Volumetric Pricing for Sanitary Sewer Service in the State of California

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Introduction

A & N Technical Services, Inc. was asked to quantify the effect on statewide potable water demand from a transition of sanitary sewer service revenue generation from fixed charges to volumetric pricing for residential customers. With legislative requirements (SB7x7) to reduce per capita water demand by 20 percent in 2020, water agencies throughout the state are looking for additional ways to achieve water savings; Cooperation with wastewater agencies is one such means. Converting to volumetric sewer pricing can provide a water benefit in addition to the benefits of more equitable and sustainable wastewater financing.

Although roughly 90 percent of California households served by a public water supplier pay for drinking water through a volumetric rate applied to metered water deliveries, about 70 percent of such California households pay for sewer service through a flat non-volumetric charge. With sewer charges equal to or greater than water charges in most jurisdictions, the price signal rewarding water efficiency is being cut in half for a majority of California households. Water efficiency can reduce future infrastructure requirements for sewer service, and volumetric pricing for sewer service is encouraged by the U.S. Environmental Protection Agency, the Water Environment Federation, and the California Urban Water Conservation Council (CUWCC). New hardware is generally not required, but where water and sewer are provided by different agencies, interagency cooperation is needed and billing software modifications are likely.

On the sewer side, wastewater volumetric rates provide important incentives to customers. While fixed charges have the advantage of being simple, they do not distinguish between customers within the same class that produce larger amounts of wastewater and those that produce smaller amounts. Fixed charges also do not provide signals to customers about the potential monetary savings from water use efficiency or on-site treatment and reuse. A recent study for the CUWCC and the U.S. EPA developed a model to define costs that could be avoided for wastewater utilities as a result of the permanent reductions in potable water demand.[1]

This white paper seeks to quantify the effect of shifting residential sewer service billing from

[1] Fiske, G. and T. Chesnutt, *The California Urban Water Conservation Council Wastewater Avoided Cost Model: Final Report*, A report for CUWCC and the US EPA, February 2010.

collections based on fixed charges to a billing system based on the volume of water consumption. The fact that customers generally choose to consume less of a consumptive good when it becomes relatively more expensive is known in economics as “The Law of Demand.” Potable water consumption and its attendant generation of wastewater are not immune to this fundamental law of economics. More than 137 different empirical studies have been completed that document the inverse relationship between water prices and water demand.

Using statewide water data compiled by the California Department of Water Resources, statewide wastewater agency data compiled by the State Water Resources Control Board (SWRCB), and price elasticity estimates from the empirical literature, this analysis quantifies the predictable effect on residential water demand that will occur as a result of volumetric sewer pricing. It is expected that these empirical estimates of predictable effects on California urban water demand will inform statewide policy discussions.

Linkages Between Volumetric Water Rates And Water Use

Analysts have pointed out that water rates can be an extremely valuable public policy tool. Water rates can be more than a means of meeting utility revenue requirements. Water rates can be used to communicate to water users the private and social costs of water development. Water users can then base their consumption decisions on a more accurate accounting of the benefits and costs of using more or less water. If done correctly, the pricing of water can be a powerful means of signaling the cost and scarcity of the resource to water users, most of whom experience very little connection between their water usage and their total bill. In an era in which customer water demands are increasing while water supplies are constant or diminishing, it is important to apply economic tools to communicate the true value of fresh water.

The “Law of Demand” underpins the ability of water rate structures to promote water conservation. The “Law of Demand” derives from the empirical fact that, all else equal, as the price of a good or service increases, the quantity demanded tends to decrease.[2] This relationship is why graphical depictions of demand curves are usually presented as downward sloping.

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[2] Economists have noted rare exceptions to this “Law”; these exceptions include some luxury goods and heroin. Presumably, potable water supply is not included in this subset of goods immune to the “Law of Demand”.

To be sure, some goods and services exhibit this tendency to a greater degree than others. Economists use the concept of "price elasticity" to measure the extent to which the demand for a good or service is sensitive to changes in its price. Price elasticity tells you the percentage change in demand for a one percent change in price. For example, if a good has an elasticity of magnitude 1.0, then a 10% increase in its price will produce a 10% decrease in its demand.[3] If instead, the good had an elasticity of magnitude 0.5, then the same 10% increase in price would produce only a 5% decrease in demand. Economists describe a good or service as "inelastic" when its price elasticity is of magnitude less than 1.0,[4] which means the percentage change in demand will be less than the percentage change in price. Conversely, an "elastic" demand is one with a price elasticity magnitude greater than 1.0. For an elastic demand, the percentage change in demand is greater than the percentage change in price.

Over the historic range of prices and consumption, urban residential demand for water has been relatively inelastic – generally the percentage change in customer water demand has been smaller than the percentage increase in water price. A large body of empirical research over the last 30 years has demonstrated this conclusively.[5] While the residential demand for water in urban settings is inelastic, its elasticity is not zero, as has been sometimes assumed by water planning studies done over the past several decades. This distinction is crucial. If demand for water exhibited zero elasticity, what economist's term "perfect inelasticity," water rates would have no relevance to consumer decisions about water use, and rate structure would prove an ineffective policy instrument for encouraging water conservation. But customer demand for water is not perfectly inelastic. It is relatively inelastic, yes, but not perfectly inelastic. This means that rates can be used strategically to influence the level of demand.

Comprehensive reviews of the empirical evidence have suggested the following regarding the price elasticity of residential customers demand for water:[6]

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[3] Price elasticity actually has a negative sign because price and quantity demanded move in opposite directions. To keep the discussion simple, we are presenting elasticity as a positive parameter. Technically, what we actually are presenting is the absolute value of the elasticity parameter.

[4] Note that many often read the label of "inelasticity" to mean "no elasticity". The authors are unaware how the label of "inelasticity" was chosen to mean "limited elasticity". Economists refer to a complete lack of demand responsiveness to price as "perfectly inelastic". This subtlety has been a longstanding and unfortunate source for misunderstanding between economists studying water demand and non-economists.

[5] Renzetti, Steven (2002). The Economics of Water Demands, Kluwer Academic Publishers, Boston.

[6] Epsey, M., J. Epsey, and W. Shaw (1997). *Price Elasticity of Residential Demand for Water: A Meta-Analysis.*

- The majority of empirical studies have found the long-term residential price elasticity to range between 0.2 and 0.6. After reviewing the evidence, Griffin (2006) concluded that price elasticity for annual residential water use is likely to lie in the range of 0.35 to 0.45, meaning a 10% rate increase may produce a 3.5% to 4.5% reduction in demand over time.[7] Several of these studies include the effects of combined water and wastewater bills.
- Key for this study, indoor residential water demand is even more inelastic than outdoor residential demand. On a percentage basis, residential water users have displayed a willingness to reduce outdoor consumption more readily than indoor consumption. The corollary of this finding is that summer demand tends to be more elastic than winter demand, because most outdoor use occurs during the summer. One study that did separately estimate residential price elasticities that varied as a function of outdoor water use (outdoor irrigated area) found an increasing magnitude of price response. Households having no outdoor irrigated area had a price elasticity of about 4.6%.[8] Figure 1 depicts how single family residential price response varied as a function of irrigated area.

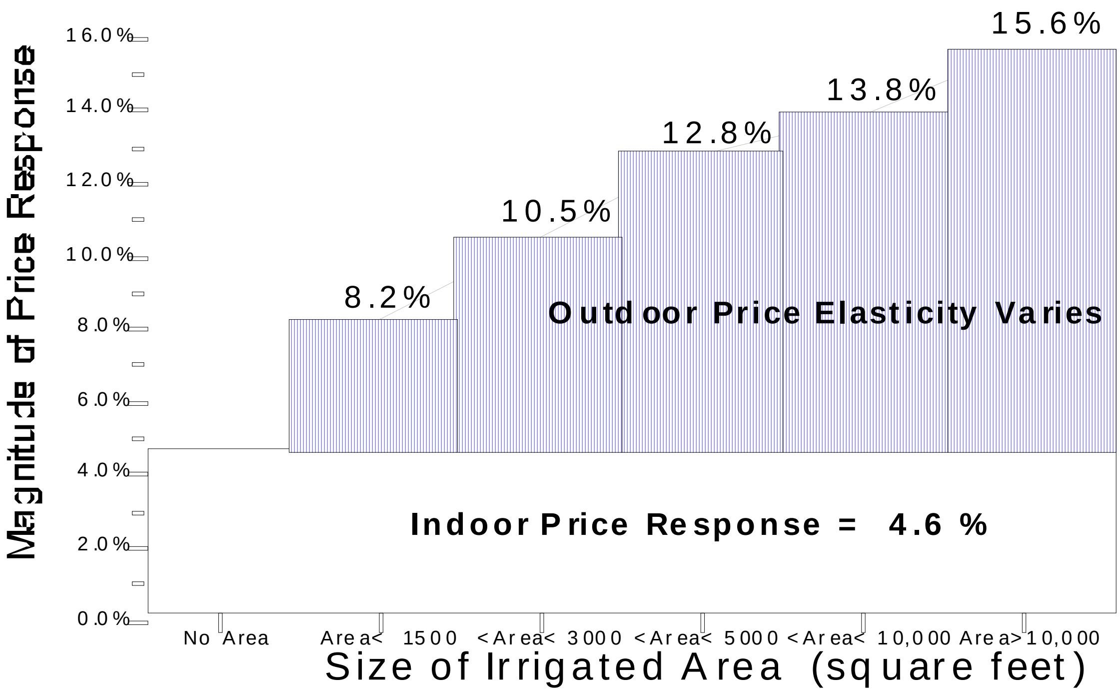

Figure 1: Residential Price Elasticity varies with Outdoor Water Use, (p. A-18, Ultra Low Flush Toilet Programs, Evaluation of Program Outcomes and Water Savings)

Water Resources Research 33 (June) 1369-1374. Also see Dalhuisen, J., et. al. (2003). *Price and Income Elasticities of Residential Demand: A Meta-Analysis.* Land Economics 79 (May): 292-308.

[7] Griffin, Ronald C. (2006). Water Resource Economics: The Analysis of Scarcity, Policies, and Projects. The MIT Press, Cambridge, MA.

[8] Chesnutt, T.W., C.N. McSpadden, and A. Bamezai, *Ultra Low Flush Toilet Programs: Evaluation of Program Outcomes and Water Savings*, A report for the Metropolitan Water District of Southern California, July 1995. The time-series cross-sectional panel data of 2944 single family households in Los Angeles and Santa Monica controlled for household meter-specific variability, season of the year, a seasonally-varying response to weather variations, and participation in ongoing ULF toilet, LF showerhead, and meter replacement programs.

- Residential customer demand for water is more responsive to price over the long-term than over the short-term. Another way of stating this is that it takes time for price changes to fully influence the demand for water. Right after a price increase, consumers are mostly locked into their water using appliances and landscaping. While they can modify their water using behavior in response to the price increase or change in rate structure, they may not be able to adjust their stock of water using capital, at least not right away. Over time, as this stock of capital wears out and is replaced, improvements in the efficiency of the capital can be realized. Thus, long-run demand tends to be less inelastic than short-run demand. These are broad generalizations, however. Demand responses are often specific to the time and circumstances in which the price adjustment occurs, and therefore can significantly vary by region and time period.

Estimate of the Statewide Volume of Price-Induced Water Conservation from Volumetric Sewer Pricing

Quantification of the conserving effect on statewide potable water demand of a transition to volumetric sewer pricing proceeds using the following three analytical subtasks:

1) **Affected Sewer Agencies** - Estimate number of potentially affected sewer agencies (residential accounts, monthly residential fixed charge, and total fixed residential revenue) from SWRCB wastewater annual reports;
2) **Revenue/Volumetric Price Impacts**-Translation of revenue generation from flat charges to a comparable volumetric price increase; and
3) **Volumetric Potable Water Conservation** - Estimation of price-induced water conservation of customer potable water demand using empirical parameters from the economic literature (price elasticities).

The estimate of the statewide volume of price-induced water conservation from volumetric sewer pricing is presented by discussing the methods, data, and results.

Method

1) **Affected Sewer Agencies** - Estimate the number of potentially affected sewer agencies (residential accounts, monthly residential fixed charge, and total fixed residential revenue) from SWRCB wastewater annual reports.

$$Annual\ Fixed\ Revenue\ at\ Agency\ i = Residential\ Accounts_i \cdot Monthly\ Fixed\ Charge_i \cdot 12\ months$$

2) **Revenue/Volumetric Price Impacts**-Translation of revenue generation from flat charges to a comparable volumetric price increase.

The total volume of potable water associated with sewer agencies having fixed charge revenue only is estimated by multiplying the number of residential accounts at agency i, by an estimate of water use per household—the DWR estimate of per capita water use per capita (in the applicable hydrologic region) multiplied by the number of persons per household (in the applicable county).

$$Total\_Potable\_Water\_Demand_i \cong Residential\ Accounts_i \cdot \left[\left(\frac{Use}{Person}\right)_{Hydro} \cdot \left(\frac{Persons}{Household}\right)_{Cnty}\right]$$

The estimate of the total volume of affected potable water is obtained by summing across affected sewer agencies. An estimate of indoor potable water use is developed by using the DWR estimated ratio of indoor residential use to total residential use.

$$Indoor\ Water\ Use_i = Statewide\ Indoor\ Use\ Share \cdot Total\_Potable\_Water\_Demand_i$$

Converting the wastewater system fixed revenue to volumetric revenue generation through water system rates requires additional assumptions. At the level of individual customer bills, we can derive a relationship between wastewater bills and water bills from the California utilities included in a national survey of wastewater and water agencies:

$$\frac{Wastewater\_System\_Revenue}{Person} = \gamma \cdot \left(\frac{Water\_System\_Revenue}{Person}\right)$$

This proportion of wastewater revenue to water revenue (γ) will be used to specify a rule to translate the implication of volumetric wastewater pricing into a percentage increase in the volumetric price of potable water: Each wastewater dollar needed translates into γ cents additional charge for each water dollar.[9]

[9] Note that this assumption is invariant to how the water system generates revenue between fixed charges and volumetric rates. If a water system is currently generating 25 percent of its revenue from fixed charges and the remainder from volumetric charges, we assume that the wastewater system will generate its revenue in a similar fashion and this assumption will remain valid.

3) **Volumetric Potable Water Conservation** –

To estimate the potential volume of price-induced potable water conservation we examine the definition of a parameter used to describe economic demand functions, the price elasticity:

$$\eta_{Price} \equiv \frac{\partial Q}{\partial P} \cong \frac{\%\Delta Q}{\%\Delta P}$$

The price elasticity is defined as the partial derivative of the quantity of potable water demand with respect to changes in the real price of potable water. It follows from this relationship that, at a first order, the expected change in potable water demand from a change in the real price of potable water is:

$$\%\Delta Potable\ Water\ Demand \cong \%\Delta WaterPrice \cdot \eta_{Price}$$

This is the basic formula used to estimate the price-induced water conservation of customer potable water demand. The estimates will calculate a percentage change in the real price of potable water and multiply this by specific empirically-estimated price elasticities from the water demand literature. Price elasticity values will need to be specific to indoor water use and separate short-run effects (over a 1 -- 4 year time horizon, predominately behavioral responses) from long-run effects (over a 10 -- 20 year time horizon, inclusive of changes in the efficiency of water-using equipment.)

Data

Data sources for the estimates include:

- The California State Water Resources Board (SWRCB) collects annual reports from wastewater agencies.
- The California Department of Water (DWR) compiles water use balances by 10 Hydrologic zones. From 1998-2005 annual data we extract the residential indoor use, residential outdoor use, and residential total. DWR also provides population estimates aggregated to 10 Hydrologic Zones;
- The California Department of Finance publishes annual estimates of population, housing stock, and persons per household for each county.
- AWWA performs a periodic rate survey across the country collecting information on water rate structures and wastewater rate structures.

1) **Affected Sewer Agencies** – Table 1 summarizes compiled data from SWRCB wastewater annual reports: the number of potentially affected sewer agencies, residential accounts, and total fixed residential revenue.

State Water Resources Control Board Survey for Municipal Wastewater Collection, Transport, and/or Treatment Agencies Compiled through FY07/08	
Number of sewer agencies generating revenue from fixed-charges only	776 agencies of 943 reporting
Number of residential accounts from fixed-charge only sewer agencies	8,622,970 accounts (about 77.8%)
Total annual revenue generated by fixed-charge only sewer agencies (derived as number of residential accounts * monthly fixed charge * 12 months, summed over affected agencies)	$ 2,076,103,380

Table 1: State Water Resources Control Board Survey

2) **Revenue/Volumetric Price Impacts**- Data for translating revenue generation from flat charges to a comparable volumetric price increase are found below.

Tables 2 and 3 summarize the DWR water balance estimates and DOF population estimates used to infer a per account average residential water use. Table 4 summarizes the 2008 AWWA Rate Survey per capita revenue from California wastewater and water systems.

California Department of Water Resources (DWR) California Water Plan 2009 Water Balances 1998-2005 (unpublished spreadsheet)						
	1998-2005	1998-2005	1998-2005	1998-2005	2003	2003
Hydrologic Region	Indoor Use (TAF)	Outdoor Use (TAF)	Indoor-Share	Total Residential Use (TAF)	Population	Resid. Total Per Capita (AFY)
North Coast	45.6	45.6	50.0%	91.20	660,935	0.14
San Francisco Bay	349.4	325.9	51.7%	675.23	6,248,495	0.11
Central Coast	84.7	112.2	43.0%	196.96	1,507,886	0.13
South Coast	1449.3	1402.7	50.8%	2,851.99	19,296,182	0.15
Sacramento River	231.5	303.1	43.3%	534.56	2,797,803	0.19
San Joaquin River	193.9	243.4	44.3%	437.24	1,916,251	0.23
Tulare Lake	264.1	276.6	48.8%	540.68	2,016,285	0.27
North Lahontan	7.7	8.7	47.0%	16.42	101,874	0.16

South Lahontan	30.8	177.3	14.8%	208.06	780,308	0.27
Colorado River	46.9	154.7	23.3%	201.55	669,735	0.30
California	2707.1	3049.2	47.0%	5756.3		0.16

Table 2: DWR California Water Plan 2009

California Department of Finance, County Population, 2003		
CNTYNO	**County_Name**	**PERSONS PER HOUSE-HOLD**
1	Alameda County	2.739
2	Alpine County	2.434
3	Amador County	2.406
4	Butte County	2.475
5	Calaveras County	2.410
6	Colusa County	3.112
7	Contra Costa County	2.760
8	Del Norte County	2.601
9	El Dorado County	2.659
10	Fresno County	3.166
11	Glenn County	2.894
12	Humboldt County	2.391
13	Imperial County	3.400
14	Inyo County	2.339
15	Kern County	3.090
16	Kings County	3.238
17	Lake County	2.479
18	Lassen County	2.536
19	Los Angeles County	3.085
20	Madera County	3.267
21	Marin County	2.346
22	Mariposa County	2.308
23	Mendocino County	2.533
24	Merced County	3.320
25	Modoc County	2.363
26	Mono County	2.401
27	Monterey County	3.181
28	Napa County	2.640
29	Nevada County	2.447
30	Orange County	3.061
31	Placer County	2.587
32	Plumas County	2.206
33	Riverside County	3.071
34	Sacramento County	2.699
35	San Benito	3.317
36	San Bernardino County	3.271
37	San Diego County	2.793
38	San Francisco County	2.321

39	San Joaquin County	3.094
40	San Luis Obispo	2.475
41	San Mateo County	2.734
42	Santa Barbara County	2.820
43	Santa Clara County	2.912
44	Santa Cruz County	2.692
45	Shasta County	2.569
46	Sierra County	2.297
47	Siskiyou County	2.327
48	Solano County	2.904
49	Sonoma County	2.580
50	Stanislaus County	3.099
51	Sutter County	2.932
52	Tehama County	2.625
53	Trinity County	2.311
54	Tulare County	3.337
55	Tuolumne County	2.395
56	Ventura County	3.079
57	Yolo County	2.742
58	Yuba County	2.986
	California	2.935

Table 3: California Department of Finance, County Population, 2003

2008 AWWA Rates Survey All Calif. Agencies		
WW Revenue per Person per Year	$ 146.03	
Water Revenue per Person per Year	$ 158.88	
Ratio of WW to Water Revenue	0.919069	

Table 4: 2008 AWWA Rates Survey

3) **Volumetric Potable Water Conservation** – Data for estimating price-induced water conservation of customer potable water demand using an estimated price change and empirical parameters from the economic literature (price elasticities) can be found below.

From Table 4 we can infer that shifting entirely from wastewater agency fixed charges to water agency revenue generation – at a revenue neutral level that holds the combined customer wastewater and water bill constant -- could increase customers average water bill by (γ=) 91.9 percent. How does this translate into a price change for potable water (ΔP) and how would this price change reduce the volumetric quantity demanded (ΔQ)?

Change in Price: One assumption is that 91.9 percent increase applies to both the volumetric potable water rate and to the fixed charge. To tie this to a specific volumetric rate, the approximately two billion dollars of fixed-charge revenue (Table 1) compiled from the 776 wastewater agencies would need to be recovered through volumetric rates. If this entire revenue were recovered by a volumetric rate on all potable water, the estimated volumetric rate would be \$1.08/HCF (≈\$2,076,103,380/1,928,860,758 HCF).

Alternatively, if wastewater agencies were to adhere to CUWCC's minimum conservation rate structure BMP, they could continue generating up to 30 percent of their revenue from fixed charges. We assume that wastewater agencies continue to generate 30 percent of their revenue requirements through fixed charges and the resultant volumetric rate would be \$0.75/HCF (≈ (1-.30)*\$2,076,103,380/1,928,860,758 HCF).

Practically speaking, many large wastewater agencies attempt to get a better measure of residential water entering the sewer system by basing bills upon an account's minimum winter use (1-2 meter reads, or 2-4 months of consumption). Basing 70 percent volumetric revenue generation on this measure of indoor water use (which is very similar to how DWR water balance estimates residential indoor use) would result in an estimated volumetric rate of \$1.60 per "indoor" HCF (≈ (1-.30)*\$2,076,103,380/ 907,111,977HCF). The percentage increase in the price of potable water will be greater in winter months and less in nonwinter months. The percentage price increase can also vary to the extent that the potable water agency uses seasonal pricing or block rate pricing. This analysis does not address the local agency-specific complications that could occur for individual agencies. The average effect on customer bills, as converted by the proportionality factor γ= 91.9 percent will be used to convert raw dollar changes into percentage price changes.

Change in Quantity: To compute the short and long run change in expected potable water demand, empirical estimates are needed of the short and long run price elasticity of demand for indoor water uses. The previously cited estimate of short-run indoor price elasticity, $\eta = -0.046$, taken from a time-series cross-section regression model using a sample of 2,944 individual households in Los Angeles and Santa Monica will be used for the short run (1-4 year) price elasticity. It should be noted that both Los Angeles and Santa Monica recover wastewater costs through potable water volumetric rates. The long run price elasticity is assumed to be twice as high as the short-run price elasticity.[10]

[10] Dalhuisen, Jasper M., Raymond J. G. M. Florax, Henri L. F. de Groot, and Peter Nijkamp. 2003. "Price

It should be noted that price elasticity estimates used are "pure" price effects in that the effects of participation in conservation programs and an ongoing meter replacement program were separately controlled for using multivariate statistical methods. Because these price effects do not include the effects of conservation device replacement, they can be used to decrement water demand without raising concerns about "double-counting" conservation that would be happening anyway. These empirical estimates of price elasticities are believed to be conservative in the direction of not overstating potential water savings.

Results

Table 5 provides an estimate of the statewide volume of price-induced water demand reduction attributable to a shift to volumetric sewer pricing. Statewide, the short-run pure price effects (over a 1-4 year period) were estimated to be approximately 141 thousand acre-feet per year with long-run pure-price effects (over a 10 to 20 year time horizon) exceeding 283 thousand acre-feet per year.

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and Income Elasticities of Residential Water Demand: A Meta Analysis". *Land Economics* 79 (May): 292–308.

Estimate of the Statewide Volume of Price-Induced Water Conservation from Volumetric Sewer Pricing

Variable	Value	Units	Source
Residential Accounts	8,622,970	Connections with only Fixed Charges (SWRCB 2008)	State Water Resouces Control Board, compiled through FY2007-08
		Number of Residential Accounts, Agency *i*	SWRCB_FY2007-08 DATA
		Per Capita Residential Use, Hydro region *h*	DWR, California Water Plan Update 2009, Unpublished spreadsheet. 1999-2005, 8-Year Average
		Persons per Household, county-specific	California Department of Finance, 2003
Total Residential Use	4,428,055	Acre Feet per Year	Sum over FixedChargeOnly Agencies, Number of Residential Accounts per Fixed Charge Agency * [Per capita Residential Use * Persons per Household]
	1,928,860,758	HCF per Year	Use (AFY) * 435.6 (HCF/AF)
	47.03%	Statewide Indoor Residential/Total Residential Use (presumed to flow to WW system.)	DWR, California Water Plan Update 2009, Unpublished spreadsheet. 1999-2005, 8-Year Average
Residential - Indoor Use	2,082,443	Acre Feet per Year	
	907,111,977	HCF per Year	
Sum WW Fixed Revenue	$ 2,076,103,380	WW Revenue from Connections with only Fixed Charges	SWRCB_FY2007-08 DATA
	$ 1,453,272,366	70% of WW Revenue to be recovered volumetrically	Cost recover assumption: 30 % remains fixed, 70% to be volumetric (see CUWCC Conservation Pricing BMP)
Price per Potable Water Billing Unit	$ 0.75	$ per HCF, if recovered across all potable water	
	$ 1.60	$ per indoor HCF	
Per capita WW Revenue	$ 146.03	WW Revenue per Person	Calif. Agencies in 2008 AWWA Rates Survey
Per capita W Revenue	$ 158.88	Water Revenue per Person	Calif. Agencies in 2008 AWWA Rates Survey
	0.919069	Ratio of WW to Water Revenue	Calculated from above. Implies the following rule…
			Rule: Each WW dollar needed translates into 91.9 cents additional charge for each water dollar
% Price Change, All Wate	69.2%	A $0.75 increase in water prices translates to a 69.2% price increase if priced across all water.	
Price Elasticity	-0.0462	Short Run Indoor Price Elasticity	Chesnutt, et al., Ultra Low Flush Toilet Programs: Evaluation of Program Outcomes and Water Savings, A report for the Metropolitan Water District of Southern California, July 1995
	-0.0924	Long Run Residential Indoor Price Elasticity	Long run elasticity assumed to be twice as great as short run elasticity.
	-3.20%	Short Run Reduction in water use w/ pricing on all water	
	-6.40%	Long Run Reduction in water use w/ pricing on all water	
Short Run Reduction	**141,700**	**Acre Feet per Year**	Sum across Fixed Charge Agencies, Delta Short Run Change in Use
Long Run Reduction	**283,400**	**Acre Feet per Year**	Sum across Fixed Charge Agencies, Delta Long Run Change in Use

Table 5: Estimate of the Statewide Volume of Price-Induced Water Conservation/ Volumetric Sewer Pricing

Table 6 provides the volumetric estimates of price-induced conservation by hydrologic region. Note that the total revenue generated from water and wastewater bills is designed to be the same, only the form of wastewater revenue generation has changed from fixed-charge revenue generation to volumetric-pricing revenue generation.[11]

Estimate of the Statewide Volume of Price-Induced Water Conservation from Volumetric Sewer Pricing by DWR Hydrologic Region

Hydrologic Region	Sum of Resid. Revenue at Fixed-Charge only Agencies	Total Est. Residential Use (AFY)	Est. Short Run Water Savings (AFY)	Est. Long Run Water Savings (AFY)
North Coast	$ 27,548,812	22,335	715	1,429
San Francisco Bay	$ 556,089,749	782,250	25,025	50,051
Central Coast	$ 85,846,082	123,283	3,944	7,888
South Coast	$ 785,727,179	2,173,581	69,536	139,073
Sacramento River	$ 367,946,449	588,625	18,831	37,662
San Joaquin River	$ 123,937,392	180,141	5,763	11,526
Tulare Lake	$ 112,367,961	516,986	16,539	33,078
North Lahontan	$ 1,707,767	1,770	57	113
South Lahontan	$ 3,470,019	9,753	312	624
Colorado River	$ 11,461,971	29,331	938	1,877
California	$2,076,103,380	4,428,055	~141,700	~283,400

Table 6: Estimate of the Statewide Volume of Price-Induced Water Conservation/ Volumetric Sewer Pricing by DWR Hydrologic Region

Understanding that residential water use constitutes approximately 66 percent of total urban water use in the state (DWR), these reductions in residential use can also translate into significant contributions toward meeting mandated GPCD goals. Table 7 expresses the price-induced conservation in GPCD terms by hydrologic region.

This estimate of price-induced conservation potential is believed to be a conservative lower-bound in that it does not include:

1) rate reform for any of the 15.9 percent of residential accounts currently using both fixed charges and volumetric rates that may be less than optimal or
2) rate reform for any nonresidential accounts whose revenue generation may be based entirely on fixed charges.

One key uncertainty is the rate at which sanitary sewer service could be converted to revenue generation based on volumetric pricing. Volumetric measurement (metering) of potable water, for example, is a prerequisite for volumetric pricing. The following section identifies key implementation issues.

[11] This statement is only true at the first order. Customer chosen reductions of potable water demand would require a second order adjustment in volumetric rates to be revenue-neutral.

Estimate of Price-Induced Water Conservation from Volumetric Sewer Pricing by DWR Hydrologic Region, Expressed in Gallons per Capita per Day (GPCD)

Hydrologic Region	Baseline GPCD (1995-2005, DWR)[1]	Population (2000, DWR)[2]	Demand AFY[3]	GPCD-After, Short Run[4]	GPCD-After, Long Run[4]	Interim Target[1]	2020 Target[1]
North Coast	165	644,400	119,100	164	163	151	137
San Francisco Bay	157	6,105,650	1,073,755	153	150	144	131
Central Coast	154	1,459,205	251,716	152	149	139	123
South Coast	180	18,223,425	3,674,314	177	173	165	149
Sacramento River	253	2,593,110	734,878	247	240	215	176
San Joaquin River	248	1,751,010	486,423	245	242	211	174
Tulare Lake	285	1,884,675	601,666	277	269	237	188
North Lahontan	243	99,035	26,957	242	242	208	173
South Lahontan	237	721,490	191,537	237	236	204	170
Colorado River	346	606,535	235,075	345	343	278	211
California (weighted average)	192	34,088,535	7,331,340	188	185	173	154
Sources:	[1]DWR 20x2020 Conservation Plan Final Report http://www.swrcb.ca.gov/water_issues/hot_topics/20x2020/docs/comment043009/202020_final_report_draft.pdf						
		[2]DWR Water Plan http://www.waterplan.water.ca.gov/cwpu2009/index.cfm					
			[3]BaselineGPCD*Population*365/325,851				
				[4] (Demand_AFY-Savings_AFY)*325,851/365			

Table 7: Estimate of Price-Induced Water Conservation from Volumetric Sewer Pricing by DWR Hydrologic Region, Expressed in Gallons per Capita per Day (GPCD)

Implementation Issues

A transition to volumetric sewer pricing will need to address a number of implementation issues including, but not limited to:

1) Billing Capability: volumetric wastewater pricing requires access to metered water consumption records and the ability to generate a customer bill. Sewer agencies currently billing fixed charges on a combined water-wastewater bill would have the fewest implementation constraints. Sewer agencies whose service area cuts across multiple water agency service area boundaries would face more implementation challenges.
2) Determination of sewer flow component of total water consumption: Different sewer agencies have used different assumptions to determine the fraction of residential total potable water demand that actually enters sanitary systems—a rough range might include 60 percent indoor water use in coastal climate zones with limited outdoor irrigation to 30 percent indoor water use in inland climate zones with more substantial outdoor irrigation. Because volumetric sewer service is typically based on an average of winter meter reads, it also provides incentives to avoid unnecessary winter irrigation.
3) Internal Management Approval: Any proposed change to revenue generation will require internal management approval. Management must be convinced that the change will be worth the effort.
4) External Policy Approval of Board, Council: The Board of Directors or City Council must also vote to approve changes to revenue generation.
5) Regulatory Support: Moving to volumetric sewer pricing can be enhanced or impeded by regulatory inducements or constraints.