NATIONAL SMALL FLOWS CLEARINGHOUSE

Water Efficiency

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Fact Sheet

Introduction

Although most of the earth is covered with water, only 1% of that water is actually potable. In spite of its importance, potable water is often taken for granted. For many people, fresh water is as close as their faucets. This accessibility can give the illusion that the supply of potable water is unlimited. It also makes it easy for people to be unconcerned with all of the necessary treatment water undergoes prior to reaching their faucets.

With the growing shortage of fresh water supplies in many parts of the U.S., particularly in cases of drought, it has become essential to find ways to conserve water and use it efficiently. Water resource management has traditionally focused on developing new water supplies and expanding treatment facilities while giving little thought to how efficiently existing water is used.

The demand for water in the U.S. necessitates stream and river impoundments, the drilling of deeper wells, and water withdrawals from most natural water bodies across the country.

Water problems encountered by homeowners and communities are raw water supply and quality problems, insufficient water and wastewater treatment capacity, and environmental problems. These problems can, in part, be countered by adopting water-efficient programs that target both the engineering and behavioral practices of the community.

Although there are different types of offstream water users, the focus of this fact sheet will be on domestic (residential) uses only. Domestic water use includes everyday uses such as drinking, cooking, bathing, toilet flushing, washing clothes and dishes, watering lawns and gardens, maintaining swimming pools, washing cars, etc.

Why Conserve Water

Even in locations where potable water is not scarce, water conservation is important because wasteful habits can deplete water reserves quicker than it is possible to replenish them. Water conservation also has an effect on how much wastewater is produced, thereby having a direct impact on the performance and life of the wastewater system.

This extends the life of onsite systems, improves performance of treatment plants that have flows near design capacity, and reduces operating costs of treatment plants. Communities faced with having to build new wastewater facilities may be able to delay or reduce the size of those facilities with a comprehensive water program.

Thus, a reduction in the amount of wastewater due to water conservation practices can be extremely beneficial to an onsite or community wastewater system. In addition, water efficiency measures can also lower the water, sewer, and energy bills of the homeowner, thus reducing the water utility operating cost.

Water efficiency programs should be tailored to the local conditions, taking into account various factors to determine the proper mix of efficiency measures and the priority of the program. Any program that is implemented should include the local utility and the user. Discussed in the following sections are various utility-based measures, as well as engineering and behavioral water efficiency options for residential users.

Utility-Based Efficiency Measures

Some of the many utility-based water efficiency measures include metering, rate structures, leak detection and repair programs, and pressure reduction programs. These are some first steps a local utility can take toward conserving water.

Rate structures and metering are ways to encourage customers to use less water and not waste the resource. It creates an awareness as to how much water is used, which would be evident by the customer's bill. These messages may encourage customers to install water efficient devices and repair all leaks.

More recently, communities have started revising the rate structures to signal that

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future supply would cost more than the present supply, and that peak supply costs will be higher than the base supply to discourage excessive water use. New rates that are implemented should be gradual to allow for periodic evaluation of their effectiveness and their revenue impacts. Also, when there is a rate increase, customers should be provided with information on ways to reduce their water bills.

Despite high initial costs, programs for finding and repairing leaking water mains and laterals can be very cost-effective. These programs are particularly effective in communities that have large, old, and deteriorating systems.

Many water systems deliver water at a pressure higher than what customers need, thus resulting in inefficient water use. Although installing pressure-reducing valves is cost-effective, it should be noted that, in some cases, they might have a negative impact on some homes with systems already designed and installed. Care should be taken to ensure adequate fire flow is maintained.

Table 1: Potential Water Savings from Low-Flow Fixtures

Fixture (a)	Fixture Capacity (b)	Water Use (gpd) Per Capita	Water Use (gpd) 2.7 - Person Household	Water Savings (gpd) Per Capita	Water Savings (gpd) 2.7 - Person Household
Toilets (c)					
Low-flow	1.6 gallons/flush	6.4	17.3	N/A	N/A
Conventional	3.5 gallons/flush	14.0	37.8	8.0	20.5
Conventional	5.5 gallons/flush	22.0	59.4	16.0	42.1
Conventional	7.0 gallons/flush	28.0	75.6	22.0	58.3
Showerheads (d)					
Low-flow	2.5 (1.7) gpm	8.2	22.1	N/A	N/A
Conventional	3.0 to 5.0 (2.6) gpm	12.5	33.8	4.3	11.7
Conventional	5.0 to 8.0 (3.4) gpm	16.3	44.0	8.1	22.0
Faucets (e)					
Low-flow	2.5 (1.7) gpm	6.8	18.4	N/A	N/A
Conventional	3.0 (2.0) gpm	8.0	21.6	1.2	3.2
Conventional	3.0 to 7.0 (3.3) gpm	13.2	36.6	6.4	17.2
Toilets, Showerheads, and Faucets Combined					
Low-flow	N/A	21.0	56.7	N/A	N/A
Conventional	N/A	34.5	93.2	13.4	36.4
Conventional	N/A	54.5	147.2	33.5	90.4

N/A = not applicable gpm = gallons per minute gpd = gallons per day

(a) Low-flow = post-1994
Conventional = pre-1980 to 1994

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

(c) Assumes four flushes per person per day; does not include losses through leaks.

(d) Assumes 4.8 shower-use minutes per person per day at 80 psi.

(e) Assumes 4.0 faucet-use minutes per person per day at 80 psi.

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Engineering Practices for Residential Users

One way to reduce wastewater flow is to adopt engineering practices based on modifications in plumbing, fixtures, or water supply operating procedures on the customer's side of the meter. Installing water-saving devices and repairing leaky pipes, faucets, and toilets could save thousands of gallons of water per person each year. The following section presents different engineering practices that can help residential users conserve water (see Table 1).

Plumbing

An engineering practice for individual residential water users is the installation of indoor plumbing fixtures that save water or the replacement of existing equipment with those that use less water. Low-flow plumbing fixtures and retrofit programs are one-time conservation measures for new construction or for replacing conventional fixtures in an existing structure. The low-flow plumbing fixtures can be implemented with little or no additional cost over their lifetime. Listed below are some of the options for reducing water use.

Low-Flush Toilets

Nearly 40% of indoor residential water use is accounted for by toilet use (at 3.5 gallons per flush [gpf]). An average American uses 9,000 gallons of water to flush 230 gallons of waste per year. Ultra low-flush (efficient) toilets use only 1.6 gallons of water or less, while conventional toilets use 3.5 to 5 gallons or more of water per flush. The ultra low-flush toilet has the potential to reduce a typical household's per capita water use by 8 to 22 gallons per day (gpd) (7,900 to 21,700 gallons per year [gal/yr]). Since these toilets use less water, they reduce the volume of wastewater produced, thus improving the overall efficiency of the wastewater system.

Replacement of conventional toilets with water-efficient toilets for existing residences is a practical and economical alternative. Effective January 1, 1994, the Energy Policy Act of 1992 requires that all new toilets produced for residential and nonresidential use should operate on 1.6 gallons or less.

Toilet Dams and Displacement Devices

A toilet displacement device reduces the amount of water used per flush by conventional, 3.5+ gpf toilets. A toilet dam can be used to hold back a reservoir of water when the toilet is flushed. About 1 to 2 gallons of water can be saved when toilet dams are used.

Plastic containers, such as milk jugs, can be filled with water or pebbles and placed in a toilet tank. These containers must be placed so that they do not interfere with the flushing mechanisms or the flow of water. Although these devices save up to 25% or more of water per flush, they achieve less water savings than replacement with an ultra low-flush toilet. There are also several commercially available retrofit devices that are inexpensive and eliminate the need to replace old toilets.

Low-Flow Showerheads

About 20% of indoor residential water use is attributed to showers. A low-flow showerhead is basically a conventional showerhead where the surge of water is restricted. A family of four can save approximately 20,000 gal/yr (4.3 gallons per

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capita per day [gpcd]) by replacing a conventional 4.5 gallons per minute (gpm) showerhead with a 2.5 gpm low-flow showerhead. A properly designed low-flow showerhead should be able to provide the quality of service found in the higher-volume models.

Faucet Aerators

An inexpensive device that can be installed in sinks to reduce water is a faucet aerator. Faucet aerators break the flowing water into fine droplets and introduce air without compromising quality. These aerators can be installed easily and reduce the water use at a faucet by as much as 60% while maintaining a strong flow. Kitchen and bathroom faucets that use 2 gpm are available now and can be used instead of a conventional 3 to 5 gpm faucet.

Pressure Reduction

The maximum water flow from a fixture operating on a fixed setting can be reduced if the water pressure is reduced, since flow rate is related to pressure. For example, a reduction of water use (about one-third) can be observed when there is a reduction from a 100 psi to 50 psi at the outlet.

For homes served by wells, reducing the system pressure can save both water and energy. Since many water-using fixtures (such as washing machines and toilets in a home) use a controlled amount of water, a reduction in the water pressure will have little effect on water use at these locations.

The reduction in water pressure should be done by a plumber and can reduce the likelihood of leaking water pipes, leaking water heaters, and dripping faucets. It can also help reduce dishwasher and washing machine noise and breakdowns in a plumbing system.

Washing Machines

Water use can usually be reduced at the laundry room by using high-efficiency front-loading washing machines rather than the top-loading ones. As much as 40% less water use can be seen when the front-loading machines are used.

Graywater

Graywater is domestic wastewater comprised of wash water from kitchen sinks and tubs, clothes washers, and laundry tubs. Reusing graywater can conserve potable water and lower water bills, reduce pollution of natural waters, and make use of nutrients in the graywater that would otherwise be wasted if the graywater was not segregated from blackwater (see ETI fact sheet on graywater treatment/disposal/reuse).

Landscaping

Nationally, lawn care accounts for 50 to 75% of outdoor residential water use. Outdoor residential water use is influenced by income level and local climate characteristics (e.g., people in the southwestern U.S. tend to water lawns, etc., more frequently than those in the northeast).

One option is to practice water-saving horticulture by choosing native or adaptive species of plants that do not require as much water. A similar method is grouping plants with similar needs. To maximize the water that is used, water lawns and gardens slowly, thoroughly, and as infrequently as possible. Watering at night or in the early morning hours can lessen the amount of water that is lost to evaporation. Mulch can be used as a filler between plants.

For plants and trees, use drip irrigation systems with water timers instead of running water continuously. Other water-saving practices for turf include using cycle irrigation, bubbler/soaker systems, and low precipitation-rate sprinklers that have better distribution uniformity. Manual (hand-held) hose watering is usually the most efficient.

Xeriscape™ Landscapes

Xeriscaping is an innovative, comprehensive approach to landscaping for water conservation that incorporates all of the following: planning and design, soil analysis, selection of suitable plants, practical turf areas, efficient irrigation, use of mulch, and appropriate maintenance.

The benefits of Xeriscape™ landscaping include reduced water use, decreased energy use (less pumping and treatment required), reduced heating and cooling costs, decreased storm water and irrigation runoff, fewer yard wastes, increased habitat for plants and animals, and low labor and maintenance costs.

Behavioral Practices for Residential Users

In addition to using water-saving devices, there are personal habits that an individual can practice to use water efficiently, thereby reducing the overall consumption in a home. Adopting new habits of using water more efficiently could save thousands of gallons of water per person each year. Behavioral practices of residential users can be applied both indoors in the kitchen, bathroom, and laundry room, as well as outdoors. Described below are some measures that can be taken for more efficient water use.

Kitchen

For heavy cleaning of pots and dishes, recycled water can be used if it is followed by a clean rinse. It is best if the least possible soap or cleaning agent is used. In addition, presoaking dishes will cut down on rinse water. Dishes can be scraped with used paper napkins in order to clean off food without using water. Rinsing all of the dishes at once will decrease the number of on/off cycles for the faucet. If a dishwasher is used, wash only full loads.

Defrosting without using water can also help to conserve water by planning ahead to thaw frozen foods in the refrigerator. For immediate defrosting where water is necessary, having low consumption (2 gpm) faucet aerators can decrease the water used.

Bathroom

Water can be saved in the bathroom by not keeping the faucet on while brushing teeth or shaving. Taking short showers or baths and turning the water off while soaping can also save water.

Laundry

Adjusting water levels in the washing machine to match the size of the load can save water. If a washing machine does not have a variable load control, use the washer only when it is full. If washing is done by hand, do not keep the water running; instead use a tub filled with water. Reuse the wash and rinse water as much as possible.

Other

Other water-saving options include covering the pool when it is not in use to reduce water loss by evaporation; discouraging restaurant servers from bringing you water unless you request it or from automatically refilling your empty water glass; and

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using cups to collect the water at drinking fountains, which prevents some of the water from going down the drain. To save water when washing a car, clean the car in sections and rinse in short spurts with a hose. Try to wash the car in a spot where shrubs or hedges are close by so that they may receive some of the water. Also, rainwater can be collected and used to reduce the amount of water taken from community water reserves.

Community-wide water conservation programs can also include water use surveys, plumbing fixture retrofit kits, rebate or incentive programs for low-flow toilet replacement, and informational/educational programs.

Application

Stillaguamish Tribe in Arlington, Washington

The Stillaguamish Tribe in Arlington, Washington, developed a water conservation program to help alleviate problems associated with a failing community septic tank and drainfield system. Originally, five separate drainfields and two community drinking water wells were constructed to serve 30 homes on 20 acres of land. However, within 5 years, two of the five drainfields had to be replaced because of failure.

The goal of the water conservation program was to reduce the community use of drinking water from the tribe's system, which would subsequently reduce the amount of water loaded into the septic tank drainfield system.

In 1991, the water conservation program included retrofitting the standard toilets with ultra low-flush toilets, installing flow restriction devices on all faucets, and implementing a water conservation education program for the homeowners in the development. In 1992, failing water meters were replaced, which allowed for individual water use to be measured and leaks to be discovered within the water distribution system.

The water conservation program reduced the average community water use from 250,000 to 200,000 gallons per month. Water usage dropped about 35% per home for the first 9 months after the water conservation program was adopted. In addition, there was a reduction in operation and maintenance costs for the two water supply wells due to the reduced water demand, and surfacing septage in the tribe's drainfields has not been a problem since the water conservation program was implemented.

Santa Monica, California

Since the mid-1980s, Santa Monica, California, has faced significant constraints on its water supplies for two reasons: primarily, a severe drought of 6 consecutive years, and secondly, chemical contamination of municipal wells. Despite efforts to decrease its reliance on imported water, Santa Monica was obtaining 80% of its water through the Metropolitan Water District of Southern California, which imports water from the Colorado River and from Northern California.

Santa Monica's water conservation program included regulating lawn-watering, swimming pools, and other outdoor water use. A staff of water inspectors enforce the program's ordinances. Other aspects of the program are that fountains must use recycled water, the extent of turf is limited in landscape areas, and underground and/or drip irrigation systems are required.

However, the focal point of Santa Monica's conservation program has been the Baysaver Plumbing Fixture Rebate Program, which began in 1989. Residents received rebates for retrofitting their bathrooms with 1.6 gpf toilets and efficient showerheads. The city then offered to install the new fixtures, and as an additional incentive, placed a surcharge on the water bills of customers who failed to replace all of their water-wasting fixtures. The surcharge revenues were applied toward the program's funding.

The Baysaver Plumbing Fixture Rebate Program was well marketed, with inserts placed in water bills, displays set up at plumbing stores and home improvement centers, advertisements in newspapers, public service announcements broadcasted on local radio stations, and other promotional activities. The Baysaver program has been very successful, resulting in approximately 60% of the toilets in Santa Monica being replaced with new, water saving models. In addition to decreasing the demand for potable water, it has reduced flows into the city's sewage systems. The Baysaver Program resulted in reductions in water use by 15% and sewage flows by approximately 16%. The program is expected to save Santa Monica $6 million by the year 2002.

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For more information on water efficiency or a list of other fact sheets, contact the NSFC at West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Phone: (800) 624-8301 or (304) 293-4191. Fax: (304) 293-3161. World Wide Web site: http://www.nsfc.wvu.edu.

The NSFC provides free and low-cost informational services and products to help homeowners and small communities address their wastewater needs. Also, information about manufacturers, consultants, regulations, and facilities can be obtained from the NSFC's databases.