

# Public opinion on water reuse options

William H. Bruvold

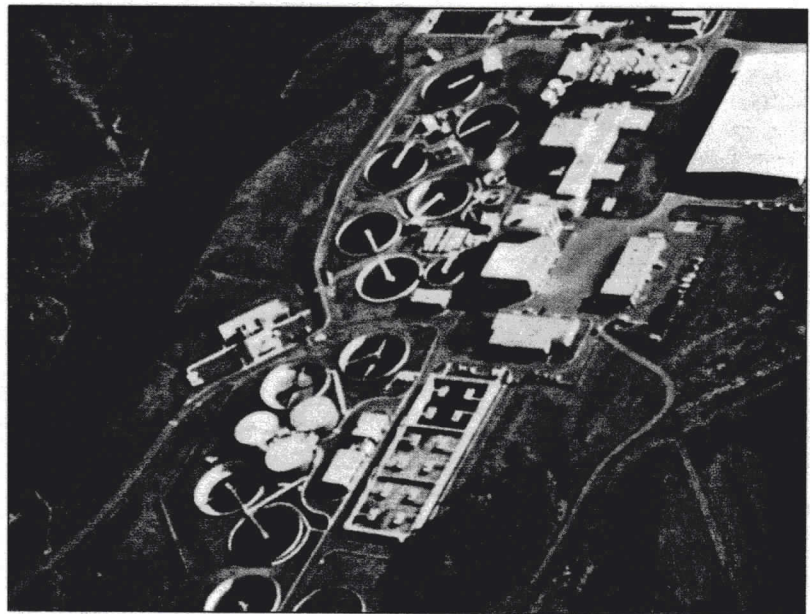
Public policy on wastewater reuse options must be informed by public opinion because it is the public who must pay the cost of developing the option and who will be served by the option in the future. Knowing what the public thinks of competing reclamation and reuse options is very important. Determinants associated with these options are complex but the complexity does not lessen the importance of fully understanding these determinants if innovations are to be successful.

For public policy on reuse, guidance for innovative reuse is not as simple as first believed. It seems that public opinion regarding actual community reuse options is affected by the linkage of several factors, including water conservation, health protection, treatment and distribution costs, and environmental enhancement.

Probability sampling was used in 7 studies to select respondents who were queried regarding their opinions on various reclaimed water uses ranging from irrigation to full domestic use. These 7 are briefly reviewed below in order of study publication.

Bruvold<sup>1</sup> surveyed 100 respondents in 10 California communities. Respondents were chosen by randomly selecting 100 dwelling units from each area under study. One person was selected at random from each dwelling unit. In a face-to-face interview, respondents were asked if they would or would not oppose 25 distinct uses of reclaimed water ranging from drinking to road construction.

Stone and Kahle<sup>2</sup> performed a telephone survey that yielded 100 complete interviews from each of 10 southern California cities. This survey used randomly generated telephone numbers, which



Upper Occoquan Sewage Authority plant in Centreville, Va., protects the Occoquan Reservoir in Northern Virginia.

established a probability sample of telephone subscribers for each city surveyed. The attitude measurement consisted of a 10-point rating scale ranging from "favor intensely" to "violently against" 13 uses of reclaimed water. Uses included drinking and golf course irrigation.

Kasperson *et al.*<sup>3</sup> reported results from surveys done in five cities in 1971 that produced an overall total of 400 respondents. Sampling procedures were not reported in detail; however, a probability procedure was used to select respondents. Attitudes toward eight uses of reclaimed water were assessed using a five-point evaluative scale ranging from minus two to plus two.

Olson *et al.*<sup>4</sup> performed surveys in Anaheim and Irvine, Calif. Five hundred addresses were randomly selected from

the telephone listing for each city, resulting in the mailing of 1000 questionnaires. A total of 123 usable returns were obtained from Anaheim and 121 from Irvine. The attitude measurement involve a "would oppose" or "would not oppose" response to the proposed use of reclaimed water ranging from drinking to road construction.

Bruvold<sup>5</sup> conducted a study in Irvine, that measured attitudes toward five uses of reclaimed water that had actually been underway in that community for several years. Additionally, attitudes toward possible future use of reclaimed water for drinking were assessed. A total of 140 respondents was selected by choosing 35 census blocks at random from all those comprising Irvine and then interviewing four respondents from each block under

quotas for gender and age. The attitude measurement for the five current uses of reclaimed water was an open-ended question coded on a 5-point evaluative scale ranging from very negative to very positive. Attitudes toward drinking reclaimed water were assessed using an 11-point Thurston Scale.

Milliken and Lohman<sup>6</sup> performed a telephone survey in Denver, Colo., that produced 399 completed interviews. Using randomly selected base numbers, telephone numbers were generated from the Denver metropolitan directory. This procedure was designed to give each telephone in the Denver Water Department service area an equal probability of selection. Respondents indicated approval, disapproval, or no opinion regarding seven uses of reclaimed water.

Lohman and Milliken<sup>7</sup> performed a follow-up telephone survey in Denver, that produced 403 completed interviews. Sampling procedures were the same as in the first study and the interview schedule was very similar to that used in the first survey; however, a completely new group of respondents was contacted by the second survey. The same questions assessing attitudes toward reuse of reclaimed water were used in the follow-up survey.

#### Degree of conduct

Table 1 summarizes results from the seven studies just reviewed. The data clearly show that unfavorability toward reuse of reclaimed water varies directly with intimacy or degree of human contact. The higher the degree of contact the more unfavorable most respondents were toward the use assessed. Stated differently, the respondents in the studies reviewed were more favorably disposed toward reuse as the degree of human contact diminished. This generalized finding is so stable across the available literature that it can be used as a basis for policy regarding the initiation of innovative forms of reuse: begin with lower contact uses for reclaimed water and move upward along the contact continuum once acceptance has been widely attained for existing uses.<sup>8</sup>

Against this background, an extensive study of public opinion in California regarding specific uses of reclaimed water in the respondents' home community was conducted.<sup>9</sup> In contrast to the seven studies reviewed above and summarized in Table 1, the survey on salient options focused on specific uses of reclaimed water actually proposed for the respondents' community in the near future, not generalized uses for some undefined community at some unspecified future time. The research was also

**Table 1—Percentage of respondents opposed to 27 uses of reclaimed water in the general options surveys.**

	Bruvold <sup>1</sup> N=972	Stone and Kahle <sup>2</sup> N=1,000	Kasperson <i>et al.</i> <sup>3</sup> N=400	Olson <i>et al.</i> <sup>4</sup> N=244	Bruvold <sup>5</sup> & Lohman <sup>6</sup> N=140	Milliken & Lohman <sup>6</sup> N=399	Lohman and Milliken <sup>7</sup> N=403
Food preparation in restaurants	56%			57%			
Drinking water	56	46	44	54	58	63	67
Cooking in the home	55	38	42	52		55	55
Preparation of canned vegetables	54	37		52			
Bathing in the home	37	22		37		40	38
Pumping down special wells	23			40			
Home laundry	23		15	19		24	30
Swimming	24	20	15	25			
Commercial laundry	22	16		18			
Spreading on sandy areas	13			27			
Irrigation of dairy pastures	14			15			
Irrigation of vegetable crops	14		16	15	21	7	9
Vineyard irrigation	13			15			
Orchard irrigation	10			10			
Pleasure boating	7	14	13	5			
Hay or alfalfa irrigation	8	9		8			
Commercial air conditioning	7			9			
Golf course hazard lakes	3	8		5	8		
Electronic plant process water	5	5	3	12			
Home toilet flushing	4	5		7		3	4
Residential lawn irrigation	3	6		6	5	1	3
Irrigation of recreation parks	3			5	4		
Golf course irrigation	2	5	2	3	4		
Irrigation of freeway greenbelts	1			5			
Road construction	1			4			
Stream or river discharge							
Bay or ocean discharge							

unique in that it presented information to each respondent on selected reuse options for their community that covered, in lay language, the type of treatment planned, the type of reuse envisioned and the environmental, health and economic impacts of each option. This kind of educational venture is unusual in survey research; however, the informational statements were carefully prepared, designed to be balanced, and carefully pre-tested, which lead to successful survey completion. Details of the salient options survey are that 10 communities were surveyed, that 140 respondents were obtained from each community

using a combination probability—quota sampling procedure, and that opinions regarding three prominent reuse options were obtained from each community after an educational presentation about these options had been given each respondent. Results from the salient options survey are shown in Table 2.

Twenty-seven uses of reclaimed water have been rank ordered in Table 3 according to the weighted mean of percentages of unfavorable responses from the seven studies reviewed above. Mean percents opposed to reuse options from the salient options survey are also shown in Table 3. Two discharge options, not

**Table 2—Respondents opposed to uses of reclaimed water in the salient options surveys.**

	Communities surveyed	Number opposed (%)
Food preparation in restaurants		
Drinking water	1	64
Cooking in the home		
Preparation of canned vegetables		
Bathing in the home		
Pumping down special wells	1	41
Home laundry		
Swimming	1	66
Commercial laundry		
Spreading on sandy areas	2	64, 66
Irrigation of dairy pasture		
Irrigation of vegetable crops	7	13-64
Vineyard irrigation		
Orchard irrigation	1	66
Pleasure boating	1	24
Hay or alfalfa irrigation	3	33-46
Commercial air conditioning		
Golf course hazard lakes		
Electronic plant process water	1	34
Home toilet flushing		
Residential lawn irrigation		
Irrigation of recreation parks	3	21-31
Golf course irrigation		
Irrigation of freeway greenbelts		
Road construction		
Stream or river discharge	4	36-35
Bay or ocean discharge	5	59-81

**Table 3—Weighted mean percent opposed to 27 uses of reclaimed water.**

Type of reuse	Degree of Contact	General options surveys	Salient options surveys
Food preparation in restaurants	Very high	56%	
Drinking water	Very high	54	64%
Cooking in the home	Very high	48	
Preparation of canned vegetables	Very high	46	
Bathing in the home	High	33	
Pumping down special wells	High	27	41
Home laundry	High	23	
Swimming	High	21	66
Commercial laundry	High	19	
Spreading on sandy areas	High	16	65
Irrigation of dairy pasture	Moderate	14	
Irrigation of vegetable crops	Moderate	13	40
Vineyard irrigation	Moderate	13	
Orchard irrigation	Moderate	10	66
Pleasure boating	Low	10	24
Hay or alfalfa irrigation	Low	8	40
Commercial air conditioning	Low	7	
Golf course hazard lakes	Low	6	
Electronic plant process water	Low	5	34
Home toilet flushing	Low	4	
Residential lawn irrigation	Low	4	
Irrigation of recreational parks	Low	3	26
Golf course irrigation	Low	3	
Irrigation of freeway greenbelts	Low	2	
Road construction	Low	2	
Stream or river discharge	Low		50
Bay or ocean discharge	Very Low		71

addressed by the literature review, but covered by the salient options survey, are also shown in Table 3.

In Table 3 the results from the survey of salient options ordered by degree of contact make it immediately apparent that favorability is *not* inversely related to degree of contact as expected from a review of general option surveys. The earlier studies indicate that acceptance should go up regularly as degree of contact goes down. This expectation is not confirmed by Table 3 which suggests little or no relationship between degree of contact and opinion toward reuse for the salient options research. Developing an explanation for the apparently anomalous findings from the salient options surveys, and then considering the implications of the explanation developed, represent the major purposes of this paper.

In an effort to explain why the salient option survey results differ from those of the previous surveys, respondents' reasons for favoring or not favoring a specific option were reviewed, categorized and tabulated.<sup>9</sup> The findings revealed that respondents favored reuse options that conserved water, enhanced the environment, protected health and held down treatment and distribution costs. Respondents were influenced by all five factors and even though the relative influence of each of the five was not evident from the survey it was clear that each was considered important. With the principle that five factors influence opinion about reuse, how can the ordering of results from the survey of salient options be explained?

The option rating scheme proposed by Bruvold, Olson, and Rigby<sup>10</sup> provides, a mechanism for evaluating each specific reuse proposal studied. Health risks for each option assessed here were evaluated as proposed by Bruvold, Olson, and Rigby.<sup>10</sup> Likewise, evaluation of the environmental effects, treatment costs and distribution costs were evaluated as proposed by Bruvold, Olson, and Rigby.<sup>10</sup> Evaluation of the water conservation potential of each option was accomplished by assigning 0 for no disbenefit, -1 for some disbenefit and -2 for a substantial disbenefit. The ratings used to evaluate all options are shown in Table 4. For example, use of reclaimed water for drinking was rated as -6, 0, -2, 0, and 0 for health, environment, treatment, distribution and conservation, respectively and, for example, analogous ratings for hay or alfalfa irrigation were 0, -1, 0, -1, and 0.

It may now be proposed that there are two major determinants of public opinion toward specific uses of reclaimed

**Table 4—Summary analysis of health and environmental effects, treatment and distribution costs, and conservation.**

Reuse category	Health effects	Environmental effects	Treatment costs	Distribution costs	Conservation	Algebraic sum
Ground recharge						
Spreading	-2	-1	-1	0	0	-4
Injection	-2	-1	-2	-1	0	-6
Industrial use						
Human contact unlikely	0	0	0	-1	0	-1
Human contact likely	-2	0	-1	-2	0	-5
Irrigation						
Fodder and fiber crops	0	-1	0	-1	0	-2
Food crops	-3	-1	0	-1	0	-5
Park and playground	-2	0	-1	-1	0	-4
Recreational lakes						
Restricted impoundments	0	-1	0	0	0	-1
Non-restricted impoundments	-2	-1	-1	0	0	-4
Direct municipal reuse						
Potable reuse	-6	0	-2	0	0	-8
Residential lawn irrigation	-2	0	-1	-2	0	-5
Discharge						
Stream or river	-2	-1	0	0	-1	-4
Bay or ocean	0	-1	0	-2	-2	-5

**Table 5—Regression/analyses.**

Surveys	Predictors	Outcome	P	C	Residual SS	R Square	P
General options	Degree of contact	Percent opposed	2	2.2	5141	0.8368	-0.01
General options	Health effects environmental effects treatment cost distribution cost conservation	Percent opposed	6	6.0	6624	0.7886	-0.01
Salient options	Degree of contact	Percent opposed	2	4.1	11280	0.0052	-0.10
Salient options	Health effects environmental effects treatment cost distribution cost conservation	Percent opposed	6	6.0	5820	0.4868	-0.01

water: degree of human contact, the five factors of health, environment, treatment, distribution, and conservation. Two hypotheses flow from this proposal. First, in surveys of general reuse options not specifically timed or located, degree of human contact will be the more important determinant of public opinion data. Second, in surveys of salient reuse options specifically designed for the respondents' home community, the five factors will be the more important determinant of public opinion data. Table 5 summarizes evidence that supports the two hypotheses just developed. For the general options surveys an index of bias in the regression model called Mallows' Cp, the residual sum of squares, and the squared correlation coefficient all indicate that the simple correlation of degree of contact with percent opposed provided a better predictive model than one comprised of the five predictor variables of health, environment, treatment, distribution, and conservation ratings. The situation, however, is completely reversed for the salient option surveys where Mallows' Cp, the residual sum of squares and the squared correlation coef-

ficient all indicate that the five variable model was superior to the simple model using only degree of contact as a predictor. Thus the present findings indicate that a multivariate model will have more success in explaining and accounting for public opinion regarding water reuse options that are actually proposed for the respondents' community.

These hypotheses have important implications for research and innovative reuse, which will be discussed in turn as the conclusion to this paper. For research, the implication is to undertake a new generation of public opinion surveys designed to test the hypotheses proposed. It must be emphasized that in order to test the second hypothesis research must be conducted on salient reuse options in communities facing imminent reclamation decisions.

For innovative reuse, the implication is that degree of contact may not provide clear guidelines regarding which reuse options are most favorably viewed by the public. The salient reuse options research reported here implies that more research must be done on such options before reliable general guidelines can be

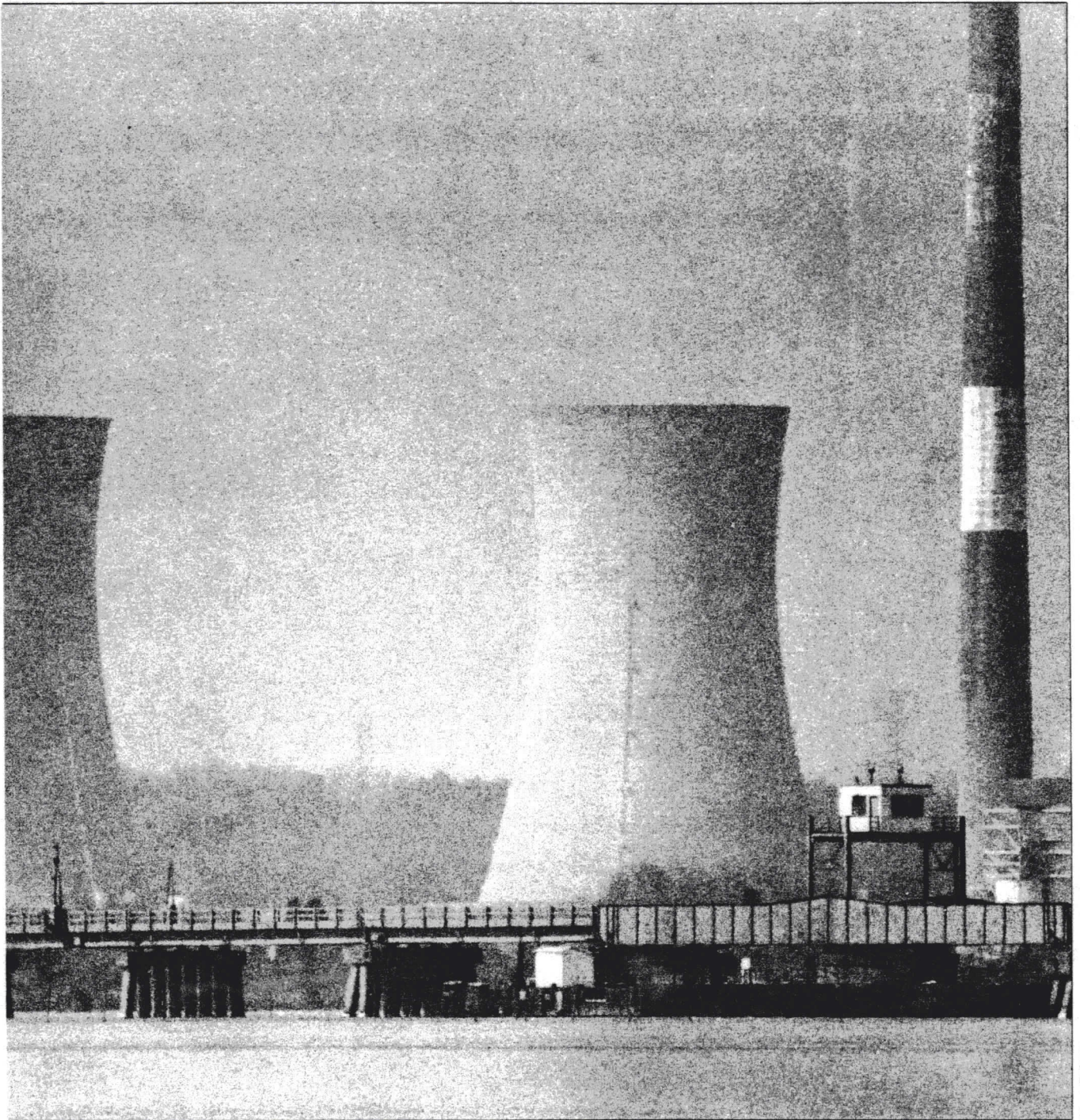
developed that will inform innovative adoptions of water reuse in the future. In the meantime, research on salient options conducted in the local community is necessary before decisions can be reached regarding an innovative reuse strategy designed to enhance prospects of successful adoption. ■

*The research leading to this report was supported in part by the University of California Water Resources Center Project W-515.*

*William H. Bruvold is a professor at the School of Public Health, University of California, Berkeley. Correspondence should be addressed to him at 503 Earl Warren Hall, School of Public Health, University of California, Berkeley, CA 94720.*

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Steve Delany

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