# Chapter 5
# Comprehensive Plans

This chapter provides an overview of the five comprehensive plans, including a discussion of comprehensive plan formulation, management measures common to all comprehensive plans, major components of dam raise scenarios, and costs and benefits of each comprehensive plan. Also included is a general description of the No-Action Alternative and the five comprehensive plans. For each of the five comprehensive plans, major components, benefits, and primary effects are described.

## Overview of Comprehensive Plans

The comprehensive plans in this EIS include the following:

- **Comprehensive Plan 1 (CP1) –** 6.5-foot dam raise, enlarging the reservoir by 256,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.
- **Comprehensive Plan 2 (CP2)** – 12.5-foot dam raise, enlarging the reservoir by 443,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.
- **Comprehensive Plan 3 (CP3)** – 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on both agricultural water supply reliability and anadromous fish survival.
- **Comprehensive Plan 4 (CP4) and Comprehensive Plan 4A (CP4A)** – 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on anadromous fish survival while increasing water supply reliability.
- **Comprehensive Plan 5 (CP5) –** 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, a combination plan focusing on all objectives.

## Development and Refinement of Comprehensive Plans

Consistent with the P&G, the iterative plan formulation process included assessing and refining concept plans and management measures carried forward to formulate comprehensive plans. As described in Chapters 2 and 4, numerous management measures were identified, evaluated, and screened, and from them various initial plans were developed that encompass the scope of potential alternatives focused on addressing the planning objectives. Plans including the following attributes were identified for further development into comprehensive plans. Fundamentally, these plans consist of the following:

- Plan(s) to raise Shasta Dam between 6.5 feet and 18.5 feet, focusing on both water supply reliability and anadromous fish survival but with benefits to various secondary planning objectives

- Plan(s) to raise Shasta Dam by about 18.5 feet, focusing on increased anadromous fish survival but also including water supply reliability, and other secondary planning objectives

- Plan(s) to raise Shasta Dam by about 18.5 feet, focusing on all planning objectives

Considering results of initial plan formulation efforts, the approach was to first formulate plans focusing on different dam raise heights within the range of 6.5 feet to 18.5 feet to address the first plan type listed above. This is generally addressed by the first plan type listed above. A dam raise of 12.5 feet was chosen because it represented a midpoint between the smallest and largest practical dam raises. In addition, features were added to alternatives involving raising Shasta Dam to address maintaining or increasing recreation in the lake area. Next, the approach was to identify the most efficient and effective dam raise height and formulate comprehensive plans to focus on anadromous fish survival and other objectives at this height.

### Comprehensive Plans in the Draft Feasibility Report and Supporting Documents

Using the general rationale described above, and incorporating input from the public scoping process and continued coordination with resource agencies and other interested parties, five comprehensive plans were developed for the Draft Feasibility Report and Preliminary DEIS:

- **Preliminary Comprehensive Plan 1 (PCP1) –** 6.5-foot dam raise, enlarging the reservoir by 256,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Preliminary Comprehensive Plan 2 (PCP2) –** 12.5-foot dam raise, enlarging the reservoir by 443,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Preliminary Comprehensive Plan 3 (PCP3) –** 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on both anadromous fish survival and water supply reliability.

- **Preliminary Comprehensive Plan 4 (PCP4) –** 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, focusing on anadromous fish survival while increasing water supply reliability.

- **Preliminary Comprehensive Plan 5 (PCP5) –** 18.5-foot dam raise, enlarging the reservoir by 634,000 acre-feet, a combination plan focusing on all objectives.

As described further in Chapter 3 of the EIS, Section 3.2.3, "Methods and Assumptions," due to uncertainty related to CVP and SWP operational constraints, water operations modeling and related evaluations in the 2011 Draft Feasibility Report and Preliminary DEIS were based on available modeling analyses at the time. This modeling reflected CVP and SWP operations and constraints described in:

- The Reclamation 2004 *Long-Term CVP and SWP Operations Criteria and Plan Biological Assessment* (2004 OCAP BA) (Reclamation 2004)

- The NMFS 2004 *Biological Opinion on the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan NMFS Biological Opinion* (2004 NMFS BO) (NMFS 2004)

- The USFWS 2005 *Reinitiation of Formal and Early Section 7 Endangered Species Consultation on the Coordinated Operations of the Central Valley Project and State Water Project and the Operational Criteria and Plan to Address Potential Critical Habitat Issues* (2005 USFWS BO) (USFWS 2005)

These analyses were suitable for comparison purposes, and reflected expected variation among the alternatives, including the type and relative magnitude of anticipated impacts and benefits.

Because of the large number of possibilities for increasing anadromous fish survival, additional analyses were conducted to determine the combination of actions that would provide the greatest overall benefits within PCP4. These analyses are described below.

#### *Refinement of Plan for Anadromous Fish Survival Focus with Water Supply Reliability*

Primarily using the SALMOD model, and based on output from the water operations (CalSim-II), reservoir temperature, and river temperature models, a suite of flow-focused and temperature-focused actions (scenarios) were investigated to assess which combination of actions would likely result in the maximum increase in fish populations.

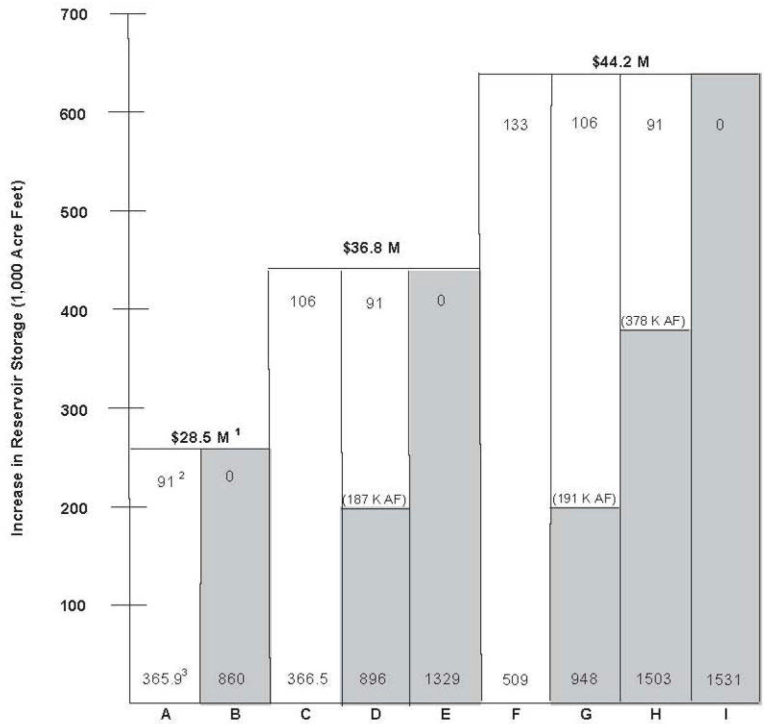
To formulate PCP4, three dam height raises were considered (6.5 feet, 12.5 feet, and 18.5 feet), resulting in 256,000 acre-feet, 443,000 acre-feet, and 634,000 acre-feet of increased storage, respectively. For each of these proposed dam raises, several combinations for allocating the increased storage were analyzed. For instance, assuming a dam raise of 12.5 feet, three options were considered: (1) no increase in the minimum pool, (2) an increase in the minimum pool similar to a 6.5-foot dam raise, and (3) all of the increased space dedicated to increased fisheries. The combinations considered represent scenarios developed to focus on increasing the cold-water pool, and are listed in Table 5-1. Figure 5-1 illustrates the various combinations considered. Included in the figure is information about cost (average annual), increased dry and critical year water supplies for CVP/SWP deliveries, and increased numbers of anadromous fish for the various combinations considered.

**Table 5-1. Scenarios Considered for Cold-Water Storage as Part of Fish Focus Plan**

| Scenario | Dam Raise (feet) | Enlarged Reservoir | Description |
|---|---|---|---|
| **A (PCP1)** | 6.5 | 256,000 acre-feet | No increase in minimum pool |
| **B** | 6.5 | 256,000 acre-feet | Dedicating 256,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit. |
| **C (PCP2)** | 12.5 | 443,000 acre-feet | No increase in minimum pool |
| **D** | 12.5 | 443,000 acre-feet | Dedicating 187,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit. |
| **E** | 12.5 | 443,000 acre-feet | Dedicating 443,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit. |
| **F (PCP3/ PCP5)** | 18.5 | 634,000 acre-feet | No increase in minimum pool |
| **G** | 18.5 | 634,000 acre-feet | Dedicating 191,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit. |
| **H (PCP4)** | 18.5 | 634,000 acre-feet | Dedicating 378,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit. |
| **I** | 18.5 | 634,000 acre-feet | Dedicating 634,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit. |

Notes:
Water operations based on the Reclamation 2004 Long-Term CVP and SWP Operations Criteria and Plan Biological Assessment (2004 OCAP BA) (Reclamation 2004); the NMFS 2004 Biological Opinion on the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan NMFS Biological Opinion (2004 NMFS BO) (NMFS 2004); and the USFWS 2005 Reinitiation of Formal and Early Section 7 Endangered Species Consultation on the Coordinated Operations of the Central Valley Project and State Water Project and the Operational Criteria and Plan to Address Potential Critical Habitat Issues

Key:
PCP1 = Preliminary Comprehensive Plan 1
PCP2 = Preliminary Comprehensive Plan 2
PCP3 = Preliminary Comprehensive Plan 3
PCP4 = Preliminary Comprehensive Plan 4
PCP5 = Preliminary Comprehensive Plan 5




Notes:
[1] Average annual cost ($ millions).
[2] Average annual increase in dry and critical year CVP/SWP deliveries (1,000 acre-feet per year).
[3] Average annual increase in anadromous fish survival (1,000 fish).

**Figure 5-1. Combinations Considered Between Increased Storage Dedicated to Either Water Supply Reliability or Increasing Cold-Water Supply for Fisheries**

Additional scenarios focused on increasing Sacramento River flows with an 18.5-foot raise were also analyzed. The flow combinations were based primarily on flows identified as part of the Anadromous Fish Restoration Plan (USFWS 2001). These scenarios are listed in Table 5-2.

**Table 5-2. Scenarios Considered to Augment Flows as Part of Fish Focus Plan**

| Scenario | Dam Raise (feet) | Enlarged Reservoir | Description |
|---|---|---|---|
| 1 | 18.5 | 634,000 acre-feet | October - March Anadromous Fish Restoration Program flows or 500 cfs increase, whichever is lower |
| 2 | 18.5 | 634,000 acre-feet | October - March Anadromous Fish Restoration Program flows or 750 cfs increase, whichever is lower |
| 3 | 18.5 | 634,000 acre-feet | October - March Anadromous Fish Restoration Program flows or 1,000 cfs increase, whichever is lower |
| 4 | 18.5 | 634,000 acre-feet | Increase August flows to 10,000 cfs and September flows to 6,000 cfs for temperature control |

Note:
Water operations based on the NMFS 2004 Biological Opinion on the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan NMFS Biological Opinion (2004 NMFS BO) (NMFS 2004); and the USFWS 2005 Reinitiation of Formal and Early Section 7 Endangered Species Consultation on the Coordinated Operations of the Central Valley Project and State Water Project and the Operational Criteria and Plan to Address Potential Critical Habitat Issues
Key:
cfs = cubic feet per second

Quantitative analysis indicated that increasing the minimum pool in Shasta Reservoir would have the greatest net fishery benefit. By increasing the minimum pool, the allowable carryover pool storage in the reservoir would be increased. This carryover would act to conserve cold water that could be managed to better benefit anadromous fish. Scenarios 1, 2, 3, and 4 (flow augmentation scenarios) showed limited benefits to anadromous fish compared with other scenarios and were eliminated from further analysis.

As can be seen in Figure 5-1, Scenarios B, E, and I would not have contributed to increased water supply reliability. Even though PCP4 focused on anadromous fish survival, because these three concepts would not have contributed to the other primary planning objective of increasing water supply reliability, they were removed from further consideration. Table 5-3 compares the remaining scenarios. Each of the scenarios was assessed against the relative increase in fish production versus the remaining cost between water supply forgone for each scenario and the overall annual cost for the concept. Figure 5-2, is a plot of increased fish production versus remaining cost for each of the scenarios considered from Table 5-3. Included in the figure is an estimate of the "best buy" envelope. As indicated in the figure, Scenarios D and H appeared to be more cost-effective than the other scenarios because they were generally along the "best buy" envelope.

**Table 5-3. Cost Effectiveness Screening for Efficiency of Annualized Preliminary Combined Scenarios**

| Water Supply Benefits | | | | | |
|---|---|---|---|---|---|
| Scenario | Increase in Fish Production[1] (1,000) | Increased CVP/SWP Deliveries (1,000 acre-feet/ Year)[2] | Benefit ($1,000)[3] | Annual Costs ($1,000) | Remaining Costs ($1,000) |
| NA | - | - | - | - | - |
| A (PCP1) | 387 | 91 | 13,600 | 29,800 | 16,200 |
| C (PCP2) | 337 | 106 | 18,500 | 38,200 | 19,700 |
| D | 816 | 91 | 13,600 | 38,200 | 24,600 |
| F (PCP3) | 627 | 133 | 18,500 | 46,400 | 27,900 |
| G | 816 | 106 | 18,500 | 46,400 | 27,900 |
| H (PCP4) | 1,195 | 91 | 13,700 | 46,400 | 32,700 |

Notes:
[1] Derived using SALMOD
[2] Water operations based on the NMFS 2004 Biological Opinion on the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan NMFS Biological Opinion (2004 NMFS BO) (NMFS 2004) and the USFWS 2005 Reinitiation of Formal and Early Section 7 Endangered Species Consultation on the Coordinated Operations of the Central Valley Project and State Water Project and the Operational Criteria and Plan to Address Potential Critical Habitat Issues
[3] See Economic Valuation Appendix for the Draft Feasibility Report.
Key:
- = not applicable
CVP = Central Valley Project
NA = No-Action Alternative
PCP1 = Preliminary Comprehensive Plan 1
PCP2 = Preliminary Comprehensive Plan 2
PCP3 = Preliminary Comprehensive Plan 3
PCP4 = Preliminary Comprehensive Plan 4
SWP = State Water Project

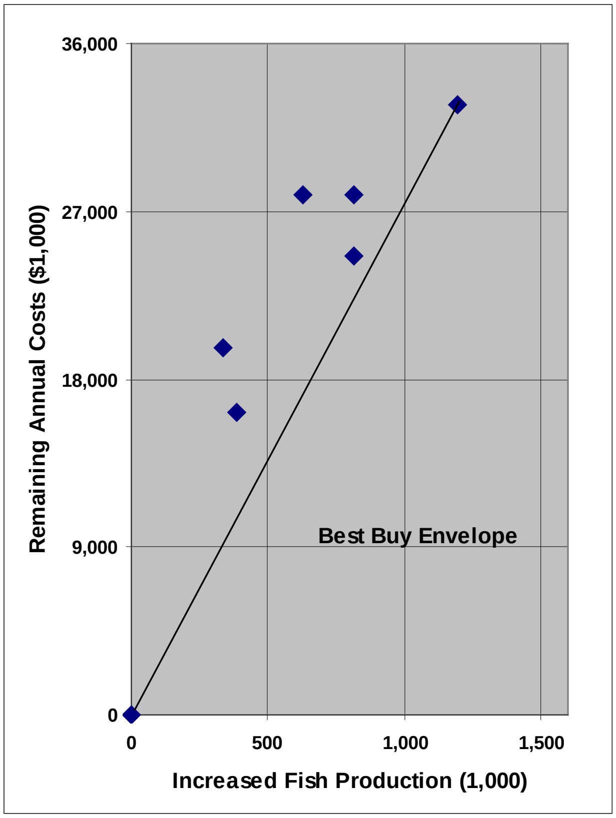



**Figure 5-2. Cost-Effectiveness Assessment of Combined Scenarios**

Based on numerical modeling results, Scenario H was chosen to represent reservoir operation in PCP4 because it provided the greatest benefit to anadromous fish while still meeting the primary objective of water supply reliability. Accordingly, PCP4 included raising Shasta Dam 18.5 feet and increasing the storage for cold-water supply in Shasta Reservoir by about 378,000 acre-feet.

## Refinement of Comprehensive Plans for the DEIS and Final EIS

Comprehensive plans were further refined for the DEIS and Final EIS based on several factors, including updates to CVP and SWP water operations and stakeholder input. Since the release of the Draft Feasibility Report and Preliminary DEIS, water operations modeling in CalSim-II and related analyses for the SLWRI were updated to reflect the following:

- 2008 Long-Term Operation BA (Reclamation 2008)
- 2008 USFWS BO (USFWS 2008)
- 2009 NMFS BO (NMFS 2009)

- Additional changes in CVP and SWP facilities and operations, such as the enlarged Los Vaqueros Reservoir and implementation of the San Joaquin River Restoration Program
- Additional changes in non-CVP/SWP facilities and operations, such as the addition of the Freeport Regional Water Project

Preliminary analyses based on these updated operations indicated shifts in the distribution of water supply benefits from M&I to agricultural uses, resulting in decreased M&I water supply benefits for the Draft Feasibility Report comprehensive plans. Draft Feasibility Report comprehensive plans with updated water operations modeling are labeled with “No Storage Reserved for M&I” in Table 5-4.

To improve the balance between agricultural and M&I water supply benefits, refined scenarios were considered for comprehensive plans in which a portion of the increased storage capacity in Shasta Reservoir was reserved to specifically focus on increasing M&I deliveries. Table 5-4 highlights the range of scenarios considered and water supply reliability and fisheries benefits under each scenario. Based on resulting water supply and fisheries benefits under these scenarios, a portion of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries during dry and critical years under CP1, CP2, CP4, and CP5. Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP, which provides M&I water to a majority of the State’s population.

In addition, to provide a greater range of focus and operations within the set of comprehensive plans, water supply operations for CP3 were focused on agricultural water supply reliability and anadromous fish survival. Accordingly, for CP3, none of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries.

### *Scenario Screening and Selection*

This section describes scenarios selected for DEIS and Final EIS comprehensive plans along with rationale for scenario selection and screening. Comprehensive plans are described in more detail in the “Comprehensive Plans” section below.

## Table 5-4. Scenarios Considered for Refinement of DEIS Comprehensive Plans

| Item | CP1- No Storage Reserved for M&I | CP1- 70/35 M&I[2] | CP1- 100/50 M&I[3] | CP1- 120/60 M&I[4] | CP2- No Storage Reserved for M&I | CP2- 100/50 M&I[2] | CP2- 120/60 M&I[4] | CP2- 150/75 M&I[5] | CP3/CP5- No Storage Reserved for M&I | CP5- 120/60 M&I[4] | CP5- 150/75 M&I[5] | CP4- No Storage Reserved for M&I | CP4- 70/35 M&I[2] | CP4- 100/50 M&I[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dam Raise Height (feet)** | 6.5 | 6.5 | 6.5 | 6.5 | 12.5 | 12.5 | 12.5 | 12.5 | 18.5 | 18.5 | 18.5 | 18.5 | 18.5 | 18.5 |
| **Increased CVP Water Supply Reliability[1]** | | | | | | | | | | | | | | |
| Average (AF/year) | 32,400 | 16,300 | 12,400 | 8,300 | 45,400 | 29,300 | 26,900 | 18,700 | 69,900 | 52,000 | 47,600 | 32,400 | 16,300 | 12,400 |
| Dry/Critical (AF/year) | 45,400 | 13,700 | 8,600 | 2,400 | 53,900 | 29,000 | 24,700 | 14,600 | 85,300 | 63,800 | 55,200 | 45,400 | 13,700 | 8,600 |
| **Increased SWP Water Supply Reliability[1]** | | | | | | | | | | | | | | |
| Average (AF/year) | (4,300) | 14,700 | 21,200 | 24,300 | (1,600) | 21,400 | 24,400 | 31,900 | (8,200) | 20,200 | 28,200 | (4,300) | 14,700 | 21,200 |
| Dry/Critical (AF/year) | (13,500) | 33,600 | 48,400 | 58,100 | (7,600) | 46,800 | 53,100 | 64,400 | (22,200) | 48,100 | 58,300 | (13,500) | 33,600 | 48,400 |
| **Increased Agricultural Water Supply Reliability[1]** | | | | | | | | | | | | | | |
| Average (AF/year) | 29,600 | 20,300 | 18,200 | 14,400 | 42,200 | 33,400 | 31,400 | 25,900 | 62,200 | 52,500 | 50,900 | 29,600 | 20,300 | 18,200 |
| Dry/Critical (AF/year) | 38,700 | 22,500 | 21,900 | 18,600 | 48,400 | 41,100 | 37,600 | 31,200 | 70,600 | 70,800 | 66,100 | 38,700 | 22,500 | 21,900 |
| **Increased M&I Water Supply Reliability[1]** | | | | | | | | | | | | | | |
| Average (AF/year) | (1,600) | 10,700 | 15,400 | 18,200 | 1,700 | 17,300 | 19,900 | 24,700 | (500) | 19,700 | 25,000 | (1,600) | 10,700 | 15,400 |
| Dry/Critical (AF/year) | (6,800) | 24,800 | 35,000 | 41,800 | (2,200) | 34,700 | 40,200 | 47,900 | (7,500) | 41,100 | 47,400 | (6,800) | 24,800 | 35,000 |
| **Total Increase in Water Supply Reliability[1]** | | | | | | | | | | | | | | |
| Average (AF/year) | 28,000 | 31,000 | 33,700 | 32,600 | 43,900 | 50,700 | 51,300 | 50,600 | 61,700 | 72,200 | 75,900 | 28,000 | 31,000 | 33,700 |
| Dry/Critical (AF/year) | 31,900 | 47,300 | 57,000 | 60,500 | 46,200 | 75,800 | 77,800 | 79,100 | 63,100 | 111,900 | 113,500 | 31,900 | 47,300 | 57,000 |
| **Increased Anadromous Fish Survival** | | | | | | | | | | | | | | |
| Production Increase (number of fish)[6] | 148,600 | 61,300 | 28,600 | Not Modeled | 295,300 | 285,800 | 379,200 | 311,600 | 207,400 | Not Modeled | 377,800 | 953,800 | 812,600 | 800,700 |

Notes:
1 Increased water supply reliability was simulated with CalSim-II based on October to September water years.
2 For this scenario, 70 TAF and 35 TAF of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively.
3 For this scenario, 100 TAF and 50 TAF of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively.
4 For this scenario, 120 TAF and 60 TAF of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively.
5 For this scenario, 150 TAF and 75 TAF of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively.
6 Average annual increase in juvenile Chinook salmon surviving to migrate downstream from Red Bluff Pumping Plant simulated using SALMOD. These estimates represent an index of production increase, based on the simulated average annual increase in juvenile Chinook salmon surviving to migrate downstream from the RBPP.

Key:
AF = acre-feet
CP = Comprehensive Plan
CVP = Central Valley Project
M&I = municipal and industrial
SWP = State Water Project
TAF = thousand acre-feet

**Comprehensive Plan 1 (CP1) – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability** CP1 focuses on increasing anadromous fish survival and water supply reliability primarily through raising Shasta Dam by 6.5 feet, enlarging Shasta Reservoir by approximately 256,000 acre-feet.

*CP1 Storage Reserved for Increasing M&I Deliveries* As shown in Table 5-4, four operational scenarios were evaluated for CP1. The selected scenario includes reserving 70,000acre-feet and 35,000 acre-feet of the expanded storage capacity in Shasta Reservoir to specifically focus on increasing M&I deliveries during dry and critical years, respectively. This scenario is identified as "CP1-70/35 M&I" in Table 5-4.

*Rationale for Screening and Selection* The selected scenario contributes to both primary objectives through providing increased agricultural and M&I water supply reliability and increased anadromous fish survival. Scenarios that did not contribute to both primary objectives were deleted from further consideration for CP1. Of the remaining scenarios, CP1-70/35 M&I was selected because it allowed for improved balance between agricultural and M&I water supply benefits compared to other scenarios considered for CP1.

**Comprehensive Plan 2 (CP2) – 12.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability** CP2 focuses on increasing anadromous fish survival and water supply reliability primarily through raising Shasta Dam by 12.5 feet, enlarging Shasta Reservoir by approximately 443,000 acre-feet.

*CP2 Storage Reserved for Increasing M&I Deliveries* As shown in Table 5-4, four operational scenarios were evaluated for CP2. The selected scenario includes reserving 120,000acre-feet and 60,000 acre-feet of the expanded storage in Shasta Reservoir to specifically focus on increasing M&I deliveries during dry and critical years, respectively. This scenario is identified as "CP2-120/60 M&I" in Table 5-4.

*Rationale for Screening and Selection* The selected scenario contributes to both primary objectives through providing increased agricultural and M&I water supply reliability and increased anadromous fish survival. Scenarios that did not contribute to both primary objectives were deleted from further consideration for CP2. Of the remaining scenarios, CP2-120/60 M&I was selected because it maximizes potential average year increases in water supply reliability and better balances agricultural and M&I water supply benefits compared to other scenarios considered for CP2.

**Comprehensive Plan 3 (CP3) – 18.5-Foot Dam Raise, Agricultural Water Supply Reliability and Anadromous Fish Survival** CP3 focuses on increasing agricultural water supply reliability and anadromous fish survival primarily through raising Shasta Dam by 18.5 feet, enlarging Shasta Reservoir by approximately 634,000 acre-feet.

*CP3 Storage Reserved for Increasing M&I Deliveries* Because CP3 focuses on increasing agricultural water supply reliability and anadromous fish survival, none of the increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries. This scenario is identified as “CP3-No Storage Reserved for M&I” in Table 5-4.

*Rationale for Screening and Selection* Scenario CP3-No Storage Reserved for M&I was selected because it maximizes potential agricultural water supply deliveries under a 6.5-foot to 18.5-foot raise of Shasta Dam. Since CP3 focuses on agricultural water supply reliability, scenarios reserving storage capacity for increasing M&I deliveries were deleted from further consideration.

**Comprehensive Plan 4 (CP4) – 18.5-Foot Dam Raise, Anadromous Fish Survival Focus with Water Supply Reliability** CP4 focuses on increasing anadromous fish survival, primarily through raising Shasta Dam by 18.5 feet and enlarging Shasta Reservoir by approximately 634,000 acre-feet, while also increasing water supply reliability.

*CP4 Storage Reserved for Increasing M&I Deliveries* As shown in Table 5-4, three operational scenarios were evaluated for CP4. Under CP4, approximately 378,000 acre-feet of the increased storage capacity would be dedicated to increasing the supply of cold water in Shasta Reservoir for anadromous fish survival purposes. For the selected scenario, operations for the remaining portion of the increased storage (approximately 256,000 acre-feet) would be the same as in CP1, with 70,000 acre-feet and 35,000 acre-feet of the expanded storage in Shasta Reservoir reserved to specifically focus on increasing M&I deliveries during dry and critical years, respectively. This scenario is identified as “CP4-70/35 M&I” in Table 5-4.

*Rationale for Screening and Selection* Scenario CP4-70/35 M&I was selected because it maximizes potential fisheries benefits while still increasing agricultural and M&I water supply reliability. Scenarios that did not contribute to both primary objectives were deleted from further consideration for CP4. CP4-70/35 M&I also allows for improved balance between agricultural and M&I water supply benefits compared to other scenarios considered for CP4 that contribute to both primary objectives.

**Comprehensive Plan 5 (CP5) – 18.5-Foot Dam Raise, Combination Plan** CP5 focuses on increased water supply reliability, anadromous fish survival, Shasta Lake area environmental resources, and increased recreation opportunities, primarily through raising Shasta Dam by 18.5 feet, enlarging Shasta Reservoir by approximately 634,000 acre-feet.

*CP5 Storage Reserved for Increasing M&I Deliveries* As shown in Table 5-4, three operational scenarios were evaluated for CP5. The selected scenario includes reserving 150,000acre-feet and 75,000 acre-feet of the expanded storage in Shasta Reservoir to specifically focus on increasing M&I deliveries during dry and critical years, respectively. This scenario is identified as “CP5-150/75 M&I” in Table 5-4.

*Rationale for Screening and Selection* The selected scenario contributes to both primary objectives through providing increased agricultural and M&I water supply reliability and increased anadromous fish survival. Scenarios that did not contribute to both primary objectives were deleted from further consideration for CP5. Of the remaining scenarios, CP5-150/75 M&I was selected because it maximizes both average year and dry and critical year increases in water supply reliability and better balances agricultural and M&I water supply benefits compared to other scenarios considered for CP5.

**Refinement of Operational Scenario for Plan Focused on Anadromous Fish Survival with Water Supply Reliability** Based on public comments on the Draft Feasibility and Draft EIS, a refined operational scenario (Comprehensive Plan 4A (CP4A)) was developed for the anadromous fish focus plan. This new operational scenario is a refinement of the operations for CP4, based on several factors, including the updated CVP and SWP operations, described above, which are based on the 2008 USFWS BO and 2009 NMFS BO. A suite of temperature and flow-focused actions (scenarios) were investigated to assess which combination of actions would likely maximize increases in anadromous fish populations. These investigations primarily used the SALMOD model, and were based on output from the water operations (CalSim-II), reservoir temperature, and river temperature models. Similar scenario refinements were considered for the Draft Feasibility Report, as summarized in Table 5-1 and Table 5-2. However, Draft Feasibility Report scenarios were based on CVP and SWP operational scenarios including the 2004 NMFS BO and 2005 USFWS BO, which have been since updated.

A range of scenarios were considered during the development of CP4A. For these scenarios, several combinations for allocating the increased storage were analyzed, focusing on either increasing the volume of the cold-water pool in Shasta Reservoir or augmenting flows downstream from Shasta Dam. Flow augmentation scenarios were based primarily on flows identified as part of the Anadromous Fish Restoration Plan (USFWS 2001). Table 5-5 highlights the range of scenarios considered and estimated benefits to water supply reliability and anadromous fisheries under each scenario.

Scenario G in Table 5-5 was selected as the refined operational scenario CP4A, as it allows for improved balance between water supply benefits and fisheries benefits compared to other scenarios.

**Table 5-5. Scenarios Considered for Refinement of Final EIS Comprehensive Plans**

| Scenario | Dam Raise (feet) | Enlarged Reservoir (acre-feet) | Description | Production Increase (number of fish)[1] | Total Increase in Water Supply Reliability[2] Average (acre-feet/year) | Total Increase in Water Supply Reliability[2] Dry/Critical (AF/year) |
|---|---|---|---|---|---|---|
| **Scenarios Considered for Cold-Water Storage as Part of Fish Focus Plan** | | | | | | |
| **A (CP1)** | 6.5 | 256,000 | No increase in minimum cold-water pool for fishery benefit. 70,000 acre-feet and 35,000 acre-feet of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively | 61,300 | 31,000 | 47,300 |
| **B** | 6.5 | 256,000 | Dedicate 256,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit. No increased storage capacity in Shasta Reservoir reserved for water supply. | 673,000 | 0 | 0 |
| **C (CP2)** | 12.5 | 443,000 | No increase in minimum cold-water pool for fishery benefit. 100,000 acre-feet and 50,000 acre-feet of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively. | 379,200 | 51,300 | 77,800 |
| **D** | 12.5 | 443,000 | | 428,700 | 31,000 | 47,300 |
| **E** | 12.5 | 443,000 | Dedicate 443,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit. No increased storage capacity in Shasta Reservoir reserved for water supply. | 999,900 | 0 | 0 |
| **F (CP3)** | 18.5 | 634,000 | No increase in minimum cold-water pool for fishery benefit. Increased storage capacity in Shasta Reservoir dedicated to agricultural deliveries. | 207,400 | 61,700 | 63,100 |
| **F (CP5)** | 18.5 | 634,000 | No increase in minimum cold-water pool for fishery benefit. 150,000 acre-feet and 75,000 acre-feet of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively. | 377,800 | 75,900 | 113,500 |

**Table 5-5. Scenarios Considered for Refinement of Final EIS Comprehensive Plans (contd.)**

| Scenario | Dam Raise (feet) | Enlarged Reservoir (acre-feet) | Description | Production Increase (number of fish)[1] | Total Increase in Water Supply Reliability[2] Average (acre-feet/year) | Total Increase in Water Supply Reliability[2] Dry/Critical (AF/year) |
|---|---|---|---|---|---|---|
| **G (CP4A)** | 18.5 | 634,000 | Dedicate 191,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit. 100,000 acre-feet and 50,000 acre-feet of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively. | 710,000 | 51,300 | 77,800 |
| **H (CP4)** | 18.5 | 634,000 | Dedicate 378,000 acre-feet of the additional water from increased storage to increase the size of the cold-water pool for fishery benefit. 70,000 acre-feet and 35,000 acre-feet of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively. | 812,600 | 31,000 | 47,300 |
| **I** | 18.5 | 634,000 | Dedicate 634,000 acre-feet of water from increased storage to increase the size of the cold-water pool for fishery benefit. No increased storage capacity in Shasta Reservoir reserved for water supply. | 971,400 | 0 | 0 |
| **Scenarios Considered to Augment Flows as Part of Fish Focus Plan** | | | | | | |
| **1[2]** | 18.5 | 634,000 | October - March Anadromous Fish Restoration Program flows or 500 cfs increase, whichever is lower. Increased storage capacity in Shasta Reservoir dedicated to agricultural deliveries. | 348,700 | 54,600 | 57,200 |
| **1[3]** | 18.5 | 634,000 | October - March Anadromous Fish Restoration Program flows or 500 cfs increase, whichever is lower. 150,000 acre-feet and 75,000 acre-feet of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively. | 319,300 | 65,000 | 91,300 |
| **3[2]** | 18.5 | 634,000 | October - March Anadromous Fish Restoration Program flows or 1,000 cfs increase, whichever is lower. Increased storage capacity in Shasta Reservoir dedicated to agricultural deliveries. | 222,800 | 42,200 | 35,700 |
| **3[3]** | 18.5 | 634,000 | October - March Anadromous Fish Restoration Program flows or 1,000 cfs increase, whichever is lower. 150,000 acre-feet and 75,000 acre-feet of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively. | 309,500 | 54,600 | 69,300 |

## Table 5-5. Scenarios Considered for Refinement of Final EIS Comprehensive Plans (contd.)

| **Scenario** | **Dam Raise (feet)** | **Enlarged Reservoir (acre-feet)** | **Description** | **Production Increase (number of fish)[1]** | **Total Increase in Water Supply Reliability[2] Average (acre-feet/year)** | **Total Increase in Water Supply Reliability[2] Dry/Critical (AF/year)** |
|---|---|---|---|---|---|---|
| **4[2]** | 18.5 | 634,000 | Increase August flows to 10,000 cfs and September flows to 6,000 cfs for temperature control. Increased storage capacity in Shasta Reservoir dedicated to agricultural deliveries. | 88,400 | 62,600 | 76,400 |
| **4[3]** | 18.5 | 634,000 | Increase August flows to 10,000 cfs and September flows to 6,000 cfs for temperature control. 150,000 acre-feet and 75,000 acre-feet of the increased storage capacity in Shasta Reservoir was reserved for increasing M&I deliveries in dry and critical years, respectively. | 63,900 | 73,000 | 122,800 |

Notes:

[1] Estimates of increased anadromous fish survival were based on simulations using the SALMOD model. These estimates represent an index of production increase, based on the simulated average annual increase in juvenile Chinook salmon surviving to migrate downstream from the RBPP.

[2] Increased water supply reliability was simulated with CalSim-II based on October to September water years. Water Year Types Based on the Sacramento Valley Water Year Hydrologic Classification. Water operations based on the USFWS 2008 Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP (USFWS 2008) and NMFS 2009 BO and Conference Opinion on the Long-Term Operations of the CVP and SWP (NMFS 2009).

[2] Refined operational scenario based on CP3 distribution of water supply benefits

[3] Refined operational scenario based on CP5 distribution of water supply benefits

Key:
CP = Comprehensive Plan
M&I = municipal and industrial
SWP = State Water Project

The refined operational scenario, CP4A, is identical to CP4, except for operations of Shasta Dam and Reservoir. CP4 and CP4A have similar reservoir operations in that they each dedicate a portion of the new storage in Shasta Lake for fisheries purposes, however, the portion of this dedicated storage varies. Under CP4A, approximately 191,000 acre-feet of the increased 634,000 acre-feet storage capacity would be dedicated to increasing the supply of cold water in Shasta Reservoir for anadromous fish survival purposes. Operations for the remaining portion of the increased storage (approximately 443,000 acre-feet) would be the same as in CP2, with 120,000 acre-feet and 60,000 acre-feet of the expanded storage in Shasta Reservoir reserved to specifically focus on increasing M&I deliveries during dry and critical years, respectively.

## No-Action Alternative

NEPA and CEQA require the analysis of a baseline alternative, representing a scenario in which the project is not implemented. For all Federal feasibility studies of potential water resources projects, the No-Action Alternative is intended to account for existing facilities, conditions, land uses, and reasonably foreseeable actions expected to occur in the study area. Reasonably foreseeable actions include actions with current authorization, secured funding for design and construction, and environmental permitting and compliance activities that are substantially complete.

Under CEQA, the No-Project Alternative is similar to NEPA's No-Action Alternative, but it involves the review of two scenarios: the existing condition baseline, which represents only current conditions at the time the Notice of Preparation is published, and "reasonably foreseeable" future conditions without the project (which is equivalent to the NEPA No-Action Alternative).

For the SLWRI, the No-Action/No-Project Alternative is based on CVP and SWP operational conditions described in the 2008 Long-Term Operation BA, and the BOs issued by USFWS and NMFS in 2008 and 2009, respectively. The No-Action Alternative also includes continued implementation of actions identified under the CVPIA. In addition, the No-Action Alternative includes key projects assumed to be in place and operating in the future, including the Freeport Regional Water Project, Delta Water Supply Project, South Bay Aqueduct Improvement and Enlargement Project, a functional equivalent of the Vernalis Adaptive Management Plan, full restoration flows under the San Joaquin River Restoration Program, and full implementation of the Grassland Bypass Project. The existing and future conditions for the SLWRI are further described in EIS Chapter 3, Section 3.2.3. In addition, Table 2-1 of the Modeling Appendix shows which actions were assumed to be part of the existing condition and the future condition (or No-Action /No-Project Alternative) in the SLWRI 2012 Version CalSim-II model.

The No-Action Alternative is considered to be the basis for comparison with potential action alternatives, consistent with NEPA and the P&G (WRC 1983) guidelines. Thus, if no proposed action is determined to be feasible, the No-Action Alternative is the default option.

Under the No-Action Alternative, the Federal Government would continue to implement reasonably foreseeable actions, as defined above, but would not take additional actions toward implementing a plan to raise Shasta Dam to help increase anadromous fish survival in the upper Sacramento River, nor help address the growing water supply and reliability issues in California. The following discussions highlight the consequences of implementing the No-Action Alternative, as they relate to the planning objectives of the SLWRI.

In addition to comparing the No-Action Alternative to potential action alternatives, the potential action alternatives were also compared to the existing condition baseline (as described above) in consideration of CEQA requirements.

The accompanying EIS Chapters 4 through 25 include detailed descriptions of existing reservoir area infrastructure and study area resource conditions. Anticipated future resources conditions in the study area are also characterized. Detailed information on the study area is contained in the EIS and supporting appendices.

### Anadromous Fish Survival

Much has been done to address anadromous fish survival problems in the upper Sacramento River. Solutions have ranged from changes in the timing and magnitude of releases from Shasta Dam to constructing and operating the TCD at the dam. Actions also include site-specific projects, such as introducing spawning gravel to the Sacramento River and work to improve or restore spawning habitat in tributary streams. However, to increase anadromous fish survival and reduce the risk of extinction, further water temperature improvements are needed in the Sacramento River, especially in dry and critical years. Increased demand for water for urban, agricultural, and environmental uses is also expected to reduce the reliability of cold water for anadromous fish. Prolonged drought that depletes the cold-water pool in Shasta Reservoir could put populations of anadromous fish at risk of severe population decline or extirpation in the long-term (NMFS 2014). The risk associated with a prolonged drought is especially high in the Sacramento River, as Shasta Reservoir is operated to maintain only 1 year of carryover storage.

Under the No-Action Alternative, it is assumed that actions to protect fisheries and benefit aquatic environments would continue, including maintaining the TCD, ongoing spawning gravel augmentation programs, and satisfying other existing regulatory requirements.

## Water Supply Reliability

Demands for water in the Central Valley and throughout California exceed available supplies, and the need for additional supplies is expected to grow. There is growing competition for limited system resources among various users and uses, including urban, agricultural, and environmental. Urban water demand and environmental water requirements have each increased, resulting in greater competition for limited water supplies. As mentioned, the population of California and the Central Valley is expected to increase by more than 60 and 130 percent above 2005 levels, respectively, by 2050 (California Department of Finance 2007). As these population increases occur, and are coupled with the need to maintain a healthy and vibrant industrial and agricultural economy, the demand for water would continue to significantly exceed available supplies. Competition for available water supplies would intensify as water demands increase to support this population growth.

Water conservation and reuse efforts are expected to substantially increase and forced conservation resulting from increasing water shortages would continue. In the past, during drought years, many water conservation measures have been implemented to reduce the effects of the drought. In the future, as more water use efficiency actions become necessary to help meet even average year demands, the impacts of droughts will be much more severe. Besides forced conservation, without developing cost-efficient new sources, the growing urban population would increasingly rely on shifting water supplies from such areas as agricultural production to satisfy M&I demands. In the urban sector, reduced supplies or increased supply uncertainty could cause water rates to increase as agencies seek to remedy supply shortfalls by implementing measures to reduce demand and/or augment supplies.

It is likely that with continued and deepening shortages in available water supplies, adverse economic and socioeconomic impacts would increase over time in the Central Valley and elsewhere in California. One example could include higher water costs, resulting in a further shift in agricultural production to areas outside California and/or outside the United States. Another example could include water supply shortages resulting in changes in land use patterns, loss and destruction of permanent crops, and/or decreased production of existing crops. In response to reduced water supplies, farmers may fallow fields, reducing agricultural productivity directly resulting in layoffs, reduced hours for agricultural employees, and increased unemployment in agricultural communities. Reduced water supplies and the resulting employment losses could also cause socioeconomic impacts in affected communities.

Under the No-Action Alternative, Shasta Dam would not be modified and the CVP would continue operating similarly to existing conditions. The No-Action Alternative would continue to meet water supply demands at levels similar to existing conditions, but would not be able to meet the expected increased demand in California.

### Ecosystem Resources, Flood Management, Hydropower Generation, Recreation, and Water Quality

As opportunities arise, some efforts would likely continue to improve environmental conditions on tributaries to Shasta and along the upper Sacramento River. However, overall, future environmental-related conditions in these areas would likely be similar to existing conditions. The quantity, quality, diversity, and connectivity of riparian, wetland, and riverine habitats along the Sacramento River have been limited by confinement of the river systems by levees, reclamation of adjacent lands for framing, bank protection, channel stabilization, and land development.

Shasta Dam and Reservoir have greatly reduced flood damage along the Sacramento River. Shasta Dam and Reservoir were constructed at a total cost of about $36 million in 1936 (about $2 billion in 2014 dollars). Shasta Dam, in combination with the Sacramento River Flood Control Project, protects about 1 million people and over $60 billion in assets. However, residual risks to human life, health, and safety along the Sacramento River remain. Development in flood-prone areas has exposed the public to the risk of flooding. Storms producing peak flows, and volumes greater than the existing flood management system was designed for, can occur, and result in extensive flooding along the upper Sacramento River. Under the No-Action Alternative, the threat of flooding would continue, and may increase as population growth increases.

California's demand for electricity is expected to substantially increase in the future. Under the No-Action Alternative, no actions would be taken to help meet this growing demand.

As California's population continues to grow, demands would grow substantially for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley. This increase in demand will be especially pronounced at Shasta Lake.

To address the impact of water quality deterioration on the Sacramento River basin and Delta ecosystems and endangered and threatened fish populations, several environmental flow goals and objectives in the Central Valley (including the Delta) have been established through legal mandates aimed at maintaining and recovering endangered and threatened fish and wildlife, and protecting designated critical habitat. Despite these efforts, under the No-Action Alternative, these resources would continue to decline and ecosystems would continue to be impacted. In addition, Delta water quality may continue to decline.

## Comprehensive Plans

The following sections describe the comprehensive plans developed as action alternatives for the SLWRI. Management measures and environmental commitments common to all comprehensive plans are described first, followed by descriptions of major components, potential benefits, and potential primary effects for each comprehensive plan.

## Management Measures Common to All Comprehensive Plans

Eight of the management measures retained in the alternatives development process (see Chapter 2) are included, to some degree, in all of the comprehensive plans. These measures were included because they (1) would either be incorporated or required with any dam raise, (2) were logical and convenient additions that would significantly improve any alternative, or (3) should be considered with any new water increment developed in California. The eight measures include (1) enlarging the Shasta Lake cold-water pool, (2) modifying the TCD, (3) increasing conservation storage, (4) reducing demand, (5) modifying flood operations, (6) modifying hydropower facilities, (7) maintaining or increasing recreation opportunities, (8) and maintaining or improving water quality.

### *Enlarge Shasta Lake Cold-Water Pool*

Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. At a minimum, all comprehensive plans would include enlarging the cold-water pool by raising Shasta Dam to enlarge Shasta Reservoir. Some alternatives would also increase the seasonal carryover storage in Shasta Lake.

### *Modify Temperature Control Device*

For all comprehensive plans, the TCD would be modified to account for an increased dam height and to reduce leakage of warm water into the structure. Minimum modifications to the TCD include raising the existing structure and modifying the shutter control. This measure would increase the ability of operators at Shasta Dam to meet downstream temperature requirements, and provide more operational flexibility to achieve desirable water temperatures during critical periods for anadromous fish.

### *Increase Conservation Storage*

All comprehensive plans would include increasing the amount of space available for water conservation storage in Shasta Reservoir by raising Shasta Dam. Conservation storage is the portion of the capacity of the reservoir available to store water for subsequent release to increase water supply reliability for M&I, agricultural, and environmental purposes. All comprehensive plans would include a range of dam enlargements and various increases in conservation space.

### *Reduce Demand*

All comprehensive plans would include an additional water conservation program for increased water deliveries that would be created by the project to augment current water use efficiency practices. The proposed program would consist of a 10-year initial program in which Reclamation would allocate approximately $1.6 million to $3.8 million, proportional to additional water supplies delivered, to fund water conservation efforts. Funding would focus on assisting project beneficiaries (agencies receiving increased water supplies because of the project), with developing new or expanded urban water conservation, agricultural water conservation, and water recycling programs. Program actions would be a combination of technical assistance, grants, and loans to support a variety of water conservation projects such as recycled wastewater projects, irrigation system retrofits, and urban utilities retrofit and replacement programs. Reclamation, in collaboration with project beneficiaries, would identify and develop water conservation projects for funding under the program. Reclamation would then implement an investment strategy, in coordination with project beneficiaries, to identify and prioritize projects which, in conjunction with other water conservation activities, would cost-effectively reduce water demand and increase water conservation. This process would result in developing, evaluating, and prioritizing projects for funding. The program could be established as an extension of existing Reclamation programs, or as a new program, through teaming with cost-sharing partners. Combinations and types of water use efficiency actions funded would be tailored to meet the needs of identified cost-sharing partners, including consideration of cost-effectiveness at a regional scale for agencies receiving funding.

#### *Modify Flood Operations*

Potential modification of flood operations would be considered for all comprehensive plans. Enlargement of Shasta Reservoir would require alterations to existing flood operation guidelines or rule curves, to reflect physical modifications, such as an increase in dam/spillway elevation. The rule curves would be revised with the goal of reducing flood damage and enhancing other objectives to the extent possible.

#### *Modify Hydropower Facilities*

Under each comprehensive plan, enlargement of Shasta Dam would likely require various minimum modifications, commensurate with the magnitude of the enlargement, to the existing hydropower facilities at the dam to enable their continued efficient use. These modifications, in conjunction with increased lake surface elevations, may provide incidental benefits to hydropower generation. Although modifications could also be included to further increase the power production capabilities of the reservoir (e.g., additional penstocks and generators), they are believed to be a detail beyond the scope of this investigation and are not considered further at this level of planning.

#### *Maintain and Increase Recreation Opportunities*

In addition to the measures described above, all comprehensive plans would address, to some extent, the secondary planning objective of maintaining and increasing recreation opportunities at Shasta Lake. Outdoor recreation, and especially recreation at Shasta Lake, represents a major source of enjoyment to millions of people annually and is a major source of income to the northern

Sacramento Valley. Shasta Dam and Reservoir are within the Shasta Unit of the Whiskeytown-Shasta-Trinity NRA. Recreation within these lands is managed by USFS. As part of this administration, USFS either directly operates and maintains, or manages through leases, numerous public campgrounds, marinas, boat launching facilities, and related water-oriented recreation facilities. Enlarging Shasta Dam and Reservoir would affect some of these facilities. Consistent with the position of USFS, and planning conditions described in this chapter, all of the comprehensive plans would include features to, at a minimum, maintain the overall recreation capacity of the existing facilities. All comprehensive plans would also provide for modernization of relocated recreation facilities, including, at a minimum, modifications to comply with current standards for health and safety.

#### *Maintain or Improve Water Quality*

All alternatives could contribute to improved Delta water quality conditions and Delta emergency response. Additional storage in Shasta Reservoir would provide improved operational flexibility. Shasta Dam has the ability to provide increased releases and high flow releases to improve Delta water quality. Improved Delta water quality conditions could provide benefits for both water supply reliability and ecosystem restoration by potentially increasing Delta outflow during drought years and reducing salinity during critical periods.

### Environmental Commitments Common to All Comprehensive Plans

Reclamation and/or its contractors would incorporate certain environmental commitments and best management practices (BMP) into any plan identified for implementation to avoid or minimize potential impacts. Reclamation would also coordinate planning, engineering, design and construction, operation, and maintenance phases of any authorized project modifications with applicable resource agencies.

The following environmental commitments would be incorporated into any action alternative for any project-related construction activities. This section does not include mitigation measures. A comprehensive mitigation strategy to mitigate potential effects of comprehensive plans is included in the EIS in the Preliminary Environmental Commitments and Mitigation Plan Appendix.

#### *Develop and Implement Construction Management Plan*

Reclamation would develop and implement a construction management plan to avoid or minimize potential impacts on public health and safety during project construction, to the extent feasible. The construction management plan would inform contractors and subcontractors of work hours, modes and locations of transportation and parking for construction workers; location of overhead and underground utilities; worker health and safety requirements; truck routes; stockpiling and staging procedures; public access routes; terms and conditions of all required project permits and approvals; and emergency response services contact information.

The construction management plan would also include construction notification procedures for the police, public works, and fire departments in the area where construction would occur. In addition, the construction management plan would include similar procedures for Federal and State agencies with similar jurisdictions, including USFS. Notices would also be distributed to neighboring property owners. The health and safety component of the construction management plan would be monitored for the implementation of the plan on a day-to-day basis by a Certified Industrial Hygienist.

The construction management plan would include effort to notify businesses, residents, and visitors associated with recreation activities on and surrounding Shasta Lake. In addition to information available at the Shasta Lake Visitors Center, informational signs and booths would be placed at key locations to be identified by Reclamation in conjunction with agencies and local business organizations. Reclamation will also develop and maintain a project-specific website that will be used for a wide range of informational purposes.

#### Comply with Permit Terms and Conditions

If any action alternative is approved and authorized for construction, Reclamation would require its contractors and suppliers, its general contractor, and all of the general contractor's subcontractors and suppliers to comply with all of the terms and conditions of all required project permits, approvals, and conditions attached thereto. If necessary, additional information (e.g., detailed designs and additional documentation) would be prepared and provided for review by decision makers and the public. Reclamation would ultimately be responsible for the actions of its contractors in complying with permit conditions. Compliance with applicable laws, policies, and plans for this project is discussed in Section 26.6 of this EIS.

#### Provide Relocation Assistance through Federal Relocation Assistance Program

All Federal, State, and local government agencies, and others receiving Federal financial assistance for public programs and projects that require the acquisition of real property must comply with the policies and provisions set forth in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Uniform Act) (Title 49, CFR, Part 24). All relocation and property acquisition activities would be performed in compliance with the Uniform Act. Any individual, family, or business displaced by implementation of any of the action alternatives would be offered relocation assistance services for the purpose of locating a suitable replacement property, to the extent consistent with the Uniform Act.

Under the Uniform Act, relocation services for residences would include providing a determination of the housing needs and desires, a list of comparable properties, transportation to inspect housing referrals, and reimbursement of moving costs and related expenses. For business relocation activities, relocation services would include providing a determination of the relocation needs and requirements; a determination of the need for outside specialists to plan, move, and reinstall personal property; advice as to possible sources of funding and assistance from other local, State, and Federal agencies; listings of commercial properties, and reimbursement for costs incurred in relocating and reestablishing the business. No relocation payment received would be considered as income for the purpose of the Internal Revenue Code.

#### *Remain Consistent with USFS Built Environment Image Guide*

Any facilities subject to USFS authorization that are constructed or reconstructed facilities would be consistent with USFS Built Environment Image Guide. The architectural character of facilities on National Forest System lands would be constructed using materials and design that keep with the visual and cultural identity of the landscape in which they are constructed. Reclamation would seek to maintain the quality of visitor experiences, affected facilities capacity will be replaced with facilities providing equivalent visual resource quality and amenities.

#### *Protect Public Land Survey System Monuments and Property Corners*

Reclamation would identify Public Land Survey System (PLSS) monuments or survey property corners affected by either inundation due to increased lake levels or construction activities. Reclamation or its contractors would protect all PLSS monuments and associated references and all property corners, either by positioning, or, where necessary, creating new references. The results will be filed with BLM and Shasta County.

#### *Evaluate and Protect Paleontological Resources Discovered During Construction*

If paleontological resources are discovered during construction activities, all work in the immediate vicinity of the discovery will stop immediately and Reclamation will be notified (as applicable). A qualified paleontologist will be retained to evaluate the find and recommend appropriate conservation measures, such as data recovery or protection in place. The conservation measures will be implemented before re-initiation of activities in the immediate vicinity of the discovery.

#### *Develop and Implement Stormwater Pollution Prevention Plan*

Any project authorized for construction would be subject to the construction-related stormwater permit requirements of the CWA National Pollutant Discharge Elimination System program. Reclamation would obtain any required permits through the Central Valley Regional Water Quality Control Board before any ground-disturbing construction activity. According to the requirements of Section 402 of the CWA, Reclamation and/or its contractors would prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) before construction, identifying BMPs to prevent or minimize erosion and the discharge of sediments and other contaminants with the potential to affect beneficial uses of or lead to violations of water quality objectives for surface waters. The SWPPP would include site-specific structural and operational

BMPs to prevent and control impacts on runoff quality, and procedures to be followed before each storm event. BMPs would control short-term and long-term erosion and sedimentation effects and stabilize soils and vegetation in areas affected by construction activities. The SWPPP would contain a site map that shows the construction site perimeter, existing and proposed buildings, lots, roadways, and stormwater collection and discharge points; drainage patterns across the project; and general topography both before and after construction. Additionally, the SWPPP would contain a visual monitoring program, a chemical monitoring program for "non-visible" pollutants that would be implemented if a BMP fails, and a sediment monitoring plan to be implemented if a particular site discharges directly to a water body listed on the CWA 303(d) list for sediment. BMPs for the project could include, but would not be limited to, silt fencing, straw bale barriers, fiber rolls, storm drain inlet protection, hydraulic mulch, and stabilized construction entrances.

**Develop and Implement Erosion and Sediment Control Plan** Reclamation would prepare and implement an erosion and sediment control plan to control short-term and long-term erosion and sedimentation effects, and to stabilize soils and vegetation in areas affected by construction activities. The plan would include all of the necessary local jurisdiction requirements regarding erosion control, and would implement BMPs for erosion and sediment control, as required. Types of BMPs may include, but would not be limited to, earth dikes and drainage swales, stream bank stabilization, and use of silt fencing, sediment basins, fiber rolls, and sandbag barriers.

**Develop and Implement Feasible Spill Prevention and Hazardous Materials Management** As part of the SWPPP, Reclamation and/or its contractors would develop and implement a spill prevention and control plan to minimize effects from spills of hazardous, toxic, or petroleum substances for project-related construction activities occurring in or near waterways. The accidental release of chemicals, fuels, lubricants, and nonstorm drainage water into water bodies would be prevented to the extent feasible. Spill prevention kits would always be close by when hazardous materials would be used (e.g., crew trucks and other logical locations). Feasible efforts would be implemented so that hazardous materials would be properly handled and the quality of aquatic resources would be protected by all reasonable means during work in or near any waterway. No fueling would be done within the ordinary high-water mark, immediate floodplain, or full pool inundation area, unless equipment stationed in these locations could not be readily relocated. Any equipment that could be readily moved out of the water body would not be fueled in the water body or immediate floodplain. For all fueling of stationary equipment done at the construction site, containments would be installed so that any spill would not enter the water, contaminate sediments that may come in contact with the water, or damage wetland or riparian vegetation. Any equipment that could be readily moved out of the water body would not be serviced within the ordinary high-water mark or immediate floodplain.

Additional BMPs designed to avoid spills from construction equipment and subsequent contamination of waterways would also be implemented. These could include, but would not be limited to, the following:

- Storage of hazardous materials in double-containment and, if possible, under a roof or other enclosure.
- Disposal of all hazardous and nonhazardous products in a proper manner.
- Monitoring of on-site vehicles for fluid leaks and regular maintenance to reduce the chance of leakage.
- Containment (using a prefabricated temporary containment mat, a temporary earthen berm, or other feature can provide containment) of bulk storage tanks.

Haulers delivering materials to the project site would be required to comply with regulations on the transport of hazardous materials codified in Title 49, CFR Part 173; Title 49, CFR Part 177; and Title 26, California Code of Regulations (CCR) Division 6. These regulations provide specific packaging requirements, define unacceptable hazardous materials shipments, and prescribe safe-transit practices, including route restrictions, by carriers of hazardous materials.

#### *Water Quality Protection for In-River Construction*

The efforts discussed below would be implemented to minimize potential adverse effects to water quality.

**Implement In-River Construction Work Windows** All construction activities along the Sacramento River would be conducted during months when instream flows were managed outside the flood season (e.g., June to September). In-river work between Keswick Dam and the RBPP would be conducted to minimize impacts to Sacramento River winter-run Chinook salmon (i.e., mid-August through September).

**Comply with All Water Quality Permits and Regulations** Project activities would be conducted to comply with all additional requirements specified in permits relating to water quality protection. Relevant permits anticipated to be obtained for the proposed action include a CWA Section 401 certification, and CWA Section 404 compliance through the USACE.

**Implement Water Quality Best Management Practices** BMPs that would be implemented to avoid and/or minimize potential impacts associated with construction and the 10-year-long spawning gravel augmentation program are described below.

*Handle Spawning Gravel to Minimize Potential Water Quality Impacts* Gravel would be sorted and transported in a manner that minimizes potential water quality impacts (e.g., management of fine sediments). Gravel would be washed at least once and have a cleanliness value of 85 or higher based on California Department of Transportation (Caltrans) Test No. 227. Gravel would also be completely free of oils, clay, debris, and organic material.

*Minimize Potential Impacts Associated with Equipment Contaminants* For in-river work, all equipment would be steam-cleaned every day to remove hazardous materials before the equipment entered the water. Biodegradable hydrocarbon products would be used in the heavy equipment in the stream channel.

*Implement Feasible Spill Prevention and Hazardous Materials Management* The accidental release of chemicals, fuels, lubricants, and non-storm drainage water into channels would be prevented to the extent feasible. Spill prevention kits would always be in close proximity when using hazardous materials (e.g., crew trucks and other logical locations). Feasible efforts would be implemented to ensure that hazardous materials are properly handled and the quality of aquatic resources is protected by all reasonable means. No fueling would be done within the ordinary high-water mark or immediate floodplain, unless equipment stationed in these locations was not readily relocated (i.e., pumps, generators). For stationary equipment that must be fueled on site, containments would be provided in such a manner that any accidental spill of fuel would not be able to enter the water or contaminate sediments that could come in contact with water. Any equipment that was readily moved out of the channel would not be fueled in the channel or immediate floodplain. All fueling done at the construction site would provide containment to the degree that any spill would be unable to enter the channel or damage wetland or riparian vegetation. No equipment servicing would be done within the ordinary high-water mark or immediate floodplain, unless equipment stationed in these locations could not be readily relocated (i.e., pumps, generators). Additional BMPs designed to avoid spills from construction equipment and subsequent contamination of waterways would also be implemented.

*Minimize Potential Impacts Associated with Access and Staging* Existing access roads would be used to the extent possible. Equipment staging areas would be located outside of the Sacramento River ordinary high water mark or the Shasta Dam full pool inundation area, and away from sensitive resources.

*Remove Temporary Fills as Appropriate* Temporary fill for access, side channel diversions, and/or side channel cofferdams, would be completely removed after completion of construction.

*Remove Equipment from River Overnight and During High Flows* Construction contractors would remove all equipment from the river on a daily basis at the end of the workday. Construction contractors would also monitor

Reclamation's Central Valley Operations Office Web site daily for forecasted flows posted there to determine and anticipate any potential changes in releases. If flows were anticipated to inundate a work area that would normally be dry, the contractor would immediately remove all equipment from the work area.

#### *Extend and Enhance Existing Fish Habitat Structures in Shasta Lake*

Reclamation and USFS, in conjunction with resource management agencies would identify areas at appropriate elevations to replace, extend, and enhance existing structural fish habitat. The structures would be installed concurrently with construction activities in the vicinity of construction sites or at locations identified by resource agencies. These activities would include maintaining shallow water and transitional riverine habitat with the placement of manzanita brush structures, large woody debris, and rock-boulder clusters. To the extent feasible, vegetation cleared for construction and borrow pit areas would be used to extend and enhance fish habitat structures. Excess vegetative materials cleared from construction and borrow pit areas would be stockpiled for future fish habitat enhancement. Additionally, areas within the enlarged reservoir having appropriate conditions to establish living plants, including willow (Salix sp.), buttonbush (*Cephalanthus* sp.), and cottonwood (*Populus* sp.), would be identified for the purposes of providing structural fish habitat when the established plants are inundated.

#### *Fisheries Conservation*

The efforts discussed below would be implemented to minimize potential adverse effects on fish species.

**Implement In-Water Construction Work Windows** Reclamation would identify and implement feasible in-water construction work windows in consultation with NMFS, USFWS, and CDFW. In-water work windows would be timed to occur when sensitive fish species were not present or would be least susceptible to disturbance.

**Monitor Construction Activities** A qualified biologist would monitor potential impacts to important fishery resources throughout all phases of project construction. Monitoring may not be necessary during the entire duration of the project if, based on the monitor's professional judgment (and with concurrence from Reclamation), a designated on-site contractor would suffice to monitor such activities and would agree to notify a biologist if aquatic organisms are in danger of harm. However, the qualified biologist would need to be available by phone and Internet and be able to respond promptly to any problems that arose.

**Perform Fish Rescue/Salvage** If spawning activities for sensitive fish species were encountered during construction activities, the biologist would be authorized to stop construction activities until appropriate corrective activities were completed or it was determined that the fish would not be harmed.

A qualified biologist would identify any fish species that may be affected by the project. The biologist would facilitate rescue and salvage of fish and other aquatic organisms that become entrapped within construction structures and cofferdam enclosures in the construction area. Any rescue, salvage, and handling of listed species would be conducted under appropriate authorization (i.e., incidental take statement/permit for the project, Federal Endangered Species Act Section 4(d) scientific collection take permit, or a Memorandum of Understanding).

If fish were identified as threatened with entrapment in construction structures, construction would be stopped and efforts made to allow fish to leave the project area before resuming work. If fish were unable to leave the project area of their own volition, then fish would be collected and released outside the work area. Fish entrapped in cofferdam enclosures would be rescued and salvaged before the cofferdam area was completely dewatered. Appropriately sized fish screens would be installed on the suction side of any pumps used to dewater in-water enclosures.

**Reporting** A qualified biologist would prepare a letter report detailing the methodologies used and the findings of fish monitoring and rescue efforts. Monitoring logs would be maintained and provided, with monitoring reports. The reports would contain, but not be limited to, the following: summary of activities; methodology for fish capture and release; table with dates, numbers, and species captured and released; photographs of the enclosure structure and project site conditions affecting fish; and recommendations for limiting impacts during subsequent construction phases, if appropriate.

#### *Survey and Monitor Fish Migration between Shasta Lake and Squaw Creek*

Reclamation would fund and implement an adaptive management effort to survey and monitor fish migration between Shasta Lake and Squaw Creek, within and immediately upstream from the new inundation zone, before and immediately after project completion, to determine if warm-water fish (bass) actively migrated into and cause adverse effects on native fish, amphibians, and mollusks. These study and monitoring activities would be warranted due to uncertainties associated with the potential for warm-water fish accessing tributary stream reaches currently isolated by passage barriers near the head of the existing reservoir. The surveys would document occurrences and abundances of warm-water fish species and USFS special-status species in lower Squaw Creek before and immediately after project completion to evaluate if reservoir enlargement coincides with increases in warm-water predator species and declines of special-status indicator species. If warm-water fish abundance increases or adverse effects attributed to warm-water fish predation on native fish, amphibians or mollusks is documented within 3-5 years after the project was completed, a fish barrier or other acceptable feature would be implemented to prevent or minimize further invasions and colonization by warm-water fish.

### *Revegetation Plan*

Reclamation, in conjunction with cooperating agencies and private landowners, would prepare a comprehensive revegetation plan to be implemented in conjunction with other management plans (e.g., SWPPP). This plan would apply to any area included as part of an action alternative, such as inundation, relocation, or mitigation activities. Overall objectives of the revegetation plan would be to reestablish native vegetation to control erosion, provide effective ground cover, minimize opportunities for nonnative plant species to establish or expand, and provide habitat diversity over time. Reclamation would work closely with cooperating agencies, private landowners, and revegetation specialists to develop the sources of native vegetation, site-specific planting patterns and species assemblages necessary for a revegetation effort of this magnitude.

### *Invasive Species Management*

Reclamation would develop and implement a control plan to prevent the introduction of zebra/quagga mussels, invasive plants, and other invasive species to project areas. The control plan would cover all workers, vehicles, watercraft, and equipment (both land and aquatic) that would come into contact with Shasta Reservoir, the shoreline of Shasta Reservoir, the Sacramento River, and any riverbanks, floodplains, or riparian areas. Plan activities could include, but would not be limited to, the following:

- Preinspection and cleaning of all construction vehicles, watercraft, and equipment before being shipped to project areas

- Reinspection of all construction vehicles, watercraft, and equipment on arrival at project areas

- Inspection and cleaning of all personnel before work in project areas

All inspections would be conducted by trained personnel and would include both visual and hands-on inspection methods of all vehicle and equipment surfaces, up to and including internal surfaces that have contacted raw water.

Approved cleaning methods would include a combination of the following:

- **Precleaning –** Draining, brushing, vacuuming, high-pressure water treatment, thermal treatment

- **Cleaning –** Freezing, desiccation, thermal treatment, high-pressure water treatment, chemical treatment

On-site cleanings would require capture, treatment, and/or disposal of any and all water needed to conduct cleaning activities.

### *Fire Protection and Prevention Plan*

Reclamation would prepare and implement a fire protection and prevention plan to minimize the risk of wildfire or threat to workers, property, and the public. The USFS will maintain a plan similar to this Fire Protection and Prevention Plan which addresses preventing and controlling wildfires in the NRA as described by the interagency agreement with the California Department of Forestry and Fire Protection (CAL FIRE) and other associated entities. Reclamation's contractors would follow relevant safety standards/procedures related to fire prevention would be incorporated into the project design, and would be used during construction activities and project operation and maintenance. Safety standards and procedures include the California Building Code; the Shasta County Fire Plan; USFS safety requirements regarding fire hazards; CAL FIRE requirements for private lands; and California Public Utilities Code General Order 95, which provides procedures for proper removal, disposal, and placement of poles, wires, and associated infrastructure; and the National Electric Safety Code (a voluntary code that provides safety procedures for electric utility installation and operation). Precautionary activities to prevent construction-related fires wouldl include locating utilities a safe distance from vegetation and structures, proper construction of power lines, and construction worker safety training. Postconstruction infrastructure operation and maintenance would follow current safety practices associated with fire prevention and would include clearing vegetation from power utility facilities and other sources using combustion engines (e.g., water pumps) on a regular basis.

### *Construction Material Disposal*

Reclamation's contractors would recycle or reuse demolished materials, such as steel or copper wire, concrete, asphalt, and reinforcing steel, as required and where practical.  Other demolished materials would be disposed of in local or other identified permitted landfills in compliance with applicable requirements.

To reduce the risk to construction workers, the public, and the environment associated with exposure to hazardous materials and waste, Reclamation would implement the following:

- A Hazardous Materials Business Plan (HMBP) would be developed and implemented to provide information regarding hazardous materials to be used for project implementation and hazardous waste that would be generated. The HMBP would also define employee training, use of protective equipment, and other procedures that provide an adequate basis for proper handling of hazardous materials to limit the potential for accidental releases of and exposure to hazardous materials. All procedures for handling hazardous materials would comply with all Federal, State, and local regulations.

- Soil to be disposed of at a landfill or recycling facility would be transported by a licensed waste hauler.

- All relevant available asbestos survey and abatement reports and supplemental asbestos surveys would be reviewed. Removal and disposal of asbestos-containing materials would be performed in accordance with applicable Federal, State, and local regulations.

- A lead-based paint survey would be conducted to determine areas where lead-based paint is present and the possible need for abatement before construction.

#### *Asphalt Removal*

Per California Fish and Game Code 5650 Section (a), all asphaltic roadways and parking lots inundated by project implementation would be demolished and removed according to Shasta County standards. Asphalt would be disposed of at an approved and permitted waste facility. Dirt roads inundated by project implementation would remain in place.

The environmental commitment section of the DEIS included a commitment to develop and implement a comprehensive mitigation strategy to minimize potential impacts to physical, biological, and socioeconomic resources described in the DEIS. In conjunction with an interagency, interdisciplinary team, Reclamation refined and enhanced the mitigation measures, including development of a framework to quantify impacts (where appropriate) and establish mitigation ratios that were applicable to a number of impacts related to biological resources. The result of the development of a comprehensive mitigation strategy is documented in the Preliminary Environmental Commitments and Mitigation Plan (an appendix to this EIS).

### Major Components of Comprehensive Plans

Three dam raise options were considered for the comprehensive plans, including 6.5-foot, 12.5-foot, and 18.5-foot raises. Other raise options up to 18.5 feet are possible; however, it is believed that the above three adequately represent the extent of benefits, effects, and costs associated with any raise within the range considered for this feasibility study. Table 5-6 summarizes the physical features associated with the comprehensive plans. Figure 5-3 illustrates major features in the Shasta Lake area common to all comprehensive plans.

### Table 5-6. Summary of Physical Features of Comprehensive Plans

| Main Features | Comprehensive Plans | | | | | |
|---|---|---|---|---|---|---|
| | CP1 | CP2 | CP3 | CP4 | CP4A | CP5 |
| **Dam and Appurtenant Structures** | | | | | | |
| **Shasta Dam** | | | | | | |
| *Crest Raise (feet)* | 6.5 | 12.5 | 18.5 | 18.5 | 18.5 | 18.5 |
| *Full Pool Height Increase (feet)* | 8.5 | 14.5 | 20.5 | 20.5 | 20.5 | 20.5 |
| *Elevation of Dam Crest (feet)1* | 1084.0 | 1090.0 | 1096.0 | 1096.0 | 1096.0 | 1096.0 |
| *Elevation of Full Pool (feet)2* | 1,078.2 | 1,084.2 | 1,090.2 | 1,090.2 | 1,090.2 | 1,090.2 |
| *Capacity Increase (acre-feet)* | 256,000 | 443,000 | 634,000 | 634,000 | 634,000 | 634,000 |
| *Main Dam* | Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower. | Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower. | Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower. | Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower. | Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower. | Raise dam crest. Construct new parapets and utility gallery. Raise existing elevator tower and hoist tower. |
| *Wing Dams* | Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam. | Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam. | Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam. | Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam. | Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam. | Raise to meet dam crest. Build new visitor center along left wing dam. Relocate gantry crane on right wing dam. |
| *Spillway* | Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates. | Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates. | Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates. | Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates. | Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates. | Raise crest and extend piers. Replace 3 drum gates with 6 sloping fixed-wheel gates. |
| *River Outlets* | Replace 4 lower-tier tube valves with jet flow gates. | Replace 4 lower-tier tube valves with jet flow gates. | Replace 4 lower-tier tube valves with jet flow gates. | Replace 4 lower-tier tube valves with jet flow gates. | Replace 4 lower-tier tube valves with jet flow gates. | Replace 4 lower-tier tube valves with jet flow gates. |
| *Temperature Control Device* | Raise/modify controls. | Raise/modify controls. | Raise/modify controls. | Raise/modify controls. | Raise/modify controls. | Raise/modify controls. |
| **Shasta Powerplant/ Penstocks** | Raise penstock hoists. | Raise penstock hoists. | Raise penstock hoists. | Raise penstock hoists. | Raise penstock hoists. | Raise penstock hoists. |

**Table 5-6. Summary of Physical Features of Comprehensive Plans (contd.)**

| Main Features | Comprehensive Plans | | | | | |
|---|---|---|---|---|---|---|
| | **CP1** | **CP2** | **CP3** | **CP4** | **CP4A** | **CP5** |
| **Pit 7 Dam/Powerhouse** | Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7ancillary facilities. | Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7ancillary facilities. | Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7ancillary facilities. | Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7ancillary facilities. | Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7ancillary facilities. | Increase height of training walls on dam spillway. Install a tailwater depression system. Modify other Pit 7ancillary facilities. |
| **Reservoir Area Clearing** | Clear 150 acres completely and 220 acres with overstory removal. | Clear 240 acres completely and 350 acres with overstory removal. | Clear 340 acres completely and 500 acres with overstory removal. | Clear 340 acres completely and 500 acres with overstory removal. | Clear 340 acres completely and 500 acres with overstory removal. | Clear 340 acres completely and 500 acres with overstory removal. |
| **Reservoir Area Dikes and Railroad Embankments** | Construct 3 railroad embankments and 2 new dikes. | Construct 3 railroad embankments and 3 new dikes. | Construct 3 railroad embankments and 4 new dikes. | Construct 3 railroad embankments and 4 new dikes. | Construct 3 railroad embankments and 4 new dikes. | Construct 3 railroad embankments and 4 new dikes. |
| **Relocations** | | | | | | |
| **Roadways** | Match replacement widths to existing paved roads to be replaced. | Match replacement widths to existing paved roads to be replaced. | Match replacement widths to existing paved roads to be replaced. | Match replacement widths to existing paved roads to be replaced. | Match replacement widths to existing paved roads to be replaced. | Match replacement widths to existing paved roads to be replaced. |
| *Length of Relocated Roadway (linear feet)* | 16,700 | 28,400 | 33,100 | 33,100 | 33,100 | 33,100 |
| *Number of Road Segments Affected* | 10 | 21 | 30 | 30 | 30 | 30 |
| Vehicle Bridges | Relocate 4 bridges, modify 1 bridge. | Relocate 4 bridges, modify 1 bridge. | Relocate 4 bridges, modify 1 bridge. | Relocate 4 bridges, modify 1 bridge. | Relocate 4 bridges, modify 1 bridge. | Relocate 4 bridges, modify 1 bridge. |
| Railroad | Relocate 2 bridges and realign track in-between, modify 1 bridge | Relocate 2 bridges and realign track in-between, modify 1 bridge | Relocate 2 bridges and realign track in-between, modify 1 bridge | Relocate 2 bridges and realign track in-between, modify 1 bridge | Relocate 2 bridges and realign track in-between, modify 1 bridge | Relocate 2 bridges and realign track in-between, modify 1 bridge |
| Recreation Facilities | Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 202 campsites/day-use sites/RV sites, 2 USFS facilities, 8.1 miles of trail, and 2 trailheads. | Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 261 campsites/ day-use sites/RV sites, 2 USFS facilities, 9.9 miles of trail, and 2 trailheads. | Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads. | Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads. | Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads. | Modify or replace 9 marinas, 6 public boat ramps, 6 resorts, 328 campgrounds/day-use areas/RV sites, 2 USFS facilities, 11.6 miles of trail, and 2 trailheads. Add 6 trailheads and18 miles of new hiking trails. |

**Table 5-6. Summary of Physical Features of Comprehensive Plans (contd.)**

| Main Features | Comprehensive plans | | | | | |
|---|---|---|---|---|---|---|
| | **CP1** | **CP2** | **CP3** | **CP4** | **CP4A** | **CP5** |
| Utilities | Relocate inundated utilities. Construct wastewater treatment facilities. | Relocate inundated utilities. Construct wastewater treatment facilities. | Relocate inundated utilities. Construct wastewater treatment facilities. | Relocate inundated utilities. Construct wastewater treatment facilities. | Relocate inundated utilities. Construct wastewater treatment facilities. | Relocate inundated utilities. Construct wastewater treatment facilities. |
| Ecosystem Enhancements | None | None | None | Reserve 378 TAF of the additional storage for cold-water supply for anadromous fish. Implement adaptive management plan to benefit anadromous fish. Augment spawning gravel in the upper Sacramento River at the rate of up to 10,000 tons per year. Restore riparian, floodplain, and side channel habitat along the upper Sacramento River. | Reserve 191 TAF of the additional storage for cold-water supply for anadromous fish. Implement adaptive management plan to benefit anadromous fish. Augment spawning gravel in the upper Sacramento River at the rate of up to 10,000 tons per year. Restore riparian, floodplain, and side channel habitat along the upper Sacramento River. | Construct shoreline fish habitat around Shasta Lake. Enhance aquatic habitat in tributaries to Shasta Lake to improve fish passage. Augment spawning gravel in the upper Sacramento River at the rate of up to 10,000 tons per year. Restore riparian, floodplain, and side channel habitat along the upper Sacramento River. |

Notes:
[1] Dam crest elevations are based on the National Geodetic Vertical Datum of 1929 (NGVD29). All current feasibility-level designs and figures for Shasta Dam and appurtenant structures are based on NGVD29.
[2] Full pool elevations are based on the North American Vertical Datum of 1988 (NAVD88), which is 2.66 feet higher than NGVD29. All current feasibility-level designs and figures for reservoir area infrastructure modifications and relocations to accommodate increased water levels are based on a 2001 aerial survey of the reservoir using NAVD88.

Key:
CP = comprehensive plan
RV = recreational vehicle
TAF = thousand acre-feet
USFS = U.S. Department of Agriculture, Forest Service

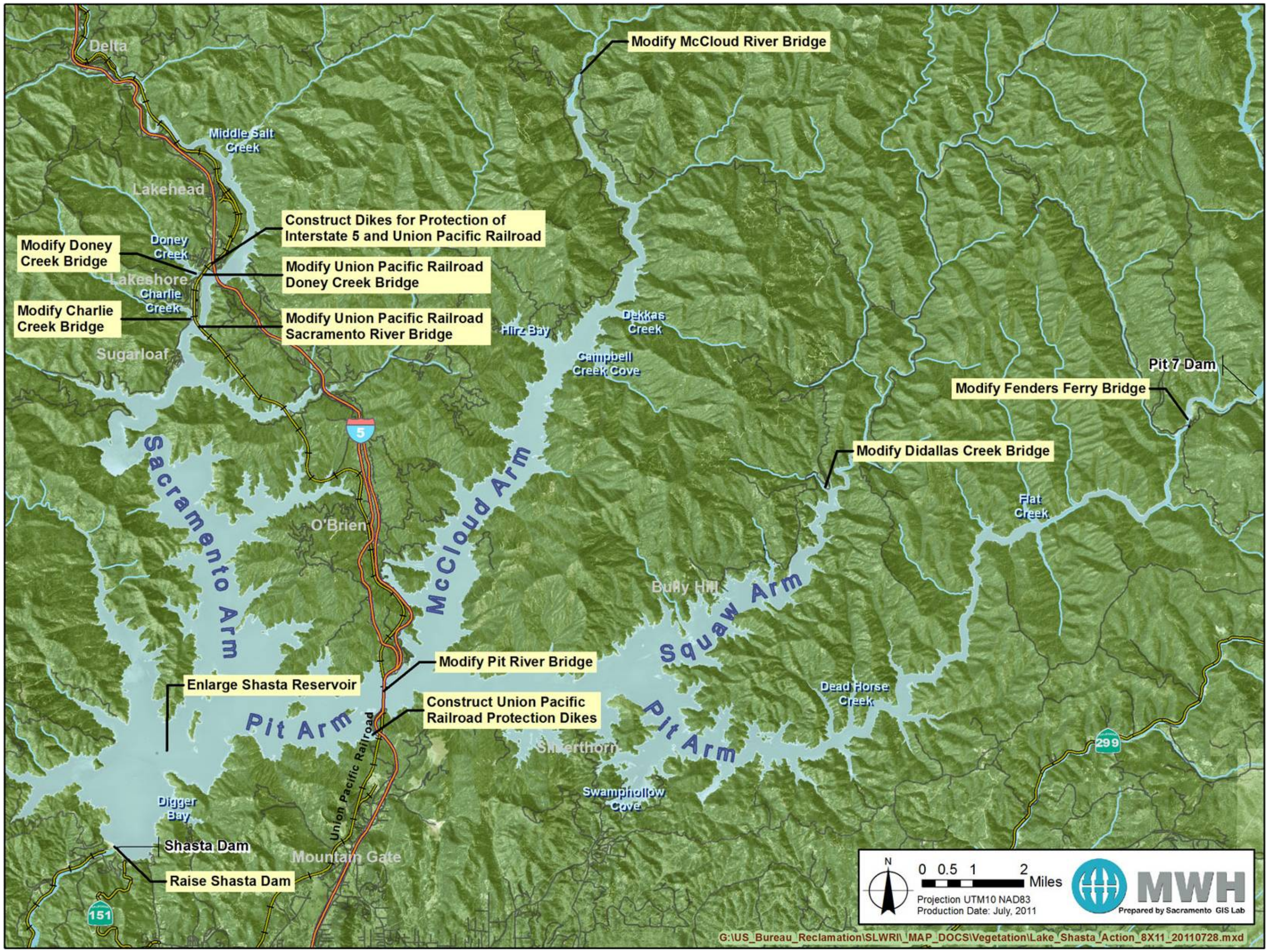



**Figure 5-3. Major Features Common to All Comprehensive Plans**

## CP1 – 6.5-Foot Dam Raise, Anadromous Fish Survival and Water Supply Reliability

CP1 was formulated to represent a likely minimum raise of Shasta Dam, and consists primarily of enlarging Shasta Dam by raising the crest 6.5 feet and enlarging the reservoir by 256,000 acre-feet. Major features of CP1 are shown in Figure 5-3 and summarized in Table 5-6.

### *Major Components of CP1*

CP1 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 6.5 feet
- Implementing the set of eight common management measures described above
- Implementing the common environmental commitments described above

As shown in Table 5-6, by raising Shasta Dam 6.5 feet, from crest elevation of 1,077.5 feet to 1,084.0 feet (based on the National Geodetic Vertical Datum 1929 (NGVD29)),[1] CP1 would increase the height of the reservoir full pool by 8.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications, including replacing the three drum gates with six sloping fixed-wheel gates. This increase in full pool height would add approximately 256,000 acre-feet of additional storage to the overall reservoir capacity. Accordingly, the overall full pool storage would increase from 4.55 MAF to 4.81 MAF. Figure 5-4 shows the increase in surface area and storage capacity for each dam raise.

Under CP1, the additional storage in Shasta Reservoir would be used to increase water supply reliability and to expand the cold-water pool for downstream anadromous fisheries. This alternative (and all comprehensive plans) involves extending the existing TCD for efficient use of the expanded cold-water pool. Operations for water supply, hydropower, and environmental and other regulatory requirements would be similar to existing operations, except during dry and critical years when a portion of the increased storage capacity in Shasta Reservoir would be reserved to specifically focus on increasing M&I deliveries. In dry years, 70,000 acre-feet of the 256,000 acre-feet increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries. In critical years, 35,000 acre-feet of the increased storage capacity would be reserved for increasing M&I deliveries.

[1] Dam crest elevations are based on NGVD29. All current feasibility-level designs and figures for Shasta Dam and appurtenant structures are based on NGVD29.

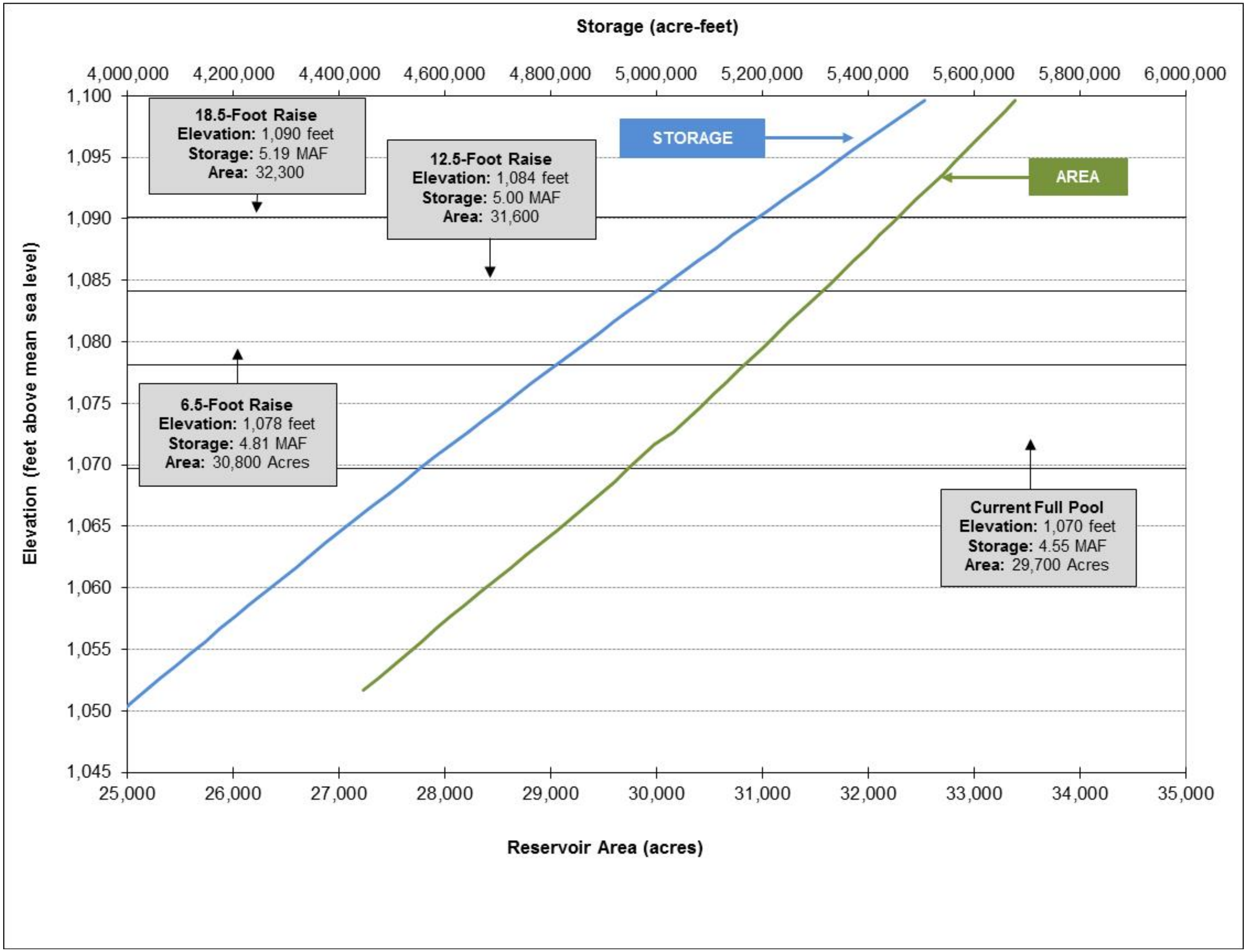



**Figure 5-4. Enlarged Shasta Reservoir Area Capacity Relationships (elevations based on NAVD88)**

CP1 would also include the potential to revise the operational rules for flood control at Shasta Dam and Reservoir, which could reduce the potential for flood damage, and benefit recreation. Although the volume of the flood control pool would remain the same as under existing operations (1.3 MAF), the bottom of the flood control pool elevation would likely be increased based on increased dam height and reservoir capacity. Because of reservoir geometry, this would decrease the depth of the flood control pool, allowing higher winter and spring water levels. Increased reservoir capacity could have further flood damage reduction benefits in years when water levels are below the new flood control pool elevation.

A limited potential also exists for changes in flood control rules to allow more operational flexibility in reservoir drawdown requirements in response to storms, resulting in a net increase in the rate of spring reservoir filling during some years. The ability to revise the operational rules might result from using advanced weather forecasting tools and enhanced basin monitoring, which may be included during refinement of operational parameters after authorization. Higher spring water levels and associated increases in reservoir surface area would benefit recreation.

#### *Construction for CP1*

Construction activities associated with physical features under CP1 would include land-based construction activities associated with the following:

- Clearing vegetation from portions of the inundated reservoir area
- Constructing the dam raise, appurtenant structures, reservoir area dikes, and railroad embankments
- Relocating roadways, bridges, recreation facilities, utilities, and miscellaneous minor infrastructure

Construction activities for CP1 are described in detail in the Engineering Summary Appendix.

#### *Operations and Maintenance for CP1*

Shasta Dam is operated in conjunction with other CVP facilities and SWP facilities to manage floodwater, storage of surplus winter runoff for irrigation in the Sacramento and San Joaquin valleys, M&I use, maintenance of navigation flows, protection and conservation of fish in the Sacramento River and Delta, and generation of hydroelectric energy. Storage in Shasta Reservoir fluctuates greatly throughout the year; storage is typically highest at the end of winter, in April and May, as the need for flood control reservation space in the reservoir decreases. Storage is typically at its lowest in September and October, after the irrigation season and before winter refill begins. Shasta Reservoir capacity is currently 4.552 MAF, with a maximum objective release capacity of 79,000 cfs. Storage levels are lowest by October to provide sufficient flood risk reduction and capture capacity during the following wet months. The storage target gradually increases beginning in October to full pool in May; storage is then withdrawn for high water demand (e.g., agricultural, M&I, fishery, and water quality uses) during summer.

A series of rules and regulations in the form of flood control requirements, flow requirements, water quality requirements, and water supply commitments governs operations at Shasta Dam. Federal and State laws, regulations, standards, and plans regulating Shasta Dam operations are described in detail in Chapter 6 of the EIS, "Hydrology, Hydraulics, and Water Management," and include the following:

- 2009 NMFS BO (NMFS 2009)
- 2008 USFWS BO (USFWS 2008)
- CVPIA Programmatic EIS (Reclamation 1999)
- CVP long-term water service contracts (see *Hydrology, Hydraulics, and Water Management Technical Report*, Table 1-25)
- Trinity River ROD (Reclamation 2000)
- 2008 Long-Term Operation BA (Reclamation 2008)
- Flood management requirements in accordance with the Water Control Manual (USACE 1977)
- State Water Board Orders 90-05 and 91-01
- California Department of Fish and Game and Reclamation Memorandum of Agreement (CDFG and Reclamation 1960)
- Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary (State Water Board 1995)
- State Water Board Water Right Revised Decision 1641 (State Water Board 2000)
- CVP and SWP Coordinated Operations Agreement (Reclamation and DWR 1986)

In addition, Shasta Dam and Reservoir are operated according to the *Standing Operating Procedures for Shasta Dam and Reservoir*. However, due to sensitivity regarding this information, including security and public health and safety concerns, this document is not available to the general public.

Under CP1, the additional storage would be retained to increase water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Shasta Dam operational guidelines would continue unchanged, except during dry years and critical years, when 70,000 acre-feet and 35,000 acre-feet, respectively, of the 256,000 acre-feet increased storage capacity in Shasta Reservoir would be operated primarily to increase M&I deliveries. Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP, which provides M&I water to a majority of the State's population. For this EIS, these operations were simulated in CalSim-II by using the reserved storage capacity to provide deliveries for previously unmet SWP demands during dry and critical years. For CP1, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would be released primarily for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not required for water supply purposes.

In comparison to current operations, CP1 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool and increase end-of-September carryover storage in Shasta Reservoir, increasing the ability of Shasta Dam to improve water temperatures for anadromous fish in the upper Sacramento River.

Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP1 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur under Shasta Reservoir's current operations.

Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

Operation of pumping facilities downstream from Shasta Dam would vary slightly from current operations and would result in higher costs. In addition, Reclamation would provide in-kind power to offset reduced generation at Pit 7 Dam and related facilities.

***Potential Benefits of CP1***

Major potential benefits of CP1 related to contributions to the planning objectives and broad public services, are described below.

**Increase Anadromous Fish Survival** Water temperature is one of the most important factors affecting anadromous fish survival in the Sacramento River. CP1 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 6.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant benefits to anadromous fish would occur upstream from the RBPP. It is estimated that under CP1, improved water temperature and flow conditions could result in an average annual increase in the salmon population of about 61,300 out-migrating juvenile Chinook salmon per year.[2]

Figure 5-5 shows an exceedence probability relationship of maximum annual storage in Shasta Lake for CP1 and other comprehensive plans compared to the No-Action Alternative, illustrating expected increases in storage volumes under each comprehensive plan. Storage volumes for Figure 5-5 were simulated with the CalSim-II model as discussed in detail in the Modeling Appendix. Figure 5-6 shows simulated reservoir storage fluctuations for the No-Action Alternative and CP1 for a representative period of 1972 through 2003.

[2] Estimates of increased anadromous fish survival were based on simulations using the SALMOD model. These estimates represent an index of production increase, based on the simulated average annual increase in juvenile Chinook salmon surviving to migrate downstream from the RBPP.

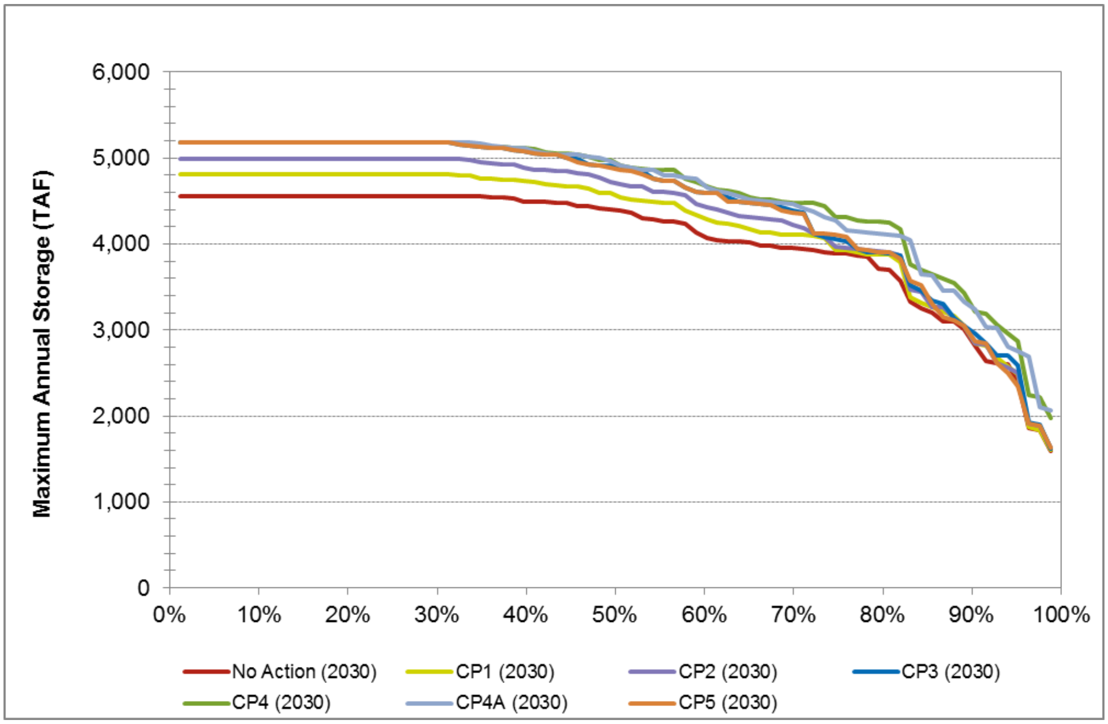



**Figure 5-5. Simulated Exceedence Probability Relationship of Maximum Annual Storage in Shasta Lake for a Future Level of Development (2030)**

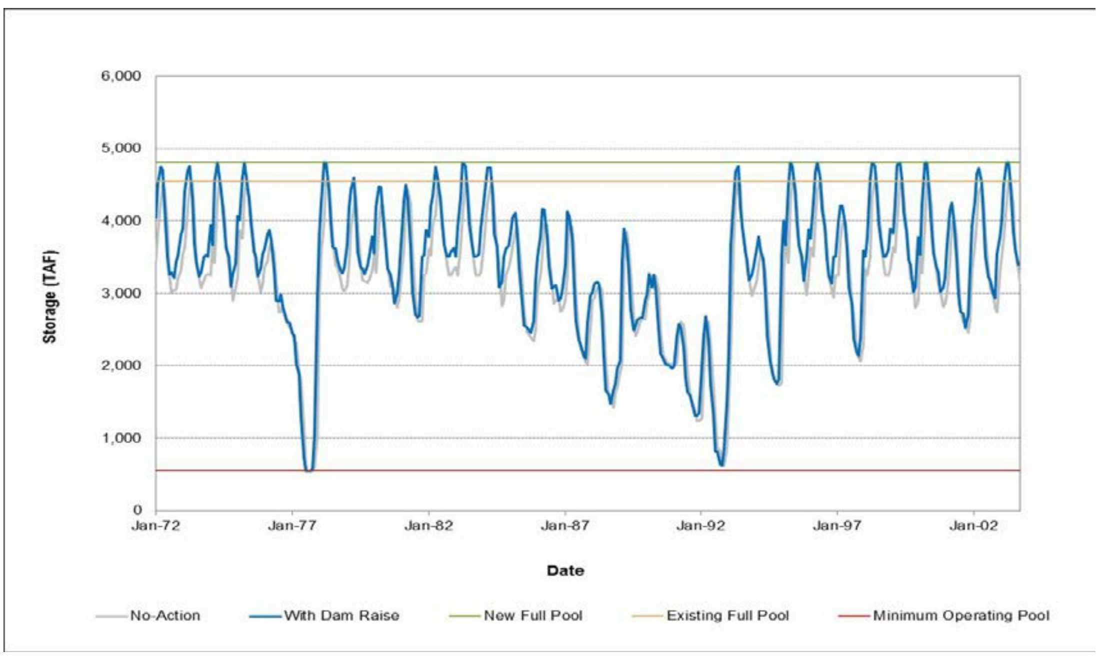
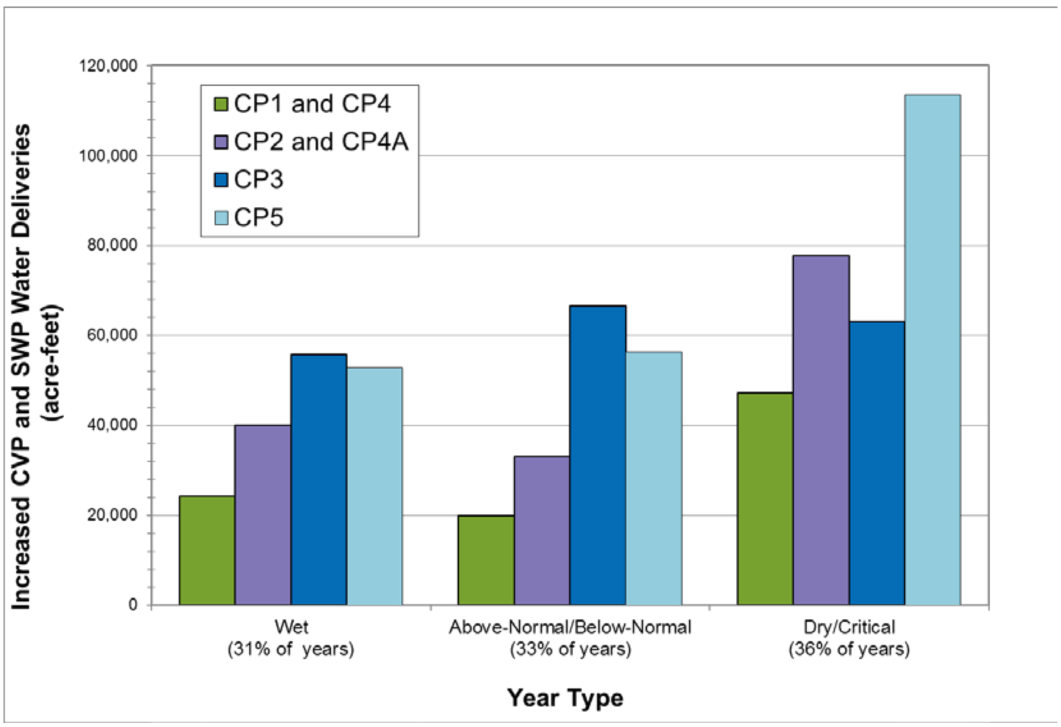



**Figure 5-6. Simulated Shasta Reservoir Storage from 1972 to 2003 for the No-Action Alternative and CP1**

**Increase Water Supply Reliability** CP1 would increase water supply reliability by increasing water supplies for CVP and SWP irrigation and M&I deliveries. Resulting increases in deliveries, based on CalSim-II modeling results, are shown in Figure 5-7 and Table 5-7. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP1would help reduce estimated future water shortages by increasing dry and critical year water supplies for agricultural and M&I deliveries by at least 47,300 acre-feet per year and average annual deliveries by about 31,000 acre-feet per year. As shown in Table 5-7, the majority of increased dry and critical year water supplies, 42,700 acre-feet, would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effective use of these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP1, about $1.6 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.




Note: Deliveries were simulated using CalSim-II and water year types were based on the Sacramento Valley Water Year Hydrologic Classification.

**Figure 5-7. Comparison of Increased CVP and SWP Water Deliveries by Year Type for Comprehensive Plans**

**Table 5-7. Increases in CVP and SWP Water Deliveries for Comprehensive Plans**

| Total CVP/SWP Deliveries | Average All Years | | | | Dry and Critical Years[2] | | | |
|---|---|---|---|---|---|---|---|---|
| | CP1/CP4 (acre-feet) | CP2/CP4A (acre-feet) | CP3 (acre-feet) | CP5 (acre-feet) | CP1/CP4 (acre-feet) | CP2/CP4A (acre-feet) | CP3 (acre-feet) | CP5 (acre-feet) |
| **North of Delta** | | | | | | | | |
| Agriculture | 5,900 | 10,900 | 25,900 | 19,600 | 4,200 | 9,500 | 29,400 | 21,100 |
| M&I | 100 | 1,400 | 4,400 | 3,300 | 300 | 1,200 | 5,800 | 4,100 |
| Total | 6,000 | 12,300 | 30,300 | 22,900 | 4,500 | 10,700 | 35,200 | 25,200 |
| **South of Delta** | | | | | | | | |
| Agriculture | 14,400 | 20,500 | 36,400 | 31,300 | 18,300 | 28,100 | 41,300 | 45,000 |
| M&I | 10,600 | 18,500 | (4,900) | 21,700 | 24,400 | 39,000 | (13,300) | 43,300 |
| Total | 25,000 | 39,000 | 31,500 | 53,000 | 42,700 | 67,100 | 28,000 | 88,300 |
| **Combined North and South of Delta** | | | | | | | | |
| Agriculture[1] | 20,300 | 31,400 | 62,200 | 50,900 | 22,500 | 37,600 | 70,600 | 66,100 |
| M&I[1] | 10,700 | 19,900 | (500) | 25,000 | 24,700 | 40,200 | (7,500) | 47,400 |
| ***Total[1]*** | ***31,000*** | ***51,300*** | ***61,700*** | ***75,900*** | ***47,300*** | ***77,800*** | ***63,100*** | ***113,500*** |

Notes:
[1] Totals may not sum due to rounding.
[2] Based on the Sacramento Valley Water Year Hydrologic Classification
Key:
CP = Comprehensive Plan
CVP = Central Valley Project
M&I = Municipal and Industrial
SWP = State Water Project

**Develop Additional Hydropower Generation** Higher water surface elevations in the reservoir would result in a net increase in power generation of about 52 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities. Other power benefits include additional capacity (i.e., the rate at which power can be generated) and ancillary services, which provide the ability to manage the electric grid in a reliable manner.

**Maintain and Increase Recreation Opportunities** CP1 includes features to at least maintain the existing recreation capacity at Shasta Lake. Although CP1 does not include specific features to further increase recreation capacity, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 1,110 acres (4 percent), from 29,700 to about 30,800 acres. The average surface area of the lake during the recreation season from May through September would increase by about 800 acres (3 percent), from 23,900 acres to 24,700 acres. There is also limited potential to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

**Benefits Related to Other Planning Objectives** CP1 could also provide benefits related to flood damage reduction, ecosystem restoration, and water quality. Enlarging Shasta Dam would provide for incidental increased reservoir capacity to capture flood flows, which could reduce flood damage along the upper Sacramento River. Improved fisheries conditions as a result of CP1, as described above, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River. For example, increasing anadromous fish survival could inherently benefit other species that prey on adult and juvenile anadromous fish, and increased storage could provide water that would have otherwise been unavailable to improve flow and temperature conditions during a multiple year drought. Furthermore, CP1 could potentially benefit ecosystem restoration through improved Delta water quality conditions by increasing Delta outflow during drought years and reducing salinity during critical periods. CP1 may also contribute to improving Delta water quality through increased Delta emergency response capabilities. When Delta emergencies occur, additional water in Shasta Reservoir could improve operation flexibility for increasing releases to supplement existing water sources to reestablish Delta water quality. In addition to Delta emergency response, increased storage in Shasta Reservoir could increase emergency response capability for CVP/SWP water supply deliveries.

**Additional Broad Public Benefits** Additional broad public benefits of CP1 (and all comprehensive plans) obtained through pursuing project objectives are summarized in Table 5-8. These include benefits to reservoir water quality, traffic and transportation, and public services from modernization and upgrades of relocated facilities. Long-term benefits to air quality, groundwater, Shasta Lake fisheries, and system-wide operations are due to increased overall system capacity, allowing for increases in clean energy production, surface water deliveries, and storage capacity in Shasta Reservoir.

**Table 5-8. Summary of Additional Broad Public Benefits for SLWRI Comprehensive Plans**

| Category | Benefit Description |
|---|---|
| System-Wide Water Management Flexibility | All CPs improve system-wide water management flexibility for storage and operations to meet multiple competing public objectives |
| Air Quality | All CPs would provide for increased clean energy generation potentially reducing GHG emissions |
| Groundwater | All CPs allow for decreased groundwater pumping and related groundwater overdraft conditions in CVP/SWP water service areas |
| Reservoir Water Quality | All CPs replace reservoir area septic systems with centralized wastewater treatment plants |
| Shasta Lake Cold-Water Fisheries | All CPs improve Shasta Lake cold-water fisheries conditions through increasing the cold-water pool |
| Traffic and Transportation | All CPs modernize relocated roadways and bridges with facilities designed to meet current public safety standards |
| Public Services | All CPs relocate USFS emergency response facilities to a more centralized location adjacent to interstate transportation corridors |

Notes:
[1] Broad public benefits listed above are additional to benefits associated with project objectives.

Key:
CP = Comprehensive Plan
CVP = Central Valley Project
GHG = greenhouse gas
SWP = State Water Project
USFS = U.S. Forest Service

### *Potential Primary Effects from CP1*

Several potential environmental consequences of CP1 are included in this section. A detailed discussion of potential effects and proposed mitigation measures for CP1 are included in Chapters 4 through 25 of the EIS and summarized in Table 5-9 below.

**Shasta Lake Area** Within the reservoir area, the primary long-term impacts of this and other comprehensive plans would be due to the increased water surface elevations and inundation area and/or indirect effects related to facility modifications and relocations. Raising the full pool of the lake would cause direct impacts due to higher water surface elevations and inundation area. General types of impacts would include potential inundation of terrestrial and aquatic habitat, and inundation and resulting relocation of buildings, sections of paved and nonpaved roads, campground facilities (such as parking areas and restrooms), and low-lying bridges. Use of, and access to, recreation facilities also would be impacted, including trails, day-use picnic areas, boat ramps, marinas, campgrounds, resorts, and beaches. Several of the main buildings associated with Bridge Bay Resort and Marina, the largest resort and marina complex on Shasta Lake, are located within a few feet of the existing full pool elevation. Any potential real estate acquisition, or necessary relocations of displaced parties, would be accomplished under Public Law 91-646.

The without-project and with-project relationship of water stored in Shasta Reservoir is shown in Figure 5-4. Figure 5-5 shows the exceedence probability of maximum annual storages in Shasta Reservoir. From these graphics, it can be seen that Shasta Reservoir fills to (or near) full pool levels in the without-project condition about once every 3 years (about 35 percent of the years). In addition, on the basis of water operations modeling (CalSim-II), Shasta Reservoir fills to 80 percent capacity in about 81 percent of the years over the 82-year period of analysis of the CalSim-II model. With this plan, Shasta would fill to the new full pool storage of 4.81 MAF at about the same frequency as under without-project conditions – about once every 3 years. Further, Shasta Lake would also fill to 80 percent of the new capacity in about 81 percent of the years. Accordingly, annual operations in the reservoir generally would mirror existing operations except the water surface in the lake would be about 8.5 feet higher. The primary difference in additional reservoir area exposed under without-project versus with-project conditions would be that during extended drought periods, the reservoir would be drawn down to without-project minimum levels.

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| **Geology, Geomorphology, Minerals, and Soils** | | |
| Impact Geo-2: Alteration of Fluvial Geomorphology and Hydrology of Aquatic Habitats | CP1 – CP5 | Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact. |
| Impact Geo-9: Substantial Increase in Channel Erosion and Meander Migration | CP1 – CP5 | Mitigation Measure Geo-9: Modification of Flow Releases in Response to River Management and Habitat Restoration Efforts between Keswick Dam and Red Bluff. |
| **Air Quality and Climate** | | |
| Impact AQ-1: Short-Term Emissions of Criteria Air Pollutants and Precursors at Shasta Lake and Vicinity During Project Construction | CP1 – CP5 | Mitigation Measure AQ-1: Implement Standard Measures and Best Available Mitigation Measures to Reduce Emissions Levels. |
| **Hydrology, Hydraulics, and Water Management** | | |
| No mitigation measures proposed. | | |
| **Water Quality** | | |
| Impact WQ-1: Temporary Construction-Related Sediment Effects on Shasta Lake and Its Tributaries that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses | CP1 – CP5 | Mitigation Measure WQ-1: Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area. |
| Impact WQ-4: Long-Term Sediment Effects that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries | CP1 – CP5 | Mitigation Measure WQ-4: Implement Mitigation Measure WQ-1 (CP1): Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area. |
| WQ-6: Long-Term Metals Effects that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in Shasta Lake or Its Tributaries | CP1 – CP5 | Mitigation Measure WQ-6: Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines. |

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| Impact WQ-7: Temporary Construction-Related Sediment Effects on the Upper Sacramento River that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses | CP1 – CP5 | Mitigation Measure WQ-7: Implement Mitigation Measure WQ-1 (CP1): Develop and Implement a Comprehensive Multi-scale Sediment Reduction and Water Quality Improvement Program Within Watersheds Tributary to the Primary Study Area. |
| Impact WQ-12: Long-Term Metals Effects that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Upper Sacramento River | CP1 – CP5 | Mitigation Measure WQ-12: Implement Mitigation Measure WQ-6 (CP1): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines |
| Impact WQ-18: Long-Term Metals Effects that Would Cause Violations of Water Quality Standards or Adversely Affect Beneficial Uses in the Extended Study Area | CP1 – CP5 | Mitigation Measure WQ-18: Implement Mitigation Measure WQ-6 (CP1): Prepare and Implement a Site-Specific Remediation Plan for Historic Mine Features Subject to Inundation in the Vicinity of the Bully Hill and Rising Star Mines |
| **Noise and Vibration** | | |
| Impact Noise-1: Exposure of Sensitive Receptors in the Primary Study Area to Project-Generated Construction Noise | CP1 – CP5 | Mitigation Measure Noise-1: Implement Measures to Prevent Exposure of Sensitive Receptors to Temporary Construction Noise at Project Construction Sites. |
| **Hazards and Hazardous Materials and Waste** | | |
| Impact Haz-1: Wildland Fire Risk (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure Haz-1: Coordinate and Assist Public Services Agencies to Reduce Fire Hazards. |
| Impact Haz-2: Release of Potentially Hazardous Materials or Hazardous Waste (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure Haz-2: Reduce Potential for Release of Hazardous Materials and Waste. |
| Impact Haz-4: Exposure of Sensitive Receptors to Hazardous Materials (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure Haz-4: Reduce Potential for Exposure of Sensitive Receptors to Hazardous Materials or Waste. |

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| **Agriculture and Important Farmlands** | | |
| No mitigation measures proposed. | | |
| **Fisheries and Aquatic Ecosystems** | | |
| Impact Aqua-4: Effects on Special-Status Aquatic Mollusks | CP1 – CP5 | Mitigation Measure Aqua-4: Implement Mitigation Measure Geo-2: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact. |
| Impact Aqua-7: Effects on Spawning and Rearing Habitat of Adfluvial Salmonids in Low-Gradient Tributaries to Shasta Lake | CP1 – CP5 | Mitigation Measure Aqua-7: Implement Mitigation Measure Aqua-4: Replace Lost Ecological Functions of Aquatic Habitats by Restoring Existing Degraded Aquatic Habitats in the Vicinity of the Impact. |
| Impact Aqua-14: Reduction in Ecologically Important Geomorphic Processes in the Upper Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows | CP1 – CP5 | Mitigation Measure Aqua-14: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| Impact Aqua-15: Changes in Flow and Water Temperatures in the Lower Sacramento River and Tributaries and Trinity River Resulting from Project Operation – Fish Species of Primary Management Concern | CP1 – CP5 | Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements. |
| Impact Aqua-16: Reduction in Ecologically Important Geomorphic Processes in the Lower Sacramento River Resulting from Reduced Frequency and Magnitude of Intermediate to High Flows | CP1 – CP5 | Mitigation Measure Aqua-16: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| **Botanical Resources and Wetlands** | | |
| Impact Bot-2: Loss of MSCS Covered Species | CP1 – CP5 | Mitigation Measure Bot-2: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate MSCS Plants; and Revegetate Affected Areas. |
| Impact Bot-3: Loss of USFS Sensitive, BLM Sensitive, or CRPR Species | CP1 – CP5 | Mitigation Measure Bot-3: Acquire and Preserve Mitigation Lands; Avoid Populations; Relocate USFS Sensitive, BLM Sensitive, and CRPR Plants and Revegetate Affected Areas. |
| Impact Bot-4: Loss of Jurisdictional Waters | CP1 – CP5 | Mitigation Measure Bot-4: Mitigate Loss of Jurisdictional Waters. |
| Impact Bot-5: Loss of General Vegetation Habitats | CP1 – CP5 | Mitigation Measure Bot-5: Acquire and Preserve Mitigation Lands for Loss of General Vegetation Habitats. |

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| Impact Bot-6: Spread of Noxious and Invasive Weeds | CP1 – CP5 | Mitigation Measure Bot-6: Develop and Implement a Weed Management Plan In Conjunction with Stakeholders. |
| Impact Bot-7: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes | CP1 – CP5 | Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| Impact Bot-8: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management | CP1 – CP5 | Mitigation Measure Bot-8: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| Impact Bot-11: Loss of Sensitive Natural Communities or Habitats Resulting from Implementing the Gravel Augmentation Program or Restoring Riparian, Floodplain, and Side Channel Habitats | CP4 – CP5 | Mitigation Measure Bot-11: Revegetate Disturbed Areas, Consult with CDFW, and Mitigate Loss of Jurisdictional Waters. |
| Impact Bot-12: Loss of Special-Status Plants Resulting from Implementing the Gravel Augmentation Program, or Restoring Riparian, Floodplain, and Side Channel Habitats | CP4 – CP5 | Mitigation Measure Bot-12: Conduct Preconstruction Surveys for Special-Status Plants and Avoid Special-Status Plant Populations During Construction. |
| Impact Bot-13: Spread of Noxious and Invasive Weeds Resulting from Implementing the Gravel Augmentation Program, Restoring Riparian, Floodplain, and Side Channel Habitats | CP4 – CP5 | Mitigation Measure Bot-13: Implement Weed Management Measures and Revegetation. |
| Impact Bot-14: Altered Structure and Species Composition and Loss of Sensitive Plant Communities and Special-Status Plant Species Resulting from Altered Flow Regimes on the Lower Sacramento River | CP1 – CP5 | Mitigation Measure Bot-14: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| Impact Bot-15: Conflict with Approved Local or Regional Plans with Objectives of Riparian Habitat Protection or Watershed Management Along the Lower Sacramento River | CP1 – CP5 | Mitigation Measure Bot-15: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| **Wildlife Resources** | | |
| Impact Wild-1: Take and Loss of Habitat for the Shasta Salamander | CP1 – CP5 | Mitigation Measure Wild-1: Avoid, Relocate, and Acquire Mitigation Lands for Shasta Salamander. |
| Impact Wild-2: Impact on the Foothill Yellow-Legged Frog and Tailed Frog and Their Habitat | CP1 – CP5 | Mitigation Measure Wild-2: Avoid, Relocate, and Acquire Mitigation Lands for Foothill Yellow-Legged Frog and Tailed Frog. |
| Impact Wild-3: Impact on the Northwestern Pond Turtle and Its Habitat | CP1 – CP5 | Mitigation Measure Wild-3: Avoid, Relocate, and Acquire Mitigation Lands for Northwestern Pond Turtle. |
| Impact Wild-4: Impact on the American Peregrine Falcon | CP1 – CP5 | Mitigation Measure Wild-4: Conduct Preconstruction Surveys for the American Peregrine Falcon and Establish Buffers. |
| Impact Wild-5: Take and Loss of Habitat for the Bald Eagle | CP1 – CP5 | Mitigation Measure Wild-5: Acquire and Preserve Mitigation Lands; Conduct Protocol-Level Surveys for the Bald Eagle and Establish Buffers. |
| Impact Wild-6: Loss of Dispersal Habitat for the Northern Spotted Owl | CP1 – CP5 | Mitigation Measure Wild-6: Acquire and Preserve Mitigation Lands, Habitat Enhancement. |
| Impact Wild-7: Impact on the Purple Martin and Its Habitat | CP1 – CP5 | Mitigation Measure Wild-7: Conduct a Preconstruction Survey for Purple Martin and Establish Buffers. |
| Impact Wild-8: Impacts on the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Their Foraging and Nesting Habitat | CP1 – CP5 | Mitigation Measure Wild-8: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Willow Flycatcher, Vaux's Swift, Yellow Warbler, and Yellow-Breasted Chat and Establish Buffers. |
| Impact Wild-9: Impacts on the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Their Foraging and Nesting Habitat | CP1 – CP5 | Mitigation Measure Wild-9: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for the Long-Eared Owl, Northern Goshawk, Cooper's Hawk, Great Blue Heron, and Osprey and Establish Buffers. |
| Impact Wild-10: Take and Loss of Habitat for the Pacific Fisher | CP1 – CP5 | Mitigation Measure Wild-10: Acquire and Preserve Mitigation Lands; Conduct Preconstruction Surveys for the Pacific Fisher and Establish Buffers. |

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| Impact Wild-11: Impacts on Special-Status Bats (Pallid Bat, Spotted Bat, Western Red Bat, Western Mastiff Bat, Townsend's Big-Eared Bat, Long-Eared Myotis, and Yuma Myotis), the American Marten, and Ringtails and Their Habitat | CP1 – CP5 | Mitigation Measure Wild-11: Acquire and Preserve Mitigation Lands; Conduct a Preconstruction Survey for Special-Status Bats, American Marten, and Ringtails and Establish Buffers. |
| Impact Wild-12: Impacts on Special-Status Terrestrial Mollusks (Shasta Sideband, Wintu Sideband, Shasta Chaparral, and Shasta Hesperian) and Their Habitat | CP1 – CP5 | Mitigation Measure Wild-12: Avoid Suitable Habitat; Acquire and Preserve Mitigation Lands for Special-Status Terrestrial Mollusks. |
| Impact Wild-13: Permanent Loss of General Wildlife Habitat | CP1 – CP5 | Mitigation Measure Wild-13: Acquire and Preserve Mitigation Lands for Permanent Loss of General Wildlife Habitat. |
| Impact Wild-14: Impacts on Other Birds of Prey (Red-Tailed Hawk and Red-Shouldered Hawk) and Migratory Bird Species (American Robin, Anna's Hummingbird) and Their Foraging and Nesting Habitat | CP1 – CP5 | Mitigation Measure Wild-14: Acquire and Preserve Mitigation Lands and Conduct Preconstruction Surveys for Other Nesting Raptors and Migratory Birds and Establish Buffers. |
| Impact Wild-15: Loss of Critical Deer Winter and Fawning Range | CP1 – CP5 | Mitigation Measure Wild-15: Acquire and Preserve Mitigation Lands for Permanent Loss of Critical Deer Wintering and Fawning Range. |
| Impact Wild-16: Take and Loss of California Red-Legged Frog | CP1 – CP5 | TBD |
| Impact Wild-17: Impacts on Riparian-Associated Special-Status Wildlife Resulting from Modifications to the Existing Flow Regime in the Primary Study Area | CP1 – CP5 | Mitigation Measure Wild-17: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| Impact Wild-20: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat in the Primary Study Area | CP1 – CP5 | Mitigation Measure Wild-20: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| Impact Wild-21: Impacts on Riparian-Associated Special-Status Wildlife Resulting from the Gravel Augmentation Program | CP4 – CP5 | Mitigation Measure Wild-21: Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal near Active Nest Sites. |

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| Impact Wild-22: Impacts on Riparian-Associated Special-Status Wildlife Species Resulting from Restoration Projects | CP4 – CP5 | Mitigation Measure Wild-22: Implement Mitigation Measure Wild-21: Conduct Preconstruction Surveys for Elderberry Shrubs, Northwestern Pond Turtle, and Nesting Riparian Raptors and Other Nesting Birds. Avoid Removal or Degradation of Elderberry Shrubs and Avoid Vegetation Removal near Active Nest Sites. |
| Impact Wild-23: Impacts on Riparian-Associated and Aquatic Special-Status Wildlife Resulting from Modifications to Existing Flow Regimes in the Lower Sacramento River and Delta | CP1 – CP5 | Mitigation Measure Wild-23: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| Impact Wild-26: Consistency with Local and Regional Plans with Goals of Promoting Riparian Habitat along the Lower Sacramento River and in the Delta | CP1 – CP5 | Mitigation Measure Wild-26: Implement Mitigation Measure Bot-7: Implement a Riverine Ecosystem Mitigation and Adaptive Management Plan to Avoid and Compensate for the Impact of Altered Flow Regimes on Riparian and Wetland Communities. |
| **Cultural Resources** | | |
| Impact Culture-1: Disturbance or Destruction of Archaeological and Historical Resources Due to Construction or Inundation | CP1 – CP5 | Mitigation Measure Culture-1: Develop and Implement measures identified in an NHPA Section 106 MOA or PA. |
| Impact Culture-2: Inundation of Traditional Cultural Properties | CP4 – CP5 | Mitigation Measure Culture-2: Adverse effects will be avoided, minimized, or mitigated through project redesign, when warranted, or through the development and implementation of an MOA or PA. |
| Impact Culture-3: Disturbance or Destruction of Archaeological and Historical Resources near the Upper Sacramento River Due to Construction | CP4 – CP5 | Mitigation Measure Culture-3: Implement Mitigation Measure Culture-1: Develop and Implement measures identified in an NHPA Section 106 MOA or PA. |
| **Indian Trust Assets** | | |
| No mitigation measures proposed. | | |
| **Socioeconomics, Population, and Housing** | | |
| Impact Socio-14: Potential Temporary Reduction in Shasta Project Water or Hydropower Supplied to the CVP and SWP Service Areas During Construction | CP1 – CP5 | Mitigation Measure Socio-14: Secure Replacement Water or Hydropower During Project Construction. |

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| **Land Use Planning** | | |
| Impact LU-1: Disruption of Existing Land Uses (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure LU-1: Minimize and/or Avoid Temporary Disruptions to Local Communities. |
| Impact LU-2: Conflict with Existing Land Use Goals and Policies of Affected Jurisdictions (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure LU-2: Minimize and/or Avoid Conflicts with Land Use Goals and Policies. |
| **Recreation and Public Access** | | |
| Impact Rec-2: Temporary Construction-Related Disruption of Recreation Access and Activities at and near Shasta Dam | CP1 – CP5 | Mitigation Measure Rec-2: Provide Information About and Improve Alternate Recreation Access and Opportunities to Mitigate the Temporary Loss of Recreation Access and Opportunities During Construction at Shasta Dam. |
| Impact Rec-4: Increased Hazards to Boaters and Other Recreationists at Shasta Lake from Standing Timber and Stumps Remaining in Untreated Areas of the Inundation Zone | CP1 – CP5 | Mitigation Measure Rec-4: Provide Information to Shasta Lake Visitors About Potential Safety Hazards in Newly Inundated Areas from Standing Timber and Stumps. |
| Impact Rec-15: Increased Difficulty for Boaters and Anglers in Using the Sacramento River and Rivers Below CVP and SWP Reservoirs as a Result of Decreased River Flows | CP1 – CP5 | Mitigation Measure Rec-15: Implement Mitigation Measure Aqua-15: Maintain Flows in the Feather River, American River, and Trinity River Consistent with Existing Regulatory and Operational Requirements and Agreements. |
| **Aesthetics and Visual Resources** | | |
| Impact Vis-1: Consistency with Guidelines for Visual Resources in the STNF LRMP (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure Vis-1: Amend the STNF LRMP to Include Revised VQOs for developments at Turntable Bay area. |
| Impact Vis-2: Degradation and/or Obstruction of a Scenic View from Key Observation Points (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure Vis-2: Minimize Construction-Related Visual Impacts on Scenic Views From Key Observation Points. |
| Impact Vis-3: Generation of Increased Daytime Glare and/or Nighttime Lighting (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure Vis-3: Minimize or Avoid Visual Impacts of Daytime Glare and Nighttime Lighting. |

## Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| **Transportation and Traffic** | | |
| Impact Trans-1: Short-Term and Long-Term Increases in Traffic in the Primary Study Area in Relation to the Existing Traffic Load and Capacity of the Street System | CP1 – CP5 | Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan. |
| Impact Trans-2: Adverse Effects on Access to Local Streets or Adjacent Uses in the Primary Study Area | CP1 – CP5 | Mitigation Measure Trans-2: To Reduce Effects on Local Access, Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan |
| Impact Trans-4: Adverse Effects on Emergency Access in the Primary Study Area | CP1 – CP5 | Mitigation Measure Trans-4: To Reduce Effects on Emergency Access, Implement Mitigation Measure Trans-1: Prepare and Implement a Traffic Control and Safety Assurance Plan |
| Impact Trans-5: Accelerated Degradation of Surface Transportation Facilities in the Primary Study Area | CP1 – CP5 | Mitigation Measure Trans-5: Identify and Repair Roadway Segments Damaged by the Project. |
| **Utilities and Service Systems** | | |
| Impact Util-1: Damage to or Disruption of Public Utility and Service Systems Infrastructure (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure Util-1: Implement Procedures to Avoid Damage to or Temporary Disruption of Service. |
| Impact Util-2: Utility Infrastructure Relocation or Modification (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure Util-2: Adopt Measures to Minimize Infrastructure Relocation Impacts. |
| **Public Services** | | |
| Impact PS-1: Disruption of Public Services (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure PS-1: Coordinate and Assist Public Services Agencies. |
| Impact PS-2: Degraded Level of Public Services (Shasta Lake and Vicinity and Upper Sacramento River) | CP1 – CP5 | Mitigation Measure PS-2: Provide Support to Public Services Agencies. |
| **Power and Energy** | | |
| No mitigation measures proposed. | | |
| **Environmental Justice** | | |
| No mitigation measures proposed. | | |

**Table 5-9. Summary of Proposed Mitigation Measures for Comprehensive Plans (contd.)**

| Resource Topic/Impact | Alternative | Mitigation Measure |
|---|---|---|
| **Wild and Scenic Rivers Considerations for McCloud River** | | |
| Impact WASR-3: Effects to McCloud River Wild Trout Fishery, as Identified in the California Public Resources Code, Section 5093.542 | CP1 – CP5 | Mitigation Measure WASR-3: Develop and Implement a Comprehensive Multi-scale Fishery Protection, Restoration and Improvement Program for the Lower McCloud River Watershed. |
| Impact WASR-4: Effects to McCloud River Free-Flowing Conditions, as Identified in the California Public Resources Code, Section 5093.542 | CP1 – CP5 | Mitigation Measure WASR-4: Implement Protection, Restoration, and Improvement Measures to Benefit Hydrologic Functions Within the Lower McCloud River Watershed. |

Key:
Ag = Agriculture and Important Farmlands
AQ = Air Quality and Climate
Aqua = Fisheries and Aquatic Ecosystems
BLM = U.S. Bureau of Land Management
BMP = best management practice
Bot = Botanical Resources and Wetlands
CDFW = California Department of Fish and Wildlife
CP – Comprehensive Plan
CRPR = California Rare Plant Rank
Culture = Cultural Resources
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
Geo = Geology, Geomorphology, Minerals, and Soils
Haz = Hazards and Hazardous Materials and Waste
LU = Land Use Planning
MSCS = Multi-Species Conservation Strategy
MOA = Memorandum of Understanding
NHPA = National Historic Preservation Act
Noise = Noise and Vibration
PA = Programmatic Agreement
PS = Public Services
Rec = Recreation and Public Access
Socio = Socioeconomics, Population, and Housing
SWP = State Water Project
TBD = to be determined
Trans = Transportation and Traffic
USFS = U.S. Forest Service
Util = Utilities and Service Systems
Vis = Aesthetics and Visual Resources
Wild = Wildlife Resources
WQ = Water Quality

The increased area of inundation for CP1 is about 1,110 acres. This equates to an average increase in the lateral zone of about 21 feet. An example of the extent of inundation for the 6.5-foot dam raise (as well as 12.5-foot and 18.5-foot dam raises) is shown in Figure 5-8. The figure shows increased inundation of the Sacramento River arm at the community of Lakeshore, considering proposed protective dikes and embankments. Lakeshore is the most populated area around the lake. Because of the gently sloping shoreline adjacent to Lakeshore, this area is representative of the maximum lateral increase in inundation that could be expected with dam raises up to 18.5 feet. The community of Sugarloaf would also be impacted.

The duration of inundation at given drawdown levels (e.g., 10 feet from top of full pool) would be similar to existing conditions. Water would inundate the highest levels of the reservoir for periods ranging from several days to about 1 month. Much of the vegetation in the enlarged drawdown zone on steeper lands would be removed during construction. In addition, much of the remaining vegetation in the expanded drawdown zone would eventually be lost over time. However, it is expected that significant amounts of vegetation could remain on the flatter slopes because of the infrequent inundation.

The McCloud River is an area of specific interest. California Public Resources Code 5093.542 (c) and (d) may limit State involvement in studies to enlarge Shasta Dam and Reservoir if that action could have an adverse effect on the free-flowing conditions of the McCloud River or its wild trout fishery. Figure 5-9 illustrates the estimated increase in area of inundation on the McCloud River upstream from the McCloud Bridge for CP1 (6.5-foot dam raise). As shown in Figure 5-9, raising Shasta Dam 6.5 feet would result in inundating an additional 1,470 lineal feet (about 9 acres) of the lower McCloud River compared to existing conditions. Raising Shasta Dam 18.5 feet would result in inundating an additional 3,550 lineal feet (about 27 acres) of the lower McCloud River, compared to existing conditions. This represents a maximum of about 3 percent of the 24-mile-reach of river between the McCloud Bridge and McCloud Dam, which controls flows on the river.

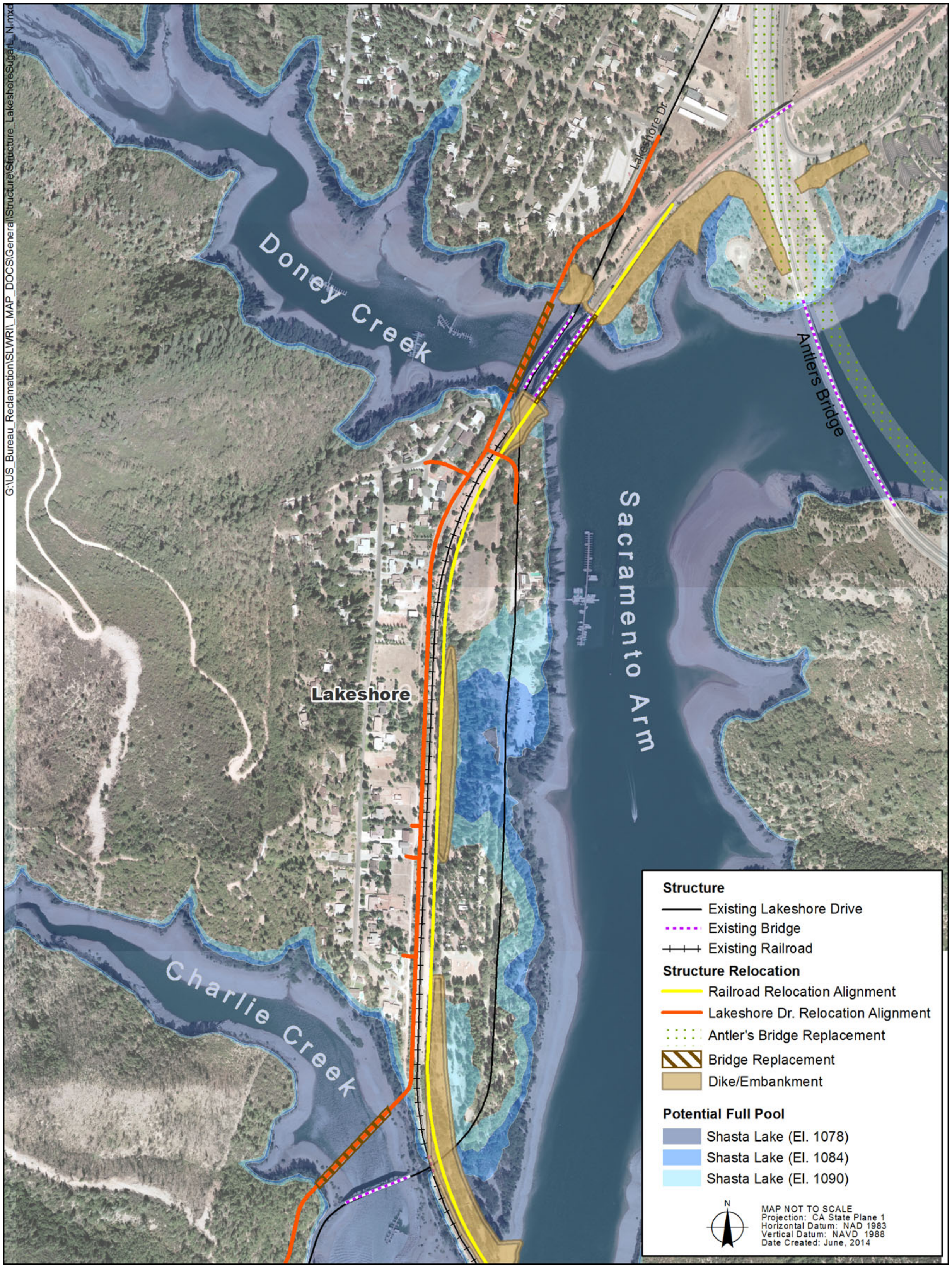



**Figure 5-8. Estimated Maximum Inundation in the Lakeshore Area for Dam Raises of 6.5 Feet, 12.5 Feet, and 18.5 Feet**

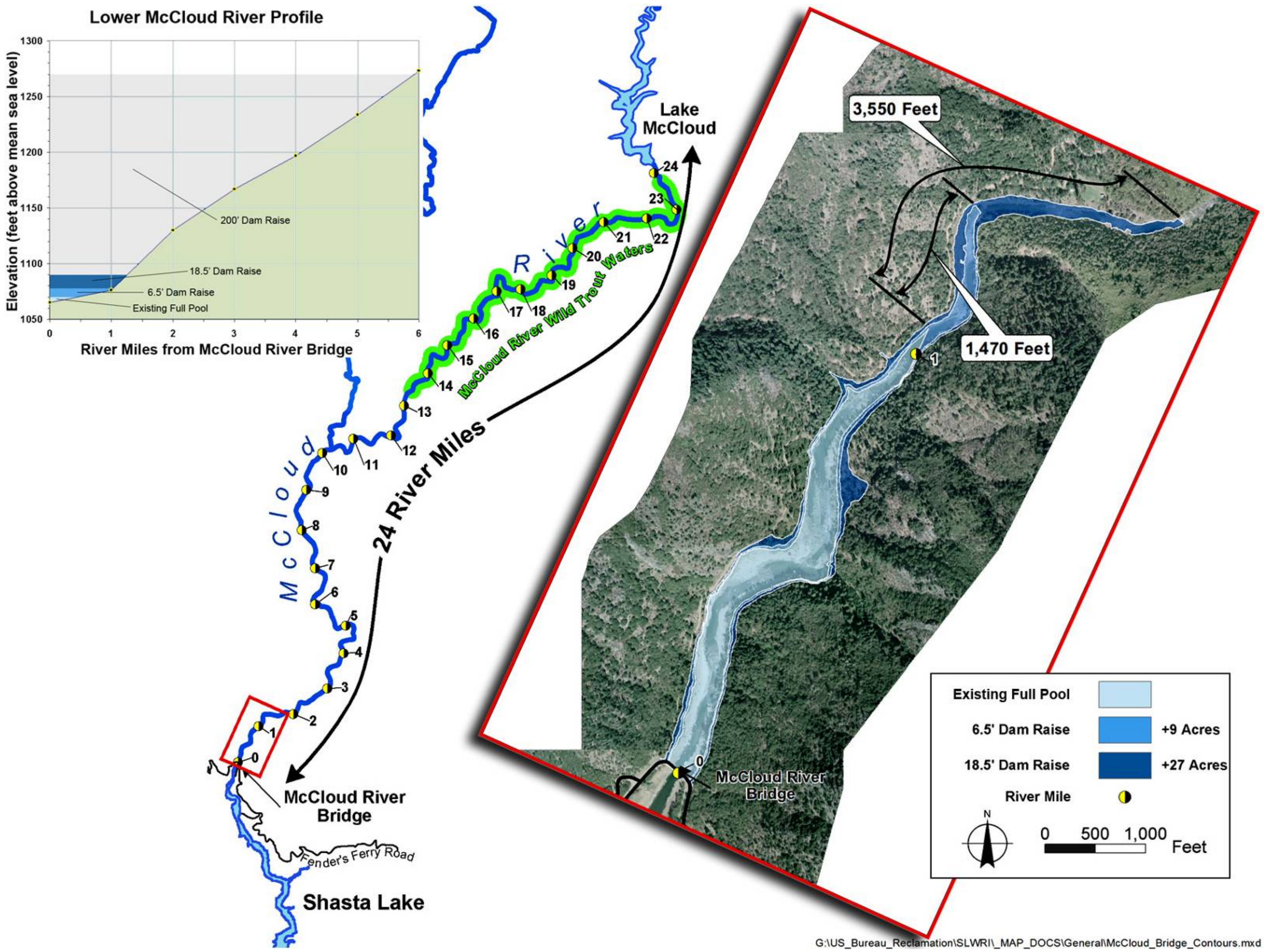



**Figure 5-9. McCloud River Maximum Inundation for 6.5-foot and 18.5-foot Dam Raises**

Significant effects to cultural resources due to enlarging Shasta Dam and Reservoir for CP1 include: (1) the disturbance or destruction of archaeological and historic resources due to construction or inundation, and (2) inundation of traditional cultural properties and sacred sites. Sensitivity and archival studies estimate that for CP1, approximately 355 and 529 historic sites are within the inundation zone and fluctuation, respectively. The local Native American community has also identified several locations they consider to be sacred with potential for inundation under CP1; notable among these are the Winnemem Wintu locations Puberty Rock and the doctoring pools near Nawtawaket Creek. Although Puberty Rock would still be accessible for portions of the year, when lake levels are lower, CP1 would increase the frequency of inundation. Effects to historic properties are regulated under Section 106 of the National Historic Preservation Act, requiring measures to avoid, minimize, or mitigate adverse effects. The Winnemem Wintu will have the opportunity to participate, and continue to provide input, through the Section 106 process as an invited consulting party, and through the NEPA process.

Additional long-term effects on biological resources associated with the relocation of reservoir area infrastructure are anticipated. Short-term, construction-related effects are also anticipated in the primary study area.

**Upper Sacramento River** Potential effects on flow and stages of the upper Sacramento River from this and other comprehensive plans would be minimal. Included in Figure 5-10 is an estimate of the percent change in river flows at Bend Bridge near Red Bluff for this and other dam raise scenarios under average, wet, and dry year conditions. Figures 5-11, 5-12, and 5-13 show CalSim-II simulated Sacramento River flows below Keswick Dam, above RBPP, and below Stony Creek, respectively, under wet, above- and below-normal, and dry and critical year conditions for the No-Action Alternative, compared to CP1 and CP4. As can be seen, during most years, annual operations of Shasta Reservoir, and subsequent flows and stages in the Sacramento River, would be relatively unchanged. Also, flows and stages would increase slightly from June through November. Although small, this increase would be most pronounced during dry periods as more water is released from Shasta Dam for water supply reliability purposes. During dry periods, however, there are few to no changes in water flows or changes during the winter and spring periods. Potential noticeable changes in river flows and stages diminish rapidly downstream from the RBPP. This is primarily because of the significant amount of tributary inflows, especially from the Feather River system.

No effects on cultural resources are expected to occur in the upper Sacramento River region.

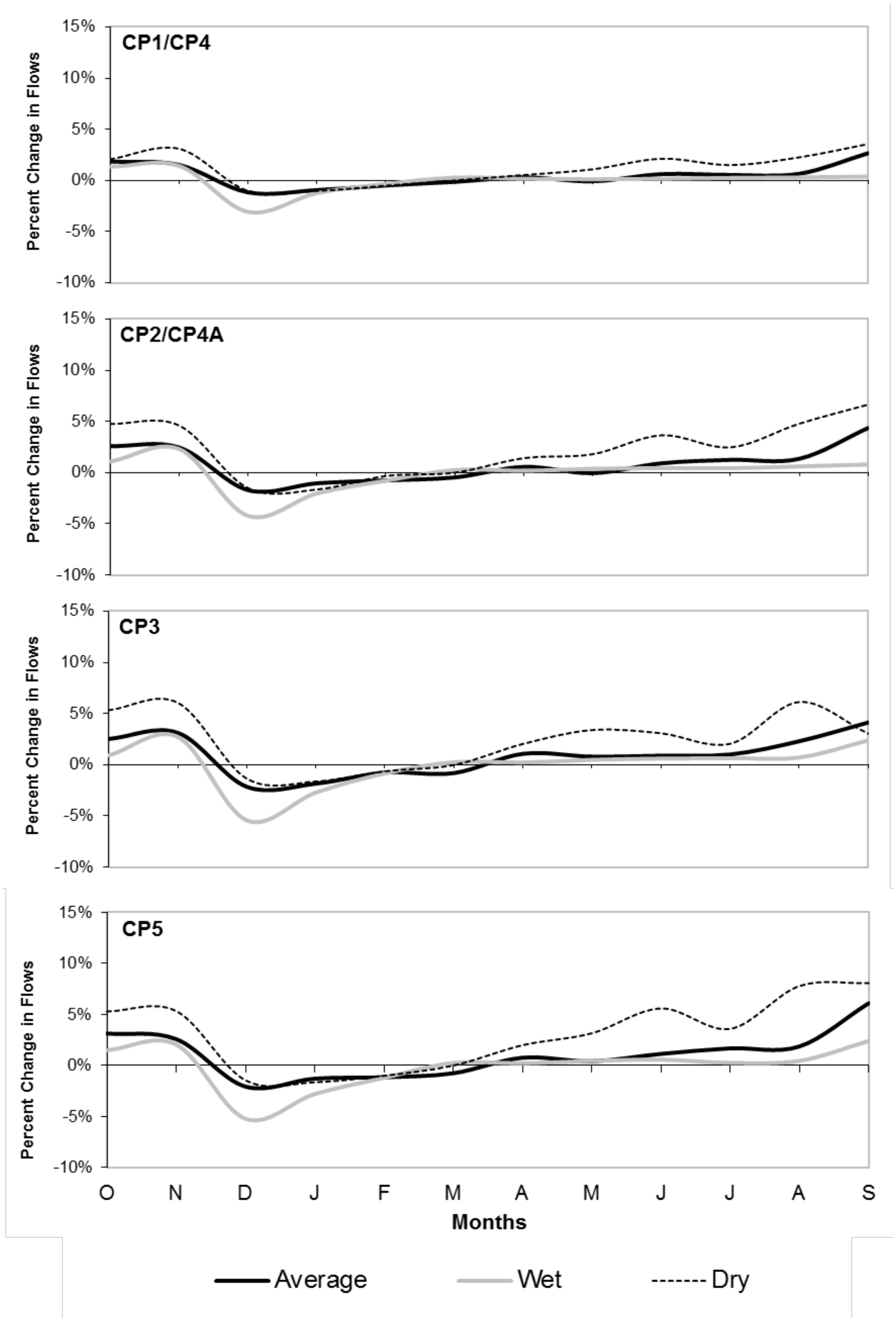



**Figure 5-10. Percent Change in Simulated Flows at Bend Bridge for Average, Dry, and Wet Year Conditions**

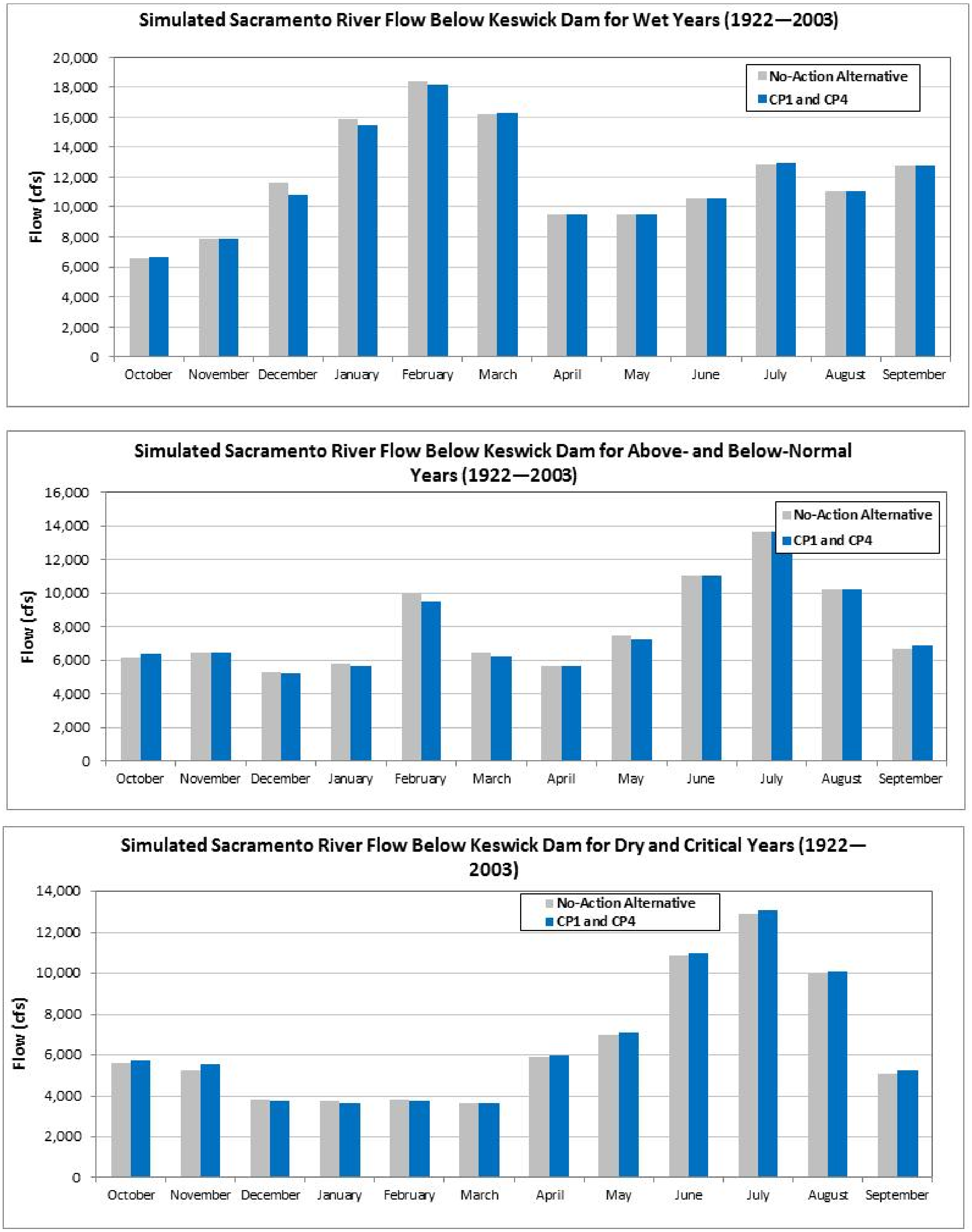
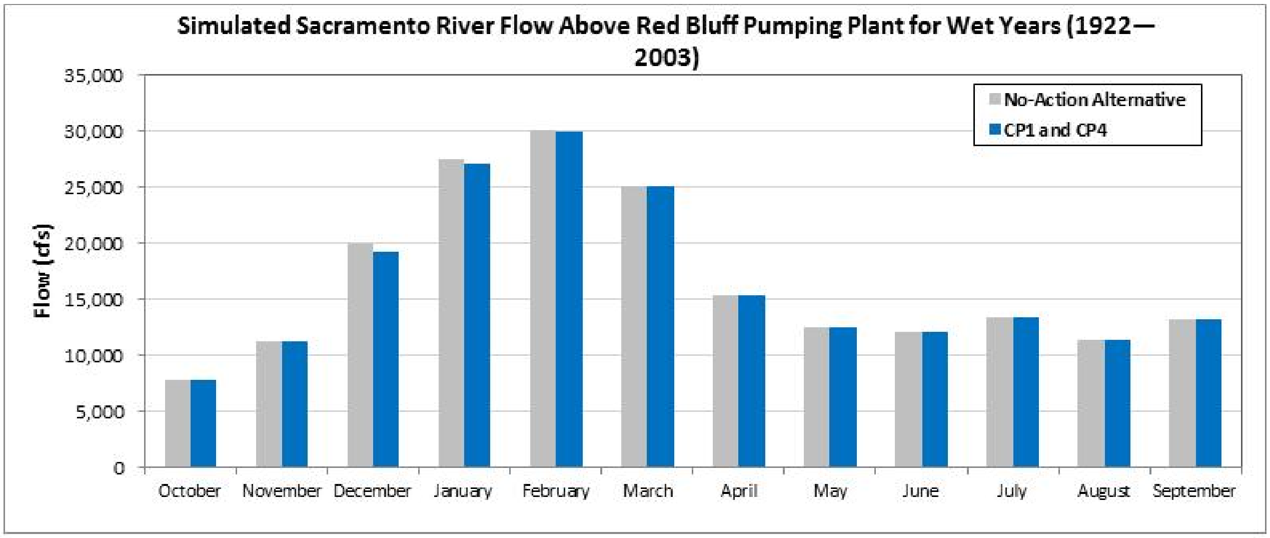
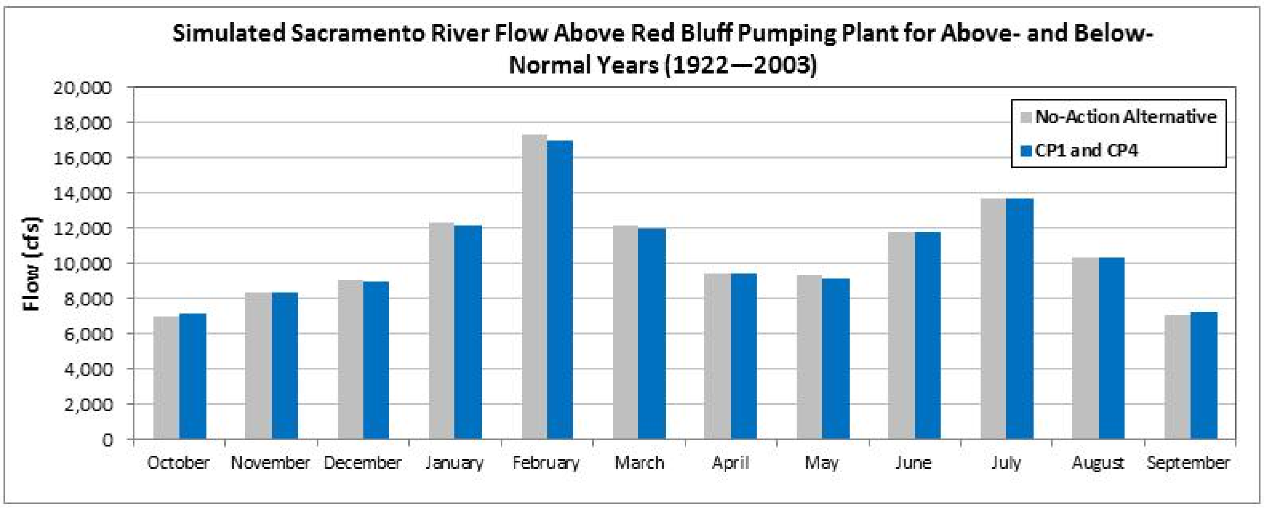



**Figure 5-11. Simulated Sacramento River Flow Below Keswick Dam in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action, CP1, and CP4**



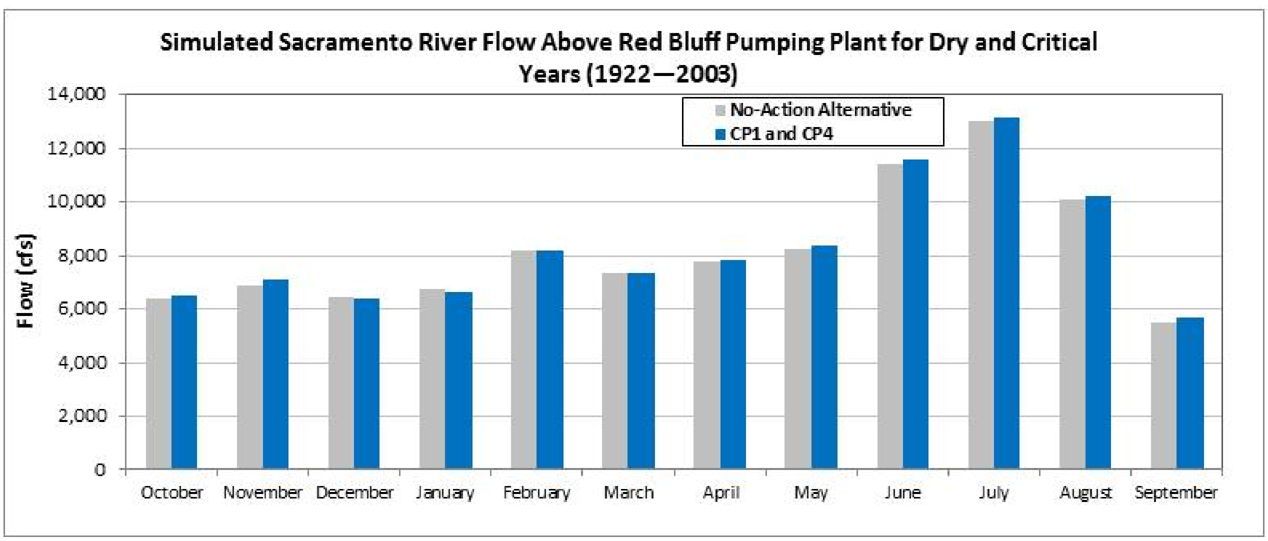




**Figure 5-12. Sacramento River Flow Above Red Bluff Pumping Plant in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action, CP1, and CP4**

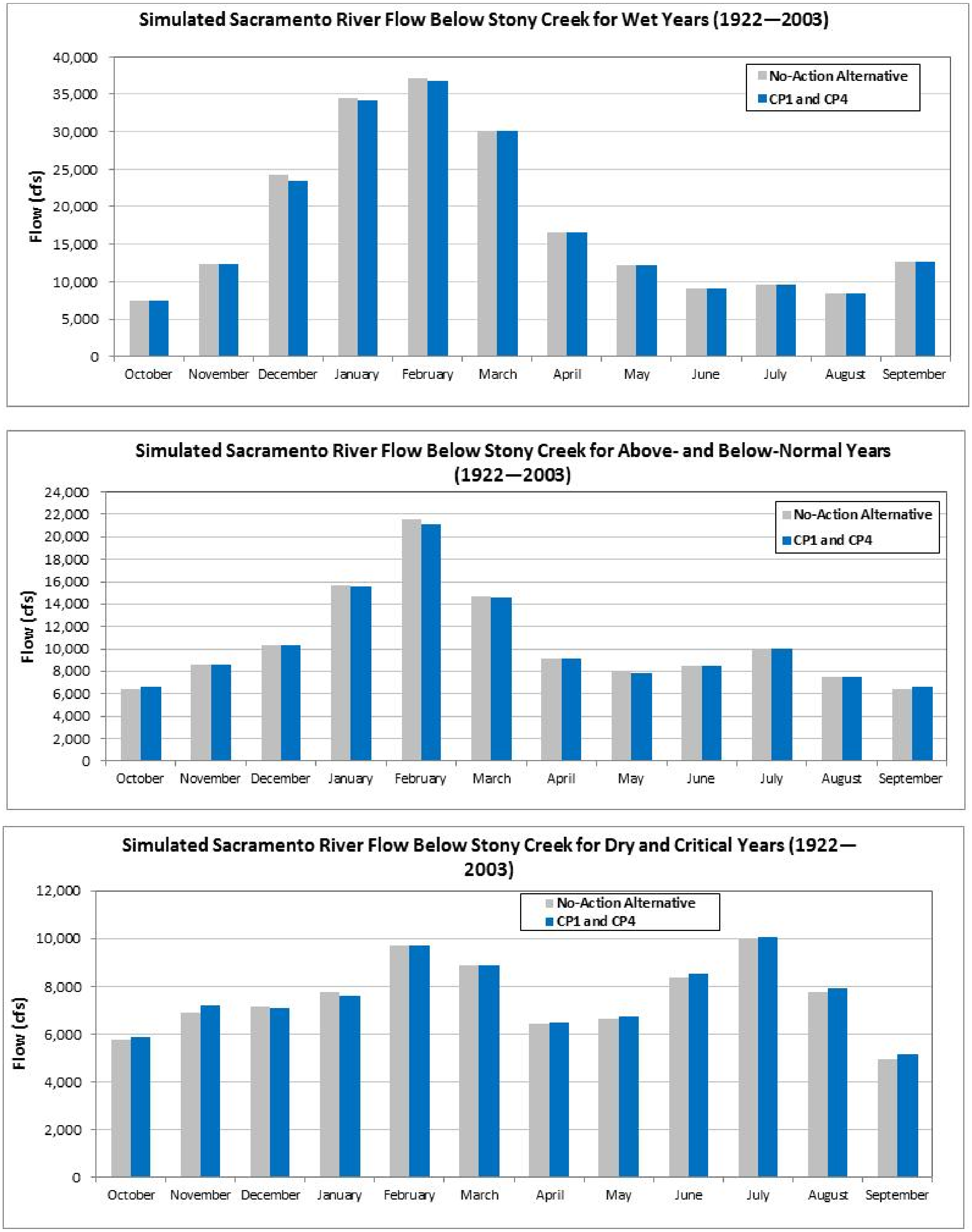



**Figure 5-13. Sacramento River Flow Below Stony Creek in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action, CP1, and CP4**

Changes in river flows and stages may impact geomorphic conditions along the river, existing riparian vegetation, and other wildlife resources. As mentioned above, the changes in temperatures and flows are, however, expected to have a beneficial effect on anadromous fish resources. A possibility exists, however, that by benefiting anadromous fish, a slightly altered flow and temperature regime may adversely impact warm-water species in the Sacramento River. This impact is not expected to be significant.

## CP2 –12.5-Foot Dam Raise, Anadromous Fish and Water Supply Reliability

CP2 consists primarily of enlarging Shasta Dam by raising the crest 12.5 feet and enlarging the reservoir by 443,000 acre-feet. Major features of CP2 are shown in Figure 5-3 and summarized in Table 5-6.

### *Major Components of CP2*

CP2 includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 12.5 feet.
- Implementing the set of eight common management measures described above.
- Implementing the common environmental commitments described above.

A dam raise of 12.5 feet was chosen because it represents a midpoint between the likely smallest dam raise considered and the largest practical dam raise that would not require relocating the Pit River Bridge. By raising Shasta Dam from a crest elevation of 1,077.5 feet to 1,090.0 feet (based on NGVD29), CP2 would increase the height of the reservoir's full pool by 14.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to the modifications proposed under CP1. This increase in full pool height would add approximately 443,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.0 MAF. Figure 5-4 shows the increase in surface area and storage capacity for CP2.

Under CP2, the additional storage in Shasta Reservoir would be used to increase water supply reliability and to expand the cold-water pool for downstream anadromous fisheries. The existing TCD would also be extended for efficient use of the expanded cold-water pool. Operations for water supply, hydropower, and environmental and other regulatory requirements would be similar to existing operations, except during dry and critical years when a portion of the increased storage in Shasta Reservoir would be reserved to specifically focus on increasing M&I deliveries. In dry years, 120,000 acre-feet of the 443,000 acre-feet increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries. In critical years, 60,000 acre-feet of the increased storage capacity would be reserved for increasing M&I deliveries.

As described for CP1, this plan would include the potential to revise flood control operational rules, which could potentially reduce flood damage and benefit recreation.

#### *Potential Benefits of CP2*

Major potential benefits of CP2, related to the planning objectives and broad public services, are described below.

**Increase Anadromous Fish Survival** Water temperature is one of the most important factors affecting anadromous fish survival in the Sacramento River. CP2 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 12.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant benefits to anadromous fish would occur upstream from the RBPP. It is estimated that improved water temperature and flow conditions under CP2 could result in an average annual increase in the Chinook salmon population of about 379,200 out-migrating juvenile Chinook salmon.

**Increase Water Supply Reliability** CP2 would increase water supply reliability by increasing water supplies for CVP and SWP irrigation and M&I deliveries. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP2 would help reduce estimated future water shortages by increasing the reliability of dry and critical year water supplies for agricultural and M&I deliveries by at least 77,800 acre-feet per year and average annual deliveries by about 51,300 acre-feet per year. As shown in Table 5-7, the majority of increased dry and critical year water supplies, 67,100 acre-feet, would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effective use of these supplies could reduce potential critical impacts on agricultural and urban areas resulting from water shortages. Under CP2, approximately $2.6 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

**Develop Additional Hydropower Generation** Higher water surface elevations in the reservoir would result in a net increase in power generation of about 87 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities. Other power benefits include additional capacity (i.e., the rate at which power can be generated) and ancillary services, which provide the ability to manage the electric grid in a reliable manner.

**Maintain and Increase Recreation Opportunities** CP2 includes features to, at minimum, maintain the existing recreation capacity at Shasta Lake. Although CP2 does not have specific features to further increase recreation capacity, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 1,900 acres (6 percent), from 29,700 acres to about 31,600 acres. The average surface area of the lake during the recreation season from May through September would increase by about 1,300 acres (5 percent), from 23,900 acres to 25,200 acres. There is also limited potential to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

**Benefits Related to Other Planning Objectives** CP2 could also provide benefits related to flood damage reduction, ecosystem restoration, and water quality, as described for CP1, but to a greater extent because of increased capacity and associated overall system flexibility.

**Additional Broad Public Benefits** Additional broad public benefits of CP2 obtained through pursuing project objectives are summarized in Table 5-8. Broad public benefits for CP2 are similar to CP1 but amplified due to the higher dam raise further enlarging system capacity and the facility upgrades associated with additional relocations.

#### *Construction for CP2*

Construction activities associated with physical features under CP2 would include land-based construction activities associated with the following:

- Clearing vegetation from portions of the inundated reservoir area
- Constructing the dam raise, appurtenant structures, reservoir area dikes, and railroad embankments
- Relocating roadways, bridges, recreation facilities, utilities, and miscellaneous minor infrastructure

Construction activities for CP2 are described in detail in the Engineering Summary Appendix.

#### *Operations and Maintenance for CP2*

Operations under CP2 are governed by the same regulatory constraints as described for CP1. Similar to CP1, the additional storage would be retained to increase water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Shasta Dam operational guidelines would continue unchanged, except during dry years and critical years, when 120,000 acre-feet and 60,000 acre-feet, respectively, of the 443,000 acre-feet increased storage capacity in Shasta Reservoir would be operated primarily to increase M&I deliveries. Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP. For CP2, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would be released primarily for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not usable for water supply purposes.

In comparison to current operations, CP2 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool and increase end-of-September carryover storage in Shasta Reservoir, increasing the ability of Shasta Dam to improve water temperatures for anadromous fish in the upper Sacramento River.

Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP2 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur with Shasta Reservoir's current operations.

Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

Operation of pumping facilities downstream from Shasta Dam would vary slightly from current operations and would result in higher costs. In addition, Reclamation would provide in-kind power to offset reduced generation at Pit 7 Dam and related facilities.

#### *Potential Primary Effects of CP2*

Following is a summary of the potential environmental effects of CP2. Potential environmental effects are generally comparable between comprehensive plans; some adverse effects would be exacerbated by larger dam raises and the associated scale of those effects, such as expanded construction areas and increased area of inundation around Shasta Lake. Proposed mitigation measures to address potential adverse impacts of CP2 are summarized in Table

5-9. As mentioned, a detailed discussion of potential effects and proposed mitigation measures are included in Chapters 4 through 25 of the EIS.

**Shasta Lake Area** As with CP1, the primary long-term effects of this comprehensive plan would be due to the increased water surface elevations and inundation area. The dam raise scenario under CP2 is greater than under CP1; therefore, anticipated effects under CP2 are expected to be slightly greater. As with the above plan, raising the full pool of the lake would cause direct effects due to higher water levels, and/or indirect impacts related to facility modifications and relocations.

CP2 includes modifying two bridges and replacing six other bridges, inundating a number of small segments of existing paved and nonpaved roads, and relocating a number of potable water facilities, wastewater facilities, gas and petroleum facilities, and power distribution and telecommunications facilities. A number of recreation facilities would also be impacted, including campgrounds, marinas, resorts, boat ramps, day-use areas, and trails. Approximately 21 segments of roadway would be relocated, including portions of Lakeshore Drive, Fenders Ferry Road, Gilman Road, and Silverthorn Road. Embankments would be constructed to protect I-5 at Lakeshore and UPRR at Bridge Bay. Any potential real estate acquisitions or necessary relocations of displaced parties would be accomplished under Public Law 91-646.

With CP2, Shasta Reservoir would fill to the new full pool storage of 5.0 MAF at a frequency similar to without-project conditions. On the basis of water operations modeling (CalSim-II), Shasta Reservoir fills to 80 percent or its current capacity in about 81 percent of the years over the 82-year period of analysis of the CalSim-II model. Figure 5-5 shows an exceedence probability relationship of maximum annual storage in Shasta Reservoir for this and other dam raises. With this alternative, Shasta Reservoir would fill to 80 percent of the new capacity in about 74 percent of the years. Accordingly, annual operations in the reservoir would generally mirror existing operations, but the water surface in the reservoir would be about 12.5 feet higher. The primary difference in the reservoir area would be that during extended drought periods, the reservoir would be drawn down to without-project minimum levels. Figure 5-14 shows the changes from without-project conditions for CP2 for a representative period of 1972 through 2003.

The increased area of inundation for CP2 is about 1,900 acres. As with the previous plan, much of the vegetation in the enlarged drawdown zone on steeper lands would be removed during construction. In addition, some vegetation in the expanded drawdown zone would eventually be lost over time. However, it is expected that significant amounts of vegetation could remain on the lower slopes because of the infrequent inundation. The lower reaches of tributaries to Shasta Lake also would experience increased inundation.

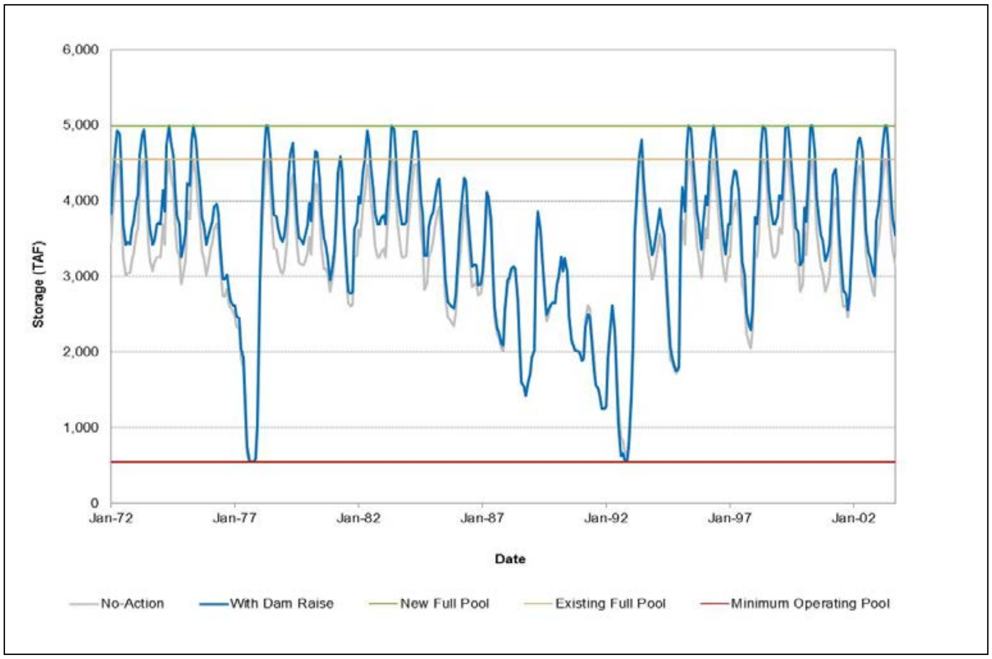



**Figure 5-14. Simulated Shasta Reservoir Storage from 1972 to 2003 for the No-Action Alternative and CP2**

Raising Shasta Dam 12.5 feet would result in inundating an additional 2,740 linear feet (about 18 acres) of the lower McCloud River. This represents about 2 percent of the 24-mile reach of river between the McCloud Bridge and the McCloud Dam, which controls flows on the river.

Significant effects to cultural resources due to enlarging Shasta Dam and Reservoir for CP2 include: (1) the disturbance or destruction of archaeological and historic resources due to construction or inundation, and (2) inundation of traditional cultural properties and sacred sites. Sensitivity and archival studies estimate that for CP2, approximately 371 and 529 historic sites are within the inundation zone and fluctuation, respectively. Effects to traditional cultural properties and sacred sites under CP2 would be similar to CP1.

Although recreation would generally improve under this plan, water in the lake would be drawn down to existing conditions during the late fall and winter periods of some dry years, representing a drawdown 14.5 feet greater than under existing conditions. In addition, clearances for boat traffic under the Pit River Bridge would be restricted to the north end of the bridge during periods of high reservoir levels (at or near full pool). This condition would typically occur in the late spring (May to June) in about 1 out of 3 years, and could last several days to a week. The estimated minimum clearance at the new full pool would be about 20 feet between Piers 6 and 7. This would not be expected to significantly impact boating on the lake.

Additional long-term effects on biological resources associated with the relocation of reservoir area infrastructure are anticipated. Short-term, construction-related impacts are also anticipated in the primary study area.

**Upper Sacramento River** As with the previous plan, potential effects on flow and stages of the upper Sacramento River from CP2 and other comprehensive plans would be minimal. Figures 5-15, 5-16, and 5-17 show CalSim-II simulated Sacramento River flows below Keswick Dam, RBPP, and Stony Creek, respectively, under wet, above- and below-normal, and dry and critical year conditions for the No-Action Alternative compared to CP2. During most years, annual operations of Shasta Reservoir, and subsequent flows and stages in the Sacramento River would be relatively unchanged. Also, flows and stages would increase slightly from June through November. Although small, this increase would be most pronounced during dry periods as more water is released from Shasta Dam for water supply reliability purposes. During dry periods, however, there are few to no changes in water flows or changes during the winter and spring periods. All potential noticeable changes in flows and stages would diminish rapidly downstream from the RBPP.

No effects on cultural resources are expected to occur in the upper Sacramento River region.

Similar to CP1, changes in river flows and stages may impact geomorphic conditions, existing riparian vegetation, and other wildlife resources of the upper Sacramento River. As mentioned above, the changes in temperatures and flows are expected to have a beneficial effect on anadromous fish resources. A possibility exists, however, that by benefiting anadromous fish, a slightly altered flow and temperature regime may adversely impact warm-water species in the Sacramento River. This effect is not expected to be significant.

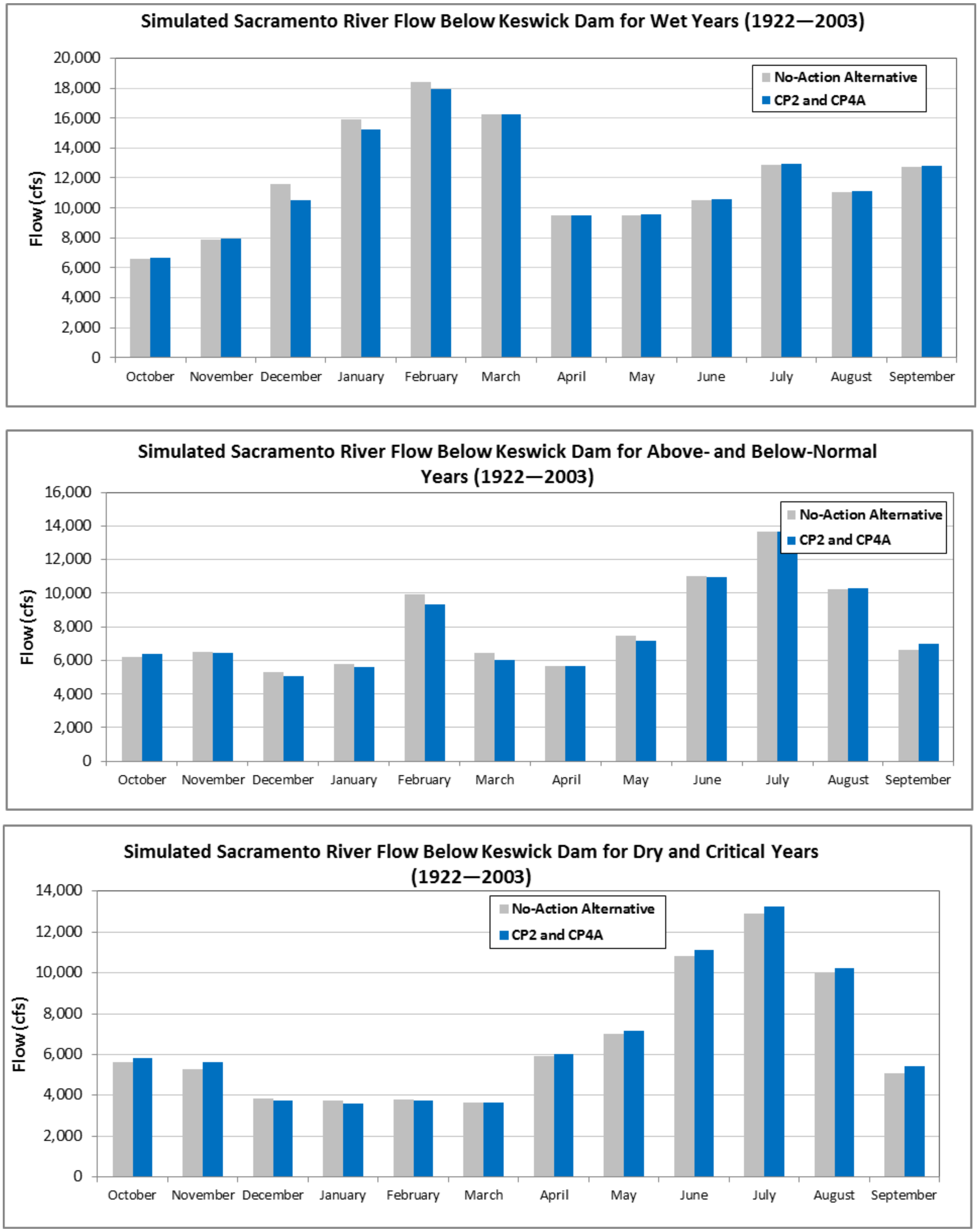



**Figure 5-15. Simulated Sacramento River Flow Below Keswick Dam in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action, CP2, and CP4A**

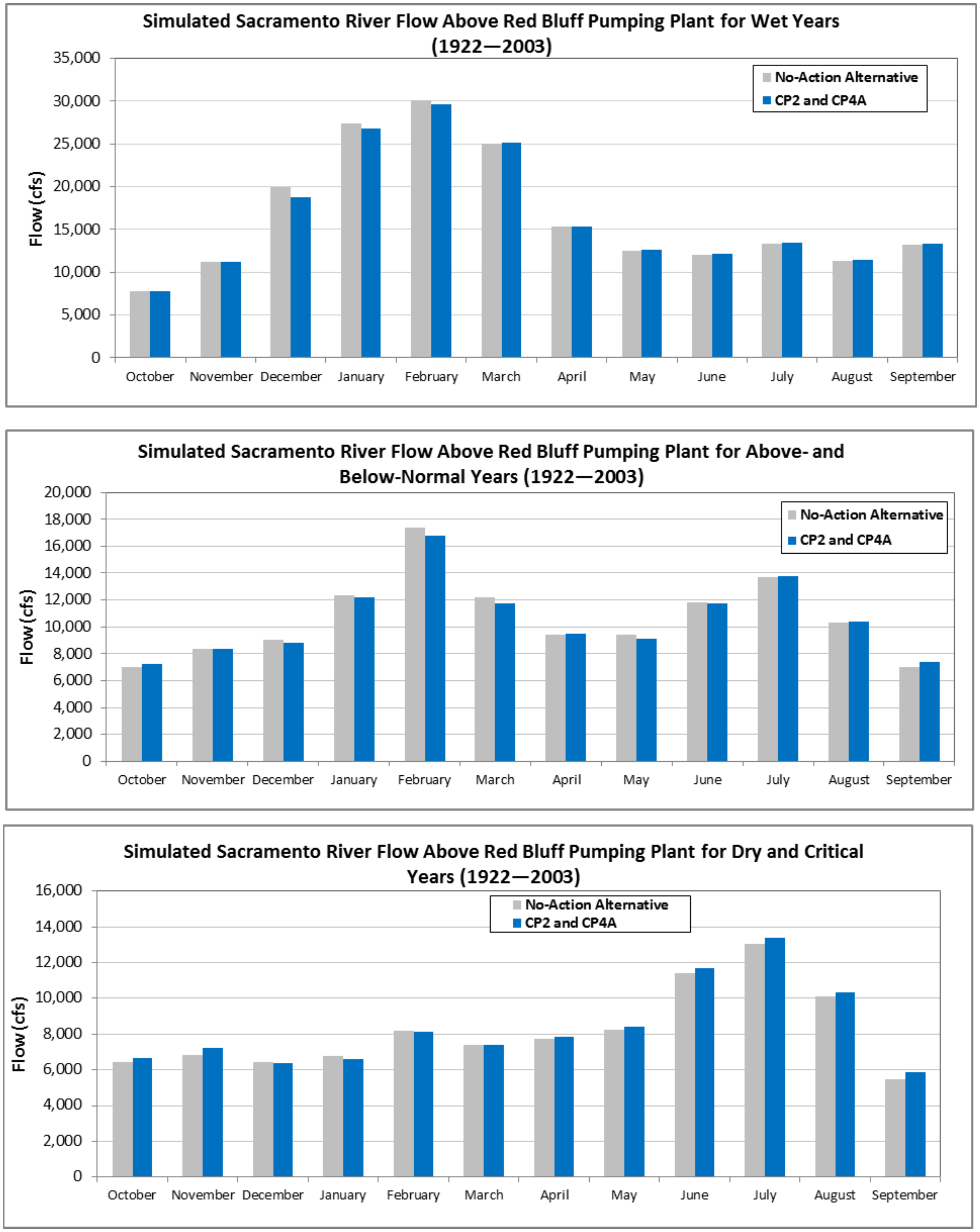



**Figure 5-16. Sacramento River Flow Below Red Bluff Pumping Plant in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action, CP2, and CP4A**

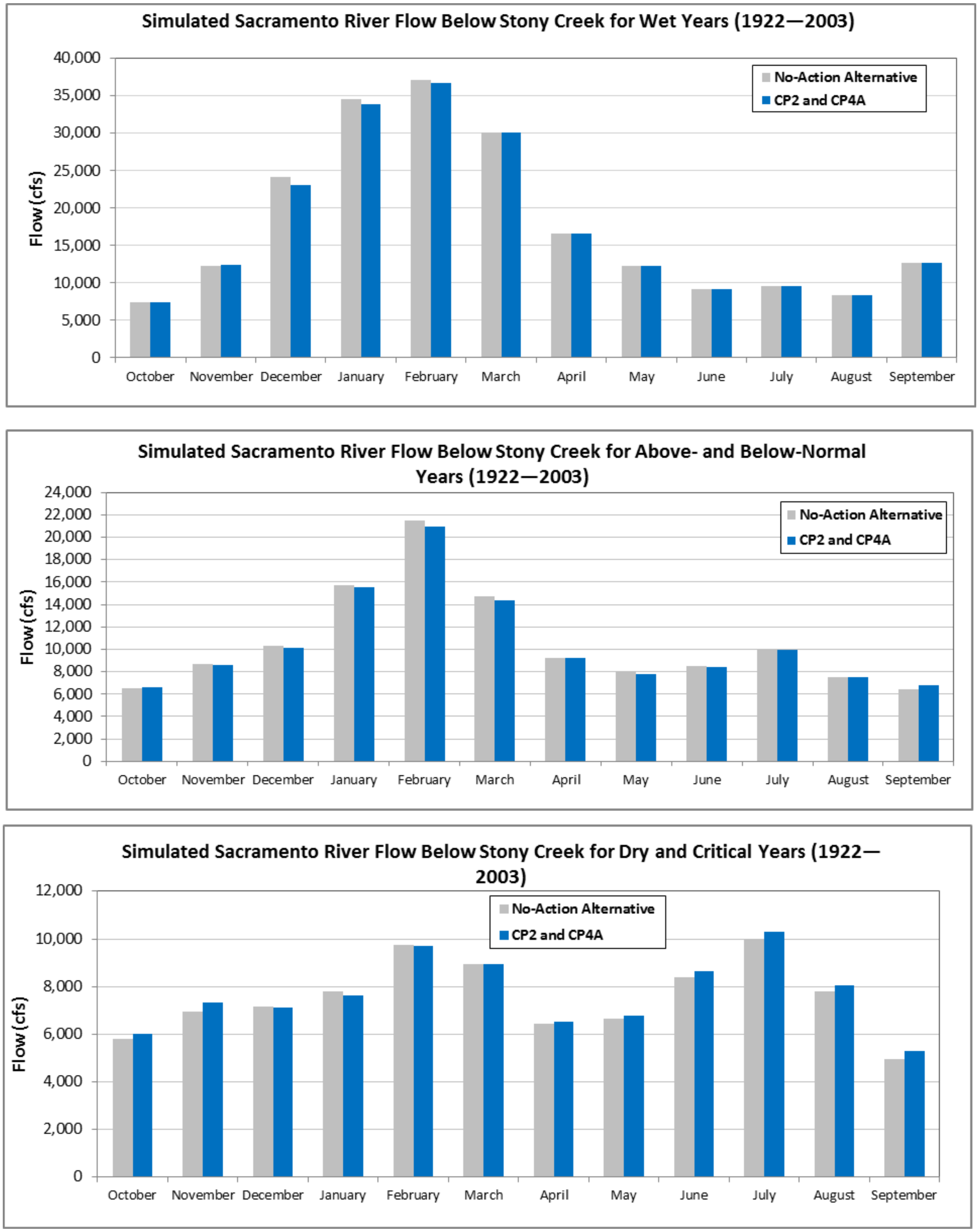



**Figure 5-17. Sacramento River Flow Below Stony Creek in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action, CP2, and CP4A**

## CP3 – 18.5-Foot Dam Raise, Agricultural Water Supply Reliability and Anadromous Fish Survival

CP3 consists primarily of enlarging Shasta Dam and Reservoir by raising the dam crest 18.5 feet and enlarging the reservoir by 634,000 acre-feet. Major features of CP3 are shown in Figure 5-3 and summarized in Table 5-6.

### *Major Components of CP3*

Major components of this plan include the following:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Implementing the set of eight common management measures previously described.
- Implementing the common environmental commitments described above

By raising Shasta Dam 18.5 feet, from a crest elevation of 1,077.5 feet to 1,096.0 feet (based on NGVD29), CP3 would increase the height of the reservoir full pull by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to the modifications proposed under CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would increase from 4.55 MAF to 5.19 MAF. Although higher dam raises are technically and physically feasible, 18.5 feet is the largest dam raise that would not require extensive and very costly reservoir area relocations such as relocating the Pit River Bridge, I-5, and the UPRR tunnels, as shown in Figure 5-18. Raising the dam 18.5 feet would provide the minimum clearance required (4 feet) at the south end of the Pit River Bridge, while still providing more than 14 feet of clearance at the north end of the bridge. Figure 5-4 shows the increase in surface area and storage capacity for CP3.

Because CP3 focuses on increasing agricultural water supply reliability and anadromous fish survival, none of the increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries. Operations for water supply, hydropower, and environmental and other regulatory requirements would be similar to existing operations. The additional storage would be retained for water supply reliability and to expand the cold-water pool for downstream anadromous fisheries. The existing TCD would also be extended for efficient use of the expanded cold-water pool.

As described for the above plans, this plan would include the potential to revise flood control operational rules, which could reduce the potential for flood damage and benefit recreation.

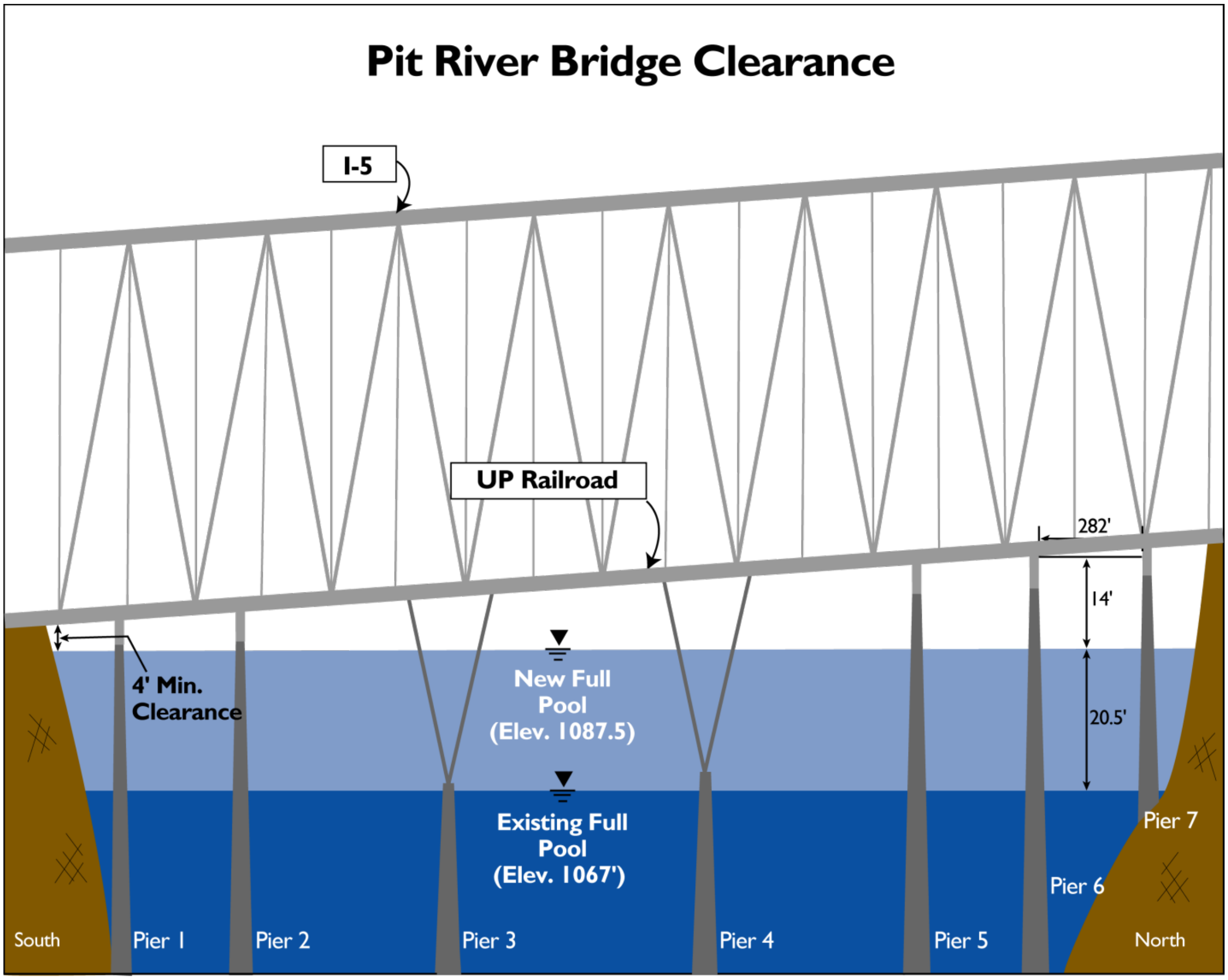



**Figure 5-18. Minimum Clearance for Boat Traffic at Pit River Bridge, Full Pool with 18.5-foot Dam Raise**

### *Potential Benefits of CP3*

Major potential benefits of CP3, related to the planning objectives and broad public services, are described below.

**Increase Anadromous Fish Survival** Water temperature is one of the most important factors affecting anadromous fish survival in the Sacramento River. CP3 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBPP. It is estimated that improved water temperature and flow conditions under CP3 could result in an average annual increase in the Chinook salmon population of about 207,400 out-migrating juvenile fish.

**Increase Water Supply Reliability** CP3 would increase water supply reliability by increasing water supplies for CVP irrigation and M&I deliveries, primarily during drought periods. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP3 would help reduce estimated future water shortages by increasing the reliability of dry and critical year water supplies for agricultural deliveries by at least 63,100 acre-feet per year and average annual deliveries by about 61,700 acre-feet per year. As shown in Table 5-7, almost half of the increased dry and critical year water supplies, 28,000 acre-feet, would be for south-of-Delta agricultural deliveries, with the remainder for north-of-Delta agricultural deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effective use of these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP3, approximately $3.1 million would be allocated over an initial 10-year period to fund agricultural water conservation programs, focused on agencies benefiting from increased project water supplies.

**Develop Additional Hydropower Generation** Higher water surface elevations in the reservoir would result in a net increase in power generation of about 86 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities. Other power benefits include additional capacity (i.e., the rate at which power can be generated) and ancillary services, which provide the ability to manage the electric grid in a reliable manner.

**Maintain and Increase Recreation Opportunities** CP3 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. Although CP3 does not include specific features to further increase recreation capacity, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 2,600 acres (9 percent), from 29,700 acres to about 32,300 acres. The average surface area of the lake during the recreation season from May through September would increase by about 2,000 acres (8 percent), from 23,900 acres to 25,900 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

**Benefits Related to Other Planning Objectives** CP3 could also provide benefits related to flood damage reduction, ecosystem restoration, and water quality, as described for CP1, but to a greater extent because of increased capacity and associated overall system flexibility.

**Additional Broad Public Benefits** Additional broad public benefits of CP3 obtained through pursuing project objectives are summarized in Table 5-8. Broad public benefits for CP3 are similar to CP1 and CP2 but are amplified due to the higher dam raise further enlarging system capacity and facility upgrades associated with additional relocations.

### *Construction for CP3*

Construction activities associated with physical features under CP3 would include land-based construction activities associated with the following:

- Clearing vegetation from portions of the inundated reservoir area
- Constructing the dam raise, appurtenant structures, reservoir area dikes, and railroad embankments
- Relocating roadways, bridges, recreation facilities, utilities, and miscellaneous minor infrastructure

Construction activities for CP3 are described in detail in the Engineering Summary Appendix.

### *Operations and Maintenance for CP3*

Operations under CP3 are governed by the same regulatory constraints as described for CP1. Under CP3, Shasta Dam operational guidelines would continue unchanged, with the additional storage retained for agricultural water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Unlike CP1 and CP2, none of the increased storage space in Shasta Reservoir would be reserved for increasing M&I deliveries under CP3. Existing water quality and temperature requirements would be met in most years; therefore, additional water in storage would be released primarily for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not usable for water supply purposes.

In comparison to current operations, CP3 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation’s abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool and increase end-of-September carryover storage in Shasta

Reservoir, increasing the ability of Shasta Dam to improve water temperatures for anadromous fish in the upper Sacramento River.

Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP3 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur with Shasta Reservoir's current operations.

Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

Operation of pumping facilities downstream from Shasta Dam would vary slightly from current operations and would result in higher costs. In addition, Reclamation would provide in-kind power to offset reduced generation at Pit 7 Dam and related facilities.

#### *Potential Primary Effects of CP3*

Following is a summary of potential environmental consequences of CP3. Potential environmental effects are generally comparable between comprehensive plans; some adverse effects would be exacerbated by larger dam raises and the associated scale of those effects, such as expanded construction areas and increased area of inundation around Shasta Lake. Proposed mitigation measures to address potential adverse impacts of CP3 are summarized in Table 5-9. A detailed discussion of potential effects and proposed mitigation measures associated with raising Shasta Dam by 18.5 feet are included in Chapters 4 through 25 of the EIS.

**Shasta Lake Area** As with the other comprehensive plans, the primary long-term effects of CP3 would be due to the increased water surface elevations and inundation area. The dam raise scenario under CP3 is greater than under CP1 or CP2; therefore, anticipated effects under CP3 are expected to be slightly greater. As with the above plan, raising the full pool of the lake would cause direct effects due to higher water levels, and/or indirect impacts related to facility modifications and relocations.

CP3 includes modifying two bridges and replacing six other bridges, inundating a number of small segments of existing paved and nonpaved roads, and relocating a number of potable water facilities, wastewater facilities, gas and petroleum facilities, and power distribution and telecommunications facilities. A number of recreation facilities would also be impacted, including campgrounds, marinas, resorts, boat ramps, day use areas, and trails. Approximately 30 segments of roadway would be relocated, including portions of Lakeshore Drive, Fenders Ferry Road, Gilman Road, and Silverthorn Road. Embankments would be constructed to protect I-5 at Lakeshore and the UPRR at Bridge Bay. Any potential real estate acquisitions or necessary relocations of displaced parties would be accomplished under Public Law 91-646.

With CP3, Shasta Reservoir would fill to the new full pool storage capacity of 5.19 MAF at a frequency similar to without-project conditions. On the basis of water operations modeling (CalSim-II), Shasta Reservoir fills to 80 percent of its current capacity in about 81 percent of the years over the 82-year period of analysis of the CalSim-II model. Included in Figure 5-5 is an exceedence probability relationship of maximum annual storage in Shasta Lake for this and other dam raises. Under CP3, Shasta Reservoir would also fill to 80 percent of the new capacity in about 72 percent of the years. Accordingly, the annual operations in the reservoir would generally mirror existing operations, except the water surface in the lake would be about 18.5 feet higher. The primary difference in the reservoir area would be that during extended drought periods, the reservoir would be drawn down to without-project minimum levels. Figure 5-19 shows the changes from without-project conditions for CP3 for a representative period of 1972 through 2003.

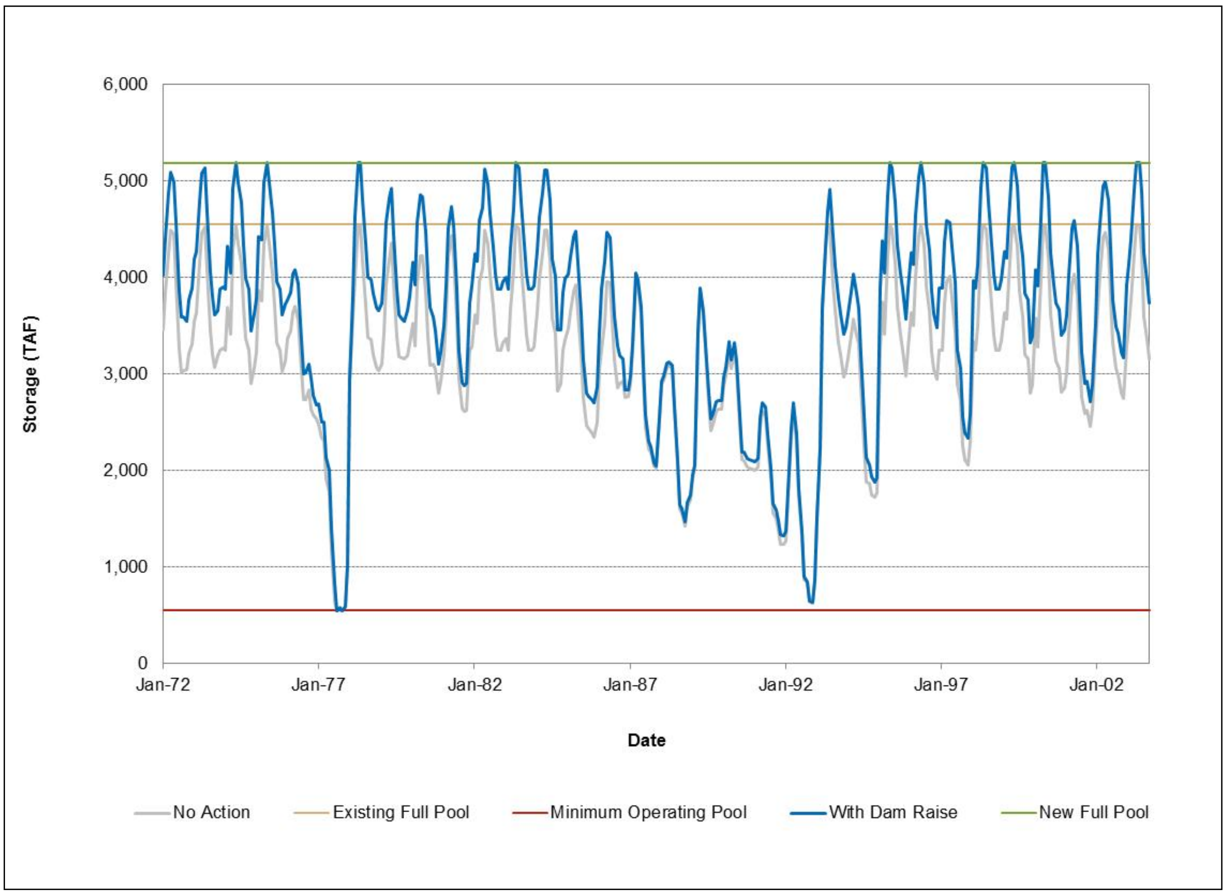



**Figure 5-19. Simulated Shasta Reservoir Storage from 1972 to 2003 for the No-Action Alternative and CP3**

The increased area of inundation for this plan is about 2,600 acres. As with the previous plans, much of the vegetation in the enlarged drawdown zone on steeper lands would be removed during construction. In addition, some vegetation in the expanded drawdown zone would eventually be lost over time. However, it is expected that significant amounts of vegetation could remain on the lower slopes because of the infrequent inundation. The lower reaches of tributaries to Shasta Lake also would experience increased inundation.

As shown in Figure 5-9, raising Shasta Dam 18.5 feet would result in inundating an additional 3,550 linear feet (about 27 acres) of the lower McCloud River. This represents about 3 percent of the 24-mile reach of river between the McCloud Bridge and the McCloud Dam, which controls flows on the river.

Although it is believed that recreation use would generally improve under this plan because of a larger lake surface area, water in the lake would be drawn down to existing conditions during the late fall and winter periods of some dry years, representing a drawdown 20.5 feet greater than under existing conditions. During these periods, the drawdown zone could increase by about 50 linear feet. In addition, clearances for boat traffic under the Pit River Bridge would be restricted to the north end of the bridge during periods of high reservoir levels (at or near full pool). This condition would typically occur in the late spring (May to June) in about 1 out of 3 years, and could last several days to 1 or 2 weeks. Figure 5-18 illustrates that the minimum clearance at the new full pool would be about 14 feet between Piers 6 and 7. This could impact boating on the lake, as some houseboats exceed 16 feet in height. Since houseboating is a major recreational experience on Shasta Lake, especially around Memorial Day, restrictions on large boat traffic under the Pit River Bridge during maximum pool levels could adversely impact lake area boat rentals, marinas, and other recreation-dependent businesses.

Significant effects to cultural resources due to enlarging Shasta Dam and Reservoir for CP3 include: (1) the disturbance or destruction of archaeological and historic resources due to construction or inundation and (2) inundation of traditional cultural properties and sacred sites. Sensitivity and archival studies estimate that for CP3, approximately 391 and 529 historic sites are within the inundation zone and fluctuation, respectively. Effects to traditional cultural properties and sacred sites under CP3 would be similar to CP1.

Additional long-term effects on biological resources associated with the relocation of reservoir area infrastructure are anticipated. Short-term, construction-related impacts are also anticipated in the primary study area.

**Upper Sacramento River** As with the previous plan, potential effects on flow and stages of the upper Sacramento River from this and other comprehensive plans would be minimal. Figures 5-20, 5-21, and 5-22 show CalSim-II simulated Sacramento River flows below Keswick Dam, RBPP, and Stony

Creek, respectively, under wet, above- and below-normal, and dry and critical year conditions for the No-Action Alternative compared to CP3. During most years, annual operations of Shasta Reservoir, and subsequent flows and stages in the Sacramento River, would be relatively unchanged. Also, flows and stages would increase slightly from June through November. Although small, this increase would be most pronounced during dry periods as more water is released from Shasta Dam for water supply reliability purposes. During dry periods, however, there are few to no changes in water flows or changes during the winter and spring periods. All potential noticeable changes in flows and stages would diminish rapidly downstream from the RBPP.

Similar to other comprehensive plans, changes in river flow and stages may impact geomorphic conditions, existing riparian vegetation, and wildlife resources of the upper Sacramento River. As mentioned above, the changes in temperature and flows are expected to have a beneficial effect on anadromous fish resources. A possibility exists, however, that by benefiting anadromous fish, a slightly altered temperature and flow regime may adversely impact warm-water species in the Sacramento River. This effect is not expected to be significant.

No effects on cultural resources are expected to occur in the upper Sacramento River region.

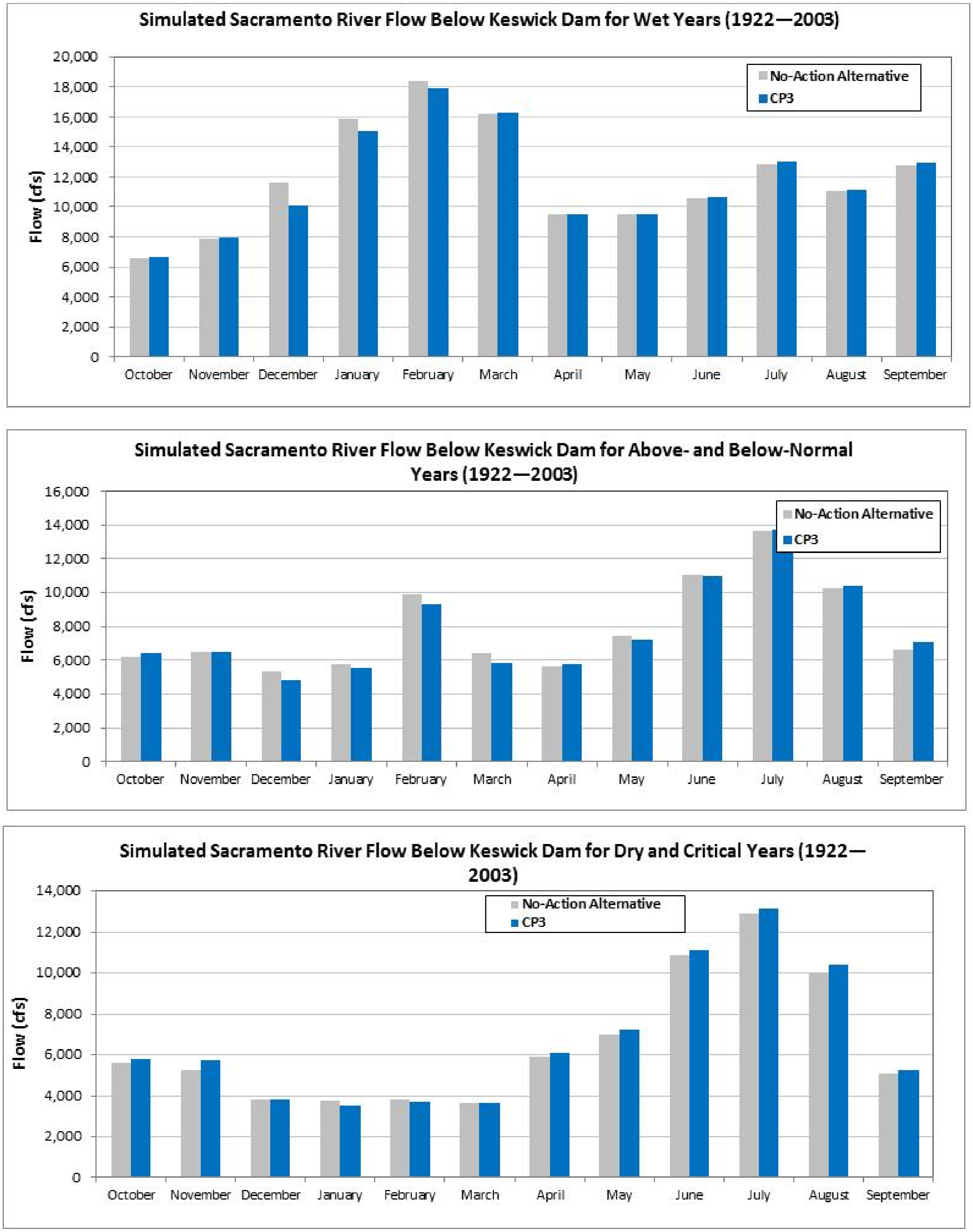
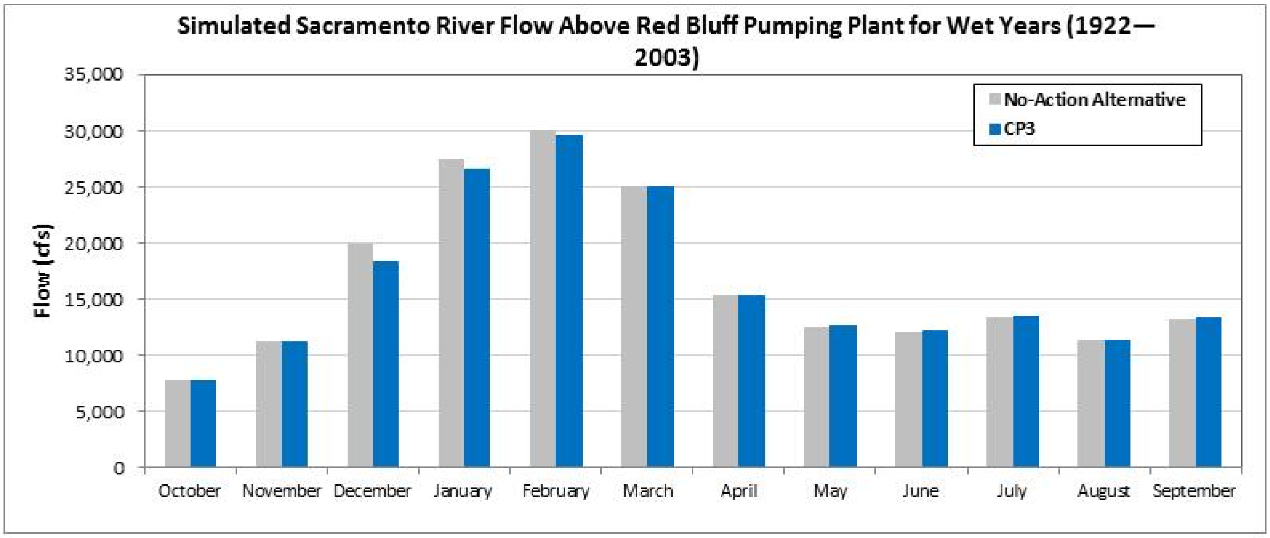
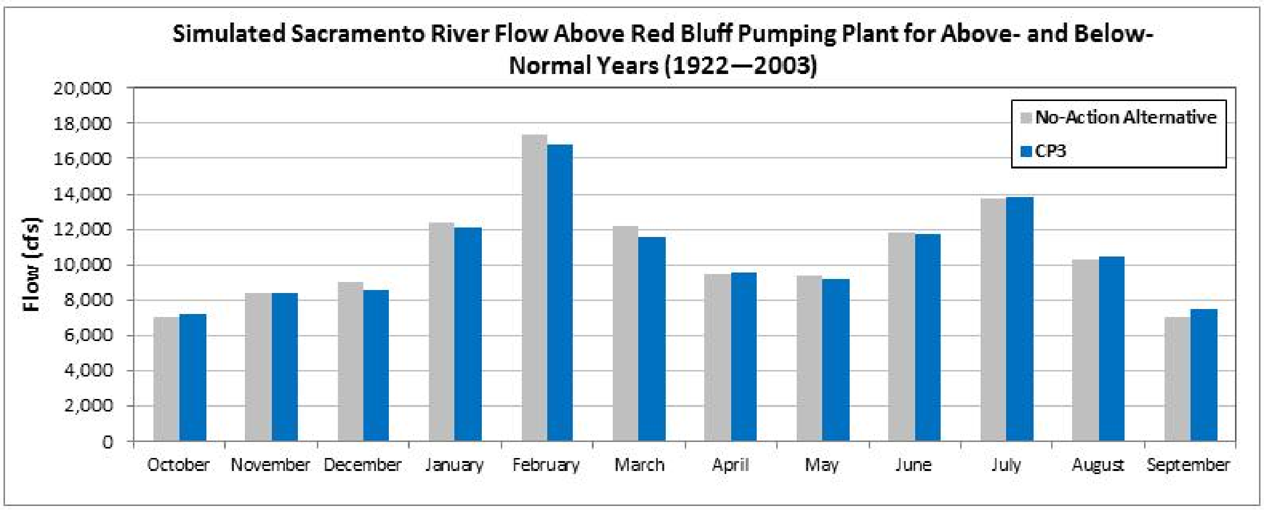



**Figure 5-20. Simulated Sacramento River Flow Below Keswick Dam in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action and CP3**



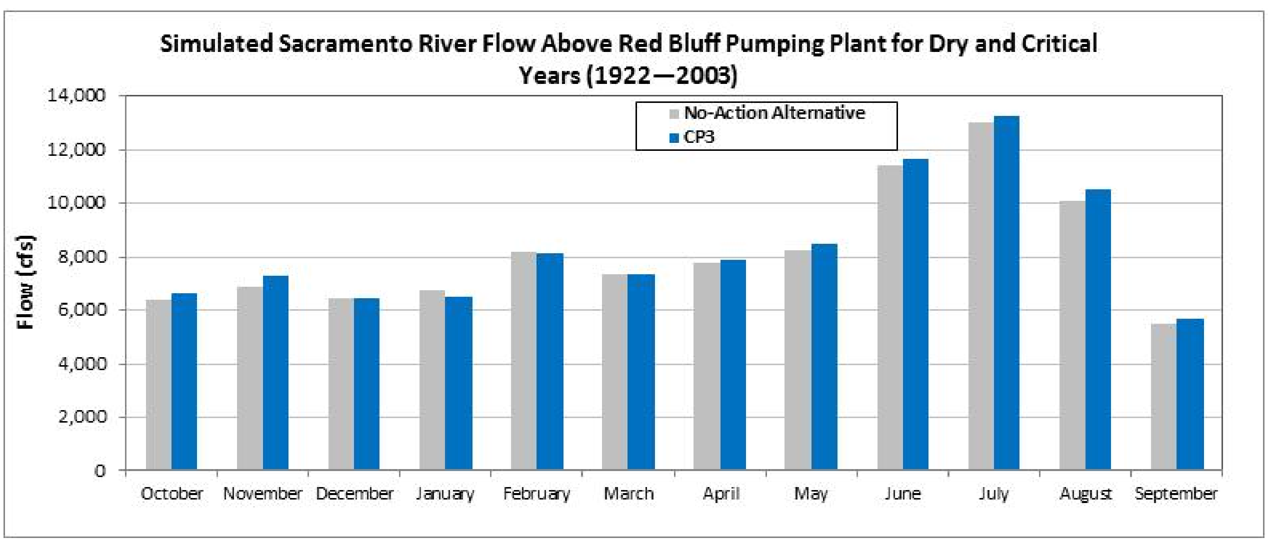




**Figure 5-21. Simulated Sacramento River Flow Below Red Bluff Pumping Plant in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action and CP3**

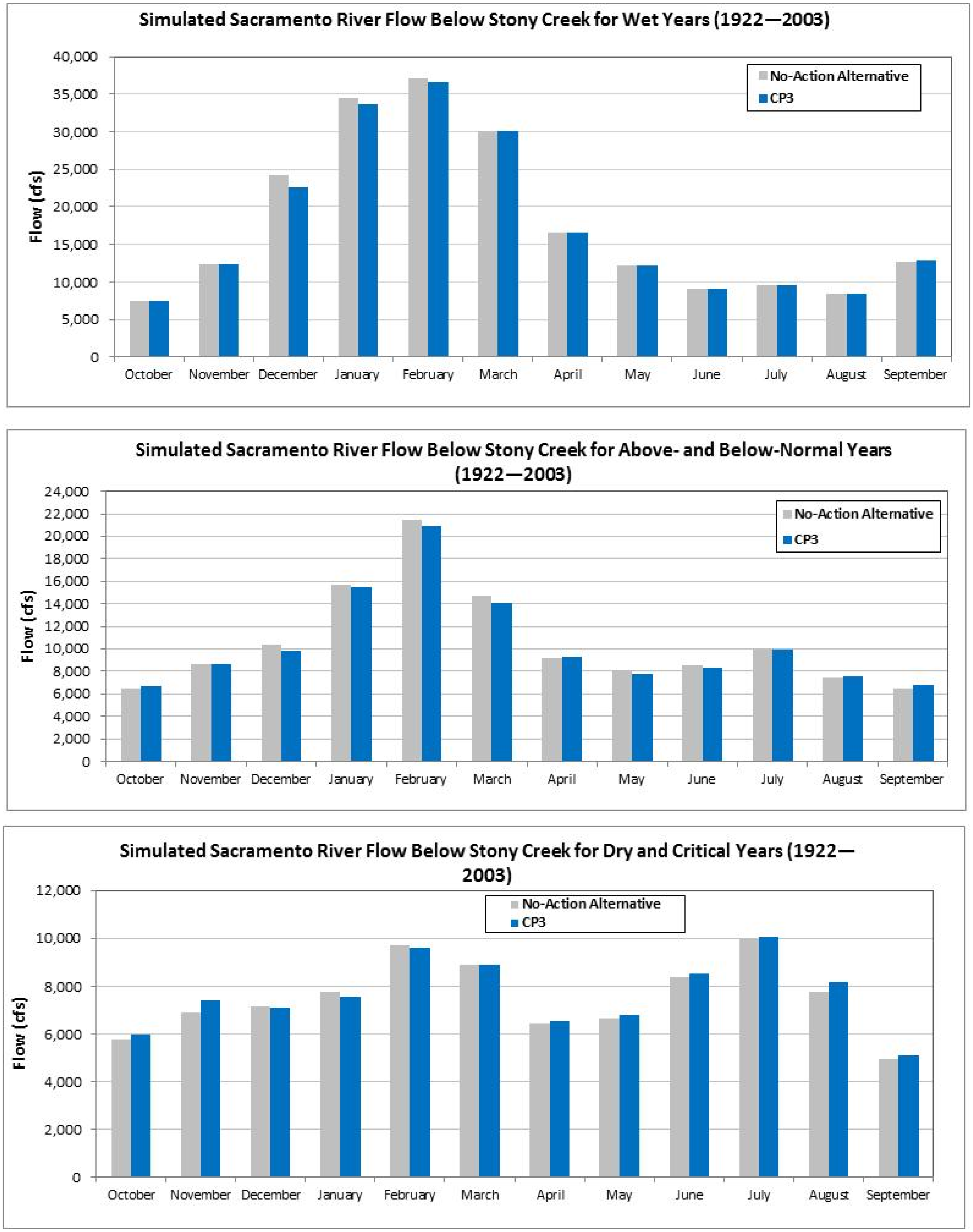



**Figure 5-22. Simulated Sacramento River Flow Below Stony Creek in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action and CP3**

### CP4 and CP4A – 18.5-Foot Dam Raise, Anadromous Fish Focus with Water Supply Reliability

CP4 and CP4A focus on increasing anadromous fish survival by raising Shasta Dam 18.5 feet, while also increasing water supply reliability. CP4 and CP4A are identical except for Shasta Dam and reservoir operations. CP4 and CP4A have similar reservoir operations in that they each dedicate a portion of the new storage in Shasta Lake for fisheries purposes, however, the portion of this dedicated storage varies. Major features of CP4 and CP4A in the Shasta Lake area are shown in Figure 5-3 and summarized in Table 5-6.

#### *Major Components of CP4 and CP4A*

Major components of CP4 and CP4A include the following:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Reserving a portion of the increased storage in Shasta Lake for maintaining cold-water volume or augmenting flows as part of an adaptive management plan for anadromous fish survival (378,000 acre-feet for CP4, 191,000 acre-feet for CP4A).
- Augmenting spawning gravel in the upper Sacramento River.
- Restoring riparian, floodplain, and side channel habitat in the upper Sacramento River.
- Implementing the set of eight common management measures, described above.
- Implementing the common environmental commitments described above.

By raising Shasta Dam 18.5 feet from a crest elevation of 1,077.5 feet to 1,096.0 feet (based on NGVD29), CP4 or CP4A would increase the height of the reservoir full pull by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to the modifications proposed under CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would be increased from 4.55 MAF to 5.19 MAF.

The additional storage created by the 18.5-foot dam raise would be used to improve the ability to meet temperature objectives and habitat requirements for anadromous fish during drought years, while increasing water supply reliability. Of the increased reservoir storage space of CP4, about 378,000 acre-feet would be dedicated to increasing the cold-water supply for anadromous fish purposes. Of the increased storage space of CP4A, about 191,000 acre-feet would be dedicated to increasing the supply of cold water for anadromous fish survival purposes. Figure 5-4 shows the increase in surface area and storage capacity for CP4 and CP4A.

For CP4, operations for the remaining portion of increased storage (approximately 256,000 acre-feet) would be the same as in CP1, with 70,000 acre-feet reserved in dry years and 35,000 acre-feet reserved in critical years to specifically focus on increasing M&I deliveries. For CP4A, operations for the remaining portion of increased storage (approximately 443,000 acre-feet) would be the same as in CP2, with 120,000 acre-feet reserved in dry years and 60,000 acre-feet reserved in critical years to specifically focus on increasing M&I deliveries. The existing TCD would also be extended to achieve efficient use of the expanded cold-water pool for CP4 or CP4A.

As described for the above plans, both CP4 and CP4A would include the potential to revise the operational rules for flood control for Shasta Dam and Reservoir, which could reduce the potential for flood damage and benefit recreation.

CP4 and CP4A also include an adaptive management plan for the cold-water pool, augmenting spawning gravel, and restoring riparian, floodplain, and side channel habitat at one or more sites in the upper Sacramento River.

**Adaptive Management of Cold-Water Pool** Both CP4 and CP4A may also include development of an adaptive management plan for the storage capacity dedicated to increasing the supply of cold water for anadromous fish survival (378,000 acre-feet for CP4, 191,000 acre-feet for CP4A). The adaptive management plan may include operational changes to the timing and magnitude of releases from Shasta Dam to benefit anadromous fish, as long as there are no conflicts with current operational guidelines or adverse impacts on water supply reliability. These changes may include increasing minimum flows, timing releases from Shasta Dam to mimic more natural seasonal flows, meeting flow targets for side channels, or retaining the additional water in storage to meet temperature requirements. Reclamation would manage the cold-water pool each year in cooperation with the SRTTG. Because adaptive management is predicated on using best available science and new information to make decisions, a monitoring program would be implemented as part of the adaptive management plan. SRTTG would conduct monitoring, develop monitoring protocols, and set performance standards to determine the success of adaptive management actions. Adaptive management of the cold-water pool for anadromous fish is discussed further below under “Operations and Maintenance for CP4 and CP4A.”

**Augment Spawning Gravel in Upper Sacramento River** Gravel suitable for spawning has been identified as a significant influencing factor in the recovery of anadromous fish populations in the Sacramento River (USFWS 2001, NMFS 2009a). Reclamation replenishes spawning gravel in the upper reaches of the Sacramento River, immediately below Keswick Dam and at Salt Creek, as part of the CVPIA. However, the annual gravel budget deficit is estimated to be far greater than what the CVPIA program currently supplies (Hannon 2008). Under CP4 and CP4A, spawning-sized gravel would be injected at multiple locations along the Sacramento River between Keswick Dam and the RBPP.

In December 2008, a workshop was held with Reclamation, USFWS, and CDFW to identify the goals and priorities of the SLWRI gravel augmentation program. Input from the resource agencies during the workshop was used to define the program. Gravel augmentation would occur at one to three locations every year, for a period of 10 years, unless unusual conditions or agency requests precluded placement during a single year. This program, in addition to the ongoing CVPIA gravel augmentation program, would help address the gravel deficit in the upper Sacramento River. However, this reach may continue to be gravel-limited in the future. Therefore, the proposed gravel augmentation program would be reevaluated after the 10-year period to assess the need for continued spawning gravel augmentation, and to identify opportunities for future gravel augmentation actions.

On average, 5,000 to 10,000 tons of gravel would be placed each year, although the specific quantity of gravel placed in a given year may vary from that range. Gravel would be obtained as uncrushed, rounded river rock, free of debris and organic material from local, commercial sources. To maximize the benefit to anadromous fish, gravel would be washed and sorted to meet specific size criteria. To minimize impacts on salmonid spawning activity, gravel placement within the active river channels would occur between August and September each year, consistent with the time frame for the ongoing CVPIA gravel augmentation.

Input from the resource agencies during the December 2008 led to the identification of 15 potential areas for spawning gravel augmentation in the Sacramento River between Keswick Dam and Shea Island. Selection of specific locations was based on potential benefits to anadromous fish and site accessibility. Gravel placement would provide either immediate spawning habitat or long-term recruitment.

Fifteen preliminary locations for spawning gravel augmentation were identified in the Sacramento River between Keswick Dam and Shea Island. Each site would be eligible for gravel placement one or more times during the 10-year program. Selection of these locations was based on potential benefits to anadromous fish and site accessibility. Gravel placement would provide either immediate spawning habitat or long-term recruitment.

Although preliminary sites have been identified, specific gravel augmentation site(s) and volume(s) would be selected each year in the spring or early summer through discussions among Reclamation, USFWS, CDFW, and NMFS. The discussions would include topics such as: avoiding redundancy with planned CVPIA gravel augmentation activities in a given year; identifying hydrology or morphology issues that could affect the potential benefit of placing gravel at any particular site; identifying changes in spawning trends based on ongoing CVPIA monitoring efforts; evaluating potential new sites; and appropriately distributing selected gravel sites along the river reach(es).

**Restore Riparian, Floodplain, and Side Channel Habitat** Under CP4 and CP4A, riparian, floodplain, and side channel habitat restoration would occur at one or a combination of potential locations along the upper Sacramento River. Restoration measures for six potential sites, referred to collectively as “upper Sacramento River restoration sites”, are described below. The sites under consideration for habitat restoration are shown in Figure 5-23.

*Henderson Open Space* The City of Redding Henderson Open Space area is located south of Cypress Bridge on the east side of the Sacramento River at River Mile (RM) 295. Riparian and side channel restoration at the Henderson Open Space site could consist of enhancing an existing side channel to activate the frequency and duration of flows for Chinook salmon spawning habitat throughout the side channel. This potential modification would create up to 2,000 more linear feet of spawning habitat near areas of the Sacramento River that are actively used by anadromous fish for spawning.

*Tobiasson Island* Tobiasson Island is located downstream from South Bonnyview Bridge in the center of the Sacramento River at RM 292. Riparian, floodplain, and side channel habitat enhancement at this site would involve creating a side channel through the island to be activated at Sacramento River flows for Chinook salmon spawning. Riparian vegetation would be established along the course of the new side channel, adding approximately 1,350 linear feet of spawning and floodplain habitat to this section of the Sacramento River.

*Shea Island Complex* The Shea Island Complex is located on the west side of the Sacramento River upstream from the river’s confluence with Clear Creek at RM 291. Restoration at the Shea Island Complex to improve side channel, riparian, and floodplain habitat would involve enhancing a major side channel through the site to keep the side channel hydraulically connected with the main stem of the Sacramento River at a broader range of flows. Adding channel complexity and enhancing riparian vegetation throughout the length of the side channel would improve Chinook salmon habitat along an additional 1,930 feet of the Sacramento River.

*Kapusta Island* Kapusta Island is located adjacent to the Kapusta Open Space area upstream from the I-5 crossing of the Sacramento River at RM 288. Restoration of riparian, side channel and floodplain habitat at Kapusta Island would involve enhancing an existing side channel by allowing it to carry water at a broader range of flows specifically to increase spawning habitat for winter-run and spring-run Chinook salmon. Allowing flow through the island, and increasing floodplain habitat would increase potential spawning habitat in this area of the river by about 1,590 linear feet.

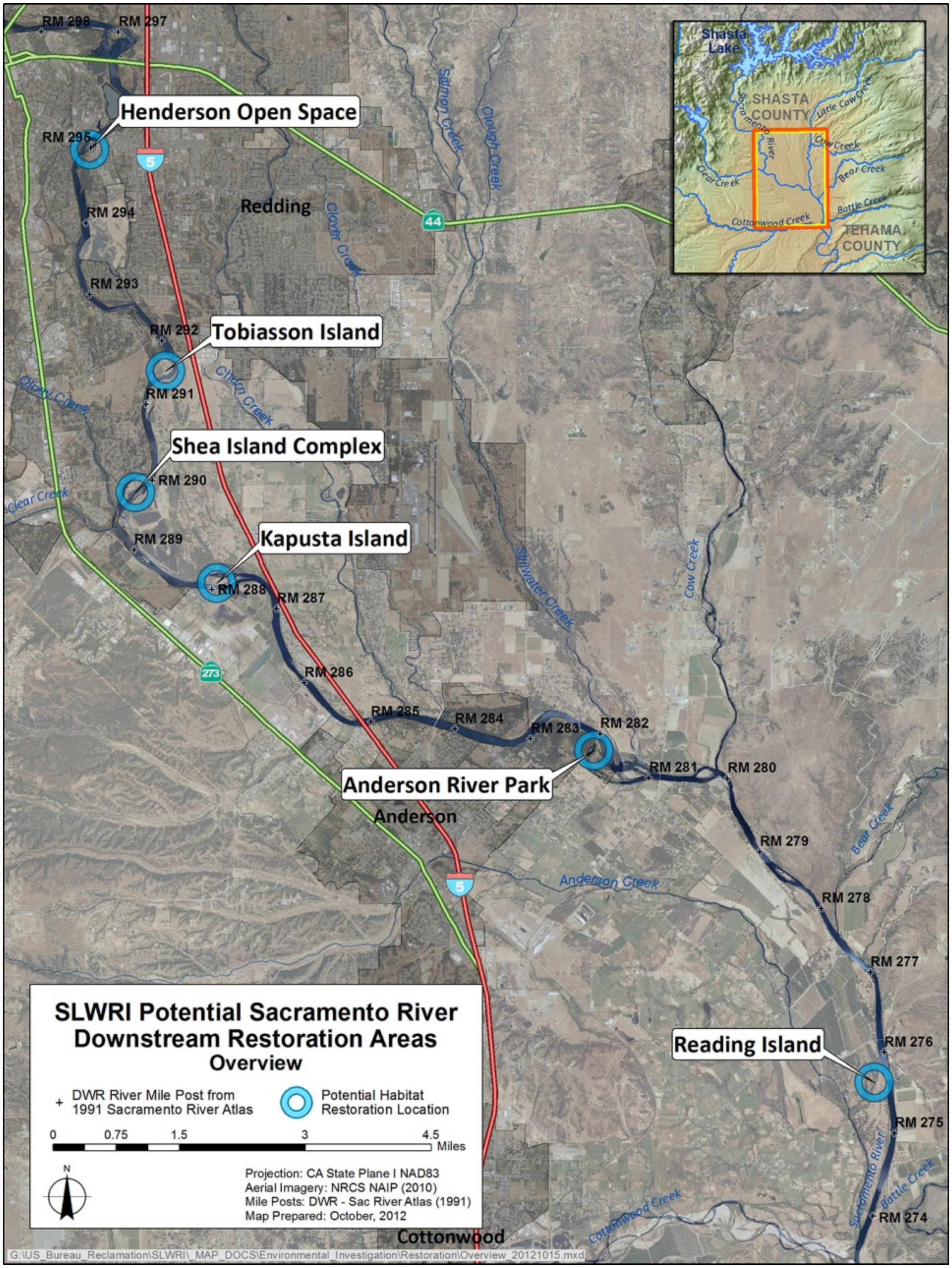



**Figure 5-23. Potential Sacramento River Habitat Restoration Areas**

*Anderson River Park* Anderson River Park is an open space area on the south bank of the Sacramento River downstream from Churn Creek, and upstream from the Deschutes Road crossing at RM 283. Restoration at this site would involve hydraulically reconnecting a remnant Sacramento River side channel with the Sacramento River. Regularly flowing water throughout the length of this side channel would increase anadromous fish rearing habitat along 4,750 feet of side channel in this section of the river.

*Reading Island* Reading Island lies along the Sacramento River just north of Cottonwood Creek at RM 274. The channel for Anderson Creek, a remnant Sacramento River side channel, defines the western edge of Reading Island. Construction of a levee on Anderson Creek has blocked the channel's connectivity with the Sacramento River and has created Anderson Slough, an area of still water. Riparian, floodplain, and side channel restoration on Reading Island would involve restoring flows in Anderson Creek and through Anderson Slough. These activities, alongside removal of invasive aquatic vegetation in the channel and reestablishment of riparian vegetation would aid in restoring rearing habitat for winter-run Chinook, and spawning habitat for steelhead along 4,225 feet of channel in this area of the river.

#### Potential Benefits of CP4 and CP4A

Major potential benefits of CP4 and CP4A, related to the planning objectives and broad public services, are described below.

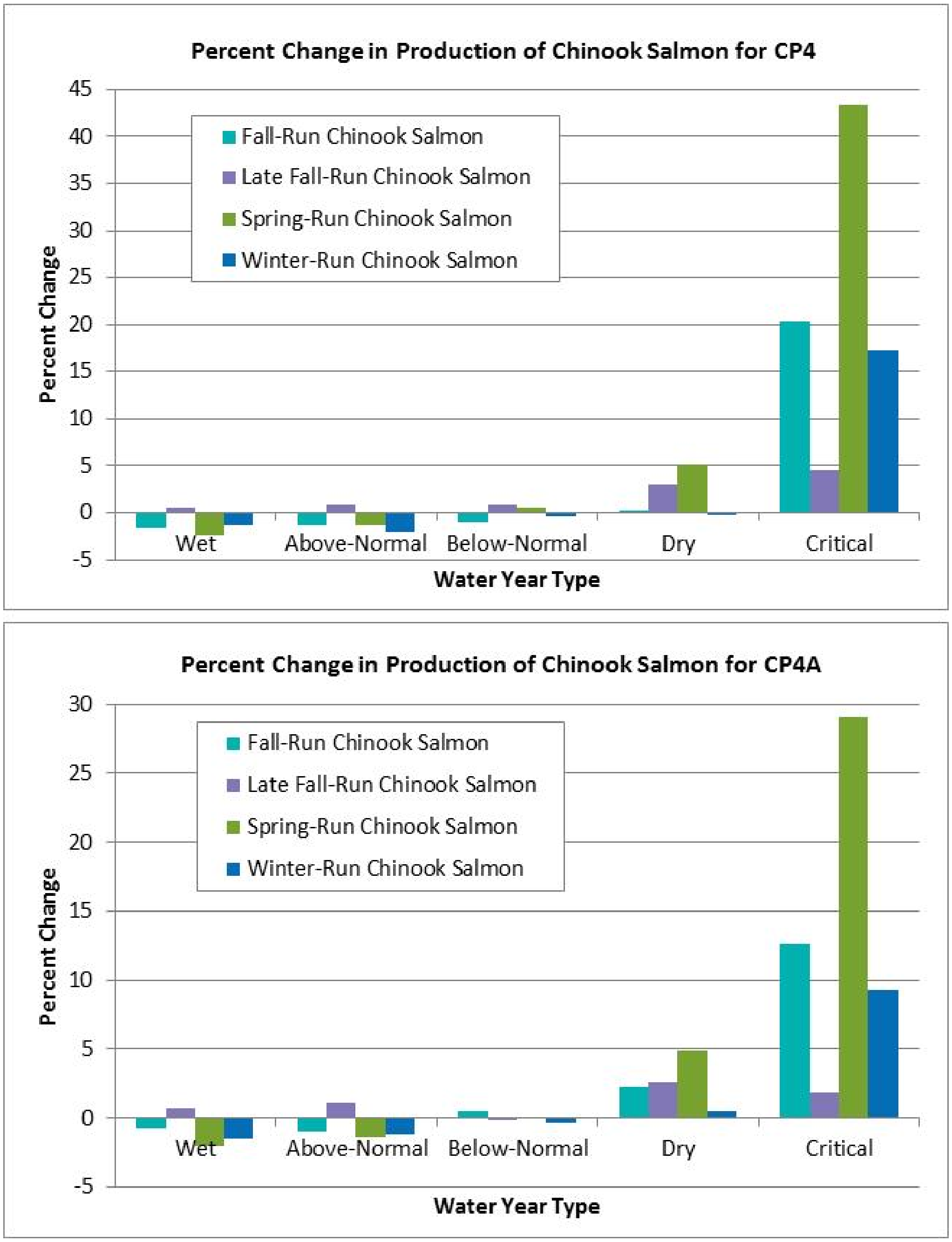
**Increase Anadromous Fish Survival** Water temperature is one of the most important factors affecting anadromous fish survival in the Sacramento River. CP4 or CP4A would increase the ability of Shasta Dam to make cold-water releases and regulate water temperatures for fish in the upper Sacramento River, primarily in dry and critical water years. CP4 would significantly increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River. CP4 would benefit anadromous fish by improving temperature conditions in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBPP.

It is estimated that improved temperature and flow conditions under CP4 could result in an average annual increase in Chinook salmon population of nearly 812,600 out-migrating juvenile fish. It is estimated that improved water temperature and flow conditions under CP4A could result in an average annual increase in Chinook salmon population of nearly 710,000 out-migrating juvenile fish.

Under CP4 and CP4A, an increase in the cold-water pool would allow Reclamation to operate Shasta Reservoir to provide not only a more reliable source of water during dry and critical water years, but also to provide more cool water for release into the Sacramento River to improve conditions for anadromous fish. Of the increased storage space for CP4, about 378,000 acre-feet (60 percent) would be dedicated to increasing the cold-water supply for anadromous fish survival purposes. Of the increased storage space for CP4A, about 191,000 acre-feet (30 percent) would be dedicated to increasing the cold-water supply for anadromous fish survival purposes. Reclamation would manage the cold-water pool each year based on recommendations from the SRTTG. To assess the effects of operations on Chinook salmon in the upper Sacramento River, the computer model SALMOD was upgraded to evaluate changes in Chinook salmon population between Keswick Dam and the RBPP. In response to changes in Shasta Reservoir operations under CP4 and CP4A during dry and critical water years – the years targeted for improving water reliability for both users and fish – SALMOD modeling showed increases in production of Chinook salmon populations, especially winter-run and spring-run Chinook (Figure 5-24).

In addition, CP4 and CP4A include a gravel augmentation program. Gravel augmentation would occur on average at one or more locations in the Sacramento River between Keswick Dam and the RBPP for a period of 10 years. On average, 5,000 to 10,000 tons of gravel would be placed each year, although the specific quantity of gravel placed in a given year may vary from that range. Spawning gravel augmentation is expected to positively influence anadromous fish populations in the Sacramento River.

Potential benefits to anadromous fish survival through conserving, restoring, and enhancing ecosystem resources are described below.




Note: Simulated using SALMOD; Water Year Types Based on the Sacramento Valley Water Year Hydrologic Classification

**Figure 5-24. Percent Change in Production of Chinook Salmon for CP4 and CP4A**

**Increase Water Supply Reliability** CP4 or CP4A would increase water supply reliability by increasing water supplies for CVP and SWP irrigation and M&I deliveries. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP4 would help reduce estimated future water shortages by increasing the reliability of dry and critical year water supplies for agricultural and M&I deliveries by at least 47,300 acre-feet per year and average annual deliveries by about 31,000 acre-feet per year. CP4A would help reduce estimated future water shortages by increasing the reliability of dry and critical year water supplies for agricultural and M&I deliveries by at least 77,800 acre-feet per year and average annual deliveries by about 51,300 acre-feet per year. As shown in Table 5-7, the majority of increased dry and critical year water supplies, 42,700 acre-feet for CP4 and 67,100 acre-feet for CP4A, would be for south-of-Delta agricultural and M&I deliveries. In addition, water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effective use of these supplies could reduce potential critical impacts to agricultural and urban uses resulting from water shortages. Under CP4 and CP4A, approximately $1.6 million and $2.6 million, respectively, would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

**Develop Additional Hydropower Generation** Higher water surface elevations in the reservoir would result in a net increase in power generation of about 127 GWh per year for CP4 and 125 GWh for CP4A. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities. Other power benefits for both CP4 and CP4A include additional capacity (i.e., the rate at which power can be generated) and ancillary services, which provide the ability to manage the electric grid in a reliable manner.

**Conserve, Restore, and Enhance Ecosystem Resources** In the upper Sacramento River, the addition of spawning gravel and the restoration of riparian, floodplain, and side channel habitat are expected to improve the complexity of aquatic habitat and its suitability for anadromous salmonid spawning and rearing habitat. Riparian areas provide habitat for a diverse array of plant and animal communities along the Sacramento River, including several threatened or endangered species. Riparian areas also provide shade and woody debris that increase the complexity of aquatic habitat and its suitability for spawning and rearing. Lower floodplain areas, river terraces, and gravel bars play an important role in the health and succession of riparian habitat. Restoration would support the goals of the Sacramento River Conservation Area Forum and other programs associated with riparian restoration along the Sacramento River. Side channels can support important habitat for anadromous salmonids, including rearing and spawning habitat. Side channel habitats also provide refuge from predators and productive foraging habitat for juvenile anadromous salmonids. In addition, improved fisheries conditions as a result of cold-water carryover storage in CP4 or CP4A, as described above, and increased flexibility to meet flow and temperature requirements, could also enhance overall ecosystem resources in the Sacramento River.

**Maintain and Increase Recreation Opportunities** CP4 and CP4A include features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. Potential recreation benefits would be similar to CP3. Although neither CP4 nor CP4A include specific features to further increase recreation capacity, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. For CP4 and CP4A, the maximum surface area of the lake would increase by about 2,600 acres (9 percent), from 29,700 acres to about 32,300 acres. For CP4, the average surface area of the lake during the recreation season from May through September would increase by about 2,600 acres (11 percent), from 23,900 acres to 26,500 acres. For CP4A, average surface area of the lake during the recreation season from May through September would increase by about 2,300 acres (10 percent), from 23,900 acres to 26,200 acres. There is also limited potential to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

**Benefits Related to Other Planning Objectives** CP4 and CP4A could also provide benefits related to flood damage reduction and water quality, similar to CP1.

**Additional Broad Public Benefits** Additional broad public benefits of CP4 and CP4A obtained through pursuing project objectives are summarized in Table 5-8. Broad public benefits for CP4 are similar to those for CP3.

### *Construction for CP4 and CP4A*

Construction activities associated with physical features under CP4 and CP4A would include land-based construction activities associated with the following:

- Clearing vegetation from portions of the inundated reservoir area
- Constructing the dam raise, appurtenant structures, reservoir area dikes, and railroad embankments
- Relocating roadways, bridges, recreation facilities, utilities, and miscellaneous minor infrastructure
- Augmenting spawning gravel in the upper Sacramento River
- Restoring riparian, floodplain, and side channel habitat

Construction activities for CP4 are described in detail in the Engineering Summary Appendix.

**Operations and Maintenance for CP4 and CP4A** Operations differ between CP4 and CP4A, as described below. The anticipated maintenance for CP4 and CP4A are identical to one another.

### *Operations for CP4*

Operations under CP4 are governed by the same regulatory constraints as described for CP1. Under CP4, the additional storage would be retained to increase water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Of the 634,000 acre-feet of additional storage, 378,000 acre-feet of water (60 percent) would be dedicated to increasing the cold-water supply for anadromous fish survival purposes. This would be in addition to any storage targets set by regulations described in Chapter 6 of the EIS, “Hydrology, Hydraulics, and Water Management.” Similar to CP1, Shasta Dam operational guidelines would continue unchanged under CP4, except during dry and critical years, when 70,000 acre-feet and 35,000 acre-feet, respectively, of the increased storage capacity in Shasta Reservoir would be operated primarily to provide increased M&I deliveries. Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP.

As modeled for CP4, the 378,000 acre-feet of additional water would be the first increment of the reservoir filled after the reservoir was enlarged. This amount of water would be available as additional water for the cold-water pool each year regardless of water year type, unless Reclamation elected to use the additional water to augment flows protecting anadromous fish in the Sacramento River, as part of a proposed adaptive management plan, as explained below. An additional 256,000 acre-feet of the increased storage space would be used primarily to improve water supply reliability; operations of Shasta Dam related to the 256,000 acre-feet of storage would be similar to operations under CP1.

As stated above, of the total 634,000 acre-feet of additional storage, 378,000 acre-feet of water would be used to increase the cold-water pool for fisheries. Reclamation is currently working with NMFS, USFWS, and CDFW through the SRTTG, a multiagency group established to adaptively manage flows and water temperatures in the Sacramento River to improve and stabilize Chinook salmon populations in the upper Sacramento River. The additional 378,000 acre-feet of cold-water pool would be managed by Reclamation in coordination with the SRTTG.

Current analysis indicates that the most beneficial use of the additional 378,000 acre-feet of storage for fisheries protection is as an expanded cold-water pool; however, Reclamation has agreed to adaptively manage the 378,000 acre-feet of water, as appropriate, to increase benefits to anadromous fish as part of CP4. Adaptive management is an approach allowing decision makers to take advantage of a variety of strategies and techniques that are adjusted, refined, and/or modified based on an improved understanding of system dynamics. Adaptive management, if applied appropriately, allows for flexible operations based on best available science and new information as it becomes available.

The adaptive management plan may include operational changes to the timing and magnitude of releases primarily to improve the quality and quantity of aquatic habitat. These changes may include increasing minimum flows, timing releases from Shasta Dam to mimic more natural seasonal flows, meeting flow targets for side channels, or retaining the additional 378,000 acre-feet of water in storage to meet temperature requirements. Reclamation would work cooperatively with the SRTTG to determine the best use of the cold-water pool each year under an adaptive management plan. Reclamation would manage the cold-water pool and operate Shasta Dam each year based on recommendations from the SRTTG. Because adaptive management is predicated on using best available science and new information to make decisions, a monitoring program would be implemented as part of the adaptive management plan. SRTTG members would conduct monitoring, develop monitoring protocols, and set performance standards to determine the success of adaptive management actions.

Under the currently proposed operations, the 378,000 acre-feet of additional storage would be the first increment of water in the reservoir to fill after dam enlargement. This water would be available each year independent of water year type if used exclusively to enlarge the cold-water pool. If the 378,000 acre-feet of stored water is used to augment flows based on recommendations from the SRTTG, this water would not be guaranteed to be available for use the following year because of uncertainty in hydrologic conditions. Once water was released to augment flows as part of the adaptive management plan, the 378,000 acre-feet of additional storage space would be refilled after the 256,000 acre-feet of additional storage space was filled for the primary purpose of increasing water supply reliability. Each year that the 378,000 acre-feet of additional water was held in storage as part of an increase in the cold-water pool, the allocated amount would be available as long as the cold-water pool continued to provide benefits to fisheries.

SALMOD modeling and related analysis indicate that in most cases, providing an increased cold-water pool benefits Chinook salmon populations in the Upper Sacramento River more than increasing flows. Therefore, the impacts and benefits of increasing flows under CP4 are not presented in this EIS. Per recommendations in Title 43 of the Code of Federal Regulations, Part 46, Section 46.145, substantive increases in flows associated with the adaptive management plan would be evaluated in subsequent NEPA analysis.

Operation of pumping facilities downstream from Shasta Dam would vary slightly from current operations and would result in higher costs. In addition, Reclamation would provide in-kind power to offset reduced generation at Pit 7 Dam and related facilities.

**Operations for CP4A** As modeled for CP4A, the 191,000 acre-feet of additional water would be the first increment of the reservoir filled after the reservoir was enlarged. This amount of water would be available as additional water for the cold-water pool each year regardless of water year type, unless Reclamation elected to use the additional water to augment flows protecting anadromous fish in the Sacramento River, as part of a proposed adaptive management plan, as explained below. An additional 443,000 acre-feet of the increased storage space would be used primarily to improve water supply reliability; operations of Shasta Dam related to the 443,000 acre-feet of storage would be similar to operations under CP2.

As stated above, of the total 634,000 acre-feet of additional storage, 191,000 acre-feet of water would be used to increase the cold-water pool for fisheries. Reclamation is currently working with NMFS, USFWS, and CDFW through the SRTTG, a multiagency group established to adaptively manage flows and water temperatures in the Sacramento River to improve and stabilize Chinook salmon populations in the upper Sacramento River. The additional 191,000 acre-feet of cold-water pool would be managed by Reclamation in coordination with the SRTTG.

Current analysis indicates that the most beneficial use of the additional 191,000 acre-feet of storage for fisheries protection is as an expanded cold-water pool; however, Reclamation has agreed to adaptively manage the 191,000 acre-feet of water, as appropriate, to increase benefits to anadromous fish as part of CP4A. Adaptive management is an approach allowing decision makers to take advantage of a variety of strategies and techniques that are adjusted, refined, and/or modified based on an improved understanding of system dynamics. Adaptive management, if applied appropriately, allows for flexible operations based on best available science and new information as it becomes available.

The adaptive management plan may include operational changes to the timing and magnitude of releases primarily to improve the quality and quantity of aquatic habitat. These changes may include increasing minimum flows, timing releases from Shasta Dam to mimic more natural seasonal flows, meeting flow targets for side channels, or retaining the additional 191,000 acre-feet of water in storage to meet temperature requirements. Reclamation would work cooperatively with the SRTTG to determine the best use of the cold-water pool each year under an adaptive management plan. Reclamation would manage the cold-water pool and operate Shasta Dam each year based on recommendations from the SRTTG. Because adaptive management is predicated on using best available science and new information to make decisions, a monitoring program would be implemented as part of the adaptive management plan. SRTTG members would conduct monitoring, develop monitoring protocols, and set performance standards to determine the success of adaptive management actions.

Under the currently proposed operations, the 191,000 acre-feet of additional storage would be the first increment of water in the reservoir to fill after dam enlargement. This water would be available each year independent of water year type if used exclusively to enlarge the cold-water pool. If the 191,000 acre-feet of stored water is used to augment flows based on recommendations from the SRTTG, this water would not be guaranteed to be available for use the following year because of uncertainty in hydrologic conditions. Once water was released to augment flows as part of the adaptive management plan, the 191,000 acre-feet of additional storage space would be refilled after the 443,000 acre-feet of additional storage space was filled for the primary purpose of increasing water supply reliability. Each year that the 191,000 acre-feet of additional water was held in storage as part of an increase in the cold-water pool, the allocated amount would be available as long as the cold-water pool continued to provide benefits to fisheries.

SALMOD modeling and related analysis indicate that in most cases, providing an increased cold-water pool benefits Chinook salmon populations in the Upper Sacramento River more than increasing flows. Therefore, the impacts and benefits of increasing flows under CP4A are not presented in this EIS. Per recommendations in Title 43 of the CFR, Part 46, Section 46.145, substantive increases in flows associated with the adaptive management plan would be evaluated in subsequent NEPA analysis.

Operation of pumping facilities downstream from Shasta Dam would vary slightly from current operations and would result in higher costs. In addition, Reclamation would provide in-kind power to offset reduced generation at Pit 7 Dam and related facilities.

**Maintenance for CP4 and CP4A** Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

#### *Potential Primary Effects of CP4 and CP4A*

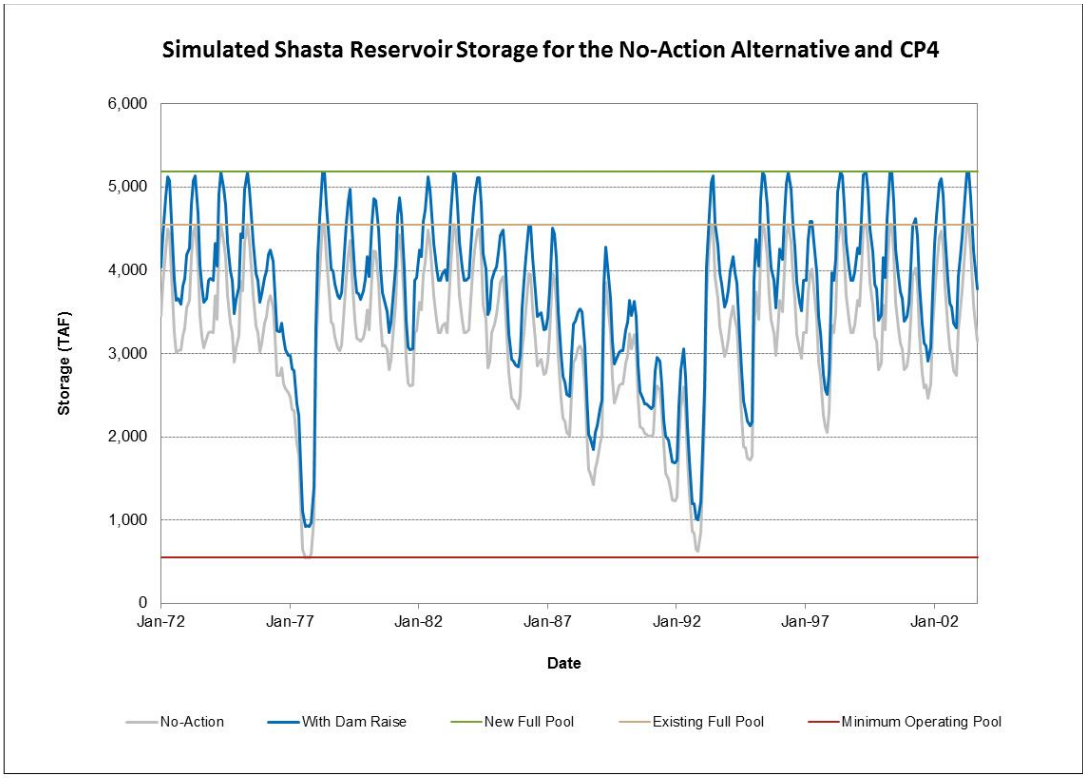
Following is a summary of potential environmental consequences of CP4 and CP4A. Potential environmental effects are generally comparable between comprehensive plans; some adverse effects would be exacerbated by larger dam raises and the associated scale of those effects, such as expanded construction areas and increased area of inundation around Shasta Lake. Anticipated inundation, construction, cultural, and relocation impacts associated with CP4 and CP4A are similar to CP3, as summarized above. Proposed mitigation measures to address potential adverse impacts of CP4 and CP4A are summarized in Table 5-9. A detailed discussion of potential effects and proposed mitigation measures associated with raising Shasta Dam by 18.5 feet are included in Chapters 4 through 25 of the EIS.

**Shasta Lake Area** As with the other comprehensive plans, the primary long-term effects of CP4 and CP4A would be due to the increased water surface elevations and inundation area. Anticipated effects of increased water surface elevations under CP4 and CP4A are similar to CP3. As with the above plan, raising the full pool of the lake would cause direct effects due to higher water levels, and/or indirect impacts related to facility access modifications and relocations.

CP4 and CP4A include modifying two bridges and replacing six other bridges, inundating a number of small segments of existing paved and nonpaved roads, and relocating a number of potable water facilities, wastewater facilities, gas and petroleum facilities, and power distribution and telecommunications facilities. A number of recreation facilities would also be impacted, including campgrounds, marinas, resorts, boat ramps, day use areas, and trails. Approximately 30 segments of roadway would be relocated, including portions of Lakeshore Drive, Fenders Ferry Road, Gilman Road, and Silverthorn Road. Embankments would be constructed to protect I-5 at Lakeshore and the UPRR at Bridge Bay. Any potential real estate acquisitions or necessary relocations of displaced parties would be accomplished under Public Law 91-646.

With CP4 and CP4A, Shasta Reservoir would fill to the new full pool storage capacity of 5.19 MAF at a frequency similar to without-project conditions. On the basis of water operations modeling (CalSim-II), Shasta Reservoir fills to 80 percent of its current capacity in about 81 percent of the years over the 82-year period of analysis of the CalSim-II model. Included in Figure 5-5 is an exceedence probability relationship of maximum annual storage in Shasta Lake for this and other dam raises.

Under CP4, Shasta Reservoir would also fill to 80 percent of the new capacity in about 82 percent of the years. Under CP4A, Shasta Reservoir would fill to 80 percent of the new capacity in about 77 percent of the years. Accordingly, the annual operations in the reservoir under CP4 and CP4A would generally mirror existing operations, except the water surface in the lake would be about 18.5 feet higher. The primary difference in the reservoir area would be that during extended drought periods, the reservoir would be drawn down to approximately 378,000 acre-feet above without-project minimum levels under CP4 and 191,000 acre-feet above without-project minimum levels under CP4A. This is because of the dedicated storage capacity for increasing the cold-water pool for anadromous fish purposes. Figure 5-25 shows the changes from without-project conditions for CP4 and CP4A for a representative period of 1972 through 2003.



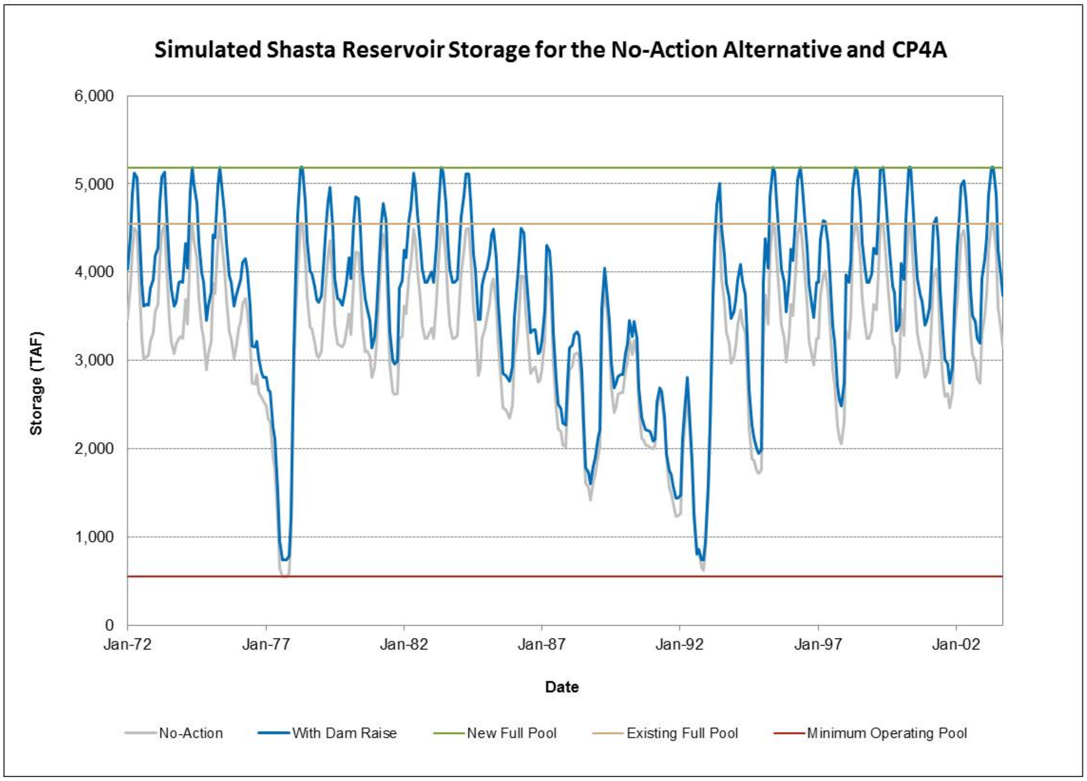




**Figure 5-25. Simulated Shasta Reservoir Storage from 1972 to 2003 for CP4 and CP4A Compared to the No-Action Alternative**

The increased area of inundation for CP4 and CP4A is about 2,600 acres. As with the previous plans, much of the vegetation in the enlarged drawdown zone on steeper lands would be removed during construction. In addition, some vegetation in the expanded drawdown zone would eventually be lost over time. However, it is expected that significant amounts of vegetation could remain on the lower slopes because of the infrequent inundation. The lower reaches of tributaries to Shasta Lake also would experience increased inundation.

As shown in Figure 5-9, raising Shasta Dam 18.5 feet would result in inundating an additional 3,550 linear feet (about 27 acres) of the lower McCloud River. This represents about 3 percent of the 24-mile reach of river between the McCloud Bridge and the McCloud Dam, which controls flows on the river.

As shown in Figure 5-25, since a portion of the increased storage capacity would be dedicated to increasing the cold-water pool, water levels in the lake under CP4 and CP4A would generally be higher than under without-project conditions. It is anticipated that recreation use would generally improve under CP4 and CP4A because of a larger lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. Although water levels would generally be higher than under existing conditions and drawdown during the recreation season would generally be reduced, during some dry years, the total drawdown zone could increase under CP4 and CP4A. Figure 5-18 illustrates that the minimum clearance at the new full pool would be about 14 feet between Piers 6 and 7. This could impact boating on the lake, as some houseboats exceed 16 feet in height. Since houseboating is a major recreational experience on Shasta Lake, especially around Memorial Day, restrictions on large boat traffic under the Pit River Bridge during maximum pool levels could adversely impact lake area boat rentals, marinas, and other recreation-dependent businesses.

Significant effects to cultural resources due to enlarging Shasta Dam and Reservoir for CP4 and CP4A include: (1) the disturbance or destruction of archaeological and historic resources due to construction or inundation and (2) inundation of traditional cultural properties and sacred sites. Sensitivity and archival studies estimate that for CP4 and CP4A, approximately 391 and 529 historic sites are within the inundation zone and fluctuation, respectively. Effects to traditional cultural properties and sacred sites under CP4 would be similar to CP1.

Additional long-term effects on biological resources associated with the relocation of reservoir area infrastructure are anticipated. Short-term, construction-related impacts are also anticipated in the primary study area.

**Upper Sacramento River** Potential effects on flow and stages of the upper Sacramento River from CP4 are identical to CP1. Figures 5-11, 5-12, and 5-13 show simulated Sacramento River flows below Keswick Dam, RBPP, and

Stony Creek, respectively, under wet, average, and dry year conditions for the No-Action Alternative compared to CP1 and CP4.

Potential effects on flow and stages of the upper Sacramento River from CP4A are identical to CP2. Figures 5-15, 5-16, and 5-17 show simulated Sacramento River flows below Keswick Dam, RBPP, and Stony Creek, respectively, under wet, average, and dry year conditions for the No-Action Alternative compared to CP2 and CP4A.Some potential exists for impacting existing habitat at upper Sacramento River restoration sites, but these impacts would likely result from converting present land use back to a more typical riverine environment.

## CP5 – 18.5-Foot Dam Raise – Combination Plan

CP5 primarily focuses on increasing water supply reliability, anadromous fish survival, Shasta Lake area environmental resources, and increased recreation opportunities. Major features of CP5 are shown in Figure 5-3 and summarized in Table 5-6.

### *Major Components of CP5*

This plan includes the following major components:

- Raising Shasta Dam and appurtenant facilities by 18.5 feet.
- Constructing additional resident fish habitat in Shasta Lake and along the lower reaches of its tributaries (Sacramento River, McCloud River, and Squaw Creek).
- Constructing shoreline fish habitat around Shasta Lake.
- Augmenting spawning gravel in the upper Sacramento River.
- Restoring riparian, floodplain, and side channel habitat in the upper Sacramento River.
- Increasing recreation opportunities at various locations at Shasta Lake.
- Implementing the set of eight common management measures described above.
- Implementing the common environmental commitments previously described.

By raising Shasta Dam 18.5 feet from a crest elevation of 1,077.5 feet to 1,096.0 feet (based on NGVD29), CP5 would increase the height of the reservoir full pull by 20.5 feet. The additional 2-foot increase in the height of the full pool above the dam raise height would result from spillway modifications similar to the modifications proposed under CP1. This increase in full pool height would add approximately 634,000 acre-feet of storage to the reservoir's capacity. Accordingly, storage in the overall full pool would be increased from 4.55 MAF to 5.19 MAF. Figure 5-4 shows the increase in surface area and storage capacity for CP5.

Under CP5, the additional storage in Shasta Reservoir would be used to increase water supply reliability and to expand the cold-water pool for downstream anadromous fisheries. The existing TCD would be extended to achieve efficient use of the expanded cold-water pool. Operations for water supply, hydropower, and environmental and other regulatory requirements would be similar to existing operations, except during dry and critical years when a portion of the increased storage in Shasta Reservoir would be reserved to specifically focus on increasing M&I deliveries. In dry years, 150,000 acre-feet of the 634,000 acre-feet increased storage capacity in Shasta Reservoir would be reserved for increasing M&I deliveries. In critical years, 75,000 acre-feet of the increased storage capacity would be reserved for increasing M&I deliveries.

As described for the above plans, this plan also would include the potential to revise the flood control operational rules for Shasta Dam and Reservoir, which could reduce the potential for flood damage reduction and benefit recreation.

CP5 also involves (1) restoring resident fish habitat in Shasta Lake, (2) restoring fisheries and riparian habitat at several locations along the lower reaches of the tributaries to Shasta Lake, (3) augmenting spawning gravel in the upper Sacramento River, (4) restoring riparian, floodplain, and side channel habitat in the upper Sacramento River, and (5) increasing recreation opportunities at Shasta Lake.

**Construct Reservoir Shoreline Enhancement** The ecosystem enhancement goal for the shoreline environment of Shasta Lake is to improve the warm-water fish habitat associated with the transition between the reservoir's aquatic and terrestrial habitats. Shoreline enhancement entails the range of enhancement opportunities along the Shasta Lake shoreline below the full pool elevation of 1,090 feet (based on the North American Vertical Datum of 1988 (NAVD88))[3] that would occur with an 18.5-foot dam raise. This area is typically between 0.1 mile and 1.5 miles upslope from the current full pool elevation of 1,070 feet (based on NAVD88). The shoreline is defined as the area encompassing nearshore aquatic habitat within the reservoir itself, and vegetation and other habitat components adjacent to the reservoir.

Two categories of potential nearshore warm-water fish habitat enhancement activities are (1) structural enhancements, which entail placing artificial structures in Shasta Lake's littoral zone, and (2) vegetative enhancements, which entail planting and seeding to provide submerged and partly submerged

[3] Shasta Lake water surface elevations are based on NAVD88. All current feasibility-level designs and figures for reservoir area infrastructure modifications and relocations to accommodate increased water levels are based on a 2001 aerial survey of the reservoir which was completed using NAVD88.

vegetative cover when the reservoir is at full pool capacity during the winter/spring months.

Construction activities common to all action alternatives include stockpiling manzanita for fish habitat. CP5 would include clearing additional manzanita from above the new full pool inundation zone to create further structural enhancements for fish habitat in Shasta Lake's littoral zone.

Vegetative enhancements associated with CP5 include planting willows (Salix) to enhance nearshore fish habitat, and single treatment aerial and hand seeding of annual native grasses to treat shoreline areas at Shasta Lake. Aerial and hand seeding of annual native grasses provides only short-term cover but is cost-effective across large areas and can be implemented quickly and efficiently. The annual native grasses provide cover for young fish and also nutrients for plankton as the grasses decompose. The plankton, in turn, are a valuable food source for juvenile fish.

**Construct Reservoir Tributary Aquatic Habitat Enhancement** The primary goal for the enhancement of aquatic habitat in the watershed is to enhance the connectivity for native fish species and other aquatic organisms between Shasta Lake and its tributaries. Two categories of potential aquatic habitat enhancement in tributaries are (1) fish passage enhancements, which entail identifying and correcting barriers to fish passage, particularly at culverts and other human-made barriers, and (2) aquatic habitat enhancements, which entail identifying and implementing feasible habitat improvements intended to conserve or restore degraded aquatic and riparian habitat in tributaries to Shasta Lake.

Fish passage enhancements associated with CP5 includes opportunities to restore and/or enhance five perennial stream crossings. Barriers to fish passage in the watersheds above Shasta Lake are associated primarily with culverts or other types of stream crossings.

Aquatic habitat enhancements associated with CP5 involve enhancing aquatic connectivity and reducing sediment related to roads constructed across intermittent streams. The preliminary site survey identified opportunities to enhance 14 intermittent stream crossings. Based on the information obtained in the survey, these crossings provide opportunities for meeting the objectives of enhancing aquatic connectivity and/or reducing the potential for road-related sediment. Two sites have been identified in the Salt Creek watershed, two sites have been identified in the Sugarloaf Creek watershed, and ten sites have been identified in the McCloud River Arm watershed.

**Augment Spawning Gravel in Upper Sacramento River** As part of CP5, spawning-sized gravel would be placed at multiple locations along the Sacramento River between Keswick Dam and the RBPP. Gravel augmentation under CP5 would be identical to the gravel augmentation component of CP4.

**Restore Riparian, Floodplain and Side Channel Habitat** As described in CP4, riparian, floodplain, and side channel habitat restoration would occur at suitable locations along the Sacramento River. This measure is identical to that proposed under CP4 and CP4A.

**Recreation Enhancements** A total of 18 miles of new hiking trails and 6 trailheads would be constructed to enhance recreation under CP5.

#### *Potential Benefits of CP5*

Major potential benefits of CP5, related to the planning objectives and broad public services, are described below.

**Increase Anadromous Fish Survival** Water temperature is one of the most important factors affecting anadromous fish survival in the Sacramento River. CP5 would increase the ability of Shasta Dam to make cold-water releases and regulate water temperature in the upper Sacramento River, primarily in dry and critical water years. This would be accomplished by raising Shasta Dam 18.5 feet, thus increasing the depth of the cold-water pool in Shasta Reservoir and resulting in an increase in seasonal cold-water volume below the thermocline (layer of greatest water temperature and density change). Cold water released from Shasta Dam significantly influences water temperature conditions in the Sacramento River between Keswick Dam and the RBPP. Hence, the most significant water temperature benefits to anadromous fish would occur upstream from the RBPP. It is estimated that improved water temperature and flow conditions under CP5 could result in an annual average increase in the Chinook salmon population of about 377,800 outmigrating juvenile Chinook salmon.

**Increase Water Supply Reliability** CP5 would increase water supply reliability by increasing water supplies for CVP and SWP irrigation and M&I deliveries. This action would contribute to replacement of supplies redirected to other purposes in the CVPIA. CP5 would help reduce estimated future water shortages by increasing the reliability of dry and critical year water supplies for agricultural and M&I deliveries by at least 113,500 acre-feet per year and average annual deliveries by about 75,900 acre-feet per year. As shown in Table 5-7, the majority of increased dry and critical year water supplies, 88,300 acre-feet, would be for south-of-Delta agricultural and M&I deliveries. In addition, increased water use efficiency could help reduce current and future water shortages by allowing a more effective use of existing supplies. As population and resulting water demands continue to grow and available supplies continue to remain relatively static, more effective use of these supplies could reduce potential critical impacts to agricultural and urban areas resulting from water shortages. Under CP5, approximately $3.8 million would be allocated over an initial 10-year period to fund agricultural and M&I water conservation programs, focused on agencies benefiting from increased reliability of project water supplies.

**Develop Additional Hydropower Generation** Higher water surface elevations in the reservoir would result in a net increase in power generation of about 112 GWh per year. This generation value is the expected increased generation from Shasta Dam and other CVP/SWP facilities. Other power benefits include additional capacity (i.e., the rate at which power can be generated) and ancillary services, which provide the ability to manage the electric grid in a reliable manner.

**Conserve, Restore, and Enhance Ecosystem Resources** CP5 would provide for habitat improvements both in the reservoir area and downstream from Shasta Dam on the upper Sacramento River.

Along the Shasta Lake shoreline, shallow warm-water fish habitat would be improved by using manzanita cleared from above the inundation zone to create structural enhancements, planting willows (*Salix*) to enhance nearshore fish habitat, and seeding of native grasses to treat shoreline areas. Once established, the willows and native grasses would provide submerged and partly submerged vegetative cover when the reservoir is at full pool capacity during the winter/spring months. These improvements would help provide favorable spawning conditions, and juvenile fish leaving the tributaries would benefit from improved adjacent shoreline habitat. Placing manzanita brush structures near the shoreline would enhance the diversity of structural habitat available for the warm-water fish species that occupy Shasta Lake. Establishing vegetation also could benefit terrestrial species that inhabit the shoreline of Shasta Lake.

The lower reaches of perennial tributaries to Shasta Lake would be the focus for aquatic restoration because they provide year-round fish habitat. Native fish species require connectivity to the full range of habitats offered by Shasta Lake and its tributaries. Improved fish passage addresses the requirement to provide access and/or modify barriers necessary to improve ecological conditions that support these native fish assemblages. Aquatic habitat improvements include enhancing aquatic connectivity and reducing sediment related to roads constructed across intermittent streams.

In the upper Sacramento River, the addition of spawning gravel and the restoration of riparian, floodplain, and side channel habitat are expected to improve the complexity of aquatic habitat and its suitability for spawning and rearing. Riparian areas provide habitat for a diverse array of plant and animal communities along the Sacramento River, including numerous threatened or endangered species. Riparian areas also provide shade and woody debris that increase the complexity of aquatic habitat and its suitability for spawning and rearing. Lower floodplain areas, river terraces, and gravel bars play an important role in the health and succession of riparian habitat. Restoration would support the goals of the Sacramento River Conservation Area Forum and other programs associated with riparian restoration along the Sacramento River. Side channels can support important habitat for anadromous salmonids, including rearing and spawning habitat. Side channel habitats also provide refuge from predators and productive foraging habitat for juvenile anadromous salmonids.

**Maintain and Increase Recreation Opportunities** CP5 includes features to, at a minimum, maintain the existing recreation capacity at Shasta Lake. In addition, this alternative involves construction of 18 miles of new trails and 6 trailheads to enhance recreation opportunities at Shasta Lake. As with the other alternatives, benefits to the water-oriented recreation experience at Shasta Lake would likely occur because of the increase in average lake surface area, reduced drawdown during the recreation season, and modernization of recreation facilities. The maximum surface area of the lake would increase by about 2,600 acres (9 percent), from 29,700 acres to about 32,300 acres. The average surface area of the lake during the recreation season from May through September would increase by about 1,900 acres (8 percent), from 23,900 acres to 25,800 acres. There is also limited potential for reservoir reoperation to provide additional benefits to recreation by allowing more reliable filling of the reservoir during the spring.

**Benefits Related to Other Planning Objectives** CP5 could also provide benefits related to flood damage reduction and water quality, similar to CP3.

**Additional Broad Public Benefits** Additional broad public benefits of CP5 obtained through pursuing project objectives are summarized in Table 5-8. Broad public benefits for CP5 are similar to CP3.

#### *Construction for CP5*

Construction activities associated with physical features under CP5 would include land-based construction activities associated with the following:

- Clearing vegetation from portions of the inundated reservoir area
- Constructing the dam raise, appurtenant structures, reservoir area dikes, and railroad embankments
- Relocating roadways, bridges, recreation facilities, utilities, and miscellaneous minor infrastructure
- Augmenting spawning gravel in the upper Sacramento River
- Restoring riparian, floodplain, and side channel habitat
- Enhancing Shasta Lake and tributary shoreline

Construction activities for CP5 are described in detail in the Engineering Summary Appendix.

### *Operations and Maintenance for CP5*

Operations under CP5 are governed by the same regulatory constraints as described for CP1. Similar to CP1, the additional storage would be retained to increase water supply reliability and to expand the cold-water pool in Shasta Reservoir for fisheries benefits. Similar to CP1, Shasta Dam operational guidelines would continue unchanged, except during dry years and critical years, when 150,000 acre-feet and 75,000 acre-feet, respectively, of the 634,000 acre-feet increased storage capacity in Shasta Reservoir would be operated primarily to provide increased M&I deliveries. Operations targeting increased M&I deliveries were based on existing and anticipated future demands, operational priorities, and facilities of the SWP. For CP5, existing water quality and temperature requirements would typically be met in most years; therefore, additional water in storage would be released primarily for water supply purposes. Accordingly, minimal increases in flow would be expected in months when Delta exports were constrained, or when flow was not usable for water supply purposes.

In comparison to current operations, CP5 would store some additional flows behind Shasta Dam during periods when downstream needs would have already been met, but flows would have been released because of storage limitations. The resulting increase in storage would be released downstream when there were opportunities for beneficial use of the water, either to meet water supply reliability demands or to improve Reclamation's abilities to meet its environmental objectives. The additional water in storage would also expand the cold-water pool and increase end-of-September carryover storage in Shasta Reservoir, increasing the ability of Shasta Dam to improve water temperatures for anadromous fish in the upper Sacramento River.

Conversely, if water in storage were insufficient to meet all of the project purposes, the first increment to be reduced would be deliveries to water service contractors. Releases from Shasta Dam under CP5 would typically increase in the summer months, corresponding with the periods of greatest agricultural demands. Similarly, releases would be reduced in the winter months, when the increased storage space could be used to capture additional runoff rather than releasing water to the downstream river, as would occur with Shasta Reservoir's current operations.

Maintenance of facilities related to the proposed dam and reservoir enlargement would be similar to maintenance activities currently conducted at Shasta Dam and Reservoir.

Operation of pumping facilities downstream from Shasta Dam would vary slightly from current operations and would result in higher costs. In addition, Reclamation would provide in-kind power to offset reduced generation at Pit 7 Dam and related facilities.

### *Potential Primary Effects from CP5*

Following is a summary of potential environmental consequences of CP5. Anticipated inundation, construction, cultural, and relocation impacts associated with CP5 are similar to CP3, CP4, and CP4A as summarized above. Proposed mitigation measures to address potential adverse impacts of CP5 are summarized in Table 5-9. As mentioned, a detailed discussion of potential effects and proposed mitigation measures associated with raising Shasta Dam by 18.5 feet are included in Chapters 4 through 25 of the EIS.

**Shasta Lake Area** As with the other comprehensive plans, the primary long-term effects of CP5 would be due to the increased water surface elevations and inundation area. Anticipated effects of increased water surface elevations under CP5 are similar to CP3. As with the above plan, raising the full pool of the lake would cause direct effects due to higher water levels, and/or indirect impacts related to facility access modifications and relocations.

CP5 includes modifying two bridges and replacing six other bridges, inundating a number of small segments of existing paved and nonpaved roads, and relocating a number of potable water facilities, wastewater facilities, gas and petroleum facilities, and power distribution and telecommunications facilities. A number of recreation facilities would also be impacted, including campgrounds, marinas, resorts, boat ramps, day use areas, and trails. Approximately 30 segments of roadway would be relocated, including portions of Lakeshore Drive, Fenders Ferry Road, Gilman Road, and Silverthorn Road. Embankments would be constructed to protect I-5 at Lakeshore and the UPRR at Bridge Bay. Any potential real estate acquisitions or necessary relocations of displaced parties would be accomplished under Public Law 91-646.

With CP5, Shasta Reservoir would fill to the new full pool storage capacity of 5.19 MAF at a frequency similar to without-project conditions. On the basis of water operations modeling (CalSim-II), Shasta Reservoir fills to 80 percent of its current capacity in about 81 percent of the years over the 82-year period of analysis of the CalSim-II model. Included in Figure 5-5 is an exceedence probability relationship of maximum annual storage in Shasta Lake for this and other dam raises. Under CP5, Shasta Reservoir would also fill to 80 percent of the new capacity in about 72 percent of the years. Accordingly, the annual operations in the reservoir would generally mirror existing operations, except the water surface in the lake would be about 18.5 feet higher. The primary difference in the reservoir area would be that during extended drought periods, the reservoir would be drawn down to without-project minimum levels. Figure 5-26 shows the changes from without-project conditions for CP5 for a representative period of 1972 through 2003.

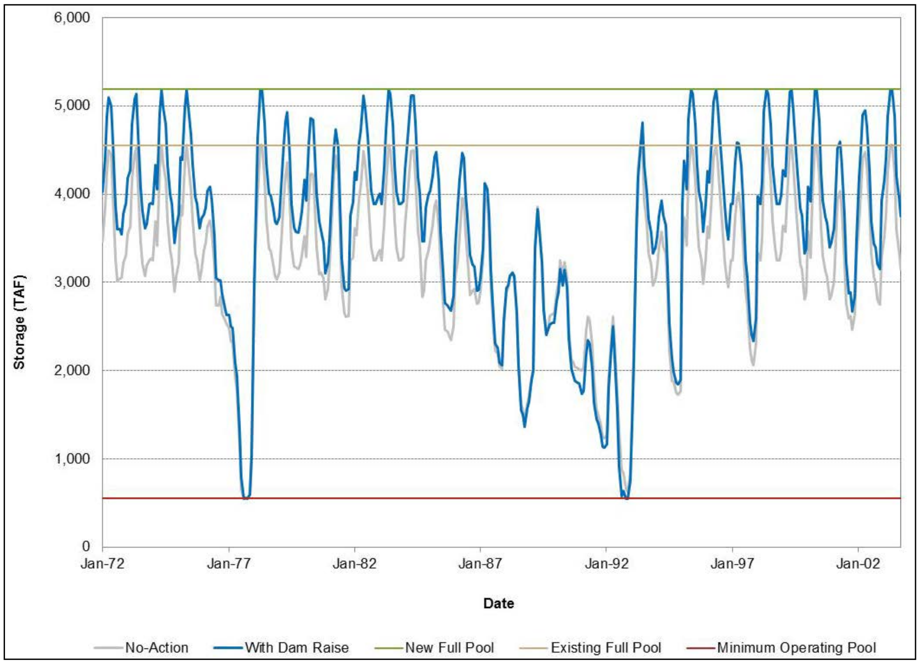



**Figure 5-26. Simulated Shasta Reservoir Storage from 1972 to 2003 for the No-Action Alternative and CP5**

The increased area of inundation for this plan is about 2,600 acres. As with the previous plans, much of the vegetation in the enlarged drawdown zone on steeper lands would be removed during construction. In addition, some vegetation in the expanded drawdown zone would eventually be lost over time. However, it is expected that significant amounts of vegetation could remain on the lower slopes because of the infrequent inundation. The lower reaches of tributaries to Shasta Lake also would experience increased inundation.

As shown in Figure 5-9, raising Shasta Dam 18.5 feet would result in inundating an additional 3,550 linear feet (about 27 acres) of the lower McCloud River. This represents about 3 percent of the 24-mile reach of river between the McCloud Bridge and the McCloud Dam, which controls flows on the river.

Although it is believed that recreation use would generally improve under this plan because of a larger lake surface area, water in the lake would be drawn down to existing conditions during the late fall and winter periods of some dry years, representing a drawdown 20.5 feet greater than under existing conditions. During these periods, the drawdown zone could increase by about 50 linear feet. In addition, clearances for boat traffic under the Pit River Bridge would be restricted to the north end of the bridge during periods of high reservoir levels (at or near full pool). This condition would typically occur in the late spring (May to June) in about 1 out of 3 years, and could last several days to 1 or 2 weeks. Figure 5-18 illustrates that the minimum clearance at the new full pool would be about 14 feet between Piers 6 and 7. This could impact boating on the lake, as some houseboats exceed 16 feet in height. Since houseboating is a major recreational experience on Shasta Lake, especially around Memorial Day, restrictions on large boat traffic under the Pit River Bridge during maximum pool levels could adversely impact lake area boat rentals, marinas, and other recreation-dependent businesses.

Significant effects to cultural resources due to enlarging Shasta Dam and Reservoir for CP5 include: (1) the disturbance or destruction of archaeological and historic resources due to construction or inundation and (2) inundation of traditional cultural properties and sacred sites. Sensitivity and archival studies estimate that for CP5, approximately 391 and 529 historic sites are within the inundation zone and fluctuation, respectively. Effects to traditional cultural properties and sacred sites under CP5 would be similar to CP1.

Additional long-term effects on biological resources associated with the relocation of reservoir area infrastructure are anticipated. Short-term, construction-related impacts are also anticipated in the primary study area.

**Upper Sacramento River** As with the previous plan, potential effects on flow and stages of the upper Sacramento River from this and other comprehensive plans would be minimal. Figures 5-27, 5-28, and 5-29 show CalSim-II simulated Sacramento River flows below Keswick Dam, RBPP, and Stony Creek, respectively, under wet, above- and below-normal, and dry and critical year conditions for the No-Action Alternative compared to CP5. During most years, annual operations of Shasta Reservoir, and subsequent flows and stages in the Sacramento River, would be relatively unchanged. Also, flows and stages would increase slightly from June through November. Although small, this increase would be most pronounced during dry periods as more water is released from Shasta Dam for water supply reliability purposes. During dry periods, however, there are few to no changes in water flows or changes during the winter and spring periods. All potential noticeable changes in flows and stages would diminish rapidly downstream from the RBPP.

Similar to other comprehensive plans, changes in river flow and stages may impact geomorphic conditions, existing riparian vegetation, and wildlife resources of the upper Sacramento River. As mentioned above, the changes in temperature and flows are expected to have a beneficial effect on anadromous fish resources. A possibility exists, however, that by benefiting anadromous fish, a slightly altered temperature and flow regime may adversely impact warm-water species in the Sacramento River. This effect is not expected to be significant.

No effects on cultural resources are expected to occur in the upper Sacramento River region.

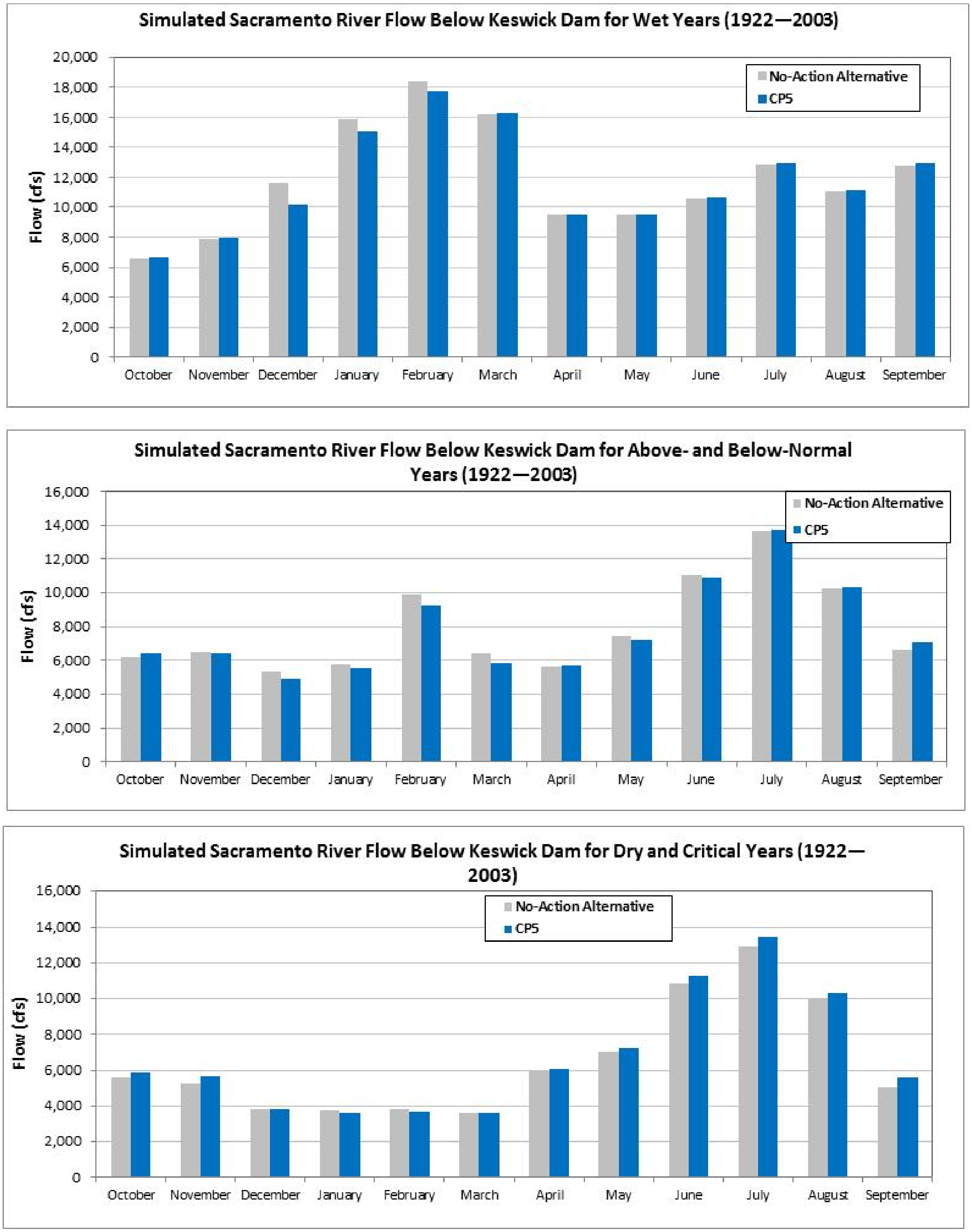



**Figure 5-27. Simulated Sacramento River Flow Below Keswick Dam in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action and CP5**

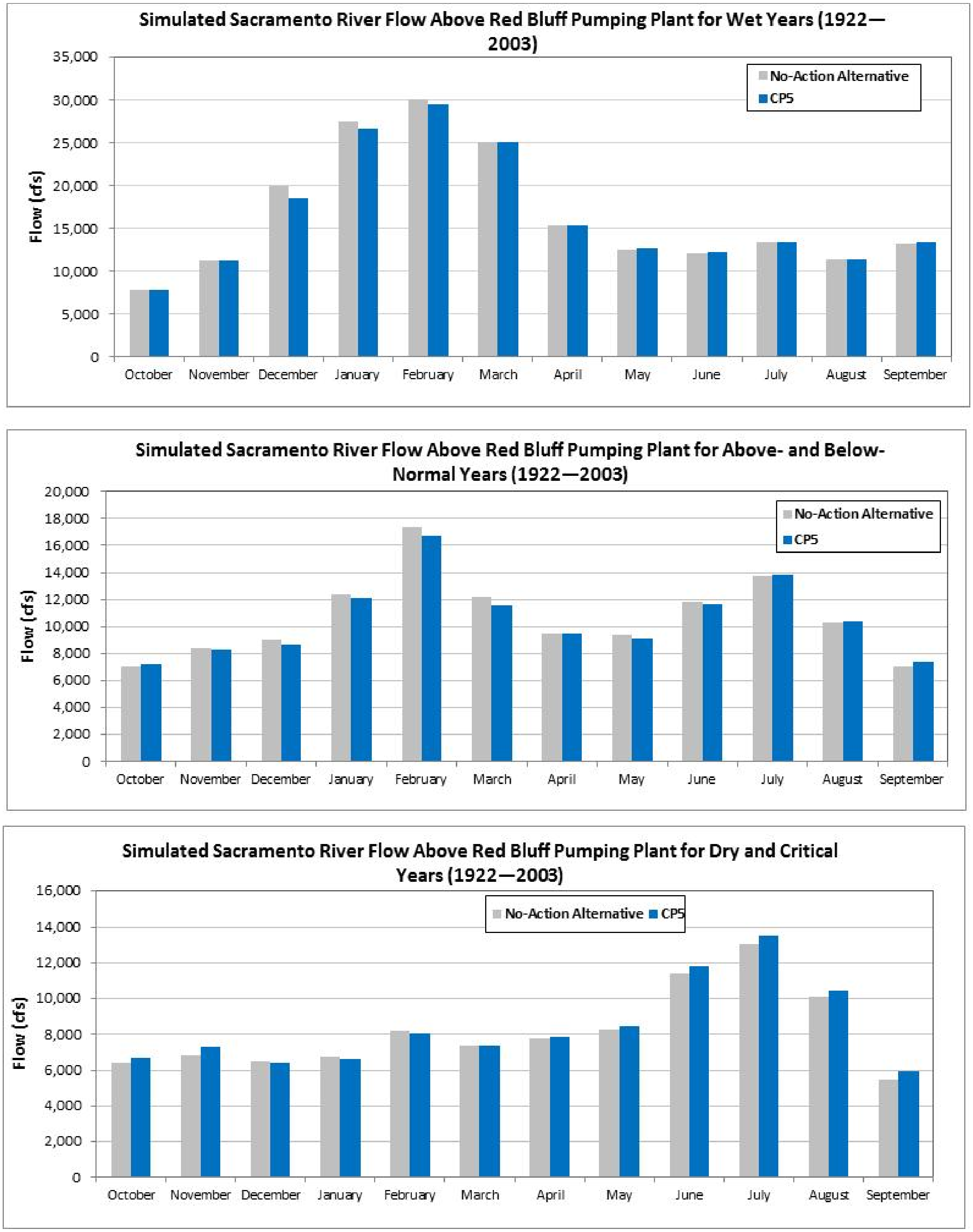



**Figure 5-28. Simulated Sacramento River Flow Below Red Bluff Pumping Plant in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action and CP5**

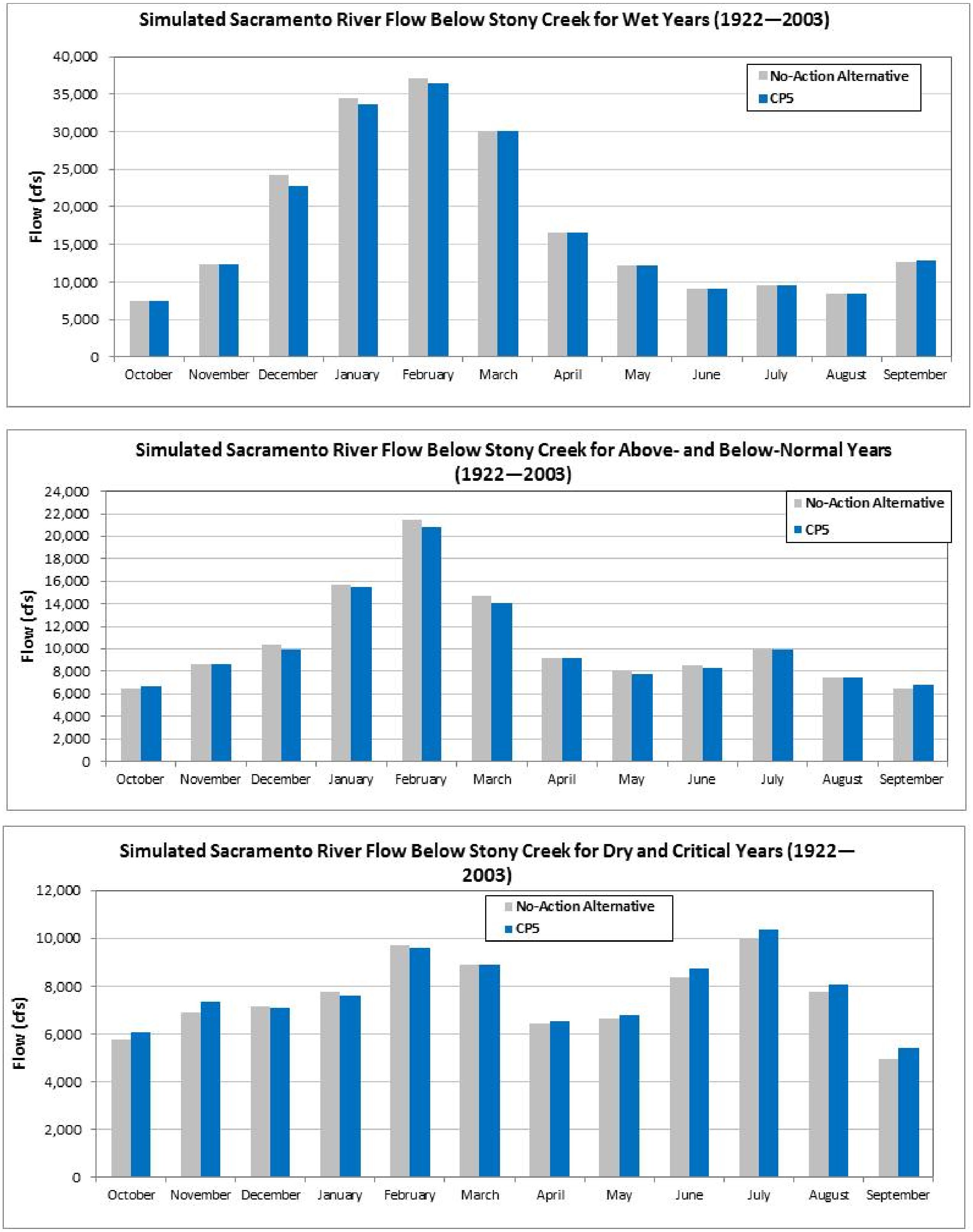



**Figure 5-29. Simulated Sacramento River Flow Below Stony Creek in Wet, Above- and Below-Normal, and Dry and Critical Years for No-Action and CP5**

Some potential exists for impacting existing habitat at upper Sacramento River restoration sites, but these impacts would likely result from converting present land use back to a more typical riverine environment.

## Potential Benefits and Costs of Comprehensive Plans

The following sections summarize the estimated costs and potential benefits of SLWRI EIS comprehensive plans.

### Estimated Costs for Comprehensive Plans

Table 5-10 summarizes estimated construction and average annual costs for each of the Comprehensive Plans. These costs were developed to a feasibility level in April 2012 dollars. More detailed information regarding estimated construction costs for the comprehensive plans is included in the Engineering Summary Appendix. Field cost is an estimate of capital costs of a feature from award to construction closeout. Construction cost is the sum of the feature field costs plus non-contract costs. Non-contract costs refer to costs of work or services provided in support of feature construction, and other work that can be attributed to the feature as a whole, which include facilitating services, investigations, design and specifications, construction management, environmental compliance, and archeological considerations. Total capital cost is the sum of the construction costs and IDC, which is interest that accrues on a loan that finances construction.

Total annual costs were estimated using interest and amortization of the capital cost over 100 years and at the current Federal discount rate of 4 percent. Estimated annual O&M costs are also included, which is estimated at 0.2 percent of the field cost plus the costs associated with the increase in CVP/SWP system pumping energy use.

### Summary of Potential Benefits of Comprehensive Plans

Major potential benefits of the comprehensive plans, in relation to contributions to the SLWRI planning objectives, are summarized in Table 5-11. Quantified benefits in Table 5-11 are based on modeling efforts that are described in several locations of the EIS, including Chapter 6, “Hydrology, Hydraulics, and Water Management;” Chapter 11, “Fisheries and Aquatic Resources;” Chapter 23, “Power and Energy;” and the Modeling Appendix.

**Table 5-10. Estimated Construction and Average Annual Costs[1]**

| Item | CP1 6.5 Feet ($ millions) | CP2 12.5 Feet ($ millions) | CP3 18.5 Feet ($ millions) | CP4 18.5 Feet ($ millions) | CP4A 18.5 Feet ($ millions) | CP5 18.5 Feet ($ millions) |
|---|---|---|---|---|---|---|
| **Construction Costs** | | | | | | |
| **Field Costs** | | | | | | |
| Relocations | | | | | | |
| Vehicular Bridges | $34 | $34 | $54 | $54 | $54 | $54 |
| Doney Creek Railroad Bridge | $56 | $56 | $56 | $56 | $56 | $56 |
| Sacramento River Railroad Bridge, Second Crossing | $116 | $116 | $116 | $116 | $116 | $116 |
| Pit River Bridge Modifications | $17 | $23 | $31 | $31 | $31 | $31 |
| Railroad Realignment | $8.2 | $8.2 | $8.2 | $8.2 | $8.2 | $8.2 |
| Roads | $17 | $26 | $37 | $37 | $37 | $37 |
| Local Utilities | $24 | $24 | $30 | $30 | $30 | $30 |
| Transmission Lines | $19 | $19 | $19 | $19 | $19 | $19 |
| Buildings/Facilities – Recreation | $133 | $150 | $166 | $166 | $166 | $166 |
| Dams and Reservoirs | | | | | | |
| Main Dam | $54 | $64 | $76 | $76 | $76 | $76 |
| Outlet Works | $27 | $27 | $27 | $27 | $27 | $27 |
| Spillway | $126 | $131 | $131 | $131 | $131 | $131 |
| Temperature Control Device | $28 | $30 | $31 | $31 | $31 | $31 |
| Powerhouse and Penstocks | $1.3 | $1.3 | $1.3 | $1.3 | $1.3 | $1.3 |
| Right Wing Dam | $4.6 | $5.7 | $6.9 | $6.9 | $6.9 | $6.9 |
| Left Wing Dam | $13 | $18 | $26 | $26 | $26 | $26 |
| Visitor Center | $8.4 | $8.8 | $9.1 | $9.1 | $9.1 | $9.1 |
| Dikes | $14 | $16 | $27 | $27 | $27 | $27 |
| Reservoir Clearing | $4.5 | $7.2 | $21 | $21 | $21 | $21 |
| Pit 7 Dam and Powerhouse Modifications | $8.2 | $8.2 | $8.2 | $8.2 | $8.2 | $8.2 |
| Environmental Restoration | - | - | - | $6.2 | $6.2 | $18.2 |
| Recreation Enhancement | - | - | - | - | - | $1.3 |
| **Total Field Costs** | $713 | $773 | $881 | $887 | $887 | $901 |
| Planning, Engineering, Design, and Construction Management | $160 | $174 | $198 | $200 | $200 | $203 |
| Lands | $30 | $47 | $69 | $70 | $70 | $70 |
| Environmental Mitigation | $71 | $77 | $88 | $88 | $88 | $88 |
| Cultural Resource Mitigation | $14 | $15 | $18 | $18 | $18 | $18 |
| Water Use Efficiency Actions | $1.6 | $2.6 | $3.1 | $1.6 | $2.6 | $3.8 |
| **Total Construction Cost** | **$990** | **$1,089** | **$1,257** | **$1,264** | **$1,265** | **$1,283** |
| Interest During Construction[1] | **$83** | **$91** | **$105** | **$105** | **$105** | **$108** |
| **Total Capital Cost** | **$1,073** | **$1,180** | **$1,362** | **$1,370** | **$1,371** | **$1,391** |
| 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** | **$45** | **$51** | **$54** | **$57** | **$59** | **$61** |

Notes:
[1] For SLWRI comprehensive plans, IDC was applied over the time until the debt is to begin being served, which was estimated at 4 years for all of the comprehensive plans, at the current Federal discount rate of 3.5 percent.
[2] Cost estimate is feasibility-level in January 2014 dollars, and subject to change in the future. Escalation from published price level to notice to proceed is excluded. Estimates may include discrepancies due to rounding. For appropriate use and terminology, see Reclamation Manual, Directives and Standards FAC; 09-01, 09-02 and 09-03. Detailed information regarding cost estimates and assumptions for the Comprehensive Plans is included in the Engineering Summary Appendix.

**Table 5-11. Summary of Potential Features and Benefits of SLWRI Comprehensive Plans (Compared to No-Action Alternative)**

| 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 | 379 | 207 | 813 | 710 | 378 |
| 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 Damage | | | | | | |
| Increased Reservoir Storage Capacity | Yes | Yes | Yes | Yes | Yes | Yes |
| Additional Hydropower Generation | | | | | | |
| Increased Hydropower Generation (GWh/year)[4] | 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 Restoration Habitat | - | - | - | 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 |

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 drought period reliability for Central Valley Project and State Water Project deliveries. 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 this EIS are 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, 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. For more detailed information related to estimated recreation user days, please see Chapter 10, “Recreational Visitation,” of the Modeling Appendix.

**Table 5-11. Summary of Potential Features and Benefits of SLWRI Comprehensive Plans (Compared to No-Action Alternative) (contd.)**

Key:
- = not applicable
CP = comprehensive plan
Delta = Sacramento-San Joaquin Delta
GWh/year = gigawatt-hours per year
NOD = north of Delta
SOD = south of Delta
SLWRI = Shasta Lake Water Resources Investigation
RBPP = Red Bluff Pumping Plant
TAF = thousand acre feet

## Preferred Alternative and Rationale for Selection

NEPA guidelines (Title 40, Code of Federal Regulations (CFR) Section 1502.14(e) (40 CFR 1502.14(e))) require that the DEIS “identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.” The preferred alternative is the alternative which is believed to fulfill Reclamation’s statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors (CEQ 1981).

A plan recommending Federal action should be the plan that best addresses the targeted water resources problems considering public benefits relative to costs. The basis for selecting a plan for recommendation is to be fully reported and documented, including the criteria and considerations used in selecting a recommended course of action by the Federal Government. It is recognized that most of the activities pursued by the Federal Government will require assessing trade-offs by decision makers and that in many cases, the final decision will require judgment regarding the appropriate extent of monetized and nonmonetized effects.

The needed rationale to support Federal investment in water resources projects is described in the 2009 Council on Environmental Quality’s Draft *Proposed National Objectives, Principles, and Standards for Water and Related Resources Implementation Studies (CEQ 2009)*:

> *The presentations shall summarize and explain the decision rationale leading from the identification of need through the recommendation of a specific alternative. This shall include the steps, basic assumptions, analysis methods and results, criteria and results of various screenings and selections of alternatives, peer review proceedings and results, and the supporting reasons for other decisions necessary to execute the planning process. The information shall enable the public to understand the decision rationale, confirm the supporting analyses and findings, and develop their own fully-informed opinions and/or*

*decisions regarding the validity of the study and its recommendations.*

*Opportunities shall be provided for public reaction and input prior to key study decisions, particularly the tentative and final selection of recommended plans. The above information shall be presented in a decision document or documents, and made available to the public in draft and final forms. The document(s) shall demonstrate compliance with the National Environmental Policy Act (NEPA) and other pertinent Federal statutes and authorities.*

NEPA CEQ Regulations requires the identification of the alternative or alternatives that are environmentally preferable in the Record of Decision (ROD) (40 CFR 1505.2(b)). The environmentally preferable alternative generally refers to the alternative that would result in the fewest adverse effects to the biological and physical environment. It is also the alternative that would best protect, preserve, and enhance historic, cultural, and natural resources. Although this environmentally preferable alternative must be identified in the ROD, it need not be selected for implementation. For the purposes of NEPA, an environmentally preferable alternative will be identified in the ROD associated with this EIS.

The preferred alternative has been identified in the Final EIS in consideration of public, stakeholder, and agency comments on the DEIS.

***Preferred Alternative***

Each of the action alternatives – CP1, CP2, CP3, CP4, CP4A, and CP5 – includes enlarging Shasta Dam and Reservoir and a variety of management measures to address, in varying degrees, all of the project objectives. The major benefits of the action alternatives are summarized in Table 2-24 of the Final EIS, and the impacts and mitigation measures are summarized in Table S-3 of the EIS Executive Summary. The cost estimates are presented in the Engineering Summary Appendix, Attachment 1, “Cost Estimates for Comprehensive Plans.”

In the action alternatives, dam raises of three different heights were evaluated – 6.5 feet, 12.5 feet, and 18.5 feet. While all action alternatives provide primary and secondary project benefits (to varying degrees), the overall benefits of an 18.5-foot raise (CP3, CP4, CP4A, or CP5) were found to be greater than those of either a 6.5-foot raise (CP1) or 12.5-foot raise (CP2). Therefore, only the 18.5-foot raise action alternatives were retained as possibilities for the preferred alternative. For example, the additional reservoir storage would increase from 256,000 acre-feet with the 6.5-foot raise to 634,000 acre-feet with the 18.5-foot raise – nearly 2.5 times the additional reservoir storage of the 6.5-foot raise for between 15-25 percent greater construction costs. This additional reservoir storage space would support both water supply reliability and fisheries objectives.

Reservoir operations and the resulting benefits were the differentiators amongst the 18.5-foot raise action alternatives (CP3, CP4, CP4A, or CP5). For example, CP3 would maximize agricultural water supply reliability, but would the least beneficial to fisheries of the 18.5-foot raises. CP4 would provide the best opportunity to address anadromous fish survival in the upper Sacramento River; however, CP4 would provide the lowest benefits to water supply reliability.

Below is a summary of each action alternative eliminated for consideration as the preferred alternative.

- CP1, formulated to address both anadromous fish survival and water supply reliability, would result in the lowest benefits of all of the action alternatives. Greater project benefits could be recognized with higher dam raises for relatively low increases in costs. Therefore, CP1 was eliminated for consideration as the preferred alternative

- CP2, formulated to address both anadromous fish survival and water supply reliability, would have relatively low benefits when compared to the other action alternatives. Greater project benefits could be recognized with higher dam raises for relatively low increases in costs. Therefore, CP2 was eliminated for consideration as the preferred alternative.

- CP3, formulated to address both agricultural water supply reliability and anadromous fish survival, would greatly increase agricultural water supply reliability. However, CP3 would have no M&I water supply benefits and very low anadromous fish survival benefits when compared to the other 18.5-foot raises. Therefore, CP3 was eliminated for consideration as the preferred alternative.

- CP5, formulated as a combination plan focusing on all objectives, would greatly increase water supply reliability. However, CP5 would have relatively low increased anadromous fish survival benefits in comparison with all other 18.5-foot raises. Therefore, CP5 was eliminated for consideration as the preferred alternative.

- CP4, formulated to focus on anadromous fish survival while water supply reliability.  Although CP4A would have the highest increase in anadromous fish survival of all of the alternatives, CP4A would have the lowest water supply reliability compared to all of considered alternatives (equal to CP1).  CP4 would not best meet both of the primary objectives; water supply reliability would be compromised for increased anadromous fish survival. Therefore, CP4 was eliminated for consideration as the preferred alternative.

CP4A would best balance and meet both of the primary objectives. CP4A, formulated to address both anadromous fish survival and water supply reliability, would have the second highest water supply reliability of all alternatives (equal to CP2) and the second highest increase in anadromous fish survival of all of the alternatives. CP4A would have the ability to meet the secondary project objectives, which were considered to the extent possible through pursuit of the primary project objectives. Secondary objectives include ecosystem enhancement, flood damage reduction, improved Delta water quality, increased hydropower generation and increased recreation. As an 18.5-foot raise, CP4A would best maximize benefits relative to costs. For these reasons, CP4A is the preferred alternative

# Chapter 6 References

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