

Affordability Insights Obscured by a Flood of Miscalculation

Water affordability is an important topic and a growing problem in need of careful research and attention. Water and sewer systems will need substantial additional investment in the years ahead to protect public health and the environment, and it is critical to ensure that the revenues to support those investments are raised in ways that maintain the affordability of essential levels of utility service. Regrettably, this research article is severely compromised by the data choices and methodological problems outlined below. Chief among them was the failure to review the current literature on water consumption, which has been declining on a per capita and per household basis for the last 15 years or so. As a result, the quantitative and spatial assessments in this study are not well grounded, leaving the dimensions of the “burgeoning crisis” of water affordability proclaimed by the authors still quite hazy.

The authors’ research approach was to compare an average household water bill with household income data on a census tract level, which offers potentially useful new insight into the geographic distribution of water affordability problems. The study constructed an average water bill that is the same for the whole country. Using a level of 4.5% of household income as the upper bound for affordability for water and sewer service, the study determined the annual income (\$32,000) at which 4.5% would be sufficient to pay for the average water bill. Census tracts with a median household income at or below \$32,000 were identified as “hi-risk” for affordability challenges at current rates. Additionally, the authors escalated the dollar amount of the average bill by 6% and by 41% and calculated the income level at which the escalated costs applied to the same quantity of water resulted in a bill that surpassed the 4.5% threshold. Census tracts with a median household income at or below this level were identified as “at-risk”.

The problems with this study begin with the construction of the average water bill.

1. The water consumption used to construct the average monthly water and sewer bill -- 12,000 gallons per month -- is outdated, and ignores more recent data. The source cited for this volume is a one-page handout produced by the US Environmental Protection Agency in 2008, which uses a per capita consumption of 100 gallons per day to yield a household consumption of 400 gallons per day for an illustrative family of four.¹ 100 gallons/capita/day (gpcd) was a reasonably good estimate in 2008, likely drawn from the US Geological Survey’s estimate of 99 gpcd for domestic use of public water supplies in 2005.² But the USGS estimates for 2010 became available in 2014, and documented that per capita consumption had dropped to 89 gpcd.³ Thus, the authors did not use the most current published data for residential consumption, and did not acknowledge peer reviewed literature showing that household water use throughout the country has been in decline for the last 15 years,⁴ and is expected to continue to decline in the future.⁵ The rate survey report⁶ used by the authors to construct an average national water bill itself contained an estimate of median household consumption in 2014 of 5,984 gallons per

¹ The handout states: “A family of four can use 400 gallons of water every day, and, on average, approximately 70 percent of that water is used indoors.” Clearly this is meant to be illustrative, and not a representation of either the actual average or median household size or average or median household water use in the United States.

² Kenny, et al, *Estimated Use of Water in the United States in 2005*, USGS Circular 1344.

³ Maupin, et al, *Estimated Use of Water in the United States in 2010*, USGS Circular 1405.

⁴ Rockaway, et al, Rockaway, et al, “Residential Water Use Trends in North America.” *Journal AWWA*. Vol. 103, Issue 2. 2011

⁵ DeOreo, et al, *Residential End Uses of Water, Version 2*, Water Research Foundation, April 2016.

⁶ AWWA and Raftelis Financial Consulting, *2014 Water and Wastewater Rate Survey*, AWWA/Raftelis 2015, p. 15.

month, less than half the 12,000 gallons chosen by the authors. And nowhere did the authors take into account that disadvantaged households are more likely to consume less than average volumes of water since water consumption is known to rise with income.⁷

2. Even the outdated source used by the authors for estimated household consumption noted that about 30% of that 400 gpd for a family of four is attributable to *outdoor* water use. The researchers acknowledged that there are several uses of water that are clearly non-essential, including swimming pools and landscape watering, but made no effort to back out any outdoor use from the total water consumption that was the basis of their affordability analysis. The article goes on to cite the 2010 United Nations General Assembly Resolution in which the UN "recognizes the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights." But the "human right to water" has never been presented as a "right" to water lawns and ornamental landscapes, which is the lion's share of outdoor use of drinking water in the US residential sector.⁸

3. The authors held the volume of the average bill constant, even in the case of sharply rising costs, suggesting that water and wastewater service is perfectly inelastic. This ignores the literature indicating that price elasticity for water exists, that price elasticity is greater in the long-run than the short run, and that price elasticity of water demand is higher among low-income/low water-use groups.⁹ Furthermore, outdoor use shows even more responsiveness to changes in price,¹⁰ leaving the authors' projections of fixed household demand in the face of sharply escalating costs unsupported.

4. The volume of water use is one input to the national average bill. The other input is the combination of water and sewer rates and charges that apply to that volume. Here the authors used AWWA-Raftelis 2014 Water and Wastewater Rate Survey to construct an average water bill. I raise no objection to the use of this source, except to note that rates and charges have been moving up at roughly twice the rate of the Consumer Price Index, as noted in the Rate Survey itself.¹¹ Rates in effect in 2014 compared with water consumption in 2010 would be somewhat of a mismatch -- let alone 2014 rates compared with 2005 consumption, which is what the authors actually did.

5. The affordability criteria (4.5% of income) was applied to the authors' theoretical national average water bill, not to the water bills that people in each census tract are *actually* receiving. Water rates and charges in tracts identified by the authors as high-risk or at-risk may lower or higher than a national average bill -- the authors did not document any local bills. The use of actual bills might produce a map of at-risk communities with significant differences. While the authors do mention this point, qualitatively, as a reason for caution in interpreting national results, the significance is great enough that this passing mention doesn't really do it justice.

6. The authors compared projected water rates with household income to yield the "at-risk" category of tracts where 4.5% of the median household income is below the level of the projected water and

⁷ Rockaway, op cit.

⁸ For example, it is estimated that 54% of California's residential use is applied outdoors. See *California Water Plan Update 2009*, Bulletin 160-2009, California Department of Water Resources, Volume 2, Chapter 3, p. 3-16.

⁹ Yoo, et al, "Estimating the Price Elasticity of Residential Water Demand: The Case of Phoenix, Arizona, *Applied Economic Perspectives and Policy*, (2014) volume 36, number 2, pp. 333-350.

¹⁰ Espey, et al, "Price Elasticity of Residential Demand for Water: A Meta-Analysis," *Water Resources Research*, Vol. 33, No. 6, pp. 1369-1374, June 1997. See p. 1373.

¹¹ *Ibid*, pp. 15-17.

wastewater charges. However, as the authors acknowledge, it is important to note that projected future rates are being compared with household income that is held constant at 2014 levels. The authors rationalize this comparison by pointing to “no change or flat trends in household incomes over the last twenty years.” The authors’ source for the claim that income growth has been flat for 20 years is about *real* income, not nominal income – a very notable distinction. Since the water rate projections are expressed in nominal dollars, it’s a clear mismatch to compare these rate increases to a scenario with no increase in *real* income. The comparison should be like to like. Nominal income has risen significantly over time. This can be seen by changing the query in the database that the author used, generating a graph of nominal income over time, showing a 66.3% increase from 1994 to 2014: <https://fred.stlouisfed.org/series/MEHOINUSA672N>. Thus a comparison of projected nominal water and wastewater prices with constant 2014 income is not justified.

An additional problem for any affordability analysis is that the impact of rising water and sewer charges on economically challenged households that are not utility customers is not necessarily straightforward. Renters generally, and occupants of multifamily buildings in particular, are typically provided with water and sewer service through rent and do not have a customer relationship with the water or wastewater utility. Little research has effectively mapped the effects of water and sewer bill increases through the decision-making process of building owners to assess actual impacts of bill increases on occupants who rent. This topic is beyond the scope of this research article, but particularly impacts the report’s findings of households deemed at risk due to future rate increases if there is no reliable documentation of the response of building owners to such increases.

The recommendations at the end of the paper include a suite of policy solutions very similar to those advocated by my own organization: increased federal and state infrastructure investment, increased utility customer assistance programs, rate restructuring, and water conservation. There is little doubt that water and wastewater bills have already risen to levels that pose a challenge to disadvantaged households in some areas. But we knew that before this research article was published. The authors attempted to map out the most likely areas of stress, but in overstating their case they have obscured our view of where the most serious affordability problems are occurring. We hope they will make another run at it, because the topic of this research demands further attention, even if the product of the initial attempt is far less informative than readers might have hoped.

These comments and recommendations to, "A Burgeoning Crisis? A Nationwide Assessment of the Geography of Water Affordability in the United States" by Elizabeth Mack and Sarah Wrase from Michigan State University were provided by Ed Osann, Senior Policy Analyst and Larry Levine, Senior Attorney, at Natural Resources Defense Council.