Chapter 5
Plan Evaluation, Comparison, and Selection

The evaluation and comparison of alternative plans provide the basis for plan selection. This chapter presents results of the evaluation and comparison of the final comprehensive plans (i.e., action alternatives) described in Chapter 4, and concludes with the rationale for plan selection, including identification of CP4A as the NED Plan.

Summary of Comprehensive Plan Evaluation

The results of feasibility analyses for the SLWRI are presented in the form of four accounts established by the P&G (WRC 1983) to display, and facilitate evaluation of, the effects of alternative plans: NED, environmental quality (EQ), regional economic development (RED), and other social effects (OSE). These four accounts can encompass all significant beneficial and adverse effects of a plan on the human environment, as required by NEPA (42 USC 4321 et seq.). Further, effects of alternative plans are to be displayed as the difference in conditions compared to the No-Action Alternative.

National Economic Development Account

The objective of an NED analysis is to determine the change in net value of the Nation's output of goods and services that would result from implementing each project alternative. Beneficial and adverse effects are evaluated in monetary terms, and measured in terms of changes in national income between the No-Action and various action alternatives. The NED account describes the part of the NEPA human environment that identifies beneficial and adverse effects on the economy. Beneficial effects in the NED account are (1) increases in the economic value of the national output of goods and services from a plan, (2) the value of output resulting from external economies caused by a plan, and (3) the value associated with the use of otherwise unemployed or underemployed labor resources. Adverse effects in the NED account are the opportunity costs of resources used in implementing a plan. These adverse effects include (1) implementation outlays, (2) associated costs, and (3) other direct costs. Specific guidelines, standards, and procedures used in the NED analysis are contained in the P&G (WRC 1983).

The NED account may include economic benefits to the following categories: irrigation water supply, M&I water supply, flood damage reduction, power (hydropower), transportation (inland navigation and deep draft navigation), recreation, commercial fishing, unemployed or underemployed labor resources, and other categories of benefits for which procedures are documented in the

planning report and are consistent with the general measurement standard in the P&G. For this analysis, the NED account includes the M&I water supply, irrigation water supply, hydropower, recreation, as well as other categories of benefits for anadromous fish survival.

Environmental benefits, including fisheries and ecosystem resources, are typically included in the EQ account if monetary units cannot be attributed to these benefits. However, for this analysis, fisheries benefits were developed as monetary units, and are included in the NED account. The contribution of the various alternatives to anadromous fish survival is included in the NED account under "other categories of benefits."

Monetized Benefits

Estimating the economic value of potential effects is critical to establishing economic feasibility and identifying the plan with the highest net NED benefits (the NED plan). This section summarizes the valuation methods and valuation estimates for the benefit categories associated with the SLWRI planning objectives. Detailed valuation methods and results for each benefit category and associated sensitivity analyses are presented in the Economic Valuation Appendix.

Increase Anadromous Fish Survival The method for assessing the economic value of contributions of comprehensive plans to anadromous fish survival used a "cost of the most likely alternative" approach. The underlying premise for the approach was that increasing salmon populations would be a socially desirable goal, as indicated by the listing of several species as threatened or endangered, passage of the CVPIA, and expenditures on salmon restoration projects.

Because the increased potential to reduce water temperatures during critical periods provided by additional surface storage would be essential to increasing salmon production, the cost of the most likely alternative was based on the cost of various dam raises operated solely for the purpose of increasing the number of salmon smolt in the Sacramento River. Evaluating the cost of the most likely alternative included analysis of three separate dam raises operated solely for increased anadromous fish production, and was estimated using habitat units. While habitat units could be quantified in simplistic terms such as changes in flow or temperature conditions, such characterizations would not capture the complex physical and biological interrelationships within the system. Improvements in habitat conditions for anadromous fish in the Sacramento River were directly evaluated through the use of the SALMOD, a deterministic salmon production model. Habitat units were based on 1,000 smolt passing downstream at the location of the RBPP. A cost-per-habitat-unit estimate was calculated for each alternative through dividing annual costs by the expected change in habitat units. The lowest cost-per-habitat-unit estimate was used as a per-habitat-unit benefit estimate. Anadromous fish benefits were computed though multiplying the per-habitat unit benefit estimate by the estimated change in habitat units under each of the comprehensive plans (Table 5-1).

Uncertainty A sensitivity analysis was conducted to address risk and uncertainty of the benefit estimates for anadromous fish survival focused alternatives, CP4 and CP4A. This sensitivity analysis estimated the economic benefits of improving habitat for ESA-listed species of anadromous fish. This analysis was based on values from a recent study in the Klamath River basin which addressed benefit transfer methods for habitat improvements for fish. For example, this sensitivity analysis for CP4 and CP4A resulted in estimated total benefits of $423.5 million and $276.3 million per year, respectively. This is in comparison to the $38.1 and $33.3 million per year benefits for CP4 and CP4A, respectively, shown in Table 5-1 and used in the NED analysis.

Increase Water Supply Reliability The CalSim-II model was used to estimate potential increases in water supply reliability to the CVP and SWP for the comprehensive plans. Table 5-2 shows results of the water operations modeling analyses to determine the average year and dry/critically dry year conditions north and south of the Delta for the comprehensive plans.

Table 5-1. Least Cost Alternative Estimates of Average Annual Salmon Production for Comprehensive Plans

Item	CP1	CP2	CP3	CP4	CP4A	CP5
Change in Average Annual Salmon Production Relative to No-Action Alternative (thousands of fish)	61.3	379.2	207.4	812.6	710.0	377.8
Total Annual Benefits[1] ($ millions/year)	2.9	17.8	9.7	38.1	33.3	17.7

Note:
[1] Dollar values are expressed in January 2014 price levels.
Key:
CP = comprehensive plan

Table 5-2. Estimated Increases in Irrigation and M&I Deliveries and Water Supply Reliability Benefits for Comprehensive Plans

Item	CP1	CP2	CP3	CP4	CP4A	CP5
CVP/SWP Irrigation Water Supply Reliability						
Dry/Critical Years NOD (acre-feet/year)[1]	4,200	9,500	29,400	4,200	9,500	21,100
Dry/Critical Years SOD (acre-feet/year)[1]	18,300	28,100	41,300	18,300	28,100	45,000
Average – All Years NOD (acre-feet/year)	5,900	10,900	25,900	5,900	10,900	19,600
Average – All Years SOD (acre-feet/year)	14,400	20,500	36,400	14,400	20,500	31,300
Annual Benefit ($ millions/year)[2]	***3.3***	***5.1***	***10.2***	***3.3***	***5.1***	***8.5***
CVP/SWP M&I Water Supply Reliability						
Dry/Critical Years NOD (acre-feet/year)[1]	300	1,200	5,800	300	1,200	4,100
Dry/Critical Years SOD (acre-feet/year)[1]	24,400	39,000	(13,300)	24,400	39,000	43,300
Average – All Years NOD (acre-feet/year)	100	1,400	4,400	100	1,400	3,300
Average – All Years SOD (acre-feet/year)	10,600	18,500	(4,900)	10,600	18,500	21,700
Annual Benefit ($ millions/year)[2]	***11.9***	***21.8***	–	***11.9***	***21.8***	***26.3***
Total Water Supply Reliability[3]						
Dry/Critical Years[1] (acre-feet/year)	47,300	77,800	63,100	47,300	77,800	113,500
Average – All Years (acre-feet/year)	31,000	51,300	61,700	31,000	51,300	75,900
Total Annual Benefit						
Estimated Value – At Inflation ($ millions/year)[2,3,4]	***15.2***	***26.9***	***10.2***	***15.2***	***26.9***	***34.8***
Estimated Value – 2% Above Inflation ($millions/year)[2,3,5]	***28.1***	***49.8***	***18.8***	***28.1***	***49.8***	***64.4***

Notes:

[1] Year-types as defined in the Sacramento Valley Water Year Hydrologic Classification Index.

[2] Dollar values are expressed in January 2014 price levels.

[3] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

[4] Assumes the costs of water supplies would increase at the same rate as inflation.

[5] Includes increase of water supply costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for change in water supply benefits are included in the Economic Valuation Appendix.

Key:

CP = comprehensive plan
CVP = Central Valley Project
M&I = municipal and industrial
NOD = North of Delta
SOD = South of Delta
SWP = State Water Project

Irrigation Water Supply This analysis provided benefit estimates produced through applying the "change in net income," method as estimated by the SWAP model. In the SWAP model, parameters ranging from crop mixes, prices, and yields to irrigation efficiency were modeled for CVP and SWP service areas. Then a potential new increment, such as increased storage at Shasta Reservoir was added, and the net increase in the value of increased production was estimated. The majority of increases in water supply reliability developed under SLWRI comprehensive plans would be achieved during drought periods when new increments of reliable water supply would be most needed. This is because, under current conditions, there would be an increased frequency of water supply shortages in dry and critical years. Similarly, under current conditions, there would be greater Delta export capacity in dry years due to less water in the system. Because of data limitations, the SWAP model is currently calibrated to 2005, a relatively normal water year. As a result, the effects of dry years on cropping decisions and production costs may not be fully represented by the model. In this analysis, the SWAP model was run for the long-term above/below normal, dry, and wet water supply conditions. The estimated annual benefit associated with comprehensive plans is represented by the probability weighted average across the three water year types. Table 5-2 displays average annual irrigation water supply benefits estimated with the SWAP model. Comprehensive plan irrigation water supply benefits range from $3.3 million per year for CP1 to $10.2 million for CP3.

Municipal and Industrial Water Supply All comprehensive plans except CP3 would increase water supplies to M&I water users, especially during dry years. Estimates of dry and critical year and average deliveries to M&I water users located north and south of the Delta for CP1 through CP5 are shown in Table 5-2. As shown in the table, M&I water supply benefits would largely accrue to CVP and SWP contract holders located south of the Delta. M&I water users have increasingly participated in the water transfer market to augment supplies. M&I water supply reliability benefits were estimated based on the average annual deliveries shown in Table 5-2. This analysis assumed that the next increment of water supply to M&I users would likely be obtained through water transfers. The analysis also relied on values estimated through application of a water transfer pricing model, and through consideration of the costs associated with conveying the water to the M&I service areas. This method is consistent with the "cost of the most likely alternative" method recommended by the P&G.

Uncertainty As described in Chapter 2, demands for water in California exceed available supplies. It is expected that the difference between available supplies and demands for water will increase in the future, especially during drought periods. Although recent facility improvements have improved delivery capability, no material increases in supply have been added to the CVP or the SWP for nearly 40 years. To date, increases in water demands have primarily been accommodated through operational changes in the existing CVP and SWP water supply systems, and increased reliance on groundwater, recycled water, and local conservation measures. California's population is expected to increase

by more than 60 percent above 2005 levels by 2050 (California Department of Finance 2007). This increase in population, coupled with lack of new sources of supply, could appreciably transform the future of water in California. One of the expected results will be a shift in water deliveries from agricultural to urban uses. In addition, declines are likely in other water supply sources for reasons ranging from increased local and regional needs to groundwater overdraft and climate change.

Traditional approaches for estimating water supply benefits, using the methods described above, are appropriate as accounting tools and in estimating benefits for increases in reliability today. However, these methods do not account for the growing complexities resulting from increasing demands and dwindling supplies. Current models used to help estimate water benefits are static models and only useful for estimating the increase in production at one point in time, given numerous highly constrained assumptions.

To account for the significant uncertainties associated with estimating the value of new supplies, a sensitivity analysis was performed assuming the value of water increases above the inflation rate (up to 2 percent above inflation). Accordingly, the benefit of the increased supplies resulting from each comprehensive plan, based on a 2 percent rate above inflation, is included in Table 5-2. As described in the Economic Valuation Appendix, an additional sensitivity analysis was performed for irrigation water supply based on a statistical model of the California spot market water transfer activity. The results using the spot market model were similar to values assuming water increases above the inflation rate (e.g., 2 percent above inflation). The LCPSIM was used to evaluate the sensitivity of M&I water supply benefits. Although the LCPSIM provided lower estimated benefits for M&I water supply reliability in comparison to the NED analysis, this is due to several key assumptions and related model limitations as described in the Economic Valuation Appendix.

Develop Additional Hydropower Generation Increasing the size of Shasta Dam and Reservoir would also result in increased hydropower capacity, generation, and the ability to provide ancillary services[1] at Shasta Dam and other hydropower facilities throughout the CVP and SWP. As can be seen in Table 5-3, raising Shasta Dam by 6.5 feet to 18.5 feet would result in increased hydropower generation of 52 to 127 GWh per year and would provide capacity and ancillary service benefits. CP4 and CP4A would result in the largest increases in hydropower generation, capacity, and ancillary services because of the greater hydraulic head resulting from storing more water for anadromous fish purposes. As can be seen in Table 5-3, estimated average annual hydropower benefits of the plans would range from about $6.8 million for CP1 to about $14.9 million for CP4.

[1] The California Independent System Operator's (CAISO) ancillary service market is comprised of regulation up, regulation down, spinning reserve, and non-spinning reserve providing frequency support, voltage support, and load-following. These services are needed to allow CAISO to precisely match generation and load and operate the grid in a reliable manner.

Implementation of recent California renewable resources mandates will require significant increases in non-dispatchable intermittent renewable resources, such as wind and solar generation, in California's power system. This means that other significant flexible generation resources will be needed to support and integrate renewable generation. The California Independent System Operator has an ongoing Renewables Integration Initiative to evaluate the changing resources needed to meet California's Renewable Portfolio Standard goals. These potentially costly mandates will likely influence the value of future hydropower supplies at Shasta Dam. To account for this uncertainty, a sensitivity analysis was performed assuming the value of hydropower increases at 2 percent above the inflation rate. Accordingly, the benefit of the increased supplies resulting from each comprehensive plan, based on a 2 percent rate above inflation, is included in Table 5-3.

Table 5-3. Summary of Estimated Hydropower Benefits of Comprehensive Plans

Item	CP1	CP2	CP3	CP4	CP4A	CP5
Increased CVP and SWP Hydropower Generation						
Increased CVP Generation (GWh/year)	38.6	65.6	91.0	113.3	103.7	88.9
Increased SWP Generation (GWh/year)	13.7	21.2	(5.3)	13.7	21.2	23.5
Total Increased Generation[1] (GWh/year)	***52.3***	***86.8***	***85.7***	***127.1***	***124.8***	***112.4***
Annual Hydropower Benefits						
Increased CVP Generation ($ millions/year)	$2.6	$4.4	$6.0	$7.5	$6.9	$5.9
Increased SWP Generation ($ millions/year)	$0.9	$1.5	($0.4)	$0.9	$1.5	$1.6
Ancillary Services Benefit ($ millions/year)	$0.2	$0.3	$0.4	$0.7	$0.5	$0.4
Capacity Benefit ($ millions/year)	$3.1	$4.1	$5.1	$5.7	$5.5	$5.6
Total Annual Hydropower Benefits[2] (at inflation) ($ millions/year)	***$6.8***	***$10.3***	***$11.1***	***$14.9***	***$14.4***	***$13.4***
Total Annual Hydropower Benefit[3,4] (2% above inflation) ($millions/year)	***$12.5***	***$19.0***	***$20.6***	***$27.6***	***$26.7***	***$24.8***

Notes:

[1] Power generation estimates represent the increased load center generation (accounting for transmission losses) at CVP and SWP facilities. Energy requirements for pumping and conveyance of increased water deliveries were accounted for in operations and maintenance costs for each alternative.

[2] Ancillary services and capacity benefits were based on at-plant hydropower parameters.

[3] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

[4] Includes increase of hydropower costs at 2 percent above inflation.

Key:

CP = comprehensive plan

CVP = Central Valley Project

GWh/year = gigawatt-hours per year

SWP = State Water Project

Maintain and Increase Recreation Shasta Lake is a major recreational venue in California, and is the centerpiece of the Shasta Unit of the Whiskeytown-Shasta-Trinity NRA. The combination of large size, plentiful water-based recreation opportunities, favorable climate, and easy access make Shasta Lake

one of the most visited recreation destinations in the State and region. Enlarging Shasta Dam, including relocating facilities to maintain at least the existing recreation opportunities, would affect recreation participation by providing modernized recreational facilities, increasing the reservoir surface area throughout the year, and decreasing reservoir drawdown during the peak recreation season (May to September). Table 5-4 displays user days (visitor days) and estimated recreation values for each comprehensive plan. The estimated resulting increase in user values was based on a recreation unit-day value of $57.85, the midpoint between the USFS (2005) benefit estimate for a unit day engaged in motorboating ($57.30 in 2014 dollars) and a unit day engaged in fishing ($58.40). The estimated benefit to recreation due to estimated increased visitor days ranges from $4.9 million to $17.8 million per year.

Table 5-4. Average Annual Estimated Change in Visitor Days and Recreational Values

Item	CP1	CP2	CP3	CP4	CP4A	CP5
Increase in Average Annual Visitor Days (1,000)	85	116	201	307	246	142
Increase in Average Annual Benefits ($ millions/year)[1]	4.9	6.7	11.6	17.8	14.3	8.2

Note:
[1] Dollar values are expressed in January, 2014 price levels.
Key:
CP = comprehensive plan

Benefit Summary Table 5-5 summarizes the estimated annual average economic benefits from Tables 5-1 through 5-4 above.

Table 5-5. Summary of Estimated Comprehensive Plan Economic Benefits [1, 2]

Item	CP1 ($ millions/ year)	CP2 ($ millions/ year)	CP3 ($ millions/ year)	CP4 ($ millions/ year)	CP4A ($ millions/ year)	CP5 ($ millions/ year)
Anadromous Fish Survival	2.9	17.8	9.7	38.1	33.3	17.7
Water Supply Reliability						
Estimated Benefit (at inflation)[3]	15.2	26.9	10.2	15.2	26.9	34.8
Estimated Benefit (2% above inflation)[4]	28.1	49.8	18.8	28.1	49.8	64.4
Hydropower						
Estimated Benefit (at inflation)[3]	6.8	10.3	11.1	14.9	14.4	13.4
Estimated Benefit (2% above inflation)[4]	12.5	19.0	20.6	27.6	26.7	24.8
Recreation	4.9	6.7	11.6	17.8	14.3	8.2
Flood Damage Reduction[5]	Not quantified	Not quantified	Not quantified	Not quantified	Not quantified	Not quantified
Water Quality[5]	Not quantified	Not quantified	Not quantified	Not quantified	Not quantified	Not quantified
Total Annual Benefits						
Estimated Value (at inflation)[3, 6]	***29.7***	***61.6***	***42.6***	***86.0***	***88.9***	***74.2***
Estimated Value (2% above inflation)[4, 6]	***48.4***	***93.3***	***60.7***	***111.6***	***124.1***	***115.2***

Notes:

[1] Any dam raise could provide incidental benefits to secondary objectives.

[2] Benefits were not monetized for ecosystem restoration including (1) restoring resident fish habitat in Shasta Lake, (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the upper Sacramento River and tributaries to Shasta Lake, (3) augmenting spawning gravel in the upper Sacramento River, and (4) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River.

[3] Assumes the costs of water supplies and hydropower would increase at the same rate as inflation.

[4] Includes increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for change in water supply and hydropower benefits are included in the Economic Valuation Appendix.

[5] Benefits for flood damage reduction and water quality are limited and have not been monetized.

[6] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:

CP = comprehensive plan

Cost Summary Table 5-6 summarizes estimated construction, investment, and annual costs for each of the comprehensive plans. Total investment cost is the sum of total construction costs and interest during construction (IDC) cost. The IDC cost was computed using Reclamation-defined practices, and was based on an estimated construction period for all plans of approximately 5 years. Total investment cost was annualized over the project's assumed 100-year lifespan at the Federal interest rate of 3-1/2 percent to compute interest and amortization. Total annual cost is the sum of interest and amortization and estimated annual O&M costs. Cost estimates for comprehensive plans are presented in more detail in the Engineering Summary Appendix to the accompanying Final EIS.

Table 5-6. Estimated Construction and Annual Costs of Comprehensive Plans[1]

Item	CP1 ($ millions)	CP2 ($ millions)	CP3 ($ millions)	CP4 ($ millions)	CP4A ($ millions)	CP5 ($ millions)
Construction Cost						
Field Costs	$713	$773	$881	$887	$887	$901
Noncontract Costs	$278	$316	$376	$378	$379	$383
Total Construction Cost[2]	$990	$1,089	$1,257	$1,264	$1,265	$1,283
Investment Cost						
Interest During Construction	$83	$91	$105	$105	$105	$108
Total Investment Cost[2]	$1,073	$1,180	$1,362	$1,370	$1,371	$1,391
Annual Cost						
Interest and Amortization	$39	$43	$49	$50	$50	$50
Operations and Maintenance	$6.3	$8.5	$4.6	$7.5	$9.4	$10.7
Total Annual Cost[2]	$45.1	$51.2	$53.8	$57.1	$59.0	$61.0

Notes:
[1] Based on January 2014 price levels, 100-year period of analysis, and 3-1/2 percent interest rate.
[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
CP = comprehensive plan

Net National Economic Development Benefits

The P&G states that the alternative that reasonably maximizes net NED benefits, consistent with the Federal objectives, is identified as the NED plan (WRC 1983). The alternative that would generate the maximum net NED benefit is CP4A (Table 5-7), and, accordingly, CP4A is identified as the NED plan. Assuming the cost of water and energy supplies increased at the same rate as inflation, CP4A would generate net benefits of $29.9 million annually. Assuming an increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity of available supplies in the future, CP4A would generate $65.1 million in net benefits.

Table 5-7. Summary of Estimated Annual Costs, Annual Benefits, and Net Benefits for Comprehensive Plans[1]

Item	CP1 ($ millions)	CP2 ($ millions)	CP3 ($ millions)	CP4 ($ millions)	CP4A ($ millions)	CP5 ($ millions)
Annual Cost						
Total Annual Cost	45.1	51.2	53.8	57.1	59.0	61.0
Annual Benefits						
Estimated Value (at inflation)[2]	29.7	61.6	42.6	86.0	88.9	74.2
Estimated Value (2% above inflation)[3]	48.4	93.3	60.7	111.6	124.1	115.2
Benefit/Cost Ratio						
Estimated Value (at inflation)[2]	0.66	1.20	0.79	1.51	1.51	1.22
Estimated Value (2% above inflation)[3]	1.07	1.82	1.13	1.95	2.10	1.89
Net Benefits						
Estimated Value (at inflation)[2,4]	-15.4	10.5	-11.2	28.9	29.9	13.2
Estimated Value (2% above inflation)[3, 4]	3.3	42.1	6.9	54.5	65.1	54.2

Notes:

[1] Based on January 2014 price levels, 100-year period of analysis, and 3-1/2 percent interest rate.

[2] Assumes the costs of water supplies and hydropower would increase at the same rate as inflation.

[3] Includes increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for change in water supply and hydropower benefits are included in the Economic Valuation Appendix.

[4] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:

CP = comprehensive plan

Nonmonetized Benefits

Several potential benefit categories associated with comprehensive plans were not monetized or included under the NED account. All plans would contribute to maintaining or improving water quality in the Sacramento River and the Delta; however, the associated economic benefits have not been quantified and included in the NED account. All comprehensive plans would also increase operational flexibility and improve Delta emergency response, but benefits were not quantified. This is because methodologies for monetization of water quality and Delta emergency response benefits are not well established.

Environmental Quality Account

The EQ account is a means of integrating information about the EQ resources and NEPA human environment effects (as defined in 40 CFR 1507.14) of alternative plans into water resources planning. This is essential to a reasoned choice among alternative plans.

For the SLWRI, benefits assessed in the EQ account include: (1) restoring resident fish habitat in Shasta Lake, (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the upper Sacramento River and tributaries to Shasta Lake, (3) augmenting spawning gravel in the upper Sacramento River, and (4) restoring riparian, floodplain, and side channel

habitat in the upper Sacramento River. Implementing these ecosystem restoration measures would not require implementing other project features (e.g., dam raise, reservoir area relocations).

A thorough evaluation of other positive and negative EQ benefits was performed as part of the NEPA environmental review and documentation process. A detailed discussion of potential effects of comprehensive plans and proposed mitigation measures is included in Chapters 4 through 25 of the accompanying Final EIS and summarized in Table S-3 in the Final EIS. The environmental commitments common to all comprehensive plans are described in Chapter 4 of this Feasibility Report. Also, Chapter 26 of the Final EIS describes short-term use of the human environment and the maintenance and enhancement of long-term productivity and presents potential irreversible or irretrievable commitments of resources for the comprehensive plans.

Table 5-8 summarizes key effects for all resource categories for the EQ account. All comprehensive plans would be similar in terms of their potential environmental effects, although some adverse effects would be exacerbated by larger dam raises and by the associated scale of the effects, such as expanded construction areas and increased area of inundation around Shasta Lake. Generally, the adverse effects would be mitigated to less-than-significant levels with prescribed mitigation measures. Some adverse effects for all of the action alternatives – e.g., the short-term generation of construction-generated emissions in excess of Shasta County Air Quality Management District (SCAQMD) thresholds and generation of increased daytime glare and/or night time lighting – would remain unavoidable despite mitigation measures. Altered flow regimes along the upper Sacramento River, changes to the areas inundated by Shasta Lake, and disturbances associated with construction activities would have the potential to affect environmental resources. However, these adverse effects would be mitigated to the extent practicable.

Table 5-8. Summary of Potential Environmental Effects in the Environmental Quality Account

Resource Area	Alternatives	Primary Study Area		Extended Study Area			Key Considerations and Exclusions
		Shasta Lake & Vicinity	Sacramento River (Shasta Dam to RBPP)	Sacramento River (RBPP to Delta)	Delta	CVP/SWP Facilities and Water Service Areas	
Geology, Geomorphology, Minerals, and Soils	CP1 – CP5	🟧	🟩	🟩	🟩	🟩	Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation. Long -term adverse effects associated with operations reduced through mitigation.
Air Quality and Climate	CP1	🟧	🟩	🟩	🟩	🟩	Long-term effects due to slight increase in net energy requirements. Short-term unavoidable adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
	CP2, CP3, CP4, CP4A, CP5	🟧	🟩	🟪	🟪	🟪	Long-term benefits related to reduced emissions due to increased hydropower generation. Short-term unavoidable adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Hydrology, Hydraulics, and Water Management	CP1-CP5	🟩	🟩 🟦	🟩 🟦	🟩 🟦	🟩 🟪 🟦	Beneficial effects to groundwater levels in CVP/SWP water service areas. Long-term beneficial effects related to water supply reliability included in NED account. Long-term beneficial effects related to reduced flood risk included in OSE account.
Water Quality	CP1 – CP5	🟩	🟩 🟦	🟩 🟦	🟩 🟦	🟩 🟦	Long-term beneficial effects to reservoir water quality due to replacement of reservoir area septic systems with centralized wastewater treatment plants. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation. Long-term beneficial water quality effects in Sacramento River and Delta included in NED account.
Noise and Vibration	CP1 – CP5	🟩	🟩	🟩	🟩	🟩	Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Hazards and Hazardous Materials and Waste	CP1 – CP5	🟩	🟩	🟩	🟩	🟩	Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Agriculture and Important Farmland	CP1 – CP5	🟩	🟩	🟩	🟩	🟩 🟦	Long-term beneficial effects from improved agricultural/irrigation water supply reliability included in NED account. Long-term adverse effects due to conversion of forest lands.

Table 5-8. Summary of Potential Environmental Effects in the Environmental Quality Account (contd.)

Resource Area	Alternatives	Primary Study Area		Extended Study Area			Key Considerations and Exclusions
		Shasta Lake & Vicinity	Sacramento River (Shasta Dam to RBDD)	Sacramento River (RBPP to Delta)	Delta	CVP/SWP Facilities and Water Service Areas	
Fisheries and Aquatic Ecosystems	CP1 – CP5	🟩 🟪	🟩 🟦 🟪	🟩 🟦	🟩 🟦	🟩	Long-term beneficial effect on cold-water fisheries habitat in Shasta Lake. CP4, CP4A, and CP5 provide ecosystem restoration benefits for fisheries and aquatic habitat through (1) augmenting spawning gravel in the upper Sacramento River, and (2) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River. CP5 provides ecosystem restoration benefits for fisheries and aquatic habitat, including (1) restoring resident fish habitat in Shasta Lake, and (2) restoring fisheries and riparian habitat at several locations along the lower reaches of tributaries to Shasta Lake. Long-term beneficial effects on anadromous fisheries included in NED account.
Botanical Resources and Wetlands	CP1 – CP5	🟧	🟩 🟪	🟩	🟩	🟩	CP4, CP4A, and CP5 provide ecosystem restoration benefits for botanical resources through restoring riparian, floodplain, and side channel habitat in the upper Sacramento River. Long-term adverse effects due to inundation and relocations in primary study area. Short-term adverse effects due to construction in primary study area. Adverse effects reduced through mitigation.
Wildlife Resources	CP1 – CP5	🟧	🟩 🟪	🟩	🟩	🟩	CP4, CP4A, and CP5 provide ecosystem restoration benefits for wildlife resources through restoring riparian, floodplain, and side channel habitat in the upper Sacramento River. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Cultural Resources	CP1 – CP5	🟧	🟩	🟩	🟩	🟩	Adverse effects due to construction in primary study area; adverse effects reduced through mitigation. Some adverse effects due to operations/inundation in the primary study area are unavoidable.
Socioeconomics, Population, and Housing	CP1 – CP5	🟩 🟦	🟩 🟦	🟩	🟩	🟩 🟦	Long-term beneficial effects from improved agricultural/irrigation water supply reliability included in NED account. Short-term beneficial effects of construction activities included in RED account.
Land Use and Planning	CP1 – CP5	🟧	🟩	🟩	🟩	🟩	Long-term adverse effects to land use in reservoir area are unavoidable; adverse effects reduced through mitigation.

Table 5-8. Summary of Potential Environmental Effects in the Environmental Quality Account (contd.)

Resource Area	Resource Area/ Alternatives	Primary Study Area		Extended Study Area			Key Considerations and Exclusions
		Shasta Lake & Vicinity	Sacramento River (Shasta Dam to RBPP)	Sacramento River (RBPP to Delta)	Delta	CVP/SWP Facilities and Water Service Areas	
Recreation and Public Access	CP1 – CP5						Long-term beneficial effects on recreation included in NED account. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation. Long-term beneficial effects due to enhanced angling opportunities in the upper Sacramento River.
Aesthetics and Visual Resources	CP1 – CP5						Long-term adverse effects to aesthetics in reservoir area are unavoidable; adverse effects reduced through mitigation.
Transportation and Traffic	CP1 – CP5						Long-term beneficial effects due to modernized roadway/bridge relocations. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Utilities and Service Systems	CP1 – CP5						Long-term beneficial effects due to replacing and modernizing utilities. Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Public Services	CP1 – CP5						Short-term adverse effects due to construction in primary study area; adverse effects reduced through mitigation.
Power and Energy	CP1 – CP5						Long-term beneficial effects from increased hydropower generation included in NED account.
Environmental Justice	CP1 – CP5						Not disproportionately high and adverse effects to minority and low income populations in the vicinity of Shasta Lake and upper Sacramento River. Disproportionately high and adverse effects to Native American populations in vicinity of Shasta Lake. Not disproportionately high and adverse effects to Native American populations in the vicinity of the upper Sacramento River.

Table 5-8. Summary of Potential Environmental Effects in the Environmental Quality Account (contd.)

Resource Area	Alternatives	Primary Study Area		Extended Study Area			Key Considerations and Exclusions
		Shasta Lake & Vicinity	Sacramento River (Shasta Dam to RBPP)	Sacramento River (RBPP to Delta)	Delta	CVP/SWP Facilities and Water Service Areas	
Wild and Scenic Rivers	CP1 – CP5						Long-term adverse effects in wet years are unavoidable for up to 0.67 miles of the McCloud River, designated for special protection, but not as a Wild & Scenic River.

Note:
For some resource categories, both no (or minimal) effects and beneficial effects are indicated for the same portion of the study area. This is because there may be differences between short-term environmental effects (from construction) and long-term environmental effects of project operations, or differences in effects to different portions of a resource category. Where multiple effects are indicated, an explanation is provided in the "Key Considerations and Exclusions" column.

Key:
- No effect, minimal effect, not disproportionately high and adverse (environmental justice), and/or minimal effect after mitigation for the Environmental Quality account.
- Unavoidable and/or disproportionately high and adverse (environmental justice) for the Environmental Quality account.
- Beneficial effect for the Environmental Quality account.
- Beneficial effects associated with anadromous fish survival, agricultural/irrigation water supply reliability, municipal and industrial water supply reliability, hydropower, and recreation accounted for in the NED account. Beneficial effects to regional economics (including jobs and income) included in RED accounts. Beneficial effects on life, health, and safety related to reduced flood risk are accounted for in the OSE account.

CP = comprehensive plan
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NED = National Economic Development
OSE = other social effects
RBPP = Red Bluff Pumping Plant
RED = Regional Economic Development
SWP = State Water Project

Regional Economic Development Account

Changes in the distribution of regional economic activity that would result from each alternative plan are included in the RED account. According to the P&G, two measures of regional economic effects are considered: regional income and regional employment. A region is generally defined as an area that encounters "significant" income and employment effects. Income and employment effects are further divided into "positive" and "negative" effects. Each of the four categories (positive income, positive employment, negative income, and negative employment) is equal to the sum of the NED effects that accrue in a region, plus transfers between the region and outside the region (i.e., positive income effects equal the NED benefits in the region plus the transfers of income to the region from outside the region). Transfers can come from implementation outlays, transfers of basic economic activity, indirect effects, and induced effects. The positive (and negative) effects on regional employment are directly parallel to effects on income; therefore, typically the analysis of regional employment effects is organized in the same categories as regional income effects. Regional employment effects are also analyzed according to relevant service, trade, industrial, and other sectors as well as skill levels (unskilled, semiskilled, and highly skilled).

Employment and income effects of the proposed alternatives were determined through the use of IMPLAN (IMpact analysis for PLANning) modeling. This modeling was completed based on an input/output (I/O) analysis. I/O models are essentially accounting tables that trace the linkages of inter-industry purchase and sales within a given region and year. In addition to inter-industry data, the IMPLAN model used several assumptions to analyze the RED benefits and impacts of all alternatives regarding construction duration, origin of the labor force, size of labor force, payroll costs as a percent of total construction costs, and origin of construction materials. For specific assumptions, see Chapter 8 of the Economic Valuation Appendix. The IMPLAN model yields "multipliers" that were used to calculate the total direct, indirect, and induced effects on employment and income, among other factors. The resulting benefits are displayed in Table 5-9.

Increased levels of income are expected to accompany the increase in employment (Table 5-10). The level of increased income is directly related to the quantity of employment opportunities and the duration of the project. Construction activity associated with each of the alternatives would take place over 4.5 to 5 years, depending on the alternative selected. Because economic impacts are typically measured and reported in annual terms, costs were converted to average annual expenditures for the duration of the construction period.

Table 5-9. Summary of Estimated Annual Employment Benefits for RED Account

Item	CP1	CP2	CP3	CP4	CP4A	CP5
Construction Duration (years)	4.5	5	5	5	5	5
Short-Term Employment[1]						
New Direct Jobs	300	300	350	350	350	360
Local Labor Force	300	300	350	350	350	360
Construction	300	300	350	350	350	360
External Labor Force	0	0	0	0	0	0
Indirect and Induced Jobs	1,010	1,010	1,160	1,170	1,170	1,190
Construction Support	400	400	460	460	460	470
Total Direct, Indirect, and Induced Employment[2]	1,320	1,320	1,510	1,520	1,520	1,540
Long-Term Employment						
Long-Term Maintenance Positions	2	2	2	2	2	2

Notes:
[1] Results showing jobs per year for the construction duration were based on application of IMPLAN model.
[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
CP = comprehensive plan
IMPLAN = IMpact analysis for PLANning
RED = Regional Economic Development

Table 5-10. Summary of Estimated Annual Income Effects for RED Account

Item	CP1	CP2	CP3	CP4	CP4A	CP5
Construction Duration (years)	4.5	5	5	5	5	5
Income[1]						
Direct ($ millions/year)	85.9	85.1	98.2	98.7	98.8	100.2
Indirect/Induced ($ millions/year)	48.3	47.8	55.2	55.4	55.4	56.3
Total Income[2] ($ millions/year)	134.2	132.8	153.3	154.2	154.3	156.5

Notes:
[1] Results showing personal income per year for the construction duration were based on application of IMPLAN model and are expressed in April 2012 price levels.
[2] All numbers are rounded for display purposes; therefore, line items may not sum to totals.

Key:
CP = comprehensive plan
IMPLAN = IMpact analysis for PLANning
RED = Regional Economic Development

In addition to employment and income benefits, all comprehensive plans would also provide additional benefits due to implementation outlays for construction activities. Construction activities would primarily occur in the immediate vicinity of Shasta Lake in Shasta County. RED effects due to implementation outlays are estimated to affect primarily the four-county region surrounding Shasta Lake, including Shasta, Tehama, Trinity, and Siskiyou counties. Effects to both regional employment and regional income are expected to be beneficial during the project construction period and would be approximately proportional to construction costs of the comprehensive plans.

Other Social Effects Account

The OSE account provides a means of displaying information on alternative plan effects from perspectives that are not reflected in the other three accounts. Categories of effects included in the OSE account include: urban and community impacts; life, health, and safety factors; displacement; long-term productivity; and energy requirements and conservation. Both the beneficial and adverse effects in the OSE account are expected to be similar across all comprehensive plans, but generally proportional to the respective dam enlargement and newly inundated areas.

Threats to people, for loss of life and injury from flood events, must be addressed for public safety. Enlarging Shasta Dam and Reservoir has the potential to reduce flood flows in the upper Sacramento River. Through increased available storage in Shasta Reservoir, the comprehensive plans would reduce the frequency, magnitude, and duration of some potential future flood events, which have affected structures and residents in this part of the primary study area in the past. Table 5-11 illustrates the average monthly increase in available storage space from December through March (the peak of the flood season) for all of the comprehensive plans.

Table 5-11. Estimated Increase in Shasta Lake Available Storage Space of Comprehensive Plans Relative to the No Action Alternative (Average Monthly[1])

Month	No-Action Alternative Available Storage	Increase in Available Storage Space (TAF)					
		CP1	CP2	CP3	CP4	CP4A	CP5
October	1,965	115 (6%)	198 (10%)	268 (14%)	115 (6%)	198 (10%)	283 (14%)
November	1,979	122 (6%)	209 (11%)	283 (14%)	122 (6%)	209 (11%)	296 (15%)
December	1,817	104 (6%)	180 (10%)	242 (13%)	104 (6%)	180 (10%)	257 (14%)
January	1,542	92 (6%)	164 (11%)	221 (14%)	92 (6%)	164 (11%)	237 (15%)
February	1,273	78 (6%)	144 (11%)	199 (16%)	78 (6%)	144 (11%)	210 (17%)
March	916	75 (8%)	136 (15%)	187 (20%)	75 (8%)	136 (15%)	198 (22%)
April	618	83 (13%)	145 (24%)	200 (32%)	83 (13%)	145 (24%)	210 (34%)
May	591	82 (14%)	144 (24%)	203 (34%)	82 (14%)	144 (24%)	211 (36%)
June	899	87 (10%)	152 (17%)	208 (23%)	87 (10%)	152 (17%)	220 (24%)
July	1,385	89 (6%)	160 (12%)	217 (16%)	89 (6%)	160 (12%)	233 (17%)
August	1,711	97 (6%)	170 (10%)	236 (14%)	97 (6%)	170 (10%)	247 (14%)
September	1,890	106 (6%)	183 (10%)	252 (13%)	106 (6%)	183 (10%)	265 (14%)

Note:

[1] Highlighted months represent the flood control season, with darker highlighting indicating more critical periods for flood control when the maximum allowable storage may be at a minimum.

Key:

CP = comprehensive plan

TAF = thousand acre feet

As a result of greater reservoir capacity, the overall risk of flooding and related consequences below Shasta Dam are expected to be reduced. The potential for loss of life would also be reduced. Flood damage reduction benefits of the dam enlargement would not be expected to change the existing floodplain or Federal Emergency Management Agency flood zone designations; therefore, the comprehensive plans would not remove an obstacle to development. Thus, flood protection benefits are not considered growth inducing.

Environmental justice review is required to determine if a disproportionate share of a proposed project's adverse socioeconomic and other environmental impacts are borne by low-income and minority communities. The disturbance or loss of resources associated with certain locations that are important to the Winnemem Wintu (a Native American group) and Pit River Madesi Band members for their religious and cultural significance would result in an unmitigable, disproportionately high and adverse effect on Native American populations in the vicinity of Shasta Lake.

All comprehensive plans are estimated to displace people and businesses in the Shasta Lake area because of expanded reservoir inundation areas. Any potential real estate acquisition, or necessary relocations of displaced parties, would be accomplished consistent with Public Law 91-646.

All comprehensive plans would provide beneficial effects on health and safety in the Shasta Lake area and downstream along the Sacramento River. Under all comprehensive plans, relocated roadways, bridges, utilities, and recreation facilities would be replaced with modernized and upgraded facilities, using current design standards and construction practices. Additionally, many reservoir area septic systems would be replaced with centralized wastewater treatment plants. USFS emergency response facilities would also be relocated to a more centralized location adjacent to major transportation corridors.

Comparison of Comprehensive Plans

All of the comprehensive plans were developed based on the P&G (WRC 1983) criteria, as described in Chapter 3: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability. Table 5-12 displays the benefits and costs for each comprehensive plan, and Table 5-13 displays comparisons of the comprehensive plans according to the evaluation criteria.

Table 5-12. Summary of Potential Benefits and Costs of Comprehensive Plans

Item	CP1	CP2	CP3	CP4	CP4A	CP5
Shasta Dam Raise (feet)	**6.5**	**12.5**	**18.5**	**18.5**	**18.5**	**18.5**
Total Increased Storage (TAF)	256	443	634	634	634	634
Benefits						
Increase Anadromous Fish Survival						
Dedicated Storage (TAF)	-	-	-	378	191	-
Production Increase (thousand fish)[1]	61.3	379.2	207.4	812.6	710.0	377.8
Spawning Gravel Augmentation (tons)[2]				10,000	10,000	10,000
Side Channel Rearing Habitat Restoration				Yes	Yes	Yes
Increase Water Supply Reliability						
Total Increased Dry and Critical Year Water Supplies (TAF/year)[3]	47.3	77.8	63.1	47.3	77.8	113.5
Increased NOD Dry and Critical Year Water Supplies (TAF/year)[3]	4.5	10.7	35.2	4.5	10.7	25.2
Increased SOD Dry and Critical Year Water Supplies (TAF/year)[3]	42.7	67.1	28.0	42.7	67.1	88.3
Increased Water Use Efficiency Funding	Yes	Yes	Yes	Yes	Yes	Yes
Increased Emergency Water Supply Response Capability	Yes	Yes	Yes	Yes	Yes	Yes
Reduce Flood Damages						
Increased Reservoir Storage Capacity	Yes	Yes	Yes	Yes	Yes	Yes
Additional Hydropower Generation						
Increased Hydropower Generation (GWh/year)	52 - 54	87 - 90	86 - 90	127 - 133	125 - 130	112 - 117
Conserve, Restore, and Enhance Ecosystem Resources						
Shoreline Enhancement (acres)	-	-	-	-	-	130
Tributary Aquatic Habitat Enhancement (miles)[5]	-	-	-	-	-	6
Riparian, Floodplain, and Side Channel Habitat Restoration	-	-	-	Yes	Yes	Yes
Increased Ability to Meet Flow and Temperature Requirements Along Upper Sacramento River	Yes	Yes	Yes	Yes	Yes	Yes
Improve Water Quality						
Improved Delta Water Quality	Yes	Yes	Yes	Yes	Yes	Yes
Increased Delta Emergency Response Capability	Yes	Yes	Yes	Yes	Yes	Yes
Increase Recreation						
Recreation (user days, thousands)[6]	85 - 89	116 - 134	201 - 205	307 - 370	246 - 259	142 - 175
Modernization of Recreation Facilities	Yes	Yes	Yes	Yes	Yes	Yes

Table 5-12. Summary of Potential Benefits and Costs of Comprehensive Plans (contd.)

Item	CP1	CP2	CP3	CP4	CP4A	CP5
Economics [7]						
Cost						
Construction Cost ($ millions)	990	1,089	1,257	1,264	1,265	1,283
Interest During Construction ($ millions)	83	91	105	105	105	108
Total Capital Cost ($ millions)	1,073	1,180	1,362	1,370	1,371	1,391
Annual Cost ($ millions/year)	45.1	51.2	53.8	57.1	59.0	61.0
Annual NED Benefits ($ millions/year)[8]						
Estimated Value (at inflation)[9]	29.7	61.6	42.6	86.0	88.9	74.2
Estimated Value (2% above inflation)[10]	48.4	93.3	60.7	111.6	124.1	115.2
Net NED Benefits ($ millions/year)[7]						
Estimated Value (at inflation)[9]	-15.4	10.5	-11.2	28.9	29.9	13.2
Estimated Value (2% above inflation)[10]	3.3	42.1	6.9	54.5	65.1	54.2

Notes:

[1] Numbers were derived from SALMOD and represent an index of production increase, based on the estimated average annual increase in juvenile Chinook salmon surviving to migrate downstream from the RBPP.

[2] Average amount per year for 10-year period.

[3] Total increased deliveries during dry and critical years (based on the Sacramento Valley Water Year Hydrologic Water Classification) to CVP and SWP. Does not reflect benefits related to water use efficiency actions included in all comprehensive plans.

[4] Annual increases in hydropower generation were estimated using two methodologies – at load center (accounting for transmission losses) and at-plant (no transmission losses). To provide a more conservative estimate of potential hydropower benefits, load center generation values were used to estimate potential benefits of increased hydropower generation under comprehensive plans. However, increased generation values reported in Chapter 23 of the accompanying EIS were based on at-plant generation values to capture the largest potential effects from changes in hydropower generation and pumping.

[5] Tributary aquatic enhancement provides for the connectivity of native fish species and other aquatic organisms between Shasta Lake and its tributaries. Estimates of benefits reflect only connectivity with perennial streams and do not reflect additional miles of connectivity with intermittent streams.

[6] Annual recreation visitor user days were estimated using two methodologies. The minimum user day value was used to estimate potential recreation benefits to provide a more conservative estimate of the potential benefits of increased recreation under comprehensive plans. However, in the accompanying EIS, the maximum user value was used for direct and indirect effects evaluations in each resource area chapter to capture the largest potential effects from increased visitation. These values do not account for increased visitation due to modernization of recreation facilities associated with all comprehensive plans.

[7] Based on January 2014 price levels, 3-1/2 discount rate, and 100-year period of analysis.

[8] Economic benefits reflect increases in anadromous fish production, water supplies for CVP and SWP deliveries, hydropower generation and ancillary services/capacity benefits, and recreation (increased user days). Does not include monetized annual benefits for ecosystem restoration, flood damage reduction, or water quality.

[9] Assumes the costs of water supplies and hydropower would increase at the same rate as inflation.

[10] Includes increase of water supply and hydropower costs at 2 percent above inflation to account for growing scarcity in the future. Sensitivity analyses for changes in water supply and hydropower benefits are included in Economic Valuation Appendix.

Key:
- = not applicable
CP = comprehensive plan
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
GWh/year = gigawatt-hours per year
NED = National Economic Development
NOD = north of Delta
SALMOD = Salmonid Population Model
SOD = south of Delta
SWP = State Water Project
TAF = thousand acre-feet

Table 5-13. Summary Comparison of Comprehensive Plans

Comprehensive Plan	Comparison Criteria				Relative Ranking
	Completeness	Effectiveness[1]	Efficiency[2]	Acceptability	
No-Action Alternative	Although the No-Action Alternative would require no additional future action, it would address none of the planning objectives.	Water supply reliability and hydropower needs would continue to increase. High anadromous fish survival, ecosystem restoration, and recreation needs would remain unchanged.	Highly cost inefficient. By taking no additional action, as problems and needs continued and grew, either other significantly more costly actions would be undertaken, especially to address water supply and power needs, or problems and needs would continue unabated.	Would not further address any CALFED or CVPIA goal.	*Very Low*
Relative Rank	*Very Low*	*None*	*None*	*Very Low*	
CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability	Could be implemented with minimum impact and would not require future elements. Would not preclude future action at Shasta Dam and Reservoir or elsewhere in CVP. Would address primary planning objectives.	Relatively low potential to effectively increase water supply reliability and improve fish survival. Would contribute to hydropower and recreation planning objectives.	Low cost efficiency. Unit cost for water supply reliability would likely be superior to other new sources.	Would meet goals of CALFED and consistent with plan in 2000 CALFED Programmatic ROD. High potential for avoiding perceived impacts.	*Moderate*
Relative Rank	*Very High*	*Low*	*Low*	*High*	
CP2 – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability	Similar to CP1. Significant potential for avoiding/mitigating potential increased impacts.	Moderate potential to effectively address primary objectives. Would significantly contribute to water supply reliability. Would contribute to hydropower and recreation planning objectives.	High cost efficiency. Unit cost for water supply reliability would likely be superior to other new sources.	Would be consistent with goals of CVPIA, CALFED, and other related programs. Significant potential for avoiding perceived impacts.	*Moderate to High*
Relative Rank	*Very High*	*Moderate*	*Moderate to High*	*Moderate to High*	

Table 5-13. Summary Comparison of Comprehensive Plans (contd.)

Comprehensive Plans	Comparison Criteria				Relative Ranking
	Completeness	Effectiveness[1]	Efficiency[2]	Acceptability	
CP3 – 18.5-Foot Dam Raise, Agricultural Water Supply Reliability and Anadromous Fish Survival	Similar to CP1. Significant potential for avoiding/mitigating potential increased impacts.	High potential to effectively address anadromous fish survival and agricultural water supply reliability. Low potential to address M&I water supply reliability. Would contribute to hydropower and recreation objectives.	Low cost efficiency. Unit cost for water supply reliability would likely be superior to other new sources.	Would be consistent with goals of CVPIA, CALFED, and other related programs.	*Moderate*
Relative Rank	*Very High*	*Moderate*	*Low*	*Moderate to High*	
CP4 – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability	Significant potential for avoiding/mitigating potential increased impacts. Moderate degree of uncertainty about permanently implementing changed operation for anadromous fish.	Would have major increases in benefits to anadromous fish but relatively lower potential to effectively increase water supply reliability. Highest potential to contribute to hydropower and recreation objectives.	Very high overall cost efficiency. High cost efficiency for anadromous fish survival. Moderate cost efficiency for water supply reliability.	Would be consistent with goals of CVPIA, CALFED, and other related programs.	*High*
Relative Rank	*High*	*High*	*Very High*	*Moderate to High*	
CP4A – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability	Significant potential for avoiding/mitigating potential increased impacts. Moderate degree of uncertainty about permanently implementing changed operation for anadromous fish.	Would have major increases in benefits to anadromous fish and significant contribution to water supply reliability. High potential to contribute to hydropower and recreation objectives.	Very high overall cost efficiency. High cost efficiency for both anadromous fish survival and water supply reliability.	Would be consistent with goals of CVPIA, CALFED, and other related programs. Consistent with the goals of CALFED for various programs, including water supply reliability and ecosystem restoration.	*Very High*
Relative Rank	*High*	*Very High*	*Very High*	*High*	

Table 5-13. Summary Comparison of Comprehensive Plans (contd.)

Comprehensive Plans	Comparison Criteria				Relative Ranking
	Completeness	Effectiveness[1]	Efficiency[2]	Acceptability	
CP5 – 18.5-Foot Dam Raise, Combination Plan	Could be implemented with minimum impact and would not require future elements. Would not preclude future action at Shasta Dam and Reservoir or elsewhere in CVP. Would address all planning objectives.	High potential to address primary planning objectives. Would contribute to secondary objectives with emphasis on ecosystem restoration and recreation.	High cost efficiency. Unit cost for water supply reliability would likely be superior to other new sources. Would have high potential for helping restore ecosystem resources and additional recreation at and near Shasta Lake.	Would be consistent with goals of CVPIA, CALFED, and other related programs. Would be consistent with the goals of CALFED for various programs, including water supply reliability and ecosystem restoration.	*High*
Relative Rank	*High*	*High*	*High*	*Moderate to High*	

Notes:

[1] For the primary planning objective of anadromous fish survival, two major relative ranking factors were considered: (1) increasing salmon survival (decreasing salmon mortality) and (2) increasing habitat for spawning. For the primary planning objective of increasing water supply reliability, ranking was based on the relative amount of estimated increased dry and critical year deliveries under each comprehensive plan. For the secondary planning objectives, four relative ranking factors were considered: (1) whether a comprehensive plan included ecosystem restoration, (2) potential to affect flood peaks downstream from Keswick Dam, (3) potential to increase net power generation, and (4) amount of increased recreation opportunities at Shasta Lake.

[2] The relative rankings for efficiency were based primarily on estimated net NED benefits obtained under each plan.

Key:

CALFED = CALFED Bay-Delta Program

CP = comprehensive plan

CVP = Central Valley Project

CVPIA = Central Valley Project Improvement Act

NED = National Economic Development

ROD = Record of Decision

Completeness

Completeness is a determination of whether a plan includes all elements necessary to realize planned effects, and the degree that intended benefits of the plan depend on the actions of others. Each of the comprehensive plans is estimated to be complete. Several subfactors that are important in measuring this criterion include the following:

- **Authorization** – All comprehensive plans would be consistent with the SLWRI feasibility study authorizations, including Public Law 96-375 (1980) and Public Law 108-361 (2004).

- **Spectrum of objectives being addressed** – As shown in Table 5-12, each of the comprehensive plans would contribute to both primary and secondary objectives.

- **Reliability** – All comprehensive plans would stand alone and would not rely on other actions. Further, the likely reliability and certainty of each of the comprehensive plans to meet overall objectives under a wide range of future conditions would be high. The analyses documented in the Climate Change Modeling Appendix to the accompanying EIS indicate that the comprehensive plans would be robust and would provide benefits under a range of future climate scenarios. However, plan components involving ecosystem restoration along the Sacramento River and in the Shasta Lake area have uncertainty related to O&M requirements to achieve objectives (e.g., siltation of restored channels), and therefore would have less reliability over the long-term. Accordingly, overall reliability would be slightly reduced for CP4, CP4A, and CP5.

- **Physical implementability** – All comprehensive plans generally consist of the same physical implementation components and are projected to be technically feasible, constructible, and able to be operated and maintained.

- **Environmental effects and mitigation** – Anticipated impacts are generally comparable between comprehensive plans, with some impacts exacerbated by larger dam raises and the associated scale of those impacts.

Effectiveness

Effectiveness is the extent to which an alternative alleviates problems and achieves objectives. As shown in Table 5-12, each of the comprehensive plans would contribute in varying degrees to the primary and secondary planning objectives. CP4, CP4A, and CP5 are estimated to have the greatest effectiveness in meeting planning objectives. This is primarily because CP4 and CP4A would provide the largest contributions toward anadromous fish survival and CP5

would provide the largest contribution toward water supply reliability. CP4A ranks slightly higher than CP4 because, as shown in Figure 5-1, in addition to high contributions to anadromous fish survival, CP4A would also provide substantial contributions to water supply reliability.

Efficiency

Efficiency is the measure of how efficiently an alternative alleviates identified problems while realizing specified objectives consistent with protecting the Nation's environment. As shown in Table 5-12, assuming the cost of water and energy supplies increases at the same rate as inflation, CP2, CP4, CP4A, and CP5 would be economically feasible. Assuming the cost of water and energy supplies increased at 2 percent above inflation to account for increasing value of water and energy supplies, all comprehensive plans would be economically feasible. Under either condition, CP4A would have the potential to provide the greatest net economic benefits.

Acceptability

Acceptability is the workability and viability of a plan with respect to its potential acceptance by other Federal agencies, State and local government agencies, and public interest groups and individuals. Acceptability would vary based on the dam raise height, focus of the comprehensive plan, and associated benefits. For CP1, CP2, and CP5, acceptability by both CVP and SWP water users would increase with higher dam raises. CP3 would rank highest for acceptability by CVP water users, but would rank lowest for acceptability by SWP water users. Acceptability by CVP and SWP water users for CP4 and CP4A would be similar to CP1 and CP2, respectively. CP4 and CP4A would rank highest in acceptability by fisheries agencies and related resource interests.

Summary of Comparisons

Each of the comprehensive plans is estimated to be complete, and it appears that each would be effective in achieving its intended objectives. As shown in Table 5-12, all comprehensive plans except CP1 and CP3 would be cost-efficient. Three comprehensive plans with an 18.5-foot dam raise, CP4, CP4A, and CP5, would best address the planning objectives, based on benefits and costs derived. This is primarily because of (1) a high certainty (completeness) that the plans could achieve their intended benefits, and (2) relatively high effectiveness and economic efficiency. CP1 and CP2 would have less of an adverse effect on land uses within the dam inundation area than the other comprehensive plans because CP1 and CP2 would raise the dam by 6.5 feet and 12.5 feet, respectively, compared to the 18.5-foot increase proposed for CP3, CP4, CP4A, and CP5. However, a majority of the construction activities, annual costs, and reservoir area relocations would be required under any dam raise. In addition, the smaller Shasta Dam raise alternatives would provide only a portion of the increased storage capacity of an 18.5-foot raise.

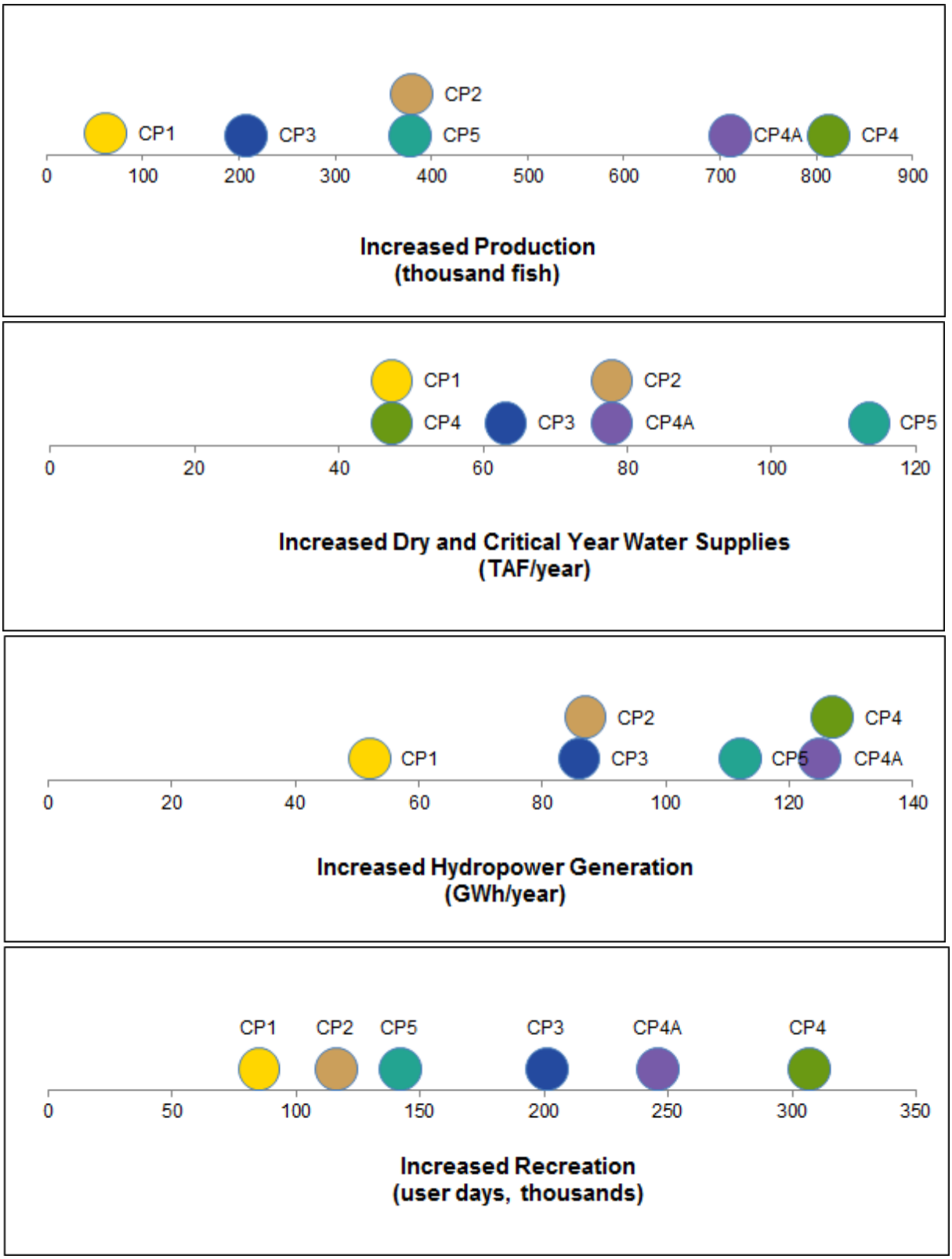

Figure 5-1. Comparison of Ability of Comprehensive Plans to Address Planning Objectives

Table 5-14 displays a comparison of the No-Action Alternative and comprehensive plans overall. Of the three highest ranking plans, CP4A is ranked highest because it would be the most effective in meeting both primary planning objectives, would be the most cost-effective, and would likely be ranked the highest in overall acceptability considering a broad range of stakeholders.

Table 5-14. Summary Comparison of No-Action and Comprehensive Plans

Alternative	Effectiveness	Efficiency	Completeness	Acceptability	Combined Ranking
No-Action Alternative	None	None	Very Low	Very Low	Very Low
CP1	Low	Low	Very High	High	Moderate
CP2	Moderate	Moderate to High	Very High	Moderate to High	Moderate to High
CP3	Moderate	Low	Very High	Moderate to High	Moderate
CP4	High	Very High	High	Moderate to High	High
CP4A	Very High	Very High	High	High	Very High
CP5	High	High	High	Moderate to High	High

Key:
CP = comprehensive plan

Rationale for Plan Selection

At this stage of the Federal planning and NEPA processes, the potential physical accomplishments and the benefits and costs of the alternative plans have been evaluated and compared based on established criteria. A plan recommending Federal action is to be the plan that best addresses the targeted water resources problems considering public benefits relative to costs. The basis for selecting the recommended plan is to be fully reported and documented, including the criteria and considerations used in selecting a recommended course of action by the Federal Government.

The Secretary of the Interior will provide this Final Feasibility Report, the accompanying Final EIS, and supporting information to Congress. The U.S. Congress will use these documents, as well as any additional information they believe appropriate, to determine the public interest in the project, and the specific project authorization language. Most of the activities pursued by the Federal Government require assessing trade-offs and, in many cases, the final decision requires judgment regarding the appropriate extent that monetized and non-monetized benefits and impacts are factored into the decision.

Based on the evaluation of the potential physical accomplishments and the benefits and costs of the alternative plans, CP4A would achieve the highest net NED benefits while protecting the environment and ranks the highest among the comprehensive plans in meeting the P&G criteria. Consistent with the P&Gs,

since CP4A generates maximum net NED benefits, CP4A is identified as the NED Plan. CP4A is also identified as the Preferred Alternative pursuant to NEPA (as described in Chapter 32 of the Final EIS) and is synonymous with the Selected Plan and Preferred Plan pursuant to Reclamation Directives and Standards and Policy (CMP 09-02). Additionally, it is anticipated that CP4A will be identified as the Least Environmentally Damaging Practicable Alternative (LEDPA) pursuant to Section 404 of the Clean Water Act, which is ultimately subject to determination by USACE. In addition, consistent with Department of the Interior climate change policy, CP4A is anticipated to provide benefits under a wide range of future climate scenarios and to provide additional flexibility to adapt to potential changes in hydrology under climate change.