



# Water Efficiency in Commercial Buildings

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April 19, 2013

ASHRAE  
Sustainability Track



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 **DENVER WATER**  
denverwater.org



# Why does Denver Water care?

- Reduce water costs & energy (heating) costs for our customers
- Reduce operating costs (water treatment, pumping)
- Reduce wastewater discharge & costs
- Save potable water for expanding population

*Water is our most precious resource,  
and irreplaceable.*

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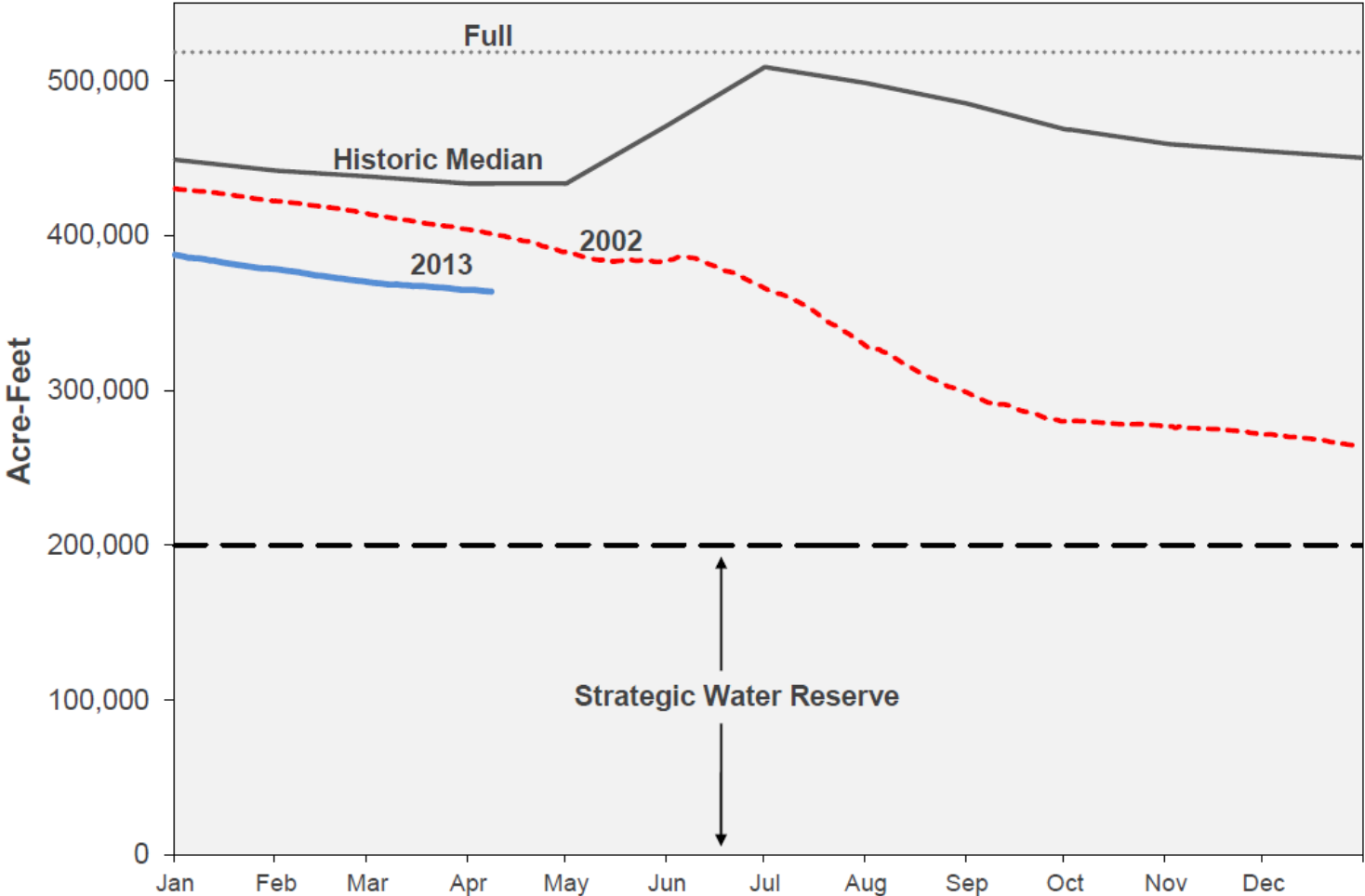




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# SUPPLY RESERVOIR CONTENTS

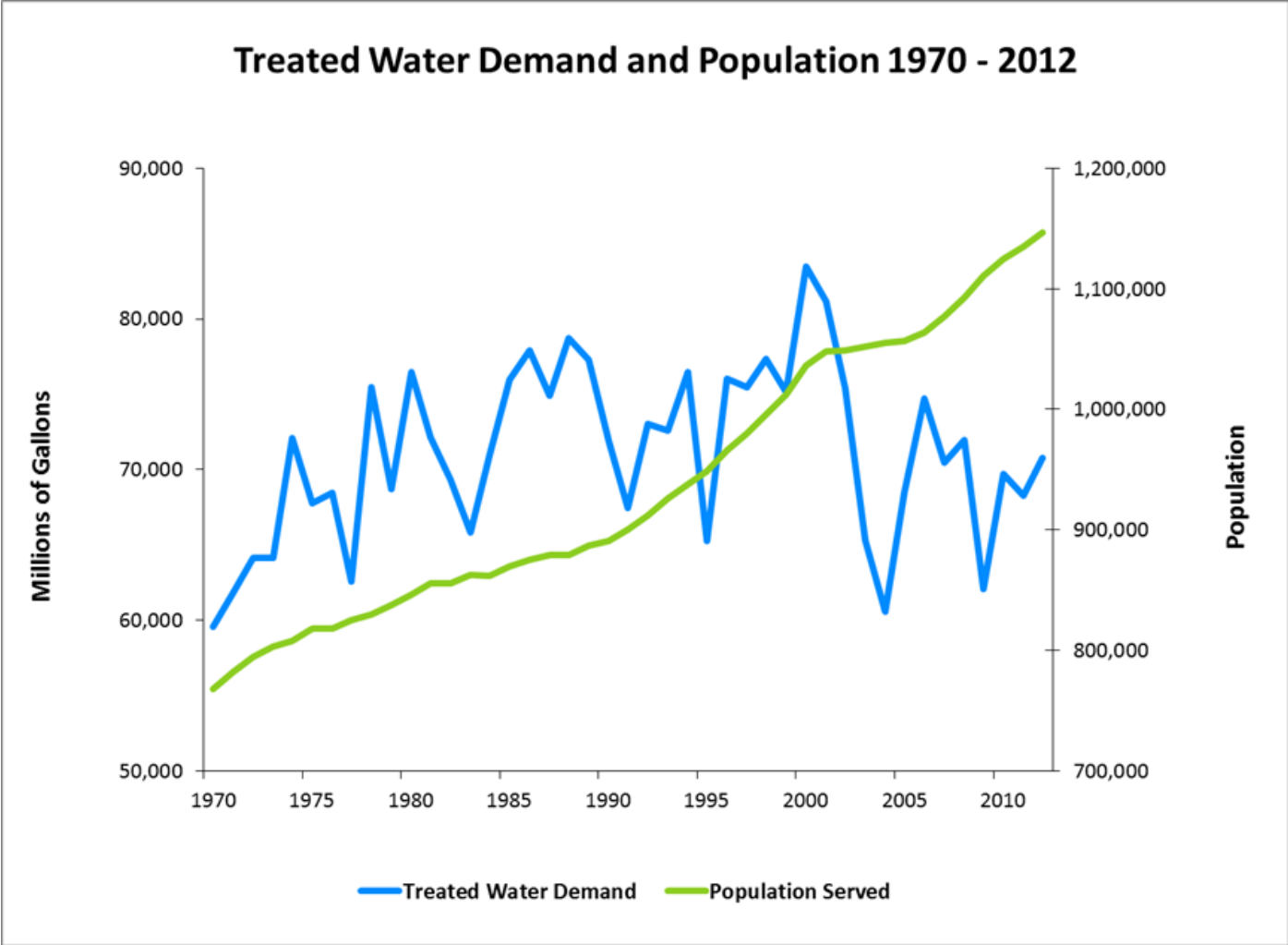


Note: The Board has designated 200,000 acre feet of stored water to protect against unforeseen circumstances such as a dam or tunnel failure, a water quality crisis, climate change or catastrophic drought.

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# Annual Treated Water Demand and Customer Growth



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# 2013 Rates (Inside City of Denver)

All Other (Non-Residential)			
	Monthly Consumption (Gallons)	Rate per 1,000 Gallons	Drought Charge (per 1,000 gal)
<b>Winter</b>	All consumption	\$1.78	\$0.30
<b>Summer</b>	All consumption	\$3.57	\$0.60

- Winter bills have billing periods ending on October 28 through May 2.
- Summer bills have billing periods ending on May 3 through October 27.

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# Indoor Water Uses

- Fixtures must meet standards set by Energy Policy Act of 1992

Fixture	EPAct of 1992 Standards for Plumbing Fixture Water Use
Water Closets (gpf)	1.6
Urinals (gpf)	1.0
Shower Heads (gpm)*	2.5
Faucets (gpm)**	2.2
Faucet Replacement Aerators**	2.2
Metering Faucets (gal/cycle)	0.25

\* When measured at a flowing water pressure of 80 pounds per square inch (psi).

\*\* When measured at a flowing water pressure of 60 pounds per square inch (psi).

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# Toilets



Toilet Age	Water Consumption
Pre-1950	7 gpf
1950 – 1980	5 - 5.5 gpf
1980 – 1994	3.5 - 4.5 gpf
1994 – Present	1.6 gpf

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# Toilet Selection



- WaterSense
- Established by utilities for rebate programs
  - MaP test measures the ability of the toilet to flush properly
  - Los Angeles SPS specification addresses reliability of savings and component durability
- High Efficiency Toilets (HET)
  - Saves additional 20% over low flow toilet
  - Dual-flush, pressure-assist
- Ultra Low Flow (ULT)
  - Meets Federal 1.6 gallon per flush standard



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# Urinals



Urinal Age	Water Consumption
1950 – 1994	1.0 gpf to > 4.0 gpf
1994 – Present	1.0 gpf
High Efficiency	0.5 gpf to ZERO

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# Waterless Urinals: The Debate

- On the market since 1991
- Plumbing Union opposition
  - IPC accepted waterless urinals in 2006
  - UPC accepted waterless urinals in 2009 – BUT water still has to be piped to the urinal & capped off
- Issues: smell, clogged drain lines, maintenance staff training
- Army Corp of Engineers: only waterless urinals since 2010
- Cartridge vs Cartridgeless
  - \$40 each, not environmentally friendly

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# Faucets

- Replace aerator
  - Inexpensive
  - Several options
    - Spray
    - Bath / Kitchen 0.5 – 2.5 GPM
    - Tamper proof



Faucet Age	Water Consumption
Pre-1980	3 - 7 GPM
1980 - 1994	3 GPM
1994 - Present	2.5 GPM

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# Water Audit

- Determine water use from billing data
- Check meters for flows when systems are off
- Test & repair leaks
- Install retrofit devices
- Maintain equipment
  - Clean or replace aerators
  - Replace washers on valve stems
- Identify all conservation opportunities



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# Irrigation System Audits



55% of the water  
Denver Water  
supplies is used  
outdoors, primarily  
for irrigation

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# Irrigation Use

- Ideally, irrigation should be scheduled on *evapotranspiration* data



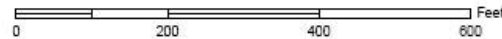
Evapotranspiration (ET)—soil evaporation and plant transpiration rate

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Estimated Irrigated Area = 773,998 sq. feet



2006 Ortho Image

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MOFFAT TREATMENT FACILITY



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# Irrigation Schedules

## HOW MUCH WATER DOES A HEALTHY LAWN NEED?

**Watering Times** will help you determine how long to water each zone on your watering day; or, **Watering Amounts** show you how much water your grass needs each week.

WATERING MONTHS	WATERING TIMES (minutes per zone)			OR	WATERING AMOUNTS
	Fixed Spray Heads	Rotor Heads	Manual Sprinklers		
JAN – APRIL	Water as needed, especially trees and shrubs.				
MAY	13	29	20		1"
JUNE	20	43	30		1 - 1/2"
JULY	23	50	35		1 - 3/4"
AUGUST	20	43	30		1 - 1/2"
SEPTEMBER	13	29	20		1"
OCTOBER	Water as needed, especially trees and shrubs.				

Need help with this chart or want more precise irrigation information?  
Visit [www.denverwater.org](http://www.denverwater.org) and click on *Tap-Smart Irrigation for Homes*.

Adjusting monthly can save 30% of the water used to irrigate every year!

Seasonal target for bluegrass:  
18 gallons per sq. ft.

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# Irrigation Reductions

Check irrigation system regularly



Broken heads (geyser)



Arc alignment



Obstructions

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# Available Technology

- Rain Sensors
  - Rebate!
- ET based irrigation (Evapotranspiration)
  - Rebate!
  - Use Evapotranspiration to determine irrigation amounts
  - Available from irrigation contractors/supply houses
- Sub-surface drip
- Micro-sprays
- Soil moisture sensors

Proper Installation!

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# Do away with grass. Xeriscape!

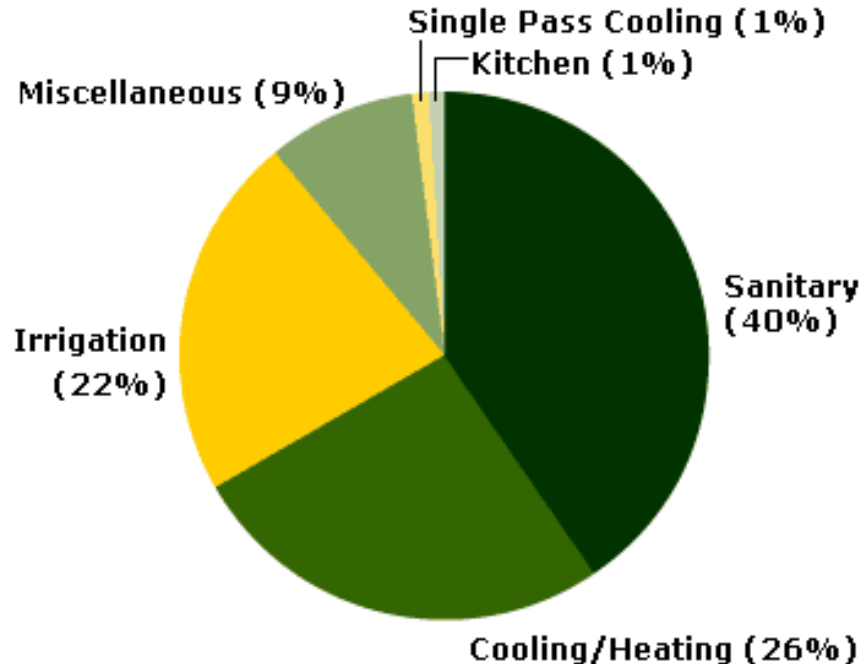


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# Other Water Uses

Fixtures and irrigation only account for 62% of total building water use for a typical office building



Source: EPA

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# Cooling Towers

- Increase cycles of concentration
  - i.e.—800 ton HVAC tower increasing from 5 to 8 can save over 330,000 gallons per year

**Green** water treatment technologies are available to eliminate waste



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# Why Cooling Towers?

- They use a lot of water
- Saving water does not require much effort
- Often does not require any capital expenditures
- Other quantifiable savings:
  - Chemicals
  - Wastewater
  - Money!

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# Cooling Tower Audit Findings

- Average of 5-6 cycles
- Uncontrolled water leaks
  - Overflow tower basins
  - Pump leaks
  - High tower drift
- Inadequate controls
  - No blowdown or make-up meters
  - Infrequent testing
  - Inoperative conductivity controllers

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# Diminishing Returns

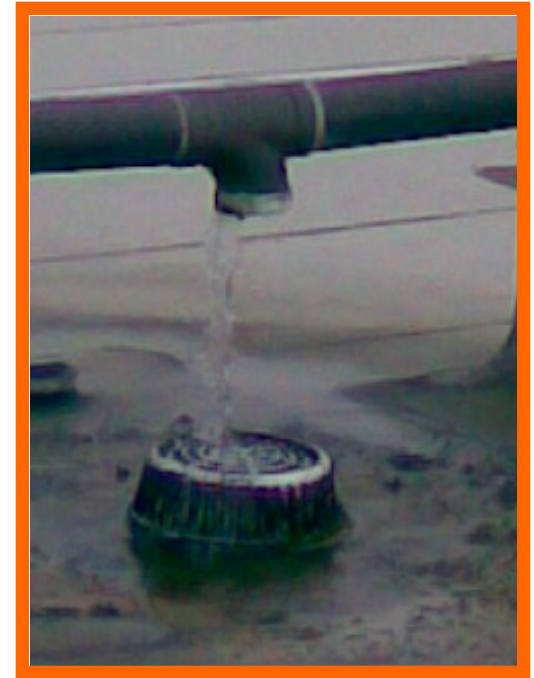
		New Cycles of Concentration												
		2	2.5	3	3.5	4	5	6	7	8	9	10	15	25
Old Cycles of Concentration	1.5	33%	44%	50%	53%	56%	58%	60%	61%	62%	63%	63%	64%	65%
	2	-----	17%	25%	30%	33%	38%	40%	42%	43%	44%	44%	46%	48%
	2.5	-----	-----	10%	16%	20%	25%	28%	30%	31%	33%	33%	36%	38%
	3	-----	-----	-----	7%	11%	17%	20%	22%	24%	25%	26%	29%	31%
	3.5	-----	-----	-----	-----	5%	11%	14%	17%	18%	20%	21%	23%	26%
	4	-----	-----	-----	-----	-----	6%	10%	13%	14%	16%	17%	20%	22%
	5	-----	-----	-----	-----	-----	-----	4%	7%	9%	10%	11%	14%	17%
	6	-----	-----	-----	-----	-----	-----	-----	3%	5%	6%	7%	11%	13%
	7	-----	-----	-----	-----	-----	-----	-----	-----	2%	4%	5%	8%	11%
	8	-----	-----	-----	-----	-----	-----	-----	-----	-----	2%	3%	6%	9%
9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1%	5%	7%	

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# Cooling Processes

- Eliminate single-pass cooling
  - Often associated with equipment cooling for pumps, compressors, ice machines, air conditioners, etc.
- Replace water-cooled with air-cooled models
- Identify opportunities to capture process water for re-use later



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# Recycled Water

- Viable alternative to domestic water
- Not always available in all areas
- Water quality does not meet federal drinking water standards



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# Commercial Indoor Rebates

Multi-Family/Commercial Multi-Tenant Sub-Metering	\$40
High Efficiency Urinal	\$100
Commercial Warewashing Equipment	\$300
Cooling Tower Conductivity Controller	\$500
Cooling Tower Make-Up or Bleed Meters	\$50
Coin/Card-Operated Laundry Equipment	\$150
High Efficiency Toilets	\$75
Flushometer Bowl/Valve Combination (1.28 gpf)	\$125

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# Commercial Incentive Program

- Commercial, Industrial and Institutional customers can earn 50% of project costs up to \$40,000 for improving the efficiency of their processes.
- Earn \$18.50 for every 1000 gallons of water saved over a one-year period.
- Must meet a minimum savings requirement of 100,000 gallons per year to qualify.

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# Our Challenges

- Everyone wants to be **GREEN**, but much of the attention is given to energy efficiency, not water efficiency
- Memories of drought fade, and old habits die hard
- Current economic factors mean that our customers may be less able to invest in efficient appliances, fixtures and processes
- The greater the snowpack, the less interested the media are in water conservation and efficiency
- As waste is eliminated, we must establish more invasive methods of conserving

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