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WATER SUPPLY OPTIONS FOR THE EAST BAY MUNICIPAL UTILITY DISTRICT: A CRITICAL ANALYSIS

by

Anthony C. Fisher

California Agricultural Experiment Station
Giannini Foundation of Agricultural Economics
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Abstract

The two main objectives of the East Bay Municipal Utility District (EBMUD) water supply management program are to cope with a failure of the aqueducts in the Delta due to earthquake and flood damage and to mitigate periodic shortages. EBMUD emphasizes construction of additional terminal storage, specifically development of a reservoir in Buckhorn Canyon, to meet both objectives. Better alternatives--cheaper and less environmentally damaging--are (to cope with failure) use of existing terminal storage and interties, along with an eventual phased construction of secure aqueducts in the Delta, and (to mitigate shortages) purchase of high quality Mokelumne River water from the nearby Woodbridge Irrigation District, along with sharply rising block rates to induce conservation by EBMUD customers. Additional terminal storage, only as a last resort, would better come from some marginal addition to capacity at the planned Los Vaqueros Reservoir rather than construction of a new reservoir in Buckhorn Canyon. Under plausible assumptions, the cost of providing high quality water during a shortage is 10 times as high under the Buckhorn option as it would be with water purchases and conservation.

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*Professor of Agricultural and Resource Economics, University of California at Berkeley. I have benefited from comments on an earlier draft by my colleagues, Professors Peter Berck and Michael Hanemann, and from access to comments on the Technical Report by David Fullerton, Chair of the Sierra Club Bay Chapter Water Committee.

WATER SUPPLY OPTIONS FOR THE EAST BAY MUNICIPAL UTILITY DISTRICT: A CRITICAL ANALYSIS

Introduction

The purpose of this paper is to provide a critical analysis of the East Bay Municipal Utility District (EBMUD) Water Supply Management Program as outlined in the revised Technical Report of September, 1988. All numbers are from the Report unless otherwise indicated.

It seems fair to say that there are essentially two purposes, or objectives, of the program: (1) to cope with a disruption of water supplies caused by failure of the Mokelumne River Aqueducts in the Delta and (2) to mitigate or eliminate periodic shortages of the sort that can arise in successive dry years, such as 1987-88. Maintenance of water quality plays a role in both. I believe the Report admirably identifies and spells out a wide range of alternatives for achieving both. I also believe that some of these alternatives should be given greater weight in the Report's conclusions and recommendations and some less.

Supply Disruption

Let us look first at disruption, which EBMUD suggests could result from earthquake activity in the region of the aqueducts through the Delta. The Report's preferred alternative is construction of additional terminal storage, specifically a large reservoir having a capacity approximately equal to that of all of the existing reservoirs combined, in Buckhorn Canyon, located in the Berkeley/Oakland hills south of Moraga, at a cost of $169 million ($152 million for construction and $17 million to fill the reservoir). This would provide enough water, in the event of failure of the three Delta aqueducts, to get

through the 13 months the Report claims would be needed to rebuild the aqueducts. But the reservoir is, in itself, not sufficient (and, as I shall suggest later on, not necessary). Since the cost of aqueduct replacement would be incurred in any case, a better alternative is to simply build a secure system through the Delta.

An important advantage of this alternative is that it allows for flexibility and a phased-in construction program, thereby reducing the present value of costs. Aqueduct No. 1, older and according to the Report less able to withstand even relatively moderate shaking or flooding, could and should be replaced first. The cost of replacing all three aqueducts with two fully secure 86-inch pipelines is given in the Report as $265 million, and the cost of one secure line is given as $175 million.

No justification is offered for the high estimate for just one line (two-thirds of the cost for two lines). Presumably, it is due to the presence of fixed costs, as for design and engineering, that would be incurred even if only one line is ever built. Although it is plausible that there would be some costs of this type, it is not plausible that they would be so high. In the Report's scenario, the second line is obtainable for $90 million. Assuming the same cost of construction for the first, this leaves nearly the same amount again, or $85 million, for the fixed costs.

Note that replacement of Aqueduct No. 1 does <u>not</u> need to wait on resolution of a current dispute concerning American River water. EBMUD has a contract for 150,000 acre-feet of American River water, over and above the 364,000 it is entitled to from the Mokelumne River. The dispute is over where the water should be taken: from the American River just above the confluence with the Sacramento River, or below the confluence. Resolution of the dispute would

determine the timing and especially the sizing of a replacement for the more secure Aqueducts No. 2 and No. 3 should this prove necessary some time in the future. Since the indicated costs would be incurred only in the future, if at all, their expected present value, i.e., their value in today's dollars multiplied by the probability that they will be incurred (a number less than one), is reduced. In other words, even if a replacement for the remaining capacity of Aqueduct No. 2 and all of Aqueduct No. 3 is needed some time in the future, the cost in today's dollars would be substantially less than the remaining $90 million. It may be worth noting here that EBMUD has never taken more than about 240,000 acre-feet, as opposed to the 364,000 to which it is entitled, and that the projection for 2020 is still just 300,000 acre-feet.

To give an idea of the value of flexibility, suppose there is a 50 percent chance (a probability of one in two, or 0.5) that a second replacement aqueduct will be constructed in 10 years. The present value of $90 million (1998 dollars), at a 10 percent discount rate (the rate used in EBMUD's cost calculation), is just under $35 million. The expected present value--this number multiplied by 0.5--is $17.5 million which, when added to the $175 million for the first replacement aqueduct, yields a figure of $192.5 million. This is, of course, substantially less than the $265 million in the Report. The figure would be still further reduced with a more plausible (lower) estimate of fixed costs.

But the important point, again, is that the cost of aqueduct replacement, whatever it is, would need to be <u>added</u> to the cost of reservoir construction under the reservoir alternative. Of course, building the reservoir now and deferring even the first replacement, until a break or until Aqueduct No. 1 becomes sufficiently old and creaky, would reduce somewhat the present value of the cost of replacement.

There is another, even more important, point that needs to be made about the reservoir as a solution to the problem of temporary supply disruption: it is not necessary. Existing alternatives are probably sufficient; and, to the extent they are not, small-scale supplements are readily obtainable at much lower cost.

The Report states that local storage is adequate for only four months at current consumption levels. Yet, there are 155,000 acre-feet in existing reservoirs, which represent approximately 64 percent of annual use, or nearly eight months' supply. It is true that storage falls to about 115,000 acre-feet during the dry season (summer and fall), but this is EBMUD policy--not a physical or technical constraint on the system. The local reservoirs can be kept full year round by pumping during the dry season. (That this has not been done suggests that EBMUD is not, in fact, especially worried about a disruption.) The Report also states that 17,500 acre-feet in local storage are not usable, presumably because they lie below intakes; but in an emergency the water could be retrieved using portable pumps. Even if not every last acre-foot in storage were available, it is clear that the standby supply capacity of existing reservoirs is much closer to eight months than to four.

Further, the California Department of Water Resources (DWR) has proposed, in the event of aqueduct failure, to supplement the standby supply with water through interties to neighboring water systems, such as an existing connection to San Francisco's Hetch Hetchy system through the city of Hayward (DWR, Sacramento-San Joaquin Delta Emergency Water Plan, 1986).

Nor is this the end of the story. The estimate of 13 months for an outage is almost certainly too high. In the Report, this is given as the maximum time needed to restore full supply. As I suggested earlier, one of the

advantages in dealing with the pipelines is that reconstruction can be phased. In this case just one line, and not a full supply, would need to be restored on an emergency basis.

Perhaps more important, the consultant's report on which the estimate of 13 months is based makes a number of curious assumptions that appear to bias the estimate upward: (1) that six months would pass after an earthquake responsible for knocking out all three aqueducts before repairs to the aqueducts would begin; (2) that, thereafter, work would proceed only five days per week; and (3) that supplies and contractors would not be obtained from outside the Bay area (Jacobs Asociates, Replacement and Repair Feasibility for the Mokelumne Aqueducts in the Sacramento-San Joaquin Region for the East Bay Municipal Utility District, April, 1987). Given the severity of the hypothesized situation, it is far more likely--indeed, virtually certain--that EBMUD would be assisted by state and federal agencies to begin emergency repairs immediately, to proceed seven days per week, and to draw on resources from outside the Bay area.

Finally, the Report assumes that in this emergency consumption levels would be maintained at historical highs. Yet, in the much less extreme current situation of shortage rather than complete disruption of water supplies, EBMUD has set (and achieved) a target reduction in consumption of 25 percent. Making the very plausible assumption that a similar reduction would be set during an aqueduct outage, annual consumption would be just 180,000 acre-feet. Existing reservoirs alone would account for over 80 percent of this, or 10 months' supply. Adding in the water promised through interties with other systems and recognizing that the length of the outage would almost certainly be well under 13 months, the need for additional backup facilities--and, in particular, the need for a new reservoir--vanishes.

An interesting problem that does remain is that of how to schedule the phased construction of a system of secure aqueducts in the Delta. From EBMUD's rather relaxed attitude toward maintaining the capacity of existing reservoirs, one gets the impression that this need not begin right away, but perhaps it should. And when should a second line--and possibly even a third, if ultimately needed, to move additional water--be started? These are questions EBMUD ought to be thinking about. But let me restate, with emphasis, that construction of a large new reservoir in Buckhorn Canyon is not relevant to the answers.

Periodic Shortages

Let us now consider the problem of shortages. The Report, again, comes down in favor of additional terminal storage--again, construction of the Buckhorn Reservoir. I believe a better (less costly and less environmentally damaging) solution would involve mainly economic innovations in water marketing and pricing. If terminal storage were still needed--and I am skeptical, especially if the other measures are taken--a marginal addition to the planned Los Vaqueros Reservoir would seem to be a better alternative than construction of Buckhorn.

Water marketing, or sales from relatively low-value uses such as irrigation to high-value uses such as municipal drinking water, has been proposed as a way of improving efficiency in allocation of California's water generally. One obstacle has been the need to negotiate across water districts as, for example, in the case of the Metropolitan Water District and the Imperial Irrigation District in southern California. This obstacle should be lower (for EBMUD) if it vigorously pursues the identified alternative of trading with the Woodbridge Irrigation District and perhaps other users of water from its own Camanche

Reservoir on the Mokelumne River (just below Pardee Reservoir, from which EBMUD takes its drinking water). In fact, it is not even clear that EBMUD needs to offer alternative water to Woodbridge, as proposed in the original (April, 1988) Report, by pumping from the eastern Delta. EBMUD customers pay far more for water than Woodbridge growers. (The Woodbridge Irrigation District gets the water for free and sells it to members of the District at a nominal rate on a per-acre basis, not per acre-foot, so that the marginal cost of water to individual growers is zero.) Essentially, all that is needed is to offer the difference (less the marginal costs of an occasional transfer of water to EBMUD customers) as a payment to the growers in a dry year. Some might turn to groundwater as a substitute, some might take marginal irrigated land out of production (for that year, at least), some might switch to less water-intensive crops, some might adopt water-saving irrigation methods, and so on.

Woodbridge alone is entitled to a maximum of 116,000 acre-feet of which 39,000-60,000 is firm. The lower figure seems relevant to a dry year, though the Report indicates that the District's lowest level of use over the last 20 years (including the drought year of 1977) was over 51,000 acre-feet. It is some portion of this water that ought to be available (at a price), along with smaller amounts from other users of Camanche Reservoir releases, even in a dry year.

In the original Report, EBMUD proposes, as just noted, not to buy water from Woodbridge and the smaller users but to exchange lower quality Delta water. This was resisted by Woodbridge and has just (August, 1988) been denied by the State Water Resources Control Board. Perhaps in response to comments on the original Report advocating instead the water-marketing approach, EBMUD more recently (July, 1988) offered Woodbridge and the others

$50 per acre-foot. Some of the smaller users have expressed interest; but Woodbridge, after some study, turned down the offer.

Does this mean that water marketing is not a viable alternative? In my judgment, it does not. The difficulty with the offer is that it was too little, too late. As I shall suggest later, a more appropriate offer would be in the $200-$300 range. Consider the situation of a typical grower applying 2.5 acre-feet per acre to 200 acres. By selling just half the water to which he is entitled, at a price of $250 per acre-foot, he would realize a profit of $62,500 in addition to what he might earn using the remaining water. Of course, the example is hypothetical but it is not unrealistic, and it suggests that the right price would provide growers a very substantial incentive, indeed, to make water available to EBMUD.

This year's offer was not only too little, it was too late, coming long after planting decisions had been made. To have a better chance of success, negotiations should begin much earlier. For example, after a single dry year, negotiations might begin concerning (contingent) sale of water after a second dry year; in the present situation, in the spring and summer of 1987 for the summer and fall of 1988.

My conclusion is that water marketing, properly pursued, remains a viable and attractive alternative for mitigating periodic shortages. The revised (September) Report indicates that discussion of this approach is continuing--though with no apparent recognition that successful implementation, along with internal pricing changes (discussed below), would make construction of a new reservoir unnecessary.

Until the institutions are in place to permit water marketing to make a significant contribution, a change in EBMUD's own water pricing can be

effective. Indeed, EBMUD has not only identified this alternative but is aggressively--and correctly, in my judgment--pursuing it, with the sharply increasing block rates adopted as of June, 1988. One may argue about details of the structure; for example, I believe an argument can be made on grounds of equity or fairness that the higher rates should start at higher levels of consumption for users east of the hills in central Contra Costa who are locked into investments in larger lots in a dryer climate. But the policy of sharply increasing block rates seems essentially correct. Further, there is evidence, from experience with the 1977 drought, that it will be effective in substantially reducing water consumption. At that time, only a two-tier structure was imposed, with use in the second tier or block priced 100 percent above use in the first. As noted in the Report, this was associated with an approximately 40 percent reduction in use. The increase in rates was accompanied by a vigorous campaign to inform and persuade people of the need to conserve water, and it is difficult to disentangle the effects of the rate change alone. But this does not matter since the current pricing scheme is also accompanied by exhortations to conserve. I note in passing that sharp increases, as in 1977 and 1988, are probably needed to bring about significant reductions in use, given the very small fraction of the typical user's budget devoted to water purchases at the old rates. (This is presumably one reason why the more modest elevation surcharges of 1983 have not had an impact.)

Can these purely economic measures provide sufficient water? Here we need to look at some hypothetical numbers. Suppose EBMUD is faced with a serious shortage (of the sort experienced in 1977 and again in 1988) every 10 years. Suppose, further, that the shortage requires a reduction in use of 25 percent, the target for 1988. We have already seen that sharply rising block rates,

coupled with a conservation program, can do the job, as in 1977 and, indeed, 1988. But this can be painful. What about interdistrict sales as an alternative? A 25 percent reduction from current use levels would mean just over 60,000 acre-feet and, from projected 2020 use levels, about 75,000 acre-feet. Woodbridge alone would not be sufficient since, as just noted, the district has perhaps 51,000 acre-feet in a dry year, not all of which would be forthcoming. Additional water might be found from other Camanche users, including the fish and other beneficiaries of instream flows. But to the extent it is not, some modest amount of conservation, price-induced or otherwise, would be needed.

Now, how does the cost of water from these sources compare with the cost of water from the proposed Buckhorn Reservoir? As we have seen, alternatives to Buckhorn exist. The only remaining question is, are they cheaper? Once again, we need some hypothetical numbers. Let us continue to assume that 60,000 acre-feet will be required every 10 years, or with a 1 in 10 probability. On a "levelized" basis, this is 6,000 acre-feet per year. The levelized cost of the reservoir, again assuming a 10 percent discount rate, is $16.9 million ($169 million multiplied by 0.10). Thus, the cost per acre-foot is approximately $2,817, in terms of the capacity that will actually be used. In fact, this is just the capital cost. Operating costs, including costs of treating the water and getting it to users, would need to be added in and would undoubtedly make the figure substantially higher.

Moreover, at least some of the 60,000 acre-feet could be obtained from existing local storage, especially if the need for a standby supply in the event of a catastrophic failure of the aqueducts in the Delta is reduced by the phased replacement of the aqueducts. If some of the shortfall is made up

by drawing on these existing sources, less than 60,000 acre-feet would be needed from the new reservoir. Since the cost of the reservoir would not change, the cost per acre-foot of water actually used would rise. For several reasons then, the $2,817 is a conservative estimate--an underestimate, probably by a large margin, of the cost of an acre-foot of Buckhorn water.

I noted earlier that it should be possible to purchase water from Woodbridge for what EBMUD customers currently pay which, converting from the per gallon bill rate, is about $291 per acre-foot. If it is desired to keep this retail price unchanged, EBMUD would need to pay Woodbridge the difference between $291 and the marginal costs of occasionally bringing the water to its customers. Very preliminary research suggests these costs are negligible, so that something close to $291 could be paid to Woodbridge and other users of Camanche water, without raising the price to EBMUD customers. This is also approximately the cost of conserved water (on the margin) since it does not pay to conserve if the cost goes above the price of water. The cost of Buckhorn water is thus approximately 10 times the cost of water from the sources I have proposed, even ignoring operating costs and the likelihood that some water could come from existing local storage. The disparity is so great that varying the assumptions used to obtain this result in any plausible way cannot possibly affect the ranking of the alternatives.

In the unlikely event the alternative sources are not adequate, and additional storage is desired, Los Vaqueros is preferable to Buckhorn for two reasons. First, the capacity of Los Vaqueros is flexible (certainly before construction, and at a cost after construction), ranging from 50,000 acre-feet to 1,000,000 acre-feet. Given the availability of the cheaper alternatives, only some marginal addition to the capacity dedicated to the Contra Costa Water

District (CCWD) might be needed. This is easily accommodated by Los Vaqueros. Second, the environmental impact of reservoir construction would be greatly reduced by having only one site developed for this purpose rather than two.

Water Quality

I mentioned at the outset that maintenance of water quality is also, and very properly, a concern of EBMUD. Notice that none of the alternatives I have put forward for achieving security and mitigating shortages involves any diminution of water quality. (Here I am assuming, with the Report, that Los Vaqueros Reservoir would be filled with Sierra water, from the Mokelumne and perhaps also the American River, if EBMUD participates.) Moreover, EBMUD's already small share of construction costs might well be forgiven by CCWD in exchange for access to this high quality water. Alternatively, EBMUD could recoup its costs by selling water to CCWD. Use of Delta water is thus not proposed. I understand that some feel this option would be preferable to those advocated here or in the Report. Their argument, as I understand it, is that treatment plants for water from the local reservoirs are adequate for Delta water, as opposed to the Orinda, Lafayette, and Walnut Creek plants which take water directly from the aqueducts. To the extent this is correct, we have an additional acceptable (safe, cheap) alternative--one that may be used in conjunction with the others discussed. It is important to note that even under this scenario only small amounts of Delta water would be added to the existing Mokelumne supply--and only very occasionally.

Irreversibility

The final point I wish to make is that the Buckhorn Reservoir alternative suffers from still another drawback: it is irreversible. Suppose EBMUD makes

a good-faith effort to try water marketing; to try (price-induced and other) conservation; to try participation with CCWD in Los Vaqueros; and that all of these fall through or, at least, fail to sufficiently mitigate shortages. EBMUD can then say, "We told you so!" and proceed to build Buckhorn Reservoir. But once the reservoir is in place, the original Buckhorn Canyon environment is lost forever. Future negotiation of water purchases, conservation, and so on becomes moot. In the economic theory of investment decisions, an extra cost or penalty attaches to an irreversible alternative.

Summary and Conclusions

In summary, I believe the Technical Report has done a good job of identifying problems in water supply management in the East Bay. It likewise does well in developing and reviewing a wide range of alternatives for dealing with these problems. The purpose of these comments is simply to suggest that some of the alternatives discussed in the Report merit more serious consideration than they are given in the Report's conclusions and recommendations and that one of the recommended alternatives deserves less.

Specifically, the water supply management problems are (1) to cope with a disruption caused by earthquake damage to the Mokelumne Aqueducts in the Delta and (2) to mitigate periodic shortages. The Report emphasizes construction of additional terminal storage capacity, in particular development of a reservoir in Buckhorn Canyon, as the lead element in a solution to both problems. By contrast, I believe better alternatives--cheaper and less environmentally damaging--are (1) to cope with disruption, use of existing terminal storage and interties, along with eventual reconstruction of the Mokelumne Aqueducts in the Delta in a phased program beginning with replacement of the relatively vulnerable Aqueduct No. 1 and (2) to mitigate shortages, purchase of Camanche

Reservoir water, primarily from the Woodbridge Irrigation District, along with (if needed) sharply rising block rates accompanied by a conservation program, and (as a last resort) an addition to the capacity dedicated to the CCWD at the planned Los Vaqueros Reservoir. These recommendations are qualified to the extent EBMUD's customers are willing to accept Delta water to mitigate a shortage rather than (for example) face sharply higher rates.