Update for Water Conservation Policy Development – Modeling the Impact of Passive Savings on Future Demand

Background, Definitions and Assumptions

In the contentious, water short west, predicting future local, regional and basin wide water demands requires substantial data, complex analyses, and some voodoo and witchcraft. Future water demands for municipal and industrial uses (M&I) are compiled using a combination of data types and modeling techniques; including tracking per capita and/or per connection water use, population served, number of connections, etc. Using these data, future M&I demands incorporating future water conservation efforts are estimated by developing discounts on current per capita and/or per connection water use to account for improved customer water use efficiencies. Utilities estimate the discounts based on the impact and effectiveness of their "active" water conservation programs, meaning those programs that they fund and implement.

Passive water conservation (i.e., those water demand reductions that result from the impacts of plumbing codes, ordinances and standards that improve the efficiency of water use) are so called because water utilities do not typically fund and implement programs that produce these types of savings.

For the analyses presented herein, the analysis of passive savings includes those permanent water savings related to retrofitting homes and businesses with high efficiency fixtures and appliances that are subject to not only the 1992 National Energy Policy Act, but to the other relevant regulations and market influences not actively funded or implemented by Colorado's water utilities. To this point, passive water savings are calculated to occur as a result of retrofitting housing stock and businesses that exist prior to 2016 (using variable dates depending on the appliance or fixture and the relevant influencing regulation (see below)).

Passive savings could also occur as a result of local, state or federal regulations or requirements not currently "on the books"; however, no attempt was made to predict the effect of potential regulations or requirements on future water use demand given the amount of speculation necessary to conduct such analyses. Behavioral changes in water use by customers were also excluded from the passive savings estimates given that water demand reductions associated with behavioral changes are difficult to quantify and in some cases (e.g., drought response reductions), may not be permanent. Future water demand reductions related to densification of housing and businesses were also not included in this analysis. Given these assumptions, it is anticipated that actual future water demand reductions associated with passive savings will likely be in the same range, if not higher than the estimates provided herein.

For the purposes of this exercise, passive water savings are directly linked to the replacement of older, inefficient water using fixtures and appliances with high efficiency fixtures and appliances. There are a number of key legislative acts that have or will influence the rate and type of fixtures and appliances that will be replaced in Colorado. These include the following:

1992 – National Energy Policy Act - this Federal act required uniform water efficiency standards on nearly all toilets, urinals, showerheads, and faucets manufactured after January 1994; and included efficiency standards for toilets used in commercial installations by 1997.

2002 – California Energy Commission (CEC) Water Efficiency Standards – the California legislature ordered the CEC to establish water efficiency standards for residential clothes washers. Accounting for a reported 22% of an average household's water usage; washing machines are prime candidates for increased water efficiency regulation. The proposed standards required machines to meet a certain "water factor" (WF) ratio calculated by dividing a washer's gallons of water used per load by its water capacity starting in 2007. Although the federal Energy Policy and Conservation Act (ECPA) expressly preempts states from regulating "energy efficiency, energy use, or water use of any product covered by federal energy efficiency standards," the CEC requested a waiver from the DOE that would allow California to regulate water efficiency standards for residential washing machines. CEC won its request for a waiver in 2009 (Proctor, 2010).

2007 – California Assembly Bill 715 – this bill required high-efficiency (HE) standards for all toilets (1.28 gallons per flush (gpf) or less) and urinals (0.5 gpf or less) sold in the state after January 1, 2014[1].

2009 – US Department of Energy State Energy Efficient Appliance Rebate Program – is a program that will provide states with $300 million to design and implement rebate programs that encourage consumers to turn in their old, inefficient appliances for new energy efficient ENERGY STAR models. Water-efficient dishwashers and clothes washers are included under the ENERGY STAR label and will be targeted to receive the biggest rebates. Using these funds, the State of California targeted dishwashers (Griffiths-Sattenpiel, 2009).

The specific impacts of these acts on Colorado's urban water demand have been mixed. For example, no appreciable water demand reductions were seen in association with the 1992 National Energy Policy Act, even though many Colorado water providers point to this piece of legislation as a firm part of their water conservation programs, helping reduce urban water demand in customer's homes and businesses. The lack of observed water savings from the 1992 Act is due to technology challenges before 2002, and that water conservation savings associated with the 1992 Act were small enough to not necessarily be measurable versus other water demand impacts. For example, the technology of low flow toilets produced before 2002 did not necessarily reduce flushing flows, since prior to that time toilet performance which was previously thought to be homogeneous showed a wide variation.

> "With utility funding, the National Association of Home Builders (NAHB) Research Center put 49 popular toilets through a battery of tests and reported in 2002 that nearly three-quarters of them performed unsatisfactorily. In October 2002, Consumer Reports published an article on toilet performance that used very different testing methods and produced strikingly different results. Consumers and builders were left frustrated and without a place to turn for toilet performance information they could trust.
>
> In response, more than a dozen municipal water utilities in the United States and Canada—including agencies that were actively promoting water conservation—funded projects to develop a comprehensive testing protocol that would accurately measure toilet flush was the Maximum Performance (MaP) testing. MaP measures how much mass of a standardized testing media (cultured soy encased in latex sleeves) a toilet will flush successfully in two out of three tries" (Wilson, 2006).

The Maximum Performance testing program provided an objective standard by which to compare toilet flush performance thus leveling the toilet industry. Along with the MaP testing, EPA's WaterSense program (launched in June 2006) has substantially improved toilet reliability, and therefore, efficiency of high-efficiency toilets. However, water savings associated with the 1992 Federal act were difficult to ascertain prior to this time.

In addition, new construction has been found to utilize about the same amount of water as older homes (Mayer, 2010). This is presumably due to the fact that while indoor water use in toilets and other appliances has been reduced, outdoor water use has increased in association with the installation of automated irrigation systems (versus older homes without automated systems). Although more data is needed to better clarify residential and commercial "end use", analyses conducted have not verified the savings expected at the time the California 2007 legislation was enacted.

In fact, the legislation in California has arguably had a greater impact on Colorado's urban water use than the 1992 Federal Act. This is primarily due to the size and power of California's economy. Creating and satisfying demand in California dominates the manner in which manufacturers and suppliers operate in the western US. Thus, California's actions have dominated the clothes washer and dishwasher markets in recent years, in combination with actions by the California Energy Commission and the US EPA (through their Energy Star and WaterSense programs). It is becoming increasingly difficult for consumers in Colorado to purchase clothes washers that are not substantially more water efficient than those produced before 2005. Commercially available top loaders are 24% more water efficient and front loader can be more than 40% more water efficient than their predecessors. Similarly, dishwashers have can be as much as 67% more water efficient when compared to those available prior to 2005.

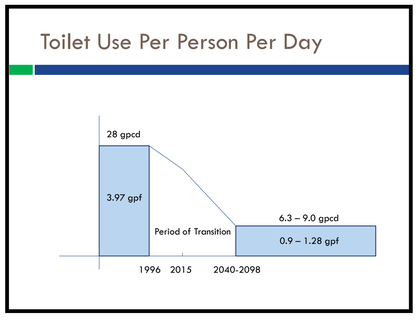
No other type of indoor or outdoor water use was included in the passive saving estimates since other domestic and commercial water uses are subject to potential quality of life issues. For example, low flow showerheads could save considerable water, not to mention energy; however, customers have the propensity to not select high efficiency showerheads for reasons that are not entirely clear. Faucet aerators could easily be downsized to 0.5 gallon per minute (gpm) flow rates in bathrooms. However, many newer faucet and lavatory configurations require special hardware configurations for the aerator to attach to the spigot which do not lend themselves to the 0.5 gpm option. Hot water on demand may or may not reduce water use in a home or business depending on the configuration of the system and its use.

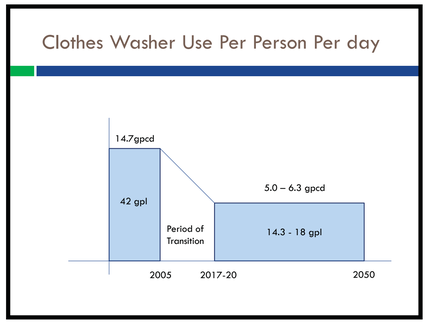
As previously indicated, outdoor water use has increased with new construction. For those entities willing to remove current landscape in favor of native plantings and Xeriscape material, water use reductions can be substantial for existing construction. However, there are a substantial number of home and business owners that are installing automated irrigation systems to maintain turf each year. For this reason, there does not appear to be adequate data to support passive calculations that extend beyond toilets, clothes washing machines and dishwashers.

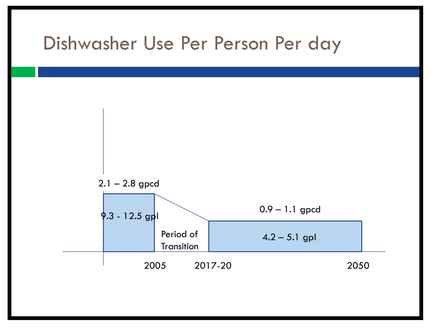
Summary of Passive Saving Calculation Assumptions

	Per Use[1]		Rate of Use (daily)		Replacement Rate	
	Min	Max	Min	Max	Min	Max
Toilets						
Average Pre-1996 Toilet	3.97 gpf	3.97 gpf	7	7	25 years	83 years
1.6 gpf Toilet	1.6 gpf	1.6 gpf	7	7	25 years	83 years
1.28 gpf Toilet	0.9 gpf	1.28 gpf	7	7	25 years	83 years
Clothes Washers						
Pre-2005	42 gpl	42 gpl	0.35	0.35	12 years	15 years
Post-2005	14.3 gpl	18 gpl	0.35	0.35	12 years	15 years
Dishwashers						
Pre-2005	9.3 gpl	12.5 gpl	0.225	0.225	12 years	15 years
Post-2005	4.2 gpl	5.1 gpl	0.225	0.225	12 years	15 years

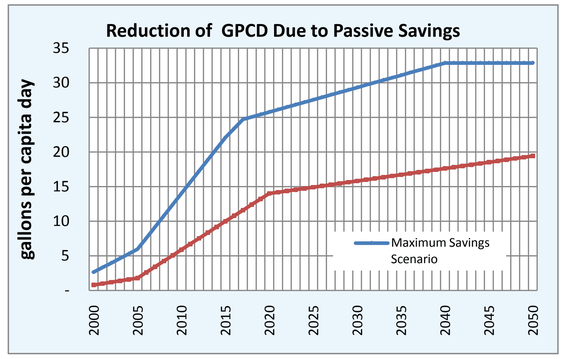
[1] gpf – gallons per flush; gpl – gallons per load







Results



This figure presents the reduction of daily per capita water use as toilet, clothes washer and dishwasher replacement occurs in Colorado over the next few decades. Based on the analyses represented in the figure, passive savings are expected to reduce system wide daily per capita water use by between 19 and 33 gpcd by 2050. These savings, which are chiefly associated with residential indoor water use, represent a reduction of between 23% and 39% of the average indoor water use reported by Western Resource Advocates (2003) for Colorado of 69.3 gpcd[2].

Noteworthy is that technologies may be developed to reduce any number of domestic or commercial water uses that would positively impact passive saving estimates after 2020. New ordinances and/or regulations dictating water use efficiency could also be established at the local, regional, state or federal level penetrating 100% of the targeted market, thus allowing for significant increases in passive water savings not included in the current analyses. Finally, increased density of housing within urban centers is expected to reduce outdoor water demand, but not substantially impact indoor residential use on a per capita basis.

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[1] The import and relevance of this bill to the production and sales of high efficiency toilets and urinals in California and the western United States was further increased by the passage of California Senate Bill 407 which requires point-of-sale retrofits for all residential and commercial property sold after January 1, 2014.

[2] The maximum and minimum savings for residential indoor water use were estimated to be about 17 and 27 gpcd, respectively. The remaining passive water savings relate to water use at businesses associated with increased toilet efficiency.

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