CHAPTER XII. ECONOMIC IMPACTS OF THE PREFERRED ALTERNATIVE

A. OVERVIEW

The proposed standards will reduce the amount of water pumped from the Delta by the SWP and the CVP below the amount permitted under D-1485. In addition, the standards will reduce the amount of water that can be diverted from tributaries of the San Joaquin River. These water supply impacts are discussed in detail in Chapter VII. Water deliveries to SWP contractors are also affected by the Monterey Agreement. Among the provisions of this agreement, made in December 1995, is a change in the way that deliveries are curtailed in dry years. In general, deliveries to agricultural contractors are cut back less and deliveries to urban contractors are cut back more than under the operating agreements previously in force.

The economic impacts presented in this chapter are based on a comparison of water deliveries under the preferred alternative and operations under the Monterey Agreement to deliveries under D-1485 and the operating agreement existing until December 1995. Because provisions of the ESA currently limit deliveries to below those permitted under D-1485, the economic impacts presented here are larger than those that would result from implementation of the plan given actual current conditions.

The economic impact of implementation of the draft plan on agriculture may vary substantially depending on the extent that water can be transferred between users and on the extent that growers are able to respond to reduced availability of surface water by changing crops and pumping groundwater. Under the most pessimistic scenario examined in this analysis, where water transfers are limited and growers are unable to change crops, losses in producers' net income average $14 million annually. However, with more water transfers and greater flexibility in plantings, losses could be lower than half this figure.

Total job displacement resulting from reduced agricultural production averages about 1,000 jobs under the most pessimistic scenario. Although this job displacement may cause individual hardship, it is small in comparison to total employment in the area and is likely to be absorbed by general economic growth.

Impacts on urban water users depend on utilities' ability to secure supplies of transferred water. If all of the water supplies are replaced by transferred water, the total cost to utilities will average $5 million annually. Payments to growers for transferred water will offset the income losses from reductions in water deliveries to agriculture. However, if water utilities respond to the standards by imposing rationing on their customers, the resulting shortage costs are estimated to be in the region of $33 million annually.

Detailed benefits of the preferred alternative could not be estimated because of resource constraints and uncertainty regarding water users' response to the draft plan. Moreover, the effect of regulatory action on fish populations is not known with certainty. However, a review of the literature covering the economic value of resources similar to the Bay-Delta system shows that the benefits of protection are potentially significant.

B. IMPACTS ON AGRICULTURE

1. Introduction

The proposed standards will reduce the amount of water delivered to growers by the SWP and the CVP and by irrigation districts on the east side of the San Joaquin valley. Growers will likely fallow acreage and change crops in response to reduced deliveries of water. In many cases, growers will be able to pump additional groundwater, use water transferred from other areas, use what water they have on high-valued crops, and improve their irrigation systems; these actions will offset the impacts of reduced deliveries. Nevertheless, agricultural production will be reduced because less water will be available overall. Growers' income will be reduced, both because production will be reduced and because groundwater and transferred water will be more expensive than project water. Reduced production will also result in job losses in agriculture and other industries in the areas affected by the reduced deliveries. These impacts are discussed in section D of this chapter.

The cost that the standards will impose on growers is measured as the impact of the standards on producers' net income. Producers' net income is defined as crop production receipts less operating costs. Operating costs include labor, fuel, seed, chemicals, and groundwater pumping. In other words, producers' net income is the return to land, improvements, management, and business risk. Because producers' net income includes the return to land and improvements, impacts on producers' net income include impacts on land values.

Impacts on gross crop production are also presented. These figures do not represent the impact on agriculture because about half of gross production receipts is spent on operating costs, which fall as production is curtailed. However, impacts on gross production are useful for comparison with production trends in recent years.

The economic analysis of the preferred alternative was done by estimating water supplies in 21 regions in the Central Valley under D-1485 and two alternative standards for which information was available in mid-October 1994. Economic models were used to estimate agricultural production in each region with these water supplies. When water deliveries under the preferred alternative became available, agricultural production under this alternative was estimated by interpolation. The economic impacts of the preferred alternative were estimated from the difference between agricultural production under D-1485 and agricultural production under the preferred alternative.

2. Water Supplies

a. <u>Project Deliveries</u>. The economic analysis was based on estimates of water deliveries to SWP contractors and CVP regions obtained from DWRSIM modeling studies. More information on the use of DWRSIM is in Chapters VI and VII. Water deliveries were estimated for 71 years of historical hydrology under D-1485 and the alternative standards under consideration by the SWRCB. Deliveries to CVP contractors were estimated from the DWRSIM output using a model of the control rules of the CVP developed by Larry Dale Associates in cooperation with Westlands Water District (Dale 1994).

b. Eastside Districts. No models of reservoir operations on the Merced and Tuolumne rivers are available. Consequently, it is uncertain how the requirements for additional flows in the San Joaquin River will affect deliveries to growers in irrigation districts diverting water from these rivers. For the purposes of this analysis, it was assumed that these eastside districts have no flexibility in operating their reservoirs and must reduce deliveries to growers by an amount equal to their contribution to the additional flow. Since some changes in reservoir operations are in fact possible, this assumption has the effect of exaggerating the economic impacts of the standards.

c. Other Local Supplies. Data compiled by the USBR were used to estimate local supplies in each region. Actual local supplies for the period of 1985–1992 were used to estimate local supplies that would be expected in the 71 years of DWRSIM deliveries. Throughout this analysis, it was assumed that, except for the eastside districts, availability of water from local supplies was not affected by the standards.

d. Groundwater. Groundwater use varies from year to year depending on the availability of surface water. Data compiled by the USBR for the period of 1985–1992 were used to establish a relationship between groundwater use and deliveries of surface water in each region. This relationship was used to estimate average groundwater use in each year with water deliveries under D-1485.

3. Assumptions and Methodology

a. General. The extent of the economic impacts of the standards depends largely on the ability of growers to use groundwater and transferred water and to change crops and irrigation systems. This ability is not known with certainty; consequently, impacts were estimated under a number of scenarios which embody various assumptions on the response of the agricultural sector to reduced water deliveries. All of the scenarios embodied the assumption that growers were not able to respond to reduced availability of water by changing their irrigation systems. Because this assumption removes one of the ways that growers can respond to water cutbacks, it tends to overestimate the economic impacts of the standards.

b. Year Types. It is impractical to do an analysis of economic impacts in every year for which simulated water deliveries are available. For the purposes of this economic analysis, the years were grouped into three year types, based on water deliveries. Because economic impacts depend on water deliveries rather than hydrologic conditions, this grouping is a better basis for economic analysis than a grouping based on hydrologic conditions. The low-delivery years are the seven years of lowest water deliveries under a particular standard. In this context, water deliveries means the total of CVP deliveries, SWP deliveries, and local supplies. The high-delivery years are the 36 years with the highest water deliveries, and the medium-delivery years are the remaining 28 years. The grouping is done independently for each standard. For example, the seven low-delivery years under D-1485 are not the same years as the seven low-delivery years under any of the alternative proposed standards.

c. Groundwater Use. The effect of the standards on groundwater use is complex and only partially predictable. In the short run, growers with access to groundwater are likely to partially substitute groundwater for project deliveries. However, with continued groundwater use, it is likely that groundwater will become less easily available. Water levels will fall as a result of increased pumping. Costs will increase and, in some areas, groundwater may become less available because of water quality problems or other physical limitation. It is also possible that concern over depletion of groundwater may lead to restrictions on pumping.

Two alternatives on groundwater use were considered in the analysis. In the first, groundwater use is assumed to increase with water shortages in the same way as it has in recent years. The relationship between water deliveries and groundwater use discussed in section 2.d of this chapter was used to estimate groundwater use in each region under the reduced deliveries following the implementation of the standards. This alternative represents the likely short-term response of growers to reduced deliveries of project water.

In the second alternative, groundwater use is restricted to current amounts, but with higher costs resulting from several years of increased pumping. Because reduced deliveries are likely to result in increased groundwater use for several years, this represents a lower limit on the ability of growers to substitute groundwater for project water and so will tend to exaggerate the economic impacts of the standards.

d. Water Transfers. The extent to which growers are able to use water transferred from other areas is of crucial importance in this analysis. Reductions in water deliveries to growers of high-valued vegetable and tree crops, or growers in areas with favorable soil and climatic conditions, will have large economic impacts. These impacts will be mitigated significantly if these growers can use water transferred from growers of low-valued crops or growers in less productive areas.

The extent to which water transfers will increase as a result of the standards is uncertain. Growers of high valued crops will have a strong incentive to secure water to replace that lost from cutbacks. State policy encourages transfers which do not adversely affect legal users of water and do not unreasonably affect fish and wildlife. However, transfers may be limited the availability of facilities to transfer the water. Transfers are discussed in Chapter X, section C.

Two alternatives were considered on the extent of water transfers following the introduction of the standards. In the first alternative, cropping patterns are estimated, assuming water can be transferred freely within each of the 21 regions, but not between regions. Since transfers between regions take place, this alternative understates the extent of transfers actually occurring. Moreover, transfers are likely to increase after the introduction of the standards, since reduced water deliveries will increase incentives to transfer water. Because transfers will mitigate economic impacts, this alternative will tend to exaggerate the economic impacts of the standards.

In the second alternative, the San Joaquin Valley was divided into two regions and it was assumed that water can be transferred freely within each of these regions, but not between the two regions. The first region consisted of the eastside districts supplied by the San Joaquin River and its tributaries; the second region was the remainder of the San Joaquin Valley. This alternative illustrates an example of how economic impacts can be mitigated by transfers.

Neither of these alternatives contain trades from the Sacramento Valley to the San Joaquin Valley. Such transfers have occurred in the past and are expected to occur in the future. These transfers would mitigate the economic impact of the standards, because water, generally, is more available, and has less economic value, in the Sacramento Valley. The ability of water users to transfer water across the Delta will be subject to maintenance of the new water quality standards.

e. Crop Changes. Two alternatives on the way in which growers adjust their crop mix in response to water shortages were used in this analysis. In the first alternative, it is assumed that the only possible response to reduced water availability is to fallow some acreage. A rationing model developed by Zilberman (Dale 1994) was used to estimate how cropping patterns would respond to reductions in water deliveries under this alternative. In this model, crops are ranked within regions in order of their return to each acre-foot of irrigation water. As water supplies are reduced, crops are taken out of production in order of their net returns to water.

This model embodies the assumption that growers are always able to fallow their least-profitable crops. This is obviously a simplification of growers' actual response to reduced deliveries. In many cases, low-valued crops are planted in rotation with higher-valued crops for agronomic reasons, such as replenishment of soil nutrients or pest control. However, crop rotations are not fixed. It is likely that in years of extreme water shortages, growers use what water they have on their higher valued crops, while in years with more moderate water shortages, the need to maintain rotations has some affect on plantings.

The rationing model also embodies the tacit assumption that water can be transferred freely within each region. This assumption is a reasonable approximation of current practices. The regions in the model correspond roughly to irrigation districts or groups of irrigation districts. Trades or sales of water between growers within the same irrigation district are very common. Exchanges between irrigation districts are less common, but still fairly frequent.

In the second alternative, it was assumed that growers are able to respond to reduced water deliveries by changing crops in a way to maximize their profits under reduced water availability. The Central Valley Agricultural Production Model (CVAPM) developed by the

University of California, the DWR, and the USBR (Dale 1994) was used to estimate agricultural production in each region with the water available in each year type.

This model assumes that growers continually adjust production levels in an effort to maximize their returns on investment. In practice, growers' flexibility is limited in the short run. Consequently, production levels indicated by the model are a long-run response to changing conditions. As used in this analysis, the model implicitly assumes that growers adjust their production levels to average water supplies in the three year types. However, water supplies vary from year to year, so there will not actually be a movement toward the production levels that are optimum for supplies in the three year types. The actual long-run response to the standards will be an adjustment to lower, but variable, water availability. As a result, the model will tend to underestimate economic impacts because a complete long-run response to average supplies in each year type is never achieved.

f. Scenarios Used in Analysis. Four scenarios were developed by combining the alternatives on crop changes, groundwater use, and water transfers. Economic impacts were estimated for these scenarios. The less restrictive alternative on groundwater use was combined with the less flexible alternative on crop changes to give a "Non-Adaptive Scenario". This scenario restricts growers' ability to respond to reduced water deliveries by changing crops but allows them to pump additional groundwater. This scenario is intended to represent the immediate economic impacts of the standards; however, it overestimates economic impacts because even in the short run, some changes in crops are possible.

A second scenario was formed by combining the flexible alternative on crop changes with the more restrictive alternative on groundwater use. This "Adaptive Scenario" gives an indication of the economic impacts occurring after growers have had time to adapt to reduced project deliveries. The more restrictive alternative on groundwater use was used in this scenario because the high levels of pumping implied by the current relationship between groundwater use and deliveries of surface water cannot continue indefinitely.

Each of these two combined scenarios on crop changes and groundwater use was combined with the two alternatives on water transfers to give a total of four scenarios for which impacts were estimated. These scenarios are summarized in Table XII-1.

Table XII-1. Scenarios Used in Estimation of Economic Impacts

Alternative on crop changes and groundwater use	Alternative on Water Transfers	
	Within regions only	Within groups of regions
Non-adaptive No changes in crops, increased groundwater available.	*Scenario 1.* Gives an overestimate of immediate impacts of standards.	*Scenario 2.* Gives an underestimate of immediate impacts of standards. Extent of underestimation depends on how restrictive assumption on crop changes is offset by unrestrictive assumption on transfers.
Adaptive Crop changes, groundwater use restricted to current amounts.	*Scenario 3.* May give an overestimate of impacts occurring after growers have had some time to adapt because transfers are limited and growers are assumed not to change irrigation systems.	*Scenario 4.* Gives an underestimate of impacts occurring after growers have had some time to adapt.

4. Results

The cost to the agricultural sector of the SWRCB's preferred alternative may vary substantially depending on the ability of growers to change crops and use transferred water. Under Scenario 1, the most restrictive scenario, losses in net income average $14 million per year (Table XII-2). Losses are mitigated substantially by water transfers and the ability to change crops. Under Scenario 2, where water can be transferred freely within the two San Joaquin valley regions, losses are only $7 million. Transfers within the San Joaquin Valley are unlikely to be as high as implied in this scenario. However, transfers between regions are likely to increase following the introduction of the standards. Under Scenario 1, at least two-thirds of the losses in net income occur in western Fresno County. Water is very valuable in this area, particularly in low-delivery years. Growers in this area will have strong incentive to seek transfers from areas where water has less value, such as western Merced and Stanislaus counties. In addition, transfers from the Sacramento Valley to the San Joaquin Valley are likely to increase because of reduced project deliveries.

Table XII-2. Impacts on Agriculture of the Preferred Alternative

	Loss in crop production (million $/year)				Loss in producers' income (million $/year)			
	Low-delivery years	Medium-delivery years	High-delivery years	Average over all years	Low-delivery years	Medium-delivery years	High-delivery years	Average over all years
Scenario 1	49	21	9	18	30	16	9	14
Scenario 2	8	9	4	6	7	7	6	7
Scenario 3	45	39	22	31	9	3	4	4
Scenario 4	-3	-19	-10	-13	0	-3	-1	-2

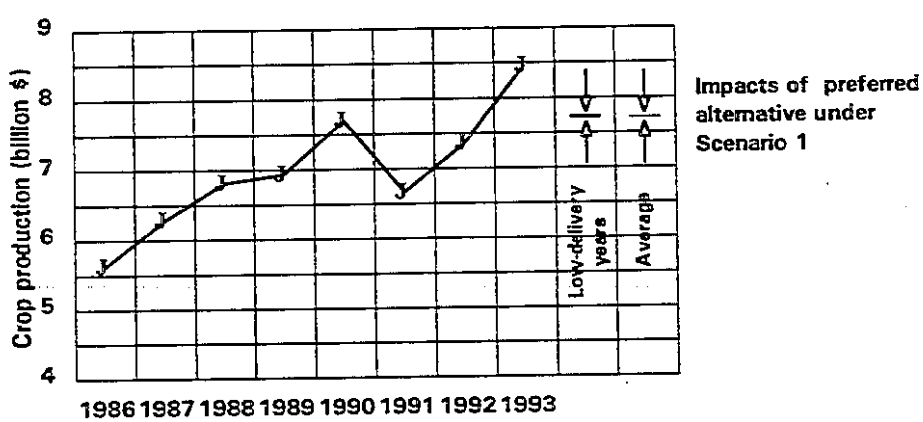
The ability to change crops also reduces impacts. Under Scenario 3, losses in net income are $4 million, showing that the gains from crop changes outweigh the losses from the more restrictive assumption on groundwater use. Under Scenario 4 there is a slight gain in net income, indicating that the gains from crop changes and extensive transfers outweigh the effects of the standards.

Economic impacts are substantially higher in dry years. Under Scenario 1, losses in the years of lowest deliveries average $30 million. This loss falls to $7 million under Scenario 2 and $9 million under Scenario 3.

All of these impacts show the effect of a change from deliveries under D-1485 and the former operating agreement of the State Water Project to deliveries under the preferred alternative and the Monterey Agreement. Because the Monterey Agreement gives agricultural water users more water in drier years, impacts will be greater if measured using D-1485 and the Monterey Agreement as a base. As noted earlier, estimates of economic impacts are based on economic analysis done using information available in October 1994. Consequently, no analysis could be made of the impact of the increase in water deliveries occurring as a result of the Monterey Agreement. However, the results suggest that in the absence of changes in water quality standards, the Monterey Agreement will result in an increase in net income of $5–10 million in low-delivery years and up to $5 million in medium-delivery years. The Monterey Agreement will have no effect in high delivery years. Thus, impacts measured using D-1485 and the Monterey Agreement as a base will be $5–10 million greater in low-delivery years and up to $5 million greater in medium-delivery years than the figures presented in Table XII-2.

Losses in crop production range widely, depending on year type and assumption on transfers and crop changes. However, these losses are within the range of the normal fluctuation in agricultural production in the last several years. Between 1986 and 1990, crop production in the eight San Joaquin Valley counties increased by an average of $520 million annually (Figure XII-1). Under Scenario 1, the loss in low-delivery years resulting from the preferred alternative is $49 million but averages only $18 million.

Figure XII-1. Recent Crop Production and Impacts of Preferred Alternative



C. IMPACTS ON URBAN WATER USERS

1. Introduction

The proposed standards will reduce deliveries of SWP and CVP water to water wholesaling agencies. The water deliveries affected will be SWP deliveries to the Metropolitan Water District of Southern California (MWD) and SWP and CVP deliveries to the Santa Clara Valley Water District (SCVWD). Opportunities for developing new water supplies are very limited. Consequently, these agencies and retail water utilities that they serve are likely to respond by arranging transfers of water from agricultural users, increasing use of recycled water, reducing water use by more extensive conservation programs, and perhaps imposing rationing on their customers.

Because of resource constraints, this analysis does not examine the extent to which water utilities might increase use of recycled water and reduce water demand further by conservation programs. Consequently, economic impacts were estimated under the assumption that the only options available to water utilities are additional water transfers and rationing. To the extent possible, wholesaling agencies and water utilities will try to avoid rationing by arranging water transfers, since the cost of transferred water is far lower than the shortage costs that occur as a result of water rationing. However, transfers are limited by the factors discussed in Chapter X, section C and lack of physical transfer capacity at the time of year when the water can be used by water utilities. The SCVWD is particularly limited by a lack of physical transfer capacity.

Modeling results reported by the USEPA (USEPA 1994) indicate that significant transfer capacity exists in the SWP system in late summer. In order to make use of this capacity, the MWD and the SCVWD would need to increase storage near their service areas, since the transfer capacity is not available at the same time as the transferred water could be used. The SCVWD's storage capacity is currently limited. The MWD is in the process of increasing its storage capacity.

Because the extent to which water agencies will be able to replace project deliveries with transferred water is unknown, economic impacts of two scenarios were estimated. In one scenario, it is assumed that the entire reduction in water project deliveries is replaced by water transfers. The value of the impacts was estimated as the cost of the replacement water. Estimates of the cost per acre-foot of replacement water were developed in consultation with planning staff of the MWD and the SCVWD. The cost of transfers to the MWD was estimated as $200 per acre-foot, and the cost of transfers to the SCVWD was estimated as ranging from $250–350 per acre-foot.

In a second scenario, it is assumed that no additional water transfers can be made so that reduced deliveries result in water rationing. The value of impacts was estimated as the shortage costs resulting from this rationing. Shortage costs were estimated using a cost function developed by Larry Dale Associates (Dale 1994). The function is as follows: for shortages of up to 10 percent, shortage costs are $1,400 per acre-foot; for shortages of 10 to 20 percent, shortage costs are $1,700 per acre-foot; and for shortages over 20 percent, shortage costs are $2,000 per acre-foot.

2. Results

Under the transfer scenario the total cost of transferred water averages $5 million annually; costs average $30 million in the seven low-delivery years. The total amount of water transferred to both service areas averages 23,000 acre-feet over all year types and averages 130,000 acre-feet in low-delivery years. More details are given in Table XII-3. A study of SWP operations (Dale 1994) indicated that sufficient capacity exists to make these transfers. However, for several reasons, transfers may be limited to less than these amounts. For example, in dry years, less water may be available for transfers.

Because water utilities have good access to credit and can borrow to cover high costs occurring in dry years, the average costs over all years are the relevant measure of costs to utilities. Under the transfer scenario, the average cost of transferred water to the MWD is less than two tenths of one percent of the total retail cost of water delivered to urban users in southern California. The average cost of transferred water to the SCVWD is about three tenths of one percent of the total retail cost of water delivered to the south San Francisco Bay Area.

Table XII-3. Impacts of Preferred Alternative on Urban Water Users

	Seven low-delivery years	71-year average
Metropolitan Water District		
Reduction in deliveries (acre-feet)	105,000	15,000
Cost of transfers ($ million)	21	3
Additional shortage costs if no additional transfers possible ($ million)	147	21
Santa Clara Valley Water District		
Reduction in deliveries (acre-feet)	25,000	8,000
Cost of transfers ($ million)	9	2
Additional shortage costs if no additional transfers possible ($ million)	43	12

Under the second scenario with no additional transfers, shortage costs in both agencies' service areas were estimated as averaging $190 million in the low-delivery years (Table XII-3). These costs are additional to shortage costs occurring under baseline conditions. Over all years, shortage costs average $33 million annually.

Shortage costs represent the value lost to consumers as a result of reducing water use below desired levels, rather than out-of pocket expenses for increased water bills. Shortage costs are a measure of value of the cost and inconvenience to consumers of reducing water use in response to rationing and price increases. These costs reflect the following responses. Some consumers will pay more rather than reduce their use, some consumers will reduce their water use by purchasing water-saving devices, and some consumers will choose to bear the inconvenience of using less water.

These impacts represent the combined effect of the introduction of the standards and the change in SWP operation specified in the Monterey Agreement. Because the Monterey Agreement will reduce deliveries to urban contractors in dry years, impacts will be smaller than those presented in Table XII-3 if the Monterey Agreement is included in the base. In the case of MWD, about 30 percent of the impacts in the seven low-delivery years result from the Monterey agreement. For SCVWD, about 40 percent of the impacts in the seven low-delivery years result from the Monterey agreement.

D. IMPACTS ON REGIONAL ECONOMIES

1. Extent of Impacts

a. General. Reductions in water deliveries to agriculture will affect all sectors of the economy. When farm production falls as a result of reduced water availability, growers will hire fewer seasonal workers and may lay off some year-round workers. Until they find other jobs, consumer spending by these workers is likely to fall, affecting retailers and other businesses in the area. In addition, growers will reduce purchases of equipment, materials, and services from local businesses, reducing jobs and income with these suppliers.

Job and income losses resulting from the preferred alternative were estimated using input-output analysis, a widely-used economic technique. The procedure is described in section D.2 of this chapter. Input-output analysis usually overestimates indirect job and income losses. One of the fundamental assumptions in input-output analysis is that trading patterns between industries are fixed. This assumption implies that suppliers always cut production and lay off workers in proportion to the amount of product supplied to farms or other industries reducing production. In reality, businesses are always adapting to changing conditions. When a farm cuts back production, some suppliers will be able to make up part of their losses in business by finding new markets in other areas. Growth in other parts of the local economy will often provide opportunities for these firms. For these and other reasons, job and income losses estimated using input-output analysis should be treated as upper limits on the actual losses expected.

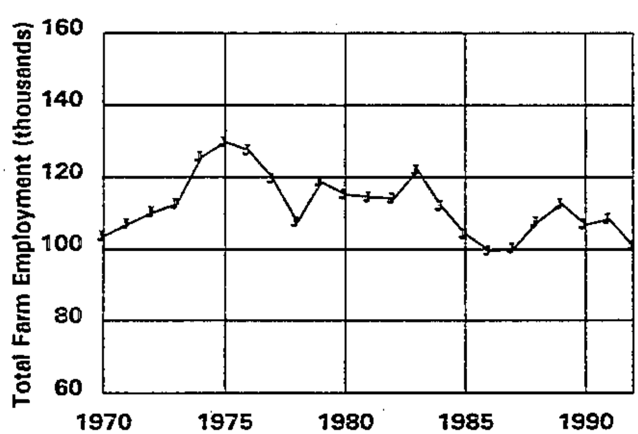
b. Employment Impacts. The effect of the preferred alternative on employment may vary substantially, depending on the extent to which growers change crops or use groundwater and transferred water. Under Scenario 1, where crop changes and access to transferred water are limited, the number of jobs displaced in the agricultural sector is estimated to average about 230 over all years, but climbs to about 640 in low-delivery years (Table XII-4). However, under Scenario 2, where water can be transferred throughout the San Joaquin Valley, job displacement is significantly lower, particularly in low-delivery years. Short-term job impacts are likely to be higher than the displacements shown for Scenario 2. However, Scenario 2 gives an indication of the potential effect of water transfers on job impacts.

Table XII-4. Regional Employment Impacts of the Preferred Alternative

	Direct job displacement				Indirect job displacement			
	Low-delivery years	Medium-delivery years	High-delivery years	Average over all years	Low-delivery years	Medium-delivery years	High-delivery years	Average over all years
Impacts of reduced deliveries to agriculture								
Scenario 1	640	270	120	230	900	380	170	320
Scenario 2	100	120	50	80	140	170	70	110
Scenario 3	590	510	290	400	830	710	410	560
Scenario 4	-40	-250	-130	-170	-60	-350	-180	-240
Impacts of transfers to urban users								
Hay and grains only	160	—	—	30	220	—	—	40
Hay, grains, field crops	420	—	—	80	590	—	—	110

This job displacement is within recent fluctuations in farm employment. Farm employment in the San Joaquin Valley has gradually drifted downward since the mid-1970s, fluctuating by an average of 5,600 each year since 1975 (Figure XII-2). The job displacement under Scenario 1 in low-delivery years—the most severe condition—is about three-quarters of the drop in farm employment between 1980 and 1981.

Figure XII-2. Farm Employment, San Joaquin Valley



It should be emphasized that these displaced jobs do not represent a permanent job loss to the region. Regional job markets are affected by growth in all sectors of the economy and migration to and from the area. Moreover, the agricultural labor force is very mobile with a high proportion of seasonal workers. A job displacement in agriculture is likely to result in a slight decrease in net migration into the area and a change in seasonal movements of workers. As a result, the effect of the standards on the number of unemployed farm workers in the area will be smaller than the job displacement indicated by this analysis, and will gradually decline as migration patterns change and the rest of the economy grows.

Job displacements in other sectors of the economy range up to 560 when averaged over all years. In the low-delivery years, indirect job displacements range up to 900. Although these job losses will cause individual hardship, they are small in comparison to total employment in the San Joaquin Valley. Total employment in the eight San Joaquin counties is just over 1,000,000. The region added an average of 23,000 jobs annually between 1980 and 1990. The area has lost jobs in recent years, but job growth is likely to resume as California's economy recovers, absorbing this job displacement.

c. **Income Impacts**. Income losses also give an indication of the extent of impacts on the region's economy. Income losses are estimated using input-output analysis and like the estimates of employment impacts, should be treated as upper limits. Income losses as estimated by input-output analysis will occur only if displaced workers are unable to find other jobs and businesses supplying growers and their employees have very limited ability to find new markets.

In low-delivery years, the estimated losses in personal income resulting from the SWRCB preferred alternative range up to $40 million depending on transfers, groundwater use, and the ability of growers to change crops (See Table XII-5). These income losses are small in comparison to total personal income in the region. Between 1980 and 1990, personal income in the San Joaquin Valley counties increased from $14.4 billion to $21.0 billion when measured in constant 1992 dollars.

Table XII-5. Regional Income Impacts of the Preferred Alternative

	Total job displacement				Loss in personal income (million $/year)			
	Low-delivery years	Medium-delivery years	High-delivery years	Average over all years	Low-delivery years	Medium-delivery years	High-delivery years	Average over all years
Impacts of reduced deliveries to agriculture								
Scenario 1	1,540	650	290	550	41	21	12	19
Scenario 2	240	290	120	190	11	13	8	10
Scenario 3	1,420	1,220	700	960	33	28	16	23
Scenario 4	-100	-600	-310	-410	-2	-14	-7	-9
Impacts of transfers to urban users								
Hay and grains only	380	—	—	70	—	—	—	—
Hay, grains, field crops	1,010	—	—	190	—	—	—	—

d. <u>Impacts on Industries Processing and Using Farm Products</u>. The impacts discussed in the preceding section are limited to impacts resulting from losses in farm jobs and reduced purchases by growers. In addition to these impacts, there will be impacts on industries processing, distributing, and using farm products. If these industries reduce their output, there will be additional indirect impacts.

Not enough information was available to allow estimates of these impacts to be made. Reduced availability of locally-produced farm products will affect every industry differently. In some industries, such as fruit and vegetable canning and drying, there is a strong linkage between production and availability of locally-produced materials. These industries may be forced to reduce their output if local farm production is reduced. However, in many industries, such as bakery products, production is driven by other factors, such as markets in nearby urban areas. Output in these industries is less likely to be affected by changes in local farm production.

Reduced production of grains and alfalfa is likely to affect the dairy industry. Alfalfa, a high water use crop, will likely be grown in lesser amounts in the San Joaquin Valley. Reductions in alfalfa production could have an impact on the dairy industry, which relies heavily on alfalfa as a food source. The remainder of this subsection is based on comments submitted by Western United Dairymen (Northwest Economic Associates 1994). The accuracy of this information has not been verified by SWRCB staff.

Most of the alfalfa consumed in California is produced in the state. California alfalfa production in 1992 was 6.4 million tons, of which 41 percent was produced in the northern San Joaquin and Sacramento valleys, 18 percent in the southern San Joaquin Valley, and 41 percent in southern California. Because of high transportation costs, alfalfa is used primarily in the region it is produced.

Dairy cows account for about 50 percent of total state alfalfa consumption. About 25 percent of the state's dairies are located in the southern San Joaquin Valley, producing approximately 35 percent of the state's milk. These dairies are likely to be most affected by the proposed standards.

The primary impact on the southern San Joaquin dairies of reduced alfalfa acreage would be higher costs to transport alfalfa from more distant locations. In addition, the acreage reductions could increase alfalfa prices.

Northwest Economic Associates estimated the acreage reductions, price increases and additional transportation costs that would result from various levels of water shortage. Dairy industry cost increases are measured as the increased delivered costs of alfalfa that must be purchased to make up for regional shortfalls. These estimates were made independently of the estimates of changes in acreage described in section B of this chapter. According to this analysis, dairy industry costs would increase by $5.5 million at water shortages of 30 percent, and $13.8 million at water shortages of 50 percent. These costs represent 0.2 and 0.5 percent of total industry revenues, respectively. The costs would be split between the dairy industry and consumers in an unknown manner, depending on whether the dairy industry is able to pass on increased costs by raising prices.

e. Impacts of Transfers to Urban Use. Transfers of water to urban use may have economic impacts in the areas from which the water is transferred. To the extent that transfers depend on land fallowing, these impacts will depend on the crops fallowed by the transferring growers. Impacts will generally be lowest if grains and pasture are fallowed to release water for transfer, and higher if field crops or vegetables are fallowed. Regional impacts will be offset by funds received for water transfers. If growers use these funds to make improvement to their operations, this spending will offset the impacts of crop fallowing.

Growers are likely to fallow their lowest valued crops when releasing water for transfer. The direct and indirect job impacts of the transfer discussed in section C of this chapter are shown in Table XI-4. If there are no offsetting job gains from spending of transfer funds, job displacement in low-delivery years are estimated as about 400 jobs when the fallowing is confined to hay and grains, and about 1,000 jobs when the fallowing is evenly divided between hay, grains, and field crops. Job displacement from water transfers is insignificant when averaged over all year types. The effect of this job displacement on local labor markets will depend on how the fallowed acreage is distributed. However, if the fallowed acreage is distributed throughout the Central Valley, job impacts on labor markets will be insignificant even in low-delivery years.

2. Details of Estimation Methods

Wage losses in agriculture were estimated from changes in agricultural production using a ratio of labor costs to sales derived from statistics published in the *1987 Census of Agriculture* (U.S. Department of Commerce 1989). Payroll-to-receipts ratios ranged from 12 percent for farms primarily growing cash grains (SIC 011) to 31 percent for farms primarily growing vegetables, fruits, and tree nuts (SIC 017, 018). This analysis used the ratio for general crop farms (SIC 019), which was 20 percent. Employee benefits in agriculture are lower than in other industries, so wages represent nearly all of labor costs. Wages were estimated as 90 percent of labor costs. The number of year-round equivalent direct jobs displaced was estimated from the wage loss using average weekly earnings for crop production workers in the San Joaquin Valley (Employment Development Department no date).

Impacts on farm income were estimated by multiplying impacts on total crop production by the ratio of farm income and agricultural production for the San Joaquin Valley in the years 1986–1992. Farm income consists of agricultural wages and salaries plus income of farm proprietors. The ratio was estimated from crop production as reported by the California Department of Food and Agriculture and farm income as estimated by the U.S. Bureau of Economic Analysis.

The regional effects of reduced farm production were estimated using input-output analysis. Multipliers were estimated using the Implan system (1991 database), developed by the Minnesota Implan Group, Stillwater, Minnesota. The job multiplier for the region consisting of the eight San Joaquin Valley counties was estimated as 2.4 and the income multiplier was estimated as 2.7.

The job multiplier gives an estimate of the total number of jobs supported by each job in crop production. The multiplier includes the job in crop production. Thus, the multiplier for the San Joaquin Valley indicates that each job in crop production supports 1.4 jobs with suppliers and in businesses serving employees of farms and businesses supplying farms. The indirect job displacement shown in Table XI-4 was estimated using this figure.

The income multiplier gives an estimate of the total amount of income in the region created by each dollar in income in agriculture. Again, since the multiplier includes the income in agriculture, the multiplier for the San Joaquin Valley indicates that every million dollars in wages and salaries and proprietors' income in agriculture supports $1.7 million in personal income in the rest of the economy.

E. IMPACTS ON HYDROELECTRIC POWER PRODUCTION

1. Introduction

Hydroelectric power generation plants provide approximately 24 percent of California's electricity generating capacity. The system provides inexpensive peak power production. It is particularly valuable since it can be turned on and off to match daily load swings. Also, it displaces fossil-fuel generation in urban areas during the hottest part of the day, decreasing air pollution.

The proposed water quality standards will affect hydropower by requiring additional reservoir releases during the spring. As a result, hydroelectric power production will be shifted from the summer, when it is most valuable, to spring. The costs of lost summertime hydropower will be borne by the municipal utilities that purchase their lowest cost power from the Western Area Power Administration (WAPA).

The standards will also increase peak loads on the systems of the Pacific Gas and Electric Company and Southern California Edison. Energy use during the summer months is likely to increase as growers respond to reduced deliveries of SWP and CVP water by increasing groundwater pumping. The costs of increased agricultural pumping will be incurred by agricultural energy customers. These costs are included in the impacts discussed in section B of this chapter.

In addition, decreases in hydroelectric generation during the summer can be expected to increase generation from less efficient thermal power plants, increasing air pollution. The costs of increased air pollution will likely be borne by residents located near PG&E's natural-gas fired power plants.

The following analysis of the impact of the plan on hydroelectric power generation was provided by the Association of California Water Agencies (ACWA) and the WAPA (Beck 1994 and WAPA 1995). Costs represent increased CVP capacity costs, increased groundwater pumping costs, and increased air pollution costs.

2. Effect on CVP Hydroelectric Capacity Requirements

In the process of storing and transporting water for delivery to agricultural and municipal water users, the CVP both produces and consumes hydroelectric power. The hydropower produced is sold to municipal and agricultural customers by the WAPA. The CVP's hydroelectric facilities include Shasta Dam and Folsom Dam in northern California. The CVP hydrosystem capacity is approximately 1,800 megawatts (MW).

The objectives in the plan will result in shifting water releases, and CVP hydropower generation, to the winter and spring months at the expense of summer power generation. This shift will cost WAPA and its customers about $25 million annually from a long-term or regional perspective when compared to D-1485. This cost represents the value of lost summer hydroelectric capacity, offset by revenue generated by selling surplus capacity during the non-summer period, and energy savings from decreased project pumping. The loss of summertime hydropower capacity and energy will be borne by municipal utilities that purchase their lowest cost power from the WAPA.

Capacity is the amount of resources necessary to meet demand at any time. When the capacity of a resource is reduced, for example due to less storage in reservoirs, the utility must either purchase or build replacement capacity. Increased capacity costs for the CVP equal the amount of summer hydroelectric capacity that is lost relative to the base case. Capacity purchases are usually made on an annual rather than monthly basis. As a result, surplus capacity will be available for sale during certain times of the year.

The CVPIA created the CVP Restoration Fund, which provides for payment of up to $50 million annually for enhancements of the CVP project. Payment into the fund is allocated among power and water customers. To the extent that contributions from water users are reduced due to reduced water deliveries, the CVPIA requires that power customers increase their contributions to make up the difference. Reductions in water deliveries could result in additional payments of $1.8 to $3.0 million annually to the fund by power customers. This cost is a transfer from water customers to power customers.

In addition to the impacts associated with changes in energy production, there are also secondary effects associated with each alternative. These include the drawdown of New Melones Reservoir which could prevent that project from providing reserves to the CVP system, and reduced operational flexibility of the CVP hydroelectric facilities resulting in a long-term reduction in competitiveness of the project. (R.W.Beck, 1994)

3. Increased Groundwater Pumping

Reductions in water deliveries will likely translate into increased groundwater pumping, increasing agriculture's demand for energy, especially during the summer months. Agriculture demands about three percent of the load in the PG&E and SCE territories (McCann et. al 1994). Upwards of 70 percent of this load is related to groundwater pumping. An estimate of increased groundwater pumping was made by M. Cubed (McCann et. al 1994). That estimate was made independently of the cost estimates appearing in the section B of this chapter. The value of increased capacity required for agricultural pumping, according to M. Cubed, would be between $16.0 million and $16.5 million for the 1995 - 2000 period. Most of this cost would be incurred by agricultural energy customers (McCann et. al 1994).

4. Air Quality

The shifting of energy from the summer to other times of the year and the added capacity required for agricultural groundwater pumping could impact air quality. Decreases in hydroelectric generation during the summer can be expected to increase generation from less efficient thermal power plants.

For all three alternatives, the annualized costs are about $2.5 million per year for the 1995-2000 period. These costs are based on standard unit emission costs used by the California Energy Commission. The costs of increased air pollution will likely be borne by residents located near PG&E's natural-gas fired power plants, such as those in Pittsburg, Antioch, Moss Landing, Morro Bay, and Hunters Point. (McCann et. al 1994)

F. BENEFITS

The preferred alternative is capable of producing a wide range of benefits. Due to information limitations, however, the specific economic values of those benefits could not be estimated. In lieu of specific estimates, this section will qualitatively describe the preferred alternative's benefits, and, by way of illustrating the likely magnitude of those benefits, summarize the findings reached in other, related studies.

The preferred alternative's benefits range from those that would accrue to those who use Bay-Delta resources directly (such as commercial and recreational anglers), while others would accrue to people who do not even visit the Bay-Delta. Estimating the value of some of these benefits is a relatively simple matter of recording their effects on market transactions. Increased income from improved commercial fishing harvests can be measured in this way (provided that changes in fish populations are known). Other categories of benefits have little or no effect on markets. Hunting, fishing, and hiking are examples of active use benefits which can only be partially estimated by observing market behavior. Passive use values are held by people who may never use a good they value. People who may never visit the Sacramento-San Joaquin Delta, for example, might be willing to pay to improve conditions there. Passive use values include: (a) the satisfaction of knowing that certain valuable environmental qualities remain unthreatened (existence value); (b) preserving the option to make future use of qualities such as these (option value); and (c) knowing that qualities such as these will be available to future generations (bequest value).

The techniques used for estimating the value of benefits which have little or no effect on private markets yield values which are functionally equivalent to market prices, and which are sufficiently accurate for use in the public policy decision-making process (Arrow et al. 1993; Carson et al. 1994; Mitchell and Carson 1989; Madriaga and McConnell 1987; Cummings et al., 1986). The two techniques most widely used for this purpose are the travel cost and the contingent valuation methods.

The baseline conditions used to estimate the impacts on urban and agricultural water users, discussed earlier in this chapter, are those allowable under the standards contained in D-1485. Due to various endangered species requirements, exports are currently well below those permitted under D-1485. As a result, environmental conditions are currently better than they would be if exports were to increase to full D-1485 levels. For the recent 1984-1992 period, the preferred alternative would result in average annual exports that are slightly higher than historical levels. Of greater importance, however, would be the significant increases in Delta outflows that would be realized under the preferred alternative. Delta outflows have long been considered to be essential to the maintenance of aquatic and estuarine habitats in the Bay-Delta system. Despite the fact that exports are not now at D-1485 levels, the appropriate comparison is between the standards contained in D-1485 and the proposed regulatory requirements. For that reason, the analysis in this section reflects a difference between a future under D-1485 conditions and a future with the preferred alternative in place.

If current water quality and habitat conditions in the Bay-Delta system are not permitted to degenerate, conditions for hunting, fishing, boating, water skiing, and wildlife viewing would also be preserved. Passive use values, possibly including the potentially large value associated with avoiding species endangerment or extinction, will also be realized. By way of illustrating the potential magnitude of some of the values the preferred alternative would produce, representative benefit estimates, from existing economic studies, are displayed in Table XII-6.

Although values specific to the Bay-Delta system cannot be extracted from most of these studies, the values they contain do establish that the overall benefits of the preferred alternative could be well in excess of its costs. The reason is that passive use values for a natural resource tend to rise sharply with increasing scarcity. Estuaries are becoming increasingly rare. Because it is the largest estuary on the west coast of the Americas (USEPA 1994), the loss of estuarine values in the Bay-Delta would greatly increase the scarcity of such resources. Economic studies of other bay and estuary systems have demonstrated the relatively high passive use values associated with rare resources such as the Bay-Delta (Hayes et al. 1992; Bockstael et al. 1988). A study of the value of preserving Narragansett Bay, for example, showed that the active use benefits of preservation were less than the costs of providing those benefits. When passive use values were included, however, the benefits significantly exceeded the costs (Hayes et al. 1992).

If an estuary protection program benefits special status species, passive use values can be even higher than they would otherwise be (see the following entries in Table XII-6: Boyle and Bishop 1987; Stevens et al. 1991; Hagen et al 1992; Rubin et al 1991; Bowker and Stoll 1988; Rockel and Kealy 1991). Although the Bay-Delta system does support special status fish species, the effects of the preferred alternative on those species is uncertain. If the preferred alternative were to prevent additional rare and endangered species listings, it could provide additional benefits in the form of avoided costs. Listing the spring-run chinook salmon, for example, could lead to potentially significant costs. Perhaps the highest of these costs would be the possible (although not certain) shutdown of the commercial and recreational salmon fisheries. Because the relative role of the many environmental variables affecting salmon populations is poorly understood, however, the effects of regulatory actions on those populations cannot be accurately predicted.

Perhaps the most important use values supported by the Bay-Delta system are commercial and recreational fishing. The fish species with the highest value to the sport and commercial fishing industries is salmon. Roughly equal in importance to salmon for recreational anglers is striped bass. The California inland river, Delta, San Francisco Bay, and offshore fisheries also include sturgeon, shad, white catfish, bay shrimp, and starry flounder. According to Dumas et al (1993), anglers from central and northern California took almost 2.5 million saltwater fishing trips during the 1985-1986 season. On 38 percent of those trips, the quarry was either salmon, striped bass, or a combination of species, which included salmon or bass.

Anglers, like most recreators, are willing to pay more for the recreational experience than the costs they actually incur (see, for example, Loomis and Cooper 1990). Actual expenditures are not included in the benefit estimate because they constitute a transfer: if the opportunity to fish

Table XII-6: Benefit Estimates from the Bay-Delta and Similar Resources

Study	Setting and Data Source	Value/Good	Estimated Net Monetary Value	Baseline year
Carson & Mitchell 1993	A nation-wide CVM survey. Active & passive use values included.	(1) Improving national water quality to "boatable" levels (2) Improving national water quality to "swimmable" levels	(1) $106 - $141 per household per year (2) $89 - $116 per household per year	1990
Whittington et al. 1994	A CVM survey of 5 Texas counties. Active and Passive Use values included.	Improving water quality in Galveston Bay	$5-$13 per household per month	1993 (?)
Bockstael & McConnell 1988	Various use, travel cost, & CVM surveys of users of Chesapeake Bay	(1) Use/nonuse value of increase in water quality to swimmable level (2) 20% increase in water quality to Beach users (3) 20% increase in water quality to boaters	(1) $5-$224 per household per year (2) $1.14-$99.79 per household per year (3) $0.37-18.01 per boater per year	(1) 1984 (2) 1987 (3) 1987
Hayes, et al. 1992; Hayes 1987	A CVM survey of a sample of Rhode Island households	Swimmable and shellfishable water quality in Narragansett Bay, RI. Includes active and passive use values.	About $200 per household per year for swimmable water quality; about $200 per household per year for shellfishable water quality.	1984
Loomis & Creel 1992		(1) Wildlife viewing in the San Joaquin Valley (2) Waterfowl hunting in the San Joaquin Valley	(1) $128 per household per year (2) $159 per household per year	unknown
Walsh et al. 1992	Based on 120 outdoor recreation studies covering the whole U.S. between 1968-1988	(1) Swimming (2) Camping (3) Picnicking (4) Motorized Boating (5) Non-motorized Boating (6) Migratory Waterfowl Hunting (7) Non-consumptive Fish & Wildlife use (viewing)	(1) $15.54 - $30.40 per recreation day (2) $15.52 - $23.48 per recreation day (3) $7.37 - $27.29 per recreation day (4) $11.25 - $51.87 per recreation day (5) $17.61 - $79.75 per recreation day (6) $24.13 - $47.15 per recreation day (7) $17.69 - $26.71 per recreation day	3rd Quarter 1987
Jones & Stokes 1993, Appendix X	A CVM of California. Active & passive use values included.	Maintenance of specific water levels in Mono Lake.	$0.62 per additional foot per English-speaking household per year (6,377-6,390 feet).	unknown
Loomis 1987	A CVM of California. Active & passive use values included.	Maintenance of specific water levels in Mono Lake.	$42.71 - $94.68 per household per year for a level that will preserve wildlife & tufa.	unknown
Mannesto & Loomis 1991	A CVM survey of boaters on the Sacramento-San Joaquin Delta	Value of wetlands in the Delta to Boaters	$ 37.85 - $69.80 annually to maintain current conditions; $33.14 - $59.27 annually for additional wetland area	unknown
Boyle & Bishop 1987	A CVM of Wisconsin Taxpayers	Value of preventing the extinction of the bald eagle & the striped shiner	A median annual WTP of $4.92 - $24.63 per taxpayer for the eagle and $1.00 for the shiner	1985
Stevens et al. 1991	A CVM of Mass. and of New England re: endangered ssp. Validity of this use of CVM is questioned	Existence value of Atlantic salmon in Mass., and of the bald eagle, wild turkey and coyote in New England	avg. annual WTP per respondent of $7.93 for salmon, of $19.28 for eagle, of $11.86 for turkey, of $5.35 for coyote	unknown
Hagen et al 1992	A nationwide CVM (1,000 household sample)	active & passive use values of the northern spotted owl	$47.93 - $144.28 per household per year	unknown
Rubin et al 1991	A CVM of Washington State Residents	active & passive use values of the northern spotted owl	An avg. household willingness to pay of $34.84 per year.	unknown
Bowker & Stoll, 1988	A CVM of users of the Arkansas Nat. Wildlife Refuge, & a national sample of non-users	non-use values for the whooping crane	$21 - $132 per household per year	unknown
Rockel & Kealy 1991	Pooled TCM based on results of a national survey	all non-consumptive recreational uses of wildlife	$198 - $3,731 per trip	1980

were to become unavailable, the affected anglers would spend their recreation dollars in other ways. Recreational fishing benefits, therefore, are measured in terms of *net* willingness to pay (full willingness to pay, minus actual expenditures). This value is referred to as "consumers' surplus". It is this value that would be lost to society if the recreational opportunity were to disappear.

The selected alternative could benefit the commercial fishing industry by increasing the harvests of some or all commercial species. The value of the commercial fishery in California peaked in 1988 at about $200 million. By 1992, that figure had dropped to about $130 million. The value of the salmon harvest declined from $41.9 to $4.4 million over the same period (California Department of Finance 1987-1993). The dressed weight of the chinook salmon harvest dropped from 7,397,000 to 1,604,000 pounds between 1986 and 1992 (Dumas et al. 1993). The decline of the commercial catch has coincided with the drought, culminating in the closures of some fisheries in 1992 and 1993.

Although the economic effects of a known change in salmon populations could be estimated with acceptable accuracy (USEPA 1994), the physical and biological impacts of the preferred alternative on that fishery cannot be estimated accurately. The salmon population impact estimates appearing in this Section were derived from models which calculate salmon smolt survival based primarily on Delta flow dynamics. Actual adult population sizes also depend upon other important variables. Among those variables are the following:

(1) The relationship between smolt survival and the size of the adult population. Evidence of a significant positive relationship is lacking.

(2) Pumping, riparian land uses, and discharges along inland rivers and creeks can have significant impacts on salmon survival.

(3) Ocean temperatures, currents, and related conditions can, by affecting the food supply available to marine salmon populations, lead to substantial changes in population size. El Niño events, for example, have dramatic population effects.

Even if changes in salmon populations could be accurately predicted, uncertainties concerning future fishery regulatory actions would significantly affect fisheries benefits. The action which will have the most influence over the magnitude of those benefits is the chinook salmon escapement goal, set by the Pacific Fisheries Management Council (PFMC). The escapement goal determines how many adult salmon should return to spawn, following the commercial and recreational harvests. An increase in the salmon escapement goal could diminish or negate any commercial or recreation benefits that would otherwise result from increased salmon populations (these foregone benefits would be at least partially offset, however, by an increase in the non-use benefits associated with a larger salmon population).

As part of its Bay-Delta standard-setting process, the USEPA analyzed the fisheries benefits its standards were expected to produce (the USEPA's standards are identical to the SWRCB's Bay-Delta Alternative 1). In order to estimate the value of those benefits, however, it was necessary to make a number of assumptions to cover the gaps in our knowledge of the physical and biological processes affecting fisheries populations. The SWRCB has determined, however, that those uncertainties are too great to justify an attempt to estimate the economic value of the preferred alternative's fisheries benefits.

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