Comments on WaterSense®
Notice of Specification Review

September 26, 2019

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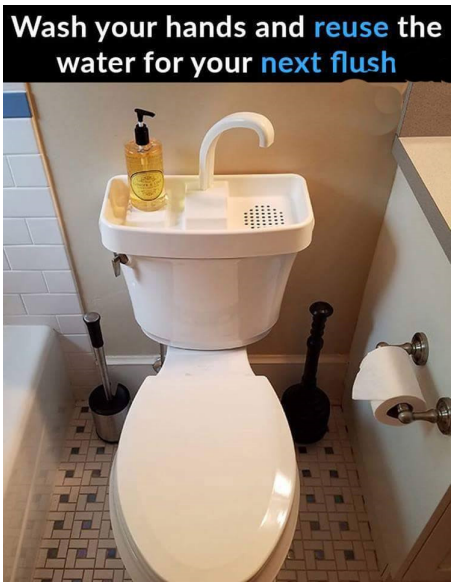
Commenter: Culver Van Der Jagt
Affiliation: Van Der Jagt Law Firm
Comment Date: February 14, 2019

Email Text:

I would like to be involved in the creation of water sense standards for toilet top sinks. These devices don't "use" any water for handwashing since they put the water into the toilet tank for flushing when done with hand washing. This technology has been successfully used in Japan for over 60 years and saves hundreds of millions of gallons every day there. The technology is also used in many correctional facilities in the USA. While I have been introducing my American made equivalent without a water sense label, I believe water sense labeling is important for this proven technology.

Culver

Email Attachment



Commenter: Trav Giese
Affiliation: Giese Construction and Renovation
Comment Date: February 18, 2019

Email Text:

Hi,

Would like to see watersense standard required silicone seals gaskets bushings as to help make toilets & fixture leak free for the life of the products. found toilets with rubber seals bushings all start to leak or drip at about 10 years of age. & often left in the state for years or permanently great mitigate any potential water savings & would like to see all 100% 316 stainless steel parts. thx please reply

Commenter: Christopher Radziminski
Affiliation: City of Vancouver, Canada
Comment Date: March 8, 2019

Email Text:

Dear Sir / Madam,

Please find attached comments responding to the EPA WaterSense Notice of Specification Review.

Have a great weekend,
Sincerely, Chris

Christopher Radziminski, M.A.Sc., P.Eng., R.P.Bio.
City of Vancouver | Water Design Branch
1100 - 450 SW Marine Drive, Vancouver, BC V5X 0C3
t: 604.873.7453 | chris.radziminski@vancouver.ca

Email Attachment

Topic: EPA WaterSense Notice of Specification Review Response to Request for Comments

Comment:

March 8, 2019
Eastern Research Group, Inc.
(EPA WaterSense contractor)
2300 Wilson Boulevard, Suite 350
Arlington, VA 22201
Sent via e-mail: watersense-products@erg.com

Dear Sir / Madam,

This letter provides comments which perhaps will be found useful in your review of the *WaterSense Specification for Tank-Type Toilets*.

Currently, the newer *WaterSense Specification for Flushometer-Valve Water Closets* permits a maximum flush of 4.8 litres (1.28 gallons). This means that the “full” flush mode of a dual-flush, flushometer-valve toilet must use **4.8 litres** (1.28 gallons) or less.

Conversely, the *WaterSense Specification for Tank-Type Toilets* permits a maximum **effective** flush of 4.8 litres (1.28 gallons). This means that the “full” flush mode of a dual-flush, tank-type toilet can use **6.0 litres** (1.6 gallons). The underlying, fundamental assumption is that for every three flushes, one is a “full” flush and two are “reduced” flushes.

This assumption does not appear to be unambiguously supported by independent reviews of user behaviour published in publicly available academic literature: The “full” flush is often used more than assumed. This is also evident when examining different sectors, as tank-type toilets can be found in a variety of private-use and public-use settings such as hotels, restaurants and shops.

In the apparent absence of unequivocal evidence supporting the assumption behind the “effective flush” concept, as of January 1, 2019 the City of Vancouver (Canada) has harmonised its requirements for all new toilets using drinking water to a maximum of 4.8 litres per flush. This change did not affect the majority of toilets already on the market.

EPA WaterSense may also wish to review the available independent literature on user behaviour to determine whether the *Specification for Tank-Type Toilets* could perhaps harmonise with the *Specification for Flushometer-Valve Water Closets* for a consistent “maximum flush” of 4.8 litres (1.28 gallons) across all toilet types and flush modes.

Hopefully these comments are helpful, and if you have any questions, please feel free to contact me.

Yours truly,

[submitted electronically]

Christopher Radziminski, M.A.Sc., P.Eng., R.P.Bio.
Policy Analyst
1100 – 450 SW Marine Drive, Vancouver, BC V5X 0C3
604.873.7453 | chris.radziminski@vancouver.ca

Commenter: Eileen Chau
Affiliation: Winfield Products
Comment Date: March 12, 2019

Email Text:

Hi,

Winfield would like to propose that once a product is tested and listed under UPC, they should be automatically be listed under WaterSense as well, no need to pay another charge for another IAPMO certificate, which is what we are doing now. Every year, we have to pay a fee to IAPMO for keeping WaterSense listing.

In order to get IAPMO UPC listing, the listee has to get the products tested and listed by IAPMO. Why should EPA has to ask WaterSense participant to get an IAPMO listing and pay extra fees every year. It is a huge burden for all the participant now. We should not be required to make double payment for the same requirements.

Thank you.

Eileen Chau

Winfield®
1689 E Mission Blvd.,
Pomona, CA 91766
Tel: (909)666-5111
Fax: (909)666-5266
www.winfieldproduct.com
Working Hours: (M-F)8:00am-4:30pm Pacific Time.

Commenter: Matt Sigler
Affiliation: Plumbing Manufacturers International (PMI)
Comment Date: March 14, 2019

Email Text:

Stephanie and Robbie-

Please accept PMI's attached comments for the EPA WaterSense® Notice of Specification Review. If you have any questions, please do not hesitate to contact me.

Regards,

Matt Sigler
Plumbing Manufacturers International
Technical Director
847-217-7212
Email: msigler@safeplumbing.org
www.safeplumbing.org

Safe, responsible plumbing. Always.

Regards,
Matt Sigler
Plumbing Manufacturers International (PMI)
847-217-7212
msigler@safeplumbing.org

Email Attachment

See pages 8 through 10.

March 14, 2019

Stephanie Tanner
U.S. Environmental Protection Agency
Office of Wastewater Management (4204M)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
watersense-products@erg.com

RE: EPA WaterSense® Notice of Specification Review

Dear Ms. Tanner:

Plumbing Manufacturers International (PMI) appreciates the opportunity to provide comments regarding the EPA WaterSense® Notice of Specification Review.

PMI is an international, U.S.-based trade association representing manufacturers that provide 90% of the plumbing products sold in the United States. We have made the promotion of water safety and efficiency a top priority and have included this in our mission statement[1]. PMI's members are industry leaders in producing safe, reliable and innovative water efficient plumbing technologies and have supported the U.S. EPA WaterSense® program since its inception. **In the U.S., plumbing manufacturers contribute $34.9 billion to the economy, provide more than 193,000 jobs (direct and indirect), and generate $10.4 billion in wages.**

Regarding the notice, PMI supports the **current** EPA WaterSense® Specifications for Tank-Type Toilets, High-Efficiency Lavatory Faucets, Flushing Urinals and Showerheads and recommends that **no changes** be made at this time. We would also like to bring to your attention the following comments for your consideration:

- There are two EPA-funded research studies currently underway that are looking into the impact of water conservation on public health. The first with Drexel University is titled: "*Water Conservation and Water Quality: Understanding the Impacts of New Technologies and New Operational Strategies*," and the second with Purdue, Michigan State and San Jose Universities is titled: "*Right Sizing Tomorrow's Water Systems for Efficiency, Sustainability, and Public Health*." As indicated during the EPA's March 2017 webinar to discuss the scope of these research projects, the hypothesis of both projects was stated as:

[1] PMI's Mission: To promote the water efficiency, health, safety, quality and environmental sustainability of plumbing products while maximizing consumer choice and value in a fair and open marketplace. To provide a forum for the exchange of information and industry education. To represent openly the members' interests and advocate for sound environmental and public health policies in the regulatory/legislative processes. To enhance the plumbing industry's growth and expansion.

Plumbing Manufacturers International | 1750 Tysons Boulevard | Suite 1500 | McLean, Virginia 22102
Tel: 847-481-5500 - Visit us at www.safeplumbing.org

"The recent use of low-flow plumbing fixtures such as faucets, toilets, and showerheads has resulted in waterborne disease outbreaks and other water quality problems in building plumbing systems."

Therefore, considering the possibility that one or both EPA-funded studies could show that low-flow plumbing fixtures and fixture fittings contribute to waterborne disease outbreaks and/or other water quality problems in building plumbing systems, PMI believes that EPA WaterSense should wait until the studies have been finalized and vetted by stakeholders before considering any further changes to the water consumption levels in the EPA WaterSense® Specifications for Tank-Type Toilets, High-Efficiency Lavatory Faucets, Flushing Urinals and Showerheads.

- Based on the November 2017 white paper titled: "*Adapting to Change: Utility Systems and Declining Flows*"[2], PMI believes that EPA WaterSense should first analyze the impact on drinking water, wastewater and recycled-water infrastructures across the U.S. before lowering the water consumption levels of tank-type toilets, lavatory faucets, flushing urinals and showerheads below the current levels outlined in the applicable EPA WaterSense® Specifications. Some of the potential impacts on infrastructures identified within the white paper due to reductions in indoor water use in California include:
    - On page 4 for water distribution systems, "*With declining water system flows, drinking water has a longer residence time in pipes, leading to chemical, biological, and physical water quality issues and potentially compromising public health and compliance with the Safe Drinking Water Act, particularly for disinfection by-products (DBPs), coliform bacteria, chlorine residual, and lead and copper action levels*."
    - On page 4 for wastewater conveyance systems, "*Declining system flows decrease wastewater flows and may increase pollutant and solids concentrations, which increase blockages, odors, and corrosion in pipes. This leads to increases in operation and maintenance (O&M) costs, odor complaints, and an accelerated degradation of infrastructure*."
    - On page 5 for wastewater treatment plant operations, "*Declining flows change the characteristics of wastewater, including the quantity and quality of wastewater treatment plant (WWTP) influent, causing impacts and stressing treatment processes as salinity, ammonia, and biochemical oxygen demand (BOD) concentrations increase beyond design specifications*."
    - On page 5 for recycled water projects, "*Declining flows can alter treatment and cost-effectiveness of recycled-water infrastructure by altering factors considered in system design, like anticipated flow and water quality*."

- Several states and municipalities (i.e. Colorado, Georgia, New York, Oregon, Texas, Vermont, etc.) have adopted EPA WaterSense requirements. The further lowering of water consumption levels for tank-type toilets, lavatory faucets, urinals and showerheads would significantly impact current laws.

[2]"Adapting to Change: Utility Systems and Declining Flows," California Association of Sanitation Agencies (CASA), Water Research Foundation (WRF), WateReuse California, California Water Environment Association (CWEA) and California Water Urban Agencies (CUWA), November 2017, http://www.cuwa.org/pubs/CUWA_DecliningFlowsWhitePaper_11-28-17.pdf.

Plumbing Manufacturers International | 1750 Tysons Boulevard | Suite 1500 | McLean, Virginia 22102 Tel: 847-481-5500 - Visit us at www.safeplumbing.org

In closing, based on the above comments, PMI supports the **current** EPA WaterSense® Specifications for Tank-Type Toilets, High-Efficiency Lavatory Faucets, Flushing Urinals and Showerheads and recommends that **no changes** be made at this time.

PMI values our continued partnership with EPA WaterSense and welcomes further discussions on the topic of water conservation. If you have any questions regarding our comments, please do not hesitate to contact me.

Sincerely,

Matt Sigler
Technical Director
Plumbing Manufacturers International
Office 847-217-7212
msigler@safeplumbing.org

cc: PMI Board of Directors

PMI Members

*Bradley Corporation *BrassCraft Mfg. Co. *CSA Group *Delta Faucet Company *Dornbracht Americas *Duravit USA *Fisher Manufacturing Company *Fluidmaster, Inc. *Franke *Global OEM *Globe Union Group, Inc.*Hansgrohe, Inc. *Haws Corporation *IAPMO *InSinkErator *International Code Council Evaluation Service *Jing Mei Industrial (USA) Inc. *KEROX *Kohler Co *Lavelle Industries, Inc. *LIXIL *Moen Incorporated *NEOPERL, Inc. *NSF International *Pfister *Reliance Worldwide Corporation *Similor AG *Sloan Valve Company *Speakman Company *Sprite *Symmons Industries, Inc. *T & S Brass and Bronze Works, Inc.*TOTO USA *Viega LLC *WaterPik *WCM Industries, Inc

Commenter: Andrew D. Morris, Neela Ram
Affiliation: Metropolitan North Georgia Water Planning District
Comment Date: March 15, 2019

Email Text:

Dear Staff,

Please find our comments attached.

Thank you,

Andrew D. Morris
Water Policy Officer

470.378.1549 office
470.747.4005 cell
www.northgeorgiawater.org

Email Attachment

See pages 12 through 27.

Metropolitan North Georgia Water Planning District
International Tower | 229 Peachtree St., NE | Suite 100 | Atlanta, GA 30303

March 15, 2019

VIA EMAIL (watersense-products@erg.com)

WaterSense
U.S. Environmental Protection Agency
Office of Wastewater Management (4204M)
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

RE: Metropolitan North Georgia Water Planning District's Comments on the WaterSense Specification Review

The Metropolitan North Georgia Water Planning District ("District") appreciates this opportunity to provide comments on the U.S. Environmental Protection Agency's ("EPA") WaterSense specifications for tank-type toilets, faucets, showerheads, flushing urinals, and weather-based irrigation controllers. The District strongly supports maintaining and, where feasible, revising product specifications to improve product efficiency and performance.

The District serves as the regional water planning organization for the metropolitan Atlanta area that includes 15-counties and 95 cities. The District also provides regional programs, education, and technical assistance to more than 50 water and sewer utilities and their customers. The metro Atlanta region is committed to water efficiency, and since 2000 these efforts have resulted in a 10% reduction in water use even as the region's population has grown by more than 1 million people. More information on the District is available at www.northgeorgiawater.org. Many of our water efficiency efforts depend on WaterSense-labeled products. For example:

- The plumbing code in Georgia already requires the use of WaterSense-labeled toilets, urinals, and lavatory faucets;
- Together with its utility partners, the District has replaced more than 135,000 older, inefficient toilets with WaterSense toilets, saving more than 2.4 million gallons of water per day;
- The District's model ordinance for large landscape irrigation efficiency requires the use of WaterSense labeled irrigation controllers;
- The District requires local governments to replace inefficient toilets and urinals in their buildings with WaterSense products; and

- Together with its utility partners, the District distributes water efficiency retrofit kits that include WaterSense showerheads.

Based on our experience with the plans, programs, and requirements outlined above, we would like you to consider the following comments:

A. Tank-type Toilets. WaterSense should consider revising the WaterSense specification for tank-type toilets to require (a) better performance in terms of waste clearance and (b) a flush volume of 1.1 gpf or less provided WaterSense satisfactorily analyzes and address any potential adverse impacts on solids transport, water age in the distribution systems, and corrosion in sewer collection systems. It is critical that these potential impacts on the utility side of the meter be considered in addition to potential impacts to premise plumbing on the customer side of the meter.

The Georgia State Minimum Standard Plumbing Code currently requires that all new toilets must use 1.28 gpf or less and be WaterSense labeled. This requirement has been in place since 2012. Based on the customer calls that come into the District's toilet rebate call center, we generally hear positive feedback and extremely few complaints from customers. To reduce even these few complaints, we support revising the performance criteria to require tank-type toilets to clear a larger quantity of waste and/or toilet paper.

The District and its utilities have been seeing a small but growing percentage of customers installing 1.1 gpf toilets. This is especially true in retrofits of multifamily residential projects, where 1.1gpf, 1.0 gpf, and 0.8 gpf toilets are frequently the toilet of choice. Given the growing number of customers in the District using 1.1 gpf or less toilets, our initial impression is that 1.1 gpf or less toilets perform well and have caused few if any problems in residential settings in terms of drain line transport. We are working on data collection efforts to evaluate their performance and customer satisfaction more rigorously. Based on positive initial customer experience, the growing number of 1.1 gpf toilets being installed, and the District's water efficiency goals, the District changed its toilet rebate program in January 2019 to offer a higher rebate amount to customers that choose to install toilets using 1.1 gpf or less.

We often receive questions from water and wastewater utilities in the District regarding the impact of high and ultra-high efficiency fixtures on water age in their distributions systems and issues with solids transport and corrosion in their sewer collection systems. At this point our information is mostly anecdotal, but we are seeking more information on this topic. We ask that WaterSense consider these two issues carefully, including additional data and analysis if possible, as part of its efforts to evaluate 1.1 gpf toilets.

B. Lavatory Faucets. WaterSense should consider revising the WaterSense specification for lavatory faucets to require a flow rate of 1.0 gpm or less and creating a new specification for kitchen faucets with flow rates of 1.5 gpm or less.

The Georgia State Minimum Standard Plumbing Code currently requires that all new lavatory faucets for private settings must use 1.5 gpm or less and be WaterSense labeled. Through the District's retail market research performed in 2018 at Home Depot, Lowe's Home Improvement, and Walmart included here as Attachment A, we found that a very significant number of lavatory faucets on the market today use 1.2 gpm. Products using 1.5 gpm as required by the current

WaterSense specification are no longer leading-edge technologies. If WaterSense wants to continue pushing the marketplace for water efficiency forward, it would need to require a flow rate of less than 1.2 gpm for lavatory faucets. Given that significant numbers of lavatory faucets with a flow rate of 0.5 gpm are used in public settings, it seems reasonable to lower the minimum flow rate for the WaterSense requirements to 0.5 gpm especially given that WaterSense is voluntary program.

Through the District's retail market research performed in 2018 at Home Depot, Lowe's Home Improvement, and Walmart included here as Attachment A, we found that many kitchen faucets are available that use 1.8 gpm and 1.5 gpm. WaterSense's Water Efficiency Management Guide for Residential Kitchen and Laundry uses 25.7 minutes as the average usage time per household per day. While lowering the flow rate will increase the duration of use to some extent for uses like pot filling, water savings can still be expected based on uses like hand washing, fruit and vegetable washing, pot rinsing, garbage disposal use, etc. Based on the significant market share of 1.8 gpm models today, 1.5 gpm may be a good standard for WaterSense to consider because it goes above and beyond what is already common in the marketplace today.

C. Showerheads. WaterSense should consider revising the WaterSense specification for showerheads to require a flow rate of 1.8 gpm.

The Georgia State Minimum Standard Plumbing Code currently requires that all new showerheads must use 2.5 gpm or less. Through the District's retail market research performed in 2018 at Home Depot, Lowe's Home Improvement, and Walmart included here as Attachment A, we found that many of the showerheads on the market today use 2.0 gpm or less, and a significant portion have a maximum flow rate of 1.8 gpm or less.

Products using 2.0 gpm as required by the current WaterSense specification could be considered mid-range in terms of their efficiency. To continue pushing innovation and efficiency forward, WaterSense should consider revising this standard to 1.8 gpm or less. There are products already available in the marketplace at a wide variety of price points using 1.8 gpm or less.

D. Flushing Urinals. WaterSense should consider revising the WaterSense specification for wall-mounted urinals to require a flush volume of 0.125 gpf or less provided WaterSense satisfactorily analyzes and address potential adverse impacts on premise plumbing systems, including potential corrosion, the buildup of minerals like struvite, and increased water age in the premise plumbing of large commercial buildings. Alternatively, WaterSense could evaluate and consider labeling hybrid urinals that that combine the non-water-using urinal technology with a periodic drain line clearing flush as this may avoid or mitigate potential adverse impacts.

The Georgia State Minimum Standard Plumbing Code currently requires that all new urinals must use 0.5 gpf or less and be WaterSense labeled, and there are numerous options available at both this 0.5 gpf level and the 0.125 gpf level. Products using 0.5 gpf as required by the current WaterSense specification could be considered mid-range in terms of their efficiency. To continue pushing innovation and efficiency, WaterSense should consider revising this standard to 0.125 gpf.

E. Weather-based Irrigation Controllers. WaterSense should maintain the labeling program for weather-based irrigation controllers and update it as appropriate based on technological trends and better data on landscape irrigation as they become available.

To improve outdoor water efficiency, the District recently began requiring enhanced irrigation system design and functionality for large landscapes (irrigated landscape areas of more than 1 acre). The District developed a model ordinance for local governments to use in implementing this requirement that specifies the use of WaterSense controllers. Checking for the WaterSense label is a simple way for local staff to ensure a controller has the necessary technical capabilities. Specifically, the WaterSense specifications for irrigation controllers require that the controller be capable of interfacing with a rain sensor shut-off and include other features and reporting capabilities to make use of pressure regulators and flow sensors.

We encourage WaterSense to maintain this labeling program and consult with manufacturers to determine the popularity of each type of controller (stand alone, plug-in, or add-on) and consider ease-of-use in product specification. In our experience, plug-in and add-ons to irrigation controllers are not common and can be confusing to consumers. If this experience is shared more broadly, WaterSense could consider whether it is desirable to continue labeling plug-in and add-ons.

Additionally, WaterSense should consider requiring that signal-based controllers not charge a monthly or annual fee to access the data sent over a signal. Users may forget to pay the fee, lose access to real time weather data, and as a result the controllers would become ineffective to respond to changing weather conditions.

F. Conclusion. WaterSense is critical to the District's work, and we support WaterSense's efforts to maintain and, where feasible, revise product specifications to improve product efficiency and performance.

Sincerely,

Andrew D. Morris
Water Policy Officer

And

Neela Ram
Water Resources Planner

Attachment A
2018 Retail Market Research

Store No. 1 Information

Store Name: Home Depot	Store Address: 5300 Windward Pkwy, Alpharetta, GA 30004
Date of Visit: March 30, 2018	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	1	15	11	1
Total WaterSense	-----	12	10	1
Brands	Sprite	Glacier Bay, Delta, Moen, Waterpik, Kohler	Glacier Bay, Delta, Moen, American Standard, Kohler	Delta
Lowest Priced	$17.98	$2.27	$9.98	12.00
Second Lowest Priced		$3.97	$19.98	NA
Third Lowest Priced		$19.98	$29.98	NA

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	1	38	0
Total WaterSense	1	38	
Brands	Glacier Bay	Glacier Bay, Delta, Moen, American Standard, Pfister	
Lowest Priced	$28.00	$11.78	
Second Lowest Priced		$18.46	
Third Lowest Priced		$19.98	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	3	33	9
Brands	Glacier Bay, Moen	Glacier Bay, Delta, American Standard, Pfister, Kohler	Moen
Lowest Priced	$39.00	$35.98	$138.00
Second Lowest Priced	$64.00	$36.95	$149.00
Third Lowest Priced	$69.00	$46.97	$168.00

Store No. 2 Information

Store Name: Lowe's	Store Address: 4925 Windward Pkwy, Alpharetta, GA 30004
Date of Visit: March 31, 2018	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	32	14	12	1
Total WaterSense	-----	13	11	1
Brands	Moen, AquaSource, Kohler, Pfister, Jacuzzi, Sprite, Delta, ProjectSource	Moen, Oxygenics, Kohler, Delta	Moen, Oxygenics, Delta	Moen
Lowest Priced	$2.98	$23.48	$27.48	64.00
Second Lowest Priced	$9.98	$29.98	$32.98	NA
Third Lowest Priced	$14.48	$32.98	$34.98	NA

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	1	109	0
Total WaterSense	-----	105	
Brands	Peerless	ProjectSource, Peerless, Delta, American Standard, AquaSource, Pfister, Moen, Jacuzzi, Giagni, Kohler, Grohe	
Lowest Priced	$59.00	$20.00	
Second Lowest Priced		$24.98	
Third Lowest Priced		$29.97	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	0	50	16
Brands		ProjectSource, AquaSource, Delta, Pfister, Peerless, American Standard, Giagni, Kohler, Grohe	Moen, Kohler, Delta
Lowest Priced		$38.99	$78.00
Second Lowest Priced		$49.00	$99.00
Third Lowest Priced		$54.00	$109.00

Store No. 3 Information

Store Name: Walmart	Store Address: 5200 Windward Pkwy, Alpharetta, GA 30004
Date of Visit: March 30, 2018	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	0	12	16	0
Total WaterSense	-----	11	16	
Brands		Peerless, Waterpik, AquaSpa	Peerless, Waterpik	
Lowest Priced		$12.97	$2.94	
Second Lowest Priced		$18.84	$6.42	
Third Lowest Priced		$19.97	$8.84	

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	4	2	0
Total WaterSense	4	2	NA
Brands	Peerless	Peerless	NA
Lowest Priced	$19.97	$24.97	NA
Second Lowest Priced	$34.97	$26.97	NA
Third Lowest Priced	$39.97	NA	NA

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	1	5	0
Brands	Mainstay	Peerless	
Lowest Priced	$12.97	$34.97	
Second Lowest Priced		$39.97	
Third Lowest Priced		$59.97	

Store No. 4 Information

Store Name: Home Depot	Store Address: 650 Ponce De Leon Ave, NE, Atlanta, GA 30308
Date of Visit: April 13, 2018	

Showerheads

	2.5 gpm	2.0 gpm	1.8 gpm & lower
Total Number	0	19	17
Total WaterSense	-----	10	14
Brands		Glacier Bay, Waterpik, Moen, Pfister	Delta, Glacier Bay, Waterpik, Moen
Lowest Priced		$2.97	$9.98
Second Lowest Priced		$3.97	$12.98
Third Lowest Priced		$9.98	$13.98

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	0	87	0
Total WaterSense		87	
Brands		Glacier Bay, Grohe, Moen, Pfister, American Standard, Delta, Kohler	
Lowest Priced		$11.78	
Second Lowest Priced		$18.46	
Third Lowest Priced		$28.00	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	0	48	14
Brands		Glacier Bay, American Standard, Kohler, Delta, Kraus, Pfister	Moen, Kohler
Lowest Priced		$17.38	$114.00
Second Lowest Priced		$35.00	$119.00
Third Lowest Priced		$39.00	$129.00

Store No. 5 Information

Store Name: Lowe's	Store Address: 1280 Caroline Street NE Atlanta GA 30307
Date of Visit: April 23, 2018	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	25	6	9	0
Total WaterSense	-----	6	9	
Brands	AquaSource, Moen, Delta	Delta, Oxygenics, Moen	Oxygenics, Moen	
Lowest Priced	$9.98	$32.98	$32.98	
Second Lowest Priced	$14.98	$49.98	$40.98	
Third Lowest Priced	$21.98		$49.98	

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	0	86	0
Total WaterSense		84	
Brands		ProjectSource, Grohe, Moen, Kohler, Delta	
Lowest Priced		$20.00	
Second Lowest Priced		$24.98	
Third Lowest Priced		$29.97	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	0	79	0
Brands		Peerless, Grohe, Pfister, Moen, Delta	
Lowest Priced		$29.00	
Second Lowest Priced		$35.99	
Third Lowest Priced		$38.99	

Store No. 6 Information

Store Name: Walmart	Store Address: 2525 N Decatur Road Decatur, GA 30033
Date of Visit: April 24, 2018	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	0	6	18	0
Total WaterSense	-----	6	18	
Brands		Peerless, WaterPik	Peerless, WaterPik	
Lowest Priced		$3.97	$23.84	
Second Lowest Priced		$6.42	$24.84	
Third Lowest Priced		$8.84	$29.87	

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	0	7	0
Total WaterSense		7	
Brands		Peerless and Mainstays	
Lowest Priced		$9.97	
Second Lowest Priced		$24.97	
Third Lowest Priced		$34.97	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	0	5	0
Brands		Peerless, Mainstays	
Lowest Priced		$12.97	
Second Lowest Priced		$34.97	
Third Lowest Priced		$39.97	

Store No. 7 Information

Store Name: Home Depot	Store Address: 875 Shugart Rd Dalton, GA 30720
Date of Visit: April 13, 2018 (online)	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	2	14	12	2
Total WaterSense	-----	11	12	2
Brands	Pfister	Glacier Bay, DANCO, Waterpik, Pfister, Delta	Glacier Bay, Delta, Moen	No brand listed
Lowest Priced	$19.98	$2.27	$9.98	$4.38
Second Lowest Priced	$29.98	$4.82	$12.98	$7.35
Third Lowest Priced		$4.85	$13.98	

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	1	73	0
Total WaterSense	1	73	0
Brands	Glacier Bay,	Glacier Bay, Delta, Moen, American Standard, Pfister, Kohler	
Lowest Priced	$28.00	$11.78	
Second Lowest Priced		$18.46	
Third Lowest Priced		$19.97	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	0	52	15
Brands		Glacier Bay, Delta, American Standard, Kohler, Pfister	Moen
Lowest Priced		$17.38	$64.00
Second Lowest Priced		$29.98	$69.00
Third Lowest Priced		$35.98	$99.00

Store No. 8 Information

Store Name: Lowe's	Store Address: 1212 Cleveland Highway Dalton, GA 30721
Date of Visit: April 18, 2018 (online)	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	29	15	8	0
Total WaterSense	-----	13	8	0
Brands	ProjectSource, AquaSource, Jacuzzi, Moen, Sprite, Kohler, Pfister, Delta, HotelSpa	Oxygenics, Kohler, Moen, Delta	Oxygenics, Delta	
Lowest Priced	$2.98	$25.98	$24.98	
Second Lowest Priced	$9.98	$29.98	$29.98	
Third Lowest Priced	$9.98	$31.98	$38.48	

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	1	95	0
Total WaterSense	1	95	0
Brands	Peerless	ProjectSource, Peerless, Delta, Pfister, Moen, Jacuzzi, Giagni, Grohe, Kohler	
Lowest Priced	$59.00	$20.00	
Second Lowest Priced		$24.98	
Third Lowest Priced		$29.97	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	3	50	20
Brands	Moen	ProjectSource, AquaSource, Delta, Pfister, Giagni, American Standard, Peerless, Kohler	Moen, Kohler
Lowest Priced	$69.00	$31.98	$69.00
Second Lowest Priced	$99.00	$40.48	$69.00
Third Lowest Priced	$199.00	$42.98	$78.00

Store No. 9 Information

Store Name: Walmart	Store Address: 2545 E Walnut Ave Dalton, GA 30721
Date of Visit: April 18, 2018 (online)	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	0	14	10	0
Total WaterSense	-----	14	10	0
Brands		Peerless	Peerless, Waterpik	
Lowest Priced		$3.97	$12.57	
Second Lowest Priced		$6.42	$19.84	
Third Lowest Priced		$8.84	$26.27	

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	1	7	0
Total WaterSense	1	7	0
Brands	Vigo	Peerless	
Lowest Priced	$101.49	$19.97	
Second Lowest Priced		$24.97	
Third Lowest Priced		$26.97	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	0	7	0
Brands		Peerless	
Lowest Priced		$29.72	
Second Lowest Priced		$34.97	
Third Lowest Priced		$39.97	

Store No. 10 Information

Store Name: Home Depot	Store Address: 2891 Sowega Dr Columbus, GA 31909
Date of Visit: April 18, 2018 (online)	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	1	11	12	0
Total WaterSense	-----	8	10	
Brands	Waterpik	Glacier Bay, Waterpik, Delta, Kohler, Moen	Glacier Bay, Waterpik, Delta, Moen	
Lowest Priced	$19.98	$2.27	$9.98	
Second Lowest Priced		$3.97	$19.98	
Third Lowest Priced		$19.98	$24.98	

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	1	69	0
Total WaterSense	1	69	
Brands	Glacier Bay	Glacier Bay, Delta, Moen, American Standard, Pfister, Kohler	
Lowest Priced	$28.00	$18.46	
Second Lowest Priced		$19.98	
Third Lowest Priced		$24.86	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	0	49	17
Brands		Glacier Bay, Delta, American Standard, Kohler, Pfister	MOEN, KOHLER
Lowest Priced		$29.98	$64.00
Second Lowest Priced		$35.98	$64.00
Third Lowest Priced		$36.95	$69.00

Store No. 11 Information

Store Name: Lowe's	Store Address: 6750 Veterans Parkway Columbus, GA 31909
Date of Visit: April 19, 2018 (online)	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	18	2	3	0
Total WaterSense	-----	2	3	
Brands	Moen, Kohler, Pfister, AquaSource, Jazz, Sprite	Delta	Oxygenics, Delta	
Lowest Priced	$2.98	$25.98	$24.98	
Second Lowest Priced	$9.98	$29.98	$34.98	
Third Lowest Priced	$14.98		$39.98	

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	0	93	0
Total WaterSense		90	
Brands		Moen, Peerless, Kohler, Delta	
Lowest Priced		$20.00	
Second Lowest Priced		$24.98	
Third Lowest Priced		$29.97	

Kitchen Faucets

	2.2 gpm	1.8 gpm	1.5 gpm and lower
Total Number	2	55	15
Brands	Moen, ProjectSource	Moen, Delta, Kohler, Pfister, Giagni, Peerless	Moen, Delta, Kohler
Lowest Priced	$39.48	$40.48	$74.98
Second Lowest Priced	$69	$42.98	$78.98
Third Lowest Priced		$49.00	$89.98

Store No. 12 Information

Store Name: Walmart	Store Address: 5448 Whittlesey Boulevard Ste B, Columbus, GA 31909
Date of Visit: March 28, 2018	

Showerheads

	2.5 gpm	2.0 gpm	1.8 / 1.75 gpm	1.5 gpm & lower
Total Number	0	6	12	0
Total WaterSense	-----	6	12	
Brands		WaterPik, AquaSpa	Peerless	
Lowest Priced		$29.97	$3.97	
Second Lowest Priced		$34.84	$8.84	
Third Lowest Priced				

Lavatory Faucets

	1.5 gpm	1.2 gpm	1.0 gpm and lower
Total Number	1	7	0
Total WaterSense	1		
Brands	Peerless	Mainstays, Peerless	
Lowest Priced	$59.00	$9.97	
Second Lowest Priced		$19.97	
Third Lowest Priced		$24.97	

Kitchen Faucets

	2.0 gpm	1.8 gpm	1.5 gpm and lower
Total Number	0	8	0
Brands		Peerless	
Lowest Priced		$34.97	
Second Lowest Priced		$39.97	
Third Lowest Priced		$49.97	

Commenter: Jeff Tejral
Affiliation: Denver Water
Comment Date: March 18, 2019

Email Text:

Dear WaterSense Staff,

Denver Water appreciates the WaterSense partnership and the value labeling of efficient water using products brings to consumers to transform markets and achieve national water savings. Please consider the following in your review of standards and specifications of WaterSense fixtures and certifications.

General comments not specific to one product:

- Changes to large market (like California, Texas or New York) standards are significant and could lead to market confusion.
- Consider water quality criteria and any associated demand differences for use of alternative water sources such as gray water, rainwater… with toilets, cooling towers and irrigation. Additional study may be required to understand if changes in water quality could increase water use or require changes to product maintenance.

Tank type Toilets:

- Consider moving to lower gallons per flush as many markets shifted to 1.28 gpf as baseline
- Consider reviewing criteria such as MaP score, Dual flush eligibility. Dual flush models may not save as much as stated due to user confusion. Consider change labeling of button on toilets to limit user confusion or remove from list.
- Lower water use could cause aging of water in service lines and potential drain line carry issues in older plumbing – could be part of new home criteria. The occurrence of pathogens in premise plumbing (e.g., Legionella) has become a high visibility topic and lower water use combined with the potential of using alternative water sources may exacerbate this concern. Studies underway could help answer in the near future (I know of two studies at Perdue and Lehigh Universities)

Flushing Urinals:

- Consider criteria for waterless technology as a separate specification

Showerheads:

- Consider California changing to 1.8 gpm as a market shift that WaterSense standards could also adopt
- Slightly increases time to deliver heated water

Weather-based Smart Controllers:

- Customers can opt in / opt out of weather based control could be a major issue. Could product specs be changed to increase adoption of weather based operations?

- Update and strengthen packaging and labeling requirements for products that require an add-on sensor.

WaterSense Homes:

- Allowed turf seems high for Western U.S., consider regional appropriateness for outdoor water use targets.
- The worksheet shows average monthly water needs but does not state if this is over a year or irrigation season. To evaluate if WaterSense homes are achieving stated savings or performing better than existing builds suggest having a monthly expected water use (Jan – Dec).
- Tree health needs more study as reductions in water use that result in tree mortality is a significant unintended consequence.
- Do decks and artificial turf add to stormwater runoff issues or increase heat island significantly?
- Synthetic turf may need its own classification or design features in the calculation sheet

Irrigation Professionals:

- Nonpotable water sources may occasionally need to be supplemented with potable water for water quality purposes; irrigation professionals should consider alternative landscape management techniques to minimize the need for occasional potable water usage and professionals should consider occasional potable water usage needs in overall water savings evaluation.
- Do any of the trainings currently offered cover nonpotable water use?

Sincerely,

Jeff Tejral

Jeff Tejral | Manager of Water Efficiency
Denver Water | t: 303-628-6301 | c: 720 -220-0090
1600 West 12th Ave | Denver, CO 80204-3412
jeff.tejral@denverwater.org | http://www.denverwater.org

Commenter: Debra R. Burden
Affiliation: Citrus County Department of Water Resources
Comment Date: May 16, 2019

Email Text:

The attached study included a WaterSense labeled irrigation controller.

Sincerely,

Debra R. Burden

Water Conservation Manager
Department of Water Resources
Citrus County Board of County Commissioners
(352) 527-7684 (f) (352) 527-5429

Email Attachment

See pages 31 through 36.

Smart Irrigation Controller Demonstration and Evaluation in Orange County Florida [Project #4227]

ORDER NUMBER: 4227

DATE AVAILABLE: June 2016

PRINCIPAL INVESTIGATORS:
Michael D. Dukes, Lynne M. Allen, Terry Thill, Bridgett Tolley, Jacqueline W. Torbert, Eliza M. Breder, Paul F. Monaghan, Maria C. Morera, and Ondine Wells

OBJECTIVES

The objective of the "Smart Irrigation Controller Demonstration and Evaluation in Orange County, Florida" project was to evaluate the water savings potential of soil moisture sensors (SMS) and evapotranspiration (ET) irrigation controllers on residential and commercial properties on two distinct soil types: flatwood soils and sandy soils. The Water Research Foundation funded this project to further the scientific and technological knowledge of smart irrigation technologies. The objectives of this report are to document the considerable effort required to engage the public in this research, present the results, and make the findings available to water utilities, water management districts, conservationists, and other stakeholders.

BACKGROUND

The Smart Irrigation Controller Demonstration and Evaluation in Orange County, Florida, project began in January 2009 under the direction of Jacqueline W. Torbert, Manager of the Water Division at Orange County Utilities Department. The primary researcher was Dr. Michael Dukes of the University of Florida Agricultural and Biological Engineering Department. Funders included Orange County Utilities Department, the South Florida Water Management District, the St. Johns River Water Management District, and the Water Research Foundation. Two factors influenced Orange County Utilities' decision to take on this study: a sustainable groundwater withdrawal limit based on the year 2035 planning horizon, and the increased affordability of Smart Irrigation Technologies.

Orange County, Florida is a 903 square mile area located in Central Florida, and Orange County Utilities is one of the water utilities providing services to residents of, and visitors to, Orange County. Orange County Utilities serves the unincorporated areas within the County. As in most of Florida, the people of Orange County rely on fresh groundwater from the Floridan Aquifer

to meet urban, agricultural and industrial uses. Additionally, Orange County is located in an area of Central Florida where the boundaries of three water management districts converge, and is one of five counties included in the Central Florida Water Initiative (CFWI) Regional Water Supply Plan (RWSP). When the research on Smart Irrigation Technologies began, multiple utilities in the region, including Orange County Utilities, were withdrawing approximately 280 million gallons of water per day (mgd) from the Floridan Aquifer.

Groundwater withdrawal in this region is regulated by three water management districts: the South Florida Water Management District, the St. Johns River Water Management District, and the Southwest Florida Water Management District. In addition to their regulatory role, the water management districts develop water supply plans and have jointly developed the Central Florida Water Initiative (CFWI) Regional Water Supply Plan (RWSP). Their combined assessments and modeling results have determined that sustainable groundwater withdrawal from the Floridan Aquifer in the five-county CFWI region is 850 mgd and any additional groundwater withdrawal would result in harmful impacts to water resources and the natural systems that rely on those resources.

The CFWI planning efforts have estimated that the population will increase from 2.7 million people to 4.1 million people by the year 2035 (a 49% increase) and that water demand will increase from 800 mgd to 1,100 mgd. The 850 mgd sustainable withdrawal limit and the 1,100 mgd demand estimate results in a 250 mgd deficit. The projected deficit has prompted Orange County Utilities to pursue alternative water supplies as well as additional water conservation initiatives in order to provide a sustainable water supply to its customers.

Orange County Utilities' history of water conservation includes education, incentives and regulatory requirements designed to change behaviors and modify water use habits. Orange County Utilities has watering restrictions and an enforcement program to encourage conservation. The current practice in Orange County is to restrict irrigation to particular days of the week based on upon addresses and further restrictions on the number of times a customer can irrigate during the course of a week based on the time of year. Even with these restrictions, homes with an in-ground irrigation system use 50% of their consumption on landscaping and these systems typically apply 2–3 times more water than the landscape requires. It was time to re-evaluate fixed irrigation schedules based upon address and day of the week and consider allowances for weather-based Smart Irrigation Technologies. Before new regulations associated with Smart Irrigation Technologies could be recommended for implementation, Orange County Utilities needed to research the water use impact of these devices in the hands of the everyday user.

University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) studies have shown that smart irrigation controllers have the potential to conserve water by efficiently scheduling irrigation. However, most of the work in Florida has been performed on tightly controlled research plots. The plot work has been valuable to assess the performance potential of these controllers, but these controllers are relatively complicated to set up and program correctly for efficient irrigation. Thus, it is not known how much feedback or interaction is needed by irrigation professionals to implement these devices to achieve their potential level of water conservation. By recruiting both residential and commercial property owners to participate in the study and incorporating two levels of contractor training and follow-up on controller operation and performance, this study was able to provide an authentic assessment of smart irrigation controller performance.

APPROACH

From over 7.5 million pieces of Orange County Utilities customer data, irrigation water uses were analyzed to isolate "over-irrigators" as potential participants for the study. The customer's irrigation was estimated by separating estimated indoor water use from the monthly total meter amount for each household. A theoretical irrigation requirement was calculated using a daily soil water balance equation for different landscape scenarios found among Orange County Utilities customers. Those customers who exceeded their corresponding theoretical irrigation requirement by 1.5 to 4.0 times were considered over-irrigators and were selected as potential cooperators for the study.

Pre-test questionnaires and site visits narrowed the participant pool to 167 residential properties across the Orange County Utilities service area in nine location clusters. Smart irrigation technology treatments were distributed within each location so that there were at least three replicates per treatment group and homes were spread across the two dominant general soil types, flatwoods soils and sandy soils, in Orange County. In addition to residential properties, non-residential properties with separate irrigation meters were identified and screened. To participate in the study, commercial properties had to have a separate irrigation meter, use potable water for irrigation, and be located in close proximity to the residential clusters. These criteria and the availability of monthly irrigation water use history narrowed the participation to four commercial properties across the two dominant soil types. These properties received evapotranspiration (ET) controllers with site-specific programming.

The two smart irrigation technology treatments evaluated were the RainBird ESP-SMT 4 Evapotranspiration Controller and the Baseline Water Tec S100 Soil Moisture Sensor. This equipment, backflow prevention devices, irrigation meters, and weather stations were installed between March 2011 and January 2012. Location clusters included some or all of the following treatments: evapotranspiration irrigation controller only (ET), soil moisture sensor only (SMS), evapotranspiration irrigation controller with educational training (ET+Edu), soil moisture sensor with educational training (SMS+Edu), and a comparison group that was monitored only. While the irrigation consumption data collected and analyzed for this study spanned a three year-period, it is worth noting that recruitment of residential cooperators and subsequent equipment installation for monitoring added a considerable amount of time to the project schedule.

Hourly irrigation consumption data was stored in Neptune T-10 Automatic Meter Reading devices and collected by Orange County Utilities on a monthly basis. The volume of irrigation was converted by the researchers to a depth using the irrigable area measured during the initial site visits. Irrigation was then totaled into weeks and averaged across treatments and statistical analyses were performed. In addition to making comparisons between treatments, irrigation was compared to the estimated irrigation needed to meet plant water needs. The irrigated area was assumed to be 100% turfgrass to allow for a generous allocation for comparison purposes. Because of this, monthly crop coefficients were selected for turfgrass in Central Florida. Turfgrass quality ratings were conducted seasonally throughout the treatment period and statistical analysis of the turfgrass quality results were conducted. Changes in turfgrass quality ratings between rating periods were modeled compared to the difference in cumulative irrigation application and cumulative irrigation required based on weather. Daily values of reference evapotranspiration for each weather station location were calculated.

For commercial properties, monthly meter readings from the outdoor water meter and newly installed water meters were provided from Orange County Utilities. By October 2014, 19

months of irrigation data was collected for the commercial properties. This data was compared to all historical irrigation data.

RESULTS/CONCLUSIONS

Location cluster was not significant to the statistical model during the study period. However, the soil type was significant, resulting in the need to separate results by soil type. The treatment effect was also significant indicating differences in irrigation applied by the various technologies and implementation approaches.

In the flatwoods soil locations, the comparison group had significantly higher weekly irrigation (averaging 0.91 inches) compared to all other treatments. Differences between the SMS treatment and the two ET controller treatments were not significant, averaging 0.76, 0.67, and 0.72 inches for ET, ET+Edu, and SMS, respectively. However, the ET treatment applied significantly more irrigation than the ET+Edu treatment. The SMS+Edu group, averaging 0.50 inches, had significantly less irrigation than all other treatments. The site specific settings as associated with the education component, appears to have significantly lowered the average irrigation application on flatwoods soils for both SMS and ET technologies.

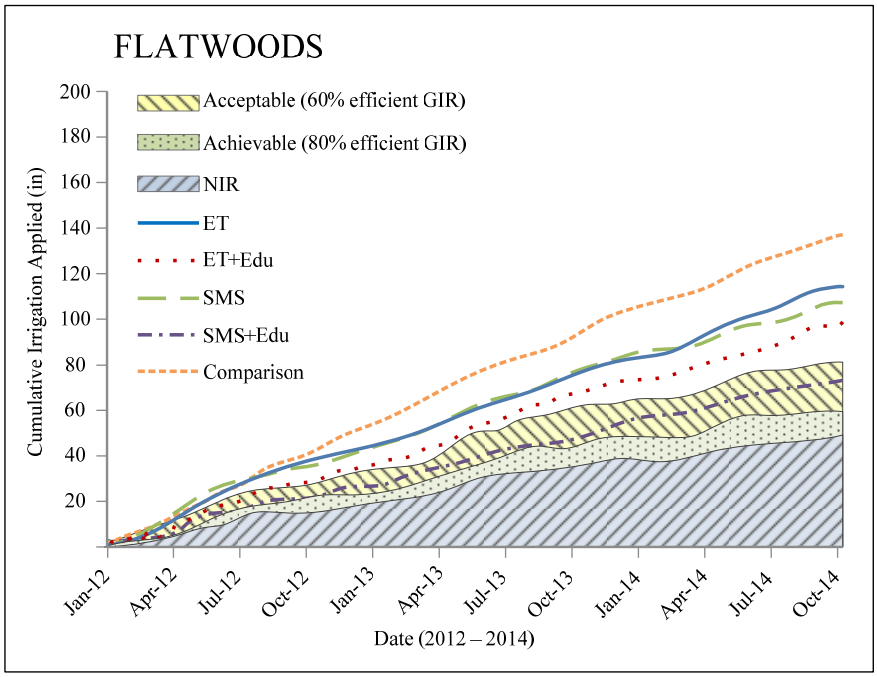


Figure ES.1. Cumulative irrigation for the study period averaged across locations for the flatwood soils

In the sandy soil locations, the comparison group had significantly higher weekly irrigation (averaging 1.21 inches) compared to all other treatments. The ET treatment irrigated significantly more (averaging 1.06 inches) than both SMS treatments and the ET+Edu treatment. Additionally, there were no significant differences between the remaining three treatments with weekly average irrigation application of 0.75, 0.75, and 0.70 inches for ET+Edu, SMS, and SMS+Edu, respectively. The education component has significantly lowered the average irrigation application for the ET technology only.

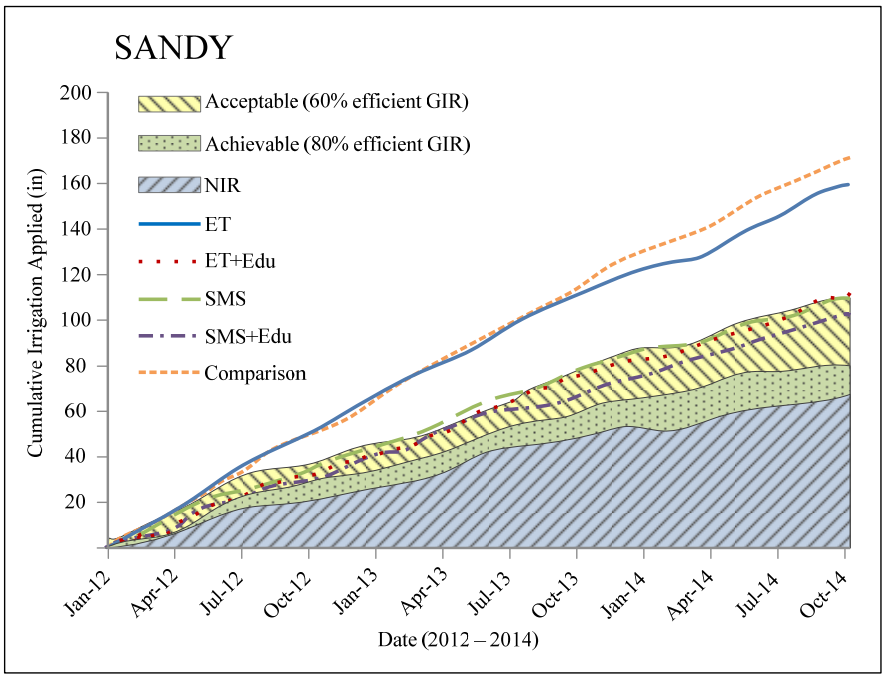


Figure ES.2. Cumulative irrigation for the study period averaged across locations for the sandy soils

On average, evapotranspiration irrigation controller treatments reduced irrigation by 18% across both sandy and flatwoods soils for the non-education group, and 32% for the education group. The soil moisture sensor technology reduced irrigation by 30% for the non-educational group and 42% for the educational group across both soils. The educational groups had a trend for less irrigation than their non-educational counterparts. A post-test survey showed that the level of irrigation knowledge did not differ between educational and non-educational treatment groups. Therefore, the study concludes that the educational groups irrigate less due to optimized controller settings with site specific parameters.

Among the four commercial properties, all of which were installed with evapotranspiration irrigation controller treatments, average irrigation was reduced across both soil types by 28%. Turfgrass quality ratings were taken quarterly and quality exceeded the minimum rating of five at all commercial properties throughout the study period.

The post-test survey was designed to be unique for each treatment group. Results provided data on water use, conservation attitudes, satisfaction with the residential use of SMS and ET controllers, as well as other aspects of the study. A range of 61% to 87% of participants in each treatment group considered themselves satisfied or very satisfied with their irrigation practices. Regarding satisfaction of yard appearance, survey participants that were either satisfied or very satisfied ranged from 61% to 77%. Finally, 65% - 81% of survey participants reported being satisfied or very satisfied with smart irrigation technology.

APPLICATIONS/RECOMMENDATIONS

Policy Changes

The results of the "Smart Irrigation Controller Demonstration and Evaluation in Orange County, Florida" project have demonstrated that smart irrigation controllers do conserve water for both residential and commercial properties that historically over irrigate by efficiently scheduling irrigation. Cooperators in the study were exempt from mandatory one and two-day-a-week irrigation restrictions imposed by the water management districts and enforced by Orange County. To realize the water conservation potential of smart irrigation technologies, it is recommended that alternatives to policy mandates such as irrigation restrictions based on days of the week be examined. This examination will likely result in state agency rule changes, modification of ordinances, and regulatory program implementation changes.

Economic Implications

Like many other parts of the country, Orange County Florida has emerged from the recession and is once again experiencing growth in the housing market. Many new homes are constructed with automatic in-ground irrigation systems. Modification to regulatory policies that allow flexibility when smart irrigation technology devices are installed may offer opportunities for developers to offer these devices in new home construction. Irrigation reductions of 18–42% should also be of interest to commercial enterprises as they endeavor to reduce overhead costs and improve their bottom line. Satisfaction expressed by customers with the technology may be of interest to irrigation technology providers and contractors as they look for additional methods to market their products.

Public Funding Allocation

Because optimized controller settings resulted in lower rates of irrigation application and high customer satisfaction, there may be opportunities for public-private partnerships between water management districts, water utilities, irrigation suppliers, and contractors for incentive programs for residential and commercial customers. Data provided in this study may help water management districts quantify water use savings as they consider funding awards for water conservation initiatives. The efficiency of smart irrigation technology to reduce wasteful watering may help water utilities extend their portfolio of water resources, including both potable and reclaimed water.

TAILORED COLLABORATION PARTNER

- Orange County Utilities

Commenter: Cooper Reaves
Affiliation: Contra Costa Water District
Comment Date: May 20, 2019

Email Text:

To Whom it May Concern,

I am writing to provide additional commentary regarding the Notice of Specification Review with specific reference to Tank-Type Toilets and Showerheads. Please verify you have received this commentary.

Tank-Type Toilets Not Delivering on Water Savings as Expected
Of upmost importance is the fact that a significant number of the toilets manufactured since 1.6 gallons per flush (gpf) became the federal standard are no longer flushing at 1.6 gpf. Many of the toilets were manufactured and the flapper designed to flush exactly 1.6 gpf and thus meeting standards.

However, upon flapper replacement, most consumers purchase a generic flapper which often flushes much greater than 1.6 gpf. Many States and Municipal Agencies have rebated these toilets with the expectation of continued water savings. However, a few studies and basic first-hand experience demonstrate that non-OEM parts may indeed increase the toilet flush volume.

This issue should be a primary concern of manufacturers, certifying bodies, and public entities. If a toilets water savings can be eliminated or significantly reduced upon simply replacing the flapper, then consideration should be given as to whether the initial certification of that plumbing fixture is legitimate. Should tank size and water volume be a consideration of WaterSense? Aftermarket toilet flappers should meet standards if they are modifying OEM toilet flush volumes and performance. WaterSense, certifying governmental agencies and ASME should evaluate what can and should be included in its criteria for certification that reduces or eliminates the possibility of reduced water savings caused by aftermarket flappers.

Often times it is near impossible to find out what replacement flapper would achieve the same flush as the original OEM as toilet model information is quite difficult to obtain or non-existent. Consideration should be given to testing toilets with multiple aftermarket flappers and further study is warranted to address this significant issue.

Tank-Type Toilet WaterSense Questions and Responses
The following comments are in reference to the questions posed by WaterSense in the Notice of Specification Review:

Changes in the market. At least six states and multiple municipalities throughout the United States have adopted regulations mandating that tank-type toilets operate at a flush volume of 1.28 gpf or less, consistent with the WaterSense specification. In a potential revision, should WaterSense consider additional reductions to the maximum allowable effective flush volume criteria to improve water efficiency beyond the current WaterSense specification and potentially further transform the market?

If additional reductions result in an increased cost to the average consumer not offset by the water bill savings, it may not be the right time. Tiers could be considered. If performance and cost of these super efficient HETs is comparable and there are enough in production, it should be evaluated. However, if this leads to eliminating 1.28 gpf from the Market then the potential externalities should be carefully evaluated.

Performance considerations. Because the specification criteria are set to pass or fail, WaterSense does not collect data on the specific levels of product performance (e.g., the amount of waste each toilet can clear). However, Maximum Performance (MaP) Testing, upon which the WaterSense waste extraction performance test was originally based, conducts independent testing of tank-type toilets to assess performance beyond the criteria established by WaterSense. WaterSense requires toilets to fully flush 350 grams of miso paste, a test media having similar physical properties to human waste, along with toilet paper. MaP evaluates tank-type toilet flushing performance up to 1,000 grams, issuing a MaP score commensurate to the grams of waste evacuated from the toilet bowl. To date, 2,163 toilet models have achieved a MaP score of 600 grams or greater, with 1,418 achieving the maximum allowable MaP score of 1,000 grams.[10] Are stakeholders aware of data to support a connection between increased performance and user satisfaction? Should WaterSense consider revising its performance criteria to require tank-type toilets to clear a larger quantity of waste and/or toilet paper?

Performance criteria should be seriously weighted and is especially important when reducing flow volumes in toilets. Performance should be set above the current limits as there are plenty of quality products that achieve much higher performance than others. WaterSense should set the high performance and high efficiency products apart from the rest.

System concerns. If WaterSense reduces the maximum allowable effective flush volume for tank-type toilets, will this have a significant and adverse impact on premise plumbing systems (e.g., drainlines)? If so, are there data to substantiate the impact at various flush volume levels?

Recommend looking at the PERC drainline carry studies for further information on flush volume impacts on drainline carry. Older properties with long sewer laterals may be affected, however, supplemental water sources from residential fixtures may offset drainline carry issues but only in a residential setting.

Showerhead Reduced Flow and Thermal Shock/Scalding Concerns

Attached is a document outlining the potential concerns related to reduced flow rates and thermal shock and scalding concerns. More evaluations may be necessary if it has not already been conducted.

Please let me know if you have any questions.

Thank you,

Cooper Reaves
Water Efficiency Specialist
Contra Costa Water District
925-688-8234 office
www.ccwater.com/conserve
Use Water Wisely: Enough to Use, None to Waste

Email Attachment

See pages 40 through 41.

Showerhead Safety Concerns

AREAS OF CONCERN:

1. Do reduced flow rates in showerheads pose any scalding or thermal shock hazards? Are they safe?

2. Do trickle flow adapters pose any scalding or thermal shock hazards? Are they safe?

DO REDUCED FLOW RATES IN SHOWERHEADS POSE ANY SCALDING OR THERMAL SHOCK HAZARDS? ARE THEY SAFE?

Scalding and thermal shock can occur due to several factors, including the temperature set point of the hot water heater, plumbing design, the type of mixing valves present, and flow rate of the showerhead. Viewpoints vary, and theoretically risks increase, however hearsay of real world experience has not shown any evidence of hazards actually occurring. Further study is warranted.

There is a correlation with reduced flows and intensification of temperature changes/fluctuations. As the flow rate of the showerhead is reduced, changes/fluctuations in temperature intensify. Older homes with no mixing valves or without non-pressure compensating/temperature compensating mixing valves have the most risk of temperature fluctuations.

Any change in the WaterSense specification should address homes and multi-family properties that have older style valves and no mixing valves or old mixing valves which may be at greater risk. It should not be expected that these properties upgrade their existing plumbing systems in order to avoid potential scalding or temperature fluctuations because they cannot obtain higher flow showerheads. The economic cost of such an upgrade should exempt such properties from any future federal standard if this issue is studied and shown to present health and safety concerns or unwelcome user experience while showering.

ASSE Caution: ASSE states, "*Under most conditions, the magnitude of the change in outlet water temperature will increase as the flow rate through the non-automatic compensating type shower valve or tub/shower valve decreases. The magnitude of the change in outlet water temperature can be significant."*
ASSE also cautions "*that low-flow showerheads should never be used with non-automatic compensating type shower or tub/shower valves*."

CEC Standard: The California Energy Commission (CEC) evaluated reduced flow rates and potential hazards and concluded in their report, linked below, that a minimum flow rate requirement is warranted to help reduce the risk of thermal shock. The CEC analysis warranted the establishment of the 1.8 gpm showerhead standard, on the premise that thermal shock and scalding can occur due to several factors.

The CEC report states that "*showerhead flow rate is not the sole determining factor for the thermal shock or scald risk… shower automatic compensating mixing valves, plumbing design, and hot water*

heater design contribute to the overall possibility of the shower water exceeding a safe temperature during a pressure change."

The report on the establishment of the standard can be found here. Pages 17-21 review the thermal shock and scalding analysis: http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205654_20150807T151426_Staff_Analysis_Of_Water_Efficiency_Standards_For_Showerheads.pdf

Manufacturers: Two manufacturers provided commentary on this issue and both were of the viewpoint that real world experience showed no issues. Thousands of ultra-low flow showerheads have been given out California energy providers with no reported issues as reported by these manufacturers.

Additional Savings?
It is unclear whether going to ultra-low flow has resulted in lower quality user experience or resulted in much additional water savings. See more studies and articles by John Koeller for additional informaton. Does the time in the shower increase as flow is reduced further? Studies should be available to demonstrate real world water use.

DO TRICKLE FLOW ADAPTERS POSE ANY SCALDING OR THERMAL SHOCK HAZARDS? ARE THEY SAFE?

Potential Hazards: Many consumers like Trickle flow shut off adapters for additional water savings and utility features while showering. Some are built into the spray head while others can be attached. With older 3 valve stem shower valves and older/no mixing valves, combined with a change in pressure, these devices could potentially cause thermal shock or scalding. This hypothetically could present a significant issue. There is very little and no research in this subject area that is easily accessible. The CEC had no comment on the safety of these devices.

Since reduced flows increase the possibility of temperature fluctuations, the use of trickle flow adapters could increase the likelihood of thermal shock and scalding given the right conditions. Hypothetical vs. real world experience should be studied further.

Example: A major change in water temperature at the showerhead could occur without a proper mixing valve, with the activation of a trickle flow valve, and a change in hot or cold water pressure in the building. This issue is more likely to occur in a multi-family setting, but could happen in any building.

Past Practice: Currently, other interests have reported that they've heard of no lawsuits, or heard of any scalding or thermal shock related to the giveaways that have been distributed for many years. Based on past experience issues are unlikely to arise, but caution should be taken with customers with older homes and especially in multi-family settings with old or no mixing valves.

Trickle Flow Provides a Warning: On a practical note, if a customer is in the shower and temperature changes with the trickle valve activated, they will notice the change in temperature and likely respond accordingly. Since the trickle flow provides a warning to the user that temperature is changing, hazards likely can be avoided.

Commenter: Matt Sigler
Affiliation: Plumbing Manufacturers International (PMI)
Comment Date: June 3, 2019

Email Text:

Stephanie and Robbie-

Please accept PMI's attached comments regarding the questions posed during the stakeholder webinars held on April 24th and May 9th for the EPA WaterSense *Notice of Specification Review*. If you have any questions, please do not hesitate to contact me.

Regards,

Matt Sigler
Plumbing Manufacturers International
Technical Director
847-217-7212
Email: msigler@safeplumbing.org
www.safeplumbing.org

Email Attachment

See pages 43 through 48.

PLUMBING MANUFACTURERS INTERNATIONAL

June 3, 2019

Stephanie Tanner
U.S. Environmental Protection Agency
Office of Wastewater Management (4204M)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
watersense-products@erg.com

RE: EPA WaterSense® Notice of Specification Review

Dear Ms. Tanner:

Plumbing Manufacturers International (PMI) appreciates the opportunity to provide comments regarding the EPA WaterSense® Notice of Specification Review.

PMI is an international, U.S.-based trade association representing manufacturers that provide 90% of the plumbing products sold in the United States. We have made the promotion of water safety and efficiency a top priority and have included this in our mission statement[1]. PMI's members are industry leaders in producing safe, reliable and innovative water efficient plumbing technologies and have supported the U.S. EPA WaterSense® program since its inception. **In the U.S., plumbing manufacturers contribute $34.9 billion to the economy, provide more than 193,000 jobs (direct and indirect), and generate $10.4 billion in wages.**

On April 30th, I notified EPA WaterSense that PMI is currently working on an update to our "U.S. Market Penetration of WaterSense Shower Heads, Lavatory Faucets And Toilets Study (2015)." We are including WaterSense flushing urinals with this update. Our goal is to have a finalized study to submit to EPA WaterSense in June for your consideration.

Regarding the questions posed during the stakeholder webinars held on April 24th and May 9th, PMI would like to provide the following responses for your consideration:

- Lavatory faucets
  1. Are there existing studies on the water efficiency and/or performance of lavatory faucets of which WaterSense should be aware? Yes, there are several studies that EPA WaterSense should review before making any further revisions to the High-Efficiency Lavatory Faucet Specification including:
     a) Two EPA-funded research studies currently underway that are looking into the impact of water conservation on public health. The first with Drexel University is titled: "Water Conservation and Water Quality: Understanding the Impacts of New

[1] PMI's Mission: To promote the water efficiency, health, safety, quality and environmental sustainability of plumbing products while maximizing consumer choice and value in a fair and open marketplace. To provide a forum for the exchange of information and industry education. To represent openly the members' interests and advocate for sound environmental and public health policies in the regulatory/legislative processes. To enhance the plumbing industry's growth and expansion.

Technologies and New Operational Strategies." The second with Purdue, Michigan State and San Jose Universities is titled: "Right Sizing Tomorrow's Water Systems for Efficiency, Sustainability, and Public Health." As indicated during the EPA's March 2017 webinar to discuss the scope of these research projects, the hypothesis of both projects was stated as: "The recent use of low-flow plumbing fixtures such as faucets, toilets, and showerheads has resulted in waterborne disease outbreaks and other water quality problems in building plumbing systems." Therefore, considering the possibility that one or both EPA-funded studies could show that low-flow plumbing fixtures and fixture fittings contribute to waterborne disease outbreaks and/or other water quality problems in building plumbing systems, PMI believes that EPA WaterSense should wait until the studies have been finalized and vetted by stakeholders before considering any further changes to the water consumption levels in the EPA WaterSense® Specifications for Tank-Type Toilets, High-Efficiency Lavatory Faucets, Flushing Urinals and Showerheads.

b) The April 2016 "Residential End Uses of Water, Version 2" study by the Water Research Foundation compares the results of a similar study sponsored by the U.S. EPA in 1999. This updated 2016 study concludes that although average faucet flow rates in single-family residential dwellings have dropped by 29%, the water savings achieved by such reductions have only been 1% or negligible (average daily faucet use - 26.7 to 26.3 gph).

c) The California Energy Commission is in the process of issuing a final report for a new study titled: "Code Changes and Implications of Residential Low Flow Hot Water Fixtures." As a member of the Technical Advisory Committee for the research project, PMI would like to note the following observations:
   - Reducing flow rates without a corresponding reduction in pipe sizing does not save water in proportion to the change in flow rate.
   - There are unintended consequences to public health that can come from reducing flow rates without a corresponding reduction in pipe size.

d) The November 2017 white paper titled: "Adapting to Change: Utility Systems and Declining Flows" (click here to view). Some of the potential impacts on infrastructures identified within the white paper due to reductions in indoor water use in California include:
   - On page 4 for water distribution systems, "*With declining water system flows, drinking water has a longer residence time in pipes, leading to chemical, biological, and physical water quality issues and potentially compromising public health and compliance with the Safe Drinking Water Act, particularly for disinfection by-products (DBPs), coliform bacteria, chlorine residual, and lead and copper action levels*."
   - On page 4 for wastewater conveyance systems, "*Declining system flows decrease wastewater flows and may increase pollutant and solids concentrations, which increase blockages, odors, and corrosion in pipes. This leads to increases in operation and maintenance (O&M) costs, odor complaints, and an accelerated degradation of infrastructure*."
   - On page 5 for wastewater treatment plant operations, "*Declining flows change the characteristics of wastewater, including the quantity and quality of wastewater treatment plant (WWTP) influent, causing impacts and stressing treatment processes as salinity, ammonia, and biochemical oxygen demand (BOD) concentrations increase beyond design specifications*."

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- On page 5 for recycled water projects, "*Declining flows can alter treatment and cost-effectiveness of recycled-water infrastructure by altering factors considered in system design, like anticipated flow and water quality*."

2. If WaterSense lowers the maximum flow rate criteria, should it also modify the minimum flow rate criteria? Yes, it can be challenging to meet the 0.8 gpm at 20 psi minimum flow rate requirement, for example, with a maximum flow rate of 1.2 gpm or less at 60 psi before and after life cycle testing. Furthermore, EPA WaterSense should conduct a user satisfaction study before revising the efficiency levels any further to ensure lavatory faucets perform to the satisfaction of the end user.
3. Is there anything else about water efficiency or performance that WaterSense should consider during its review process? Yes; the unintended consequences of increasing the water delivery time should be further examined before going lower.

- Metering and residential kitchen faucets
  1. Are there faucet types EPA should consider for inclusion in its WS specification (other than residential kitchen and metering faucets)? No. Expanding the scope of the High-Efficiency Lavatory Faucet Specification to include residential kitchen faucets, metering faucets or other types of faucets may not provide any anticipated water savings. For example, residential kitchen faucets at 1.5 - 1.8 gpm or metering faucets at 0.20 – 0.25 gpc are already readily available in the marketplace, and therefore what value to the consumer would EPA WaterSense be providing by including such faucets in the lavatory specification? Additionally, the intended purposes of a residential kitchen faucet or public metering faucet are different than that of a private lavatory faucet that is used for washing of hands, brushing of teeth, shaving, etc.
  2. Are there existing studies on the water efficiency and/or performance of residential kitchen faucets or metering faucets of which WS should be aware? Yes, see responses to Question #1 under "Lavatory faucets."
  3. If EPA develops a specification, should minimum flow rates be established for residential kitchen faucets and/or metering faucets to ensure user satisfaction? This would be contingent on the results of a user satisfaction study conducted by EPA WaterSense to ensure customer satisfaction.
  4. Could a label for metering faucets set other public lavatory faucet types at a disadvantage in the marketplace? Yes. It could skew the marketplace to metering faucets at 0.20 – 0.25 gpc versus public lavatory faucets at 0.5 gpm.
  5. Should additional faucet types be in separate specifications or included in one? No. Considering the possibility that one or both EPA-funded studies could show that low-flow plumbing fixtures and fixture fittings contribute to waterborne disease outbreaks and/or other water quality problems in building plumbing systems, PMI believes that EPA WaterSense should wait until the studies have been finalized and vetted by stakeholders before expanding the scope of the High-Efficiency Lavatory Faucet Specification or developing separate specifications for additional faucet types. Furthermore, PMI is against a separate residential kitchen or metering faucet specification for the following reasons:
     a) Because several jurisdictions throughout the U.S. have already adopted 1.5 gpm maximum for residential kitchen faucets (i.e. Boulder, CO and Miami-Dade County, FL) and California has adopted a maximum flow rate of 1.8 gpm for residential kitchen faucets and 0.20 gpc for metering faucets, the consumer value of a new specification could be negligible.
     b) Unlike a private lavatory faucet, a kitchen faucet has other attributes besides flow rate that would be difficult to quantify (i.e. pot filling, cleaning function, etc.).

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c) Manufacturers will incur significant costs and burdens to certify existing products.

- Showerheads
  1. Are there other product types EPA should consider for inclusion in the WS showerhead specification? There are no similar devices with observable market penetration that would fit within the scope of the specification and provide significant water savings.
  2. Are there existing studies on the water efficiency and/or performance of high-efficiency showerheads of which WS should be aware? Yes. See responses to Question #1 under "Lavatory faucets."
  3. Could decreasing the maximum flow rate for showerheads result in additional concerns related to thermal shock or scalding? Yes. Lowering the flow rate of showerheads would create a further disparity with ASSE 1016/ASME A112.1016 /CSA B125.16 which allows valves to be rated at 2.5 gpm. Lowering the flow rate of showerheads can also have an adverse effect on the filtration performance for filtering type showerheads.
  4. Is there anything else about water efficiency or performance that WS should consider during its review process? Yes. The unintended consequences of increasing the time of water delivery should be further examined before going lower. Additionally, EPA WaterSense should conduct a user satisfaction study before revising the efficiency levels any further to ensure showerheads perform to the satisfaction of the end user.

- Tank-type toilets
  1. Are there additional studies on the water efficiency and/or performance of tank-type toilets of which WaterSense should be aware? Yes. See responses to Question #1 under "Lavatory faucets."
  2. Are there additional studies on user behavior related to dual-flush toilets of which WaterSense should be aware? It should be noted that Australia stills uses a 2:1 effective flush ratio and Europe has even higher numbers.
  3. Is there anything else about water efficiency or performance that WaterSense should consider during its review process? Regarding the topic of increasing the waste extraction requirements for tank-type toilets, PMI is very much opposed to increasing such requirements for the following reasons:
     a) Any requirement above 350 grams does not necessarily make the extraction of solid waste more efficient or effective, but instead may encourage manufacturers to focus unduly on solid waste extraction. There are other attributes of toilet flushing, including light waste removal and bowl cleanliness, which require fluid dynamic design considerations that are different from bulk waste removal. Increasing the gram requirement could result in products that are less effective in meeting consumer needs, not more effective. The Metropolitan Water District conducted a customer study in 1999 to understand the root causes of double flushing. Bowl cleanliness was the number one cause of double flushing (47%) while bulk waste was a mere 21%. (1999, Metropolitan Water District of Southern California. "Ultra-Low-Flush Toilets, Customer Satisfaction Survey").
     b) According to John Koeller's comments submitted to the CEC for Docket #14-AAER-01 under "*Comments against mandating a minimum of 600 grams for toilets*" (click here to view):
        - *"The EPA's WaterSense High Efficiency Toilet Specification, and 350g threshold, has proven to be very effective since its introduction in 2006. Consumer feedback on WaterSense listed toilets has been excellent."*

- *"Manufacturers design toilets around a variety of tests for a well balanced approach. Requirements above 350g do not help the consumer on solid waste, rather encourages manufacturers to focus unduly on solids and not sufficiently on other attributes like cleaning the bowl and preventing plugging/clogging from the usage of toilet paper. Going to 600g will result in products that are less effective in meeting consumer needs, not more effective."*

Regarding bowl cleanliness, it should be noted that ASME A112.19.2/CSA B45.1 does include the dye test to address water exchange, ink line tests to address water distribution around the bowl circumference and floating media tests to address bowl cleanliness. This should not be overlooked and is the appropriate balance to the sinking bulk tests.

- Flushing urinals
  1. Are there existing studies on the water efficiency and/or performance of flushing urinals at various flush volumes or non-water urinals of which WaterSense should be aware? Yes. See responses to Question #1 under "Lavatory faucets." Furthermore, the City of Austin, TX is conducting research to determine the root cause for the build-up of struvite in installations with 0.125 gpf urinals. PMI recommends that EPA WaterSense contact either Dan Pedersen, PE at 512-972-0074 or Mark Jordan at 512-974-3901 for more information.
  2. Is there anything else about water efficiency or performance that WaterSense should consider during its review process? According to AWE's comments submitted to the CEC for Docket #14-AAER-1 under "*Comments on the Recommendation by the CASE Team for a Maximum Urinal Consumption Level of 0.125 gpf*" (click here to view):
     a) *"Drain line blockages (due to a buildup of struvite) and installation problems related to odors have been associated with some non-water consuming urinal installations. The model plumbing and green codes addressed these two significant issues by requiring that water supply lines be installed behind the walls in washrooms to facilitate replacement of non-water consuming urinals in the event building owners chose to replace them with flushing urinals. For 0.125 gpf urinals there is insufficient experience to date to correctly assess the magnitude of concerns that may or may not result similar to the odor and drain line issues experienced with non-water consuming urinals. It remains to be determined, and more data and time are needed, to be more certain if 0.125 gpf is adequate to remove or mitigate such concerns."*
     b) *"While 0.125 gpf urinals may be suited to new construction where new drainline systems are designed specifically for extremely low water flows from fixtures and other equipment, their feasibility in retrofit situations in existing buildings is questionable. Whereas a 1.0 gpf urinal can usually be successfully retrofitted to 0.5 gpf by installing a new flushometer valve or by changing valve components, without requiring replacement of the urinal fixture itself, this is not the case for a retrofit from 1.0 gpf to 0.125 gpf because of the physical limitations with the urinal fixture. In such an instance, both the valve and the urinal fixture would require replacement, which is costly due to labor for installation and possible wall repair, and the purchase of the urinal system components themselves. If the standard is further reduced to 0.125 gpf, retrofits could therefore be discouraged by the cost and the downtime associated with such a major changeout."*

PMI values our continued partnership with EPA WaterSense and welcomes further discussions on the topic of water conservation. If you have any questions regarding our comments, please do not hesitate to contact me.

Sincerely,

Matt Sigler
Technical Director
Plumbing Manufacturers International
Office 847-217-7212
msigler@safeplumbing.org

cc: PMI Board of Directors

PMI Members

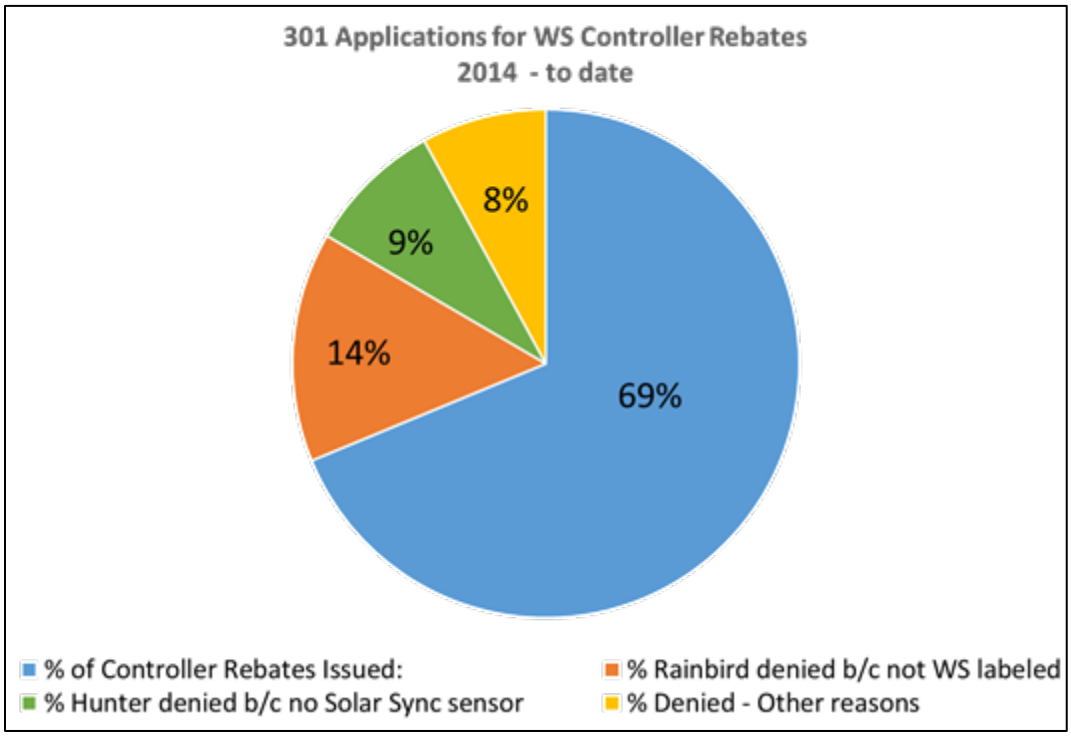
*Bradley Corporation *BrassCraft Mfg. Co. *CSA Group *Delta Faucet Company *Dornbracht Americas *Duravit USA *Fisher Manufacturing Company *Fluidmaster, Inc. *Franke *Global OEM *Globe Union Group, Inc.*Hansgrohe, Inc. *Haws Corporation *IAPMO *InSinkErator *International Code Council Evaluation Service *KEROX *Kohler Co *Lavelle Industries, Inc. *LIXIL *Moen Incorporated *NEOPERL, Inc. *NSF International *Pfister *Reliance Worldwide Corporation *Similor AG *Sloan Valve Company *Speakman Company *Sprite *Symmons Industries, Inc. *T & S Brass and Bronze Works, Inc.*TOTO USA *Viega LLC *WaterPik *WCM Industries, Inc

Commenter: Debra R. Burden
Affiliation: Citrus County Board of County Commissioners
Comment Date: June 6, 2019

Email Text:

Hello,
Please find below comments responding to the EPA WaterSense Notice of Specification Review, more specifically pertaining to irrigation controllers.

1. The utility receives a significant number of rebate applications from customers/contractors purchasing non-WaterSense labeled controllers. We must assume their intent was to purchase a qualifying model. The most frequently denied rebate application is for Rain Bird SST600o, SST1200o, SST600i, SST1200i models. Similarly named are the SST600s & SST1200s, which are WaterSense labeled controllers. The only difference between the qualifying model and non-qualifying model is the last letter, in this case. This is similarly true for many brands/models, not just this example. If WaterSense moves forward with specification changes, **I suggest that labeled controllers be required to have a unique name dissimilar to other models to reduce customer, contractor and partner confusion.**



2. Some controllers make it easy, for example a switch, to bypass integral water-saving features, like rain sensors/weather stations. More often than not, we find that homeowners are unaware the smart feature has been bypassed or overridden. We provide education to every rebate applicant to address the problem and provide education. However, this is not a long-term solution and does not help those citizens

that do not have access to personalized training. **I suggest that switches/programs that can indefinitely inhibit smart watering not be eligible for the WaterSense label. Furthermore, I suggest that features used during the WaterSense certification process only allow changes on a temporary basis and must automatically revert to smart watering after a set period.**

Thank you for your time and consideration.

Sincerely,

Debra R. Burden

Water Conservation Manager
Department of Water Resources
Citrus County Board of County Commissioners
(352) 527-7684 (f) (352) 527-5429

Commenter: Fraser Sneddon
Affiliation: Sun-Mar Composting Toilets
Comment Date: June 17, 2019

Email Text:

The WaterSense specifications for tank-type toilets focuses entirely on water flush toilets. Composting toilets which waste no water and do not pollute water are completely overlooked. Why is no attention given to these much more environmentally smart alternatives to conventional flush toilets?

Thanks

Fraser Sneddon
Sun-Mar Corp.
5370 South Service Rd.
Burlington, ON L7L 5L1
905-332-1314 Ext 212

Commenter: Hooman Borghei
Affiliation: IoTelligent
Comment Date: June 28, 2019

Email Text:

Hello,

I would like to submit the attached PDF comments responding to the EPA WaterSense notice of specification review.

If you have any questions regarding our suggestions, or fail to receive the attached PDF document, please don't hesitate to contact me directly.

Thanks!

Hooman Borghei
CEO, IoTelligent

Email Attachment

See pages 53 through 54.

8861 VILLA LA JOLLA DR #12252. SAN DIEGO. CA. 92037

RE: EPA WaterSense® Notice of Specification Review

IoTelligent, LLC appreciates the opportunity to provide comments regarding the EPA WaterSense® Notice of Specification Review, specifically for the inclusion of an innovative data analytics faucet accessory, WaterVault (www.getwatervault.com) that helps save water by identifying and alerting property owners to water leaks anywhere on their site.

The prominent management theorist, Peter Drucken, taught that "If you can't measure it, you can't improve it." Water conservation is highly dependent on understanding, analyzing, and modifying water consumption behavior. There is a strong correlation between identifying and eradicating water loss. Common sense tells us, the earlier you are able to detect a water leak, the quicker you can fix it. This translates to more water saved. Success in the field of water conservation, therefore, is rooted in the continuous and reliable measurement of water consumption.

Within recent years, technology advancements have emerged which give the ability to monitor total water consumption and in turn, identify abnormal water consumption rates (i.e. leaks). This leads to earlier identification of leaks, which, when corrected, reduces water loss.

Water consumption data collected by these devices, when revealed to the consumer, can shed light on that consumer's *actual* water consumption behavior and guide them on successful behavior modification.

This becomes extremely important in commercial or industrial type buildings where there are multiple users of water in numerous locations around the building. Data suggests, water leaks in commercial buildings often go on for weeks after they start, simply because no one took the time to report the issue to building maintenance staff. In the commercial, industrial, and institutional applications, which, as a group, are responsible for over 29 percent of the total American water supply use[1], there is a unique opportunity to leverage existing technology to save water.

---

1 USGS. Water Use in the United States: Public Supply Water Use. https://water

Within these buildings, while they may have installed an EPA-approved low flow faucet or toilet, one or two faulty fixtures (i.e. failure of a toilet flapper) can potentially offset any savings in water usage. While it is difficult to characterize how much they waste, average probability suggests upwards of 10-15% of their water consumption is lost due to leaks.[2] The EPA provides a similar statistic, but we now have an opportunity to put real data behind it.

WaterVault (www.getwatervault.com) is a faucet or toilet accessory, that attaches to your existing fixture, and notifies you when there is a leak. WaterVault's sensor can detect water flow as low as a quarter of a gallon per minute. WaterVault sensors do not require any retrofitting or modifications and can be installed with a simple plumber's wrench. Once installed and setup, the sensor operates autonomously with minimal human intervention. It currently is deployed with private businesses and residences in California to help provide insights into water usage. It is soon to be deployed in a public school district as well to help provide real data on water leaks.

While every leak is a bit different in terms of how much water they actually waste, the EPA estimates that nearly 1 Trillion gallons of water are wasted every year due to maintenance issues. WaterVault is designed to tackle this loss directly and provide a sizable impact to the total gallons saved across the country.

In the effort of reviewing older specifications, we strongly urge the EPA to review this new type of faucet/toilet accessory, that will save hundreds of thousands of gallons of water every year. We have seen how data analytics have helped green and sustainability efforts in the space of energy consumption and carbon emissions and now it is time for water consumption to see the benefits.

Hooman Borghei
Inventor, WaterVault
hooman@getwatervault.com

[2] "Perceptions of water use" https://www.pnas.org/content/111/14/5129

Commenter: Daniel Gleiberman
Affiliation: Sloan
Comment Date: June 30, 2019

Email Text:

Please accept these comments as part of the Specification review for flushing urinals. Please contact me if you have any questions or need any additional information.

Thank you.

Daniel Gleiberman
Manager-Product Compliance and Government Affairs

SLOAN
Water Connects Us®
12304 Santa Monica Boulevard Suite 300
Los Angeles, CA 90025
Mobile: 310 980 5062
Sloan.com

Email Attachments

See pages 56 through 85.

JUNE 30, 2019

U.S. Environmental Protection Agency
Office of Water-WaterSense Program
1200 Pennsylvania Avenue N.W.
Washington, D.C. 20460
Watersense-products@erg.com

RE: EPA WATERSENSE NOTICE OF SPECIFICATION REVIEW-FLUSHING URINALS

Dear EPA Office of Water:

Sloan Valve Company has supported the WaterSense program since its inception, and we are proud to be a WaterSense partner. As the industry leader in the development, design, manufacture, and maintenance of a complete line of commercial plumbing products, we greatly appreciate the opportunity to provide comments for your consideration of the review of the EPA WaterSense Flushing Urinal Specification.

Within the *WaterSense Program Guidelines,*[4] the EPA includes conditions that might trigger a technical revision to a specification. For product specifications, these conditions are described below.

- WaterSense labeled products in a specific category comprise a significant portion of the market share based on the number of units shipped as reported by WaterSense partners. In this instance, market share means the ratio of WaterSense labeled units to non-WaterSense labeled units sold in the same product category.
- The EPA identifies significant and broadly available improvements in technology or product design in any labeled product category that improves the product's water efficiency. In this context, significantly improved products include products that are approximately 10 percent more efficient or higher-performing than current WaterSense labeled products, are offered by multiple manufacturers, and/or capture approximately 10 percent or more of the total market share for that product category.
- The EPA becomes aware of performance issues associated with products that are currently labeled under the specification.
- A water efficiency standard is adopted nationally that would mandate product efficiency equivalent to that in the specification, such that the WaterSense label would no longer differentiate products that were more efficient than those meeting the national standard.

The EPA will also consider the following in determining the feasibility in establishing, or in this case, revising a product specification:[5]

- Equal or superior product performance compared to conventional models.
- Potential for significant water savings on a national level.
- State of technology development—product categories that rely on a single, proprietary technology will not be eligible for the label.
- Assurance that the development (or revision) of a specification will not lead to unintended or negative environmental or economic impacts.

- Ability to measure and verify water savings and performance.
- Cost-effectiveness.

The new technology that exists which is non-proprietary and meets all of these criteria is the nonwater urinal with a drain cleansing feature. As outlined below, product standards for urinals, technology, and the plumbing codes have all been updated with improvements to address the concern for drain line build-up since the EPA Flushing urinal specification was published in 2009. We are writing to urge EPA WaterSense to include this urinal in the review and update of the Flushing Urinal Specification.

The ANSI Approved Product Standard:

The national consensus standard from ASME entitled Vitreous China NonWater Urinals (ASME A112.19.19) was updated in 2016 to include both a definition and performance criteria and testing for a nonwater urinal with drain cleansing action. It should be noted that this definition and the performance criteria are non-proprietary as they were developed through the consensus process. This feature for nonwater urinals acknowledges that drain-line buildup of struvite materials in nonwater urinal applications can occur and the ASME committee determined that it was appropriate to include this definition and performance criteria in the standard. Please see Attachment A for the complete standard and the highlighted portions for the drain cleansing action definition and performance criteria.

The Plumbing Code:

The EPA WaterSense Flushing Urinal specification was published in 2009. At that time, nonwater urinals were included as approved plumbing fixtures in both the Uniform Plumbing Code (UPC) and the International Plumbing Code (IPC). As EPA WaterSense is aware, these model codes are amended and updated on regular cycles based on each organization's operating procedures. In the ten years since the Flushing Urinal Specification has been available, there has been much discussion at the plumbing code committees about drain line build-up from very low water consuming urinals (i.e. a pint flush) and nonwater urinals. In order to address this concern, the UPC was amended in two ways. The UPC was amended to require at least one upstream water using fixture to be installed for any nonwater urinal installation. The benefits of using a nonwater urinal with a drain cleansing feature makes the need for an upstream water using fixture unnecessary as it will keep the drainline free of buildup.

403.3.1 Non-water Urinals. Where non-water urinals are installed, not less than one water supplied fixture rated at not less than 1 water supply fixture unit (WSFU) shall be installed upstream on the same drain line to facilitate drain line flow and rinsing. Where non-water urinals are installed they shall have a water distribution line rough-in to the urinal location to allow for the installation of an approved

backflow prevention device in the event of a retrofit.

"This is something new and it's not a bad idea, it may be recommended in these installations," Jordan said. "Even if you maintain the urinal in sanitary conditions, clean it properly, and use the proper installation instructions for maintaining that urinal, you still don't get the waterflow. What we're seeing is a build up in the piping systems and over time you're going to see a failure of those systems."

From IAPMO OFFICIAL Winter Edition 2015

A nonwater urinal with drain cleansing action will meet the requirement of section 403.3.1 as it has a water supply as part of the drain cleansing feature and its very purpose is to address the issue articulated in the plumbing code-"to facilitate drain line flow and rinsing." Just as the codes have been modified and updated based on new information and new technologies, it is appropriate for EPA WaterSense to include nonwater urinals with drain cleansing action in the updated specification.

The Product:

SLOAN is the manufacturer of a series of urinal models known as the Hybrid urinal. These urinals are tested and certified by IAPMO to the aforementioned ASME A112.19.19 standard. As stated previously, the ASME standard is not proprietary and while at present there may be few products in the market, there is no limitation or restriction on the development of compliant products. Please see Attachment B for information on the SLOAN Hybrid urinals. SLOAN has determined that the optimal amount of water to be utilized in the drain cleansing action is 1 gallon. All SLOAN hybrid urinals are set to utilize this one gallon of water every 72 hours (every 3 days). Therefore, while the standard allows a maximum of 584 gallons of annual water usage, all SLOAN hybrids are factory set to use only 122 gallons annually.

The Water Savings:

The ASME product standard includes a requirement that allows a maximum of 1.6 gallons of water per day for the drain cleansing action. This calculates to an annual water consumption of 584 gallons. Unlike every other product that EPA WaterSense has a specification for, the nonwater urinal with drain cleansing action has water consumption values that are verifiable and repeatable. For example, let's compare a WaterSense labeled 0.5 gpf urinal installed in a busy airport. Daily usage of these urinals can vary quite a bit. The average usage can be estimated at 45 uses per day so the annual water consumption of this urinal would be 8,212 gallons. If we compare this to the annual water usage of a nonwater urinal with drain cleansing action, we see that the nonwater urinal uses only 584 gallons annually, or a savings of approximately 7,600 gallons. This clearly meets the EPA criteria of at least 10 percent more efficient and can be can be considered higher performing than current urinals eligible for WaterSense certification (comparing the drain cleansing feature to the three common WS flush volumes of 0.5 gpf, 0.25 gpf, and 0.125 gpf). In addition, the USGBC has provided guidance that states that these fixtures are as efficient as nonwater urinals in terms of LEED Water Efficiency credits:

PREREQUISITE/CREDIT: WE102 - INDOOR WATER USE REDUCTION
RATING SYSTEM FAMILY: BUILDING DESIGN + CONSTRUCTION, BUILDING OPERATIONS + MAINTENANCE, INTERIOR DESIGN + CONSTRUCTION, NEIGHBORHOODS
RATING SYSTEM VERSION: V4 - LEED V4

Can automated-maintenance urinals be considered "waterless" for the purposes of WE prerequisite and credit Indoor Water Use Reduction?

Ruling: Yes, automated maintenance urinals with water use not to exceed 150 gallons (568 liters) annually can be considered as waterless urinals for the purposes of credit achievement calculations in LEED v4...

Attached is a case study (Please see Attachment C) and water saving data from a commercial office building retrofit in Southern California. The water savings is based on actual billing data, and on average for the 11 urinals that were converted to drain cleansing action nonwater urinals approximately 129,000 gallons of water is saved monthly.

Also attached is a testimonial from the Los Angeles Department of Water and Power (LADWP).

Summary of Urinal Rebate Programs with WaterSense as a Requirement:

Attachment D contains excerpts from water utilities around the country that have WATERSENSE as a prerequisite for their rebate programs. Each of these utilities below does not currently offer rebates for nonwater urinals or nonwater urinals with drain cleansing action and the potential for water savings from these fixtures can be realized once the WaterSense specification is updated:

- Portland, Oregon
- Denver, Colorado
- Round Rock, Texas
- Washington County, Utah
- Broomfield, Colorado
- Santa Rosa, California
- Fresno, California
- Bozeman, Montana
- Thornton, Colorado
- Wichita, Kansas
- Scottsdale, Arizona
- St, George, Utah
- Contra Costa County, California

As varied as this list is in terms of geography and size of the utility, it is by no means comprehensive. There are likely additional rebate programs for urinals that will benefit immediately once the WaterSense specification is updated. We have also reviewed the information from the June 5, 2019 EPA WaterSense webinar for utilities and promotional partners and the results of the two poll questions indicate there is a

strong desire to include nonwater urinals within the scope of the specification.

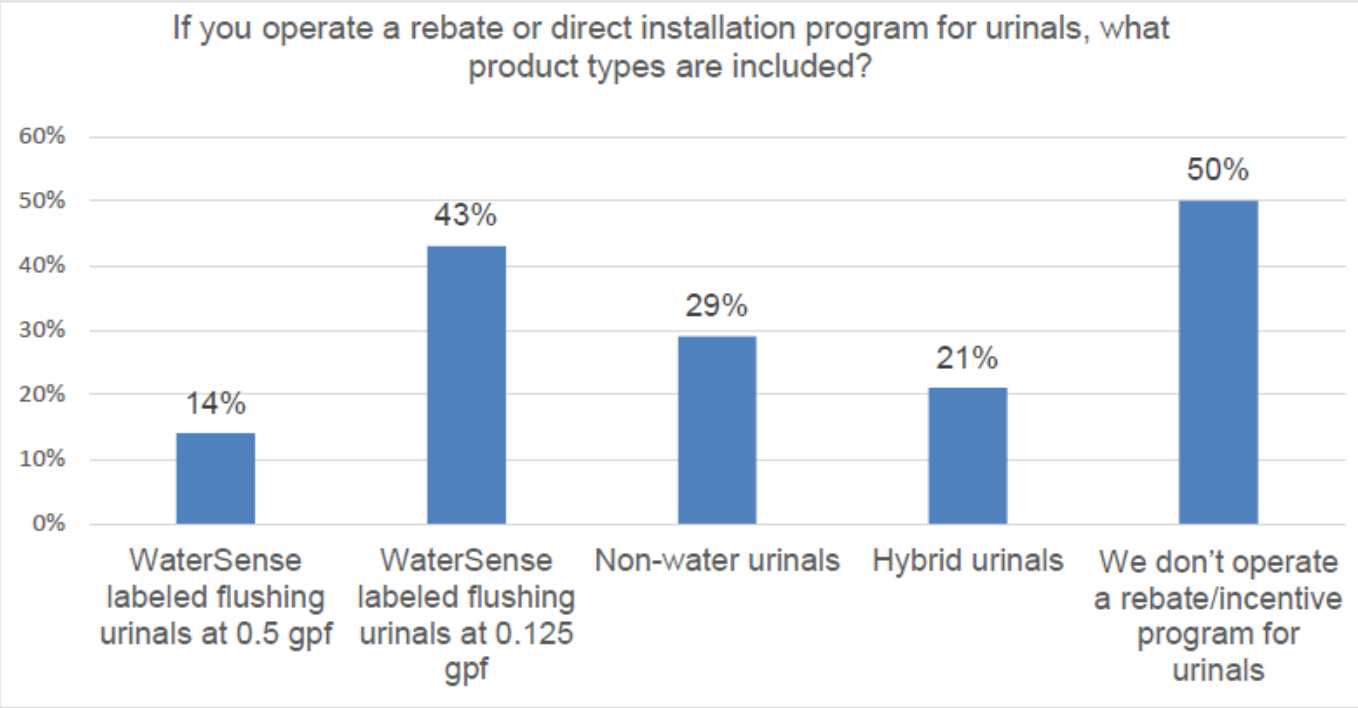


Figure 15. Poll Question #15 Results

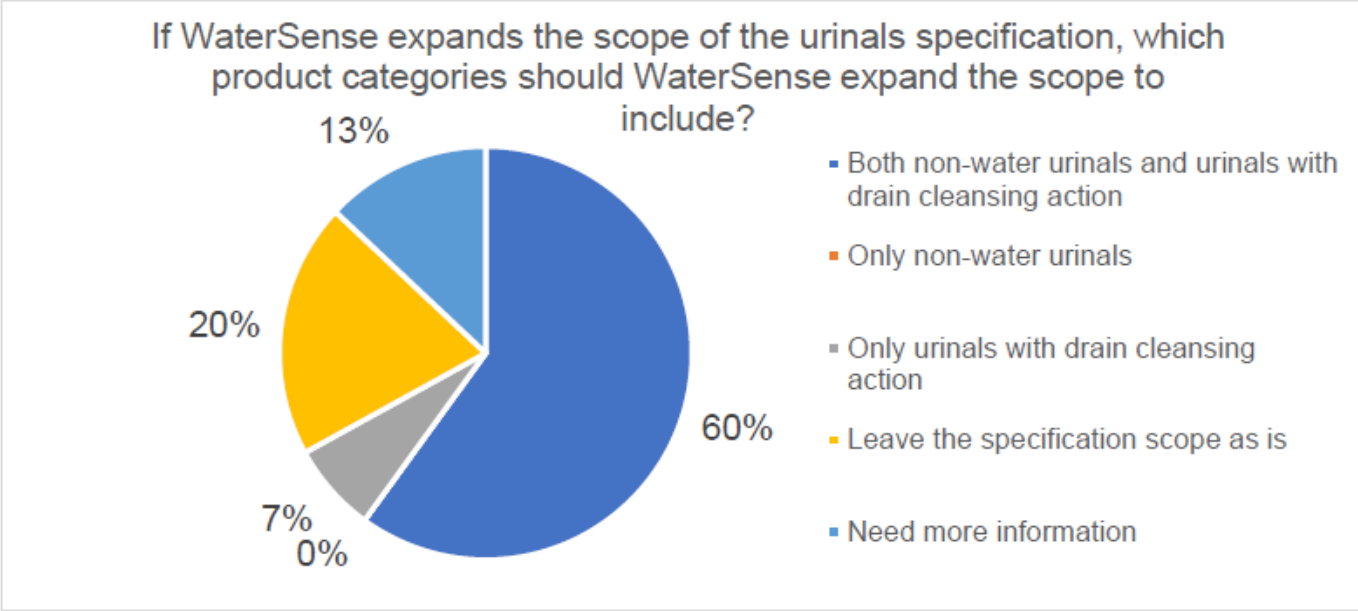


Figure 16. Poll Question #16 Results

We again thank you for the opportunity to provide comments, and urge you to include nonwater urinals with drain cleansing action in the update to the urinal specification.

Sincerely,

Daniel Gleiberman

Daniel Gleiberman
Manager, Product Compliance and Government Affairs

ASME A112.19.19-2016
[Revision of ASME A112.19.19-2006 (R2011)]

Vitreous China Nonwater Urinals

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

exposed body: unglazed portion $\frac{1}{16}$ in. (2 mm) or more in maximum dimension.

finish: texture and condition of surface other than color.

fire check: fine shallow crack in the body not covered with glaze (when covered with glaze so as to be easily cleaned, it is not detrimental).

first quality: first-class ware in conformance with the grade limitations and other requirements of this Standard, shall also be permitted to be called grade "A" ware.

fixture: the china piece only, without trim.

flood level: the portion of a plumbing fixture that will spill over when the fixture drain is shut or constricted.

glaze: the smooth, glass-like ceramic coating on a vitreous china surface that imparts impermeability and covers the body.

nonwater consuming urinal: a plumbing fixture that is designed to receive and convey only liquid waste through a trap seal into the gravity drainage system, without the use of water for such function.

permanent markings: markings that are fired, cast, sandblasted, etched, stamped, or otherwise not removable, except by excessive work or extraordinary means.

pinhole: a small hole in the glazed surface up to and including $\frac{1}{16}$ in. (2 mm) in maximum dimension.

pit: a hole in the glazed surface larger than $\frac{1}{16}$ in. (2 mm) in diameter.

polishing mark: a spot not larger than $\frac{3}{8}$ in. (10 mm) in maximum dimension where some minor blemish has been removed by polishing.

pottery square: a square 2 in. (50 mm) on each side. For grading purposes, it shall be a 2-in. (50-mm) square hole cut in a small sheet of any flexible material, such as rubber or paper, for convenience in sliding over irregular surfaces to determine segregation.

rim: the unobstructed open edge of a fixture.

roughing-in measurement: dimensions from finished wall or floor to center of waste or supply opening or mounting holes.

sanitary: for the purposes of this Standard, indicates an aesthetic condition of cleanliness, not microbiologically clean.

segregation: more than the allowable number of defects in a pottery square.

speck: an area of contrasting color less than $\frac{1}{32}$ in. (1 mm) in maximum dimension. Specks less than $\frac{1}{100}$ in. (0.3 mm) in maximum dimension, unless in sufficient number to form a discoloration, are not counted.

spot: an area of contrasting color $\frac{1}{32}$ in. (1 mm) up to and including $\frac{1}{8}$ in. (3 mm) in maximum dimension.

spot, large: an area of contrasting color greater than $\frac{1}{8}$ in. (3 mm) in maximum dimension.

trap: a fitting, device, or integral fixture portion so designed and constructed as to provide a liquid seal that will prevent the back-passage of sewer gas without materially affecting the flow of sewage or wastewater through it.

trap dip: the highest point of the opening from the well into the trapway.

trap-seal depth: the vertical depth of liquid between the highest part of the lower interior surface of a trap and the trap weir.

trim: parts other than china regularly supplied with a fixture, e.g., wall hangers. Trim shall not include fittings (see ASME A112.19.5/CSA B45.15).

urinal: a plumbing fixture that receives only liquid body wastes and conveys the waste through a trap seal into a gravity drainage system.

urinal with drain-cleansing action: a nonwater urinal that automatically performs a drain-cleansing action after a predetermined amount of time or usage. Such a urinal can function and perform waste extraction without the drain-cleansing action.

visible after installation: any surface that remains visible after the fixture has been installed, not necessarily from a normal standing position.

visible surface: the surface that is readily visible to an observer in a normal standing position after installation of the fixture.

vitreous china: as applied to plumbing fixtures (≤ 0.5% absorption) compounded of ceramic materials fired at high temperature to form a nonporous body with exposed surfaces coated with ceramic glaze fused to the body.

warpage: a defect in a fixture resulting in a concave or convex gap between the fixture and the adjacent wall or floor.

wavy finish: a defect in the finish having the appearance of numerous runs in the glaze, irregular or mottled.

well: a pocket opened at the top, formed inside a urinal bowl at the entrance to the trap.

2 VITREOUS CHINA REQUIREMENTS

2.1 Absorption

The average absorption of the ceramic test samples shall not exceed one-half of 1% (0.5%) when tested in accordance with ASME A112.19.2/CSA B45.1, para. 6.1.

2.2 Crazing

No crazing shall be permitted when tested in accordance with ASME A112.19.2/CSA B45.1, para. 6.2.

with para. 6.5.1.7 shall be conducted only between daily testing (i.e., cleaning only between days 1 and 2 and between days 2 and 3). Record the results.

6.5.2 Performance Requirement

6.5.2.1 Extraction of all liquid shall be required in eight of nine solution extraction test sets as specified in para. 6.5.1.8.2 on each of the successive 3 days of tests.

6.5.2.2 All initial ammonia sample readings taken in para. 6.5.1.8.2(b)(1) (5 min after introduction of the test sample liquid) shall not exceed 40% of the ammonia vapor measured under para. 6.5.1.8.1.

6.5.2.3 Ninety-five percent of all of the ammonia sample readings taken in paras. 6.5.1.8.2(b)(2), (3), and (4) shall not exceed 10 ppm at the end of the test periods specified.

6.6 Testing of Urinals With an Optional Drain-Cleansing Action

6.6.1 Drain-Cleansing Action. Drain-cleansing urinals shall be capable of conducting the drain-cleansing action by periodically emitting a cleansing volume of water not to exceed 1.6 gal (6.0 L) per day. The volume of water discharged through the drain-cleansing system shall be at least 0.13 gal (0.5 L) at any one drain-cleansing action.

6.6.2 Backflow Protection. A device that complies with one of the following standards shall be accessible and installed upstream of the exit of the drain-cleansing system in order to protect the potable water supply: ASME A112.1.3, CSA B64.1.4, ASSE 1001, ASSE 1011, ASSE 1018, ASSE 1044, ASSE 1052, or ASSE 1056.

6.6.3 Trap Seal Restoration Test. This test shall be conducted before and after the life cycle test as follows:

(a) activate the drain-cleansing system and allow it to complete its cleansing cycle

(b) measure the trap seal depth of the drain-cleansing system trap

(c) measure the trap seal depth of the urinal trap

(d) perform the process in (a) through (d) ten times to obtain ten sets of measurements

6.6.3.1 Performance Requirement. The drain-cleansing system trap and the urinal trap shall be restored to at least 2 in. (51 mm) after each cycle and shall not be affected by the drain-cleansing system operation.

6.6.4 Drain-Cleansing System Hydrostatic Pressure Test. The drain-cleansing system valve shall be subjected to a hydrostatic pressure of 125 psi (860 kPa) for 5 min with the valve closed and shall have no leakage from the valve.

6.6.5 Drain-Cleansing Life Cycle Test

6.6.5.1 Connect the drain-cleansing system to the water supply at a temperature of 50°F ± 10°F (10°C ± 6°C) through the test specimen at the manufacturer's specified minimum flow rate and in accordance with the manufacturer's installation instructions.

6.6.5.2 Activate the drain-cleansing action valve on and off for 10,000 cycles.

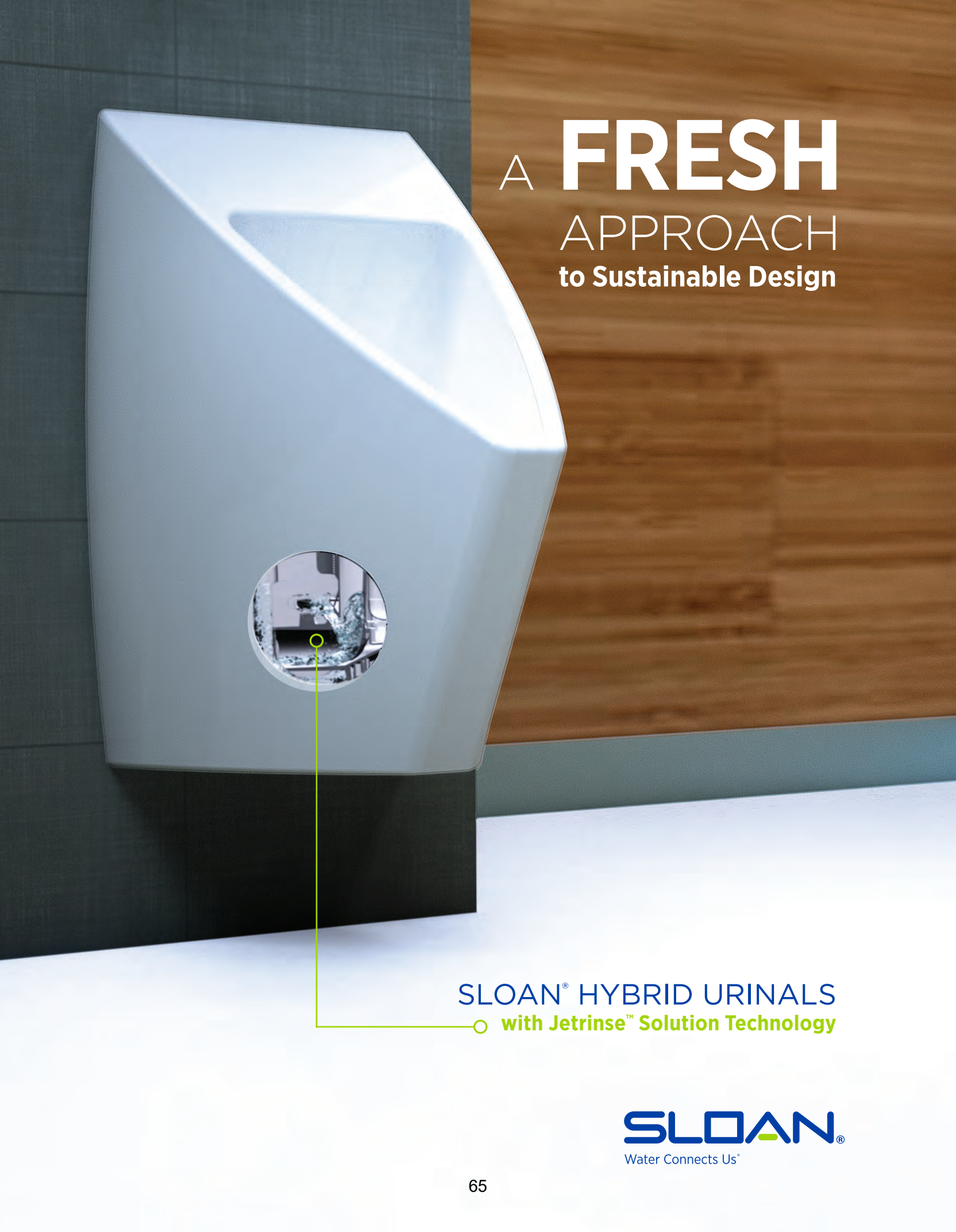
6.6.5.3 Repeat the drain-cleansing system hydrostatic pressure test in Section 6.6.4.

6.6.5.4 In the performance requirement, the volume of water discharged through the drain-cleansing system shall be at least 0.13 gal (0.5 L), ±5% before and after the test. There shall be no leakage or failure of the drain-cleansing system.

6.6.6 Burst Pressure Test for the Drain-Cleansing System

6.6.6.1 Test Procedure. The valve of the drain-cleansing system shall be subjected to a hydrostatic pressure of 500 psi (3 450 kPa) for 1 min, with the valve closed.

6.6.6.2 Performance Requirement. There shall be no leakage, permanent distortion, or failure of the pressure envelope.


A FRESH
APPROACH
to Sustainable Design
SLOAN® HYBRID URINALS
with Jetrinse™ Solution Technology
SLOAN®
Water Connects Us®

The new Sloan® Hybrid Urinals deliver unmatched performance while saving thousands of gallons of water every year. This innovative fixture combines a world-class, multi-patented urinal cartridge with our revolutionary **Jetrinse™ Solution Technology** that will keep your urinals and drain lines clean, hygienic, odor-free and clog-free.

IMPROVING A PROVEN SOLUTION

In a world of increasing water shortages—and increasingly strict usage regulations—conserving water has never been more important.

Since their introduction, waterfree and 1/8 gpf high-efficiency urinals have helped save thousands of gallons of fresh water every year with each installation. When properly maintained, these fixtures provide efficient removal of liquid waste with no odor or clogs.

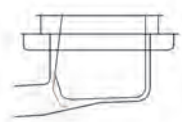
The challenge is, however, that improper or infrequent maintenance can lead to the buildup of solids in the drain line, which leads to reduced flow and bad-smelling restrooms. As a result, many customers are not satisfied and believe that these high-efficiency urinals don't live up to expectations.

Now, there's a new solution that combines the efficiency of waterfree urinals with the functionality of conventional flush urinals.

CARTRIDGE TECHNOLOGY

Sloan® Hybrid Urinals feature a multi-patented cartridge, with Falcon Waterfree Technology, for safe, long-lasting, low-odor performance while saving tens of thousands of gallons of water every year. Since the technology was introduced in 2004, there have been several improvements incorporated into the design based on feedback from customers. The latest design follows that same path and includes six all-new features to provide optimal performance.

Simplifies maintenance and optimizes cartridge effectiveness



Keeps pipes and housing cleaner—The patented flexible pour spout combines with a modified cartridge outlet to concentrate and redirect the exiting urine. This significantly increases its exit speed, which helps keep the housing and pipes cleaner.

Reduces odor—The patented cartridge features a reduced surface area that eliminates space for bacteria growth.

Retains sealant better—A new diverter combines with the internal baffle to help retain sealant, even if a bucket of water is accidentally dumped into the urinal.

Reduces splashback—An integrated diverter shield reduces splashing while helping prevent debris from entering the cartridge.

Greener footprint—The new cartridge uses 20% less material than previous models, making it even more environmentally friendly.

Maintenance indicator—The indicator lets you know when it's time to replace your cartridge.

EFFICIENCY WITH A DIFFERENCE

The Sloan® Hybrid Urinal doesn't use water to eliminate urine, and there's no need for maintenance personnel to manually clean or rinse the housing and drain line.

The difference occurs behind the scenes with our breakthrough Jetrinse™ Solution Technology. Every 72 hours, the system automatically purges the housing and pipes, rinsing them thoroughly to prevent the buildup of sediment.

The result is clean, odor-free operation, with virtually no maintenance aside from typical wipedowns and cartridge changes.

HOW JETRINSE SOLUTION TECHNOLOGY WORKS

Water is supplied to the back of the housing through a solenoid valve and air gap device.

The water is directed through a nozzle against the cartridge, powerfully redirecting it down the housing and drain line.

The solenoid valve is programmed to inject approximately one (1) gallon of water every 72 hours.

An infrared switch, discreetly located underneath the fixture, allows maintenance personnel to manually operate the Jetrinse system during cartridge changes to confirm its operation.

HYB-4000

SLOAN® HYBRID URINAL SPECIFICATIONS

	HYB-1000	HYB-4000	HYB-7000
Code Number	1001020	1004020	1007020
Nominal Dimensions	25⅞" x 16⅝" x 14⅜" 651mm x 422mm x 365mm	22⅝" x 15⅜" x 14" 575mm x 391mm x 356mm	21⅞" x 12¾" x 14⅝" 555mm x 325mm x 370mm
Approximate Weight	68 lbs	43 lbs	54 lbs
Jetrinse™ Water Supply	3/8" NPT		
Drain Connection	2" NPT		
ADA Compliant	Yes		
Certification	IAPMO		
Manual Jetrinse Activation	Infrared switch		
Urinal Construction	Vitreous china		
Urinal Operation	Waterfree		
Jetrinse Operation	1 gallon per 72 hours		
Power	6V lithium battery		

HYB-7000

HYB-1000

OPTIONS TO FIT YOUR NEEDS

Sloan® Hybrid Urinals come in three designs to meet your specifications and requirements. Ideal for a wide range of applications, the Hybrid Urinal line can deliver exceptional performance and outstanding savings for:

- Healthcare facilities
- Restaurants and hotels
- Stadiums
- Schools and universities
- Transportation terminals
- Office buildings

Presents a clean, elegant and efficient appearance styled to reflect your dedication to sustainability

sloanvalve.com/hybrid | 800.982.5839

SLOAN®
Water Connects Us®

Sloan Headquarters
10500 Seymour Avenue
Franklin Park, IL 60131
U.S.A.

November 23, 2016

Steve Nuskiewicz, SVP, North America Sales
Falcon Waterfree Technologies, LLC
2255 Barry Ave.
Los Angeles, CA 90064

To: Mr. Steve Nuskiewicz

Subject: Falcon/Sloan Hybrid Urinal Installation

The Los Angeles Department of Water in Power installed 6, Falcon/Sloan Hybrid Urinals in our Men's restrooms at our headquarters building location at 111 N. Hope Street, Los Angeles Ca 90012 in 2016.

The performance has been as it was stated it would be by the manufacturer. To date, we have had no problems with these fixtures.

We find the Hybrid Urinal fixtures not only save water compared to conventional flush type urinals but also reduce maintenance and extend cartridge life compared to other water free urinals installed at this facility. Our maintenance personnel are very happy with these fixtures.

Please contact me should you have any questions.

Sincerely,

David Jacot, P.E.
Director of Efficiency Solutions
Los Angeles Department of Water & Power
david.jacot@ladwp.com

JK:rc
c: Mr. Mike Massey

CBRE
3400 Aerojet, El Monte, CA

CBRE serves real estate owners, investors and occupiers worldwide. They manage millions of square feet of global commercial real estate and they include a wide range of office, industrial, and retail properties.

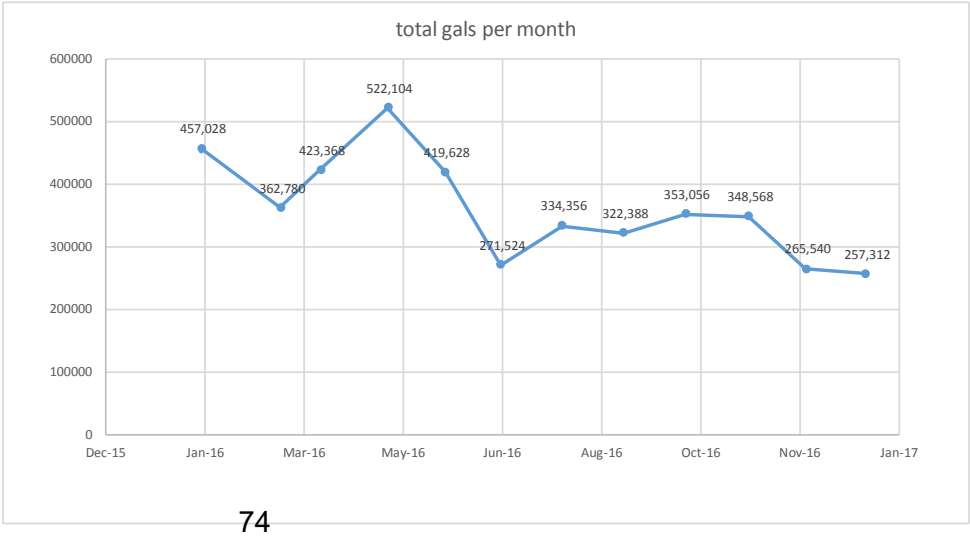
GREEN PERFORMANCE MEASURES AND COST SAVINGS

Class A office buildings have great potential to deliver significant cuts by adopting sustainable practices and opting for water and energy efficient products. CBRE El Monte took the lead on reducing water use by retroffiting their restrooms with our new Hybrid urinals.

The Hybrid delivers ease of maintenance and eliminates the root cause of issues that have come up in the past with waterfree – odor and clogs. "The decision to go with the Hybrid comes down to water. I had heard and my plumber had warned me that not enough water was going to cause problems. The Hybrid provides the water that is needed automatically, and helps meet part of CBRE's sustainable goals" said Robert Brand, CBRE Chief Engineer. After installing 11 fixtures throughout the building the water usage dropped on average **130,000 gallons per month.**

KEY PROJECT FACTS

Date of installation: June 9th, 2016
Project size: 12,2320 SF
Product: 11 Hybrid Urinals
Reductions: water - 33%
Annual savings: 1,550,000 gallons



LOCATION: 3400 AEROJET, EL MONTE, CA

On June 9th 2016, 11 Hybrid Urinals were installed at CBRE's El Monte location. The table below analysis the water consumption of 122,320 square feet of office space during the year of 2016.

SAVINGS ANALYSIS DATA	
Project size	122,320 SF
Product	11 Hybrids
Water rate	0.0537
Operating days	261
ANNUAL WATER SAVINGS	
Average monthly before Hybrid	
Gallons	436,982
Dollars	$1,803.37
Average monthly after Hybrid	
Gallons	307,535 gals
Dollars	$1,480.17
Annual savings	
Gallons	**1,550,000 gals**
Dollars	**$6,951**
ANNUAL OPERATING COST	
Cartridges per urinal	3
Total cartridges	33
Cost of cartridges	$40
Annual cartridge cost	**$1,320**

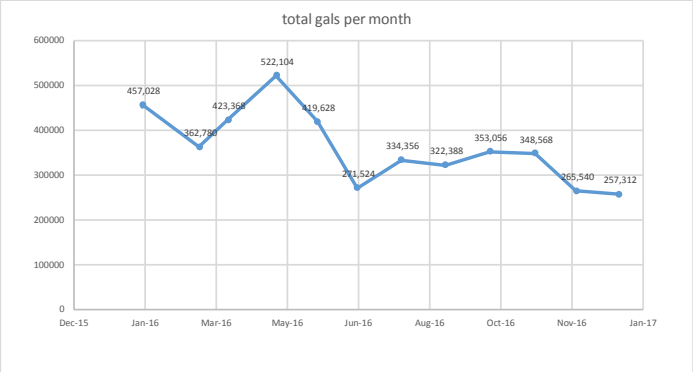
WATER BILL ANALYSIS - ADDITIONAL INFORMATION

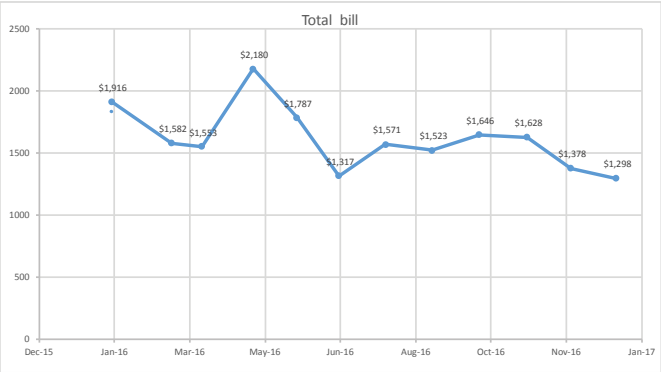
Due Date	Total gals per month
29-Jan-16	457,028
9-Mar-16	362,780
29-Mar-16	423,368
2-May-16	522,104
31-May-16	419,628
28-Jun-16	271,524
29-Jul-16	334,356
29-Aug-16	322,388
29-Sep-16	353,056
31-Oct-16	348,568
29-Nov-16	265,540
29-Dec-16	257,312

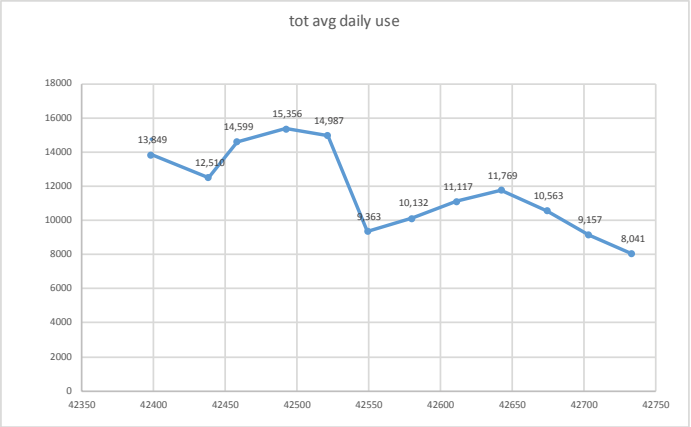
Due Date	Total bill
29-Jan-16	$1,916
9-Mar-16	$1,582
29-Mar-16	$1,553
2-May-16	$2,180
31-May-16	$1,787
28-Jun-16	$1,317
29-Jul-16	$1,571
29-Aug-16	$1,523
29-Sep-16	$1,646
31-Oct-16	$1,628
29-Nov-16	$1,378
29-Dec-16	$1,298

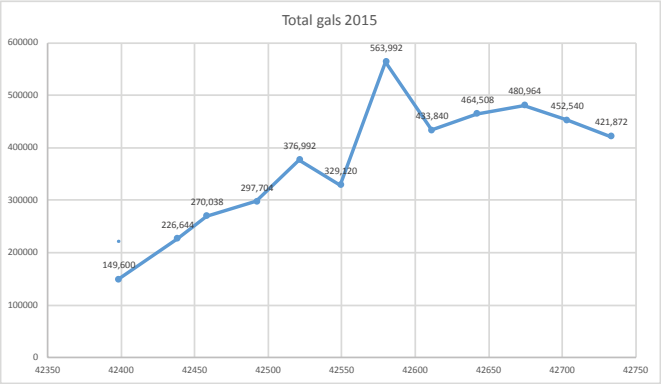
Due Date	Total avg daily use
29-Jan-16	13,849
9-Mar-16	12,510
29-Mar-16	14,599
2-May-16	15,356
31-May-16	14,987
28-Jun-16	9,363
29-Jul-16	10,132
29-Aug-16	11,117
29-Sep-16	11,769
31-Oct-16	10,563
29-Nov-16	9,157
29-Dec-16	8,041

Due Date	Total gals 2015
29-Jan-16	149,600
9-Mar-16	226,644
29-Mar-16	270,038
2-May-16	297,704
31-May-16	376,120
28-Jun-16	329,120
29-Jul-16	563,992
29-Aug-16	433,840
29-Sep-16	464,508
31-Oct-16	480,964
29-Nov-16	452,540
29-Dec-16	421,872









DENVER WATER

WaterSense®-labeled high-efficiency urinal rebate (up to $100 each)

- Only WaterSense-labeled urinals that flush 0.125 gallon per flush or less qualify.
- Waterless urinals *do not* qualify at this time.

Portland Water Bureau **MULTIFAMILY TOILET & URINAL REBATE**

Replacing older toilets and urinals is a great way to save water and money! The Portland Water Bureau is offering a **$50 rebate** for replacing older fixtures with high-efficiency WaterSense-labeled tank-style toilets, flushometer toilets, and urinals. **Apartment buildings**, **condominiums**, and other **multifamily properties** are now eligible for up to 50 rebates per active domestic water account.

HOW TO GET A REBATE:

1. **Make sure you are eligible.** Rebates are for active Portland Water Bureau drinking water accounts in good standing. **Limit of 50** toilet rebates per account. Each rebate is worth $50.
2. **Select an eligible toilet.** The toilet you purchase must be a WaterSense-labeled tank-style, urinal, or flushometer toilet. Local plumbing stores are familiar with the WaterSense label. For a complete list of approved models, visit: **www.epa.gov/watersense**.

Water Conservation Program
Commercial Toilet & Urinal Rebate Application

This rebate application applies to Commercial Properties for the purchase of WaterSense Certified toilet(s) and/or flush urinal(s). Replacing older toilets with water efficient toilets can save 4,000 gallons of water per toilet, per year. Please note that rebates are only available to direct City of Round Rock water customers. (MUD customers are not eligible)

PROGRAM GUIDELINES

ELIGIBILITY:

- Applicant must be a direct City of Round Rock water customer in good standing. (MUD customers are not eligible)
- Property must have been built prior to January 1, 2006.
- Property must be commercial, industrial, governmental or multi-family. *Irrigation-only accounts do not qualify.*
- An itemized receipt(s) must be submitted with the application within 60-days of installation. Receipt(s) must include date, vendor name and address, fixture(s) price, and brand or description.
- The City does not endorse specific brands, nor is responsible for the performance or repair of new fixture(s).
- Applicant is responsible for disposal of old fixture(s). Per state law they cannot be reused.
- Rebates are available until funds have been expended. Visit roundrocktexas.gov/rebates for available rebates. Once funds are exhausted the rebate program will no longer appear on the website.

TOILET AND/OR URINAL REQUIREMENTS:

- Program fixture(s) must be EPA WaterSense Certified, verify at www3.epa.gov/watersense/product_search.html. *(Product packaging is marked with the WaterSense label.)*

533 E Waterworks Drive
St. George, UT 84770
435.637.3617
wcwcd.org

WaterSense Labeled Commercial Urinal Rebate Application

July 1, 2016 through June 30, 2018

Rebate Availability

Rebates are available only for EXISTING commercial buildings. WCWCD rebate program may be subject to change or modification at any time. Replacement toilets must be new, must be purchased and installed prior to submitting a rebate application and must have been purchased and installed after July 1, 2016. Applications must include all information requested. Failure to provide this information may result in the delay or denial of the rebate. **Commercial rebates must be pre-approved by WCWCD.**

Rebate Qualification

This program is open to all properties in Washington County. However, if City of St. George is your water provider, please visit sgcity.org to apply for its rebate. **This rebate cannot be combined with the toilet rebate offered by City of St. George**. This program offers a rebate for replacement on 2000 or older (pre-2000) model toilet with a WaterSense labeled toilet. A list of toilets which qualify for the rebate can be found on the EPA's WaterSense website: http://www.epa.gov/watersense. This program will run from July 1, 2016 through June 30, 2018 or until funds are depleted, whichever occurs first.
For information on WaterSense urinals visit: http://www.epa.gov/WaterSense/products/urinals.html
The list of approved urinals are found at: http://www.epa.gov/WaterSense/product_search.html?Category=3

High-Efficiency Urinal Rebate

Commercial Urinal Rebate Application

The high-efficiency urinal rebate program offers a rebate of **$100** per urinal installed that flushes 0.5 gallons per flush (gpf) or less. Only EPA WaterSense-labeled, high-efficiency urinals are eligible.
Preapproval is required for rebate amount more than $2,500 (26 or more urinals). Submit your application prior to purchase.

Qualifications

- Customer must receive treated water from the City and County of Broomfield
- A receipt for the urinal(s) must be provided.
- **Applications must be submitted within 90 days of purchase.**
- Installation must be completed within 12 months.
- Only EPA WaterSense-labeled, high-efficiency urinals are eligible.

High Efficiency Urinal Rebate Program
For Commercial, Industrial, and Institutional Customers

ebate Amounts: $450.00 per urinal max* for pre-qualified hardware

**Rebates cover materials only (labor not included) and cannot exceed the cost of materials.*

pplicant must:

- Have a City of Santa Rosa water account (service) in their name for the property where the project will be completed.
  - If the property owner is the participant in the program and not the water account holder, they must receive written consent from the water account holder using a City of Santa Rosa Tenant/Account Holder Permission Form.
- Agree that the hardware is retained while you are the current account holder or property owner. If hardware is replaced with equipment of lower standards during that time, the entire rebate amount must be refunded

teps to Participate:

) If not already pre-qualified, call Water-Use Efficiency staff at 707-543-3985 for eligibility verification and a potential site visit.

) After eligibility of site is verified and approved:

a) You may then proceed with urinal replacement.

b) You have 120 days from date of approval to complete the project.

) **Project Guidelines**:

a) Existing urinal must flush at 1.0 gallons per flush or greater

b) Replacement urinal must be on the approved list and flush at 0.125 gallons (1 pint) per flush or less

i) Approved urinals located on the EPA WaterSense Product listing under the category of "Flushing Urinals" at: https://www3.epa.gov/watersense/product_search.html

City of FRESNO WATER DIVISION

COMMERCIAL & MULTI-FAMILY CUSTOMERS HIGH-EFFICIENCY URINAL REBATE PROGRAM

City of Fresno commercial and multi-family water customers may be eligible for rebates when replacing old uinals . All products must have the WaterSense label.

look for WaterSense Meets EPA Criteria

$100 rebate for new, qualifying High Efficiency Urinals (HEU) of .5 gallons per flush or less.

Efficiency measures such as replacing water-guzzling **Urinals** with the latest in low-flush technology helps ensure our community's future water supply is adequate, maintains low water rates and, most importantly, helps reduce your business' operational overhead.

For a qualifying list of **Urinals** please visit: www.epa.gov/watersense/products/urinals.html or call 621-5480.

CITY OF BOZEMAN WATER CONSERVATION

Bozeman Urinal Rebate Program

Mail to:
City of Bozeman
Water Conservation Division
P.O. Box 1230
Bozeman, MT 59771

Commercial Application Form

Office Use Only

This rebate offer is only available to residences and businesses connected to City of Bozeman water. **Rebates only apply to WaterSense® labeled** high-efficiency **urinal fixtures and valves which operate at 0.125 gallons per flush (gpf). A complete high efficiency urinal system including qualifying 0.125 gpf fixtures AND valves must be installed to be eligible for a rebate.** Rebates are not to exceed purchase price.

1. Account Information (You must receive water from the City of Bozeman to qualify for the rebate)

Account ID No. | Account Holder Phone

Name on Account | Account Holder Email

2. Applicant Information (Rebate checks sent payable to this information)

Name of Applicant ☐ Owner ☐ Tenant (Owner must authorize in writing)

Mailing Address

City | State | Zip Code | Cell Phone

How did you hear about this rebate program? ☐ Direct Mail ☐ Retailer ☐ Website ☐ Paper/Magazine ☐ Other:

3. Installation Site Information

Installation Address (if different from Applicant Address)

City | State | Zip Code

Year Built | # of tenants or employees | # of visitors | type of commercial use

4. New WaterSense® Labeled Urinal(s) Installed

WaterSense® labeled urinal fixtures and valves which operate at **0.125gpf ONLY!** To search the complete listing of **WaterSense®** labeled urinal products visit: **https://www.epa.gov/watersense/product-search** (Note! The WaterSense® efficiency standard of 0.5gpf is higher than the 0.125gpf specification required to qualify for this rebate. Check the manufacturer's specifications to make sure the product operates at 0.125gpf before purchasing your WaterSense® certified urinal fixtures and valves.)

2019 WaterSense Commercial and Multi-Family Toilet and Urinal Rebate Information

Effective January 1, 2019

This program offers water rebates to Commercial and Multi-Family accounts in the Thornton water service area for the replacement of fixtures with WaterSense labeled toilets and urinals. WaterSense labeled products are independently tested and certified to be 20% more efficient than the standard product. The rebate is up to $150 for flushometer toilets and urinals, and up to $75 for tank type toilets purchased after project approval and installed by December 14, 2019. Some examples of qualifying customers include, but are not limited to:

- Apartment buildings & Multi-Family accounts with 3 or more living units
- Churches
- Hospitals
- Hotels
- Nursing homes
- Office buildings
- Restaurants
- Retail
- Schools
- Small businesses

Rebates are available on a first-come, first-served basis and are subject to the availability of funds.

How to Apply:

Step 1 - Contact Water Resources staff at 720-977-6600 or e-mail Water@ThorntonWater.com to detail the replacement project and to obtain written pre-approval.

Step 2 - Refer to http://www.epa.gov/watersense/product_search.html for a list of approved EPA WaterSense products. EPA WaterSense toilets and/or urinals must be on the approved list to qualify for the rebate.

2019 Water Conservation Rebate Program
HIGH EFFICIENCY URINAL REBATE

High Efficiency (HE) Urinal Rebate: $100.00 for a new 0.5 gallons per flush (gpf) HE urinal that is installed and replaces an existing high-volume toilet (1.5+ gpf) in buildings built prior to 2005.

Rebate is available for all customers having active accounts with the City of Wichita Public Works and Utilities for delivery of potable water.

Specifications

The high efficiency (HE) urinal must be WaterSense certified and use 0.5 gallon per flush (gpf) or less (i.e. waterless), and be on the approved list of qualifying devices found at: www.savewichitawater.com.

Device Rebates (Toilets, showerheads, irrigation controllers, urinals)

- Purchases occurring after program deadlines and before next year's start date (July 1, 2019) are ineligible for rebates.
- All installations require WaterSense labeled products. Visit the EPA's WaterSense Product Search to look-up eligible devices.

Removal Rebates (Warm-season turf, water softener, pool/spa)

- All removal rebates require a pre-inspection to determine eligibility. Do not begin the removal process until the required pre-inspection is complete. Pre-inspections will begin on July 1, 2019.
- If the warm-season turf, water softener, or pool/spa is removed before the required pre-inspection

WaterOperations-CustomerService@ScottsdaleAZ.gov

Office Hours

Monday through Friday
7 a.m. to 4:30 p.m.

SCOTTSDALE WATER

City of St. George ("City")
Water Services Department
WaterSense Labeled Commercial Urinal Rebate Application

Important: Please read this application carefully. It is the applicant's responsibility to complete the application and submit it with the required supporting documentation. Rebates are available only for EXISTING commercial customers. The application must be signed by the individual on the City of St. George Water Utility account. Rebates will not be paid for ineligible or incomplete applications. Rebates will be paid in the form of a credit issued on the utility account. Commercial rebates must be pre-approved by the Conservation Coordinator.

Customer Information
Account Number_____

Customer Account Name_____ Phone_____

Installation Address _____ _____Zip _____

Contact Person_____

If you would like to be added to an email mailing list to receive conservation related information, please provide your email address:

CONTRA COSTA WATER DISTRICT

Urinal Rebate: Pays up to $350 towards the purchase and installation of a WaterSense labeled urinal that is one-pint per flush (0.125 gallons per flush) or less.

- Urinal rebate covers costs for the urinal fixture, flushometer valve, other required hardware, and out-of-pocket billed labor expenses.

- Rebate does not include non-billable in-house labor, shipping, or taxes.

Commenter: Edward Osann
Affiliation: Natural Resources Defense Council
Comment Date: June 30, 2019

Email Text:

Please accept these comments on behalf of the Natural Resources Defense Council, a WaterSense Partner.

We recommend that WaterSense continue forward with specification review for plumbing products and weather-based irrigation controllers. For plumbing products, we recommend consideration of expansion of the residential lavatory faucet specification to include residential kitchen faucets. For irrigation controllers, we recommend consideration of expansion of the category to include soil moisture sensor-based controllers, as well as energy performance criteria.

Plumbing Products

Regarding plumbing products, at least eight states and the District of Columbia have adopted mandatory standards for toilets and urinals that are as stringent, or in some cases more stringent, than current WaterSense specifications. A similar number of states have adopted standards for showerheads and faucets that are as stringent or more stringent than current WaterSense specifications. Taken together, jurisdictions comprising over 35% of the US population now apply these requirements to all products installed in new construction or simply all products sold or installed in their state. Manufacturers have responded, and the market share of new sales held by WaterSense labeled products in some of these categories is thought to approach 90%. (This is information that is currently known to EPA, provided by WaterSense industry partners, but not publicly released.) In light of these trends, maintaining current specification levels carries significant risk that the WaterSense label will lose its ability to differentiate product performance in the marketplace, and simply devolve to a colorful logo without substantive meaning for consumers.

Some industry comments have recommend against *any* further modification of plumbing product specifications, citing in part the observations contained in a November 2017 white paper prepared by the California Urban Water Agencies and others. However, this report is of limited value to EPA in determining whether further consideration should be given to efficiency criteria for its voluntary labeling program. This report specifically set out to collect the observations and impacts of California utilities during two years of acute drought conditions in 2015 and 2016, when all urban areas were under mandatory water curtailment orders to achieve an immediate 25% reduction in water use statewide. That many utilities found operational impacts from such a sharp and rapid curtailment of water use during extremely dry ambient conditions is far from surprising. A voluntary labeling program does not impact water use with either the severity or the immediacy of an emergency curtailment imposed by executive order. Certainly, the ability of WaterSense labelled products to provide safe and reliable service is appropriate for consideration. But relevant impacts and implications can be considered in the context of a specification review; the operating adjustments of utilities during acute

drought conditions need not serve to block any further consideration of household product efficiency improvements at this time.

Reasonable improvements in efficiency are already suggested by the number of models that surpass current WaterSense specifications in each of these categories. We urge EPA to take this analysis forward into 2020 and initiate a formal revision of plumbing product performance criteria.

Irrigation Controllers

We recommend that the specification for irrigation controllers be broadened to include criteria for energy consumption. The expanded use of these products makes their power consumption in all modes -- active mode, standby mode, and off mode -- an appropriate matter for evaluation and inclusion in a revised specification. In California, the , the Statewide Codes and Standards Enhancement (CASE) initiative, sponsored by investor-owned energy utilities, has worked to support efforts to update California's appliance efficiency regulations. As noted in the CASE Team's September 2017 comments to the California Energy Commission docket on irrigation controllers, the CASE Team proposed additional product testing to determine feasible options and technical pathways for potential energy efficiency improvements to irrigation controllers.

Although the CASE Team is continuing to explore this topic, based on initial research, the team has drawn the following conclusions:

- Smart features (sensors and wi-fi control) can double the standby power draw of irrigation controllers compared to irrigation controllers without smart features
- In particular, soil moisture sensor (SMS) controllers seem to have the most significant standby power draw requirements
- Add-on sensors may or may not increase standby power draw depending on design
- Wi-fi models offer similar or more functionality for power draw compared to controllers with local sensors
- Traditional timers without sensors or wi-fi control show consistently stable power levels, but some controllers with external sensors (rain, weather, SMS) or wi-fi control show cyclic behavior (communication pings) that can affect power draw

Therefore, in general "smart" features can add to the energy usage of landscape irrigation controllers, and it is worth considering energy performance requirements in a review of the WaterSense specification for landscape irrigation controllers to ensure that the energy penalty for using this product does not diminish the water saving benefits. EPA's leadership in this area could help support efforts in states like California that are studying this product category.

Based on product test data, there are potential opportunities to improve the energy efficiency of these products, for example:

- Most controllers do not significantly reduce power in off mode, and some controllers do not even have an off mode. This is a potential efficiency pathway to explore.
- Using more efficient internal power supplies (transformers that convert line current to current usable by the device) could significantly reduce power draw.

A WaterSense specification that includes both water and energy efficiency criteria could greatly expand the base of utilities that would be interested in partnering to support labeled products. Co-labeling with Energy Star might also be an option to explore, but with or without such co-labeling, energy performance criteria should be considered in irrigation controller specifications going forward.
Respectfully submitted,

Edward R. Osann
Senior Policy Analyst
Natural Resources Defense Council

Commenter: Matt Sigler
Affiliation: Plumbing Manufacturers International (PMI)
Comment Date: July 7, 2019

Email Text:

Stephanie & Robbie-

Please accept our attached comment letter and the report for PMI's "2019 U.S. WaterSense Market Penetration" study for your consideration regarding the Notice of Specification Review.

If you have any questions, please do not hesitate to contact me.

Regards,

Matt Sigler
Plumbing Manufacturers International
Technical Director
847-217-7212
Email: msigler@safeplumbing.org
www.safeplumbing.org

Email Attachments

See pages 90 through 137.

PLUMBING MANUFACTURERS INTERNATIONAL

July 7, 2019

Stephanie Tanner
U.S. Environmental Protection Agency
Office of Wastewater Management (4204M)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
watersense-products@erg.com

RE: EPA WaterSense® Notice of Specification Review

Dear Ms. Tanner:

Plumbing Manufacturers International (PMI) appreciates the opportunity to provide additional comments regarding the EPA WaterSense® Notice of Specification Review issued in December 2018 inviting stakeholders to provide feedback on several WaterSense specifications - including those for tank-type toilets, lavatory faucets and faucet accessories, showerheads, and flushing urinals.

PMI is an international, U.S.-based trade association representing manufacturers that provide 90% of the plumbing products sold in the United States. We have made the promotion of water safety and efficiency a top priority and have included this in our mission statement[1]. PMI's members are industry leaders in producing safe, reliable and innovative water efficient plumbing technologies and have supported the U.S. EPA WaterSense® program since its inception. **In the U.S., plumbing manufacturers contribute $34.9 billion to the economy, provide more than 193,000 jobs (direct and indirect), and generate $10.4 billion in wages.**

As promised, I am submitting the recently completed report of PMI's "2019 U.S. WaterSense Market Penetration" study conducted by GMP Research Inc. for your consideration.

Within the report, it states that the 2019 market penetration for the following WaterSense-certified products being considered under the Notice of Specification Review are:

- Flushing urinals – 1.8%
- Tank-type residential toilets – 16.8%
- Bathroom sink faucets – 40.1%
- Showerheads – 45.4%

[1] PMI's Mission: To promote the water efficiency, health, safety, quality and environmental sustainability of plumbing products while maximizing consumer choice and value in a fair and open marketplace. To provide a forum for the exchange of information and industry education. To represent openly the members' interests and advocate for sound environmental and public health policies in the regulatory/legislative processes. To enhance the plumbing industry's growth and expansion.

Based on these percentages, along with the ongoing studies cited in our June 3rd letter (click here to view), PMI believes it is premature for EPA WaterSense to consider making any changes to the WaterSense specifications on the plumbing fixtures and fixture fittings noted above at this time.

PMI values our continued partnership with EPA WaterSense and welcomes further discussions on the topic of water conservation. If you have any questions regarding our comments, please do not hesitate to contact me.

Sincerely,

Matt Sigler
Technical Director
Plumbing Manufacturers International
Office 847-217-7212
msigler@safeplumbing.org

cc: PMI Board of Directors

PMI Members

*Bradley Corporation *BrassCraft Mfg. Co. *CSA Group *Delta Faucet Company *Dornbracht Americas *Duravit USA *Fisher Manufacturing Company *Fluidmaster, Inc. *Franke *Global OEM *Globe Union Group, Inc.*Hansgrohe, Inc. *Haws Corporation *IAPMO *InSinkErator *International Code Council Evaluation Service *KEROX *Kohler Co *Lavelle Industries, Inc. *LIXIL *Moen Incorporated *NEOPERL, Inc. *NSF International *Pfister *Reliance Worldwide Corporation *Similor AG *Sloan Valve Company *Speakman Company *Sprite *Symmons Industries, Inc. *T & S Brass and Bronze Works, Inc.*TOTO USA *Viega LLC *WaterPik *WCM Industries, Inc

2019 U.S. WaterSense Market Penetration

A GMP Research Industry Report
commissioned by Plumbing Manufacturers International (PMI)

Copyright and disclaimer notice

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Executive summary

This study was commissioned by Plumbing Manufacturers International (PMI) and is a follow on to the initial market penetration study completed on WaterSense market penetration in May 2015 to determine how the market has evolved.

Products captured in this study include tank-type residential toilets, bathroom sink faucets, showerheads, flushometer-valve toilets and flushing urinals.

In 2015 we identified WaterSense-certified tank-type toilets had a 7.0% market penetration. WaterSense-certified bathroom sink faucets had a 25.4% market penetration and WaterSense-certified showerheads had a 28.7% market penetration. Flushometer-valve toilets and flushing urinals were not part of the research scope in 2015.

WaterSense market penetration is defined by the total number of WaterSense-certified products installed divided by the total number of installed products of that specific product type:

total installed WaterSense products ÷ total installed products = WaterSense market penetration rate in %

According to this study, WaterSense-certified tank-type toilets have a 16.8% market penetration. WaterSense-certified bathroom sink faucets have a 40.1% market penetration, and WaterSense-certified showerheads have a 45.4% market penetration. Flushometer-valve toilets and flushing were introduced much later into the WaterSense program (flushing urinals in 2010 and flushometer-valve toilets in 2016) and consequently have low single digit market penetration rates.

The key driver for high WaterSense market penetration is the replacement market. Plumbing fixtures have very long replacement cycles. Residential tank-type toilets are replaced in average every 30 years. Flushometer-valve toilets and flushing urinals are replaced in average every 35.9 years. Homeowners and commercial property managers are sometimes reluctant to replace a product unless it is defective, or they are undergoing a major remodel of the bathroom.

According to the leading manufacturers of plumbing fixtures and fittings, the National Association of Home Builders (NAHB) and the International Association of Certified Home Inspectors (InterNACHI), bathroom sink faucets are replaced on average every 15 years, while showerheads are replaced every 12 years.

As bathroom sink faucets and showerheads are replaced more frequently, the market penetration of WaterSense products is higher than for plumbing fixtures such as tank-type toilets, flushometer-valve toilets or flushing urinals.

Within the next 15 years, most bathroom sink faucets and showerheads installed in the United States will be WaterSense-certified or meet the WaterSense program. Within the next 30 years, most residential tank-type toilets will be WaterSense-certified or meet the WaterSense program. Within the next 40 years, most flushometer-valve toilets and flushing urinals will be WaterSense-certified or meet the WaterSense program.

Mount Pleasant, June 2019

About Plumbing Manufacturers International (PMI)

Plumbing Manufacturers International (PMI) is the trade association of plumbing product manufacturers that produce more than 90 percent of the United States' plumbing products, represent more than 150 iconic brands, and develop safe, reliable and innovative water-efficient plumbing technologies. PMI members contribute more than 464,000 jobs and $85.5 billion in economic impact to America's economy.

With a vision of safe, responsible plumbing – always, PMI advocates for plumbing product performance contributing to water efficiency and savings, sustainability, public health and safety, consumer satisfaction, and a clean environment. PMI members manufacture water-efficient toilets, urinals, faucets, showerheads and other products at more than 70 locations across the country and market them online and in home improvement stores, hardware stores and showrooms in all 50 states. PMI member products include potable water supply system components, plumbing fixtures and fittings, flushing devices, sanitary drainage system components, and plumbing appliances.

PMI provides early warning notice on critical industry issues, serves as an educational forum for collecting and exchanging industry information, and works to enhance the plumbing manufacturing industry's growth and expansion. In addition, PMI serves as a coordinating and decision-making body for dealing with industry issues. PMI works closely with government agencies at all levels – federal, state and local – and is active in many industry arenas. PMI staff members sit on a variety of key industry committees, helping to develop and maintain codes and standards.

For more information on PMI, contact the organization at:
Plumbing Manufacturers International
1750 Tysons Blvd., Ste. 1500
McLean, Va., 22102
Phone: 847-481-5500
www.safeplumbing.org

About GMP Research

GMP Research is a global full service market research and consulting firm located in Mount Pleasant, SC. GMP Research provides leaders in manufacturing, distribution, commercial, public and social sectors with facts and insights on which to base management and policy decisions.

GMP Research combines the disciplines of economics and management, employing the analytical tools of economics with the insights of business leaders. Our "micro-to-macro" methodology examines forces affecting business strategy and public policy. GMP Research's in-depth industry reports have covered more than 50 countries and various industries related to both the commercial and residential construction markets.

GMP Research works with a network of affiliated partners throughout the world. Our clients are the leaders of their industry and are at the forefront of technology and design.

Our mission is to supply our clients with the best market intelligence. We go to great lengths to research the subject matter at hand, and then spend an equal amount of time validating the data, to ensure our clients are receiving the best possible market intelligence.

For more information on GMP Research Inc, contact the company at
GMP Research Inc.
2999 River Vista Way
Mount Pleasant, SC 29466
Phone: 843-884-9567
www.gmpresearch.com

Why do a market penetration study for WaterSense products?

Water is a finite resource – even though about 70 percent of the Earth's surface is covered by water, less than 1 percent is available for human use. Despite the water supply and infrastructure challenges faced by many communities across the U.S., each American uses an average of 88 gallons of water each day at home. Water managers in at least 40 states expect local, statewide, or regional water shortages to occur over the next several years.

The average family spends more than $1,000 per year in water costs but can save more than $380 annually from retrofitting with WaterSense-labeled fixtures and Energy Star-certified appliances.

A first study on WaterSense market penetration was completed in May 2015. For consistency purposes, we have used the same methodology to examine how the market has evolved.

What is WaterSense?

WaterSense is a voluntary partnership program sponsored by the U.S. Environmental Protection Agency (EPA). It is both a label for qualified water-efficient products and a resource to help homeowners and business owners save water.

The WaterSense label makes it easy to find water-efficient products, water-efficient homes and programs that meet the EPA's criteria for efficiency and performance. WaterSense products and services are certified to use at least 20 percent less water, save energy, and perform as well as or better than non-WaterSense products.

The WaterSense website states they partner with manufacturers, retailers, distributors, homebuilders, irrigation professionals and utilities to bring WaterSense products to the market.

The following comments were taken from the WaterSense website and give an understanding of the importance of the WaterSense program:

- Bathrooms are the largest use of water in the home, using more than 50 percent of all indoor water.
- Approximately 5 to 10 percent of U.S. homes have easy-to-fix leaks that drip away 90 gallons a day or more.
- Residential outdoor water usage across the U.S. accounts for nearly 9 billion gallons of water each day, mainly for landscape irrigation.
- On average, a urinal in a public place gets flushed 18 times per day.
- Heating water is typically the second largest use of energy in a home (after space heating and cooling).

What are the benefits of WaterSense?

According to WaterSense, the average family can save 13,000 gallons of water and $130 in water costs per year by replacing all old, inefficient toilets in their home with WaterSense-labeled models.

If all U.S. households replaced their inefficient toilets, this would represent water savings of approximately 520 billion gallons of water – roughly the amount of water that flows over Niagara Falls in about 12 days.

Replacing old, inefficient bathroom faucets and aerators with WaterSense-labeled models can save the average family $250 in water and electricity costs over the faucets' lifetime.

Replacing showerheads with WaterSense-labeled models can reduce the average family's water and electricity costs by $70 and can save the average family more than 2,700 gallons of water per year, equal to the amount of water needed to wash 88 loads of laundry.

Replacing inefficient flushometer-valve toilets and flushing urinals would result in water savings of more than $500 million annually.

The U.S. Census Bureau reports there are 137.4 million homes and 11.8 million commercial non-residential facilities in the United States. If every home and commercial non-residential facility were equipped with WaterSense products, we would see an annual water savings of $ 26.445 billion.

WaterSense action	Total annual savings in billion U.S. $
Replacing inefficient residential tank-type toilets	$19.236 billion
Replacing inefficient bathroom sink faucets	$ 1.300 billion
Replacing inefficient residential showerheads	$ 5.400 billion
Replacing inefficient flushing urinals and flushometer-valve toilets	$ 0.509 billion
Total annual savings	$26.445 billion

Source: U.S. Environmental Protection Agency, U.S. Census, GMP Research estimates

When was WaterSense launched? Which plumbing products are included?

WaterSense was launched in June 2006. Products included in the WaterSense program are residential toilets, bathroom faucets and accessories, showerheads, flushing urinals, flushometer-valve toilets and landscaping irrigation products.

Tank-type high efficiency toilets

WaterSense released its initial Tank-Type High-Efficiency Toilet Specification in January 2007 and issued the first revision to the specification in May 2011. Since that time, the American Society of Mechanical Engineers (ASME) and Canadian Standards Association (CSA) have revised ASME A112.19.2/CSA B45.1 Ceramic Plumbing Fixtures to include the waste media extraction test, fill valve integrity test, and tank trim adjustability test protocols established in the WaterSense Specification for Tank-Type Toilets.

The WaterSense specification establishes a maximum effective flush requiring 1.28 gallons per flush (GPF) or less for all residential toilets.

- Single flush toilets must use 1.28 GPF or less
- Dual flush toilets must have an effective flush volume that does not exceed 1.28 GPF which is the average flush volume of two reduced flushes and one full flush

Bathroom sink faucets and accessories

WaterSense-labeled bathroom sink faucets and accessories use a maximum of 1.5 gallons per minute. WaterSense-labeled bathroom sink faucets and accessories were introduced in 2007.

Showerheads

Water-saving showerheads that earn the WaterSense label must demonstrate that they use no more than 2.0 GPM. The WaterSense label also ensures that these products provide a satisfactory shower that is equal to or better than with conventional showerheads on the market. WaterSense-certified products were introduced in 2010.

Flushing urinals

WaterSense-labeled flushing urinals use no more than 0.5 GPF and comply with existing standards for flushing urinals. To ensure adequate performance, urinals must also be independently certified to ensure that they flush effectively and have properly functioning drain traps before they can earn the WaterSense label. WaterSense-certified urinals were introduced in 2010.

Flushometer-valve toilets

WaterSense-labeled flushometer-valve toilets, whether single- or dual-flush, use no more than 1.28 GPF, which is a 20 percent savings over the federal standard of 1.6 GPF. WaterSense has also included a minimum flush volume of 1.0 GPF to ensure plumbing systems have adequate flow to function effectively. WaterSense-certified flushometer-valve toilets were introduced in 2016.

A full list of WaterSense-labeled products can be found at https://www.epa.gov/watersense/product-search.

Research methodology

During the months of May and June 2019, GMP Research reviewed the penetration rate of residential and commercial WaterSense-certified products among the installed base of bathroom fixtures in homes and non-residential commercial properties in the United States.

According to the U.S. Census Bureau, there are 137.4 million existing homes and 11.8 million commercial non-residential facilities in the United States. We reviewed the number of homes by state and examined when they were constructed. For the commercial non-residential facilities, we examined the number of hotels and motels, office buildings, retail and wholesale operations, health care facilities, day care centers, schools, universities, churches and places of worship, public safety facilities, leisure and entertainment facilities, airports and other passenger terminals, communication facilities, and manufacturing facilities.

We reviewed OSHA regulations to determine the number of commercial toilets and urinals installed per commercial property.

To determine the number of installed residential tank-type toilets, bathroom sink faucets and showerheads, we first examined how many bathrooms the average U.S. home has. We reviewed the characteristics of new housing completed provided by the U.S. Census.

The Census Bureau provides data on homes with 1-1/2 baths or less, 2 baths, 2-1/2 baths and 3 baths or more. We supplemented this information by reviewing home descriptions of 1.135 million single family and 0.271 million multi-family homes currently for sale in all price ranges on Zillow.com and sorted the homes by the number of bathrooms (1, 1-1/2, 2, 3, 4, 5, 6 and 7 or more bathrooms).

In a next step, we reviewed home floorplans to determine the average number of toilets, bathroom sink faucets and showerheads per bathroom.

We reviewed when federal legislation was enacted, determining when low flow and WaterSense products became available. For each product examined, we reviewed the WaterSense accomplishment scorecard (https://www.epa.gov/sites/production/files/2018-06/documents/ws-aboutus-2017-accomplishments_0.pdf), which gave an indication of the number of certified products that were available in a given year.

We worked closely with John Koeller of Koeller & Company of Yorba Linda, CA, to review our assumptions and to ensure they were in line with general industry views. John Koeller is a registered professional engineer with extensive experience in water-efficient technologies and products. Widely recognized as a water efficiency specialist, Koeller is a consultant to numerous water providers, green-building organizations, and private-sector firms. He is co-developer of Maximum Performance (MaP) testing for toilet fixtures (www.map-testing.com).

We interviewed the leading suppliers of plumbing fixtures and fittings and reviewed the websites of various plumbing manufacturers, wholesalers and retailers to determine the level of WaterSense-certified products available for purchase.

PMI provided us with a summary of current U.S. Plumbing Provisions by state/municipality. This list highlighted the effective date when these plumbing provisions went into effect and which products were covered. We used this information to determine when WaterSense products were required in these municipalities/states and to calculate the market penetration in these areas.

Every year GMP Research publishes the U.S. Kitchen + Bath Industry report. This is a detailed industry report card on the kitchen + bath industry, which provides market information by plumbing fixture and fitting. We referred to these studies to determine how many of the tank-type toilets, bathroom sink faucets, showerheads, flushometer-valve toilets and flushing urinals were sold during the investigation period.

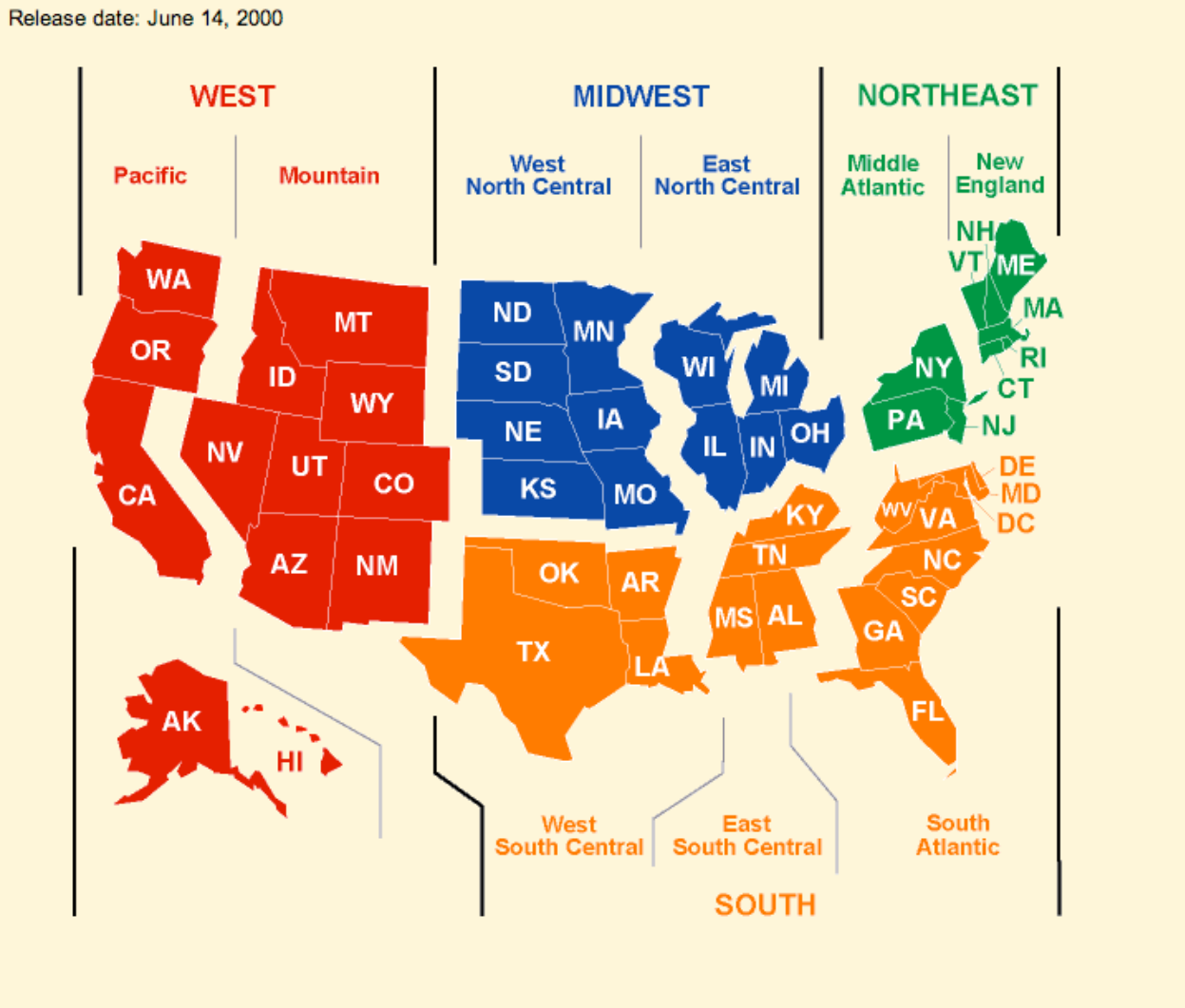
This led to a detailed assessment of the market penetration of WaterSense-certified products installed in each of the 50 U.S. states and cumulatively in the United States. While the study is based on certain product life expectancy assumptions, GMP Research interviewed several of the leading plumbing fixture and fittings manufacturers, and reviewed guidelines published by the National Association of Home Builders and International Association of Certified Home Inspectors (InterNACHI) to get as accurate a read as possible of the type of plumbing fixtures and fittings that are installed in the United States.

It is important to note that we define WaterSense market penetration as a percentage of all installed products.

- The market penetration rate of WaterSense tank-type high efficiency toilets is therefore the number of WaterSense-certified tank-type toilets installed divided by the total number of tank-type residential toilets in the United States (regardless of flushing criteria).
- The market penetration rate of WaterSense bathroom sink faucets is the number of WaterSense-certified bathroom sink faucets installed divided by the total number of installed bathroom sink faucets.
- The market penetration rate of WaterSense showerheads is the number of WaterSense-certified showerheads installed divided by the total number of installed showerheads.
- The market penetration rate of WaterSense flushometer-valve toilets is the number of WaterSense-certified flushometer-valve toilets installed divided by the total number of installed flushometer-valve toilets.
- The market penetration rate of WaterSense flushing urinals is the number of WaterSense-certified flushing urinals installed divided by the total number of installed urinals.

U.S. Census regions

The U.S. Census Bureau segments the country into nine U.S. Census regions. We followed this approach to determine the regional market penetration of WaterSense products:



Source: U.S. Census Bureau

Residential WaterSense products

To determine the market penetration of residential WaterSense products, we first need to determine the installed base of the target residential products. This is achieved by examining the number of existing homes in the United States. Next, we need to determine how many bathrooms per home exist to identify the number of toilets, bathroom sink faucets and showerheads per bathroom are installed.

a) The U.S. Census provides information on the characteristics of homes completed from 1973 to present for both single family and multi-family homes. Based on the U.S. Census data, we completed an analysis of the number of bathrooms per completed home for every year from 1973 to present.

   For single family homes, census data was available for 1-1/2 or less bathrooms, 2 bathrooms, 2-1/2 bathrooms and 3 bathrooms or more. For multi-family homes, Census data was available for 1 bathroom, 1-1/2 bathrooms and 2 or more bathrooms.

   To get a finer estimate of the number of bathrooms per home, we examined the characteristics of 1.135 million single family homes and 0.271 million multi-family homes in all nine U.S. Census regions currently for sale by number of bathrooms, number of rooms and price point. We used this information to fine tune the 1 and 1-1/2 bathroom category and the 3+ bathroom category for single family homes and for 2+ bathrooms for multi-family homes.

b) In a third step, we calculated the number of toilets, bathroom sink faucets and showerheads per single family and multi-family homes to arrive at the total installed base of products in the U.S.

c) U.S. Census provided housing starts per state by housing type from 1939 to present.

d) For residential tank-type toilets, we assumed a replacement cycle of 30 years. For bathroom sink faucets we assumed a replacement cycle of 15 years. For showerheads we assumed a replacement cycle of 12 years. This is based on data from the NAHB/Bank of America Study of Life Expectancy of Home Components, InterNACHI's standard estimated life expectancy for homes and input from manufacturers.

a) Existing homes in the U.S. by number of bathrooms per home

	Existing homes with one bathroom	Existing homes with 1-1/2 bathrooms	Existing homes with two or 2-1/2 bathrooms	Existing homes with three bathrooms	Existing homes with four bathrooms	Existing homes with five bathrooms	Existing homes with six bathrooms	Existing homes with more than 6 bathrooms	Average
Single family homes	27.1%	11.8%	35.0%	5.9%	6.3%	5.8%	4.6%	3.5%	2.5 bathroom per home
Multi-family homes	47.0%	10.1%	9.5%	9.4%	9.2%	8.2%	3.8%	2.8%	2.3 bathrooms per home

Source: U.S. Census Bureau Characteristics of New Homes Completed 1973-present, GMP Research analysis of 1.135 million and 0.271 million multi-family homes currently for sale in the United States, 2019 U.S. Kitchen + Bath Industry Report, 2018 GMP Research study on the RV and mobile home market

b) Average number of toilets, bathroom sink faucets and showerheads per bathroom

	Average number of toilets per bathroom	Average number of sink faucets per bathroom	Average number of showerheads per bathroom
Products per bathroom	1.0	1.46	0.93

Source: U.S. Census Bureau Characteristics of New Homes Completed 1973-present, GMP Research analysis of 1.135 million single family and 0.271 million multi-family homes currently for sale in the United States, 2019 U.S. Kitchen + Bath Industry Report, 2018 GMP Research study on the RV and mobile home market

c) Total existing homes, bathrooms, installed toilets, bathroom sink faucets and showerheads

	Total number of existing homes	Number of bathrooms	Number of installed toilets	Number of installed bathroom sink faucets	Number of installed showerheads
	Million units	Million units	Million units	Million units	Million units
Single family homes	92.790	231.975	231.975	338.684	215.737
Multi-family homes	44.617	102.619	102.619	149.824	95.436
Total installed base	137.407	334.594	334.594	488.508	311.173

Source: U.S. Census Bureau Characteristics of New Homes Completed 1973-present, GMP Research analysis of 1.135 million and 0.271 million multi-family homes currently for sale in the United States, 2019 U.S. Kitchen + Bath Industry Report, 2018 GMP Research study on the RV and mobile home market

d) 2019 U.S. existing home inventory by type of home, U.S. Census region and by state

Census region	State	Total existing homes	 Single Family	 Duplex	 3 or 4 units	 5 to 9 units	 10 to 19 units	 20 or more units	 Mobile home	 Boat, RV, Van
USA	USA	137,407,308	92,789,782	4,914,617	5,990,555	6,424,836	6,065,580	12,593,793	8,500,432	127,713
New England	CT	1,517,495	983,758	119,504	132,115	80,228	52,840	137,718	11,234	98
	MA	2,894,590	1,660,911	287,664	315,792	168,362	120,201	316,227	24,452	981
	ME	742,644	542,841	32,540	40,354	26,866	11,598	26,704	61,456	285
	NH	634,689	442,805	33,034	36,650	28,110	17,695	44,853	31,123	419
	RI	468,266	272,371	54,576	56,054	21,729	18,432	39,961	4,905	238
	VT	335,248	232,849	21,447	19,952	17,496	6,538	13,981	22,664	321
Middle Atlantic	NJ	3,615,891	2,286,170	338,282	238,440	168,054	168,772	383,252	32,601	320
	NY	8,327,621	3,917,640	848,967	574,232	430,141	351,697	2,009,212	193,493	2,239
	PA	5,694,402	4,303,251	248,439	225,305	180,953	147,157	358,682	228,843	1,772
South Atlantic	DC	314,843	116,774	9,412	19,932	22,674	26,974	118,528	485	64
	DE	432,853	321,466	7,605	9,450	16,309	26,927	19,603	31,086	407
	FL	9,441,585	5,728,688	197,887	374,130	460,321	534,477	1,291,572	841,439	13,071
	GA	4,282,254	3,021,894	91,124	127,997	198,552	190,908	272,298	376,636	2,845
	MD	2,449,123	1,781,539	35,560	51,684	130,110	192,247	220,923	36,318	742
	NC	4,622,656	3,220,365	92,756	130,588	188,327	191,787	207,588	587,857	3,388
	SC	2,284,820	1,497,253	43,463	70,377	96,995	75,961	122,507	375,996	2,268
	VA	3,512,917	2,549,764	53,602	95,855	170,365	198,295	262,067	181,909	1,060
	WV	892,240	646,833	19,699	26,410	25,517	14,678	24,427	134,178	498
East South Central	AL	2,258,669	1,565,024	51,442	67,368	97,107	78,662	90,580	305,749	2,737
	KY	1,984,235	1,383,423	66,135	87,231	83,807	65,932	64,115	231,981	1,611
	MS	1,323,754	921,423	32,196	39,698	52,464	34,988	32,060	209,273	1,652
	TN	2,958,799	2,109,694	81,170	95,049	141,497	120,188	135,829	272,708	2,664
West South Central	AR	1,370,109	977,060	40,078	45,766	48,876	53,308	35,708	167,714	1,599
	LA	2,061,582	1,400,672	85,737	84,349	65,886	57,253	94,150	271,171	2,364
	OK	1,734,074	1,293,394	33,753	45,371	66,271	60,510	66,093	165,848	2,834
	TX	10,933,375	7,394,305	206,625	348,816	519,410	689,692	959,301	795,075	20,151
East North Central	IL	5,359,416	3,463,847	302,686	347,719	338,175	200,939	572,846	131,258	1,946
	IN	2,885,342	2,215,331	73,367	99,374	128,198	104,851	126,752	136,756	713
	MI	4,595,274	3,536,356	107,770	118,485	196,420	159,995	236,214	238,789	1,245
	OH	5,201,701	3,798,575	220,911	229,039	245,072	208,027	297,891	200,183	2,003
	WI	2,695,303	1,905,393	169,684	103,038	131,333	95,580	198,445	90,931	899
West North Central	IA	1,397,739	1,087,859	31,487	45,907	48,117	53,936	79,499	50,464	470
	KS	1,273,776	986,121	32,095	46,613	48,115	44,136	61,014	55,117	565
	MN	2,437,726	1,812,073	49,496	52,937	55,051	87,233	300,890	79,269	777
	MO	2,792,445	2,060,417	94,730	129,174	102,717	100,843	132,051	169,846	2,667
	ND	374,591	233,619	8,479	14,168	12,934	22,447	55,564	27,234	146
	NE	837,540	641,008	15,989	23,176	36,108	36,827	58,170	26,010	252
	SD	392,650	277,941	7,996	14,128	16,224	17,571	25,889	32,717	184
Mountain	AZ	2,999,185	2,085,747	39,482	98,192	121,005	130,585	210,979	300,378	12,817
	CO	2,385,495	1,671,624	42,249	73,355	111,073	132,664	258,111	94,905	1,514
	ID	721,818	559,580	14,993	30,957	18,485	15,151	28,190	53,556	906
	MT	510,408	375,062	14,132	21,386	16,036	11,130	17,092	54,696	874
	NM	937,976	629,008	17,641	36,862	27,601	23,044	37,827	163,897	2,096
	NV	1,249,733	806,457	14,674	80,171	108,726	62,385	112,210	63,237	1,873
	UT	1,084,685	808,706	29,814	50,477	38,457	44,083	75,530	36,944	674
	WY	276,733	196,004	6,724	11,115	10,050	6,765	7,173	38,674	228
Pacific	AK	316,968	223,887	17,076	22,198	13,478	9,002	15,917	14,685	725
	CA	14,177,270	9,210,270	342,567	770,463	844,841	735,724	1,738,818	519,658	14,929
	HI	542,955	336,324	10,568	21,532	36,860	29,323	106,799	1,099	450
	OR	1,768,582	1,211,751	46,578	77,305	75,894	66,943	149,903	135,265	4,943
	WA	3,103,263	2,084,655	70,732	113,819	137,439	158,679	342,080	188,670	7,189

Source: U.S. Census Bureau

Total installed residential plumbing products by state and region

U.S. Census Region	State	Total existing homes	 Existing single family homes	 Existing multi-family homes	 Total existing bathrooms	 Total installed residential toilets	 Total installed bathroom sink faucets	 Total installed showerheads
USA	USA	137,407,308	92,789,782	44,617,526	334,594,765	334,576,763	488,508,357	311,173,131
New England	CT	1,517,495	983,758	533,737	3,686,990	3,686,623	5,383,006	3,428,901
	MA	2,894,590	1,660,911	1,233,679	6,989,739	6,989,043	10,205,019	6,500,457
	ME	742,644	542,841	199,803	1,816,649	1,816,468	2,652,308	1,689,484
	NH	634,689	442,805	191,884	1,548,346	1,548,192	2,260,585	1,439,962
	RI	468,266	272,371	195,895	1,131,486	1,131,373	1,651,970	1,052,282
	VT	335,248	232,849	102,399	817,640	817,559	1,193,755	760,405
Middle Atlantic	NJ	3,615,891	2,286,170	1,329,721	8,773,783	8,772,946	12,809,724	8,159,618
	NY	8,327,621	3,917,640	4,409,981	19,937,056	19,935,156	29,108,102	18,541,462
	PA	5,694,402	4,303,251	1,391,151	13,957,775	13,956,444	20,378,351	12,980,731
South Atlantic	DC	314,843	116,774	198,069	747,494	747,404	1,091,341	695,169
	DE	432,853	321,466	111,387	1,059,855	1,059,766	1,547,388	985,665
	FL	9,441,585	5,728,688	3,712,897	22,861,383	22,859,451	33,377,619	21,261,086
	GA	4,282,254	3,021,894	1,260,360	10,453,563	10,452,680	15,262,202	9,721,814
	MD	2,449,123	1,781,539	667,584	5,989,291	5,988,785	8,744,364	5,570,040
	NC	4,622,656	3,220,365	1,402,291	11,276,182	11,275,229	16,463,225	10,486,849
	SC	2,284,820	1,497,253	787,567	5,554,537	5,554,067	8,109,623	5,165,719
	VA	3,512,917	2,549,764	963,153	8,589,662	8,588,936	12,540,906	7,988,386
	WV	892,240	646,833	245,407	2,181,519	2,181,334	3,185,017	2,028,812
East South Central	AL	2,258,669	1,565,024	693,645	5,507,944	5,507,785	8,041,598	5,122,387
	KY	1,984,235	1,383,423	600,812	4,840,425	4,840,286	7,067,021	4,501,595
	MS	1,323,754	921,423	402,331	3,228,919	3,228,826	4,714,221	3,002,894
	TN	2,958,799	2,109,694	849,105	7,227,177	7,226,969	10,551,678	6,721,274
West South Central	AR	1,370,109	977,060	393,049	3,346,663	3,346,570	4,886,128	3,112,396
	LA	2,061,582	1,400,672	660,910	5,021,773	5,021,634	7,331,789	4,670,249
	OK	1,734,074	1,293,394	440,680	4,247,049	4,246,931	6,200,692	3,949,756
	TX	10,933,375	7,394,305	3,539,070	26,625,624	26,624,887	38,873,410	24,761,830
East North Central	IL	5,359,416	3,463,847	1,895,569	13,019,426	13,018,986	19,008,362	12,108,066
	IN	2,885,342	2,215,331	670,011	7,079,353	7,079,114	10,335,855	6,583,798
	MI	4,595,274	3,536,356	1,058,918	11,276,401	11,276,020	16,463,546	10,487,053
	OH	5,201,701	3,798,575	1,403,126	12,723,627	12,723,197	18,576,496	11,832,973
	WI	2,695,303	1,905,393	789,910	6,580,276	6,580,054	9,607,202	6,119,656
West North Central	IA	1,397,739	1,087,859	309,880	3,432,372	3,432,268	5,011,262	3,192,105
	KS	1,273,776	986,121	287,655	3,126,909	3,126,815	4,565,287	2,908,025
	MN	2,437,726	1,812,073	625,653	5,969,184	5,969,004	8,715,009	5,551,341
	MO	2,792,445	2,060,417	732,028	6,834,707	6,834,500	9,978,672	6,356,277
	ND	374,591	233,619	140,972	908,283	908,256	1,326,093	844,703
	NE	837,540	641,008	196,532	2,054,544	2,054,482	2,999,634	1,910,726
	SD	392,650	277,941	114,709	958,683	958,654	1,399,677	891,575
Mountain	AZ	2,999,185	2,085,747	913,438	7,315,275	7,315,087	10,680,301	6,803,206
	CO	2,385,495	1,671,624	713,871	5,820,963	5,820,814	8,498,606	5,413,496
	ID	721,818	559,580	162,238	1,772,097	1,772,052	2,587,262	1,648,051
	MT	510,408	375,062	135,346	1,248,951	1,248,919	1,823,468	1,161,524
	NM	937,976	629,008	308,968	2,283,146	2,283,087	3,333,394	2,123,326
	NV	1,249,733	806,457	443,276	3,035,677	3,035,600	4,432,089	2,823,180
	UT	1,084,685	808,706	275,979	2,656,517	2,656,448	3,878,514	2,470,561
	WY	276,733	196,004	80,729	675,687	675,670	986,503	628,389
Pacific	AK	316,968	223,887	93,081	773,804	773,776	1,129,754	719,638
	CA	14,177,270	9,210,270	4,967,000	34,449,775	34,448,513	50,296,672	32,038,291
	HI	542,955	336,324	206,631	1,316,061	1,316,012	1,921,449	1,223,937
	OR	1,768,582	1,211,751	556,831	4,310,089	4,309,931	6,292,730	4,008,383
	WA	3,103,263	2,084,655	1,018,608	7,554,436	7,554,160	11,029,476	7,025,625

Source: U.S. Census Bureau + GMP Research field input

Estimated replacement cycles for tank-type toilets, bathroom sink faucets and showerheads

Source: NAHB/Bank of America Study of Life Expectancy of Home Components, InterNACHI's standard estimated life expectancy for homes and from input from manufacturers of toilets, faucets and showerheads, Koeller & Company, GMP Research interviews with leading plumbing manufacturers.

To determine the average replacement cycle of the examined plumbing fixtures and fittings, we spoke with the manufacturers of the products and reviewed product replacement studies completed by the National Association of Home Builders (NAHB) and the International Association of Certified Home Inspectors (InterNACHI):

- A residential tank-type toilet has an average life expectancy of 30 years
- Bathroom sink faucets have an average life expectancy of 15 years
- Showerheads have an average life expectancy of 12 years

By 2018, the homeowner of a house built in 1939 will have experienced two replacement cycles for the toilets based on the life expectancy of the product (1st replacement in 1969; 2nd replacement in 1999).

The same homeowner would have experienced five replacement cycles for the bathroom sink faucets (1954, 1969, 1984, 1999, and 2014).

The homeowner would have experienced six replacement cycles for the showerheads (1951, 1963, 1975, 1987,1999, and 2011).

Note: Several of the utilities offering rebates for water conserving toilets refer to a 25 year replacement cycle for residential tank-type toilets. In the 2015 market penetration study, based on input from the leading manufacturers, we used a 30 year replacement cycle for residential tank-type toilets. For consistency purposes, and to better evaluate how the market has evolved, we have chosen to use a 30-year replacement cycle for tank-type toilets. If a 25 year replacement cycle were used, this would marginally increase the market penetration of WaterSense products.

Determining the market penetration of WaterSense products

According to the EPA WaterSense website, WaterSense-labeled tank-type residential toilets and bathroom sink faucets were introduced to the market in 2007. WaterSense-labeled showerheads were introduced in 2010.

Tank-type residential toilets

Toilets are by far the main source of water use in the home, accounting for nearly 30 percent of an average home's indoor water consumption.

Recent advancements have allowed toilets to use 1.28 gallons per flush or less while still providing equal or superior performance. This is 20 percent less water than the current federal standard of 1.6 gallons per flush. The WaterSense label is used on toilets that are independently certified to meet rigorous criteria for both performance and efficiency. Only water-saving toilets that complete the certification process can earn the WaterSense label.

GMP Research estimates there are currently 334.577 million residential toilets installed in the 137.407 million homes in the United States, assuming there is one toilet installed in every residential bathroom.

During the period of 2007-2018, a total of 118.126 million toilets were sold, or roughly 10.1 million toilets per year. These toilets are sold into the new residential construction market, hospitality (hotel/motel) market, and to homeowners who are replacing older toilets in their homes.

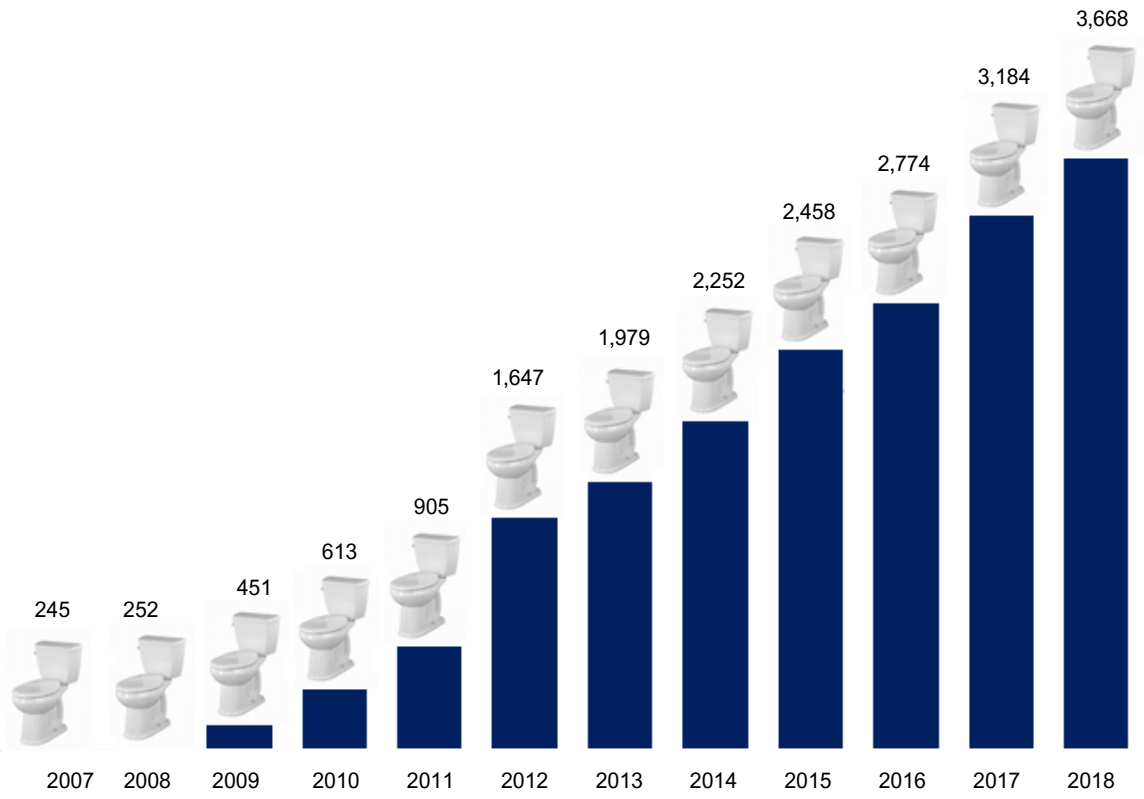
Toilets used in guest rooms of hotels are considered residential toilets and are included in these calculations. Toilets used in public restrooms are considered commercial toilets and are not included in these market estimates.

Availability of WaterSense-certified toilets

Based on information from the U.S. Environmental Protection Agency, from John Koeller & Company, from Gauley Associates, and from the manufacturers of residential toilets, we see the following availability of certified WaterSense toilets since inception of the WaterSense program.

The leading suppliers of residential tank-type toilets indicated that in 2007 roughly 25% of the toilets for sale were WaterSense-certified. At the end of 2018, roughly 75% of the tank-type toilets offered for sale were WaterSense-certified (76.8%). A list of the WaterSense-certified tank-type toilets can be found at https://www.epa.gov/watersense/product-search.

Number of certified WaterSense toilet models available for purchase



Source: https://www.epa.gov/watersense/accomplishments-and-history

Assumptions to determine the market penetration of WaterSense-certified tank-type toilets

- There is one toilet installed per residential bathroom
- Residential tank-type toilets are replaced every 30 years
- All toilets installed prior to 1992 used 3.5 gallons or more per flush. Toilets installed from 1992 to 2007 used 1.6 gallons per flush. By January 1, 1994, all replacement residential toilets installed needed to comply with the energy Policy Act of 1992. By January 1, 1997, all newly installed commercial toilets needed to comply with the Energy Policy Act.
- WaterSense-certified toilets were introduced to the marketplace in 2007. In 2007, 25% of the toilets offered for sale were WaterSense-certified or met the WaterSense specification. In 2018, 76.8% of the toilets offered for sale were WaterSense-certified or met the WaterSense specification.
- Municipalities/states requiring toilets of 1.28 gpf or less are listed below:

State/County/Municipality	Effective date	Maximum allowed flushing performance in gallons per flush	Applies to new construction only	Applies to new construction and replacement
Miami-Dade County, FL	1/1/2009	1.28 gpf	•	
State of Georgia	7/1/2012	1.28 gpf		•
Broward County, FL	6/1/2012	1.28 gpf	•	
New York City, NY	7/1/2012	1.28 gpf		•
State of Texas	1/1/2014	1.28 gpf		•
Greater Chicago, IL	11/18/2014	1.28 gpf	•	
Washington, DC	3/28/2014	1.28 gpf	•	
State of California	1/1/2014	1.28 gpf		•
State of Colorado	9/1/2016	1.28 gpf		•
Scottsdale, AZ	1/1/2017	1.28 gpf	•	
State of Oregon	10/1/2017	1.28 gpf	•	
State of New York – except NYC	10/31/2017	1.3 gpf	•	

Source: PMI summary of current U.S. Plumbing Provisions

WaterSense-certified tank-type toilet market penetration

According to our research, there are 334.577 million residential toilets installed in the United States. During 2007-2018, a total of 118.126 million tank-type toilets were sold and installed in homes throughout the United States. Based on our research, 56.212 million WaterSense toilets or those which met the WaterSense specification of not flushing more than 1.28 gallons per flush were sold. This represents 16.8% of all residential toilet installations.

Maximum flushing performance	Million installed residential tank-type toilets	% of total
1.28 gpf or less	56.212	16.8%
1.6 gpf	216.137	64.6%
3.5 gpf	52.893	15.8%
5.0 gpf or more	9.335	2.8%
Million installed residential tank-type toilets	334.577	100.0%

Source: U.S. Census + GMP Research field interviews + PMI summary of current U.S. plumbing provisions

U.S. Census Region	State	Total number of toilets installed in all homes	Total WaterSense toilets installed	WaterSense market penetration	1.6 gpf in % of total	in % of total
USA	USA	334,773,222	56,212,198	16.8%	65.5%	17.7%
New England	CT	3,700,911	573,388	15.5%	68.0%	16.5%
	MA	7,049,856	920,293	13.1%	75.3%	11.6%
	ME	1,824,379	240,678	13.2%	69.0%	17.8%
	NH	1,553,166	254,652	16.4%	59.8%	23.8%
	RI	1,143,837	147,719	12.9%	68.5%	18.6%
	VT	819,797	107,369	13.1%	69.0%	17.9%
Middle Atlantic	NJ	8,800,251	1,430,861	16.3%	64.5%	19.2%
	NY[1]	20,190,580	3,412,900	16.9%	64.5%	18.6%
	PA	13,922,069	1,858,144	13.3%	68.5%	18.2%
South Atlantic	DC[2]	754,981	110,906	14.7%	65.6%	19.7%
	DE	1,061,712	179,839	16.9%	66.1%	17.0%
	FL[3]	22,879,484	4,067,787	17.8%	63.5%	18.7%
	GA[4]	10,471,896	2,565,135	24.5%	57.0%	18.5%
	MD	5,984,197	944,112	15.8%	68.0%	16.2%
	NC	11,312,937	1,793,494	15.9%	67.0%	17.1%
	SC	5,602,712	909,938	16.2%	68.7%	15.1%
	VA	8,595,719	1,378,147	16.0%	66.8%	17.2%
	WV	2,182,412	286,478	13.1%	67.0%	19.9%
East South Central	AL	5,516,352	813,836	14.8%	64.8%	20.4%
	KY	4,837,302	663,756	13.7%	66.2%	20.1%
	MS	3,235,295	444,824	13.7%	66.7%	19.6%
	TN	7,218,671	1,120,737	15.5%	64.0%	20.5%
West South Central	AR	3,337,407	477,601	14.3%	67.0%	18.7%
	LA	5,036,969	764,690	15.2%	64.7%	20.1%
	OK	4,232,638	636,309	15.0%	64.4%	20.6%
	TX[5]	26,522,714	6,840,050	25.8%	55.0%	19.2%
East North Central	IL[6]	13,038,956	1,702,057	13.1%	68.0%	18.9%
	IN	7,049,271	907,545	12.9%	67.6%	19.5%
	MI	11,232,329	1,565,477	13.9%	66.5%	19.6%
	OH	12,672,646	1,650,419	13.0%	68.4%	18.6%
	WI	6,653,833	781,988	11.8%	69.0%	19.2%
West North Central	IA	3,407,892	406,973	11.9%	68.5%	19.6%
	KS	3,103,341	450,515	14.5%	66.0%	19.5%
	MN	5,947,901	855,702	14.4%	66.0%	19.6%
	MO	6,810,447	946,240	13.9%	66.2%	19.9%
	ND	904,764	154,395	17.1%	62.0%	20.9%
	NE	2,043,721	260,763	12.8%	68.1%	19.1%
	SD	956,147	135,268	14.1%	66.1%	19.8%
Mountain	AZ[7]	7,335,651	1,222,328	16.7%	64.1%	19.2%
	CO[8]	5,812,107	1,116,440	19.2%	62.0%	18.8%
	ID	1,772,191	261,527	14.8%	65.6%	19.6%
	MT	1,240,092	183,019	14.8%	65.0%	20.2%
	NV	3,043,633	371,557	12.2%	68.2%	19.6%
	NM	2,299,329	448,158	19.5%	57.1%	23.4%
	UT	2,653,861	438,544	16.5%	63.4%	20.1%
	WY	677,699	100,866	14.9%	61.5%	23.6%
Pacific	AK	765,908	127,109	16.6%	62.5%	20.9%
	CA[9]	34,403,742	7,212,207	21.0%	62.1%	16.9%
	HI	1,311,809	192,952	14.7%	66.1%	19.2%
	OR[10]	4,303,036	612,085	14.2%	66.8%	19.0%
	WA	7,544,672	1,164,421	15.4%	64.5%	20.1%

Notes	State / county	Effective	Construction application
1	New York New York City	10/31/2017 7/1/2012	New construction All sales
2	Washington DC	3/28/2014	New construction
3	Miami-Dade, FL Broward County, FL	1/1/2009 6/1/2012	New construction New construction
4	Georgia	7/1/2012	All sales
5	Texas	1/1/2014	All sales

Notes	State/county	Effective	Construction application
6	Chicago, IL	11/18/2014	New construction
7	Scottsdale, AZ	1/1/2017	New construction
8	Colorado	9/1/2016	All sales
9	California	1/1/2014	All sales
10	Oregon	10/1/2017	New construction

Observations concerning WaterSense tank-type toilet market penetration

WaterSense was introduced to the marketplace in June 2006. The first series of products were introduced in 2007.

By August 2006, the construction boom had noticeably cooled in all regions of the United States. At the end of 2006, more than 1.25 million homes were in foreclosure. One in 92 homes in the United States were in some stage of foreclosure.

Realtytrac.com – a wholly owned subsidiary of Attom Data Solutions LLC - is the leading authority on reporting foreclosure market information in the United States. In February 2007, more than 25 sub-prime lenders declared bankruptcy or put themselves up for sale. By August 2007, many mortgage lenders stopped offering home equity loans. By the end of 2007, a total of 2.2 million foreclosures were filed on 1.3 million properties, with more than 1% of all households in the U.S. in some stage of foreclosure.

The National Association of Realtors announced 2007 had the largest drop in existing home sales over the last 25 years. According to senior research economists, the collapse of the subprime mortgage market set in motion a chain reaction of economic and financial adversity and created depression-like conditions in the housing market.

Dropping valuations of mortgage backed securities caused by the skyrocketing default and foreclosure rates forced margin calls by the largest Wall Street banks. Rumors of major bank failings caused worldwide fear of a total financial collapse.

The Great Recession began in December 2007 and lasted until June 2009, making it the longest recession since World War II. According to senior economic and policy advisors of the Federal Reserve Bank, real gross domestic product (GDP) fell 4.3 percent from its peak in Q4 2007 to its trough in Q2 2009. The U.S. Bureau of Labor Statistics reported the unemployment rate, which was 5 percent in December 2007, rose to 9.5 percent in June 2009, and peaked at 10 percent in October 2009.

According to data from the U.S. Census Bureau, home prices fell approximately 30 percent, on average, from their mid-2006 peak to mid-2009. The Federal Reserve Bank indicated the S&P 500 index fell 57 percent from its October 2007 peak to its trough in March 2009. The net worth of U.S. households and nonprofit organizations fell from a peak of approximately $69 trillion in 2007 to a trough of $55 trillion in 2009.

Because of the financial turmoil impacting everything, homeowners were putting off the purchases of new homes and delaying any type of remodeling project, unless it was essential. In addition, consumers were cautious about the new high efficiency toilets, and did not believe these products would perform as proclaimed by the manufacturers.

As a result of these extraneous effects, our research indicates WaterSense products gained little initial traction in the marketplace. By the end of 2014, our analysis indicated 7% of the installed tank-type toilets were WaterSense-certified or complied with the WaterSense specification.

At that time, we wrote WaterSense market penetration will increase over time, as new construction continues to expand, and more homeowners were again investing in remodeling activities.

At the end of 2014, the manufacturers of tank-type toilets indicated 30% of toilets offered for sale were WaterSense-certified or met the WaterSense specification. By the end of 2018 they indicated 76.8% of the toilets offered for sale were WaterSense-certified.

Over the last 10 years, both new residential construction and residential remodeling expenditures have been expanding year over year. By 2018 remodeling accounted for 80% of all tank-type toilets while 20% were sold into new residential and light commercial construction.

Based on the proven performance of the new 1.28 gpf toilets, builders and consumers have embraced the technology. With over 3,668 models of WaterSense-certified toilets to choose from, the market penetration of these toilets was inevitably going to increase.

WaterSense-certified tank-type toilets will continue to gain market share over an extended period. With an average replacement cycle of 30 years, we can safely project WaterSense tank-type toilets will have a significant market share within the next 30 years.

Focus needs to be on motivating the homeowners to swap out their existing toilets. Consumers are reluctant to replace toilets. They perceive it as a cumbersome and messy task, that requires the services of a plumber. They are only interested in replacing a toilet if it is broken or is not working properly or because they do not like the style of the toilet.

Bathroom sink faucets

WaterSense-labeled bathroom sink faucets and accessories that use a maximum of 1.5 gallons per minute can reduce a sink's water flow by 30 percent or more from the standard flow of 2.2 gallons per minute without sacrificing performance. We could save billions of gallons nationwide each year by retrofitting bathroom sink faucets with models that have earned the WaterSense label.

All products bearing the WaterSense label complete an independent certification process to ensure they meet EPA criteria. Bathroom sink faucets and faucet accessories—products that can be attached easily to existing bathroom sink faucets to save water—that obtain the WaterSense label have demonstrated both water efficiency and the ability to provide ample flow.

According to the WaterSense website, replacing old, inefficient bathroom sink faucets and aerators with WaterSense-labeled models can save the average family 700 gallons of water per year, equal to the amount of water needed to take 40 showers. As these water savings reduce demands on water heaters, households will also save enough energy to run a hairdryer 10 minutes a day for a year.

GMP Research estimates there are 488.508 million residential bathroom sink faucets installed in the United States, assuming there are 1.46 bathroom sink faucets per residential bathroom. In addition to the existing stock, approximately 22 million new bathroom sink faucets are sold every year into the new residential and light commercial construction market and to homeowners who are replacing existing older bathroom sink faucets.

Bathroom sink faucets sold into the guest rooms of hotels are considered residential faucets and are included in these calculations. Faucets used in public restrooms are considered commercial faucets and are excluded from this exercise.

All bathroom sink faucets installed prior to 1992 had flow rates in excess of 2.2 gallons per minute (gpm). All bathroom sink faucets installed from 1992-2006 had flow rates of 2.2 gallons per minute, as stipulated by the Energy Policy Act of 1992.

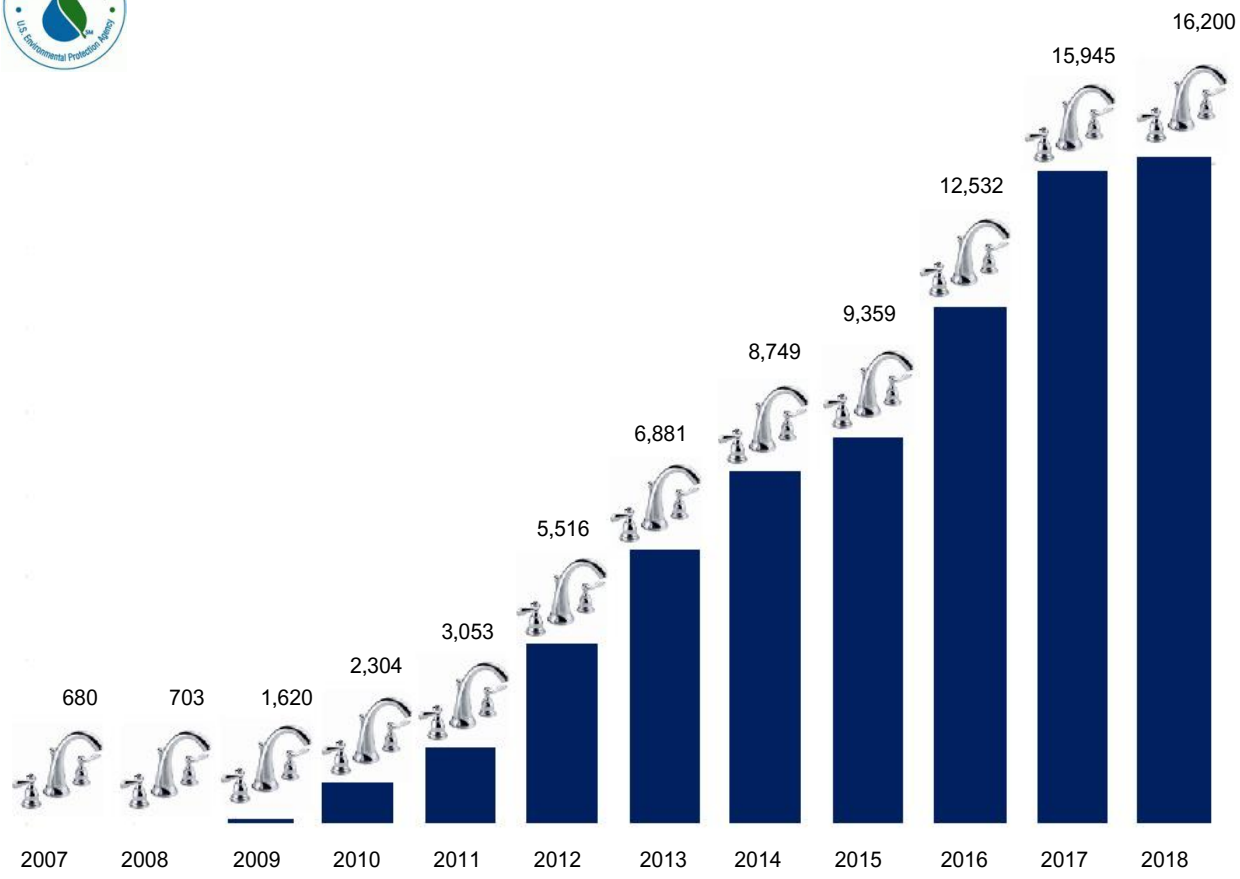
WaterSense bathroom sink faucets were introduced to the marketplace in 2007. From 2007-2018, a total of 242.5 million bathroom sink faucets were sold in the United States. Of these 242.5 million bathroom sink faucets, 195.672 million were WaterSense-certified or met the WaterSense specification.

Availability of WaterSense-certified bathroom sink faucets

Based on information from the U.S. Environmental Protection Agency, and from the manufacturers of bathroom sink faucets, the following illustrates the availability of certified WaterSense bathroom sink faucets since inception of the WaterSense program.

In 2015, the manufacturers indicated 98% of the bathroom sink faucets were either WaterSense-certified or met the requirements of the WaterSense specification. At the end of 2018, according to input from the manufacturers, 99.0% of the bathroom sink faucets for sale were either WaterSense-certified or met the requirements of the WaterSense program. A list of WaterSense-certified bathroom sink faucets can be found at https://www.epa.gov/watersense/product-search.

Number of certified WaterSense bathroom sink faucet models available for purchase



Source: https://www.epa.gov/watersense/accomplishments-and-history

Assumptions to determine the market penetration of WaterSense bathroom sink faucets

- There are 1.46 bathroom sink faucets installed per residential bathroom
- Residential bathroom sink faucets are replaced every 15 years
- All bathroom sink faucets installed prior to 1992 had flow rates in excess of 2.2 gallons per minute (gpm). All bathroom sink faucets installed from 1992-2006 had flow rates of 2.2 gallons per minute, as stipulated by the Energy Policy Act of 1992
- WaterSense-certified bathroom sink faucets were introduced to the marketplace in 2007
- In 2007, 25% of the bathroom sink faucets offered for sale were WaterSense-certified or met the requirements of the WaterSense specification. In 2018, 99% of the bathroom sink faucets offered for sale were WaterSense-certified or met the requirements of the WaterSense specification
- Municipalities/states requiring faucets with flow rates of 1.5 gpm or less listed below:

State/County/Municipality	Effective date	Maximum allowed flow performance in gallons per minute	Applies to new construction only	Applies to new construction and replacement
Miami-Dade County, FL	1/1/2009	1.5 gpm	•	
State of Georgia	7/1/2012	1.5 gpm		•
Broward County, FL	6/1/2012	1.5 gpm	•	
New York City, NY	7/1/2012	1.5 gpm		•
Greater Chicago, IL	11/18/2014	1.5 gpm	•	
Washington, DC	3/28/2014	1.5 gpm	•	
State of California	1/1/2016	Product manufactured on or after 9/1/2015 to 7/1/2016 was 1.5 gpm and after 7/1/2016 is 1.2 gpm		•
State of Colorado	9/1/2016	1.5 gpm		•
Scottsdale, AZ	1/1/2017	1.5 gpm	•	
State of New York – except NYC	10/31/2017	1.5 gpm	•	

Source: PMI summary of Current U.S. Plumbing Provisions

WaterSense-certified bathroom sink faucet market penetration

- According to our research, there are 488.508 million residential bathroom sink faucets installed in the United States
- During 2007-2018, a total of 242.5 million residential bathroom sink faucets were sold and installed in homes throughout the United States
- Of the 242.5 million bathroom sink faucets, 195.672 million were WaterSense-certified or met the WaterSense program:

Maximum flow performance in gallons per minute	Million installed bathroom sink faucets	% of total
1.5 gpm or less	195.672	40.1%
2.2 gpm or more	292.836	59.9%
Million installed bathroom sink faucets	488.508	100.0%

Source: U.S. Census + GMP Research field interviews + PMI summary of current U.S. plumbing provisions

Census Region	State	Total number of bathroom sink faucets installed	Total WaterSense bathroom sink faucets installed	WaterSense market penetration	2.2 gallons per minute or more
USA	USA	488.508	195.672	40.1%	59.9%
New England	CT	5.383	1.189	22.09%	77.9%
	MA	10.205	2.770	27.14%	72.9%
	ME	2.652	0.996	37.55%	62.4%
	NH	2.261	0.848	37.51%	62.5%
	RI	1.652	0.376	22.76%	77.2%
	VT	1.194	0.298	24.96%	75.0%
Middle Atlantic	NJ	12.810	3.746	29.24%	70.8%
	NY[1]	29.108	7.772	26.70%	73.3%
	PA	20.378	5.397	26.48%	73.5%
South Atlantic	DC[2]	1.091	0.285	26.11%	73.9%
	DE	1.547	0.679	43.88%	56.1%
	FL[3]	33.378	17.846	53.47%	46.5%
	GA[4]	15.262	8.214	53.82%	46.2%
	MD	8.744	2.824	32.30%	67.7%
	NC	16.463	7.759	47.13%	52.9%
	SC	8.110	3.920	48.34%	51.7%
	VA	12.541	5.133	40.93%	59.1%
	WV	3.185	0.846	26.56%	73.4%
East South Central	AL	8.042	3.151	39.18%	60.8%
	KY	7.067	2.395	33.89%	66.1%
	MS	4.714	1.811	38.42%	61.6%
	TN	10.552	4.005	37.95%	62.0%
West South Central	AR	4.886	1.969	40.30%	59.7%
	LA	7.332	2.840	38.74%	61.3%
	OK	6.201	2.247	36.23%	63.8%
	TX	38.873	18.840	48.47%	51.5%
East North Central	IL[5]	19.008	5.690	29.93%	70.1%
	IN	10.336	3.438	33.26%	66.7%
	MI	16.464	4.496	27.31%	72.7%
	OH	18.576	5.164	27.80%	72.2%
	WI	9.607	3.469	36.11%	63.9%
West North Central	IA	5.011	1.628	32.49%	67.5%
	KS	4.565	1.420	31.10%	68.9%
	MN	8.715	3.268	37.50%	62.5%
	MO	9.979	3.579	35.87%	64.1%
	ND	1.326	0.566	42.68%	57.3%
	NE	3.000	1.014	33.80%	66.2%
	SD	1.400	0.634	45.30%	54.7%
Mountain	AZ[6]	10.680	6.144	57.53%	42.5%
	CO[7]	8.499	4.666	54.90%	45.1%
	ID	2.587	0.454	17.56%	82.4%
	MT	1.823	0.845	46.35%	53.6%
	NM	3.333	0.596	13.45%	86.6%
	NV	4.432	1.500	44.99%	55.0%
	UT	3.879	1.707	44.00%	56.0%
	WY	0.987	0.394	39.94%	60.1%
Pacific	AK	1.130	0.368	32.57%	67.4%
	CA[8]	50.297	26.195	52.08%	47.9%
	HI	1.921	0.789	41.06%	58.9%
	OR	6.293	2.673	42.48%	57.5%
	WA	11.029	6.821	61.84%	38.2%

Notes	State / county	Effective	Construction application
1	New York New York City	10/31/2017 7/1/2012	New construction All sales
2	Washington DC	3/28/2014	New construction
3	Miami-Dade, FL Broward County, FL	1/1/2019 6/1/2012	New construction New construction
4	Georgia	7/1/2012	All sales

Notes	State/county	Effective	Construction application
5	Chicago, IL	11/18/2014	New construction
6	Scottsdale, AZ	1/1/2017	New construction
7	Colorado	9/1/2016	All sales
8	California	1/1/2016	All sales

Observations concerning WaterSense bathroom sink faucet market penetration

Bathroom sink faucets are replaced much more often than tank-type toilets. Consumers do not perceive a bathroom sink faucet replacement to be cumbersome or messy. While they may engage a plumber to do the replacement, more often they will either do it themselves (DIY) or hire a handyman to swap out the faucet.

Swapping out an aerator to achieve a higher water efficiency is a very easy and affordable task. A quick search at www.homedepot.com revealed 98.5% of the aerators cost less than $20, with 70% costing less than $10.

Swapping out the existing aerator for a water efficient aerator is the most cost effective way to significantly boost the water savings of the bathroom sink faucet.

According to input from the manufacturers, by the end of 2018, almost all the faucets for sale are either WaterSense-certified or meet the WaterSense specification (99% of all bathroom sink faucets are either WaterSense or meet the WaterSense specification).

When a homeowner replaces an existing bathroom sink faucet, they will, with 99% certainty, be replacing it with a WaterSense-certified bathroom sink faucet, or one that meets the WaterSense specification.

When a builder installs bathroom sink faucets into new homes being built, with a 99% certainty, these products will be WaterSense-certified, or will meet the WaterSense specification.

During the last study conducted in May of 2015, we identified that 25.4% of the installed bathroom sink faucets were WaterSense-certified or met the WaterSense specification. At that time, manufacturers had indicated 98% of all bathroom sink faucets available for purchase were WaterSense-certified or met the WaterSense specification.

In the last WaterSense market penetration study, we stated the market penetration of the bathroom sink faucets would steadily increase due to the high availability of the products, new home construction demand and homeowners replacing their current bathroom sink faucets as they reached their typical end of life.

And that is exactly what we are seeing in this study.

The market penetration nationwide of WaterSense bathroom sink faucets grew from 25.4% to 40.1%. As the products are replaced every 15 years, we can safely state, within the next 15 years, WaterSense will enjoy a much higher overall market penetration than we are seeing today.

59.9% of the bathroom sink faucets are still using 2.2 gallons per minute or more. To increase the water efficiency, focus needs to be on getting the homeowner to replace the existing water guzzling faucets, or at a minimum to replace the current aerator with one that meets the WaterSense program.

Showerheads

Showering is one of the leading uses of water inside the home, representing approximately 17 percent of annual residential indoor water use in the United States. This translates into more than 1.2 trillion gallons of water consumed each year.

The WaterSense program released its final specification for showerheads on March 4, 2010 to further improve upon the nation's water and energy efficiency by raising consumer awareness and promoting the use of more efficient showerheads.

There are 137.4 million existing homes in the United States. To determine the average number of bathrooms per home, we reviewed 1.135 million single family and 0.271 million multi-family homes listed on Zillow.com. Based on this analysis, we have seen the average single family home has 2.5 bathrooms and the average multi-family home has 2.3 bathrooms per dwelling, resulting in 334.594 million bathrooms.

Not every bathroom has a shower. Guest bathrooms typically have a toilet and a washbasin, while full bathrooms are equipped with a toilet, 1 or 2 bathroom sinks, a tub or a shower enclosure. In some cases, there is both a tub and a separate shower enclosure.

Bathtubs – unless it is a freestanding soaker tub or whirlpool bath - are frequently equipped with a tub/shower mixer, allowing the homeowner to use the fixture for bathing and for showering. Based on our analysis of homes, we estimate there are 311.173 million showering environments in the United States – each equipped with 1 showerhead.

Total existing homes, bathrooms, installed toilets, lavatory faucets and showerheads

Type of home	Total number of existing homes	Number of bathrooms	Number of installed toilets	Number of installed sink faucets	Number of installed showerheads
	million units	million units	million units	million units	million units
Single family homes	92.790	231.975	231.975	338.684	215.737
Multi-family homes	44.617	102.619	102.619	149.824	95.436
Total installed base	137.407	334.594	334.594	488.508	311.173

Source: U.S. Census Bureau Characteristics of New Homes Completed 1973-present, GMP Research analysis of 1.135 million single family and 0.271 million multi-family homes currently for sale in the United States, 2019 U.S. Kitchen + Bath Industry Report, 2018 GMP Research study on the RV and mobile home market

Showerheads are frequently replaced by the homeowner. This can be because of mineral deposit buildup causing clogs or reducing water pressure. It can be because the showerhead has become defective and is either rusty or is leaking. It can also be the homeowner wishes to replace an older showerhead because it does not match newer bathroom décor – especially after a remodel. And it can be because homeowners realize their showerhead is inefficient and replacing it can lower their water utility costs.

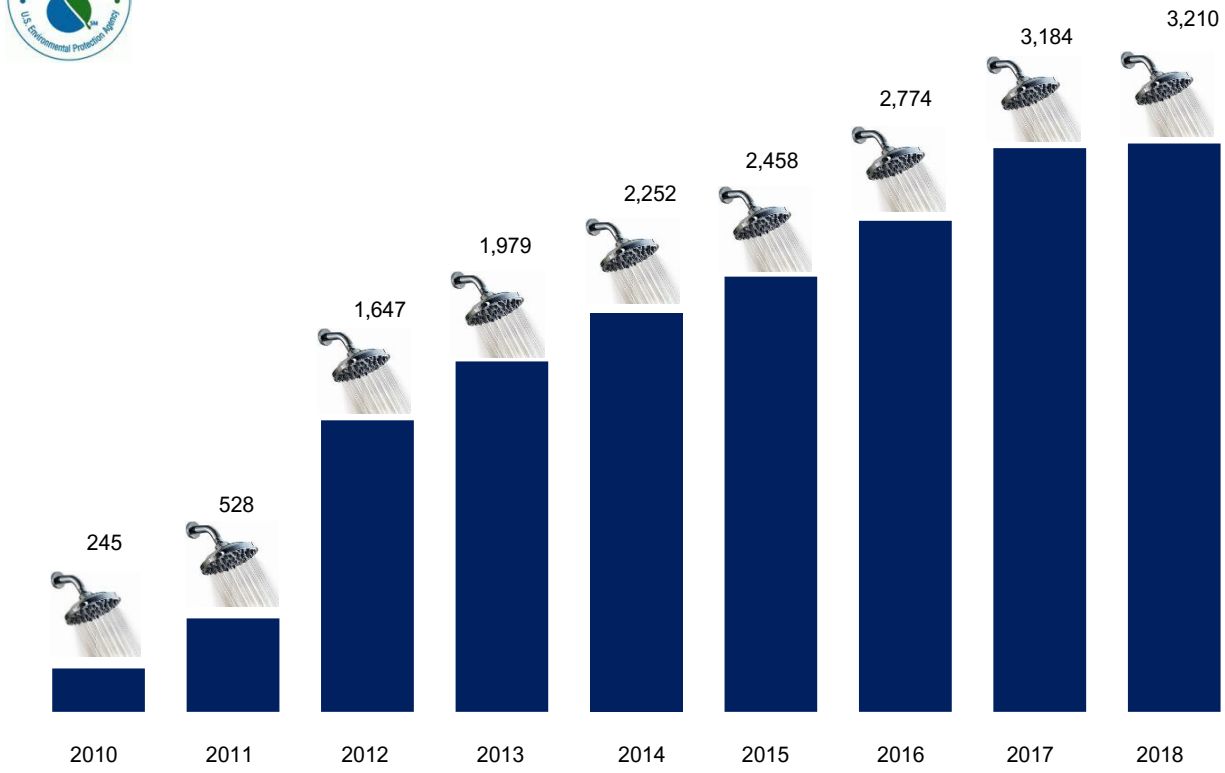
Based on input from manufacturers, we believe a showerhead is replaced in average every 12 years.

Availability of WaterSense-certified showerheads

Based on information from the U.S. Environmental Protection Agency, and from the manufacturers of showerheads, we see the following availability of certified WaterSense showerheads since inception of the WaterSense program.

In 2015, the manufacturers indicated 60% of the showerheads were either WaterSense-certified or met the requirements of the WaterSense specification. At the end of 2018, according to input from the manufacturers, 67.5% of the showerheads were either WaterSense-certified or met the requirements of the WaterSense program. A list of WaterSense-certified showerheads can be found at https://www.epa.gov/watersense/product-search.

Number of certified WaterSense showerhead models available for purchase



Source: https://www.epa.gov/watersense/accomplishments-and-history

Assumptions to determine the market penetration of WaterSense-certified showerheads

- There are 0.93 showerheads installed per residential bathroom
- Residential showerheads are replaced every 12 years
- All showerheads installed prior to 1992 had flow rates in excess of 2.5 gallons per minute (gpm). All showerheads installed from 1992-2006 had flow rates of 2.5 gallons per minute, as stipulated by the Energy Policy Act of 1992
- WaterSense-certified showerheads were introduced to the marketplace in 2010
- In 2010, 40% of the showerheads offered for sale were WaterSense-certified or met the requirements of the WaterSense specification. In 2018, 67.5% of the showerheads offered for sale were WaterSense-certified or met the requirements of the WaterSense specification.
- Municipalities/states requiring showerheads with flow rates of 2.0 gpm or less listed below:

State/County/Municipality	Effective date	Maximum allowed flow performance in gallons per minute	Applies to new construction only	Applies to new construction and replacement
Miami-Dade County, FL	1/1/2009	1.5 gpm or WS certified	•	
Broward County, FL	6/1/2012	2.0 gpm	•	
New York City, NY	7/1/2012	2.0 gpm		•
Greater Chicago, IL	11/18/2014	2.0 gpm	•	
Washington, DC	3/28/2014	2.0 gpm	•	
State of California	1/1/2016	Product manufactured on or after 7/1/2016 to 7/1/2018 was 2.0 gpm and after 7/1/2018 is 1.8 gpm	•	
State of Colorado	9/1/2016	2.0 gpm		•
Scottsdale, AZ	1/1/2017	2.0 gpm	•	
State of Oregon	10/1/2017	2.0 gpm	•	
State of New York – except NYC	10/31/2017	2.0 gpm	•	

Source: PMI summary of current U.S. Plumbing Provisions

WaterSense-certified showerhead market penetration

- According to our research, there are 311.173 million residential showerheads installed in the USA
- During 2010-2018, a total of 141.136 million showerheads were sold, which were either WaterSense-certified or met the WaterSense specification

Maximum flow performance In gallons per minute	Million installed showerheads	% of total
2.0 gpm or less	141.136	45.4%
2.5 gpm or more	170.037	54.6%
Million installed residential showerheads	311.173	100.0%

Source: U.S. Census + GMP Research field interviews + PMI summary of current U.S. plumbing provisions

Census Region	State	Total number of showerheads installed	Total WaterSense showerheads installed	WaterSense market penetration	[illegible]
USA	USA	311.173	141.136	45.36%	54.6%
New England	CT	3.429	0.789	23.00%	77.0%
	MA	6.500	1.940	29.85%	70.2%
	ME	1.689	0.720	42.60%	57.4%
	NH	1.440	0.615	42.70%	57.3%
	RI	1.052	0.253	24.04%	76.0%
	VT	0.760	0.209	27.50%	72.5%
Middle Atlantic	NJ	8.160	2.709	33.20%	66.8%
	NY[1]	18.541	5.618	30.30%	69.7%
	PA	12.981	3.764	29.00%	71.0%
South Atlantic	DC[2]	0.695	0.207	29.80%	70.2%
	DE	0.986	0.484	49.10%	50.9%
	FL[3]	21.261	12.884	60.60%	39.4%
	GA	9.722	5.950	61.20%	38.8%
	MD	5.570	1.981	35.56%	64.4%
	NC	10.487	5.537	52.80%	47.2%
	SC	5.166	2.746	53.15%	46.9%
	VA	7.988	3.619	45.30%	54.7%
	WV	2.029	0.590	29.10%	70.9%
East South Central	AL	5.122	2.228	43.50%	56.5%
	KY	4.502	1.702	37.80%	62.2%
	MS	3.003	1.150	38.30%	61.7%
	TN	6.721	2.890	43.00%	57.0%
West South Central	AR	3.112	1.217	39.10%	60.9%
	LA	4.670	1.959	41.95%	58.1%
	OK	3.950	1.572	39.80%	60.2%
	TX	24.762	13.594	54.90%	45.1%
East North Central	IL[4]	12.108	4.105	33.90%	66.1%
	IN	6.584	2.410	36.60%	63.4%
	MI	10.487	3.157	30.10%	69.9%
	OH	11.833	3.616	30.56%	69.4%
	WI	6.120	2.469	40.35%	59.7%
West South Central	IA	3.192	1.117	35.00%	65.0%
	KS	2.908	1.006	34.60%	65.4%
	MN	5.551	2.348	42.30%	57.7%
	MO	6.356	2.492	39.20%	60.8%
	ND	0.845	0.403	47.70%	52.3%
	NE	1.911	0.710	37.15%	62.9%
	SD	0.892	0.453	50.80%	49.2%
Mountain	AZ[5]	6.803	4.436	65.20%	34.8%
	CO[6]	5.413	3.367	62.20%	37.8%
	ID	1.648	1.023	62.10%	37.9%
	MT	1.162	0.594	51.15%	48.9%
	NM	2.823	1.390	49.25%	50.8%
	NV	2.123	1.094	51.50%	48.5%
	UT	2.471	1.233	49.90%	50.1%
	WY	0.628	0.280	44.60%	55.4%
Pacific	AK	0.720	0.261	36.30%	63.7%
	CA[7]	32.038	18.903	59.00%	41.0%
	HI	1.224	0.551	45.05%	55.0%
	OR[8]	4.008	1.936	48.30%	51.7%
	WA	7.026	4.855	69.10%	30.9%

Notes	State / county	Effective	Construction application
1	New York New York City	10/31/2017 7/1/2012	New construction All sales
2	Washington DC	3/28/2014	New construction
3	Miami-Dade, FL Broward County, FL	1/1/2019 6/1/2012	New construction New construction
4	Chicago	11/18/2014	New construction

Notes	State/county	Effective	Construction application
5	Scottsdale, AZ	1/1/2017	New construction
6	Colorado	9/1/2016	All sales
7	California	1/1/2016	All sales
8	Oregon	10/1/2017	New construction

Observations concerning WaterSense showerhead market penetration

Showerheads are frequently replaced by the homeowner. This can be because of mineral deposit buildup causing clogs or reducing water pressure. It can be because the showerhead has become defective and is either rusty or is leaking. It can also be the homeowner wishes to replace an older showerhead because it does not match newer bathroom décor – especially after a remodel. And it can be because homeowners realize their showerhead is inefficient and replacing it can lower their water utility costs.

As WaterSense showerheads were first introduced in 2010 – 3 years after WaterSense tank-type toilets and WaterSense bathroom sink faucets - one would assume the market penetration rate for showerheads would be lower. But because the showerhead is replaced more often than both the bathroom sink faucet and the tank-type toilet, this works as an accelerating factor. As more products are swapped out, the probability increases that it is replaced with a WaterSense-certified product.

In 2015, we reported the market penetration for WaterSense showerheads stood at 28.7%. At the end of 2018, our research indicates 45.4% of the installed showerheads were WaterSense-certified or met the WaterSense specification.

We can safely assume, by 2030, most of the showerheads will be WaterSense-certified or will be products that meet the WaterSense specification.

Flushing urinals and flushometer-valve toilets

Flushing urinals and flushometer-valve toilets are installed in non-residential commercial buildings. The non-residential commercial market is not a homogeneous market. It is a compilation of multiple industries, each with their own market dynamics.

Non-residential commercial construction markets

Non-residential commercial market	Examples of buildings	2018 Market Size in Million U.S. $
Lodging	Hotels, motels, resorts, and casinos	$32,744
Office buildings	Single + multi-level office buildings, high rises and skyscrapers	$74,096
Commercial	Retail and wholesale operations	$89,225
Health care	Hospitals, clinics, physician offices, dentist offices, medical laboratories, nursing homes	$42,186
Education	Daycares, kindergartens, primary/middle school, high schools, junior colleges, universities, vocational schools	$96,780
Religious	Churches and other places of worship	$3,083
Public safety	Police departments, fire stations, Coast Guard	$9,139
Amusement + recreations	Cinemas, museums, theatres, amusement parks	$26,863
Transportation	Airports and other types of passenger terminals	$52,495
Communication	Telephone, internet, cell towers, data centers	$25,390
Manufacturing	Places of production	$68,091

Source: U.S. Census

Existing non-residential commercial inventory in the United States

Based on U.S. Census data coupled with our own research, we believe there are 11.8 million commercial facilities in the United States.

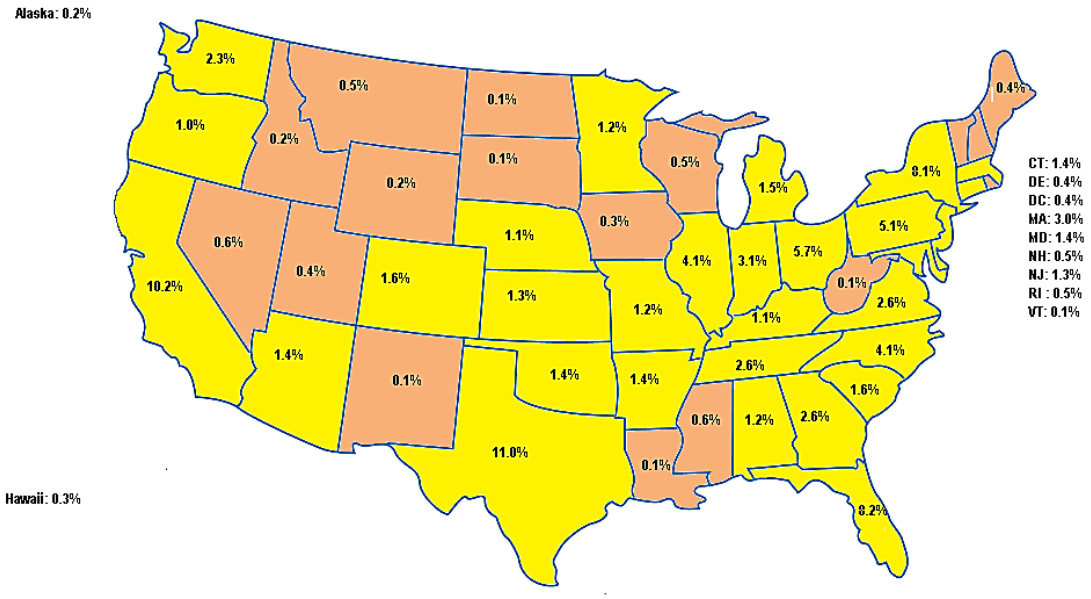
The following table gives an overview of the non-residential construction expenditures in million U.S. $ from 2013-2018 with forecasts to 2022.

Non-residential buildings	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Lodging	13,484	16,783	21,908	26,969	28,672	32,744	31,845	30,236	30,663	31,539
Office buildings	37,979	46,582	55,521	67,616	66,850	74,096	78,307	75,606	73,980	75,867
Commercial	53,159	62,841	65,899	78,151	87,733	89,225	93,163	90,782	89,552	92,231
Health care	40,689	38,647	39,147	40,157	41,916	42,186	43,270	43,989	45,060	46,740
Education	79,060	79,681	84,771	90,348	91,213	96,780	102,640	106,057	110,801	114,994
Religious	3,590	3,386	3,577	3,721	3,366	3,083	2,975	2,837	2,853	2,931
Public safety	9,506	9,437	8,484	8,023	8,290	9,139	9,850	10,288	10,553	11,066
Amusement + recreation	15,207	16,773	20,258	23,155	24,851	26,863	27,980	27,229	25,641	26,780
Transportation	39,459	42,043	44,843	43,274	45,173	52,495	56,754	61,113	66,182	70,573
Communication	17,783	17,298	21,696	22,178	24,831	25,390	26,415	26,965	27,719	28,827
Manufacturing	50,548	58,648	79,930	76,380	66,448	68,091	72,091	70,977	68,461	70,564
Total	360,464	392,074	446,034	479,972	489,343	520,093	545,291	545.979	551,463	572,130

Source: Federal Reserve Bank of St. Louis, FMI

The U.S. non-residential commercial building floor space is estimated at 128.5 billion square feet and represents approximately 20% of the 642.5 billion global commercial floor space. In the last three years, roughly 1 billion square feet of new inventory was delivered. By 2025, we believe the U.S. commercial building floor space will increase by another 166.4 billion square feet, while the global commercial floor space will experience an increase of an additional 409.02 billion square feet.

The following map gives an overview where the commercial non-residential floor space is concentrated. States highlighted in yellow are home to at least 1% of the national commercial non-residential floor space.



Source: U.S. Bureau of Economic Analysis

Determining the number of installed flushing urinals and flushometer-valve toilets

- The number of restrooms in a workplace is a requirement that is set forth by OSHA. For 15 employees, 1 restroom room is needed. For 150 employees, six restrooms are needed. If there are more than 150 employees, then there must be one restroom for every 40 people.

- U.S. Census provides accurate figures concerning the number of commercial establishments, while the Bureau of Labor Statistics provides the total number of people employed in the various fields.

- The Commercial Buildings Energy Consumption Survey provides insight to the types of buildings, the square footage, and the number of floors.

- The Federal Aviation Authority has a detailed website covering all the public and private airports in the United States.

- The CIA World Factbook/USA provides additional information on non-residential commercial facilities.

- Using all these information sources, we put together the following table, which gives an overview of the commercial non-residential properties in the United States and an estimate of the number of commercial toilets and flushing urinals installed:

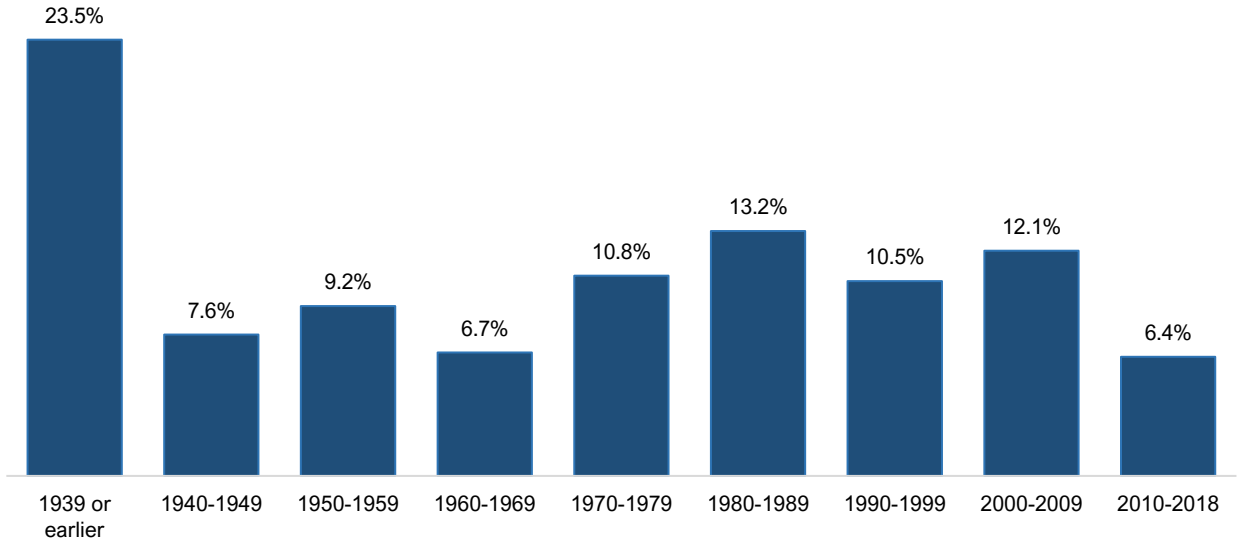
Non-residential commercial facilities and the installed base of flushing urinals and comme

Non-residential commercial facilities	Number of facilities	Number of Restrooms	Number of women's bathrooms	Number of men's bathroom	Toilets per women's bathroom	Toilets per men's bathroom	Flushing urinals per men's bathroom	Toilets installed in women's bathroom	Toilets installed in men's bathroom	Flushing urinals installed in men's bathroom
International airport	221	78	47	31	8	6	12	83,096	41,106	82,212
Major airport hub	1994	38	21	17	7	6	10	293,118	203,388	338,980
Regional airport hub	2661	6	4	3	6	5	10	57,478	39,915	79,830
Small public airport	1090	4	2	2	5	3	6	10,900	6,540	13,080
Sport stadiums	2617	17	10	7	9	6	12	235,530	109,914	219,828
Office buildings	6,100,000	5	3	2	3	2	3	54,900,000	24,400,000	36,600,000
Shopping centers	115857	14	8	6	5	4	8	4,634,280	2,780,568	5,561,136
Gas stations	126000	2	1	1	1	1	1	126,000	126,000	88,200
Wholesale operations	412,526	4	2	2	1	1	2	825,052	825,052	1,320,912
Retail operations	827,239	3	2.0	1.0	2	2	2	3,308,956	1,654,478	1,654,478
Educational buildings on university campus	106,000	5	3	2	3	2	3	954,000	318,000	636,000
Public or private elementary and middle schools	139,874	6	3	3	3	2	4	1,258,866	839,244	1,678,488
Public or private high schools	37,100	6	3	3	3	2	2	333,900	222,600	222,600
Junior colleges	1,013	6	3	3	3	2	2	9,117	6,078	6,078
Business/office management schools	7,783	4	2	2	2	2	1	31,132	31,132	15,566
Vocational schools	8,167	4	2	2	2	2	1	32,668	32,668	16,334
Other schools	50,886	6	3	3	3	3	1	457,974	457,974	152,658
Hospitals (community hospitals, federal hospitals, non-federal psychiatric hospitals, other hospitals)	6,210	10	5	5	5	2	3	155,250	62,100	93,150
Regulated long-term care service providers (nursing homes)	65,600	4	2	2	5	2	3	656,000	262,400	393,600
Offices of physicians, dentists, and other health practitioners	501,594	2	1	1	1	1	0	501,594	501,594	-
Outpatient care facilities	40,589	2	1	1	2	1	1	81,178	40,589	40,589
Medical and diagnostic laboratories	4,652	2	1	1	2	1	1	9,304	4,652	4,652
Home health care services	32,464	2	1	1	2	1	1	64,928	32,464	32,464
Other health care	239,410	4	2	2	2	1	1	957,640	478,820	478,820
Museums	7,655	6	3	3	5	4	1	114,825	91,860	22,965
Cinemas	40,313	4	2	2	5	4	1	403,130	322,504	80,626
Other amusement + entertainment	89,242	4	2	2	5	4	1	892,420	713,936	178,484
Hotels / Motels	54,882	4	2	2	1	1	3	109,764	109,764	164,646
Restaurants (independent, chain and fast food)	691,273	2	1	1	1	1	2	691,273	691,273	1,382,546
Drinking places + bars	43,985	2	1	1	1	1	1	43,985	43,985	43,985
Manufacturing establishments	291,543	4	2	2	3	2	1	1,749,258	1,166,172	583,086
Mining, quarrying and oil/gas extraction establishments	22,594	2	1	1	1	1	0	22,594	22,594	-
Construction companies	683,352	6	3	3	1	1	0	2,050,056	2,050,056	-
Government owned buildings	112,113	10	5	5	4	3	1	2,242,260	1,681,695	560,565
Utility buildings	18,160	2	1	1	2	1	1	36,320	18,160	18,160
EDP and data processing sites	146,407	4	2	2	2	1	1	585,628	292,814	292,814
Other	754,229	4	2	2	2	1	1	3,016,916	1,508,458	1,508,458
Total	11,787,295	4.53	2.57	1.96	2.70	1.83	2.37	81,936,390	42,190,547	54,565,990

1) Note: According to the Federal Aviation Authority, there are 8,292 private airports. These are not included in the above figures.

Sources: U.S. Census Bureau Number of Establishments, Federal Aviation Authority, ICS Research and CoStar Realty U.S. shopping centers, Commercial Buildings Energy Consumption Survey (CBECS), U.S. Department of Education, American Hospital Association, U.S. Department of Health and Human Services, American Hotel and Lodging Association, American Restaurant Association, Federal Real Property Public Data Set of the GSA, National Association of Manufacturers (NAM), GMP Research field input

Age of U.S. non-residential commercial buildings



Source: U.S. Census, American Fact Finder CB1600A11, Enhanced Commercial Property Database, GMP Research interviews with leading plumbing fixture manufacturers

Average age of non-residential commercial buildings by building type

Non-residential commercial building type	Average age of building	Typical toilet replacement time frame	Typical flushing urinal replacement time frame
Lodging	43.5 years	15 years	15 years
Office buildings	49 years	30 years	30 years
Commercial	61 years	40 years	40 years
Health care	45 years	35 years	35 years
Education	63 years	40 years	40 years
Religious	50 years	50 years	50 years
Public Safety	48 years	40 years	40 years
Amusement + recreation	51 years	35 years	35 years
Transportations	33 years	30 years	30 years
Communications	12 years	30 years	30 years
Manufacturing	50 years	50 years	50 years

Source: U.S. Census, American Fact Finder CB1600A11, Enhanced Commercial Property Database, GMP Research interviews with leading plumbing fixture manufacturers

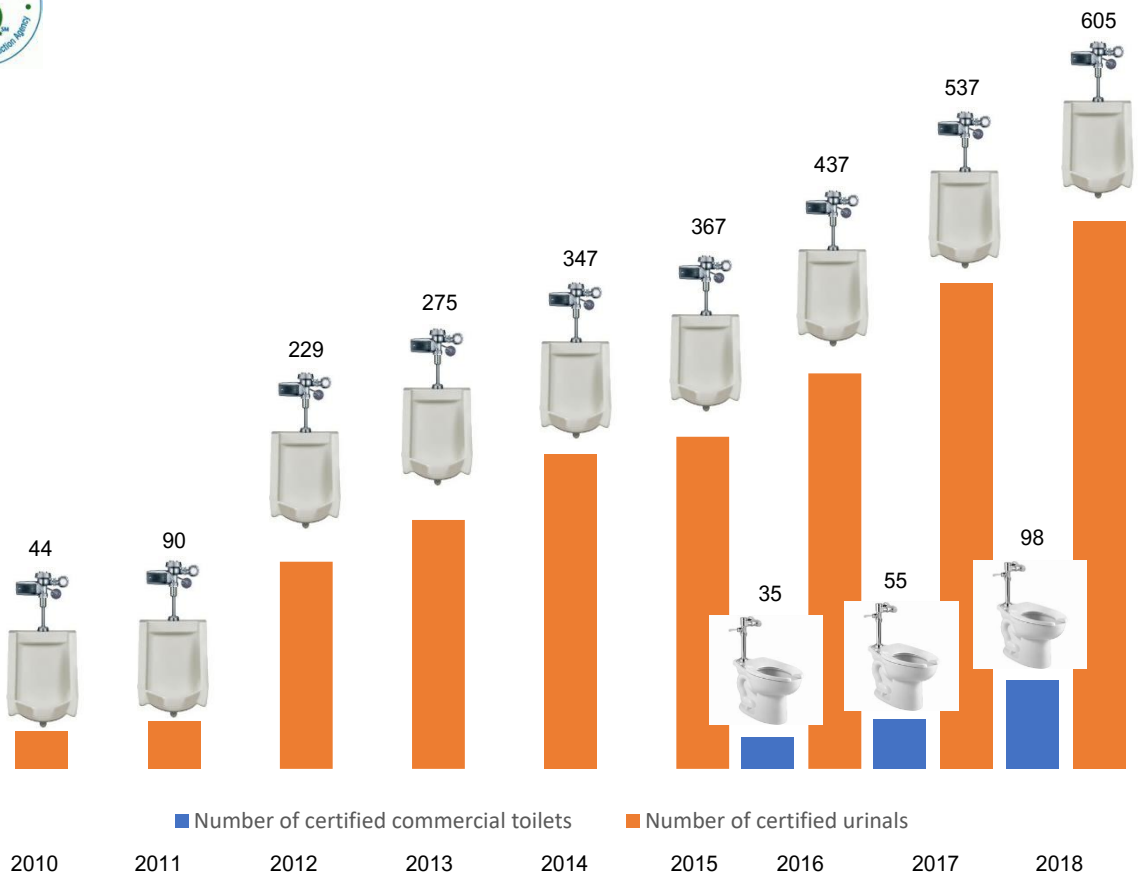
Note: Commercial toilets are frequently replaced well before they are "worn out" or inoperable. In some cases, for tank-type toilets in heavy use commercial areas (e.g., a gas station, theater, etc.) the economic lifetime may be reduced to 20 years or less, just because of physical wear and tear from abuse. For flushometer-valve toilets, replacement is not as frequent, as retrofitting the flushometer valve is often the preferred choice, rather than replacing the entire toilet and flushometer valve.

Many water utilities offering rebate programs geared toward replacing commercial toilets, generally use a 30 year replacement cycle as basis for their rebate program. They typically do not distinguish among toilets used in the various commercial/institutional buildings, because there are too many variables at play.

Availability of WaterSense-certified flushing urinals and flushometer-valve toilets

The WaterSense website indicates, WaterSense-certified flushing urinals were introduced to the market in 2010. WaterSense-certified flushometer-valve toilets were introduced in 2016. A list of WaterSense-certified flushing urinals and flushometer-valve toilets can be found at https://www.epa.gov/watersense/product-search.

Number of certified WaterSense flushing urinals and flushometer-valve toilets available for purchase



Source: https://www.epa.gov/watersense/accomplishments-and-history

According to input from the plumbing fixture and fitting manufacturers, 39.2% of the flushing urinals were WaterSense-certified, while 56.8% of the flushometer-valve toilets available for purchase were WaterSense-certified products.

WaterSense-certified flushing urinal market penetration

According to our research, there are some 54.5 million installed flushing urinals in non-residential commercial buildings. Every year roughly 400,000 - 450,000 flushing urinals are sold into new commercial construction and as replacement units for older fixtures.

The Energy Policy Act of 1992 established the maximum flush volume for all flushing urinals manufactured in the United States after January 1, 1994, at 1.0 gallons per flush (gpf).

Since the federal standards were enacted, manufacturers have developed flushing urinals that use significantly less water than the standard 1.0 gpf fixtures. These high-efficiency fixtures can save at least 0.5 gallons of water per flush compared to standard 1.0 gpf fixtures.

Since 2010 roughly 3.1 million flushing urinals have been sold. According to the WaterSense flushing urinal roll-out, we estimate approximately 1.0 million WaterSense urinals have been installed. With 54.5 million installed flushing urinals, WaterSense market penetration stands at 1.8% nationwide.

In the WaterSense® Specification for Flushing Urinals Supporting Statement from 2009, WaterSense estimates there are 12 million flushing urinals currently in use in the United States. https://www.epa.gov/sites/production/files/2017-01/documents/ws-products-support-statement-urinals.pdf.

This is based on a 2005 report published by D&R International titled “Plumbing Fixtures Market Overview: Water Savings Potential for Residential and Commercial Toilet and Urinals”.

We do not agree with that assessment, and believe the figures listed on page 40 of this report reflect the installed base of flushing urinals in the United States.

If the WaterSense Specification for Flushing Urinals Supporting Statement is correct, then by 2018, there would be 12 million existing flushing urinals + 3.1 million new flushing urinals = a total installed base of 15.1 million flushing urinals. With a total installed base of 15.1 million flushing urinals, and roughly 1.0 million WaterSense-certified flushing urinals installed, then the WaterSense market penetration for flushing urinals would be 6.6% nationwide.

WaterSense-certified flushometer-valve toilet market penetration

According to our research, there are some 124.127 million toilets installed in commercial non-residential buildings. Not all these toilets will be equipped with a flushometer valve. We believe some 20% of the toilets will be either equipped with a pressure-assist tank or are gravity-fed tank-type toilets. This would indicate there are 99.302 million installed wall- and floor-mounted flushometer-valve toilets in the United States.

WaterSense-certified flushometer-valve toilets entered the market in 2016. According to the manufacturers, roughly 56.8% of the flushometer-valve toilets currently for sale are WaterSense-certified.

Since 2016, roughly 4.0 million wall-hung and floor-mount flushometer-valve toilets have been sold. According to the WaterSense flushometer-valve toilet roll-out, we estimate 2.0 million are WaterSense-certified or meet the WaterSense specification.

According to our research, there are 99.302 million flushometer-valve toilets installed in non-residential commercial buildings. With 2.0 million WaterSense-certified flushometer-valve toilets sold, this would indicate the market penetration for WaterSense flushometer-valve toilets is 2.0% nationwide.

In the WaterSense Specification for Flushometer-Valve Water Closets Supporting Statement, WaterSense states there are approximately 27 million flushometer-valve toilets currently in use in the United States. https://www.epa.gov/watersense/watersense-specification-flushometer-valve-water-closets-supporting-statement.

This is based on the 2005 study by D&R International titled “Plumbing Fixtures Market Overview: Water Savings Potential for Residential and Commercial Toilets and Urinals”.

We do not agree with that assessment, and believe the figures listed on page 40 of this report reflect the installed base of flushometer-valve toilets in the United States.

If the 27 million flushometer-valve toilet numbers were correct, that would imply that the current installed base would be 27,000,000 + 4.0 million newly sold flushometer-valve toilets since 2015 = 31.0 million installed flushometer-valve toilets.

With 2.0 million WaterSense-certified flushometer-valve toilets sold and a total installed base of 31 million flushometer-valve toilets, then the market penetration for WaterSense-certified flushometer-valve toilets would be 6.5% nationwide.

Observations concerning WaterSense flushing urinals and flushometer-valve toilets

WaterSense flushing urinals were introduced to the market in 2010. WaterSense flushometer-valve toilets were introduced in 2016.

According to the manufacturers, 39.2% of the available flushing urinals are WaterSense-certified or meet the WaterSense specification. 56.8% of the available flushometer-valve toilets are WaterSense-certified or meet the WaterSense specification.

Both WaterSense flushing urinals and flushometer-valve toilets have low single digit market penetration nationwide. As with the residential tank-type toilet, the time of replacement for commercial plumbing fixtures is the main driver of market penetration.

The commercial building inventory in the United States is well advanced in years, as can be seen from the following table. Commercial toilets are frequently replaced well before they are “worn out” or inoperable. In some cases, for tank-type toilets in heavy use commercial areas (e.g., a gas station, theater, etc.) the economic lifetime may be reduced to 20 years or less, just because of physical wear and tear from abuse. For flushometer-valve toilets, replacement is not as frequent, as retrofitting the flushometer valve is often the preferred choice, rather than replacing the entire toilet and flushometer valve.

Public restrooms with low traffic volume will have fixtures and fittings in good functioning order. These products are typically only replaced if they are defective, or if the building is being remodeled.

With an average replacement happening 35.9 years after initial installation, it will take roughly 40 years before WaterSense-certified flushing urinals or flushometer-valve toilets gain any serious market penetration.

Non-residential commercial building type	Average age of building	Typical flushometer-valve toilet replacement time frame	Typical flushing urinal replacement time frame
Lodging	43.5 years	15 years	15 years
Office buildings	49 years	30 years	30 years
Commercial	61 years	40 years	40 years
Health care	45 years	35 years	35 years
Education	63 years	40 years	40 years
Religious	50 years	50 years	50 years
Public safety	48 years	40 years	40 years
Amusement + recreation	51 years	35 years	35 years
Transportation	33 years	30 years	30 years
Communications	12 years	30 years	30 years
Manufacturing	50 years	50 years	50 years

Conclusions and final thoughts

Products captured in this study included tank-type residential toilets, bathroom sink faucets, showerheads, flushing urinals and flushometer-valve toilets.

WaterSense market penetration is defined by the total number of WaterSense-certified products installed divided by the total number of installed products of that specific product type.

WaterSense Products	2015 market penetration	2019 market penetration
Tank-type residential toilets	7.0%	16.8%
Bathroom sink faucets	25.4%	40.1%
Showerheads	28.7%	45.4%
Flushing urinals	Not included	1.8%
Flushometer-valve toilets	Not included	2.0%

Source: GMP Research estimates

Based on the data reviewed, we believe the key driver for high WaterSense market penetration is the replacement market. Plumbing fixtures have very long replacement cycles. Homeowners and commercial property owners are reluctant to replace a plumbing fixture unless it is either broken or is being replaced as part of a major remodeling project.

Bathroom sink faucets and showerheads are easier to replace and are often completed by the homeowner or a handyman. WaterSense-certified showerheads were introduced a few years after the bathroom sink faucets. As showerheads are replaced more often than bathroom sink faucets, the market penetration for the WaterSense-certified showerheads is higher and will continue to outpace the other products.

Within the next 15 years, most bathroom sink faucets and showerheads installed in the United States will be WaterSense-certified or meet the WaterSense program. Within the next 30 years, most residential tank-type toilets will be WaterSense-certified or meet the WaterSense program. Within the next 40 years, most flushometer-valve toilets and flushing urinals will be WaterSense-certified or meet the WaterSense program.

Mount Pleasant, June 2019

Commenter: Ron Wolfarth
Affiliation: Rain Bird Corporation
Comment Date: July 31, 2019

Email Text:

Stephanie,

Please consider our response to a comment made in response to the Notice of Specification Review.

Thank you.

Ron Wolfarth
Corporate Communications Manager

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Email Attachments

See page 139.

July 31, 2019

Ms. Stephanie Tanner
Lead Engineer
WaterSense Program

United States Environmental Protection Agency
1200 Pennsylvania Ave. N.W.
Mail Code 4204M
Washington, DC 20460
Via email: tanner.stephanie@epa.gov

Dear Ms. Tanner,

Please consider Rain Bird's response to a comment submitted by Citrus County Board of County Commissioners by Debra R. Burden regarding the 'sensor bypass' switch on irrigation controllers.

Rain sensors and other water savings devices (sensors) connected to irrigation controllers need periodic maintenance for proper operation and fail over time. A malfunctioning sensor can be conveniently and obviously 'bypassed' or turned off at the controller via the 'bypass' switch rather than allow the sensor to continue to cause improper operation.

Many homeowners are not aware that the alternative to using the 'bypass' switch is to remove the wiring of the sensor and replace the original 'jumper wire' connecting the two sensor terminals as it came from the factory. If they remove the sensor wiring without re-installing the 'jumper wire', then watering is interrupted indefinitely, potentially harming the landscape. Then, the homeowner may incorrectly believe they need to replace the irrigation controller when they may only need to service or replace the sensor or re-install the 'jumper wire'.

This is the purpose of the 'bypass' switch. It provides a simple, obvious solution to a malfunctioning sensor until it is serviced or replaced.

While we understand the point made by the commenter, it does not take into account the original purpose of the bypass switch. Rain Bird believes that the value of the original purpose of the bypass switch and its obvious and easy access is more valuable than the concerns expressed by the commenter.

Thank you for your consideration of our response.

Sincerely,

Ron Wolfarth
Corporate Communications Manager
Rain Bird Corporation

(520) 741-6539
rwolfarth@rainbird.com