

MEMO

April 29, 2020

From: Peter Mayer, P.E., Principal, WaterDM

To: Alliance for Water Efficiency

Summary of Conclusions

- The April 10, 2020 Notice in the Federal Register requested information, data, surveys and studies to help assess customer satisfaction with WaterSense labeled products which could help inform future product specification.
- While not addressing customer satisfaction or WaterSense products directly, the 1999 and 2016 Residential End Uses of Water Studies measured how people use water at home in their daily lives. The studies reveal how frequently people use toilets and faucets and clothes washers and to what extent those behaviors have changed over time. This information can be an indicator of customer satisfaction.
- The results for toilet flushing, showering, and faucet use show that over 15 years, fixtures themselves have become more efficient, but the use of these fixtures has not changed.
 - The average volume of water used to flush a toilet has decreased, but the average number of flushes per person per day has stayed the same.
 - The average number of minutes spent in the shower has stayed the same.
 - The average faucet use per person per day has stayed the same.

Why a Residential End Use Study Memo?

The Alliance for Water Efficiency requested that WaterDM prepare a memo presenting key results from the Water Research Foundation's paired residential end uses of water studies (REUWS) published in 1999 and 2016, particularly as they relate to toilets, showers, and faucets. This information is provided to improve understanding of usage patterns over time for the purpose of responding to the Notice of Recent Specifications Review and Request for Information on the WaterSense Program published on April 10, 2020 in the Federal Register.

What Are the Residential End Uses of Water Studies?

The Residential End Uses of Water Studies are a series of research studies sponsored by the Water Research Foundation and a consortium of utilities. The 1999 *Residential End Uses of Water* (Mayer P. and DeOreo W., et. al. 1999) provided detailed information on residential water use patterns and efficiency levels from 1,187 single-family homes from random samples selected across 14 water providers. The 2016 *Residential End Uses of Water, Version 2* (DeOreo W. and Mayer P. et. al. 2016) provided an updated and expanded assessment of water use from 762 single-family households from random samples selected across 9 water providers and presents detailed information and data about how water use has changed during the 15-year period. The WaterSense program was established in 2006 in the time between these two research projects.

Do the Residential End Uses of Water Studies Address Customer Satisfaction?

The Residential End Uses of Water Studies did not specifically survey participants about “satisfaction” or “enjoyment” of fixtures like toilets, showerheads, and faucets. Rather the study measured how people use water at home in their daily lives. The studies reveal how frequently people use toilets and faucets and clothes washers and to what extent those behaviors have changed over time.

These successive residential end use studies offer the best available measurements of key metrics such as the frequency of toilet flushing, the duration of shower and faucet usage, and the flow rate of these fixtures. This information provides valuable insight about water use patterns, and indicates if people are using fixtures the same or more frequently as the flow rates and flush volumes of the fixtures have changed. This information can be a strong indicator of customer satisfaction.

THE RESULTS FROM THE LARGEST NATIONAL STUDIES SHOW THAT TOILET FLUSHING FREQUENCY HAS STAYED THE SAME, EVEN AS FLUSH VOLUMES HAVE BEEN REDUCED THROUGH PLUMBING CODES AND STANDARDS AND THE VOLUNTARY WATERSENSE PROGRAM.

Toilet Flushing

American households are equipped with thousands of different makes and models of toilets that have been installed over many years. The results from the Residential End Uses of Water studies (Table 1) show that toilet flushing became substantially more efficient between 1999 and 2016, but significantly, people flushed the toilet almost exactly the same amount. The average toilet flush volume decreased from 3.65 gallons per flush in 1999 down to 2.6 gallons per flush in 2016, but the number of flushes per person per day stayed the same. From a flushing frequency perspective, Americans are just as satisfied with their toilets that used an average of 2.6 gallons per flush as they were with their toilets that used an average of 3.65 gallons per flush.

Figure 1 presents the frequency distribution of toilet flush volumes from the two studies. High volume toilets flushing at 4 gallons per flush or more were far more common in the 1999 data set. Low volume toilets flushing below 2 gallons per flush were far more common in the 2016 data set. Flush volume has changed, but flushing behavior remained the same. If customers were experiencing problems with lower volume toilets, it would be evident from these data, but that is not the case. The results from these two major national studies show that toilet flushing frequency has stayed the same, even as flush volumes have been reduced through plumbing codes and standards and the voluntary WaterSense program.

Table 1: Toilet summary from 1999 and 2016 REUWS¹

	1999 REUWS	2016 REUWS
Number of houses	1187	762
Average flushes/household/day	12.4	13
Average flushes per person per day	5.05	5.0
Average flush volume	3.65 ± 0.06 gal	2.6 ± 0.01 gal
Average daily use for toilet flushing	45.2 gphd	33.1 ± 2 gphd
Median daily use for toilet flushing	43 gphd	29 gphd
% of Flushes < 2.2 gal	16%	48%
Average per capita toilet use (gpcd)	18.5	14.3

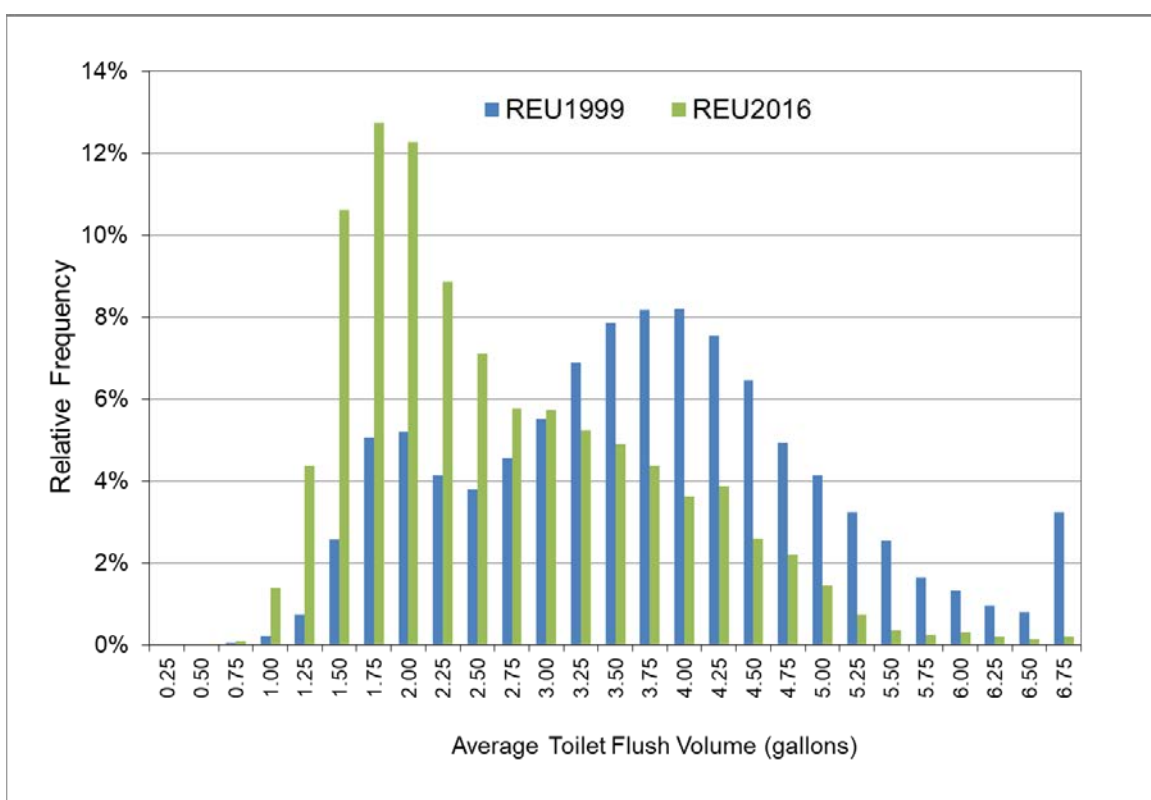


Figure 1: Frequency distribution of toilet flush volumes, 1999 and 2016 REUWS¹

Showers

The second largest category of water use inside homes in these studies was for showering. On average there were roughly two showers per day taken in the homes that had an average duration of 8 minutes and used 16 gallons of water per shower. Results from the two studies are shown in Table 2. These statistics show a consistent pattern of use for showering over the years. People generally take a shower with a duration of 7.8 minutes that uses between 15 and

¹ Source: Water Research Foundation, Residential End Uses of Water, V2 (2016)

18 gallons (57 and 68 liters) of water. The data do suggest a small but perceptible decrease in the daily use and per shower use between the two REUWS studies, but it is not significant.

As with toilet flushing, showering behavior patterns did not change much over 15 years. Subsequent analysis on shower patterns using the same Residential End Uses of Water data sets was performed in 2017 by Bill Gauley and John Koeller. That research found “on average, people do not compensate for lower flow rates by increasing the duration of their shower and that lower flow rate showerheads do, on average, result in a lower overall shower volume” (Gauley and Koeller 2017).

The Gauley and Koeller report findings also shed light on the complexities associated with showering and trying to measure customer satisfaction. “While some people take longer showers and some take shorter showers, it seems that, in general, people tend to follow their own unique routine for showering regardless of the flow rate of the showerhead. In fact, it is possible that the few extra seconds spent showering at lower flow rates is primarily related to washing and rinsing hair” (Gauley and Koeller 2017).

Table 2: Shower summary from 1999 and 2016 REUWS²

	1999 REUWS	2016 REUWS
<i>Number of houses</i>	1187	762
<i>Average showers/household/day</i>	1.8	1.8
<i>Average showers/person/day</i>	0.66	0.69
<i>Average shower volume</i>	16.7 ± 0.3 gal	15.8 ± 0.5 gal
<i>Average shower duration</i>	7.8 ± 0.14 minutes	7.8 ± 0.02 minutes
<i>Average flow rate for showers (gpm)</i>	2.2 ± 0.04 gpm	2.1 ± 0 .04 gpm
<i>Average per capita shower use</i>	11.6 gpcd	11.2 gpcd

Faucets

Faucet use in the Residential End Uses of Water studies is comprised of a wide variety of water use events, which basically do not fall into any other recognizable category within established flow constraints and include kitchen, bathroom, hose bib, and utility sink faucets.

Faucet use is highly discretionary, so it is expected to see high numbers of these events and a high degree of variability in the statistics. Table 3 shows faucet statistics from the 1999 and 2016 end use studies. Faucet use has remained similar over the roughly 15-year period between studies, with the average per capita use for faucets only differing by 0.2 gpcd.

Similar to the findings with toilets and showers, there appear to be very few differences in faucet use behavior between the two studies, even more notable because the data were

² Source: Water Research Foundation, Residential End Uses of Water, V2 (2016)

collected 15 years apart from samples of entirely different homes in different cities. The fact that faucet use patterns did not change is clear indication that changing faucet fixture flow rates including the WaterSense specification have had little overall impact on behavior or faucet use.

Table 3: Faucet summary from the 1999 and 2016 REUWS³

	1999 REUWS	2016 REUWS
<i>Number of houses</i>	1187	762
<i>Average faucet uses/person/day</i>	15	20
<i>Average faucet use volume</i>	0.7 gallons per use	0.5 gallons per use
<i>Average faucet duration</i>	30 seconds	30 seconds
<i>Average per capita faucet use</i>	10.9 gpcd	11.1 gpcd

Conclusions

- The April 10, 2020 Notice in the Federal Register requested information, data, surveys and studies to help assess customer satisfaction with WaterSense labeled products which could help inform future product specification.
- While not addressing customer satisfaction or WaterSense products directly, the 1999 and 2016 Residential End Uses of Water Studies measured how people use water at home in their daily lives. The studies reveal how frequently people use toilets, showers, faucets and clothes washers and to what extent those behaviors have changed over time.
- These paired residential end use studies offer the best available measurements of key metrics such as the frequency of toilet flushing, the duration of shower and faucet usage, and the flow rate of these fixtures. This information provides valuable insight about water use patterns and indicate if people are using fixtures the same or more frequently as the flow rates and flush volumes of the fixtures have changed to become more efficient.
- The results for toilet flushing, showering, and faucet use show that over 15 years, fixtures themselves have become more efficient, but the use of these fixtures has not changed. The average volume of water used to flush a toilet has decreased, but the average number of flushes per person per day has stayed the same. The average number of minutes spent in the shower has stayed the same. The average faucet use per person per day has stayed the same.
- If customers were satisfied with their fixtures in 1999, they appear to be equally satisfied with their fixtures in 2016 and use them in pretty much the same way, even as the fixtures themselves have become more efficient.

³ Source: Water Research Foundation, Residential End Uses of Water, V2 (2016)

References

DeOreo, W.B., P. Mayer, J. Kiefer, and B. Dziegielewski. 2016. Residential End Uses of Water, Version 2. Water Research Foundation. Denver, CO.

Gauley, B. and J. Koeller. 2017. How Showerhead Flow Rates Impact Shower Duration and Volume. Prepared for the Alliance for Water Efficiency. www.map-testing.com

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