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WATER COST OF THE EPA STANDARDS

Prepared for

California Urban Water Agencies
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and
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By

William J. (B.J.) Miller, Ph.D.
P.O. Box 5995
Berkeley, CA 94705-0995

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Notice

This draft report was prepared as a technical document for reference use by California Urban Water Agencies, San Luis Delta-Mendota Water Authority and others in preparing their comments to the US Environmental Protection Agency on "Water Quality Standards for Surface Waters of the Sacramento River, San Joaquin River, and San Francisco Bay and Delta of the State of California, January 6, 1994." This draft technical report is not part of the CUWA formal comment to EPA.

PREFACE

This report was prepared for the California Urban Water Agencies (CUWA) and the San Luis Delta-Mendota Water Authority (SLDMWA) as part of a review of the federal Environmental Protection Agency's proposed "Water Quality Standards for Surface Waters of the Sacramento River, San Joaquin River, and San Francisco Bay and Delta of the State of California" (40 CFR Part 131). CUWA/SLDMWA commissioned this report as a part of their overall review and evaluation of this standard. This report addresses the following specificquestions:

1) Would the EPA standards, as proposed, cost a lot of water?

2) Is the water cost of the proposed standards consistent with EPA's stated goal to be achieved by the standards?

3) How does the water cost of the EPA standards compare with the water costs of other new federal requirements already in effect or being proposed?

This report addresses the total water cost of the proposed standards. No attempt has been made in this report to allocate the water cost among various water users.

TABLE OF CONTENTS

WATER COST OF THE PROPOSED EPA STANDARDS
March 7, 1994

INTRODUCTION

The proposed EPA standards are comprised of three parts:

Salinity standards for the western Delta

Salmon smolt (small, out-migrating salmon) survival standards

Striped bass spawning standards for the lower San Joaquin River.

The salinity standards can be further subdivided into standards for Roe Island, Chipps Island, and the confluence of the Sacramento and San Joaquin Rivers.

The water cost of these standards has been estimated by a variety of methods. In addition, there is considerable uncertainty about exactly how the standards would be applied. Therefore, several estimates of their water cost have been made under different assumptions about their application. Most of these estimates have been made by the State Department of Water Resources. DWR used mathematical models to simulate operation of the state and federal water projects. The California Urban Water Agencies/San Luis and Delta-Mendota Water Authority team, specifically, the Contra Costa Water District, has also analyzed the water cost of the standards using a different approach.

In this section we will not attempt to reproduce these estimates, all of which will be submitted separately to EPA. Instead, we will present an overview of these estimates in an attempt to put them in perspective.

SUMMARY

Would the EPA standards, as proposed, cost a lot of water?

Yes. The water cost of the proposed EPA standards is large, in the range [1] of 0.5 to 1.5 million acre-feet (maf) per year on the average. For critically dry years, when water needs are greatest, the EPA standards would cost in the range of 1.5 to 3.0+ maf. These estimates do not account for the water cost of certain parts of the standards. For example, the

[1] These ranges occur because of different assumptions that can reasonably be made as a basis for the water cost analysis. These assumptions are discussed later in this report.

water cost of the striped bass standards in critically dry and dry years were not included because they could not be met. The water cost would, therefore, be even greater than estimated.

In addition to this direct water cost, there is an indirect cost. This indirect cost occurs arises from the riskier operation of the state and federal reservoirs. In other words, in attempting to comply with both the EPA requirements and the urban/agricultural needs, reservoirs must be drawn down more by the end of each water year than without the EPA standards.

These lower, end-of-year storage levels would cause water shortages in some years, and these shortages would be counted in the water cost estimates. However, in general, the federal and state water systems would be operating with less water in reserve, so to speak. So, in general, there would be greater risk of water shortages and the accompanying loss of hydropower energy and recreation benefits at reservoirs. In addition, there would be less opportunity to control instream temperature for fish and a greater risk of not having enough water to keep salinity from intruding into the Delta.

There is another indirect water cost that has not yet been fully analyzed. This cost relates to the "transferability" of water. Water transfers (sometimes known as "water marketing") are generally assumed to be the method by which urban and some agricultural users can make up for the water shortages caused by the EPA and other Delta protection standards.

Most transfers involve pumping the sold water out of the Delta. The same Delta protection standards that cause the shortages that provoke the need for transfers also can present severe constraints to those transfers. The State Department of Water Resources has done some analysis of transferability. Their results indicate that water transfers involving sellers other than Delta exporters may be limited to September-November. This means that the sellers would have to be able to store their water until then and the buyers would have to store the water south of the Delta or in the Bay Area after then. There are problems with providing that storage, not the least of which is the unavailability of unused storage capacity south of the Delta.

More detailed analysis of transferability is needed. Until such analysis is completed, considering the full array of Delta protection standards, water transfers cannot be assumed to "fill in the gaps" of the shortages caused by the Delta protectionstandards.

EPA sets forth their goal for western Delta salinity standards. This goal is to achieve salinities typical

of the late 1960's-early 1970's during February-June. Is the water cost of the proposed standards consistent with that goal?

No. In terms of water cost, the standards far exceed that goal. That goal should be achievable for a water cost no greater than about 0.7 maf/yr. [2]

The western Delta salinity standards would have to be modified significantly to be consistent with EPA's stated goal.

How does the water cost of the EPA standards compare with the water costs of other new federal requirements already in effect or being proposed?

These other requirements are discussed below. They consist of requirements under the federal Central Valley Project Improvement Act and requirements to protect three fish listed as threatened or endangered, the Winter-run salmon, the Delta smelt, and the Sacramento splittail.

If all of these requirements were in effect along with the EPA standards, the water cost could be even higher than for the EPA standards alone. The additional water cost cannot be estimated with much certainty for several reasons:

The endangered species requirements have been changing annually.

The recovery plans for these species have not been developed.

The take limits for endangered species have unpredictable effects on export pumping and, therefore, on water cost.

Requirements to achieve all objectives of the CVP Improvement Act have not yet been developed. Of particular concern is the requirement to double anadromous fish populations by the turn of the century. One of these anadromous fish, the striped bass, feeds on the endangered species, raising the possibility that if striped bass populations do double, more severe constraints might be

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[2] We explain this conclusion later. In brief--The goal is to achieve salinities in the western Delta typical of late 1960's-early 1970's. Salinities in the western Delta are controlled by Delta outflow. Therefore, the goal is to reproduce February-June Delta outflows as of the late 1960's-early 1970's. Therefore, the standards should cost no more than the increase in use in February-June since the late 1960's-early 1970's. This increase, most of which is in the form of increased Delta exports, is about 0.7 million acre-feet.

required for water projects to offset the increased predation of striped bass on endangered species.

However, despite these uncertainties, it is clear that the water cost of the EPA standards alone may be a considerable underestimate of the ultimate water cost of all the new federal requirements taken together.

We will now address several important background issues before considering the water cost estimates in more detail.

DEVELOPMENT OF PROPOSED WESTERN DELTA SALINITY STANDARDS

To put the water cost in context, we begin with an explanation of the basic steps used by EPA to develop the western Delta salinity standards.

Step 1: Hypothesize that the abundance of estuarine species is strongly and primarily determined by salinity in the western Delta. [3]

Step 2: Allegedly confirm that hypothesis with statistical correlations. In particular, confirm it by finding high correlations between the abundance of seven estuarine species and "X2." [4] Further conclude from these correlations that the period February-June is the most important for X2.

Step 3: Conclude that the proper location for X2 is where it was in the late 1960's-early 1970's for two reasons:

Conditions for estuarine fish were good prior to 1976.

The federal antidegradation policy, effective in 1975, and the state non-degradation policy, effective in 1968, require water quality as good as it was as of the effective dates of those policies.

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[3] Salinity in the western Delta, when averaged over a day or more, is determined by the Delta outflow that occurs in the period just prior to that averaging period. In other words, Delta outflow has a "memory effect" on western Delta salinity. When a storm occurs and Delta outflow increases, salinity drops and remains low for a time after the storm is over and Delta outflow subsides. Of course, over shorter periods of, say, several hours, salinity is strongly affected by the tides that move water back and forth from four to eight miles every 12 hours.

[4] X2 is a measure of western Delta salinity. Specifically, X2 is the distance from the Golden Gate bridge, in kilometers, of the location where the average salinity one meter off the bottom is 2.0 parts per thousand, about 6% as salty as sea water.

Step 4: Calculate a standard that will reproduce X2 in February-June as it was in the late 1960's-early 1970's. Step 4 consists of a number of sub-steps:

4a. EPA drew on results of the report cited above which included an equation relating western Delta salinity to Delta outflow based on data from the recent past.

4b. EPA concluded that the period 1940-1975 should be used to represent conditions in the period 1968-1975.

4c. EPA used daily data on Delta outflow and the equation from Step 1 to calculate X2, the location of the 2 ppt salinity line for each day in February-June in the years 1940-1975.

4d. EPA chose three locations, Roe Island, Chipps Island, and the confluence of the Sacramento and San Joaquin Rivers as control points.

4e. EPA divided the years 1940-1975 into the standard California year types, that is, wet, above normal, below normal, and dry. There were no critically dry years in that period.

4f. For the years in each year type, EPA found the average number of days in February-June that the 2 ppt line was downstream of each of the three control points.

4g. EPA extrapolated these four averages to get an estimate of the average number of days that 2 ppt would have been downstream of each of the three control points for critical years.

4h. EPA made these average number of days the standard, and allowed for the standard to be applied on the basis of a 14-day running average

Note that if Step 4 is completed correctly, it should result in X2 (and, therefore, Delta outflow) in February-June being what it was at least 19 years ago. In other words, if Step 4 is completed correctly, the water available for use or storage in February-June should be what it was 19 to 26 years ago.

Of course, D-1485, adopted in 1978, would have some water cost relative to 1975. However, as a rough approximation, the water cost of EPA's proposed salinity standard should be no more than the increase in February-June use since 1975, given that EPA's Steps 1-3 are valid. If it is more than that increase, we could conclude that Step 4 results in a standard more stringent than that required to conform with the "return to 1975" basis.

These four steps have another important implication, namely, that, in terms of these standards, X2 has no inherent ecological value. EPA could just as well have chosen X1.5 or X3. They would then have had to re-do the Step 4 calculations. Presumably, they would have arrived at much the same standard insofar as water cost goes.

After EPA had done much of the work in developing the X2 standard, Monismith (Interagency Ecological Studies Program Newsletter, Summer, 1993) published some data indicating that, fortuitously, X2 seemed to be at the upstream limit of the entrapment zone. While this means that X2 was, in retrospect, a good choice, it does not mean that some other salinity level could not have been chosen as the basis, resulting in standards that were just as protective and just as water costly.

This is a very important point. EPA is not proposing an X2 standard because they fundamentally want particular X2 values. Instead, they are proposing this particular X2 standard in order to return the habitat conditions (as measured by salinity) in February-June to what they were in the late 1960's-early 1970's. They could just as well have used Delta outflow and not bothered with salinity at all.

In fact, EPA suggests that their X2 standard could be implemented as a flow standard. Note from Step 4 above, that they really started with Delta outflow to calculate daily X2 values that were then analyzed to arrive at the standard, which could then be converted back to flow for implementation. This, again, points up the nature of X2 <u>as used in these standards</u> . It is a surrogate for returning February-June Delta outflows to the late 1960's-early 1970's rather that being a parameter of fundamental biological importanceitself.

Of course, the reason EPA did not simply use outflow is because they do not have the authority under federal law to set a flow standard. They <u>can</u> set a <u>water quality</u> standard, and X2 is a measure of water quality, namely, salinity.

ESTIMATING WATER COSTS

The water cost of the proposed EPA standards can be estimated by a three-step process:

1. Estimate the amount of water that can be delivered to urban and agricultural water users without the proposed standards.

2. Estimate the amount of water that can be delivered to urban and agricultural water users with the proposed standards. This will be a smaller amount.

3. Find the difference between the two amounts. This is the water cost of the proposed standards.

This three-step process has been completed by the State Department of Water Resources. We base our estimates of water cost on DWR's estimates. In addition, we will confirm DWR's estimates by another method developed by the Contra Costa Water District.

RESULTS OF ESTIMATES OF WATER COST

The estimates can be summarized as follows:

Estimates by the Department of Water Resources

If the combined state and federal export demand is 7.1 maf/year (roughly, current demand) and a conservative margin of error is provided (95% chance of compliance), the water cost of the EPA standards alone compared to D-1485 would be:

Average: 1.5 maf/yr
Critical Year: 3.1 maf/yr
Reduction in Carryover Storage: 2.5 maf

There is some concern that the particular method used by DWR may have overestimated the extra water required for desired margin of error at the two upstream stations, Chipps Island and the confluence of the two rivers. By the same reasoning, it would have underestimated the water required at Roe Island, the downstream station.

If the combined state and federal export demand is 7.1 maf/year (roughly current demand) and no margin of error is provided[5], the water cost of the EPA standards alone compared to D-1485 would be:

Average: 0.9 maf/yr
Critical Year: 1.6 maf/yr
Reduction in Carryover Storage: 0.6 maf

[5] There would be three general ways to avoid providing a margin of error. One would be to allow compliance to be measured on some sort of average basis. The other would be to convert salinity back into Delta outflow, as suggested by EPA in their request for comments. A third would be the "three ways to win" method of compliance recommended by the Contra Costa Water District.

If the existing Winter-run requirements are added to the EPA standards, the water costs noted above would change as follows:

Average: 0.2 maf/yr increase
Critical Year: 0.0-0.1 maf/yr increase
Reduction in Carryover Storage: 0.2-0.3 maf decrease

If the combined state and federal export demand is 6.0 maf/year (the demand a few years ago) the water costs noted above change as follows:

Average: 0.4 maf/yr decrease
Critical Year: no change (not enough water for 6.0 or 7.0 demand)
Reduction in Carryover Storage: 0.3-0.6 maf increase

There is some dispute over DWR's estimates of water required to comply with D-1485 alone. This dispute centers on DWR's use of "carriage water," water ostensibly required to keep salinity from intruding up the San Joaquin River, thereby degrading water quality in the southern Delta. If the carriage water requirements are, in fact, not needed, then DWR's estimates of water required for compliance with D-1485 could be high by several thousand acre-feet per year. Consequently, their estimates of water cost for EPA standards (which supersede carriage water in part of the year) would be low.

Estimates by the Contra Costa Water District

If the EPA standard for western Delta salinity had been in effect from 1968 to 1991, the additional Delta outflow ("water cost") would have been:

Average: 1.0 maf/yr
Critical Year: 1.6 maf/yr
Reduction in Carryover Storage: estimates not possible by this method

These water costs do not include any margin for error as some of the DWR estimates do.

Note that these estimates do not account for any changes in water project operations that may have occurred had the EPA standards been in effect in the past. This would tend to make these estimates somewhat higher than they should be. Nor do they account for the lack of D-1485 standards prior to 1978. This would also tend to make these estimates somewhat higher than they should be. Finally, these water cost estimates are based on actual Delta outflows in the past, so they inherently include past export demands that were substantially less than even the lower 6.0 maf/yr used

by DWR. This would tend to make these estimates of water cost lower than they should be.

Nevertheless, the CCWD estimates are consistent with the DWR estimates.

Estimates by both agencies support the conclusion that the water cost of the EPA standards is high.

DISCUSSION OF THE METHODS OF ESTIMATING WATER COST

While the three-step process of estimating water cost, described above, is straightforward in concept, it is confounded by several factors, the most important being the following:

- The EPA standards are not the only standards [6] of concern. The others are described briefly below:

  D-1485, the 1978 decision by the State Water Resources Control Board, includes requirements to protect Delta fish. These requirements are generally regarded as the absolute baseline of environmental protection. Some parts of the requirements listed below might also fall into the category of baseline requirements.

  Central Valley Project Improvement Act, a federal law containing several important requirements to protect fish and wildlife. This law pertains to the federal Central Valley Project. It requires the allocation of 800,000 acre-feet/year of Central Valley Project water to environmental protection. It also requires that actions, as yet not defined, be taken to double the population of anadromous fish by the turn of the century.

  Requirements to protect the Winter-run salmon, an endangered species, occur in three forms. The first of these, the "biological opinion," includes requirements to protect the species from extinction. The second, the "incidental take limits" limit the mortality of Winter-run salmon at the pumps where water is exported from the Delta. These requirements have been in effect since 1992, although the take limits are revised annually. The third form, the recovery plan, now being developed, would consist of measures to allow recovery of the Winter-run salmon population. These measures could include requirements for the water projects.

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[6] "Requirements" is probably a better term than "standards" and will be used herein to mean any rules set to protect environmental values in the Delta.

Requirements to protect the Delta smelt, a threatened [7] species, occur in the same three forms as for Winter-run salmon, that is, a biological opinion, incidental take limits, and a recovery plan. The first two of these were in effect last year and have been revised for 1994. The recovery plan is being developed.

The question arises: Which of these requirements or parts of these requirements, if any, should be included along with D-1485 as the basis for determining water cost. Put another way, in Step 1 above, just what does "without EPA standards" mean?

Obviously, the more requirements included in the basis of comparison, the lower the water cost of the EPA standards. For example, adding the current Winter-run requirements to D-1485 as the basis decreases the water cost of the EPA standards relative to D-1485 alone by roughly 400,000 acre - feet per year in critically dry years.

- o The water cost is affected by the agricultural and urban water needs. The more water that is needed, the greater the shortfall in deliveries ("water cost") that will occur. EPA has argued that the needs we are trying to meet are those that existed in the recent past. These needs amount to about 6.0 maf/yr to be exported out of the Delta by the State Water Project and the federal Central Valley Project.

  However, the current needs for Delta exports are, in fact, slightly over 7.0 maf/yr.

  Increasing the needs from 6.0 to 7.0 maf/yr increases the average water cost of the EPA standards by about 400,000 acre-feet per year. That is, the average shortfall is about 400,000 acre-feet per year more if we are trying to deliver 1.0 maf/yr more. This increase is in excess of the 0.5 to 3.0+ maf referred to above.

  The water cost for critically dry years does not increase as the need increases; in those years, there is not enough water to meet a 6.0 million acre-foot need, much less a 7.0 maf need.

- o The water cost increases if we assume that the proposed standard would be rigidly enforced. Rigid enforcement would require a margin of safety to ensure compliance. This margin of safety can be provided by having enough Delta outflow to keep the 2 ppt salinity somewhat downstream of (and X2 somewhat less that) what the standard requires. DWR

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[7] As a practical matter, there is little difference, in terms of protective requirements, between "threatened" and "endangered" species.

assumed a margin of safety that would ensure compliance with the standard most of the time.

This margin of safety roughly doubles the water cost. The upper values in the range of water costs cited above result from this margin of safety.

ERRORS IN THE CALCULATION OF THE WESTERN DELTA SALINITY STANDARD

Why would the proposed standards cost more water than necessary to conform with the late 1960's-early 1970's goal of EPA? The answer is that three errors were made in Step 4 of EPA's development of the western Delta salinity standards. These errors have been acknowledged by EPA and comments have been requested to correct them. Nevertheless, as proposed, the standards include these errors. They are as follows:

Using the average number of days as the standard, that is, making the average number of days for each year type the minimum number of days that must be achieved to comply with the standard. This results in making the x2 values that would have occurred, during dryer years of each year type, a violation of the standard. Therefore, for those drier years of each year type, the water cost for compliance would be great.

Extrapolating to get the average number of days for critically dry years. This extrapolation was done incorrectly and resulted in an overestimate of the number of days that X2 was downstream of the three locations in critically dry years. This means that compliance with the critical year standard would take far more Delta outflow than would have occurred if there had been critically dry years around 1975.

Using the period 1940-75 to represent the late 1960's-early 1970's. The early years of this period had far less water use than the late 1960's-early 1970's. Therefore, the water cost of compliance would be greater than that required to place X2 in the intended locations.

GENERAL EFFECT OF PROPOSED REFINEMENTS ON WATER COST

Note that refinements to the proposed standards are being considered by several parties:

A different relationship between X2 and Delta outflow has been developed by the Contra Costa Water District.

Surface salinity rather than bottom salinity has been considered.

Movement of salinity sampling stations has been considered.

If such refinements are recommended, they cannot be assumed to result in lower water cost. Such refinements would have to be incorporated into the Step 4 sub-steps described above. If the same sub-steps were used, the resulting standard should have about the same water cost.

On the other hand, "sliding scales" have been developed by DWR and by CCWD. These two sliding scales are similar. A sliding scale would tie the western Delta salinity standard more directly to runoff. Now, runoff is used to place each year in one of five categories ("year types," namely, wet, above normal, below normal, dry, and critically dry). This would eliminate the stepwise nature of the proposed standard. That is, with the proposed standard, slight changes in runoff can cause a shift from one water year type to another and a corresponding significant change in the western Delta salinity standards and water cost.