Saving Water Pays Dividends

Subject to strict sewage allocations, this ski resort began testing water-saving devices as early as 1977 in order to control its leachfield construction costs.

by David Fretz

This resort developer has made water-saving fixtures work for buyers, guests, and his bottom line for over five years

At Hawk Mountain Development (Plymouth, Vt.), our business is building and managing communities of luxury resort homes and ski condominiums. Our upscale clientele expects amenities and services, and they get them.

Although our clients aren't aware of it, there's one thing we're very stingy with: water. Our units are fitted with ultra-low-flush toilets, shower flow restricters, and water-saving appliances. No, we're not running out of water in this area, but with Vermont's tough environmental laws we have to make the most of our permitted sewage allocation.

Incentives

Driven by concerns for the purity of groundwater supplies, state regulations governing leachfield systems and treatment plants are very restrictive. The answer for us as builders has been to find and install quality, water-saving devices. This has cut our sewage output by 30% from the norm over the last five years and brought us both profits and savings.

Our interest in water conservation began 11 years ago during the design phase of Hawk Inn and Mountain resort, a 300-unit community of single-family homes and condominiums. Employing a cooperative sewage system, we faced several hundred thousand dollars in leachfield construction costs.

One way to reduce these costs was to cut our sewage flow enough to qualify for a 20% leachfield design reduction offered by the State of Vermont. This would allow us to reduce capital expenditures early on by using phased construction of the sewage system. But the only way to qualify reduced flows to the State regulators was to put flow meters on the system, and use ultra-low-flush toilets and low-flow shower heads that somehow met our upscale client's standards for quality and convenience.

New Criteria

We began our search for the best combination of water-saving appliances in 1977. At that time, 3.5-gallon toilets were an "oddity" that had just come on the market, and lots of people were convinced they wouldn't work. When I talked about trying to find a toilet that used even less, people looked at me as if I were hopelessly stupid.

Basically, what we were looking for was the lowest consumption toilet we could find which would appeal to both our home sales and our Four Star/Four Diamond rated rental program. It had to be well made, attractive, and work in the same way and with the same efficiency as the fixtures our clients were used to at home. This ruled out waterless, incinerating, composting, and chemical toilets, which required special operator experience or change of lifestyle.

We eliminated two more types – pressure aided and vacuum assisted – in an effort to keep operating and maintenance costs at a minimum. And any unit that didn't use standard rough-in dimensions or installation procedures was disqualified.

Figure 1. *To test ULF toilets, Hawk Mountain installed them in the company restroom with a clipboard and a sign asking for comments. Employees' comments on the clipboard (right) ranged from silly to serious, but after several months made it clear how well a toilet would do in the resort's second homes and condos.*

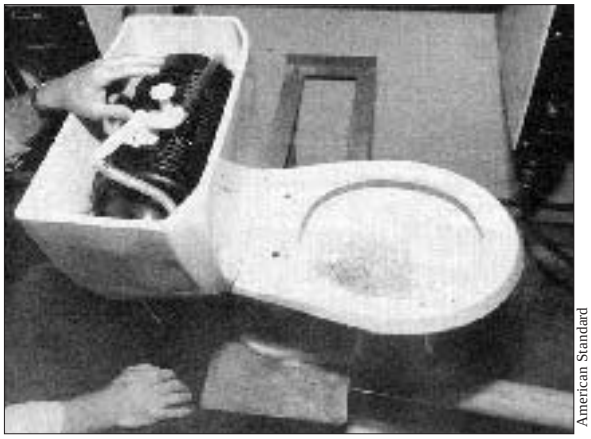
Early Toilet Testing

We began testing low-consumption tanks and bowls in an effort to break the 3.5-gallon barrier. Our methodology was simple: put the toilets in our own office restrooms, use them ourselves, and invite comments from our staff and clients.

To make sure everyone understood what we were trying to accomplish, we put an information sheet on the wall describing the current "model" under testing. A sign over the toilet explained what we were trying to accomplish and asked the staff to report their experiences (see Figure 1).

We placed a water meter in the supply line so that we could watch each flush cycle individually, and hung a clipboard on the wall above the toilet. This served as a daily log of water usage and a place for people to scribble comments or just amuse themselves. Not all the comments were serious, but even the humorous ones showed

Ultra-Low-Flush Toilets



American Standard

This test of a new 1.5-gpf toilet shows how the pressure-tank, which "supercharges" the flushing action, fits inside the familiar vitreous china tank.

The ultra-low-flush toilet industry is in flux. Even the names for the low-flush products are a matter of debate (low-flow, low-flush, low-volume, and ULF), and there are as many types as there are opinions about them. Only one thing is for sure: the second-generation toilets are proving that 1.6 gallons of water (and sometimes less) is enough to evacuate the toilet bowl.

New Standards?

A big problem is the lack of agreement on what standards should apply to ULF toilets. American National Standard Institute (ANSI) Standard A112.19.2 covers chinaware water closets, but it was last rewritten in 1982 for 3.5-gpf toilets.

For instance, one question of ultra-low-flush toilets is their solid waste transport capabilities—how far a low-volume flush will send the contents of the bowl. A new ANSI standard which may address some of these hydraulic performance characteristics is expected early next year.

Types

There are different ways to make a 1.6-gallon flush effective. Gravity-fed ULF toilets, like higher-consumption models, rely on the force of water dropping down from the tank to begin the flushing action; improved bowl design accommodates the smaller amount of water.

Some gravity-fed models use a cascade design which concentrates the water in a narrow surge at the front of the bowl to push the solid waste down the trap. Others use a siphon design that sends a concentrated volume of water down the trap early in the flush cycle, drawing the solids and remaining water after it.

Increasing the head (height) of the water with a taller, narrow tank increases the force of the water, making it more efficient. One manufacturer uses a collapsible diaphragm in the trap that allows the waste water to build up a head during the flush before forcing its way through.

A second type of ULF design is pressure-assisted. It uses a plastic flushometer tank hidden within the vitreous china tank (see photo). The pressure in the supply line compresses the air above the water in the tank. When the toilet is flushed, the air expands, driving the water into the bowl at greater speed than a gravity system. This technology was developed by Water Control International (WCI, Troy, Mich.), which continues to manufacture and provide warranty service for fixture makers using the flushometer tank system.

A few ULF toilets use compressed air and operate with minuscule amounts of water. (They do require electricity and are much higher in price.) Microphor manufactures this kind of toilet, and Control Fluidics (Greenwich, Conn.) is developing similar technology with its Fluidizer. These toilets store little or no water and are recognizable by their "tankless" look.

Subjective Ratings

But which type is best? Some critics say gravity toilets provide less carry for solid wastes, and that their bowls don't stay clean.

For flushometer designs, the complains concern the explosive noise of the flush and the departure from traditional mechanical systems to valves and sealed tanks which require proprietary repair.

Little objective evaluation has been done to date. The cascade gravity design (Sweden's IFO, which is now manufactured in the U.S. by Mansfield) was the choice of several pioneering builder-developers. One of these was John F. Long, who installed 250 units in a Phoenix, Ariz. subdivision in the early 1980s. The toilets received a very favorable review in a comparative study with 3.5-gpf toilets by environmental engineers Damann Anderson and Robert Siegrist.

In a consumer study by the Practical Homeowner Institute in 1986, the highest ratings were earned by WCI's Cashsaver, Thetford's Superinse, Eljer's Ultra One-G, and the IFO Cascade. But the pace of change in the industry is rapid, and the first two of these are no longer made.

Selection, Price, and Availability

Most ULF manufacturers produce just a few models and colors. With a couple of exceptions, a standard, white two-piece with a 12-inch rough-in and a choice of round or elongated bowl is typical. the high-end client who is used to a wide range of choice may be discouraged – Porcher does offer a French-made, one-piece unit – but this is changing as demand increases and companies commit more money to research.

Prices for ULF toilets range from $100 to $700. Generally, gravity-fed versions are the least expensive; they list at $150 to $175. Pressure-assisted toilets list in the $300 range; compressed-air toilets start at around $500.

As for availability, most manufacturers claim supplying ULF toilets is no problem. (The majority of the stock goes to southern California or Massachusetts where ULF toilets are mandated.) Some companies new to the field, such as American Standard, are only shipping to those areas initially. With some exceptions, expect six to eight weeks for delivery. If more areas mandate these toilets, supply may become a problem.

Sorting It Out

You and your client should be aware that some ULF bowls may need more frequent cleaning than standard toilets due to the reduced water in the bowl and the modified bowl design. However, reports of double flushing and clogs are unsubstantiated with most models.

There are unanswered questions concerning line carry. No one really knows if it's a problem; there's no objective research. But concern is likely to focus on big commercial and industrial settings rather than the single-family homes. Better research will be available in 1990.

Installation of ULF toilets is the same as high consumption toilets. However, with the many different technical approaches to low-consumption out there, you may not be able to interchange parts, and calls for repairs are likely to rise.

—Paul Spring

ULTRA-LOW FLUSH MANUFACTURERS (1.6 gallons per flush and less)

Manufacturer	Product	Flush Amt.	Type
American Standard P.O. Box 6820, Piscataway, NJ 08855 201/980-3000	*New Cadet* *Aquameter*	1.5 gpf	flushometer
Aqualine (formerly U.S. Brass) 901 10th St., Plano, TX 75074 214/423-3576 800/872-7277	*AquaSaver*	1.5 gpf	gravity
Artesian Plumbing Products 201 E. 5th St., Mansfield, OH 44901 419/522-4211	*Santa Fe*	1.6 gpf	gravity
Briggs P.O. Box 31622, Tampa, FL 33631-3622 813/878-0178 800/627-4447	*TurboFlush*	1.6 gpf	flushometer
Crane Plumbing 1235 Hartrey St., Evanston, IL 60202 312/864-7600 312/864-9777	*Economiser*	1.5 gpf	flushometer
Ecos, Inc. Damonmill Square, Concord, MA 01742 508/369-3951	*Fowler* (Australian import)	1.6 gpf	gravity
Eljer 901 10th St., Plano, TX 75074 214/881-7177	*Ultra One-G* *Ultra Triangle* (Shipping early '90)	1.4 gpf 1.4 gpf	gravity gravity
Gerber 4656 West Touhy, Chicago, IL 60646 312/675-6570	*UltraFlush*	1.6 gpf	flushometer
Kilgore Ceramics P.O. Box 472, Kilgore, TX 75662 214/984-3525	*Allegro* (see Mansfield)	1.5 gpf	gravity
Kohler Kohler, WI 414/457-4441 800/4Kohler	*Wellworth Lite*	1.5 gpf	gravity
Mansfield 150 East First St., Perrysville, OH 44864 419/938-5211	*Allegro* *IFO Cascade* *Quantum*	1.5 gpf 1.5 gpf 1.5 gpf	gravity gravity flushometer
Microphor P.O. Box 1460, Willits, CA 95490 707/459-5563 800/358-8280	*Microflush LF-210* *Microflush LF-16* (Japanese import)	.5 gpf 1.6 gpf	compressed air gravity
Norris P.O. Box 370, Walnut, CA 91789 818/965-3394	*Norris Plumbing Fixture*	1.6 gpf	gravity
Peerless Pottery P.O. Box 5581, Evansville, IN 47716 812/473-0500 800/457-5785	*Hydro Miser*	1.6 gpf	gravity
Porcher 13-160 Merchandise Mart, Chicago, IL 60654 312/923-0995 800/338-1756	*Veneto*	1.5 gpf	gravity
Toto, Ltd. (see Microphor)	*LF-16*	1.6 gpf	gravity
Universal Rundle 303 North St., New Castle, PA 16103 412/658-6631	*Atlas*	1.5 gpf	gravity
Western Pottery P.O. 2127, Hollydale Station Southgate, CA 90280 213-636-8124	*Aris* (Shipping early '90)	1.6 gpf	gravity

interest in our scatological experiments.

Our first success at breaking the 3.5-gallon flush barrier came two years and four trials later in the form of a combination retrofit tank from Germany (Geberit) mounted on an American low-flow bowl (Mansfield). The rated capacity of the tank was 3.5 gallons, but we found that we could adjust the float to 2.75 gallons and still get adequate cleaning.

We used this combination for three years while we searched for and then field-tested 1- and 1.5-gallon units that were just coming on the market. The only ones that met our criteria were the Briggs Superinse and IFO Cascade. We installed them both in our Plymouth offices to watch their performance.

It was around this time that we found still another incentive for water saving. Our newest project, Sunrise Mountain Village on the slopes of Killington, was originally planned for 550 condominiums, but intervening state legislation restricted the project to just 138 units. However, we won permission for an additional 34 units by proposing a sewage flow reduction of 20% using low-consumption fixtures and appliances.

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We began installing 1.5-gallon IFO Cascades at Sunrise Village and at all new homes at Hawk Mountain (see Figure 2). The response, from clients and from the flow-monitoring program, was excellent. Today, we have over 500 of these units in place.

But we haven't stopped testing. In addition to the IFO, we've had a lot of experience with the Eljer Ultra One-G and the Briggs Superinse, at about 1 gallon each. Both work well. We have had the AquaLine's AquaSaver (round bowl) in our office for a few months, and indications are good. Peerless Pottery, a small independent manufacturer in Indiana, has a conventional-back 1.5-gallon unit called the Hydro Miser (Model #5160) that seems to have promise as well.

We're just beginning tests on Kohler's Wellworth Lite. We are also monitoring a development that has chosen the Universal Rundel Atlas. It's a little early to make recommendations, but the unit seems tough to plunge (see "Ultra-Low-Flush Toilets").

Figure 2. *The IFO Cascade toilet has performed well and its European styling turned out to be a marketing asset.*

Other Water Savers

Although the big reduction in residential water usage comes from toilets, a 1984 HUD study suggested we could gain substantial savings (as high as 30%) with low-consumption shower heads, faucet aerators, and water-conserving appliances without increasing our capital costs greatly.

Shower heads. We began looking very hard at low-flow shower heads and flow restricters using the same criteria we used for toilets. We didn't have much luck. The sticking points were in the design and tamper-proof requirements. The "institutional" look of the low-flow replacement shower heads that we reviewed made them stick out; they encouraged suspicion. Owners and renters would either complain of poor showers, or worse, just change the heads back to standard models themselves. The cost was also high at $10 to $20 per unit.

We tried hard plastic and metal fixed-orifice restricters that inserted into a standard head, but we got poor flows and even poorer spray patterns. Finally, one of our plumbers discovered the Chatham Brass variable-flow restricter which gave a good pattern as well as the tremendous advantage of a consistent flow rate at variable water pressures. We installed them behind our standard Symmons/Temptrol 2.75-gpm shower head. This cut flow rates to 2.0 gpm with no complaints and no "change-outs." All for just 75¢ per shower head.

Aerators. When it comes to faucets for vanities, kitchen, bar, and utility sinks, we have found that Delta and Kohler meet our needs best (see Figure 3). they may be a little more expensive in the short run, but 2.0-gpm aerators are standard throughout their lines. This avoids the time and expense of upgrading to a different aerator. And when the original aerator is lost or "disappears," we replace it with a tamper-proof model.

Clothes washers. Our investigation of clothes washers and dishwashers was less thorough, but we have built a good experiential base over the last four years as more energy- and water-efficient models have come on the market (see "Appliance Specs").

In the case of clothes washers, we had to consider for-sale homes and rentals separately. We have found the smaller capacity, front-loading and stackable models with their 16.7-33-gallons-per-cycle range are sufficient in rentals. In non-rental homes, we use larger capacity, variable-cycle, top-loading machines at 17 to 43 gallons per cycle.

The key has been to educate our house-cleaning staff and owners to use the variable cycles. But this is plainly an area where we have to do more research on use patterns as well as unit characteristics. We hope the American Council for an Energy Efficient Economy (ACEEE) might also be able to help in this area.

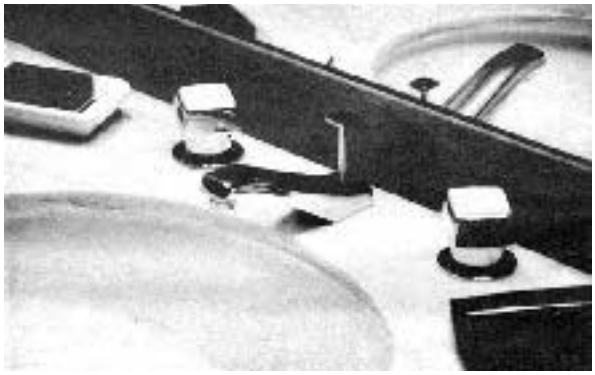

Figure 3. *Kitchen, bath, and bar sinks are all specced with faucets that have 2.0 gpm aerators. As these are lost or removed, they are replaced with a tamper-proof model.*

Dishwashers. HUD's 1984 study confirms that dishwashers use a relatively small percentage of the total household water budget—approximately 2%. In researching water-use cycles in various models, we found that they vary by less than 2 or 3 gallons per cycle. Here once again, the key is to install units that have variable cycle capacity and to educate the users. We look for attractive, reliable models that offer a light wash, which consumes around 10.5 gallons of water per cycle.

Client Acceptance

Homeowner and rental response drives many decisions in resort communities like ours, and that is one of the reasons we tested fixtures so carefully before installing them. The time we spent has paid off.

The appliances we spec work well and don't get any special notice. The same is true for shower heads and restricters, since they don't "look" any different. The IFO toilets we use are another case. These are generally perceived as stylish, and have brought us some unintentional market recognition as "the resort with the tall, sleek toilets."

There has been a good deal of concern about whether ultra-low-flush toilets will stay clean, and whether they will clog or fail to transport solid waste as well as higher gallonage models. After installing and carefully monitoring the performance of over 500 of these toilets. we haven't found problems in any of these areas. We receive no more complaints from our ULF toilets than from 3.5-gpf units. And maintenance has been minimal with these units.

The one complaint we get most often with the IFO is the fact that it doesn't have a flat top, and can't be used as a convenient shelf for tooth brushes and razors. But our plumbers just grin when they hear that. They claim that the majority of clogs they are required to snake out can be blamed on objects that fall into the toilet and get caught in the trap on the next flush.

The Bottom Line

The success of these experiments also pivoted on sewage flow reduction. We have monitored flow and occupancy on a daily basis for more than five years. This data is based on 53 single-family homes and 212 condominiums; a total of 265 dwelling units with a total of 663 bedrooms.

During this time, per-capita flows for our peak occupancy week (Christmas and New Year's, as you might expect) have varied from a high of 51.5 gallons per person per day (gpd) to a low of 3.91 gpd. The five-year average is 47.0 gpd. This compares with the state's book value of 75 gpd, and our "reduced design criteria allowance" of 60 gpd.

At the same time, we have benefited financially from these decisions. At Sunrise Mountain Village, for instance, we spent an extra $226.50 per unit for water-saving devices over the typical fixture cost of $444.50. For all the units, the water-saving extras ran $39,000. There were also costs associated with the toilet testing and sewer monitoring. But the resulting reduction in flow allowed us to build an extra 34 units. These brought in $7 million in gross sales.

At Hawk Mountain, the bottom line savings has allowed us to put off further leachfield construction. We estimate our deferred capital and interest savings since 1983 at over $450,000. With the recently announced 14% increase in local water rents/sewer use fees, a project manager on some new units we are building calculates he will pay for 1.5-gallon toilets in two years, 2.0-gpm shower heads in two months, or shower flow restricters in two weeks. ■

David Fretz is vice president of engineering and research at Hawk Mountain Resorts in Plymouth, Vt.

Appliance Specs
(Hawk Mountain Development)

Water closets.
1. IFO, Cascade, models #3180-0017, #3190, and #3180.
2. Showing promise in current tests: Briggs, model #4700; and (Squaline) Aqua-Saver. Saver.

Shower head restricters.
1. Chatham Brass Company, model #200 inserted into Symmons Temptrol, model S-96-1 or S-96-2.
2. Ecos, Lovo, Model #SH-201.

Jetted tubs.
1. One-person tubs best (no brand preferred).
2. Two-person spas restricted to 100 gallon capacity maximum, Thermasol, model #648, #548 or equivalent.

Faucets.
1. Delta, Delex, model #2522 or any similar 2-gpm aerated-flow faucets for the bath.
2. Delta, Lever Deck, model #400 or any similar 2-gpm aerated-flow faucets for kitchen and utility sinks.
3. Kohler, Alterna, model #K-6952 and Europa, model #K11930 or any similar 2-gpm aerated-flow faucets for bath and bar sink.

Clothes washers.
1. General Electric, model #WWP1180G, stackable unit with variable water level.
2. General Electric, model #WWA7070G, standard three settings with variable water level.
3. White Westinghouse, model #LT25VJ (220V), five settings with variable water level.

Dishwashers.
1. General Electric, model #GSD900G or #GSD600G, three settings with variable water level.