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Indoor Water Conservation

Toilets, Shower Heads, Washing Machines and Faucets Can All Use Less Water

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A new Texas law will soon go into effect that will boost conservation efforts by limiting the amount of water used by plumbing fixtures sold in the State.

The law (Senate Bill 587) requires that only water-conserving plumbing fixtures be manufactured, imported, or supplied for sale in Texas after January, 1, 1992. By September 1, 1992, labels with estimated water use for the fixtures will be required.

Maximum water use standards for specific types of fixtures are prescribed. Most toilets can only use 1.6 gallons per flush (GPF), while wall-mounted toilets can not use more than 2 GPF. Shower heads can use a maximum of 2.75 gallons per minute (GPM). Faucet aerators are limited to 2.2 GPM and urinals cannot use more than 1 GPF.

Interest in water conserving plumbing fixtures isn't limited to Texas. Nationally, Senate Bill 1273 has been introduced that would set water use standards and evaluate the operating costs for toilets, shower heads, faucets, urinals, dishwashers and clothes washing machines. The bill would also establish water use standards for drinking fountains, water-cooled air conditioning systems, lawn sprinklers and other devices.

Why is there such an interest in indoor water use?

One reason is that low-flow plumbing standards and retrofit programs are permanent, one-time conservation measures that can be implemented automatically at no additional cost over their lifetimes.

Because these fixtures use significantly less water than standard models, State officials are projecting significant water savings. The Texas Water Development Board (TWDB), the agency charged with requiring conservation as a part of loan applications, estimates that the use of low-flow fixtures may reduce water use Statewide by 805 million gallons per day by the year 2040. That's equal to the current daily water use of Houston, Dallas, San Antonio, El Paso, and Austin combined.

If low flow toilets that use only 1.6 GPF were utilized throughout Texas now, they could save an estimated 200 million gallons of water each day (MGD). That could reduce the need to build additional water and wastewater treatment plants by 15%, saving as much as $3.4 billion during the next 50 years. As a result, the TWDB estimates that residential water and sewer bills could also decline by roughly $200 million over the long-term even though some short-term increases could occur. State officials also predict that it will take about 40 years to replace conventional toilets with low flow models. By that time, estimated savings could total 300 MGD.

There remain some significant unresolved questions.

There is little information on the long-term success of such programs at reducing individual water use. Some critics suggest that retrofit or water use efficiency programs need to be accompanied by efficient rate structures that reflect to be unsuccessful.

In Texas, follow-up assessments of the impact of urban conservation programs have been lacking. The TWDB requires that plans to save water accompany loan and grant applications. Those plans are reviewed periodically, but so far the emphasis of the evaluations has been on measures cities have implemented; not the results of conservation programs. Meanwhile, the Texas Water Commission (TWC), the water policy enforcement agency, has shown little interest until lately in linking conservation to the issuing and renewal of water rights and water and wastewater permits. Recently, the TWC began to require that conservation plans accompany requests for water rights, and is now developing criteria to assess the performance of conservation efforts.

Much of the anticipated water savings will not come about until water saving fixtures required by the law are installed in new and remodeled homes, apartments, and commercial buildings. The Texas A&M Real Estate Research Center estimates that 40,000 homes and 7,500 apartments will be built in Texas this year, down from previous "boom" years.

Although conservation sounds like a "win-win" situation, some say this may not always be the case.

Utilities depend on water sales for a major part of their revenue to cover fixed costs like the construction of new treatment plants and distribution systems. There is a misperception that conservation programs reduce the volume of water that is sold, justifying rates increases. Proponents of conservation argue that although short-term drought management plans may temporarily raise the price of water, long-term

conservation practices save water and money. Less water will be sent to wastewater treatment plants, operating costs can be lessened, energy use will decrease, peak demands will be cut, and system expansions can be delayed.

In many parts of Texas, retrofit programs are already being implemented. El Paso offers rebates of up to $1 00 when residents replace toilets with water-saving models. From time to time, many other utilities have offered to give away or install at little cost low-flow fixtures.

THE NEW LEGISLATION

The new regulations set standards on the amount of water that can be used in shower heads, toilets, faucets, and urinals that are sold or installed in Texas. The standards will be enforced through

requirements placed directly on the manufacturers, importers and suppliers of new fixtures. They will not require that existing plumbing codes be amended.

Temporary rules to implement the new law are now being formulated by multiagency task force. Those rules are expected shortly. Final rules are expected by next summer. The TWC will oversee the rules after March 1992.

The new legislation should produce significant savings in areas with less than 5,000 residents. Previously, the only effective method to see that these fixtures were utilized was through local plumbing codes. Such codes were not required for small towns. Significant savings can also be expected in larger urban areas that have adopted ordinances that are less severe than the standards in the new legislation.

The TWDB also recommends that cities and water utilities require insulation of hot water pipes (especially those that are exposed outdoors), pressure reduction valves, and recirculating filters for swimming pools.

Why did this legislation pass this time? Many factors played a key role. A broad coalition including the TWDB, the Water Conservation Subcommittee of the Texas Section of the American Water Works Association, plumbing manufacturers and wholesalers, State agencies, environmental groups, and local water districts supported the measure. Residents of Texas are gradually becoming more aware of the short- and long-term water shortages that exist in many regions. Many other states and regions have adopted similar ordinances (it's estimated that half of the U.S. residents live in areas with such plumbing efficiency laws). Recent droughts emphasized the problems that exist when water is scarce.

A TWDB survey of roughly 300 cities and utilities earlier this year provides some insights on the attitudes of water managers about retrofit and plumbing efficiency programs. Nearly 60% said that additional information on indoor residential conservation was important, roughly 71% said that new data on fixture standards were yew, important

or important and roughly 28% said that literature on retrofits of existing structures were important. Less than 5% said more information on any of those items was not important.

ANTICIPATED SAVINGS

The amount of water that can be conserved with water efficient fixtures is substantial.

Typically, residential demands comprise three-fourths of total urban water demand. Indoor use accounts for roughly 60% of all residential use. Toilets alone use nearly 40% of all indoor water use (Consumer Reports, 1990), while toilets, showers, and faucets combined represent two-thirds of all indoor water use. More than 4.8 billion gallons of water are flushed each day, and a typical American uses about 9,000 gallons of water per year to flush a mere 130 gallons of body waste down the toilet.

The TWDB estimates that the use of water-efficient fixtures should save a typical 4-member household 55,800 gallons of water and $627 in reduced water and energy costs annually. Most of the water savings come from showers (19,200 gallons) and toilets (18,100 gallons). Most of the reduced costs ($346) will come when because less water needs to be heated.

Although specific benefits vary, local savings can be impressive. For example, the City of Corpus Christi (1990) predicts that an average 3-member household can reduce its water use by 54,000 gallons annually and can lower its water bill by roughly $60 a year if water-efficient plumbing fixtures are utilized.

If bathroom fixtures that were in use before 1980 are replaced, water use can be reduced 20 gallons per capita per day (GPCD). Replacing fixtures that were installed after 1980 can still save 13 gallons per capita per day (a 39% reduction). That would lessen a typical 3-member household's water use by about 13,000 gallons per year.

Recent design improvements have produced a new generation of plumbing fixtures that use water far more efficiently than previous models. For example, low flow toilets need just 1.6 GPF, less than half the amount used by standard models now being marketed. As recently as the 1970s, toilets typically needed as much as 7 GPF.

The City of Austin (Cobos, 1991) recently evaluated the effectiveness of 25 low flow toilets that were installed in area homes. More than 80% of the residents surveyed reported lower water bills since the toilets were installed. Average household usage dropped by 27% to 173 gallons per day (GPD) and wastewater flows were cut by 16 GPCD.

Showers now account for roughly 20% of total indoor water use. However, new shower heads that require just 2.5 GPM have been developed to replace current models that can use up to 8 GPM. The TWDB estimates that switching from a conventional 4.5 GPM shower head to an efficient model that uses only 2.5 GPM can save a family of four nearly 20,000 gallons of water a year. More efficient kitchen and bathroom faucets that

use just 2 GPM have also been developed.

Many experts believe that replacing older, water-inefficient plumbing fixtures with modern, efficient devices, is the single most effective method of conserving water inside the home.

EXISTING PROGRAMS

Although no water conserving plumbing fixture standards were in place in Texas before 1985, more than 100 cities and water districts have since adopted such ordinances.

The TWDB has been involved with many of the programs, in general, and with water-efficient fixtures, in particular.

TWDB loan and grant programs resulted in savings of roughly 12-13 MGD in 1990. More than 102 loans and 68 planning grants that have been issued by this program. The program requires that applicants seeking more than $500,000 of financial assistance develop and implement conservation programs. Water saving plumbing codes and plumbing fixture retrofit programs are recommended.

Periodic reviews and evaluations are required by the Board until the monies are repaid. So far, TWDB reviews have focused more on activities (number of brochures printed and shower heads distributed) than on water savings. As increased information is gathered on conservation programs and savings, this emphasis is expected to shift.

The TWDB also provides technical assistance, education and information on a variety of conservation-related topics.

The TWDB has limited powers to penalize those who do not report or carry out adequate conservation programs. Past conservation programs are evaluated when TWDB considers issuing new loans and grants.

The TWDB incorporates the impacts of conservation when developing short- and long-term water use estimates. For example, 1990 was the first time the TWDB provided estimates of water use and water needs with and without conservation measures in its *Water for Texas* plan.

There are other mechanisms to achieve conservation. In 1985, the Legislature gave the TWC the authority to require that applicants for water rights prepare and implement conservation plans. The TWC is now beginning a conservation program and is developing rules on how it will incorporate conservation into its programs. So far, performance based audits of conservation programs in Corpus Christi and Laredo have been evaluated. The evaluations focus on local trends in per capita use compared to regional trends, measures to account for water use and the ratio of peak to average demands. The TWC is considering regional "ceilings" of acceptable per capita use rates for individual regions.

In some areas, local governments have taken the lead in indoor water conservation.

The Edwards Underground Water District (EUWD) has helped develop plumbing efficiency ordinances and has worked with San Antonio and five other area cities to pass efficient plumbing codes. The codes establish maximum water flow and discharge rates for indoor plumbing fixtures and require insulation of exposed hot water piping. El Paso and Austin have established plumbing fixture efficiency standards, while Corpus Christi and San Antonio are expected to pass similar measures shortly. Since 1990, the Lower Colorado River Authority (LCRA) has required municipal wholesale water customers with new or amended contracts to adopt plumbing standards which incorporate 1.6 GPF toilets in new construction. LCRA also requires that new homes or remodeled homes that use septic tanks utilize low flow toilets.

The City of Austin (1991) has implemented a program to audit the amount of water used by individuals, businesses and industries, as well as a city-wide, door-to-door, retrofit project. The programs began in 1985 as a response to a TWC enforcement order for water quality violations.

The water audit assesses customer use and compares it to national averages. Recommendations to reduce water use are provided along with projected costs and paybacks.

Austin's retrofit program distributes low-flow shower heads and toilet dams. Some of the devices were installed directly by City staff, and others by depot distribution where customers picked up kits and performed their own installation. Direct installation was more expensive, but the rate of participation was 63% more than depot distribution. Roughly 40,000 lowflow shower heads and 52,000 toilet dams have been installed. Austin is now updating its conservation efforts, including rebates for low-flow toilets, plumbing fixture codes, residential and commercial water audits, and goal billing.

Austin's programs have been successful. Results estimate water use has decreased by 5 MGD because of the efforts. Wastewater flows have been cut by 180,000 GPD.

In Llano and Schulenburg, the LCRA replaced conventional toilets with low flow 1.6 GPF models. Results suggest that daily per capita water use was reduced by 15-20 GPCD in Llano and by as much as 27 GPCD in Schulenburg (Mullarkey, 1991). Results of an LCRA retrofit program to install low-flow shower heads and toilet dams in Marble Falls reduced indoor per capita water use by 21% (from 81 to 64 GPCD) in an apartment complex and by 11% (from 102 to 91 GPCD) in a public housing program.

In San Antonio, the EUWD worked with the City to install water efficient toilets, faucets, shower heads and car washes in city-owned facilities and is developing a program to replace shower heads with the San Antonio Housing Authority. The City of Houston distributed 40,000 water conservation kits. The Harris Galveston Coastal Subsidence District is working with Municipal Utility District 55 to study the benefits of retrofitting

plumbing devices. Their efforts involve installing low flow devices in single family residences and apartments. The results will be compared to a group of residents that do not use the devices and will be evaluated. Dallas has begun a pilot project to install low-flow shower heads and toilet dams.

ECONOMIC ISSUES

Cost effectiveness will decide which conservation measures should be implemented in a given case, but assigning costs and benefits is an inexact science.

Low flow fixtures are not significantly more expensive than conventional models now on the market. The most popular water saving toilets cost $80 to $125, while water saving shower heads can be purchased for less than $5. In addition, rebates on larger water saving fixtures like toilets may be available locally.

There are concerns that conservation measures can lessen utility revenues by reducing the amount of water sold. Because many capital costs (building a new water treatment plant or paying long term debt) are fixed, some utilities respond by increasing rates.

TWDB studies suggest water rates should not rise significantly because of conservation during the next 40 years, but should decrease as per capita water use drops. That's because it will take up to 40 years for conventional toilets to be replaced and because of expected population growth.

Consumer Reports (1990) estimates that converting from a 5 GPF to a 1.6 GPF toilet would slash annual water bills for a family of three by $62 in Houston and by $53 in Dallas.

The City of Austin is now quantifying the costs and water savings associated with specific conservation measures. Dollar savings from reduced water demands, capital outlays, new facilities, wastewater treatment costs, and energy savings will all be analyzed. Austin is also studying whether financial incentives could cut water use. Innovative ideas being investigated include "goal billing" and "cash for grass." In goal billing, customers are given a budget of a set amount of water

they can use in a year. If they use less a rebate is given, while surcharges are added for excess usage. In cash for grass, homeowners are rewarded for incorporating landscapes with less turfgrass areas.

A 1989 study (Macy and Maddaus) compared the costs and benefits of various water conservation measures by estimating the money it takes to save an acre-foot (AF) of water. Results suggest that plumbing codes ($86 to save an AF) are more effective than retrofit programs ($189 to save an AF). Landscape audits are the most effective ($71 to save an AF) and single family water audits are the least effective ($302 to save an AF).

PER CAPITA USAGE

Per capita usage is one of the essential components needed to plan whether conservation is needed.

Water use in cities and towns across Texas varies considerably. Average per capita usage was less than 100 GPCD before World War II, but rocketed to 182 GPCD by the 1970s. Per capita use has declined slightly in the 1980s but still averages 165 GPCD. The recent reductions in per capita use may have resulted from higher water rates brought about when many facilities over- expanded in the 1970s.

Per capita usage varies across Texas but the TWDB projects that increased plumbing efficiency will reduce indoor water use 11 to 13% in many regions of the State (see Figure). The combined effect of many conservation programs could cut use by roughly 20%.

The TWDB estimates that efficient plumbing fixture standards will reduce per capita use by 25 GPCD by the year 2040, if 90% of existing toilets are replaced with 1.6 GPF models by then. Retrofit programs and other measures are expected to curb per capita use by an extra 5 GPCD.

A new study (Holloway and Ball, 1991) for the TWDB examined per capita consumption across Texas and isolated factors that influence water usage. It found that the price consumers pay for water, household income, the ratio of commercial vs. individual users, weather conditions, and the size and location of the city being studied were the most important factors in explaining historical use and forecasting future use.

The study evaluated the impact of increasing water rates and personal income on water use to see how rate structures impact per capita usage. Some of the most likely scenarios (increases of water prices of 4% per year and gains of 1.5% per year for personal income) would lower water use some areas, but would not in others. A keys is determining individual responses to higher water cost.

Knowing per capita use rates can help decision makers and planners determine if their community needs to undertake aggressive conservation measures, and can provide estimates of the amount of water that can be saved. El Paso hopes to cut its per capita usage from 200 to 160 GPD by implementing conservation measures.

A study by the City of Austin will calculate per capita water use inside and outside the home to identify customers with the highest potential for water savings at average and peak demands. The goal is to cut per capita peak use by 10% per day, and non-peak use by 5% per day by the year 2000.

Incorporating social, demographic, and economic factors that may help explain why individuals or areas use more water was a focus of a TWRI-sponsored study by the Rural Sociology Department at Texas A&M University (Murdock and others, 1988). Trends were identified that could lead to excess water use so that strategies could be directed at the lifestyles or attitudes that led to excess use.

PERFORMANCE ISSUES

Many studies show that low flow toilets function successfully and may actually alleviate some operating problems.

For example, studies in Arizona (Anderson and Siegrist, 1990) found that extremely efficient toilets that use just 0.8 GPF had fewer problems with line plugging, toilet clogging, and double flushing than did subdivisions with 3.5 GPF models.

The TWDB suggests that the use of water-efficient fixtures will probably improve the performance of wastewater treatment plants and septic tanks by reducing the hydraulic loading (the amount of water used to carry the wastes).

SUMMARY

The mandatory statewide use of water-saving toilets, shower heads, faucets and other devices in residences, businesses, and industries, is undoubtedly a positive step that will significantly reduce water use in Texas. At the same time, numerous other benefits will accrue. Individuals will use less water and, in many cases, will see their water bills go down. Flows to wastewater treatment plants will be decreased. Expansion of existing plants and construction of new facilities will probably be delayed.

One of the best parts of the new legislation is that it should be relatively painless to implement. Many reports suggest these new devices function just as well as existing models, while saving tremendous amounts of water and energy.

There a few questions, however.

First, although huge savings are projected, more follow-up studies are needed to examine whether the use of efficient fixtures actually reduced water use. Evidence is lacking that the anticipated savings will actually be realized. Another factor that needs to be investigated is to quantify the impact of separate conservation components. For example, can we isolate the savings caused by efficient plumbing fixtures from additional water saved by landscape improvements, rate structures, and leak detection programs? Such information is needed to evaluate the costs and benefits of these programs.

State agencies should become much more aggressive about clearly examining the effectiveness of conservation programs. Effective programs with demonstrated savings should be tied to loans and water and wastewater permits.

Finally, some areas are blaming conservation for reducing water use and revenues. As a result, rate increases are being proposed. The effects of conservation on water revenues and water rates need to be examined clearly. Strategies to lessen the impact of conservation on utility revenues need to be studied. Consumers should not be punished for conserving precious and often scarce water resources.

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