

APPENDIX B

BENCHMARKS USED IN CONSERVATION PLANNING

Table B-1: Recent Estimates of Indoor Water Use With and Without Conservation

Type of Use	Without conservation		With conservation		Savings
	Amount (gpcd)	Percent of total	Amount (gpcd)	Percent of total	
Toilets	18.3	28.4%	10.4	23.2%	44%
Clothes washers	14.9	23.1%	10.5	23.4%	30%
Showers	12.2	18.8%	10.0	22.4%	18%
Faucets	10.3	16.0%	10.0	22.5%	2%
Leaks	6.6	10.2%	1.5	3.4%	77%
Baths	1.2	1.9%	1.2	2.7%	0%
Dish washers	1.1	1.6%	1.1	2.4%	0%
Total indoor water use	64.6	100%	44.7	100%	31%

Source: AWWA WaterWiser, "Household End Use of Water Without and With Conservation," 1997
Residential Water Use Summary - Typical Single Family Home
<http://www.waterwiser.org/wateruse/tables.html>.

gpcd = gallons per capita per day

Note: These data are provided for illustrative purposes only and may not be applicable to a given situation. To the extent practical, planners use system-specific assumptions and estimates.

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Table B-2: Benchmarks for Estimating Residential End Uses of Water

Type of use	Units	Likely range of average values
INDOOR USES		
Average household size	Persons	2.0-3.0
Frequency of toilet flushing	Flushes/person/day	4.0-6.0
Flushing volumes	Gallons/flush	1.6-8.0
Fraction of leaking toilets	Percent	0-30
Showering frequency	Showers/person/day	0-1.0
Duration of average shower	Minutes	5-15
Shower flow rates	Gallons/minute	1.5-5.0
Bathing frequency	Baths/person/day	0-0.2
Volume of water	Gallons/cycle	30-50
Washing machine use	Loads/person/day	0.2-0.5
Volume of water	Gallons/cycle	45-50
Dishwasher use	Loads/person/day	0.1-0.3
Volume of water	Gallons/cycle	10-15
Kitchen faucet use	Minutes/person/day	0.5-5.0
Faucet flow rates	Gallons/minute	2.0-3.0
Bathroom faucet use	Minutes/person/day	0.5-3.0
Faucet flow rates	Gallons/minute	2.0-3.0
OUTDOOR USES		
Average lot size[a]	Square feet	5000-8000
Average house size[a]	Square feet	1200-2500
Landscape area[a]	Square feet	4000-5000
Fraction of lot size in turf[a]	Percent	30-50
Water application rates[a]	Feet/year	1-5
Percent of homes with pools	Percent	10-25
Pool evaporation losses	Feet/year	3-7
Frequency of refilling pools	Times per year	1-2
Frequency of car washing	Times/month	1-2

Source: Duane D. Baumann, John J. Boland, and W. Michael Hanemann, *Urban Water Demand Management and Planning* (New York: McGraw Hill, 1998), 254.

[a] Reflects single-family averages.

Note: These data are provided for illustrative purposes only and may not be current or applicable. To the extent practical, planners should regionally appropriate or system-specific assumptions and estimates.

Table B-3: Sample Calculation of Water Savings from Showerhead Replacement

The following calculations represent the water savings expected as the result of a showerhead retrofit program. The savings rate represents a difference in average winter water use between homes with low-flow showerheads and homes without low-flow showerheads.

- Nonconserving showerhead flow rate = 3.4 gallons/minute
- Low-flow showerhead flow rate = 1.9 gallons/minute
- Estimated showering time = 4.8 minutes/person/day
- Average winter household water use = 200 gallons per household per day
- Average household size = 2.5 persons
- Water use with nonconserving showerhead = (3.4 gal/min) × (4.8 min/person/day) = 16.3 gpcd
- Water use with low-flow showerhead = (1.9 gal/min) × (4.8 min/person/day) = 9.1 gpcd
- Water savings = 16.3 gpcd - 9.1 gpcd = 7.2 gpcd

At an average household size of 2.5 persons, the savings rate would be 18.0 gallons per household per day (2.5 persons × 7.2 GPCD). The formula for calculating the reduction factors representing the fraction of, for example, single-family winter water use is

$$R = (18.0 \text{ GPHD}) / (200 \text{ GPHD during winter}) = 0.09 \text{ (or 9 percent)}$$

Source: Duane D. Baumann, John J. Boland, and W. Michael Hanemann, *Urban Water Demand Management and Planning* (New York: McGraw Hill, 1998): 255.

Note: These data are provided for illustrative purposes only and may not be current or applicable. To the extent practical, planners should regionally appropriate or system-specific assumptions and estimates.

Table B-4: Benchmarks for Savings from Selected Conservation Measures

Category	Measure	Reduction in end use	Life span (years)
LEVEL 1 MEASURES			
Universal metering	Connection metering	20 percent	8 to 20
	Submetering	20 to 40 percent	8 to 20
Water accounting and loss control	System audits and leak detection	Based on system	na
Costing and pricing	10% increase in residential prices	2 to 4 percent	na
	10% increase in nonresidential prices	5 to 8 percent	na
	Increasing-block rate	5 percent	na
Information and education	Public education and behavior changes	2 to 5 percent	na
LEVEL 2 MEASURES			
End-use audits	General industrial water conservation	10 to 20 percent	na
	Outdoor residential use	5 to 10 percent	na
	Large landscape water audits	10 to 20 percent	na
Retrofits	Toilet tank displacement devices (for toilets using > 3.5 gallons/flush)	2 to 3 gpcd	1.5
	Toilet retrofit	8 to 14 gpcd	1.5
	Showerhead retrofit (aerator)	4 gpcd	1 to 3
	Faucet retrofit (aerator)	5 gpcd	1 to 3
	Fixture leak repair	0.5 gpcd	1
	Governmental buildings (indoors)	5 percent	na
Pressure management	Pressure reduction, system	3 to 6 percent of total production	na
	Pressure-reducing valves, residential	5 to 30 percent	na
Outdoor water-use efficiency	Low water-use plants	7.5 percent	10
	Lawn watering guides	15 to 20 percent	na
	Large landscape management	10 to 25 percent	na
	Irrigation timer	10 gpcd	4
LEVEL 3 MEASURES			
Replacements and promotions	Toilet replacement, residential	16 to 20 gpcd	15 to 25
	Toilet replacement, commercial	16 to 20 gpcd	10 to 20
	Showerhead replacement	8.1 gpcd	2 to 10
	Faucet replacement	6.4 gpcd	10 to 20
	Clothes washers, residential	4 to 12 gpcd	12
	Dishwashers, residential	1 gpcd	12
	Hot water demand units	10 gpcd	na
Reuse and recycling	Cooling tower program	Up to 90 percent	na
Water-use regulation	Landscape requirements for new developments	10 to 20 percent in sector	na
	Graywater reuse, residential	20 to 30 gpcd	na
Integrated resource management	Planning and management	Energy, chemical, and wastewater treatment costs	na

Source: Compiled from various sources. Actual water savings can vary substantially according to a number of factors. These data are provided for illustrative purposes only and may not be current or applicable. To the extent practical, planners should regionally appropriate or system-specific assumptions and estimates.
na = not available

Table B-5: Water Efficiency Standards Established by The Energy Policy Act of 1992

Faucets. The maximum water use allowed by any of the following faucets manufactured after January 1, 1994, when measured at a flowing water pressure of 80 pounds per square inch, is as follows:

Faucet type	Maximum flow rate (gallons per minute or per cycle)
Lavatory faucets	2.5 gpm
Lavatory replacement aerators	2.5 gpm
Kitchen faucets	2.5 gpm
Kitchen replacement aerators	2.5 gpm
Metering faucets	0.25 gpc

Showerheads. The maximum water use allowed for any showerhead manufactured after January 1, 1994, is 2.5 gallons per minute when measured at a flowing pressure of 80 pounds per square inch.

Water Closets. (1) The maximum water use allowed in gallons per flush for any of the following water closets manufactured after January 1, 1994, is as follows:

Water closet type	Maximum flush rate (gallons per flush)
Gravity tank-type toilets	1.6 gpf
Flushometer tank toilets	1.6 gpf
Electromechanical hydraulic toilets	1.6 gpf
Blowout toilets	3.5 gpf

(2) The maximum water use allowed for any gravity tank-type white two-piece toilet which bears an adhesive label conspicuous upon installation of the words "Commercial Use Only" manufactured after January 1, 1994 and before January 1, 1997, is 3.5 gallons per flush.

(3) The maximum water use allowed for flushometer valve toilets, other than blowout toilets, manufactured after January 1, 1997, is 1.6 gallons per flush.

Urinals. The maximum water use allowed for any urinals manufactured after January 1, 1994, is 1.0 gallons per flush.

Note: These standards were developed in 1992. New and emerging technologies can increase the cost effectiveness of conservation measures, affect demand forecasts, and eventually lead to the establishment of new standards.

Table B-6: Potential Water Savings From Efficient Fixtures

Fixture [a]	Fixture capacity [b]	Water use (gpd)		Water savings (gpd)	
		Per capita	2.7-person household	Per capita	2.7-person household
Toilets [c]					
Efficient	1.5 gallons/flush	6.0	16.2	na	na
Low-flow	3.5 gallons/flush	14.0	37.8	8.0	21.6
Conventional	5.5 gallons/flush	22.0	59.4	16.0	43.2
Conventional	7.0 gallons/flush	28.0	75.6	22.0	59.4
Showerheads [d]					
Efficient	2.5 [1.7] gal/min	8.2	22.1	na	na
Low-flow	3.0 to 5.0 [2.6] gal/min	12.5	33.8	4.3	11.7
Conventional	5.0 to 8.0 [3.4] gal/min	16.3	44.0	8.1	22.0
Faucets [e]					
Efficient	2.5 [1.7] gal/min	6.8	18.4	na	na
Low-flow	3.0 [2.0] gal/min	8.0	21.6	1.2	3.2
Conventional	3.0 to 7.0 [3.3] gal/min	13.2	36.6	6.4	17.2
Toilets, Showerheads, and Faucets Combined					
Efficient	Not applicable	21.0	56.7	na	na
Low-flow	Not applicable	34.5	93.2	13.4	36.4
Conventional	Not applicable	54.5	147.2	33.5	90.4

Source: Amy Vickers, "Water Use Efficiency Standards for Plumbing Fixtures: Benefits of National Legislation," *American Water Works Association Journal*, Vol. 82 (May 1990): 53.

na = not applicable

[a] Efficient = post-1994

Low-flow = post-1980

Conventional = pre-1980

[b] For showerheads and faucets: maximum rated fixture capacity (measured fixture capacity). Measured fixture capacity equals about two-thirds the maximum.

[c] Assumes four flushes per person per day; does not include losses through leakage.

[d] Assumes 4.8 shower-use-minutes per person per day.

[e] Assumes 4.0 faucet-use-minutes per person per day.