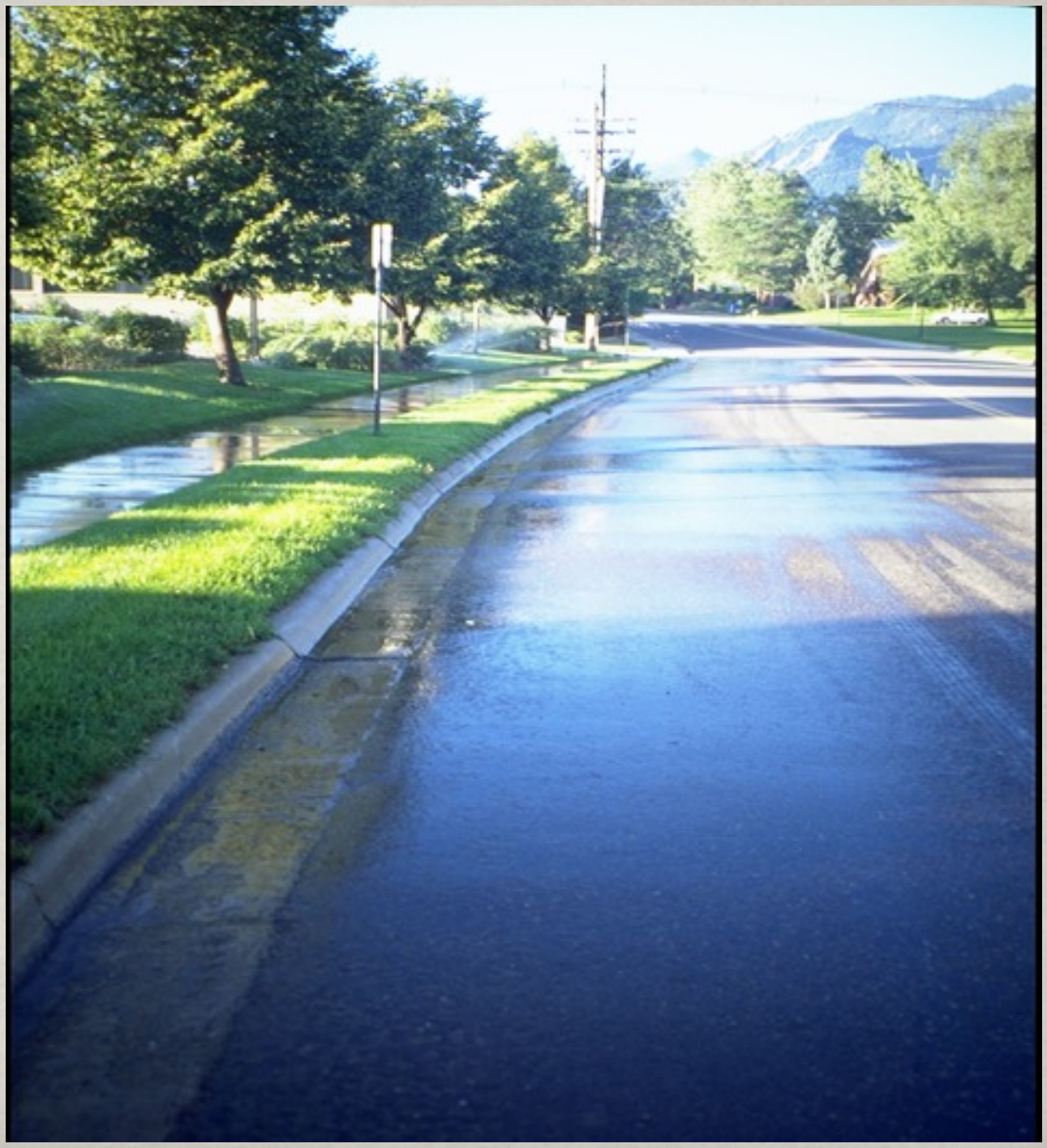
Peak Demand from Outdoor Use

Residential ~ 65% of Total Demand

Green
Infrastructure
Important, and
We Can Do Better

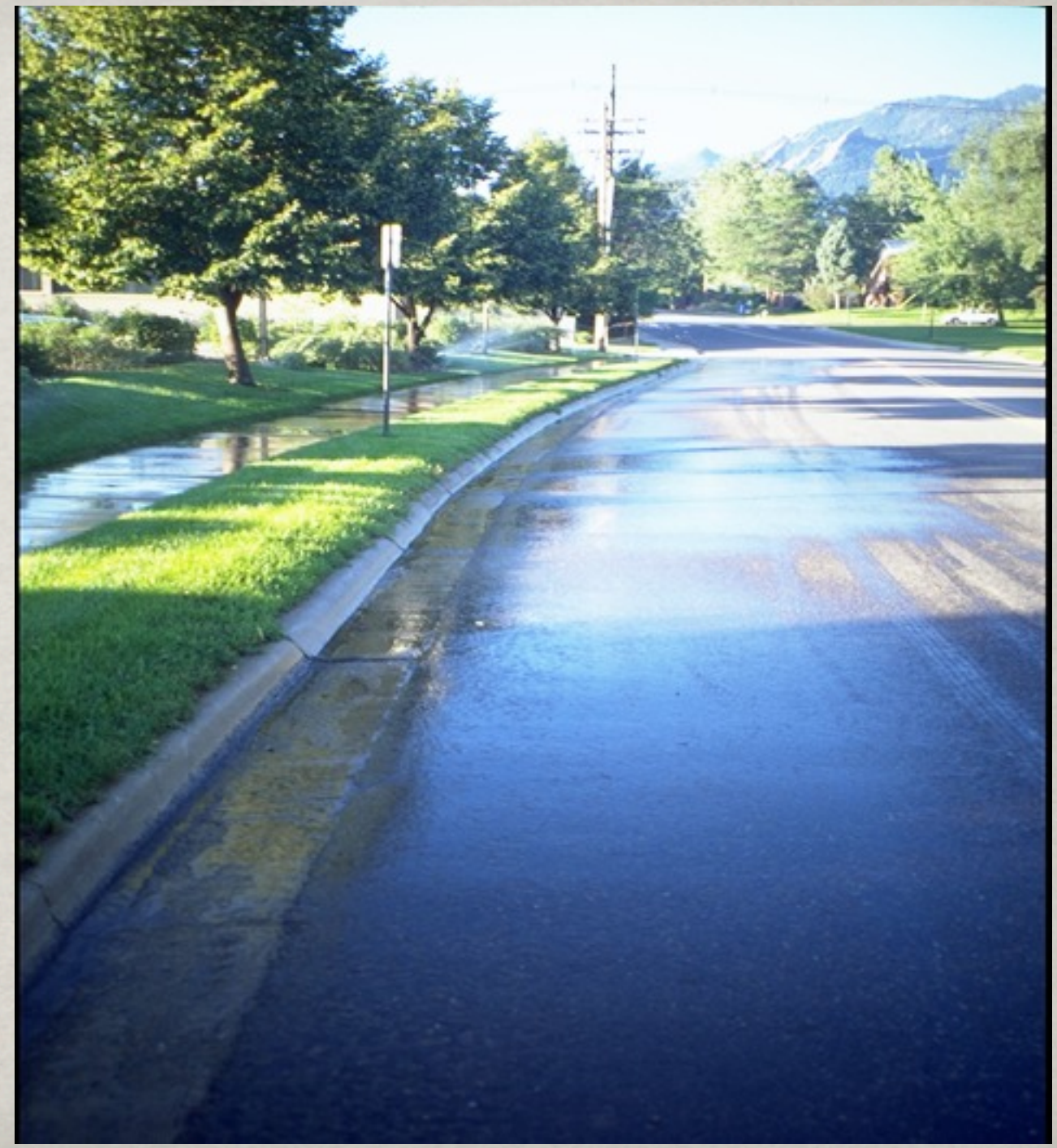
55% average measured efficiency,
CRC Slow the Flow 2004-2013

Response?



Response?

Yes, a *waste* of water

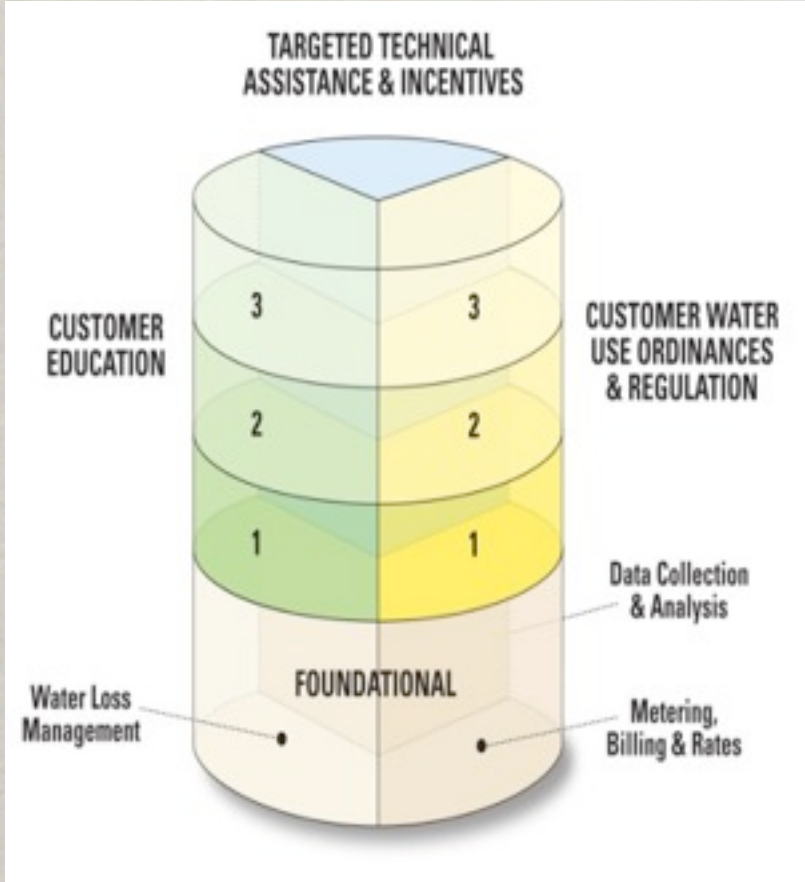


Response?

Yes, a *waste* of water

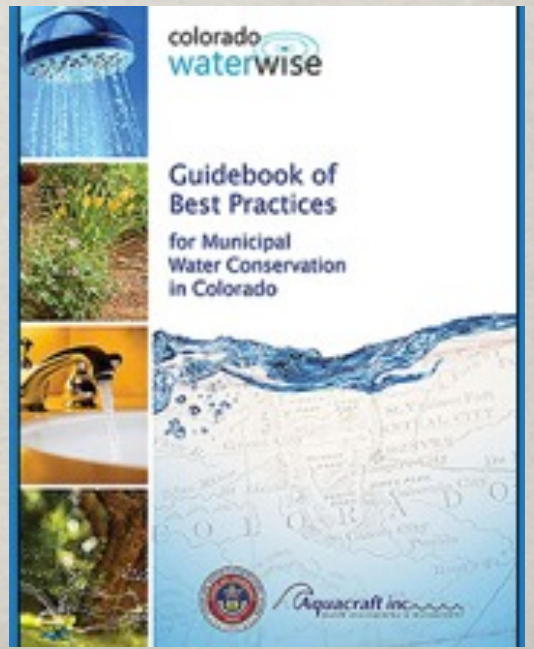
Kenny, in Colorado Water (CSU), 2010 ,and others

Definable Goals, Measurable Results

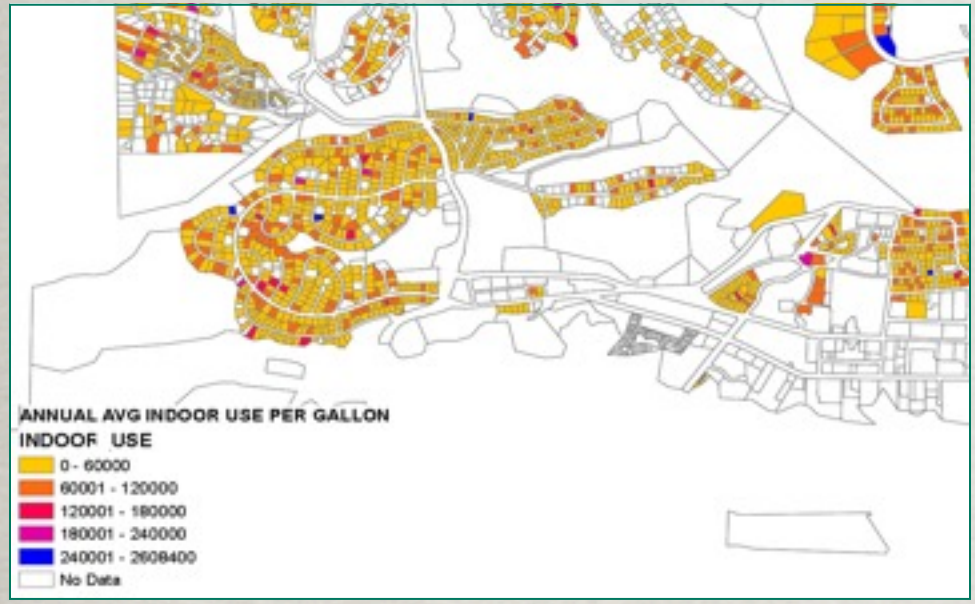


STATE OF COLORADO ^

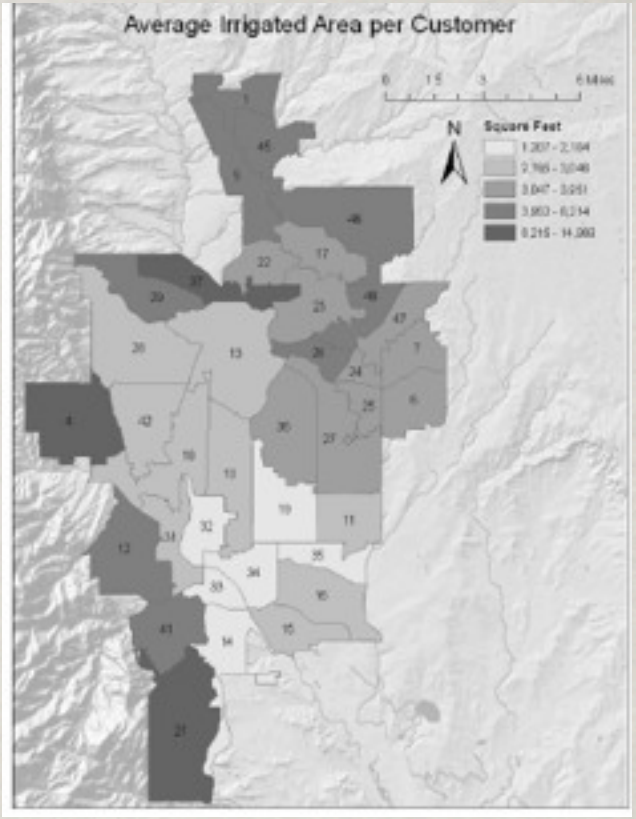
- **Data Tracking (minimum)**
  - By Customer Types
  - Monthly/Seasonal/Annually
  - By Water Supply Type
    - Treated
    - Raw/Reuse/Reclaimed
  - By Connection/GPCD



GIS & Customer Information Systems



M. Dickens ^
Veolia Water, CA



Scott Winter ^
Colo Springs, CO
influence ~ prosperity

Texas Water Development Board, Tech Note 12-01

State-wide measurement of landscape water use:
Urban water use is increasing in the West, so *without guidance*, landscape water use will also increase.

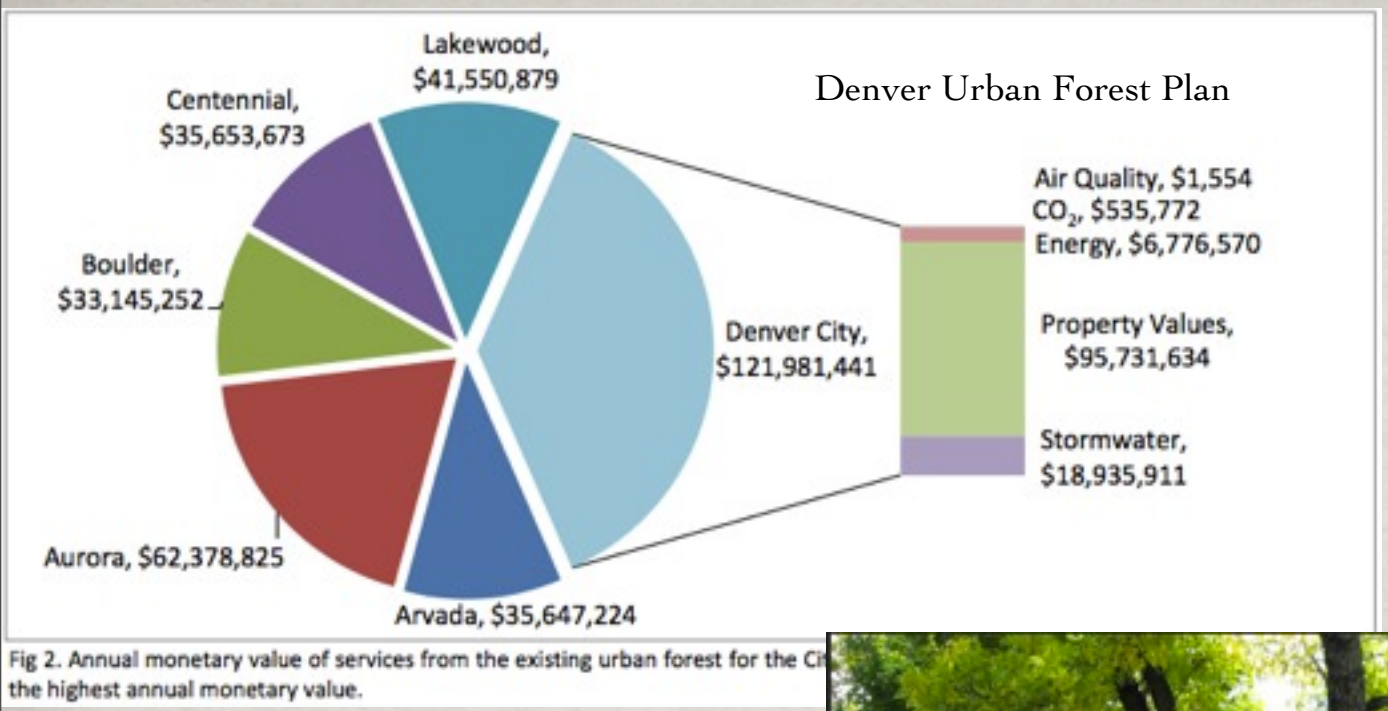
Green Infrastructure Benefits and Practices

This section, while not providing a comprehensive list of green infrastructure practices, describes the five GI practices that are the focus of this guide and examines the breadth of benefits this type of infrastructure can offer. The following matrix is an illustrative summary of how these practices can produce different combinations of benefits. Please note that these benefits accrue at varying scales according to local factors such as climate and population.

Benefit	Reduces Stormwater Runoff				Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Community Livability					Improves Habitat	Cultivates Public Education Opportunities
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding								Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture		
Practice																		
Green Roofs	●	●	●															
Tree Planting	●	●	●															
Bioretention & Infiltration	●	●	●															
Permeable Pavement	●	●	●															
Water Harvesting	●	●	●															

Step 2: **Benefit Valuation** resource unit * price	Annual Benefit $
Value of Annual Avoided Treatment Cost: 71,100 gal * $0.0000919/gal = $6.53 *(Example 1.6)*	$6.53
Value of Annual Building's Cooling Savings: 1,122 kWh* $0.0959/ kWh = $107.60 *(Example 2.5)*	
Value of Annual Building's Heating Savings: 36,158,750 Btu * $0.0000123/Btu = $444.75 *(Example 2.5)*	
Annual Off-site Water Treatment Electricity Savings will not be valued here because the value has already been accounted for above *(Example 1.6)*.	
The Total Annual Electricity Savings will not be valued here to prevent double counting. Instead, it is used to quantify "Air" and "Climate" benefits.	$107.60 + $444.75

Center Neighborhood Technology, 2010

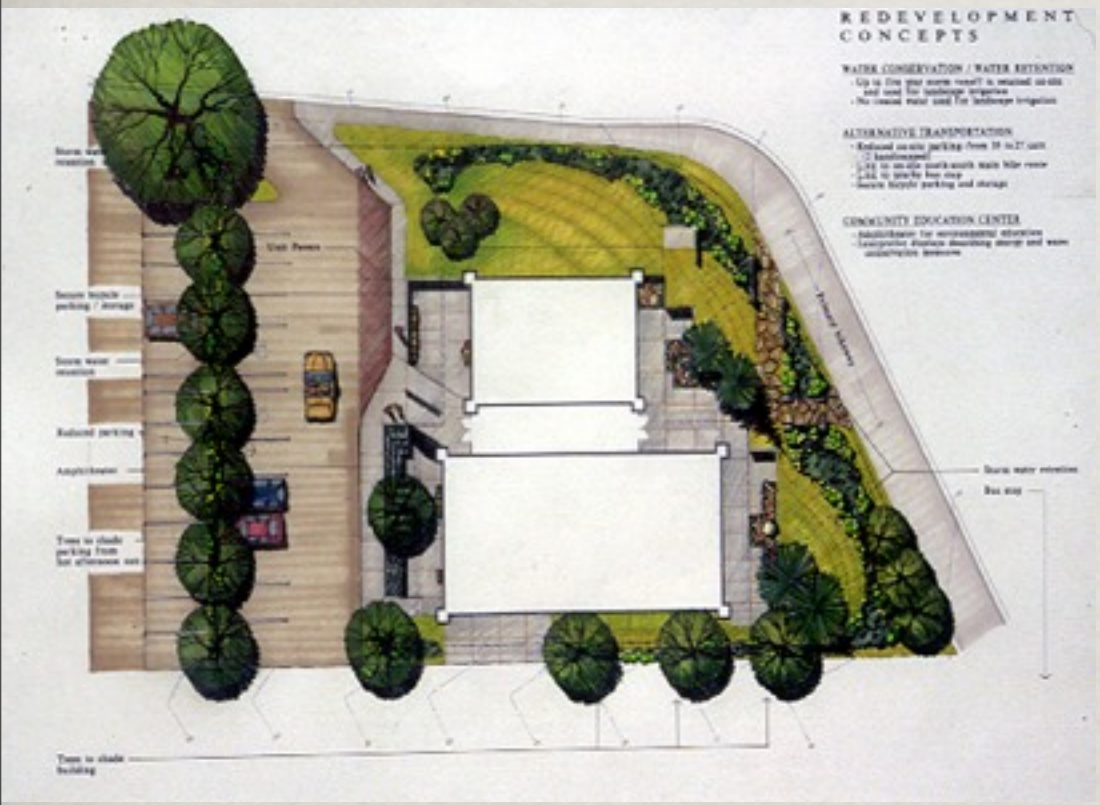


Denver Urban Forest Plan

Fig 2. Annual monetary value of services from the existing urban forest for the Ci
the highest annual monetary value.

Landscapes are valuable assets for many Colorado cities.

Water Budgets Explained



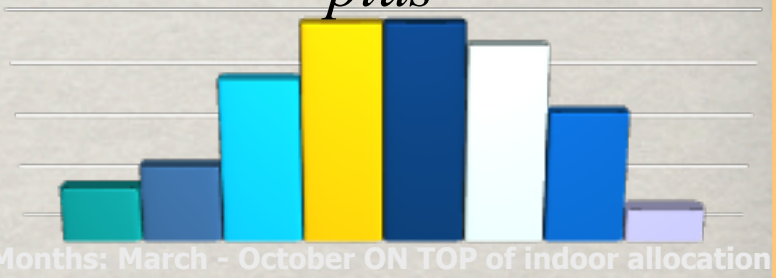
1. Calculate ^

2. Allocate >

WATER BUDGET

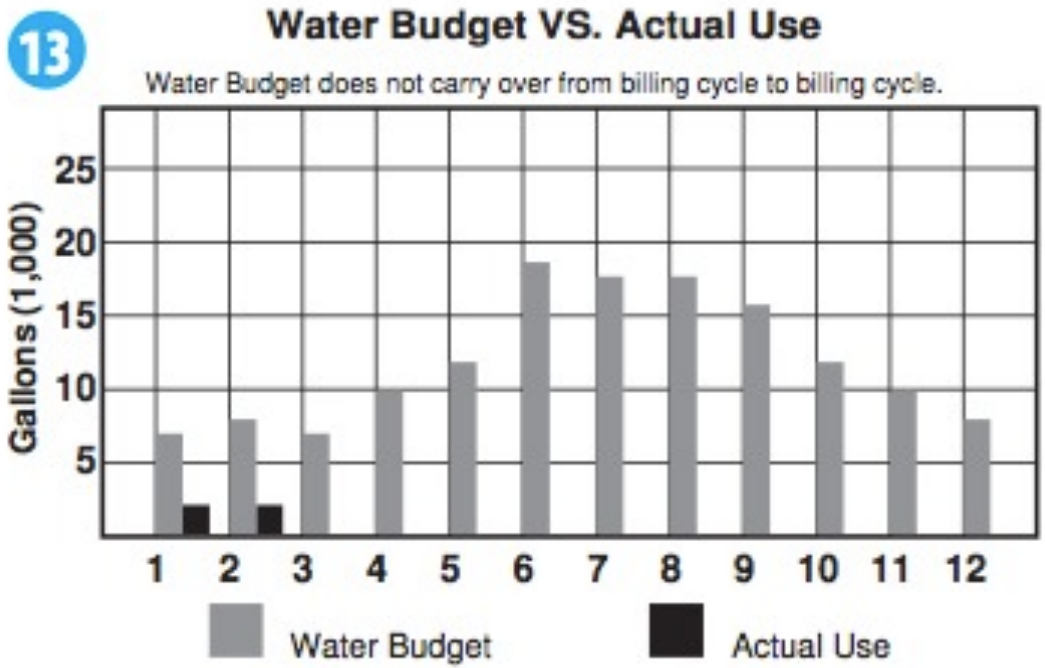
Indoor (5000 gal/month)

plus



Outdoor Allocation
15 gal/sq.ft x LS sq.ft.
(ET curve Mar-Oct)

Water Budgets Explained



3. Measure & Report

4. Educate and Charge

Boulder, CO	**$/1000 gallons**	**(% of budget)**
Block 1	2.25 (3/4 base)	0% - 60%
Block 2	**$3.00 ("base rate")**	61% - 100%
Block 3	$6.00 (2 x base)	101% - 150%
Block 4	$9.00 (3 x base)	151% - 200%
Block 5	$15.00 (5 X base)	> 200%

Rate Structure ('91) & Plant Material Selection Reduces Water Use Irvine Ranch, CA

circa 1970s circa 1990s circa 2000s

Public LS ~1990-2010

Doubled Area while Total Use Increased <4%
Avg Use Declined :3.5 AF/ac to 1.9 AF/ac
Improved Water Quality with reduced dry weather runoff
High Community Satisfaction
Relatively Quick Implementation

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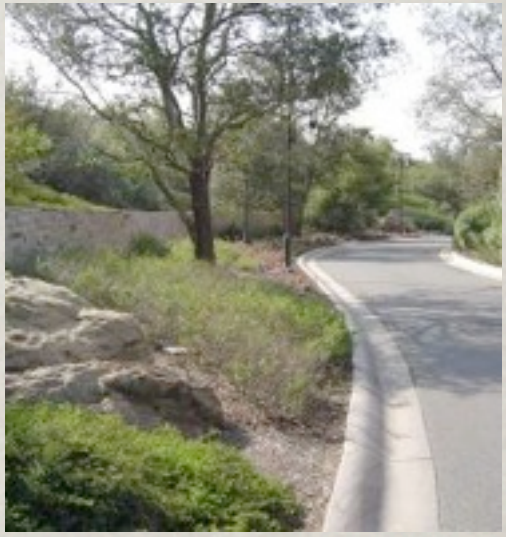

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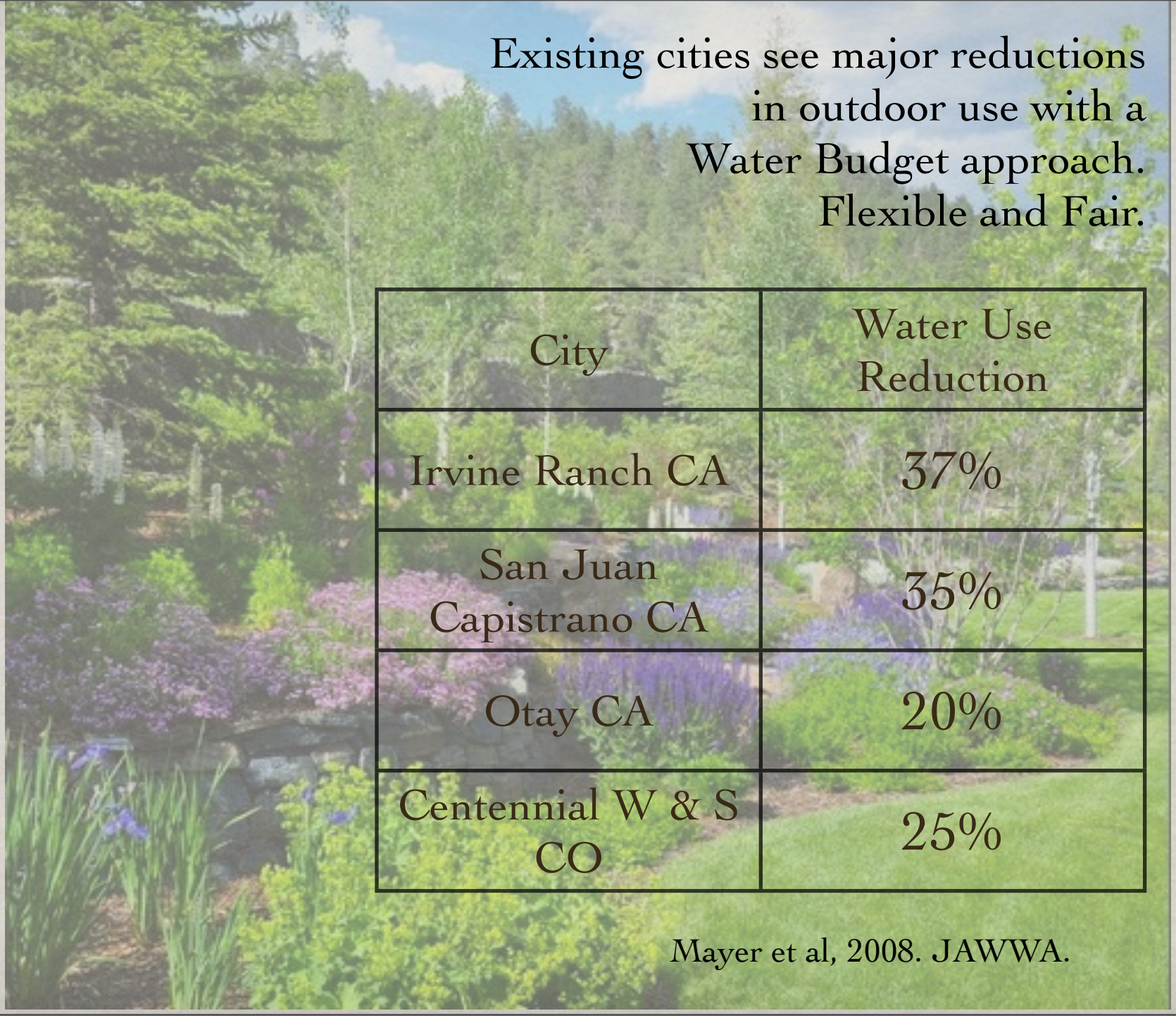
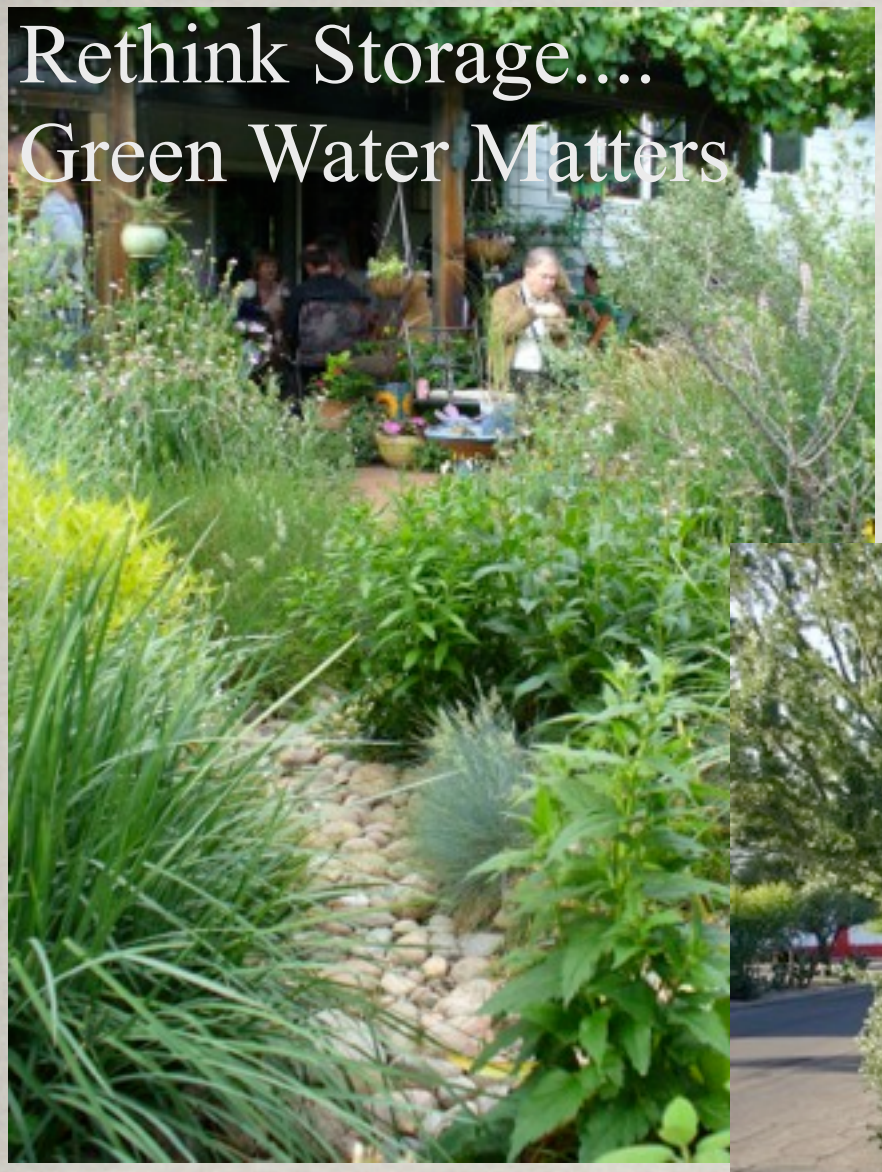


Existing cities see major reductions in outdoor use with a Water Budget approach. Flexible and Fair.

City	Water Use Reduction
Irvine Ranch CA	37%
San Juan Capistrano CA	35%
Otay CA	20%
Centennial W & S CO	25%

Mayer et al, 2008. JAWWA.

Rethink Storage....
Green Water Matters



^ Marcia Tatroe,
Aurora, CO

Water in Biosphere (km3)	
Groundwater	4000.0
Freshwater Lakes	125.0
Soil Moisture	67.0
Rivers	1.2

after Wetzel, SUNYesf.edu
1 km3 ~ 264 Bg

Brad Lancaster:
Tucson, AZ >

POLICY EVOLUTION :

Prescription to Performance to Zero Water

Prescription

Many CO HOAs pre-2009: No buffalograss or Xeriscape allowed

Sustainable Sites/ASLA (2009): reduce potable water use for irrigation by 50% from baseline

EPA (2005): Turfgrass shall not exceed 40 percent of LS area

Performance - Endorsing Water Budgets :

GreenCO California Landscape Contractors

Irrigation Association U.S. EPA 25+ Water Providers

Zero Water/Offsets:

Colorado Water Innovation Cluster

AWE White Paper, *September 2014*

Optimizing Outdoor Water Use

Action	Avg Savings	Time Frame
Restrictions/Drought	10-15%	Reactive
Water Budgets	25-30%	Existing: Educate &Manage
Zero Water/Offsets	50%+	Future: Planning & Management

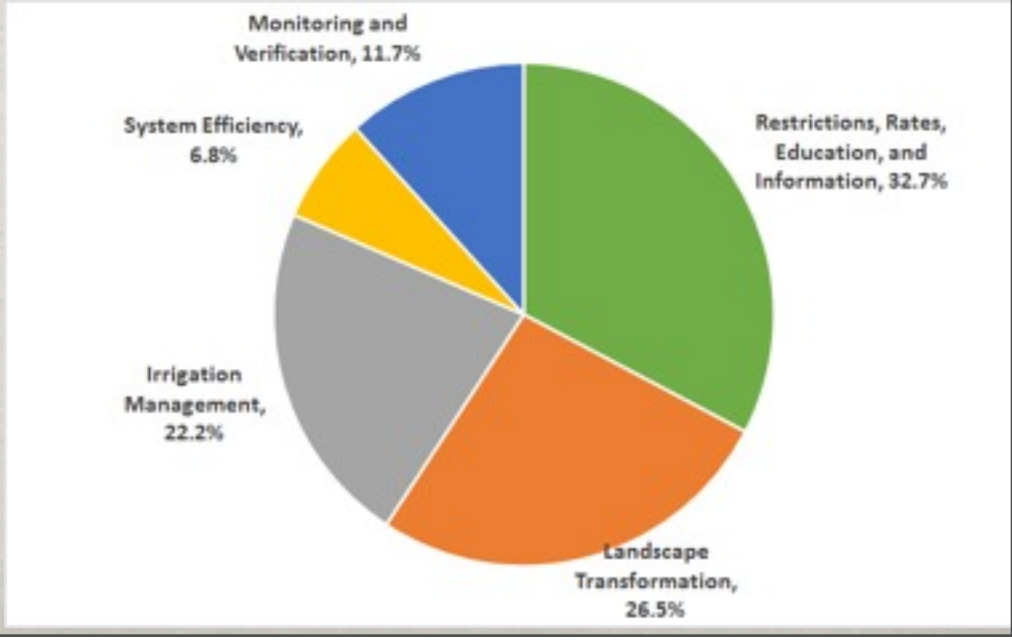
<u>AWE, Sept 2015:</u>

170 Studies Reviewed

Industry Reviewers

>Thin on Robust Documentation

> Ripe for Further Research



Urban
Landscape
Water Budgets

.Getting the Most for Our Water: Treated Dr Wtr

.measure to manage :
 little measurement now, what is shows poor effic (CRC STF) (Alb-others: top 10% use 25% of wtr)
= little wtr management/value/productivity (PK demand graph)
little research to document implementable savings (AWE)

. definable goals = water budget (HRnch/Bldr/EPA paper/CA LCC/EPA/IA)
   real targets give tools their effectiveness, flex between communities

.water key to urb LS assets/green infra (Denver > Drought 7% 'let LS go'; rocks ^ urb heat island)
(CNT: GrInfr becoming more important- in West needs water, for Diversity of LS types)
  currently little diversity (TX irrig LS inventory) using Huge Amounts of Water/Infra

.Water Offset Programs : Approaching Net-Zero Water (AWE & CWIC)