TABLE OF CONTENTS

List of Figures

List of Figures (continued)

List of Figures (continued)

List of Figures (continued)

6.0 ENVIRONMENTAL ANALYSIS OF OTHER ALTERNATIVES

6.1 CALIFORNIA DEPARTMENT OF FISH AND GAME (CDFG) ALTERNATIVE

This section provides an analysis of potential resource impacts that would arise from implementation of the proposed new environmental measures in the CDFG Alternative by resource area. The resource areas addressed by the CDFG Alternative and potential impacts of the recommended measures are discussed below. Finally, the CDFG alternative is compared to the Proposed Alternative and the No Action Alternative in subsequent subsections.

6.1.1 Water Use

This section provides an analysis of the potential impacts on water use from implementing the minimum instream flows (MIFs) set forth in the CDFG Alternative (See Section 3.2). Potential water use issues affected by the CDFG Alternative include changes in the timing, magnitude and temperature of water passing through the Big Creek Hydroelectric System (BCS) and the timing and magnitude of water storage in reservoirs.

The development and operation of the four Big Creek ALP Projects has resulted in modification of the timing and magnitude of flows in the bypass and flow augmented streams, particularly in non-spill years. Detailed information on the hydrologic effects of operations of the Projects is provided in CAWG 6, Hydrology (SCE 2004a; Volume 4, SD-D (Books 13 and 23)).

Under the CDFG Alternative, higher MIF would be present in selected reaches in the vicinity of the four Projects to potentially further enhance aquatic, riparian, and water quality resources. To provide and monitor the MIF releases proposed in the CDFG Alternative, infrastructure modifications would be required at 12 Project diversions (see Section 3.2). Implementation of these higher instream flows will cumulatively contribute to an incremental restoration of unimpaired hydrology of the Upper San Joaquin River Basin (Basin). However, the MIFs proposed in the CDFG Alternative are excessive and do not equally consider and protect the environmental resources and the need for power generation. The Proposed Action provides flows that would provide similar resource enhancement to the CDFG Alternative, while providing a better balance of power generation with protection of the environmental resources.

The timing and magnitude of flows leaving the BCS (downstream of Big Creek No. 4) are similar under the CDFG Alternative and the No Action Alternative. The higher MIF recommended in the CDFG Alternative result in only a small change relative to the volume of water routed through the seven Big Creek Projects for generation. The vast majority of water released in non-spill years, as well as in non-spill periods of spill years, downstream of the four Projects passes through SCE's water conveyance system to Project generation facilities. The timing, volume, and temperature of water released downstream of the Big Creek No.4 Project will not appreciably change under the CDFG Alternative. Therefore, water use associated with the four Big Creek ALP Projects, with

the exception of hydroelectric generation, will not be adversely impacted by environmental measures proposed in the CDFG Alternative.

6.1.1.1 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts to water use from implementing environmental measures in the CDFG Alternative.

6.1.2 Water Quality

This section provides an analysis of potential impacts on water quality from implementing new MIF described in the CDFG Alternative (See Section 3.2, California Department of Fish and Game Alternative). Potential Project-related water quality issues affected by the measures in the CDFG Alternative include water temperature, dissolved oxygen (DO), turbidity, and silver bioaccumulation in fish tissue.

Under existing operations, water quality issues associated with mean and/or maximum daily water temperatures exceeding the evaluation criteria for trout were identified at the following locations:

- Three bypass reaches associated with Mammoth Pool (FERC Project No. 2085)
- One bypass reach associated with Big Creek Nos. 1 and 2 (FERC Project No. 2175)
- Two bypass reaches associated with Big Creek Nos. 2A, 8 and Eastwood (FERC Project No. 67)
- One bypass reach associated with Big Creek No. 3 (FERC Project No. 120)

Section 5.2.2 provides a discussion of the specific locations and characterization of the water temperature exceedances under existing operations. The higher MIFs proposed in the CDFG Alternative for these bypass reaches will reduce water temperatures to levels that meet the evaluation criteria for trout and comply with Basin Plan objectives, except when the cold-water pool in Mammoth Pool Reservoir is depleted and the reservoir is destratified in September. At this time, water temperatures in the bypass reach cannot be controlled by the Project.

Dissolved Oxygen concentrations below Basin Plan objectives under the No Action Alternative were measured at the following locations:

- Five bypass reaches associated with Big Creek Nos. 2A, 8 and Eastwood (FERC Project No. 67).

Section 5.2.2, Water Quality provides a discussion of the specific locations and characterization of where DO levels were below the Basin Plan objectives under existing Project operations. The higher MIF in the CDFG Alternative for these bypass reaches may raise DO concentrations into compliance with Basin Plan objectives.

Under existing conditions (No Action Alternative), turbidity levels were measured above the Basin Plan objectives at two locations (below Hooper Creek Diversion and Balsam Forebay) associated with Big Creek Nos. 2A, 8 and Eastwood. Section 5.2.2, Water Quality provides a discussion of the specific locations and characterization of the turbidity levels under existing operations. Turbidity exceedences below Balsam Forebay occurred only once and do not appear to be Project-related, therefore, no measures were proposed. The CDFG Alternative does not propose any specific sediment management measures. However, the CDFG Alternative does recommend that the Section 1600 Stream Alteration Maintenance Agreement for Sediment Maintenance be updated and that the agreement incorporate the sediment management prescriptions provided under the Proposed Action, (see Section 3.1-7). The incorporation of the sediment management prescriptions will protect water quality conditions during sediment management activities at Project facilities.

Water quality studies conducted as part of the Big Creek ALP relicensing studies have identified elevated levels of silver in composite liver samples (but not muscle tissue) of adult trout in Mammoth Pool Reservoir. CDFG (Attachment A – CDFG Alternative, Volume 4 (Book 5)) expressed a concern that raptors and other large wildlife that consume fish and crayfish may bioaccumulate silver. CDFG recommended that SCE conduct a monitoring program to determine if silver found in fish tissue is due to upstream (non-Project) mining or from SCE's application of silver iodide to enhance rainfall in the upper San Joaquin watershed. SCE, in consultation with CDFG, developed a study program that would monitor trends in bioaccumulation of silver in Mammoth Pool, Huntington Lake and Lake Thomas A. Edison (SCE 2006). This monitoring program would be conducted in conjunction with fish monitoring in several Big Creek ALP Project reservoirs.

The study to monitor trend in silver bioaccumulations would be conducted every ten years. Ten wild fish would be collected from Mammoth Pool and Huntington Lake and ten crayfish would be collected from Mammoth Pool every ten years. These samples would be analyzed for silver content in (1) fish muscle tissue; (2) fish liver; and (3) entire crayfish. Juvenile fish are not large or old enough to indicate the level of silver bioaccumulation occurring in the reservoir and therefore, fish of catchable size or larger would be collected. Sampling methods (e.g., gillnetting and trapping) and locations would be consistent with methods utilized during the CAWG 7 study, Characterize Fish Populations (SCE 2003; Volume 4, SD-C (Books 8 and 21)).

6.1.2.1 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts to water quality from implementing environmental measures in the CDFG Alternative.

6.1.3 Geomorphology

This section provides an analysis of the potential impacts on geomorphology in relation to sediment management activities. The CDFG Alternative does not propose any

sediment transport or management measures. The CDFG has not made recommendations for CRMF releases for sediment transport. However, CDFG recommended that the 1600 Stream Alteration Maintenance Agreement, which expired on July 31, 2006, be updated to ensure that adequate fish and wildlife protection is implemented during sediment management activities at Project facilities. CDFG indicated that recommended sediment management prescriptions under the Proposed Action be attached to and incorporated into this agreement. The incorporation of the sediment management prescriptions into the Agreement will provide the same level of protection to water quality conditions during the implementation of sediment management activities as described in the Proposed Action. The implementation of the sediment management prescriptions would result in removal of sediment from select Project impoundments and transport fine sediments through the bypass reaches. The reduction in fine sediment deposition in bypass reaches should benefit aquatic life in the downstream reaches.

The proposed changes to the MIFs under the CDFG Alternative will not have any affect on the existing geomorphic resources under current Project operations.

6.1.3.1 Unavoidable Significant Adverse Impacts

There are no unavoidable adverse impacts to geomorphic resources from implementing environmental measures in the CDFG Alternative.

6.1.4 Aquatic Resources

6.1.4.1 Introduction

The following sections describe how the CDFG Alternative would affect conditions for aquatic resources in each water body affected by the operations of each of the four SCE ALP hydroelectric projects, and how this alternative addresses the resource issues described in Section 5.2.4.2. The discussion of each reach begins with a summary of the aquatic recommendation in the CDFG Alternative and a summary of effects. This is followed by a more detailed description of effects.

Additionally, the CDFG (2005) letter filed with the Commission (Attachment A – CDFG Alternative identified several potential issues for aquatic resources. These issues and CDFG's recommended actions are summarized below. Additional information can be found in the Response to FERC AIR No. 14 (SCE 2006).

<u>Downstream Anadromous Fisheries and Temperature Control Issues</u>

CDFG requested that Project Licenses be conditioned to require a study of anadromous fishery requirements downstream of Project dams, including a proportionate contribution to flows and water quality (e.g., temperature) downstream of Friant Dam in coordination with any flows required by the Natural Resources Defense Council (NRDC) v. Rodgers litigation. CDFG recommends that results of upstream operational and temperature

modeling conducted by SCE for the Big Creek ALP process be linked together with the model developed by the U.S. Bureau of Reclamation, along with other ongoing basin-wide modeling, to assess the direct, indirect and cumulative impacts of the Projects and evaluate and define alternative operational strategies over a five-year period (2005 – 2010). CDFG requested a license re-opener condition that would allow consideration and adoption of additional revised license conditions/articles.

Currently, it is unclear whether Project operations have the potential to affect or contribute to these uncertain, future needs, which will be affected by the settlement of this court case. Potential future proposals for new projects downstream of Friant Dam have not been sufficiently developed to analyze in this APDEA. In addition, there are two other water projects with impassable dams (three, counting the Big Creek 4 Hydroelectric Project) between the Big Creek ALP Projects and the SJR downstream of Friant Dam. Therefore, no specific actions for future restoration can be evaluated as part of the CDFG Alternative. The effects of Project operations on aquatic resources below Project dams are assessed for existing conditions, the Proposed Action and the CDFG Alternative in this document. CDFG participated in selecting the type and extent of studies that contributed to this assessment, as part of the Combined Aquatic Working Group (CAWG).

Resident Fish Instream Flow Recommendations

CDFG proposed MIFs for bypass and augmented reaches that are affected by the Big Creek ALP Projects. In most cases, these MIFs would be higher than those of the Proposed Action would. The CDFG proposed MIFs would include flows for wetter (Wet and Above Normal Water Years) and drier water years (Below Normal, Dry, and Critical Water Years). CDFG proposed MIFs are listed in Table 3.1.7-1.

CDFG's stated rationale for its proposed MIFs includes the following concepts. CDFG states that these MIFS are proposed to generally provide increased flows for spring-spawning fish, increased thermal protection for fish and other aquatic organisms, and passage flows in late summer and fall. Higher flows to benefit spring-spawning fish would be initiated earlier in diverted reaches that are located at lower elevations within the Project Area to coincide with earlier warming of water temperatures. Specific details are not provided for individual reaches.

While the CDFG letter (Attachment A – CDFG Alternative) refers to the desirability of flow transitions, no specific criteria were proposed. Therefore, flow transition criteria are not included in the analyzed CDFG Alternative.

CDFG has not made recommendations for CRMF; therefore, CRMFs are not included in the analyzed CDFG Alternative.

CDFG stated that a stream alteration maintenance agreement that addresses the ongoing annual removal of sediment, vegetation, and other debris from many of SCE’s small and mid-sized impoundments in the upper SJR watershed should be updated to ensure that adequate fish and wildlife protection is implemented during

sediment management activities at Project facilities. CDFG indicated that recommended sediment management plans may be attached to and incorporated into the agreement. Although CDFG did not suggest specific sediment management activities, Sediment Management Prescriptions included in the Proposed Action (Appendix J Sediment Management Prescriptions (SCE 2007a; Volume 4, SD-H, (Book 20)) are evaluated here as part of the CDFG Alternative.

Mammoth Pool Silver Monitoring

Water quality studies conducted as part of the Big Creek ALP relicensing studies have identified elevated levels of silver in composite liver samples (but not muscle tissue) of adult trout in Mammoth Pool Reservoir. CDFG (Attachment A – CDFG Alternative) expressed a concern that raptors and other large wildlife that consume fish and crayfish may bioaccumulate silver. CDFG recommends a monitoring program to determine if silver found in fish tissue is due to upstream (non-Project) mining or from SCE's application of silver iodide to enhance rainfall in the upper San Joaquin watershed.

SCE, in consultation with CDFG, developed a study program that would monitor trends in bioaccumulation of silver in two Big Creek ALP major reservoirs, Mammoth Pool and Huntington Lake (SCE 2006). Ten wild fish would be collected from each reservoir, and ten crayfish would be collected from Mammoth Pool every ten years. Samples would be analyzed for silver content in (1) fish muscle tissue, (2) fish liver and (3) entire crayfish. This monitoring program would be conducted in conjunction with fish monitoring in several Big Creek ALP Project reservoirs. This monitoring program is further discussed in Section 6.1.2, Water Quality.

Project Reservoir Minimum Pools

Under existing conditions, there are active, productive fisheries in all of the major reservoirs associated with the Big Creek ALP Hydroelectric Projects, and no aquatic resource issues were identified in any of them. CDFG states that although current operational minimum pools in the Project Area do not appear to adversely affect the fisheries in Project reservoirs, changes to reservoir operations under the new Project license could affect aquatic resources in reservoirs. CDFG recommends that fish monitoring be conducted for impacts to aquatic resources in reservoirs.

To address CDFG's concern, a fish-monitoring program for Project reservoirs was discussed with CDFG (SCE 2006), and is included in the CDFG Alternative. Study objectives would be to characterize long-term trends in the relative abundance and species composition of reservoir fish communities. Monitoring would be conducted during the fifth and tenth year after license issuance, and every ten years thereafter for the length of the license. Under the CDFG Alternative, monitoring is proposed in Mammoth Pool, Huntington Lake, and Florence Lake.

Project operations under the CDFG Alternative would result in little or no change in minimum reservoir elevations and storage from the No Action Alternative, as evaluated by the HydroBasin Model. Water surface elevations under current operations are

summarized in Section 5.2.4.2 and are described in greater detail in CAWG 1 Characterize Stream and Reservoir Habitats (CAWG 1, Characterize Stream and Reservoir Habitats, Technical Study Report (TSR) (SCE 2003; SCE 2004a; Volume 4, SD-C (Books 7 and 21) and SD-D (Books 11 and 23)). Furthermore, as part of SCE's ALP Recreation Management Plan (Recreation Management Plan, SCE 2007b; Volume 4, SD-G (Books 19 and 24)), SCE will make every reasonable effort to maintain the water surface at the maximum elevation practical for water storage and dam safety, with as little fluctuation as feasible during summer months of each year, which may further benefit fish habitat. Since little change is expected to reservoir volumes and operations, little effect is expected to habitat, water temperatures, or the potential for entrainment. Therefore, reservoir fisheries are not expected to be adversely affected.

Fish Entrainment Mortality

CDFG asserts that despite the results of entrainment studies conducted by SCE, which concluded that there was little risk of entrainment at Big Creek ALP Projects, "entrainment loss does occur, we deem it significant, and will require mitigation" (Attachment A – CDFG Alternative). CDFG recommends that drop tube intakes, primarily at those diversions that provide water to the Ward Tunnel, be screened to exclude and not impinge adult fish.

Three diversions in the upper basin (tributary to the SFSJR) have vertical intakes to Ward Tunnel: Chinquapin, Camp 62 and Bolsillo creek diversions. Entrainment studies conducted by SCE (CAWG 9, Entrainment, TSRPs (SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26))) found that the risk of entrainment at these diversions is low. There is no evidence of an entrainment issue at these intakes, nor any data that would suggest that there is likely to be one. Therefore, the biological benefit to fish populations of screening these diversions would be negligible.

All of the upper basin diversions (Big Creek Project Nos. 2A, 8 and Eastwood Project) divert water into Ward Tunnel, which in turn, discharges through an HB valve (which does not have an associated turbine) to Huntington Lake, or through Portal Powerhouse (which was studied as part of the Portal traditional license application) (CAWG 9, Entrainment, Appendix C, TSRPs (SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26))).

The Chinquapin, Camp 62, and Bolsillo creek diversions are not operated all year. Diversions on these three creeks are out of service in the winter due to icing in these high-elevation locations. In years that they are operated, the diversions are generally turned in late May or in April, and turned-out sometime between July and September, occasionally as late as late November. If these diversions are screened, screens would have to be removed from service prior to the winter months to prevent damage from icing and reinstalled yearly. There would likely be operational and maintenance issues with screens during the run-off period due to debris and clogging. There is no power available at these locations to assist with mechanical screen cleaning.

Brook trout was the only fish species found in Chinquapin, Camp 62 and Bolsillo creeks during sampling conducted as part of the Big Creek ALP studies. Under existing conditions, mean trout densities and biomass were high, mean condition factors were greater than 1.00, and the presence of multiple age classes indicates these creeks support self-sustaining populations of brook trout (CAWG 7, Characterize Fish Populations, TSRPs (SCE 2003; Volume 4, SD-C (Books 8 and 21)).

The CAWG did not consider the upper basin diversions a high priority for entrainment sampling. To assess the potential entrainment vulnerability of the small diversions within the Big Creek ALP Project Area, a sub-sample of select small diversions was chosen for evaluation, in consultation with the CAWG. Entrainment sampling occurred at Balsam and Rock Creek diversions. The low densities of fish moving downstream into the diversion pools and the low velocities near the diversion intakes suggest that the potential for entrainment at the small diversions is low.

The potential for entrainment mortality through the Portal Powerhouse, and therefore all the backcountry diversions which lead to it, is low (Southern California Edison Company, Portal Hydroelectric Power Project Application for New License, Exhibit E [SCE 2003]) (CAWG 9, Entrainment, TSRPs (SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26))). Fish sampling in the Portal Forebay confirmed that relatively few fish were present and that many of the fish collected were hatchery rainbow trout. Highest flows through Ward Tunnel occur during spring-summer run-off, when much or all of the flow bypasses the powerhouse through the HB valve. During late summer and early fall, more of the flow passes through the powerhouse. During July of 2002, when the powerhouse was operating at about 80% of maximum, fish turbine passage, based on discharge netting, was estimated to be 0.15 fish/hr. The Portal project utilizes a Francis turbine with low head, which indicates that limited mortality would occur if fish were entrained. This was supported by the results of entrainment sampling. Fish surviving turbine passage are conducted to Huntington Lake, as are fish passing through the HB valve.

Given the low risk of entrainment at the Chinquapin, Camp 62, and Bolsillo creek diversions, that these diversions are not operated all year, and given the presence of self-sustaining, high-density populations of brook trout under existing conditions, the biological benefit of screening these diversions would be very low. Furthermore, if fish are entrained to the Portal Powerhouse, the risk of entrainment mortality is low.

Data used to Determine Fish Densities in Project Reaches

CDFG expressed a concern that data used as reference fish densities within the Project Area is limited to Gerstung (1973). The basis for this concern was incorrect. At the time of CDFG's letter, the CAWG (including CDFG) developed elevation-specific regional reference densities from unimpaired stream reaches for use in streams without other reference reaches. These are presented in Attachment J - Regional Fish Densities Memo (Volume 4 (Book 5)). For smaller streams with similar channel and habitat conditions upstream and downstream of the diversion, upstream reaches are used as reference reaches for the downstream reaches. It should be noted, that

although not relied on in this document, CDFG has used the Gerstung (1973) fish densities as reference densities in other hydroelectric relicensing proceedings in California.

Hatchery Support for Stocking of Project Impoundments and Project-Affected Reaches

This proposal is evaluated in Section 6.1.8 Recreation Resources

6.1.4.2 Mammoth Pool (FERC Project No. 2085)

Mammoth Pool Reservoir

This section provides an analysis of the potential impacts on the Mammoth Pool Reservoir. The CDFG Alternative would increase MIFs to the reach below Mammoth Pool Dam, which would increase releases from Mammoth Pool Reservoir (Table 3.1.7-1). Since little change is expected to reservoir volumes and operations, little effect is expected to habitat, water temperatures, or the potential for entrainment in wetter water years. In drier water years, the increased releases would tend to induce mixing of the epilimnion and hypolimnion earlier than under the No Action Alternative. This alternative is not expected to adversely affect fish using the reservoir.

Under the CDFG Alternative, SCE would conduct monitoring studies to characterize trends in the relative abundance and species composition of the fish community. Based on discussions with CDFG, this would include fish monitoring during the fifth and tenth years after license issuance, and every 10 years thereafter for the length of the license, to determine any significant long-term trends in fish populations (SCE 2006). These studies are proposed by CDFG to identify potential impacts, if any, of Project operations on fisheries resources in Mammoth Pool Reservoir. However, because little change in reservoir elevation is expected, little change is expected in the quantity and quality of reservoir habitat.

Trends in bioaccumulation of silver in fish and crayfish in Mammoth Pool Reservoir also would be monitored to evaluate whether cloud seeding activities in the upper watershed or other sources of silver are likely to affect aquatic resources.

Habitat Impacts

The proposed MIF releases downstream of Mammoth Dam would result in relatively small reductions in the overall volume of water in storage during the summer months and would result in minor to no change in seasonal water surface elevations in Mammoth Pool (based on the results of SCE's HydroBasin model). The volume of water released under the CDFG Alternative for MIFs and generation would be increased by 6% to 10%, on average, over existing conditions during summer months in normal water years and 12% to 17% in dry water years to meet CDFG proposed MIFs. The reservoir has steep sides that result in small changes to shallow and deep-water habitat areas over a wide range of water surface elevations. Therefore, this proposal would have little effect on quality or quantity of reservoir habitat.

Temperature

Under the CDFG Alternative, changes would occur to both downstream water temperatures and to the volume of cool hypolimnetic water available as fish habitat for trout in Mammoth Pool Reservoir. The MIF releases would reduce the volume of cool water in the reservoir more rapidly than under existing conditions. This would be especially evident in drier water years with warm meteorology, when the increased MIFs in combination with generation, would likely deplete the cool water pool about two weeks earlier than currently occurs. This may have a small adverse effect on reservoir trout.

Entrainment

No increase in generation flow and little to no change in reservoir elevations would be expected under the CDFG Alternative. Therefore, no change in current low entrainment potential is expected.

Reservoir fisheries

Little change is expected from the CDFG Alternative with regard to physical habitat or entrainment. The earlier depletion of cool water in dry water years due to higher MIFs may be considered to have a slight adverse effect on reservoir trout.

Mammoth Bypass Reach – Mammoth Pool Dam to Mammoth Pool Powerhouse

The CDFG Alternative would increase MIF requirements below Mammoth Pool Dam (Table 3.1.7-1). These MIFs would provide water temperatures desirable for trout growth when and where such temperatures are not achieved under existing conditions, and when temperatures in the bypass reach are controllable by the Project. They also would increase flow-related habitat for adult trout and Sacramento sucker. Increased MIFs during trout spawning periods would increase available spawning habitat. However, water temperatures and flow-related habitat may not limit current trout populations under existing conditions, and, therefore, the CDFG Alternative may not result in increased trout densities, though it would result in increased habitat availability. CDFG has not made recommendations for channel and riparian maintenance flows. Existing frequent spills (not under Project control) would continue to provide the same beneficial flows for channel geomorphology (Section 5.2.3) as provided under existing conditions and the same adverse effects on trout recruitment in Wet and Above Normal Water Years.

Habitat Impacts

MIFs under CDFG Alternative would range from four to twelve times the existing MIFs, as identified in Table 3.1.7-1. The large increases in flow would increase habitat for both adult trout and adult Sacramento sucker.

Flow-related Habitat (WUA)

The CDFG Alternative would increase summer habitat (July through September) for adult rainbow trout by about 35% in normal and dry years[1]. Adult habitat would be increased over the course of the entire year by about 55% in both water year types (Table Attachment D-12, Volume 4 (Book 5)). For both water year types, this alternative would provide 95% of maximum WUA during the summer months and more than 88% of maximum WUA during the entire year. Under existing conditions, about 60% of maximum available habitat is provided on average (Table Attachment D-14). For rainbow trout spawning, the CDFG Alternative would increase habitat by an average of 90% over existing conditions in normal years and by 150% in dry years. The CDFG Alternative would provide more than 60% of maximum spawning WUA in all years, as compared to a maximum of 38% of maximum spawning WUA provided under existing conditions.

Adult brown trout rearing habitat would increase by about 20% in the summer months relative to the existing conditions, and by an average of about 30% over the course of the entire year, in normal and dry years (Table Attachment D-13). The CDFG Alternative would provide at least 99% of maximum WUA during the summer, and at least 95% during the rest of the year, for all water year types (Table Attachment D-14). Under existing conditions, 69% to 84% of maximum available habitat is provided in all years. Brown trout spawning habitat would increase by averages of 132% and 150% relative to existing conditions in normal and dry years, respectively. The CDFG Alternative would provide 66% to 71% of maximum spawning WUA in normal and dry years compared to 26% to 40% of maximum spawning WUA under existing conditions.

Rainbow and brown trout juvenile and fry habitats respond similarly to the flows of the CDFG Alternative. Juvenile habitat would decrease by about 15% during the summer months, and 5% to 10% on average throughout the year relative to the existing conditions identified in all water year types (Tables Attachment D-12 and D-13). During the summer months, 83% to 87% of maximum WUA would be provided for juvenile trout on average, as compared to over 97% of maximum WUA under existing conditions, in normal and dry years. In both normal and dry years, fry habitat would decrease by an average of 25% during June through September, when fry are present. The maximum WUA provided for fry would be 70% to 80% on average, compared with about 95% under existing conditions, for all years.

Sacramento sucker habitat would respond in the same manner as described for the two trout species. During normal and dry years, adult sucker habitat would increase by about 30% over that for existing conditions during the summer months, with an average increase of 43% over the entire year (Table Attachment D-15). The CDFG Alternative would provide at least 88% of maximum WUA during the summer and at least 80% of maximum WUA the rest of the year, in all water year types (Table Attachment D-16).

[1] Normal years, as used by CDFG, include Wet and Above Normal Water Years. Dry years, as used by CDFG, include Below Normal, Dry, and Critical Water Years.

This is compared with about 65% of maximum WUA provided under existing conditions in normal and dry water years. Juvenile habitat would decrease by about 10% to 15% from existing conditions on average, during the summer, and throughout the year in both normal and dry years. In all years, about 85% of maximum WUA would be provided for juvenile Sacramento sucker under the CDFG Alternative, as compared with 99% under existing conditions.

The time series analysis confirms the results of the MIF WUA analysis above, showing similar increases in habitat for all species and life stages (Tables Attachment D-2 through D-9). The time series analysis does indicate a somewhat smaller increase in rainbow trout spawning habitat than was indicated by the MIF WUA analysis (about a 100% increase). This lower value incorporates lower habitat values during spill events within the reach.

Passage and Stranding

The CDFG Alternative is not expected to substantially affect passage or the potential for fish stranding in the Mammoth Reach relative to existing conditions.

The CDFG Alternative would not affect passage through typical riffles, as adequate flows for passage are provided under both this alternative and current conditions.

Because very small young of the year fish (those most vulnerable to stranding) may be present May through July, this is the period during which fish stranding would be most likely to occur. During this period, CDFG Alternative MIFs decrease from 150 to 120 cfs, resulting in less than a 4% change in wetted perimeter (Table Attachment D-9) on July 1 of wetter years. The potential for fish stranding for this level of change would be minor (less than 5%). In drier years, CDFG Alternative MIFs drop from 120 to 100 cfs on June 1. The potential for stranding for this change also would be minor (less than 2%).

No dewatering of rainbow trout redds would be expected under this alternative, as flows are stable or increasing during their spawning and incubation season. During the brown trout spawning and incubation season, the MIF declines from 120 cfs in October to 75 cfs in January. The redd stranding analysis indicates that less than six percent of the potential brown trout redd habitat would be lost over this flow change (Table Attachment D-10) in normal years. The loss of this amount of habitat is minor and would not be expected to affect brown trout spawning success. In drier years, CDFG Alternative MIFs drop from 100 cfs in October to 60 cfs in January. The potential for stranding for this change also would be minor (with about two percent of the redd habitat being lost).

Temperature

The effect of the CDFG Alternative MIFs on water temperatures in the bypass reach was simulated using the temperature models developed for this Project (CAWG 5, Water Temperature Modeling, TSRPs (SCE 2004b; Volume 4, SD-E (Books 18 and 24))). The MIFs were predicted to result in decreased water temperatures during June, July and August of both normal and dry water year types. As shown in Figures 6.1.4-1

through -4, daily mean water temperatures during June, July and August would be reduced to 19.1°C or less, throughout the reach. The range of predicted daily mean temperatures in June through August is 9.9°C to 19.1°C, which may at times result in temperatures cooler than the optimal range for rainbow trout growth in the upper portion of the reach, but suitable for brown trout. During September of dry and warm years, after the reservoir mixes, daily mean temperatures are predicted to exceed 20°C (as warm as 20.2°C) in the lower 0.86 mile of the reach, which is higher than the target temperature (evaluation criteria) for rainbow trout growth. Increased flows would not result in lower temperatures under these conditions, since cooler water would not be available for release. Daily maximum water temperatures are predicted to be reduced to less than 21°C for all months (Attachment F - Temperature Figures (Volume 4 (Book 5)).

The CDFG Alternative, therefore, provides the beneficial impact of achieving water temperatures desirable for trout growth, when and where such temperatures are not achieved under the No Action Alternative, and when temperatures in the bypass reach are controllable by the Project. The higher MIFs associated with the CDFG Alternative during dry years would result in earlier depletion of the cool water pool stored in Mammoth Pool Reservoir. In dry years, this depletion likely would occur up to two weeks earlier than under the No Action Alternative, and daily mean water temperatures would be higher than 20°C in the lower portion of the reach for a longer period of time during the late summer. Daily maximum temperatures would not reach more than 21°C.

Aquatic Life

Fish

The higher flows of the CDFG Alternative would substantially increase habitat for adult and spawning rainbow and brown trout, and decrease habitat for juvenile and fry of both species. Adult sucker habitat would be increased, while habitat for fry and juvenile sucker would be reduced. The CDFG Alternative MIFs would slightly decrease the potential for redd and fish stranding resulting from changes in MIFs, but would have minimal effect on stranding. Decreased water temperatures in the lower portion of the bypass reach during most of the summer may improve conditions for trout growth and with this increased growth the potential for greater over-the-winter survival of young fish. However, trout condition factors in the lower and upper portion of the bypass reach were greater than 1.0 and the mean fish lengths for each age group were comparable to trout in two reference locations (Mono Creek upstream of Lake Edison for rainbow trout and SFSJR upstream of Florence Lake for brown trout). This indicates that poor trout growth is not likely a resource issue. Some benefits to trout growth in the lower part of the bypass reach would be expected. Reduced water temperatures would reduce stressful conditions for trout in hot and dry conditions only when cool water is available for release from Mammoth Pool. The extent of actual benefits to trout and sucker populations in the bypass reach under the CDFG Alternative are unclear.

The effect of uncontrollable spills on sediment movement in spring, during Wet and Above Normal water years, likely results in substantial young of the year mortality. No enhancement measure is likely to improve this source of mortality.

Macroinvertebrates

Both total macroinvertebrates and EPT organisms Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies)) were abundant in the bypass reach, especially at the sites further downstream. There is little to indicate that increased flow or decreased temperatures may potentially benefit macroinvertebrate populations or to what extent. However, some beneficial effects may occur.

Rock Creek

The CDFG Alternative would implement MIFs in the bypass reach, where there is none currently. This would provide a small improvement in the suitability of habitat. The only habitats in Rock Creek suitable for fish use are plunge pools, which are not responsive to changes in flow. Therefore increasing flows is unlikely to result in a substantial improvement in physical habitat that would support an increase in fish populations. Decreased water temperatures in dry water years and flow continuity during the summer are likely to benefit trout by providing a longer period of temperatures suitable for trout growth and fewer days with stressful water temperatures. Increased flows also may benefit macroinvertebrates, reptiles and amphibians.

Habitat Impacts

The CDFG Alternative provides MIF releases from the Rock Creek Diversion. Because there is no required MIF below Rock Creek under the current license, the CDFG Alternative could potentially provide some benefit to fish population because it provides for flow releases.

Temperature

The CDFG Alternative MIFs would reduce water temperatures in the bypass reach of Rock Creek (Figures 6.1.4-5 and -6) (Attachment F - Temperature Figures) from those present under the No Action Alternative. However, daily mean water temperatures would still exceed 20°C in the lower portion of the bypass reach during summer months in both normal and (hot and) dry water years. Modeled daily mean water temperatures exceeded 20°C for 15% and 30% of the reach in July for normal, warm, and dry years, respectively. During August of dry years there would not be sufficient flow available upstream of the diversion to maintain daily mean water temperatures under 20°C (CAWG 6, Hydrology, TSR; Fish Monitoring Plan, and CAWG 5, Water Temperature Modeling, TSR (SCE 2004a; Volume 4, SD-D (Books 13 and 23), SCE 2007b; Volume 4, SD-G (Book 19), and SCE 2004b; Volume 4, SD-E (Books 18 and 24)).

Entrainment

The evaluation of entrainment (CAWG 9, Entrainment, SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26)) found that there is little potential for entrainment at Rock Creek Diversion. Therefore, the CDFG Alternative MIFs do not provide any beneficial impact for entrainment.

Aquatic Life

Increased flow, flow continuity, and decreased water temperatures during part of the summer are likely to be beneficial to fish by providing a longer period of temperatures suitable for growth and fewer stressful days. Flows also may benefit macroinvertebrates, reptiles, and amphibians.

Ross Creek

The CDFG Alternative would set a MIF below the diversion where currently there is none. In dry years, the CDFG Alternative would establish a flow requirement of 0.5 cfs from July through February, 2 cfs from March through May, and 1 cfs in June. In wet years, the CDFG Alternative MIF would be 1 cfs from July through February, 2 cfs in March and June, and 3 cfs in April and May. The lack of summer flows available upstream of the diversion and consequent unavailability of flow below the diversion would prevent MIFs from being met in much of the summer and fall. The lack of summer flows would continue to limit the value of this stream for fish. The provision of MIFs, when flow is available, may provide benefits to macroinvertebrates, western pond turtles, Pacific tree frogs, and aquatic garter snakes, which are found in Ross Creek.

Aquatic Life

Ross Creek is dry above and below the diversion during much of the summer and fall, even in wet years, partially due to an upstream non-Project diversion. This stream currently does not support fish. The MIFs would reduce water temperatures in the bypass reach, however, daily mean water temperatures would still exceed 20°C in the lower portion of the bypass reach, and temperatures would be too warm for trout, if trout were present. The CDFG Alternative MIFs may reduce water temperatures in early summer, but water would be unavailable when flows upstream of the diversion cease. The lack of summer flows limits the value of this stream for fish. However, the provision of MIFs, when available, may provide benefits to macroinvertebrates, amphibians and reptiles.

6.1.4.3 Big Creek Nos. 1 and 2 (FERC Project No. 2175)

Huntington Lake

The CDFG Alternative does not propose modifications to MIFs in the bypass reach directly below the lake, but would implement MIFs below Dam 4 and in Balsam and Ely creeks, where currently there are none (Table 3.1.7-1). Since little change is expected

to reservoir volumes and operations, little effect is expected to habitat, water temperatures, or the potential for entrainment in the lake. This alternative is not expected to adversely affect fish using the reservoir.

CDFG has recommended that retention of water in Project reservoirs for recreational resources to be balanced with the needs of resident trout and downstream anadromous fisheries. Under the CDFG Alternative, SCE would conduct monitoring studies to characterize trends in the relative abundance and species composition of the fish community. This likely would include fish monitoring during the fifth and tenth years after license issuance, and every 10 years thereafter for the length of the license, to determine any significant long-term trends in fish populations.

In conjunction with the collection of fish for the fish monitoring study, the CDFG Alternative also proposes to monitor trends in bioaccumulation of silver in reservoir fish. This study could help to identify potential impacts, if any, of cloud seeding activities in the upper watershed. The objective of this study is to address a CDFG concern that raptors and other large wildlife that consume the fish may bioaccumulate silver. No objective for aquatic resources was identified for this measure.

Habitat Impacts

The CDFG Alternative would not result in a notable change in seasonal water surface elevations in Huntington Lake, compared to existing conditions (based on SCE's HydroBasin model). A relatively large amount of shallow habitat is available at most reservoir elevations (CAWG 1, Characterize Stream and Reservoir Habitats, SCE 2003; SCE 2004a; Volume 4, SD-C (Books 7 and 21) and SD-D (Books 11 and 23)).

Temperature

With the CDFG Alternative MIF releases downstream of Huntington Lake, there would be little change in the volume of water in the reservoir during the summer months when thermal stratification occurs. This would result in little change in the temperature or volume of cool hypolimnetic water available as fish habitat for trout in Huntington Lake. Consequently, this would result in little change in the temperature or cool water available for release to Big Creek downstream.

Entrainment

No entrainment of fish from Huntington Lake through Big Creek Powerhouse No. 1 was observed during entrainment sampling (CAWG 9, Entrainment, SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26)). The intake to Powerhouse No. 1 is located deep in the lake. Very few fish were found near the intake location or at the depth of the intake port. This results in little potential for fish to encounter the intake port. Intake approach velocities are well within the swimming capabilities of the adult fish. Because the likelihood of fish encountering the intake is low and fish are capable of escaping from the low intake velocities, the potential for entrainment is low. Since no increase in generation flow or change in reservoir elevations would be expected under the CDFG Alternative, no change in entrainment potential is expected from existing conditions.

Reservoir Fisheries

Since little change is expected to reservoir habitat, water temperatures, or entrainment, little change is expected in reservoir fisheries.

Big Creek - Dam 1 to Powerhouse 1 Bypass Reach

The CDFG Alternative does not propose changes in MIFs in this bypass reach (Table 3.1.7-1). Under current conditions, there is no MIF requirement from December 15 to April 15, although SCE releases flow during this period. Lack of flow during that period is undesirable for incubation of brown trout embryos. Nevertheless, fish populations are abundant and healthy under current conditions, and this is not expected to change under the CDFG Alternative.

Temperature

Water temperatures are cool in this reach and suitable for trout under existing conditions. This would not be expected to change.

Aquatic Life

Under existing conditions, this reach supports self-sustaining populations of brown trout (a fall-spawning species) and prickly sculpin. In general, densities of brown trout were at or above reference levels. Under the CDFG Alternative, no change would be expected from existing conditions.

Big Creek - Dam 4 to Powerhouse 2

Powerhouse 2 Forebay (Dam 4)

Powerhouse No. 2 Forebay is a small water body whose temperature and flow is dominated by discharges from Powerhouse No. 1 and withdrawals to Tunnel 2 and Powerhouse No. 2. No aquatic resource issues were identified for the forebay. The CDFG Alternative would institute MIF releases from the forebay to the bypass reach downstream. Little change is expected in aquatic habitat due to this change in operations in the forebay.

Habitat

Little change in operations or aquatic habitat is expected from existing conditions under the CDFG Alternative.

Temperature

Under existing conditions, water temperatures in the forebay are cool and reflect temperatures of water drawn from deep depths in Huntington Lake. These temperatures are suitable for trout and would remain suitable under the CDFG Alternative.

Entrainment

Under existing conditions, the majority of flow passing through the forebay has first passed through Big Creek Powerhouse No. 1; therefore, most fish present in this flow would have passed through the powerhouse turbines. Due to the principal source of flow and the small size of the forebay, the relative numbers of additional fish vulnerable to entrainment in the source water body is low. During typical operation of Big Creek Powerhouse 1, the volume of water in the forebay is replaced many times in a single day, and fish presence near the intake face is low. Intake velocities to Tunnel 2 are typically low. Therefore, overall fish vulnerability to entrainment at the intake is low under existing conditions (CAWG 9, Entrainment, SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26)). This would not be expected to change under the CDFG Alternative.

Big Creek - Dam 4 to Powerhouse 2 Bypass Reach

The potential fisheries resource issues under existing conditions in Big Creek between Dam 4 and Powerhouse 2/2A included (1) temperatures exceeding the Central Valley Regional Water Quality Control Board Basin Plan (CVRWQCB) “COLD” objective (i.e. water temperatures unsuitable for trout growth); (2) potentially insufficient flow (no MIF required under the current license); (3) potential adult rearing and spawning habitat limitations; (4) apparent recruitment failure in 2002 (although the presence of all other year classes indicates that recruitment is successful in most years); (5) potential insufficient over-wintering habitat for trout due to lack of flow and sediment in pools; and (6) periodic sedimentation of downstream pools due to sediment management during periodic de-watering of Dam 4 for tunnel inspections (Section 5.2.3 Geomorphology). Regardless of these potential resource issues, trout were relatively abundant with condition factors over 1.00.

There currently are no MIFs for the bypass reach and existing flows derive from seepage, tributaries and local area run-off. The CDFG Alternative would institute MIFs (Table 3.1.7-1). Flows were selected, in part, to address summer water temperatures, which in portions of this reach are warmer than suitable for trout growth and which may be stressful at times. In addition, MIFs address habitat limitations for adult trout rearing and spawning by enhancing flow-related habitat for those life stages. Proposed MIFs address potential insufficient over-wintering habitat for trout due to lack of flow in pools. The MIFs also would enhance habitat for macroinvertebrates.

Habitat Impacts

The instream flows proposed under the CDFG Alternative would increase flows by 7 to 20 times over existing seepage. The recommended MIFs would be lower during spring and summer of dry water years.

The CDFG Alternative summer MIFs, would increase adult rainbow trout summer habitat by 229% over existing levels in normal years, and 167% in dry years (Table Attachment D-32). These flows would provide 60% and 49% of maximum WUA, in

normal and dry water years[2], respectively (Table Attachment D-34). The habitat increase would average 192% over the course of a normal water year, and 160% during dry years. Over the entire year, an average of 53% and 48% of maximum WUA for adult rainbow trout would be provided in normal and dry years, respectively. Under existing conditions, 18% of maximum available habitat is available.

Rainbow trout spawning habitat would increase by over 20 times its current value in both water year types (Table Attachment D-32). The CDFG alternative would provide 97% and 93% of maximum available spawning habitat in normal and dry years, respectively (Table Attachment D-34). Seepage flows under existing conditions provide approximately 4% of maximum WUA for spawning.

Adult brown trout summer habitat would increase by 179% in normal years (Table Attachment D-33) and 81% of maximum available habitat would be provided (Table Attachment D-34). In dry years, the corresponding numbers would be 144% and 71%. The increases of adult habitat under the CDFG alternative over the course of the year would average 154% and 136% in normal and dry years, respectively. The CDFG alternative MIFs would provide 62% to 88% of maximum WUA throughout the year, while current conditions provide 29% of maximum available habitat.

More than six times as much habitat would be available for brown trout spawning relative to existing conditions in both normal and dry years (Table Attachment D-33). The CDFG Alternative would provide 83% to 97% of maximum spawning WUA in all years (Table Attachment D-34) compared to 13% under existing conditions.

Rainbow and brown trout juvenile and fry habitats respond similarly to the MIFs under the CDFG Alternative. Juvenile trout habitat would double (Tables Attachment D-32 and D-33), during the summer. An average of 90% to 95% of maximum WUA would be provided for both species in both normal and dry years. The existing condition MIFs provide about 45% of maximum WUA in both water supply conditions (Table Attachment D-34). Fry habitat would increase by an average of over 30% during June through September (Tables Attachment D-32 and D-33), providing about 95% to 100% of maximum WUA. This is compared to about 72% of maximum WUA provided for fry under existing conditions.

Passage and Stranding

The CDFG alternative would not adversely impact fish passage and would result in little potential for fish or redd stranding relative to existing conditions.

The MIFs under The CDFG Alternative would allow fish passage at all times, as flows would always exceed the 0.77 cfs needed to provide passage. Flow estimates by SCE indicate that sufficient flows for passage are generally provided under existing conditions; therefore, the CDFG Alternative would provide a minor benefit for passage.

[2] Normal years, as used by CDFG, include Wet and Above Normal Water Years. Dry years, as used by CDFG, include Below Normal, Dry, and Critical Water Years.

There is a low potential for fish stranding during May through July, the time when fish stranding is most likely to occur. The stranding analysis (SCE 2005) shows decreasing flows from 20 to 15 cfs in normal years would result in a change in wetted perimeter of less than 2 feet or 7% (Table Attachment D-27). In dry years, the CDFG Alternative MIFs would decrease from 15 to 10 cfs, resulting in less than an 8% change in wetted perimeter.

There is no potential for dewatering rainbow trout redds from the proposed MIFs, as the MIF is constant throughout the rainbow trout spawning and incubation season (April through June) for both water supply conditions. During the brown trout spawning season, in wetter water years, the MIF would drop from 10 cfs in October to 7 cfs in November, and remain at 7 cfs through March, increasing again in April through June. In drier years, the CDFG Alternative would have constant MIFs from October through January and there would be no loss of redd habitat. The redd stranding analysis indicates that none of the potential redd area at the starting flow would be dewatered at the end flow (Table Attachment D-28). There is little likelihood of any redd stranding mortality due to the MIFs under this Alternative.

Temperature

The MIFs that would be released from Dam 4 and Balsam Creek under the CDFG Alternative would fully mitigate the warm temperatures present under existing conditions (Section 5.2.4.2.2). Water temperatures simulated for this reach for June through September indicate daily mean water temperatures would not be expected to exceed 17.3°C and daily maximum temperatures would not exceed 20.3°C (Figures 6.1.4-7 and 6.1.4-8, and Attachment F – Temperature Figures).

Aquatic Life

The CDFG Alternative MIFs would substantially enhance trout habitat and water temperatures over existing conditions, thereby mitigating many of the identified trout resource issues for this reach. The CDFG Alternative requires MIFs below Dam 4, where currently none is required. The MIFs would potentially provide sufficient habitat to address resource issues (potential limiting factors) due to the amount of adult rearing and spawning habitat available under existing conditions. The summer MIFs under this proposal would provide enhanced adult trout rearing habitat sufficient to support more than the current population. The MIFs also would provide greatly enhanced spawning habitat. This would address the recruitment failure identified in 2002, assuming that it was due to limited habitat. The other resource issue for this reach is warm summer water temperatures. The proposed MIFs would mitigate these conditions and enhance conditions for trout growth.

Macroinvertebrate densities, including EPT densities, in this reach are relatively high under existing conditions. The CDFG Alternative MIFs and sediment prescription would be expected to be beneficial for macroinvertebrates, which in turn could further benefit trout.

Balsam Creek – Diversion to Big Creek

The CDFG Alternative would institute MIFs in the bypass reach where currently there is none (Table 3.1.7-1).

Balsam Creek Diversion

No resource issues were identified for the impoundment behind Balsam Creek Diversion Dam. Under the CDFG Alternative, there would be little, if any, change from existing conditions to aquatic habitat in the impoundment.

Habitat

Balsam Diversion forms a very small impoundment on Balsam Creek. Flows in Balsam creek upstream of the impoundment are augmented by releases from Balsam Forebay and water temperatures in the impoundment under existing conditions are cool (Section 5.2.4.2.2) and suitable for trout. Under the CDFG Alternative, water temperatures are expected to remain suitable for trout.

Entrainment

Entrainment potential under existing conditions was determined to be very low. No change would be expected under the CDFG Alternative.

Balsam Creek Bypass Reach

Under existing conditions, there are no MIF requirements in the bypass reach at Balsam Creek. Existing flows below the diversion derive from seepage, tributaries, and local area run-off. Under the CDFG Alternative, MIFs would be provided (Table 3.1.7-1).

The trout population in this reach was lower than expected in terms of fish densities and biomass. The extremely steep, bedrock stream channel provides limited physical habitat for fish. Natural, structural passage barriers are abundant in this reach and restrict upstream movement of fish. Although the proposed MIFs would enhance aquatic habitat, numerous structural barriers throughout the reach and the steepness of the habitat present would continue to limit upstream fish passage and the use of the enhanced habitat.

Habitat Impacts

CDFG Alternative MIFs are greater than the flow that the wetted perimeter analysis indicates is needed to be protective of fish and macroinvertebrate habitat (0.6 cfs) CAWG 3 Flow-Related Habitat - Lower Basin Wetted Perimeter Report, (CAWG 3, Flow-Related Habitat - Lower Basin Wetted Perimeter, SCE 2004a; Volume 4, SD-D (Books 11 and 23)). Under the CDFG Alternative, the MIFs would provide more habitat than is currently available, as there is no MIF under the current license. The change in flows from 2 cfs to 1 cfs in the spring would result in a 27% reduction in wetted perimeter that could result in fry stranding.

Temperature

Water temperatures in this reach were cool under existing conditions and suitable for trout. MIFs under the CDFG Alternative would maintain cool temperatures.

Aquatic Life

The CDFG Alternative MIFs would enhance habitat downstream of Balsam Diversion. Flows would be protective of fish and invertebrates. These flows would address resource issues related to flow-related habitat by providing MIF requirements, where currently there is none. Small seasonal changes in flow potentially could result in stranding of fry below the diversion. However, due to numerous, natural, structural barriers throughout the reach and the steepness of the channel gradient, upstream passage would remain limited, as would the use of the enhanced habitat.

Adit No. 8 Creek – Diversion to Big Creek

Adit No. 8 Creek is intermittent and fishless. Flows, to the extent they are present, result from leakage from the tunnel, the volume of which SCE cannot control. The CDFG Alternative does not include provision of a MIF or other action related to Adit No. 8 Creek.

Habitat Impacts

Adit No. 8 Creek is naturally intermittent, fishless, and has no populations of sensitive amphibians or reptiles. This alternative would maintain the same habitat conditions as the No Action and Proposed Action alternatives.

Ely Creek – Diversion to Big Creek

The CDFG Alternative proposes MIF requirements in this reach, where currently there is none (Table 3.1.7-1). Existing flows derive from seepage, tributaries, and local area run-off. Ely Creek upstream of the diversion may go dry by late summer and aquatic habitat in the bypass reach may be restricted to isolated pools or small accretion flows. The stream is inhabited by rainbow trout and rainbow trout hybrids. Under existing conditions, the trout population below the diversion is greater than above.

Ely Creek Diversion

Ely Creek Diversion forms a small impoundment on Ely Creek. Flows are intermittent upstream of the diversion. The CDFG Alternative would have little effect on aquatic habitat in the diversion impoundment.

Temperature

Under existing conditions, water temperatures are generally cool when flow is present. This would not be expected to change under the CDFG Alternative.

Entrainment

Under existing conditions, there was little potential for entrainment at this diversion (CAWG 9, Entrainment, SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26)). No change would be expected under the CDFG Alternative.

Aquatic Life

Under the CDFG Alternative, little change would be expected from existing conditions.

Ely Creek Bypass Reach

The CDFG Alternative would institute MIFs in the bypass reach (Table 3.1.7-1) that at times would exceed those identified by the wetted perimeter as being protective of fish and macroinvertebrates. Increased flow from this creek also may result in further enhancement for spawning in Big Creek below its confluence. The overall effect of the CDFG Alternative MIFs would be to enhance conditions for trout and macroinvertebrates, when flow is available.

Habitat Impacts

Flow-related Physical Habitat

The CDFG Alternative would provide increased habitat relative to the No Action Alternative during some portions of the year, through provision of MIFs ranging from 1.0 to 3.0 cfs. These flows exceed the flow that the wetted perimeter analysis identified as protective of fish and macroinvertebrates. The overall effect of these releases on fish populations in Ely Creek is unknown. Ely Creek has been observed to go dry above and below the diversion in some years, even when the diversion was turned out (CAWG 1, Characterize Stream and Reservoir Habitats, SCE 2003; SCE 2004a; Volume 4, SD-C (Books 7 and 21) and SD-D (Books 11 and 23)). Because this stream is not gaged, the frequency and duration of these dry periods is not known, therefore it is unknown to what extent enhanced flows at other times may create a useful habitat benefit.

Passage and Stranding

The abundance of cascades, natural barriers, and areas that go dry limit passage in this stream. Since flow is intermittent above the diversion, flows below the diversion may not be available to address dry areas as passage barriers. Modest changes in flow for both water supply conditions may result in large changes in wetted perimeter and increased potential for stranding under the CDFG Alterative.

Temperature

Water temperatures in this reach were generally cool, when flow was present. During periods when flow was unavailable upstream of the diversion, stagnant pools could reach temperatures stressful for trout. The CDFG Alternative MIFs would enhance water temperatures for trout, when flow is available.

Aquatic Life

The CDFG Alternative would address resource issues associated with flow-related habitat in this reach, when flow is available upstream. It would provide a MIF requirement where one does not currently exist and provide flows protective of fish and invertebrates when these flows are available. Water temperatures for trout would be enhanced, when flow is available. The overall effect of the CDFG Alternative MIFs would be to enhance conditions for trout and macroinvertebrates, when flow is available.

6.1.4.4 Big Creek 2A, 8 and Eastwood (FERC Project No. 67)

Resource issues and potential limiting factors for aquatic species in the Big Creek 2A, 8 and Eastwood Project under existing conditions are described in detail in Attachment C – Limiting Factors (Volume 4 (Book 5)), and are summarized by location in Section 5.2.4.3.2, Big Creek Nos. 1 and 2 (FERC Project No. 2174) – Project Effects on Project Waters. A summary of CDFG issues and objectives is provided at the beginning of Section 6.1.4.

Florence Lake

No resource issues were identified for Florence Lake. The CDFG Alternative would increase MIFs in the bypass reach of the SFSJR throughout the year (Table 3.1.7-1), which would increase releases from Florence Lake. There would be little or no change in operation of the reservoir, or of storage, in comparison with existing conditions (based on SCE's HydroBasin Model). Little effect is expected to habitat, water temperatures, or the potential for entrainment. This alternative is not expected to adversely affect fish using the reservoir.

Under the CDFG Alternative, SCE would conduct monitoring studies to characterize trends in the relative abundance and species composition of the fish community in Florence Lake. Because the CDFG Alternative MIFs would not result in a significant change in minimum reservoir elevations, potential impacts to trout populations, if any, are expected to be minimal from this source.

Habitat

There would be relatively little potential for habitat impacts within the reservoir.

Water Temperature

Under existing conditions, Florence Lake stratifies during the summer and begins to mix in the fall. Cool water temperatures suitable for trout growth (<20°C) are always available within the lake. When the lake is stratified, cool water from the lake's hypolimnion is available for release to the SFSJR bypass reach. There should have little or no effect on the availability of cool water in the lake or for release downstream. No impact to water temperatures in the reservoir would be anticipated.

Entrainment

Under existing conditions, fish vulnerability to entrainment at Florence Lake is low because intake velocities are low (less than 1 ft/sec). Furthermore, trout presence at the depth of the deep-water intake was low, and consisted mostly of larger fish that could escape intake velocities (CAWG 9, Entrainment, SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26)). Under the CDFG Alternative, little change would be anticipated in the effect on trout in Florence Lake compared with existing conditions.

Reservoir Fisheries

Under existing conditions, Florence Reservoir supports a brown trout fishery with smaller numbers of rainbow trout. Since little change is expected to reservoir habitat, water temperatures, or entrainment, the CDFG Alternative is expected to have little or no effect on fish populations in the reservoir.

South Fork San Joaquin River

The limiting factors analysis (Attachment C - Limiting Factors (Volume 4 (Book 5)) indicated that water temperature was the only factor that appeared to have the potential to adversely affect trout in the SFSJR bypass reach. Temperature model simulations indicate that during July of a dry water year with warm air temperatures, maximum daily water temperatures approach those that might be stressful for trout and daily mean temperatures are occasionally warmer than suitable for trout growth in the 2.5-mile reach upstream of Mono Creek. Daily mean water temperatures in a dry water year with warm air temperatures are warmer than suitable for trout in the most downstream portion of the SFSJR upstream of its confluence with the SJR (the lower five miles in July and 0.3 miles in August).

The CDFG Alternative would increase MIFs over those currently required (Table 3.1.7-1). The MIFs would be higher in normal (Wet and Above Normal) water years than in dry (Below Normal, Dry, and Critical) water years. The flow changes are proposed to help address water temperatures and to enhance flow-related habitat.

The impacts of this alternative were assessed for each of four subreaches of this bypass reach. These subreaches include from Florence Lake to the confluence with Bear Creek, from the Bear Creek confluence to the Mono Creek confluence, from the Mono Creek confluence to the Rattlesnake Creek confluence, and from the Rattlesnake Creek confluence to the confluence with the San Joaquin River.

South Fork San Joaquin River from Florence Dam to Bear Creek

The CDFG Alternative would result in increased habitat for trout in this subreach, while it provides higher flows to address water temperature impacts downstream. Water temperatures currently are suitable for trout growth in this subreach and would remain so under the CDFG Alternative.

Habitat Impacts

Flow-related Habitat (WUA)

The CDFG Alternative provides for different MIFs for normal and dry years. MIFs under this alternative would double the existing MIFs on average, as described in Section 3 (Table Attachment D-100). The increases in flow would increase adult spawning and juvenile habitat for all species.

The CDFG Alternative would increase summer habitat (July through September) for adult rainbow trout rearing by 13% during normal water years and 22% in dry years (Table Attachment D-100). Over the course of the entire year, habitat would increase by 27% and 39% in normal and dry years, respectively. The CDFG Alternative would provide about 90% of maximum WUA on average throughout the year (Table Attachment D-102). Under existing conditions, 83% and 74% of maximum WUA are provided in the summer during normal and dry years, respectively. A year-round average of 72% and 64% of maximum WUA is provided in the two respective water year types. For rainbow trout spawning, the CDFG Alternative would increase habitat by an average of about 10% in normal years, and 30% in dry years, over existing conditions. The CDFG Alternative would provide over 98% of maximum available spawning WUA in all years. Current conditions provide on average 90% of maximum available spawning WUA in normal years, and 79% in dry years.

Adult brown trout summer habitat would increase by about 5% in normal and dry years (Table Attachment D-101). Over the course of the entire year, adult brown trout habitat would increase by about 15% in relation to the existing conditions. The CDFG Alternative would provide at least 96% of maximum WUA at all times, as compared to the 77% to 93% provided under existing conditions (Table Attachment D-102). Brown trout spawning habitat would increase by 8% and 33% on average, in normal and dry years, respectively, relative to existing conditions. The CDFG Alternative would provide over 90% of maximum spawning WUA at all times, while current MIFs currently provide an average of 88% and 73% of maximum available spawning habitat in normal and dry years, respectively.

Rainbow and brown trout juvenile and fry habitat respond similarly to the flow changes under the CDFG Alternative. Juvenile habitat would be similar to that provided by existing conditions (Tables Attachment D-100 and D-101), with more than 90% of maximum WUA provided on average under both scenarios (Table Attachment D-102). Fry habitat would decrease by an average of 14% throughout both normal and dry years, providing about 80% of maximum available habitat on average. Current MIFs provide an average of about 90% of maximum WUA.

The results above were generally confirmed by the habitat TSA, except for rainbow trout spawning (Tables Attachment K-10 through K-15). The TSA indicates that rainbow trout spawning habitat would be very similar to that provided under existing conditions, while the MIF analysis found that habitat would increase for this life stage. The TSA analysis includes higher flows that are on the descending limb of the flow-habitat relationship,

while the MIF analysis does not, which accounts for the difference in predicted rainbow trout spawning habitat.

Passage and Stranding

The CDFG Alternative would not impact fish passage and would result in little potential for fish or redd stranding relative to existing conditions

Like the No Action Alternative, the CDFG Alternative would provide sufficient flows for passage at riffles at all times (CAWG 3, Instream Flow Studies – PHABSIM, SCE 2004a; Volume 4, SD-D (Books 11 and 23)). Because sufficient flow is provided for passage under both alternatives, fish passage would not be affected.

Fish stranding would be most likely to occur from April through July, when smaller fry are present. During this period, the CDFG Alternative MIFs would decrease from 45 to 40 cfs in normal years, and from 40 to 35 cfs during dry water years. These flow changes would result in less than a 1% change in wetted perimeter (Table Attachment D-43). The potential for fish stranding would be negligible. Rainbow trout spawning also occurs at this time. The stranding analysis indicates that all suitable spawning habitat would be retained over these flow changes.

During the brown trout spawning and incubation season, flows would drop from 40 to 30 cfs in normal years, and from 30 to 25 cfs in dry years under the CDFG Alternative. The redd stranding analysis indicates that less than 1% of the potential brown trout redd habitat would be lost over these flow changes (Table Attachment D-44). The loss of this amount of habitat would not be expected to affect brown trout spawning success

Temperature

Under existing conditions, this subreach of the SFSJR is consistently cool during the summer months, reflecting cool water released from Florence Lake and tributaries. Temperatures are suitable for trout. The CDFG Alternative would maintain cool water temperatures in this subreach as predicted by the stream temperature model developed by SCE (Figures 6.1.4-9 through 6.1.4-12; Figures Attachment F-25 through F-28).

Aquatic Life

<u>Fish</u>

Under existing conditions, trout are relatively abundant in this subreach and trout density is higher than at the reference site upstream of Florence Lake. Trout had condition factors over 1.00 and recruitment was successful. The CDFG Alternative would result in greater amounts of habitat for most trout life stages. Although physical habitat is not considered to be limiting, this alternative would benefit trout habitat. Water temperatures currently are suitable for trout growth and would remain so under the CDFG Alternative.

Macroinvertebrates

Under existing conditions, macroinvertebrates (including total macroinvertebrates and EPTs) were more abundant in this subreach than in the reference site upstream of Florence Lake. The CDFG Alternative would be expected to have little effect since there would be little change in wetted perimeter for increased macroinvertebrate production (Table Attachment D-43).

South Fork San Joaquin River from Bear Creek to Mono Creek

Temperature model simulations indicate that under existing conditions, during July of a dry water year with warm air temperatures, maximum daily water temperatures approach those that might be stressful for trout and daily mean temperatures are occasionally warmer than suitable for trout growth in the 2.5-mile reach upstream of Mono Creek. The CDFG Alternative would increase flows over those present under the existing conditions. These flow changes would address warm summer water temperatures in this subreach.

The increased MIFs also would enhance flow-related habitat for trout. Passage and stranding conditions currently are not, and would not become, resource issues.

Habitat Impacts

Flow-related Habitat (WUA)

Flows in this subreach derive from releases from Florence Lake, Bear Creek Diversion, and the other small tributaries to the South Fork San Joaquin River upstream of Bear Creek, as well as local run-off and accretion.

Under the CDFG Alternative, flows would double in normal years and increase by about 150% in dry years over the No Action Alternative (Table Attachment D-106)

The CDFG Alternative would increase summer habitat (July through September) for adult rainbow trout rearing by 18% in normal years, and 32% in dry years (Table Attachment D-106). Over the course of the entire year, the respective increases would average 35% and 50%. This alternative would provide about 80% of maximum WUA during the summer months and averaged throughout the year under both water supply conditions (Table Attachment D-108). For rainbow trout spawning, the CDFG Alternative would increase habitat by an average of 11% over existing conditions throughout normal years and 23% in dry years. The CDFG Alternative would provide more than 72% of maximum spawning WUA in all years, as compared to 49% to 69% of maximum available spawning habitat provided under existing conditions.

Adult brown trout summer habitat would increase by 10% in normal years and 18% in dry years (Table Attachment D-107). Over the course of the entire year, the respective habitat increases would average 19% and 30% in relation to the existing conditions for normal and dry years, respectively. The CDFG Alternative would provide more than 93% of maximum WUA during the summer months, and averaged throughout the year,

in normal and dry years (Table Attachment D-108). Brown trout spawning habitat would increase by 6% and 19% on average, in normal and dry years, respectively, relative to existing conditions. The CDFG Alternative would provide 78% of maximum spawning WUA at all times, as compared with 74% in normal years, and 66% in dry years provided under existing conditions.

Rainbow and brown trout juvenile and fry habitats would respond similarly to the MIF changes under the CDFG Alternative. Juvenile habitat would be similar to that provided by current conditions in all water year types (Tables Attachment D-106 and D-107), with more than 93% of maximum WUA provided under the CDFG Alternative (Table Attachment D-108). Fry habitat would decrease by an average of 11% throughout both normal and dry years. More than 80% of maximum WUA would be provided under the CDFG Alternative for fry of both trout species, while existing conditions provide 92% and 97% of maximum fry habitat in normal and dry years, respectively.

The habitat TSA found similar changes in habitat values to the WUA analysis for all species and life stages (Tables Attachment K-16 through K-21).

Passage and Stranding

The CDFG Alternative would not impact fish passage and would result in little potential for fish or redd stranding relative to existing conditions.

The CDFG Alternative would provide passage conditions similar to the No Action Alternative. The MIFs under both alternatives exceed the recommended passage flow when inputs from north- and south-side tributaries are included.

The probability of fish stranding and redd stranding resulting from the changes in flow under the CDFG Alternative is expected to be negligible. During the principal season for fish stranding, flows decrease from 57 to 48 cfs in normal years, and from 50 to 42 cfs in dry years. However, this change would be gradual. The reduction in wetted perimeter from the total flow change is less than 3% (Table Attachment D-50). During the rainbow trout spawning and incubation season, MIF reductions from 57 to 48 cfs in normal years and 50 to 42 cfs in dry years would result in less than a 6% loss of spawning habitat (Table Attachment D-51). During the brown trout spawning and incubation period, 47 to 34 cfs in normal years and 42 to 29 cfs in dry years would likely result in less than a 10% loss of the potential redd habitat. The potential for stranding is slightly greater than under the No Action Alternative, but is unlikely to affect fish populations.

Temperature

Under existing conditions during Wet and Above Normal Water Years, this subreach is cool throughout the summer with water temperatures suitable for trout growth. During drier years, the lower 2.5 miles of the subreach upstream of Mono Creek may occasionally be warmer than suitable for trout growth with daily maximum water temperatures approaching values stressful for trout, particularly in July (CAWG 5, Water Temperature Monitoring, SCE 2004a; Volume 4, SD-D (Books 12 and 23)). Warm

inflows from thermal springs in the area of Mono Hot Springs likely contribute to warming in this subreach. Under the CDFG Alternative, simulated daily mean water temperatures were 18.6°C or less (dry water year with warm meteorology) in this subreach (Figures 6.1.4-9 through 6.1.4-12) and daily maximum water temperatures did not exceed 22°C (Figures Attachment F-33 through F-36), thus providing a beneficial effect on temperatures for trout.

Aquatic Life

Fish

CDFG Alternative MIFs would result in substantial habitat enhancement. These would provide similar passage conditions to the No Action Alternative. Warm water temperatures under existing conditions in drier years with warm meteorology in the lower portion of this subreach may be unsuitable for trout at times. CDFG Alternative MIFs would result in suitable water temperatures throughout the summer. The enhancement of water temperatures may result in some increase in trout recruitment and density.

Macroinvertebrates

Under existing conditions, macroinvertebrates, including EPTs, were relatively abundant in this subreach and exceeded the density sampled at the reference site upstream of Florence Lake in the upper portion of the subreach. At the most downstream sampling site, upstream of Mono Creek, densities of both total macroinvertebrates and EPTs were less abundant than at the reference site, possibly due to warm temperatures, predation or both. The temperature enhancement expected under the CDFG Alternative should provide a benefit to macroinvertebrate populations.

South Fork San Joaquin River from Mono Creek to Rattlesnake Creek

Flows in this subreach would be greater than the No Action Alternative as a result of the CDFG MIFs. Higher MIFs from Florence Lake, Bear and Mono diversions, and other small tributaries would increase flows in this subreach of the SFSJR. These releases would control water temperatures in the lower portion of the SFSJR bypass subreach (next subreach downstream) and enhance flow-related habitat. Physical habitat for trout would be increased by the proposed MIFs.

Habitat Impacts

Flow-related Habitat (WUA)

Flows in the Mono Creek to Rattlesnake Creek subreach are derived from releases from Florence Lake, Bear and Mono Creek Diversions, and the other small tributaries to the South Fork San Joaquin River, as well as local run-off and accretion. The CDFG Alternative would more than double flows, on average, relative to current conditions in normal years and nearly triple the current MIFs in dry years (Table Attachment D-112).

The CDFG Alternative would increase summer habitat (July through September) for adult rainbow trout rearing by 19% and 30% on average in normal and dry years, respectively. Over the course of the entire year, the respective habitat increase was an average of 34% and 49% (Table Attachment D-112), respectively. The CDFG Alternative would provide more than 90% of maximum WUA both during the summer months, and averaged throughout the entire year, in all water year types (Table Attachment D-114). Current MIFs provide 80% of maximum habitat during the summer during normal years, and 70% in dry years. The existing conditions provide an average of approximately 65% of maximum WUA throughout the year in both water supply conditions. For rainbow trout spawning, the CDFG Alternative would increase habitat by approximately 45% over existing conditions in both normal and dry years. The CDFG Alternative would provide 95% of maximum rainbow trout spawning WUA in normal years and 85% in dry years, as compared to a little more than 60% of maximum available habitat provided in all water supply conditions under existing conditions.

The CDFG Alternative would increase adult brown trout summer habitat by about 10% in all water year types (Table Attachment D-113). Over the course of the entire year, adult brown trout habitat would increase by approximately 20% in relation to the existing conditions for both year types. The CDFG Alternative would provide more than 96% of maximum available habitat at all times in both normal and dry years (Table Attachment D-114). This is compared to an average of about 80% of maximum available habitat provided under existing conditions in both year types. Brown trout spawning habitat would increase by an average of 20% in normal and dry years, relative to existing conditions. The amount of WUA provided under the CDFG Alternative for brown trout spawning would average close to 80% of maximum spawning WUA in all years, as compared with about 65% under existing conditions.

Rainbow and brown trout juvenile and fry habitat respond similarly to the flow changes under the CDFG Alternative. Juvenile habitat would decrease slightly (3% to 11%) relative to the No Action Alternative (Tables Attachment D-112 and D-113). The CDFG Alternative would provide more than 82% of maximum WUA at all times (Table Attachment D-114), while the existing conditions provide at least 94% of maximum WUA at all times. Fry habitat would decrease by about 17% on average, providing about 75% of maximum WUA. Existing conditions provide about 90% of maximum fry habitat in all water year types.

The results above were confirmed in the habitat TSA, which showed similar changes in habitat for all species and life stages (Tables Attachment K-22 through K-27).

Passage and Stranding

The CDFG Alternative would not impact fish passage and would result in little potential for fish or redd stranding relative to existing conditions.

Sufficient flow for upstream passage would be provided under both the CDFG Alternative and the No Action Alternative, therefore the CDFG Alternative would not provide any benefit in this regard.

The probability of fish stranding resulting from the changes in flow under the CDFG Alternative is negligible. In April through July, when young of the year fish are present, the flow change would result in less than a 2% change in wetted perimeter (Table Attachment D-57) in normal years and 3% in dry years.

More than 92% of available rainbow trout redd habitat would remain viable, under the flow reductions occurring under this alternative, under both water supply conditions. This is unlikely to affect fish populations (Table Attachment D-58).

The redd stranding analysis indicates that less than 9% of the potential brown trout redd habitat would be likely lost over the entire flow change during the spawning and incubation season (Table Attachment D-58) in normal years. In dry years, the loss is likely to be less than 15%. The loss of this amount of habitat is unlikely to affect brown trout spawning success. Under the No Action Alternative, stranding is not an issue for fish or redds. The CDFG Alternative would result in very slightly higher potential for stranding of fish and redds, but this would be unlikely to affect fish populations.

Temperature

Summer water temperatures in this reach are suitable for trout under existing conditions. The CDFG Alternative, which includes increased MIFs in Mono Creek, would result in cooler water temperatures in this subreach (Figures 6.1.4-9 through 6.1.4-12; Figures Attachment F-25 through F-28).

Aquatic Life

Fish

Under existing conditions, trout are abundant in this subreach, with densities greater than the reference site upstream of Florence Lake. Condition factors averaged over 1.00 and the abundance of juvenile fish indicated successful recruitment (CAWG 7, Characterize Fish Populations, SCE 2003; Volume 4, SD-C (Books 8 and 21)). Habitat does not appear to be limiting in this subreach.

The CDFG Alternative would provide enhancements to both habitat and temperature. Increased flows would result in adult rearing habitat enhancement in drier years. This may provide some benefit to trout populations. The CDFG Alternative also would result in more spawning habitat, but may result in slightly more stranding of brown trout and to a much lesser extent rainbow trout redds than the No Action Alternative. Decreased juvenile habitat would occur under CDFG Alternative. Water temperatures currently are suitable for trout growth and would be cooler under the CDFG Alternative than under the No Action Alternative.

Macroinvertebrates

Macroinvertebrates, including EPTs, were less abundant than at the reference site. The reason for this is unknown. CDFG Alternative flows may provide some enhancement to

this subreach by increasing the stream width and area available for macroinvertebrate production in the summer months, especially in drier water years.

South Fork San Joaquin River from Rattlesnake Creek to San Joaquin River Confluence

Under existing conditions, temperatures in the lower portion of this subreach reached levels that are not conducive to good trout growth during the summer months in drier water years with warm air temperatures. Under the CDFG Alternative, flows would be greater than under the No Action Alternative. Under this alternative, temperatures in this subreach would be reduced to levels suitable for trout most of the time. Increased flows also would enhance flow-related habitat, especially in drier years. The CDFG Alternative would be expected to benefit trout populations by providing more suitable temperatures for growth, and to a lesser extent, by enhancing habitat.

Habitat and Passage

Habitat and passage relationships with flow would be the same as described above for the Mono Creek to Rattlesnake Creek Reach.

Temperature

Under existing conditions in the summer, water temperatures in this subreach warm as flow reaches the confluence with the San Joaquin River. During Dry and Critical Water Years with warm meteorology, such as 2001, daily mean water temperatures upstream of the San Joaquin River confluence exceeded 20ºC. These temperatures are considered unsuitable for optimum trout growth. Under existing conditions, daily maximum water temperatures in this subreach exceeded 22°C in 2001, but did not exceed 24°C (CAWG 5, Water Temperature Monitoring, SCE 2004a; Volume 4, SD-D (Books 12 and 23)). The CDFG Alternative would result in daily mean water temperatures of less than 20°C throughout the summer in most of the subreach (Figures 6.1.4-9 through 6.1.4-12). In July of drier years with warm meteorology, however, daily mean temperatures in the lower 1.7 miles of the subreach would still exceed 20°C. Daily maximum water temperatures would be reduced to less than 22°C (Figures Attachment F-33 through F-36). Therefore, water temperatures would be suitable for trout growth throughout this subreach except in July of warm, dry years.

Aquatic Life

Fish

Under existing conditions, trout abundance in this subreach is very high, with the second highest abundance for total trout and adult trout in the SFSJR. Condition factors for trout averaged greater than 1.00. The CDFG Alternative MIFs would substantially increase habitat. However physical habitat does not appear to be limiting under existing conditions; the only resource issue identified for this subreach is water temperature. Under existing conditions, water temperatures in the lower portion of the subreach are warmer than suitable for trout during drier water years with warm

meteorology. The CDFG Alternative would result in cooler water temperatures, but temperature simulations indicated a portion (1.7 miles) of the lower subreach would still exceed 20°C during July of Dry and Critical Water Years with warm meteorology. Cooler water temperatures resulting from the CDFG Alternative would provide an enhancement to the lower portion of this subreach and may be beneficial to fish growth in areas currently affected by warm water temperatures in drier years.

Macroinvertebrates

Both macroinvertebrate and EPT densities in this subreach were the highest of any site in the SFSJR under existing conditions. The increased flows that are part of the CDFG Alternative would decrease water temperatures and may provide some benefits to macroinvertebrate habitat in this subreach. However, it does not appear that macroinvertebrates are adversely affected by existing conditions.

Bear Creek

Bear Creek Forebay

The CDFG would increase MIF releases to the Bear Creek bypass reach. This alternative would have little effect on forebay operations and therefore, would have little effect on the fishery.

Bear Creek Bypass Reach

Under existing conditions, the brown trout populations in Bear Creek are at or above reference streams, with one of the highest densities observed in any Big Creek ALP Project stream. Recruitment is successful. However, brown trout abundance is at a level that adult and spawning habitat may be approaching limiting values, which suggests that trout abundance could increase if additional habitat for these life history stages became available. CDFG has proposed MIFs (Table 3.1.7-1) that would increase flows for spring-spawning fish (rainbow trout), which are not present in this reach, increase thermal protection for the stream fisheries and other aquatic organisms, and improve fish passage in late summer and fall.

The largest increases in MIFs would occur in the spring and summer. Increased releases in the spring would not affect spawning habitat or passage conditions for brown trout (a fall-spawning species) in Bear Creek. However, MIF increases in the fall would improve spawning habitat for brown trout, and MIF increases throughout the year would increase adult trout rearing habitat. The larger increases in the spring also would not address water temperature issues in the SFSJR, which occur in the late summer of drier years. Water temperatures in Bear Creek are currently suitable for trout and would remain suitable under the CDFG Alternative.

Habitat Impacts

Flow-related Habitat (WUA)

The CDFG Alternative provides for different MIFs in normal and dry years. Under CDFG Alternative, flows would be three to five times greater on average relative to the No Action Alternative (Table Attachment D-118).

The CDFG Alternative would increase summer habitat (July through September) for adult brown trout rearing by 52% and 79% in normal and dry years, respectively (Table Attachment D-118). Over the course of the entire year, the habitat increase would average 65% and 102% in the respective water years. This alternative would provide more than 52% of maximum WUA during the summer months, and averaged throughout the year, in all water years (Table Attachment D-119). Under existing conditions, 23% to 36% maximum WUA are provided in both water supply conditions, respectively. For brown trout spawning, the CDFG Alternative would increase habitat by an average of 22% over existing conditions in normal years and over 43% in dry years. The CDFG Alternative would provide an average of 75% of maximum spawning WUA. Under existing conditions, 62% and 53% of maximum available habitat is provided during normal and dry years, respectively.

Brown trout juvenile habitat would increase by 35% and 57% during the summer of normal and dry years, respectively, and would increase by 44% and 80% respectively over the course of the entire year (Table Attachment D-118). Approximately 85% of maximum WUA for juvenile trout would be provided, on average, throughout the entire year in both water supply conditions (Table Attachment D-119). Under existing conditions, 60% and 48% of maximum WUA are provided, on average, in normal and dry years, respectively. Brown trout fry habitat would increase by 11%, on average, during normal years and by 19% during dry years. The CDFG alternative would provide 96% of maximum fry WUA, on average, as compared with just over 80% under existing conditions.

The results of the habitat TSA, which evaluates habitat availability over a 20-year period of simulated operations, were very similar to the WUA analysis for normal years for all life stages (Tables Attachment K-28 through K-30).

Passage and Stranding

The CDFG Alternative would not impact fish passage and would result in little potential for increased fish or redd stranding relative to existing conditions.

The CDFG Alternative would result in similar passage conditions for trout as the No Action Alternative. While the No Action MIF of 1 cfs in the fall and winter of dry years is slightly less than the flow required for passage through typical riffles (1.1 cfs), over-releases, routinely made by SCE for compliance purposes, provide passage even during these times.

The probability of fish stranding and redd stranding resulting from the seasonal changes in flow under the CDFG Alternative is negligible. The change in wetted perimeter is less than 6% over the change in MIF from April through June, for both water supply conditions (Table Attachment D-62). This indicates a low potential for fry stranding. During the brown trout spawning and incubation season, flows decline gradually from 7 cfs in October to 4 cfs in January (Table Attachment D-63). The redd stranding analysis shows that this entire flow change would result in less than a 2% loss of redd area. While the current MIF is stable throughout the spawning and incubation period, this small increase in stranding potential would be negligible, and unlikely to adversely affect fish populations.

Temperature

Water temperatures in Bear Creek are cool under existing conditions and are suitable for brown trout. Water temperatures would remain suitable under the CDFG Alternative.

Aquatic Life

Fish

Under existing conditions, Bear Creek has one of the higher trout densities of any stream sampled, and condition factors were greater than 1.00. Brown trout is the only trout species currently found in the bypass reach. Water temperatures were suitable throughout the summer. While this suggests that there is no adverse effect on the trout population of the reach, increased physical habitat may provide potential enhancement to the trout population. Brown trout in Bear Creek had one of the lowest ratios of habitat per fish of any stream studied. This suggests that brown trout may be approaching or have reached a habitat bottleneck, particularly for adult rearing and spawning habitat (Attachment C - Limiting Factors). Although the CDFG MIFs do not target brown trout adult rearing and spawning habitat, increased habitat, especially in drier water years may provide an enhancement that may allow an increase in trout abundance.

Macroinvertebrates

Under existing conditions total density of macroinvertebrates in Bear Creek was greatest in the site immediately upstream of the SFSJR, and lowest just downstream of Bear Creek Diversion Dam. Factors affecting macroinvertebrate density are not clear. The increased MIFs under the CDFG Alternative would likely contribute to increased macroinvertebrate production, since the wetted perimeter of the stream would increase over that for existing conditions. Enhancements to macroinvertebrate habitat are most likely to occur during Wet and Above Normal Water Years when flows would be increased the most, relative to current MIFs.

Mono Creek

Mono Diversion Forebay

There were no identified aquatic resource issues in Mono Diversion Forebay under existing conditions. The CDFG Alternative would increase MIFs from the Mono Diversion to the Project bypass reach (Table 3.1.7-1). Water temperatures in the forebay are cool under existing conditions, and would remain so under the CDFG Alternative.

Entrainment

Overall, under existing conditions there is a low potential for entrainment through the intake and low potential for mortality. Under the CDFG Alternative, little or no change would be expected.

Aquatic Life

Fish

Under existing conditions, the forebay provides habitat for wild brown trout, which are abundant in the upstream reach. Hatchery rainbow trout may wash into the forebay from where they are stocked upstream. Sediment prescriptions that decrease sediment build-up in the impoundment would maintain pool depth (space) for fish and improve aquatic habitat within the forebay. Little or no other change to operations or habitat in the forebay would be expected from the CDFG Alternative.

Mono Creek Bypass Reach

Sedimentation of habitat, including loss of pool depth and embeddedness of gravels, is the most likely limiting factor in this stream. Under the CDFG Alternative the sediment management prescription to manage sediment in Mono Forebay in the Proposed Action (Appendix J Sediment Management Prescriptions (SCE 2007a; Volume 4, SD-H, (Book 20)) would be incorporated into CDFG's Section 1600 Stream Alteration Maintenance Agreement. Implementation of this prescription would provide a flushing flow to transport fine sediment from the bypass reach.

MIFs during the fall of dry years are lower than the identified passage flows for trout. However, the actual flows in the reach (based on the USGS record) are usually sufficient to provide passage as a result of SCE's practice of releasing slightly more than the required MIF to maintain compliance. The CDFG Alternative would increase MIFs in Mono Creek, primarily to increase habitat and to provide additional flow to the SFSJR.

Physical habitat for trout would be substantially enhanced and may be beneficial in conjunction with improved sediment conditions. The implementation of the sediment management prescription and CRM flows also would benefit the macroinvertebrate community. With the enhancement of sediment conditions, additional habitat may

provide the potential for trout population increases. Passage and stranding conditions are not currently and would not become resource issues. Water temperatures would remain favorable for trout.

Habitat Impacts

Flow-related Habitat (WUA)

The CDFG Alternative provides for different MIFs in normal and dry years. The CDFG Alternative would increase flows by three to four times, on average, over current MIFs (Table Attachment D-122).

The CDFG Alternative would increase adult rainbow trout summer rearing habitat by 47% during normal water years and 72% in dry years (Table Attachment D-122). Over the course of the entire year, habitat would increase over existing conditions by an average of 75% and 107% in normal and dry years, respectively. The CDFG Alternative would provide approximately 80% of maximum WUA, both during the summer and averaged throughout the year, in all water years (Table Attachment D-124). Current conditions provide an average of 47% of maximum WUA during normal years, and 37% in dry water years. Under the CDFG Alternative, the amount of rainbow trout spawning habitat would be 39% and 77% greater than that under current conditions in normal and dry years, respectively. The CDFG Alternative would provide more than 98% of maximum WUA for rainbow trout spawning in all years. Current conditions provide an average of 73% of maximum spawning WUA in normal years and 58% in dry years.

The CDFG Alternative would increase adult brown trout summer rearing habitat by 17% in normal years and 32% in dry years (Table Attachment D-123). Over the course of the entire year, adult brown trout habitat would increase relative to existing conditions by 32% for normal years and 53% for dry years. The CDFG Alternative would provide around 90% of maximum WUA throughout the year in all water years (Table Attachment D-124). This is compared to the 53% to 78% of maximum available habitat provided under current conditions in normal and dry years. Brown trout spawning habitat would increase by 39% in normal years and 65% in dry years, relative to existing conditions. The CDFG Alternative would provide over 98% of maximum spawning WUA at all times. Current conditions provide 72% of maximum available spawning WUA in normal years, and an average of 61% in dry years.

Rainbow and brown trout juvenile and fry habitat respond similarly to the flow changes under the CDFG Alternative. Juvenile habitat would remain similar to that under the No Action Alternative (Tables Attachment D-122 and -123) providing more than 94% of maximum WUA (Table Attachment D-124). Fry habitat would decrease by about 15% on average relative to existing conditions. The CDFG Alternative would provide more than 83% of maximum WUA, while existing conditions provide more than 96% of maximum fry habitat in all water years

The results described above were confirmed in the TSA, which showed similar changes in habitat for all species and life stages with normal year changes corresponding closely to those of the median habitat values in the TSA and the dry year changes corresponding closely to those of the 90% exceedance values in the TSA (Tables Attachment K-31 through K-36).

Passage and Stranding

The CDFG Alternative would not impact fish passage and would result in little potential for fish or redd stranding relative to existing conditions.

The CDFG Alternative would provide flows greater than that identified as being required for upstream adult passage (5.5 cfs) at all times. This could improve passage conditions for brown trout in the fall and winter of dry years, as the current MIF during this period is slightly less than the flow required for passage through typical riffles. However, releases routinely made to achieve compliance with the existing MIFs actually do provide passage at all times (CAWG 6, Hydrology, SCE 2004a; Volume 4, SD-D (Books 13 and 23)). Because of this, the CDFG Alternative is expected to provide little actual benefit for passage relative to existing conditions.

The probability of fish stranding and redd stranding resulting from the changes in MIFs under the CDFG Alternative are negligible. MIFs decrease from 35 to 30 cfs during the principal season for fish stranding in normal years, and from 30 to 25 cfs in dry years. These flow changes would result in a reduction in wetted perimeter of 4% or less (Table Attachment D-69). This is slightly greater than the No Action Alternative (where MIFs are stable during this season), but is unlikely to adversely affect fish populations. The same flow changes occur during the rainbow trout spawning and incubation season. The redd stranding analysis indicates that these flow changes would retain more than 98% of any potential redd area (Table Attachment D-70). During the brown trout spawning and incubation period, flow decreases from 30 to 20 cfs, which would result in less than a 2% reduction in potential spawning habitat. The potential for stranding is slightly greater than under the No Action Alternative (where flows are stable), but would be unlikely to affect fish populations.

Temperature

Water temperatures in Mono Creek are cool throughout the summer under existing conditions (Section 5.2.4.2.3-Affected Environment, CAWG 5, Water Temperature Monitoring, SCE 2004a; Volume 4, SD-D (Books 12 and 23)). The CDFG Alternative would likely result in a small reduction in summer water temperatures in the lower portion of Mono Creek, due to the higher release flows. However, water temperatures are suitable for trout under existing conditions in Mono Creek.

Aquatic Life

Fish

Under existing conditions, trout (rainbow and brown trout) abundance in Mono Creek is low. The ratio of WUA to trout abundance is one of the highest among Project streams. This strongly suggests that physical habitat, as derived from depths and velocities, is not limiting. Sedimentation of habitat, including loss of pool depth and embeddedness of gravels, likely have adverse effects on trout habitat, overwinter survival and recruitment, and is the most likely limiting factor in this stream. The implementation of a sediment management prescription in Wet Water Years, as recommended in the CDFG and Preferred alternatives, would result in substantial enhancement of sediment conditions and address this limiting factor for trout. This enhancement would likely improve trout recruitment and result in increased trout abundance. Physical habitat for trout would be substantially enhanced and may be beneficial in conjunction with improved sediment conditions. Improvements to sediment conditions and increased MIFs will likely provide beneficial effects to overwinter survival.

Macroinvertebrates

Under existing conditions, the densities of total macroinvertebrates and EPTs were highly variable between sampling sites along Mono Creek. The CDFG Alternative MIFs for Mono Creek would result in an increase in summer-wetted perimeter. This, combined with sediment management, would likely result in increased macroinvertebrate production and an enhancement of the macroinvertebrate community.

North Side Tributaries - Tombstone, North Slide and South Slide Creeks

These diversions are currently not in operation. During sampling conducted in 2002, not a single fish was found in North Slide Creek or South Slide Creek. In Tombstone Creek, brown trout were only found below the diversion. The CDFG would establish MIFs in the bypass reaches below the diversions (Table 3.1.7-1), but these MIFs could not exceed the unimpaired flows currently present. Under the CDFG Alternative, these diversions would remain in place and be available for operation, but with MIF requirements.

Flow-related Habitat

These diversions are currently not in operation, and have no MIF requirements. The CDFG Alternative would provide MIFs below the Tombstone, North Slide, or South Slide Creek Diversions, which would seasonally increase flows, if the diversions were to be put back into operation. The new MIFs would provide seasonal benefits to trout and macroinvertebrates, but the natural flows in these streams is insufficient to meet the proposed MIFs during the late summer and fall, so the diversions would not be able to operate at those times. Although hypothetically benefiting from CDFG Alternative MIFs, trout and macroinvertebrate production would continue to be limited by the seasonal low

flows. There would be no actual benefits when compared to existing conditions, since these diversions are not currently in operation.

Passage on these streams is limited by frequent structural barriers that restrict passage at any flow. These factors indicate that the CDFG Alternative would have only limited beneficial effects on trout and macroinvertebrates in these streams over the No Action Alternative.

Hooper Creek

Hooper Creek Impoundment

No resource issues were identified for the impoundment behind Hooper Creek Diversion. The CDFG Alternative would increase MIF releases to the bypass reach (Table 3.1.7-1). The Proposed Action sediment management prescriptions would be implemented under the CDFG Alternative. Limiting sediment build-up in the impoundment would maintain pool depth (space) for fish. Therefore, the improved sediment management under this alternative would result in a slight beneficial change from existing conditions in the impoundment.

Entrainment

The CDFG Alternative would not result in a change from existing conditions.

Hooper Creek Bypass Reach

Under existing conditions, flows for fish passage were identified as a potential resource issue. The CDFG Alternative would increase MIF releases to the bypass reach during April through September of Below Normal, Dry and Critical years, and during April through October of Wet and Above Normal Years (Table 3.1.7-1). MIFs would exceed the 2.5 cfs needed for passage through a typical riffle during the spring spawning season, particularly in wetter years, and would address the passage issue. MIFs would be protective of fish and macroinvertebrate habitat.

Habitat

In Hooper Creek, the CDFG Alternative MIFs exceed the flows identified by the wetted perimeter analysis as being protective of fish and invertebrates, as do the current MIFs. The CDFG Alternative would provide higher MIFs during the spawning period, which may facilitate passage through riffles where passage is restricted by the current MIF of 2 cfs. The passage analysis indicated that a flow of 2.5 cfs was needed to obtain passage through a typical riffle (CAWG 3, Flow-Related Habitat - Upper Basin Wetted Perimeter, SCE 2003; Volume 4, SD-C (Books 7 and 21)). The CDFG Alternative MIFs may improve passage at some riffles relative to the No Action Alternative, and thereby provide minor benefits to the trout population in this stream.

Temperature

Water temperatures in Hooper Creek are cool throughout the summer under existing conditions (Section 5.2.4.2 Affected Environment). Daily mean water temperatures in the bypass reach did not exceed 12.9°C during the temperature-monitoring period. Temperatures would be expected to remain cool under the CDFG Alternative.

Aquatic Life

Fish

Rainbow trout hybrids are abundant both above and below the diversion in Hooper Creek and condition factors were greater than 1.00. Under the CDFG Alternative, temperature conditions would remain cold and habitat would be enhanced with a small increase in wetted perimeter. Enhanced passage flows may provide some benefit to upstream movement for rainbow trout. A sediment management prescription should provide similar benefits to the Proposed Action by reducing sediment accumulations in lower Hooper Creek and replenishing spawning gravels. This will likely improve rearing and spawning habitat for trout, relative to the No Action Alternative.

Macroinvertebrates

Under existing conditions, macroinvertebrate densities immediately below the diversion were similar to those above the diversion. Densities of total macroinvertebrates and EPTs near the SFSJR confluence were lower. Under the CDFG Alternative, increased flows in Hooper Creek during the summer would increase wetted perimeter and may provide some benefit to macroinvertebrate production. Reduced sediment accumulation in the channel would also benefit macroinvertebrate production.

South Side Tributaries

Crater Creek

Crater Creek Diversion

Under the CDFG Alternative, MIFs would be instituted for the bypass reach, where currently there are no MIF requirements. The potential for brook trout to be diverted to Florence Lake from Crater Creek diversion would be reduced.

Crater Creek Bypass Reach

Under existing conditions, the bypass reach had lower than expected trout densities. The operation of the diversion results in periods when flows below the diversion are less than the flows identified by wetted perimeter analysis as protective of fish and macroinvertebrates. Natural base flows less than this protective flow likely occur during the summer and fall. The CDFG Alternative would institute MIF requirements in the bypass reach of Crater Creek, where currently there is none.

These flows would enhance physical habitat, when flow is available. However, low, dry-season, base flows would likely continue to affect trout, (brook trout is a fall-spawning species). Under current conditions, water temperatures are suitable for trout and would be expected to remain so under this alternative. Habitat and fish populations are highly fragmented by numerous falls and areas of bedrock sheet. Extensive upstream fish migration would be unlikely at any flow, and due to numerous structural barriers, upstream passage will continue to be limited.

Habitat Impacts

Flow-related Habitat

Unlike the Proposed Action, the CDFG Alternative does not call for removing Crater Diversion from service, but establishes MIFs in normal and dry years downstream of the diversion. The MIF requirements are such that water is unlikely to be available to meet them during most of the year (CAWG 6, Hydrology, SCE 2004a; Volume 4, SD-D (Books 13 and 23)). Therefore, this alternative would likely provide similar, but smaller benefits compared to the Proposed Action, as the limiting habitat conditions for trout and invertebrates would continue to be the low flows in late summer and fall under both alternatives. Upstream passage within Crater Creek will continue to be limited, due to numerous structural barriers.

Temperature

Water temperatures in Crater Creek were cool under existing conditions and were suitable for trout. Under the CDFG Alternative, temperatures would remain cool.

Aquatic Life

Fish and Macroinvertebrates

Under existing conditions, trout densities were greatest in the Crater Creek diversion channel and lowest downstream of Crater Diversion. Macroinvertebrate densities were greater above the diversion than below. The CDFG MIFs would provide habitat conditions more favorable for trout and macroinvertebrates in the bypass reach. This would be expected to enhance trout and macroinvertebrate populations. The level of enhancement would be limited by the low flow upstream of the diversion during the drier portion of the year.

Chinquapin, Camp 62, and Bolsillo Creeks

Diversion Impoundments

Under the CDFG Alternative, drop tube intakes on these three diversions would be screened. Little change would be expected to reservoir habitat, water temperatures, or entrainment.

Entrainment

Under the CDFG Alternative, drop tube intakes on diversions that provide water to the Ward Tunnel, would be screened. Only three of the diversions that feed the Ward Tunnel have vertical intakes, including the ones in Chinquapin, Camp 62 and Bolsillo creeks. Flows from each of these three creeks are diverted through a coarse trash screen and then over a circular overflow structure to a bore leading directly to Ward Tunnel. At lower flows, the flow path would tend to deter the entrainment of fish. They are out of service in the winter due to icing in these high-elevation locations. Screens would have to be removed from service prior to the winter months, to prevent damage from icing and reinstalled yearly.

Entrainment studies conducted by SCE found that the risk of entrainment at these diversions is low (CAWG 9, Entrainment, SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26)). Given the low risk of entrainment at these three diversions, that these diversions are not operated all year, and given the presence of self-sustaining, high-density populations of brook trout under existing conditions, the biological benefit of screening these diversions would be very low. Therefore, this measure is not likely to provide benefits to fish populations.

Chinquapin, Camp 62, and Bolsillo Creek Bypass Reaches

Chinquapin, Camp 62 and Bolsillo creeks are steep, boulder/bedrock streams. The existing MIFs in Chinquapin Creek approximate the flow indicated by wetted perimeter analysis to be protective aquatic habitat, but MIFs are less than the protective flow in Camp 62 and Bolsillo creeks. However, the most severe habitat bottleneck likely occurs in the summer and fall, when the natural base flows drop below the protective flows, and are less than existing MIFs. During this time, the diversions are turned out (not diverting).

The CDFG Alternative would increase MIFs over the No Action Alternative. These flows would maintain habitat in Chinquapin Creek and improve habitat conditions in Camp 62 and Bolsillo creeks, when flow is available. Because the unimpaired summer and fall flows likely impose the most severe habitat limitations on brook trout populations (a fall-spawning species) and because numerous, natural passage barriers prevent substantial upstream passage of fish at any flows, the CDFG Alternative MIFs may provide limited benefit to the populations over the No Action Alternative.

The presence of fine sediments in Bolsillo Creek was identified as a resource issue (Appendix C - Limiting Factors). Proposed Action sediment management prescriptions also would be implemented under the CDFG Alternative. These diversions would be turned out in the spring of Wet Water Years, and sediment behind the diversions sluiced as part of the sediment management prescriptions. The retention of high flows in the bypass reaches would enhance geomorphic and aquatic resources in these creeks, but especially in Bolsillo Creek, where sediment accumulation is an issue under existing conditions.

Habitat Impacts

Flow-related Habitat

On Chinquapin, Camp 62, and Bolsillo Creeks, the CDFG Alternative would require substantially higher MIFs than either the Proposed Action or the No Action Alternative, but would not require CRM flows. These higher MIFs would likely not be available for release during the majority of the year. Habitat for trout and macroinvertebrates would continue to be limited by low natural flows in late summer and fall. Because the unimpaired summer and fall flows likely impose the most severe habitat limitations on these populations, and because numerous, natural passage barriers prevent substantial upstream passage of fish at any flows, the CDFG Alternative MIFs would likely provide little benefit to fish and macroinvertebrate populations over the No Action Alternative.

Temperature

Under existing conditions, water temperatures in these small streams are cool and suitable for trout, and under the CDFG it is expected they would remain suitable for trout.

Aquatic Life

Fish and Macroinvertebrates

Under existing conditions, brook trout populations in Camp 62 and Chinquapin Creeks are healthy and abundant. In both creeks, total trout densities below these diversions are greater than above the diversions (reference sites) (CAWG 7, Characterize Fish Populations, TSRPs (SCE 2003; Volume 4, SD-C (Books 8 and 21))) (Section 5.2.4.2 Affected Environment). In Bolsillo Creek, trout densities are lower below the diversion than above. There are differences in the habitats present above and below the diversion in this creek. There also is a greater amount of fine sediments present below the diversion.

Under the Proposed Action and CDFG Alternative, sediments behind the diversions would be transported by opening drain gates during each spring run-off period in Wet Water Years, and physical removal of sediment would be implemented, if needed during the low flow period. MIFs would improve habitat conditions in Bolsillo Creek and maintain good habitat conditions in the other creeks, when flow is available. While the proposed MIFs may provide enhancements to trout and macroinvertebrate habitat, when flows are available, summer and fall habitat would remain the same as under the No Action Alternative due to naturally low base flows.

Balsam Forebay

There is some build-up of sediment in Balsam Forebay, which would be addressed by mechanical removal under the sediment management prescription (Appendix J Sediment Management Prescriptions (SCE 2007a; Volume 4, SD-H, (Book 20)). Since

little change is expected to reservoir habitat, water temperatures, or entrainment, the CDFG Alternative is expected to have little effect on habitat in the forebay.

Habitat

Operations under the CDFG Alternative are expected to be similar to those under existing conditions. The forebay contains suitable habitat for fish, but the small amount of shallow water habitat is indicative of the small size and relatively steep shoreline of the reservoir (CAWG 1, Characterize Stream and Reservoir Habitats, SCE 2003; SCE 2004a; Volume 4, SD-C (Books 7 and 21) and SD-D (Books 11 and 23)). The CDFG Alternative is expected to have little effect on habitat in the forebay.

Temperature

Under existing conditions, water temperatures may vary considerably, however, water temperatures suitable for trout growth (less than 20°C) were available throughout the summer months under existing conditions (No Action Alternative). Operations under the CDFG Alternative are expected to be similar to those under existing conditions. Therefore, the CDFG Alternative is not expected to alter water temperatures from those under existing conditions.

Entrainment

Under existing conditions, there was little potential for entrainment, which was confirmed by sampling. Since no increase in generation flow or change in reservoir elevations would be expected under the CDFG Alternative, no change in entrainment potential is expected from existing conditions.

Reservoir Fisheries

Since little change is expected to reservoir habitat, water temperatures, or entrainment from those of existing conditions, little change is expected in reservoir fisheries under the CDFG Alternative.

<u>Diverted Tributaries to Big Creek</u>

Pitman Creek

Pitman Creek Diversion

There are no identified resource issues in the diversion impoundment. There would be no change in operations expected under the CDFG Alternative and therefore no change in impacts to resources.

The diversion diverts flow to NF Stevenson Creek, or Balsam Forebay. Undiverted flows travel to Powerhouse 2 Forebay.

Entrainment studies conducted by SCE found that the risk of entrainment at small diversions is low (CAWG 9, Entrainment, SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26)). Given the low risk of entrainment and given the presence of self-sustaining populations of trout under existing conditions, there is little biological benefit of screening this diversion.

Pitman Creek Bypass Reach

The Pitman Creek bypass reach is a steep, bedrock-dominated stream. About half of the reach is plunge pool and step pool habitat with bedrock controls. These provide the vast majority of usable habitat for fish and are not responsive to changes in flow. Upstream migration is prohibited by numerous, natural, structural barriers. In spite of these constraints, the current fish populations are abundant and healthy under current conditions.

Resource issues are considered minor, but existing MIFs are below those recommended by the wetted perimeter analysis. The CDFG Alternative would increase MIFs for Pitman Creek throughout the year (Table 3.1.7-1). The CDFG Alternative MIFs would enhance habitat for both fish and macroinvertebrates below the diversion. The effective utilization of this potential enhancement by fish, however, is limited by the physical structure and passage barriers in the bypass reach.

Habitat Impacts

Flow-related Habitat

The CDFG Alternative would substantially increase MIFs on Pitman Creek relative to the No Action Alternative. The MIFs would exceed the 0.5 cfs suggested by the wetted perimeter analysis as protective of fish and macroinvertebrates, and would exceed the 2.5 cfs flow that the passage analysis indicates is adequate for passage through a typical riffle, from April through June (CAWG 3, Flow-Related Habitat - Lower Basin Wetted Perimeter, SCE 2004a; Volume 4, SD-D (Books 11 and 23)) (Table Attachment D-79). The No Action MIF does not meet the flows suggested by the wetted perimeter or passage analysis.

The Proposed Action may provide a slight benefit to fish and macroinvertebrate populations throughout the year, but likely will not result in a substantial increase in their populations. The fish populations on Pitman Creek downstream of the diversion are limited by the steep, bedrock nature of the channel (Attachment C – Limiting Factors). This habitat is not responsive to changes in flow. The nature of the channel also restricts upstream passage because of frequent structural passage barriers that would exist even at natural flows.

Temperature

Observed stream temperatures in the bypass reach of Pitman Creek were cool and suitable for trout. This would not be expected to change under the CDFG Alternative.

Aquatic Life

Fish and Macroinvertebrates

The CDFG Alternative MIFs would enhance habitat for both fish and macroinvertebrates below the diversion. The potential enhancement is limited by the physical structure and passage barriers in the bypass reach.

Balsam Creek – Balsam Forebay to Balsam Creek Diversion

Natural flow in this reach is currently augmented by releases from Balsam Forebay. Existing MIFs are greater than the flow identified by the wetted perimeter analysis as protective of fish and macroinvertebrate habitat during the summer months, and slightly less than this flow in the winter months. However, higher than required releases made to maintain compliance result in flows exceeding the protective flow at all times.

Habitat Impacts

Flow-related Habitat

The CDFG Alternative would result in improved rearing conditions for trout, as it provides flows that exceed the 0.6 cfs flow identified by the wetted perimeter analysis as being protective of fish and invertebrate habitat throughout the year (CAWG 3, Flow-Related Habitat - Lower Basin Wetted Perimeter, SCE 2004a; Volume 4, SD-D (Books 11 and 23)) (Table Attachment D-80). The No Action Alternative MIFs are slightly lower than the flow recommended by the wetted perimeter study for most of the year. The CDFG Alternative MIFs likely would provide some benefit for rainbow trout spawning and macroinvertebrates. Flows would also be higher during the migration season; however, upstream migration on Balsam Creek is limited by the steep, bedrock nature of the channel (Attachment C – Limiting Factors) which prevents migration at any flow.

Temperature

Under existing conditions, flows in this reach of Balsam Creek are primarily derived from MIFs released from Balsam Forebay, are cool throughout the summer, and are suitable for trout. Under the CDFG Alternative, little or no change would be expected.

Aquatic Life

Fish and Macroinvertebrates

Trout and macroinvertebrates are abundant in this reach under existing conditions. However, because current MIFs are less than recommended by the wetted perimeter analysis, a favorable response to increased MIFs is likely.

North Fork Stevenson Creek

Under existing conditions, flows in the reach of North Fork Stevenson Creek below Tunnel 7 are augmented by Project operations. Resource issues relate to a widening of the channel due to its use as a flow transport reach by SCE prior to the construction and operation of the Eastwood Power Station. This channel may occasionally still be used to convey high flows in the spring if the Eastwood Power Station is offline. Trout populations are lower than expected, due to high flow releases in several past years, which adversely affected recruitment. Gravel in this reach is limited in abundance (Attachment C - Limiting Factors).

The CDFG Alternative would increase MIFs downstream of the Tunnel 7 outlet over current MIFs (Table 3.1.7-1). However, the current infrastructure is not compatible with the magnitude of flow releases proposed under the CDFG Alternative. These MIFs would enhance fish habitat. Trout populations are expected to increase in the next few years, as the population is currently recovering from large flow events in the recent past that adversely affected recruitment. The frequency of natural, structural passage barriers will continue to restrict upstream spawning movements and a paucity of gravel in the uppermost portion of the reach would potentially continue to affect trout populations.

Habitat Impacts

Flow-related Habitat (WUA)

The CDFG Alternative provides for different MIFs for normal and dry years. The CDFG Alternative would increase flows by two to five times relative to current conditions (Table Attachment D-128).

Under the CDFG Alternative, rainbow trout adult rearing habitat increases would average 59% in the summer and throughout the year in normal years. During dry water years, the corresponding habitat increase would be approximately 68% on average (Table Attachment D-128). This alternative would provide around 70% of rainbow trout adult rearing maximum WUA at all times, as compared with the 38% to 47% currently provided (Table Attachment D-130). For rainbow trout spawning, the CDFG Alternative would increase habitat over existing conditions by 6% in normal years and 23% in dry years. The CDFG Alternative would provide more than 90% of maximum spawning WUA, on average, during normal and dry years, as compared to the 84% and 75% of maximum available spawning habitat provided under existing conditions, respectively.

Under the CDFG Alternative, adult brown trout rearing habitat would increase by an average of nearly 40% both during the summer months, and throughout the year in normal years. In dry years, the habitat increase would be about 47%, relative to the existing conditions, during the summer and over the year (Table Attachment D-129). The CDFG Alternative would provide over 85% of adult brown trout rearing maximum WUA in both the summer and throughout the year, as compared to about 60% provided under current conditions (Table Attachment D-130). Relative to existing conditions, the

CDFG Alternative would increase brown trout spawning habitat by 6% and 21% on average, in normal and dry years, respectively. The CDFG Alternative would provide 95% of maximum spawning WUA in all water year types, as compared with 90% of maximum spawning WUA provided under existing conditions in normal years, and 79% and dry years.

Rainbow and brown trout juvenile and fry habitats respond similarly to the flow changes under the CDFG Alternative. Averaged throughout the year and during the summer, juvenile habitat would increase by about 15% in normal years, and approximately 20% in dry years (Tables Attachment D-128 and D-129). Under the CDFG Alternative, over 97% of maximum WUA would be provided, on average, for juveniles, as compared to the 75% to 85% of maximum WUA provided under existing conditions (Table Attachment D-130). Changes in habitat for fry of both species would be negligible, as current conditions and conditions under the CDFG Alternative would vary by less than 6%. Both alternatives provide more than 96% of maximum available fry habitat.

The habitat TSA indicates that smaller increases in habitat would be provided than the MIF analysis described above (Tables Attachment K-37 through K-42). Under the CDFG Alternative, the TSA shows that the median habitat would increase by 31% for rainbow trout adult rearing WUA, relative to the No Action Alternative, and by 20% for brown trout adult rearing WUA. The median habitat for juvenile rearing and spawning would increase by about 10% for both species. The changes in habitat, based on the 90% exceedance habitat values, are more similar to those reported for the MIF analysis above.

Passage and Stranding

The CDFG Alternative would not adversely affect fish passage and would result in little potential for fish or redd stranding relative to existing conditions.

Both CDFG Alternative and the No Action Alternative MIFs exceed the flow necessary to provide passage through typical riffles (2.9 cfs) at all times. There are numerous, natural structural passage barriers on North Fork Stevenson Creek that would restrict upstream passage, every 1,000 to 2,000 feet on average, regardless of flow.

The potential for fish stranding and redd stranding would be quite low. Under the CDFG Alternative, the MIF would change from 25 cfs in May, to 20 cfs in June, to 15 cfs in July in normal years. In dry years, the flows would change from 20 to 12 cfs over this time period. The total change in wetted perimeter in either water supply condition would be 9% or less. This period is also the rainbow trout spawning and incubation season. The redd stranding analysis indicates that this flow change would retain at least 96% of the starting potential redd area (Table Attachment D-87). During the brown trout spawning and incubation period, flow decreases from 12 to 8 cfs in both normal and dry years. This would result in less than a 3% reduction in potential spawning habitat. The potential for fry and redd stranding is slightly greater than under the No Action Alternative (where flows are stable for all these periods), but would be unlikely to affect recruitment.

Temperature

Under existing conditions, water temperatures in this stream are cool throughout the summer and suitable for trout. The CDFG Alternative MIFs would result in slightly cooler water temperatures in the lower portion of the reach during summer months, due to higher flows.

Aquatic Life

Fish

The proposed MIFs would enhance fish habitat. Trout populations are expected to increase in the next few years, as the population is currently recovering from large flow events in the recent past that have adversely affected recruitment.

Macroinvertebrates

Under existing conditions, total macroinvertebrate and EPT densities in the augmented reach of North Fork Stevenson Creek were similar to or greater than those above the Tunnel 7 outlet, with the exception of the site immediately downstream of the outlet. Under The CDFG Alternative, an increase in wetted perimeter during the summer may result in increased macroinvertebrate production over existing conditions.

Shaver Lake

No resource issues were identified for Shaver Lake under existing conditions.

Reservoir Fisheries

With the CDFG Alternative, little change is expected to reservoir operations or elevations (based on SCE's HydroBasin model). Therefore, little to no change is expected to reservoir habitat, water temperatures, or entrainment, and therefore, little change is expected in reservoir fisheries.

Big Creek Dam 5 to Powerhouse 8 Reach

Dam 5 Impoundment (Big Creek Powerhouse 8 Forebay)

Under existing conditions, the only identified resource issue is related to the accumulation of sediment in the impoundment and its periodic release during tunnel walks and inspections. Under the CDFG Alternative, sediment in the forebay would be managed under a sediment management prescription, as it would under the Proposed Action (Appendix J Sediment Management Prescriptions (SCE 2007a; Volume 4, SD-H, (Book 20)).

Sediment management would maintain habitat conditions in the forebay by maintaining pool depth (space) for fish. No other change in operations or habitat would be expected under the CDFG Alternative.

Temperature

Under existing conditions, Big Creek Powerhouse No. 2 and 2A tailraces (Big Creek RM 1.85), which provide inflow to the forebay, provided cool water throughout the summer months to the forebay. These temperatures are suitable for trout. Little or no change in water temperature would be expected under the CDFG Alternative.

Entrainment

Under existing conditions, overall fish vulnerability to entrainment at the intake and mortality at Powerhouse No. 8 is low (CAWG 9, Entrainment, SCE 2004b; Volume 4, SD-E (Books 18, 24 and 26)). Under the CDFG Alternative, this would not be expected to change.

Big Creek Dam 5 to Powerhouse 8 Bypass Reach

Under existing conditions, the principal resource issues in this reach are warm water temperatures in the downstream portion of the reach, upstream passage in the fall of drier water years, overwintering flows in drier years, and periodic (approximately once every seven years) sedimentation when the impoundment is drained for tunnel inspections. Numerous natural passage barriers occur along the bypass reach, preventing extensive upstream migration under any flow conditions. Despite these resource issues, trout density is similar to that for reference streams.

The CDFG Alternative would increase MIF requirements below Dam 5 (Table 3.1.7-1). The MIFs would maintain cooler summer water temperatures in the lower portion of the reach, which at times are higher than suitable for trout growth in Dry water years with warm air temperatures. The MIFs would enhance habitat throughout the year.

Habitat Impacts

Flow-related Habitat (WUA)

The CDFG Alternative provides for different MIFs for normal and dry years. The CDFG Alternative would increase flows by three to eight times relative to current conditions (Table Attachment D-134).

Under the CDFG Alternative, adult rainbow trout rearing habitat would increase by an average of 48% to 55% both in the summer and throughout the year in the two water supply conditions (Table Attachment D-134). These MIFs would provide about 70% of maximum WUA during the summer months, and averaged throughout the entire year, in all water year types (Table Attachment D-136). Current MIFs provide 41% to 50% of maximum WUA considering both normal and dry conditions. Under the CDFG Alternative, rainbow trout spawning habitat would be increased by almost three times relative to current conditions in normal years and by four times in dry years. The CDFG Alternative would provide more than 97% of maximum WUA in all water years, as compared to a maximum of 34% of maximum WUA provided under existing conditions.

Adult brown trout rearing habitat would increase by about 35% to 40% relative to existing conditions in both water year types, during both the summer and averaged throughout the year (Table Attachment D-135). The CDFG Alternative would provide at least 82% of maximum WUA at all times, and nearly 90% during the summer, as compared with the 57% to 67% currently provided over all water year types (Table Attachment D-136). Brown trout spawning habitat would increase by 83% and 147%, on average, relative to existing conditions in normal and dry years, respectively. The CDFG Alternative would provide about 90% of maximum spawning WUA on average, in both water year types. This is compared with 50% and 37% of maximum available spawning WUA provided, respectively, in normal and dry years under existing conditions.

Rainbow and brown trout juvenile and fry habitat respond similarly to the flow changes under the CDFG Alternative. Juvenile habitat would increase by about 18% during the summer, and about 30% on average throughout the year (Tables Attachment D-134 and D-135) considering both water supply conditions. Nearly 100% of maximum WUA would be provided under the CDFG Alternative for juvenile trout, as compared to between 67% and 87% of maximum WUA provided under existing conditions (Table Attachment D-136). Under the CDFG Alternative, fry habitat would remain similar (maximum difference of 8%) to that provided under existing conditions, with more than 92% of maximum available fry WUA provided for both alternatives.

The results above were confirmed by the habitat TSA for rainbow and brown trout adult and juvenile life stages (Tables Attachment K-43 through K-48). Somewhat smaller increases in trout spawning habitat were indicated in the TSA, with a rainbow trout habitat increase of 133% at the median and a 243% increase at the 90% exceedance value. The TSA suggests that habitat increases of 56% and 166% would occur at median and 90% exceedance values, respectively, for brown trout spawning.

Passage and Stranding

The CDFG Alternative would not adversely affect fish passage and would result in little potential for fish or redd stranding, relative to existing conditions.

The CDFG Alternative would improve passage conditions for trout in December through March of dry years, when current MIFs are less than the 2 cfs needed for upstream passage through typical riffles (CAWG 3, Instream Flow Studies – PHABSIM, SCE 2004a; Volume 4, SD-D (Books 11 and 23)). Trout are unlikely to be migrating upstream at this time of year, however. In addition, there are numerous structural passage barriers in this reach that prevent upstream passage at any flow. Therefore the passage benefit provided by the CDFG Alternative would not be substantial.

During the principal season for fish stranding (April through July), the MIFs under the CDFG Alternative decrease from 20 to 15 cfs in normal years, and from 15 to 10 cfs in dry years. These changes would result in less than a 5% reduction in wetted perimeter, and therefore are unlikely to cause a substantial amount of stranding (Table Attachment D-93).

Rainbow trout redd stranding would not occur, as a result of changing MIFs under the CDFG Alternative. Flows are stable during the rainbow trout spawning and incubation season. For brown trout spawning and incubation, flows decrease from 10 to 8 cfs in normal years and are constant in dry years. The former change could result in a 5% loss of potential spawning habitat (Table Attachment D-94).

The CDFG Alternative would result in a slightly higher potential for fry and redd stranding relative to the No Action Alternative. These changes, however, are unlikely to be sufficient enough to materially affect fish populations.

Temperature

Under existing conditions, water temperatures increased from Dam 5 downstream to Big Creek Powerhouse 8, where powerhouse inflow provided cool water. Daily mean water temperatures did not exceed 20°C at the site downstream of Dam 5, but exceeded 20°C at the monitoring station upstream of Powerhouse 8 for 11 days in 2001 (CAWG 5, Water Temperature Monitoring, SCE 2004a; Volume 4, SD-D (Books 12 and 23)). In the summer of 2001, a Dry Water Year with warm meteorology, daily maximum water temperatures at the bottom of the bypass reach occasionally approached those that would be stressful for trout (up to 23.6°C) and exceeded 22°C for 24 days. The CDFG Alternative MIFs would enhance summer water temperatures for trout in this reach, resulting in temperatures suitable for trout throughout the summer (Figures 6.1.4-13 through 6.1.4-16; Figures Attachment F-37 through F-40).

Aquatic Life

Fish

Under existing conditions, trout populations in this reach have high densities and are in good condition. Physical habitat does not appear to be limiting under existing conditions. Summer water temperatures under existing conditions are warmer than desirable for trout in the lower portion of the reach. In addition, No Action sediment management operations in this reach may contribute to periodic episodes of sedimentation (Section 5.2.3, Geomorphology). Periodic sedimentation may decrease stream depth and smother spawning gravels and redds until flows of sufficient magnitude and duration occur to move this sediment downstream into the San Joaquin River. Due to the prevalence of shallow water habitats and sediment, winter flows may be lower than desirable in drier water years for over wintering under existing conditions.

The CDFG Alternative would enhance habitat throughout the year. The CDFG Alternative also would substantially increase overwintering trout habitat, which may contribute to increased long-term survival. The CDFG Alternative would enhance water temperatures in the lower portion of the reach, resulting in temperatures suitable for trout throughout the summer in all water year types. This may be beneficial to trout in the lower portion of the bypass reach. Numerous structural barriers would continue to restrict upstream passage.

The sediment management prescription for this reach, under the CDFG and Proposed Alternative, would control sediment releases and avoid periodic sedimentation of habitat. Although implementation of sediment management may result in short-term turbidity increases, there would be an overall net benefit to managing sediments in this reach. The implementation of these prescriptions would enhance habitat for fish and macroinvertebrates, which serve as their food.

Macroinvertebrates

Under existing conditions, total macroinvertebrate and EPT densities were relatively high. The CDFG Alternative would result in increased wetted perimeter in the summer months, which would enhance macroinvertebrate production. The sediment management prescription would reduce sedimentation of substrates, which also would contribute to increased production of macroinvertebrates.

Stevenson Creek

The availability of spawning habitat and passage flows were identified as potential resource issues for rainbow trout under existing conditions. Spawning habitat is likely low because suitable spawning gravels are uncommon, but current MIFs also contribute to the low availability of spawning gravels. Current MIF requirements are less than required for passage through a typical riffle, which may reduce access to areas of suitable spawning habitat, but natural structural passage barriers prevent migrations longer than 1,000 to 2,000 feet, on average, at any flow. Recruitment appears to be lower than expected.

The CDFG Alternative would increase MIF requirements throughout the year (Table 3.1.7-1). These flows address passage flows and spawning habitat for trout in a channel segment in the lower portion of the reach, which have been identified as potential resource issues in this reach. The enhancement of passage and spawning habitat should contribute to increased recruitment success and trout abundance. Macroinvertebrate densities, which are currently high, may also increase.

Habitat Impacts

Flow-related Habitat (WUA)

The CDFG Alternative provides for different MIFs for normal and dry years. The CDFG Alternative would increase MIFs by 67% to 400% relative to the current MIFs (Table Attachment D-140).

Under the CDFG alternative, adult rainbow trout rearing habitat would increase by 54% in both normal and dry summers, relative to the existing conditions (Table Attachment D-140). Over the course of the entire year, habitat would increase by an average of 59% and 51% in normal and dry water years, respectively. The CDFG Alternative would provide about 60% of maximum adult rainbow trout rearing WUA both during the summer and averaged throughout the year for both water supply conditions (Table Attachment D-141). The current MIFs provide about 40% of maximum adult WUA at all

times. Rainbow trout spawning habitat would be about five times greater during both water supply conditions, relative to existing conditions. The CDFG Alternative would provide 95% of maximum spawning WUA in normal years, and 85% in dry years on average. This is compared with 18% of maximum spawning WUA present under existing conditions.

Juvenile rainbow trout habitat would increase by about 15% during both the summer months, and on average throughout the year (Table Attachment D-140). Over 93% of maximum WUA would be provided under the CDFG Alternative for juvenile trout at all times. Under existing conditions, 80% to 88% of maximum WUA is provided for juvenile trout, with an average of 85% (Table Attachment D-141). Under the CDFG Alternative, habitat for rainbow trout fry would decrease by 9% on average. More than 87% of maximum available habitat would be provided under the CDFG Alternative, as compared with 100% provided for fry under current MIFs.

The results above were confirmed by the habitat TSA for rainbow trout adult and juvenile life stages (Tables Attachment K-49 through K-51). Smaller increases in rainbow trout spawning habitat were indicated, with a habitat increase of 272% at the median, and a 291% increase at the 90% exceedance value.

Passage and Stranding

The CDFG Alternative would not adversely affect fish passage and would result in little potential for fish or redd stranding relative to existing conditions.

The CDFG Alternative would provide sufficient flows for upstream passage at all times. This represents a benefit relative to existing MIFs, which do not provide the 4.25 cfs needed for passage through typical riffles. However, there are numerous, natural, structural barriers on Stevenson Creek. These structural barriers prevent substantial upstream migrations at any flow. Therefore, the CDFG alternative would provide minor benefits with regard to passage.

The probability of fish stranding and redd stranding resulting from the changes in flow under CDFG Alternative are negligible. MIFs gradually decrease from 15 to 8 cfs between May and July in normal years and 10 to 8 cfs in dry years. These changes in flow would result in less than a 9% reduction in wetted perimeter (Table Attachment D-98). This is greater than the stranding potential under the No Action Alternative, which has no potential to strand fish as MIFs are stable throughout this period, but is unlikely to affect the trout population. During the rainbow trout spawning and incubation season, the MIF declines from 15 to 10 cfs in normal years and 10 to 9 cfs in dry years. The stranding analysis indicates that all of potential spawning habitat would be retained over these flow changes (Table Attachment D-99). The No Action Alternative also has no potential to strand redds, as flows are stable during this season.

Temperature

Under existing conditions during the summer, water temperatures in Stevenson Creek at the release point at Shaver Lake Dam were cold when Shaver Lake was stratified

and warmed in a downstream direction. Water temperatures were suitable for trout growth. The CDFG Alternative would result in less warming of stream temperatures during the summer months (Figures 6.1.4-17 through 6.1.4-20; Figures Attachment F-41 through F-44), compared to the No Action Alternative. Since existing water temperatures are suitable for trout, there would be relatively little additional benefit from cooler temperatures.

Aquatic Life

Fish

Under existing conditions, rainbow trout are relatively abundant in Stevenson Creek. Passage flows and spawning habitat have been identified as potential resource issues in this reach under existing conditions. CDFG Alternative MIFs would provide enhanced passage flows and spawning habitat.

Macroinvertebrates

Under existing conditions, macroinvertebrate densities were relatively high but variable in this reach. The CDFG Alternative increased MIFs would increase the wetted perimeter of the stream and would likely result in additional macroinvertebrate production. This would enhance macroinvertebrate abundance.

6.1.4.5 Big Creek No. 3 (FERC Project No. 120)

Resource issues and potential limiting factors for aquatic species in the Big Creek No. 3 Project under existing conditions are described in detail in Attachment C – Limiting Factors, and are summarized by location in Section 5.2.4.2.4.

Management objectives for this reach of the San Joaquin River include maintaining the beneficial uses for both WARM and COLD Freshwater Habitat identified in the Basin Plan. The Stevenson Reach of the SJR contains a native fish assemblage, including hardhead, Sacramento pikeminnow and Sacramento sucker. Hardhead has a sensitive species status in Region 5 of the US Forest Service and is listed as a CDFG species of concern (Class 3 Watch List).

Powerhouse 3 Forebay (Dam 6)

No aquatic resource issues were identified in the forebay. The effect of the CDFG Alternative on habitat and water temperature in Powerhouse 3 Forebay is not expected to differ substantially from that of existing conditions, except in late summer of dry and warm years. The potentially accelerated depletion of cool hypolimnetic water in Mammoth Pool Reservoir (upstream) would be expected to result in loss of thermal stratification up to two weeks earlier than under existing conditions. This would result in warmer water temperatures in the forebay earlier than under existing conditions. While this may affect releases and downstream temperatures in the Stevenson Reach of the

SJR, it should have relatively little effect on fish in the forebay, since some cool water will remain available for trout originating from Big Creek.

San Joaquin River – Stevenson Reach

The potential fisheries resource issues under existing conditions in the San Joaquin River between Dam 6 and Powerhouse No. 3 include (1) water temperatures exceeding the CVRWQCB Basin Plan "COLD" objective in the lower portion of the reach - these water temperatures are too warm to be suitable for trout during summer; and (2) water temperatures within portions of the reach that are cooler than the preferred temperature range for hardhead. Trout abundance is lower than expected. A resource issue raised by the resource agencies is the need for increased adult hardhead and Sacramento pikeminnow habitats. This is based on the observation that outside of the spawning season, adult hardhead do not reside in the lower portion of the reach. Uncontrolled spills from Mammoth Pool Dam and subsequently from Dam 6 in Wet and Above Normal Water Years may scour trout embryos in their redds and result in fry mortality, which may affect recruitment in some years.

The CDFG Alternative would increase MIFs over the entire year (Table 3.1.7-1). MIFs would be higher in Wet and Above Normal Water Years than in drier years. These MIFs are intended to protect COLD water fish habitat in the bypass reach. The Basin Plan (CVRWQCB 1998) does not recognize the conflict between temperature preferences of cold water game fish and sensitive, native, transition zone species such as hardhead that have warmer temperature preferences. The reduction of summer water temperatures from those present under existing conditions may be considered an adverse impact to hardhead.

The CDFG Alternative would increase flow-related habitat for both trout and native transition zone species. Decreased water temperatures may facilitate increases in trout populations, for which increased physical habitat may be beneficial.

As with the Proposed Action, sediment pass-through activities at Dam 6 would move sediments downstream and would take place at five-year intervals. Following this activity, the stream would be hydraulically sluiced for at least 24 hours with flows of at least 3,000 cfs. This would benefit aquatic habitat by reducing the potential for long-term sediment accumulation in the impoundment and releasing sediments (including spawning gravels) to the downstream channel under conditions that provide adequate transport.

Higher MIFs from Dam 6 and Stevenson Creek would likely also result in some enhancement of macroinvertebrate populations.

Habitat Impacts

Flow-related Habitat (WUA)

MIFs under the CDFG Alternative would increase by 8 to 26 times the existing MIFs, as described in Section 3, Propose Action and Alternatives. The increases in MIFs would increase adult, spawning and juvenile habitat for all species.

The CDFG Alternative provides for different MIFs for normal and dry years. Dry year MIFs are the same as those under the Proposed Action for 11 of 12 months, while normal year MIFs are higher. The effect of dry year flows on habitat would be as described for the Proposed Action. In normal years, the increase in habitat relative to existing conditions would be 5% to 15% greater. The increase would be 5% or less for non-game fish, and 10% to 15% for trout.

The CDFG alternative MIFs would increase summer rearing habitat for adult hardhead by 50% in normal years, and 42% in dry years. Over the course of the year, the average increase in habitat for both year types would be about 40% (Table Attachment D-162). This alternative would provide between 70% and 90% of maximum WUA throughout the year, and more than 80% during the summer months. This compares with a maximum WUA of 58% under current conditions (Table Attachment D-164). This change may not provide much benefit to adult hardhead, however, as they do not remain in this reach during the summer months (CAWG 7, Characterize Fish Populations, SCE 2003; Volume 4, SD-C (Books 8 and 21)). Adult hardhead enter this reach from Redinger Lake to spawn during the spring or early summer and then return to the lake.

Juvenile hardhead rear in this reach throughout the year. The CDFG alternative would increase their habitat by about 25% in summer and throughout the year (Table Attachment D-162) in both normal and dry years. This alternative would provide over 97% of maximum WUA, during the summer months and more than 90% of maximum WUA during the entire year (Table Attachment D-164). Current MIFs provide 78% of maximum available habitat for juvenile hardhead.

Habitat for adult Sacramento pikeminnow would be increased by about 30% during the summer and throughout the year (Table Attachment D-161). The CDFG Alternative would provide more than 97% of maximum available habitat during the summer, and more than 90% of maximum WUA at all times, in all water year types (Table Attachment D-164). Under current conditions, 76% of maximum WUA is provided.

For adult Sacramento sucker, the CDFG Alternative would increase summer habitat by 65% in normal years, and 54% in dry water years. Over the course of the entire year, the habitat increases would average 57% and 49% in normal and dry years, respectively (Table Attachment D-163). The CDFG Alternative would provide more than 73% of maximum WUA during the summer and 61% to 84% of maximum available habitat over the course of the year, as compared to 48% of maximum habitat currently provided (Table Attachment D-164).

For juvenile Sacramento pikeminnow and Sacramento sucker, habitat under the CDFG Alternative would remain within 10% of that provided under current conditions (Tables Attachment D-161 and D-163). Under both CDFG and existing conditions, more than 90% of maximum WUA would be provided (Table Attachment D-164).

While trout have not been specifically identified as a management objective in this reach, the CDFG Alternative would increase habitat for them as well. Adult rainbow trout summer rearing habitat would increase by 89% in normal years, and by 74% in dry years under the CDFG Alternative. Throughout the year, the increase in adult habitat would average 77% and 67% in normal and dry years, respectively (Table Attachment D-158). During the summer, CDFG Alternative MIFs would provide 75% to 83% of maximum available habitat (Table Attachment D-160). This alternative would provide between 60% and 89% of maximum available habitat over the course of the year. Under existing conditions, 44% of maximum WUA is provided. For rainbow trout spawning, this alternative would increase habitat by more than five times, and provide more than 96% of maximum available spawning habitat, compared with 18% provided under current conditions.

Adult brown trout rearing habitat would increase by 66% and 57% in the summer months of normal and dry years, respectively, relative to existing conditions (Table Attachment D-159). Over the course of the year, the habitat increase would average about 55% in both year types. In normal water years, the CDFG Alternative would provide 92% of maximum WUA during the summer, and 87% during the rest of the year (Table Attachment D-160). During dry water years, the respective percentages would be 87% and 84%. Brown trout spawning habitat would be five times higher than under current conditions, providing an average of over 80% maximum WUA in both water years. This compares with a maximum spawning WUA of 15% under existing conditions.

Rainbow and brown trout juvenile habitat respond similarly to the flow changes under the CDFG Alternative. Juvenile habitat would increase by about 30% during the summer months, as well as, on average, throughout the year (Tables Attachment D-158 and D-159). During the summer, nearly 100% of the potential maximum juvenile habitat would be provided, and over 93% of maximum WUA would be provided at any time (Table Attachment D-160). Under existing conditions, 75% of maximum available habitat is provided for juvenile rainbow and brown trout.

Fry habitat for rainbow trout would decrease by 1% to 8% during June through September, when fry are present (Table Attachment D-158). Brown trout fry habitat will decrease by between 2% and 12% in months when they are present (Table Attachment D-159). The maximum amount of WUA provided under the CDFG Alternative for fry would be 81% to 94%, as compared with 92% under existing conditions (Table Attachment D-160).

Habitat Time Series Analysis (TSA)

For all life stages, the results of the habitat TSA were quite similar to results from the MIF analysis, especially the median habitat, showing similar increases for all species and life stages (Tables Attachment K-52 through K-65). The analysis of the amount of habitat exceeded 90% of the time under the CDFG Alternative shows smaller increases for all species and life stages. The 90% exceedance habitat would increase by 15% for juvenile hardhead, and 5% for juvenile Sacramento sucker and Sacramento pikeminnow. For adults of the native transition zone species, the 90% exceedance habitat would increase from 18% to 26%.

The amount of habitat exceeded 90% of the time would increase by 23% to 36% for the trout rearing life stages, and by over 350% for spawning under CDFG Alternative relative to the No Action Alternative.

Passage and Stranding

The MIFs for the CDFG Alternative would allow fish passage over riffles and shallow habitats at all times, which would provide an enhancement over existing conditions.

The potential for fish stranding is low during May through July, the time when young of the year fish are abundant and fish stranding is most likely to occur. The stranding analysis (Attachment E, Stranding Report) shows decreasing flows would result in a loss in wetted perimeter of about 2 feet, or 3% (Table Attachment D-156). The potential to strand the eggs of native transition zone species also would be low.

As the MIF is constant throughout the rainbow trout spawning and incubation season (April through June), there is no potential to strand rainbow trout redds. During the brown trout spawning season, the normal year MIFs would drop from 75 cfs in October to 25 cfs in November. MIFs would increase again in March. The flow decrease would result in the retention of between 80% and 92% of the habitat available at the start of the spawning period (Table Attachment D-157). During dry years, the flow would drop from 50 cfs in October to 25 cfs in November, and decrease again to 20 cfs in December. The change from 50 to 25 cfs would result in the retention of 86% to 97% of the suitable redd area at the starting flow. The 25 to 20 cfs flow change would result in the retention of over 98% of the spawning habitat. In both normal and dry years, the potential for brown trout redd stranding is increased relative to the No Action Alternative, in which flows during this period are stable.

Temperature

Under existing conditions, temperatures of water released at Dam 6 are generally cool throughout the summer and suitable for trout. Water warms as it travels downstream, but water temperatures in the upper portion of the reach are generally suitable for trout, except when Mammoth Pool loses thermal stratification and releases from Dam 6 become warmer. This would occur during a dry and warm September. Water warms as it flows downstream to the confluence of Stevenson Creek. Warm water temperatures

in the lower portion of the reach are in the preference range for hardhead and Sacramento pikeminnow, but are too warm for trout in the summer and early fall.

The CDFG Alternative MIFs would result in a substantial reduction of water temperatures in this reach in most months (Figures 6.1.4.21 through 6.1.4.24; Figures Attachment F-45 through F-48). An exception would occur in a dry and warm year after Mammoth Pool Reservoir mixes. Water temperature modeling shows that at that time, daily mean water temperatures would reach or exceed 20°C throughout most of the reach, regardless of flow released at Dam 6. Under the CDFG Alternative, this would occur about two weeks earlier than under existing conditions (No Action Alternative). In September of dry water years, daily mean water temperatures would exceed 20°C (ranging from 19.8°C to 20.7°C) throughout most (81.8%) of the reach. Modeled daily mean water temperatures in the reach were cooler than 20°C during all periods other than September of dry and warm years (Figure 6.1.4-24). Daily maximum temperatures did not exceed 22.0°C. These temperatures would benefit trout and would likely be less favorable to native transition zone fish species.

Aquatic Life

Fish

The CDFG Alternative would result in increased physical habitat for both trout and native transition zone species. Under existing conditions, water temperatures are suitable for trout in the upper portion of the reach, but not in the lower portion. However, trout abundance is low in the upper portion of the reach, where habitat is currently available and temperatures are suitable.

The CDFG Alternative MIFs also would increase habitat for native transition zone species. Habitat would increase for both juvenile and adult hardhead. Juvenile hardhead rear in this reach for extended periods. Adult hardhead apparently ascend this reach from Redinger Lake to spawn, but under existing conditions do not remain through the summer. Increased adult hardhead habitat under the CDFG Alternative may result in increased use by adult hardhead during the summer months, but cooler water temperatures due to the CDFG Alternative may discourage use by hardhead. Improved passage (due to increased passage flows) may enhance access to upstream areas in the bypass reach for hardhead and other native transition zone fish.

The CDFG Alternative would substantially reduce summer water temperatures throughout the bypass reach, as compared to existing conditions. These temperatures are lower than optimal temperatures for juvenile hardhead, which appear to be 24°C to 28°C (Moyle 2002). Moyle also states that most streams that contain hardhead have summer temperatures in excess of 20°C, and that in the Pit River hardhead generally selected the warmest temperatures available. Preliminary work by Wildlife Professor, Joseph Cech, suggests that adult hardhead acclimated to water temperatures below 20°C prefer temperatures at or above 20°C (J. Cech, University of California at Davis, pers. comm. 2006). Therefore, the reduction of summer water temperatures from those

present under existing conditions should be considered a potentially adverse impact to hardhead.

The CDFG Alternative MIFs are intended to produce compliance with the Basin Plan requirement to protect COLD water fish habitat, where practically controllable. The Basin Plan does not recognize the conflict between temperature preferences of cold water game fish and sensitive transition zone species, such as hardhead, with warmer temperature preferences.

Sediment prescriptions would benefit aquatic habitat by releasing sediments (including spawning gravels) from the impoundment to the bypass reach under conditions that provide adequate transport of fines.

Macroinvertebrates

Under existing MIFs, macroinvertebrates are abundant with greater EPT and overall densities than the reference site upstream of Mammoth Pool Reservoir. Highest densities occur downstream of Dam 6 and Stevenson Creek inflows. Under the CDFG Alternative, higher MIFs from Dam 6 and Stevenson Creek would likely result in some enhancement of macroinvertebrate populations.

6.1.4.6 Unavoidable Adverse Impacts

Operation of the four Big Creek ALP Projects under the CDFG Alternative would not result in unavoidable adverse impacts. However, there is the potential for an unavoidable adverse impact for Big Creek 3, (FERC Project No. 120) in the San Joaquin River from Dam 6 to Redinger Lake. Due to the potential effect of reduced summer water temperatures on hardhead.

The release of higher flows from Dam 6 under the Proposed Alternative would result in reduced summer water temperatures throughout the bypass reach, as compared to existing conditions. These flows would result in daily mean water temperatures less than 20°C in most years and provide water temperatures suitable for trout. Moyle (2002) states that most streams that contain hardhead have summer temperatures in excess of 20°C, and optimal temperatures for hardhead, appear to be 24°C to 28°C. Furthermore, preliminary work by Cech suggests that adult hardhead acclimated to water temperatures below 20°C prefer temperatures at or above 20°C (J. Cech, University of California at Davis, pers. comm. 2006). Warmer temperatures are present under existing conditions. The reduction of summer water temperatures from those present under existing conditions may adversely impact hardhead.

6.1.5 Terrestrial Resources

This section provides an analysis of potential resource impacts from implementation of environmental measures identified in the CDFG Alternative for the four Big Creek ALP Projects.

Increased Instream flows and Hatchery Support

It is anticipated that increased trout populations, due to increased aquatic habitat and fish stocking activities in Project impoundments and Project-affected reaches will continue to suppress amphibian populations in the Project vicinity where both are present. Trout have been shown to prey on the eggs and tadpoles of special-status amphibians including Yosemite toad (YT), foothill yellow-legged frog (FYLF), and mountain yellow-legged frog (MYLF). Under the CDFG Alternative, trout populations will likely increase due to increased MIF release, which will provide increased physical habitat for trout, as discussed above in Section 6.1.4 Aquatic Resources. Trout populations will also be supplemented by hatchery support and increased stocking activities. The CDFG hatchery support proposal is evaluated in Section 6.1.8, Recreation Resources. The CDFG is currently studying native amphibian populations throughout the Sierra and re-evaluating their fish stocking strategy to reduce adverse effects to native amphibians, especially in higher elevation lakes where trout may be absent or scarce and amphibians still present.

Mammoth Pool Deer Protection

CDFG recommends that SCE continue to implement Mammoth Pool Deer Protection measures included in the present FERC License, with the exception of the construction of deer access ramps near the Mammoth Pool Spillway. Measures to be continued include annual photo documentation of Mammoth Pool to identify the presence of debris and ensure any debris is removed in a timely manner to protect deer migration across the reservoir. Under the Proposed Action, the proposed Mule Deer License Article for the Big Creek ALP Projects includes provisions to ensure that the presence of debris that may impede deer migration across Mammoth Pool Reservoir is monitored and that any build-up of debris is removed in a timely manner. Specifically, SCE proposes to provide CDFG and USDA-FS (and other interested resource agencies) with annual photo documentation of the area at the floating boom above the spillway (i.e., area of concern), with an estimate of the extent of any debris present. If CDFG and/or USFS determine—based on review of the photograph and the estimate of the aerial extent of debris build-up—that the debris would impede deer migration, SCE will remove sufficient levels of debris before migration begins, to allow deer to migrate without impediment. The Mammoth Pool Deer Protection recommendations in the CDFG Alternative are consistent with the measures identified in the Proposed Action - Mule Deer License Article and, therefore, provide no additional protection for mule deer in the vicinity of Mammoth Pool.

Wildlife Mortality

CDFG recommends development of a Wildlife Mortality Mitigation Program to offset ongoing wildlife mortality resulting from Project reservoir operations and Project-associated traffic. However, no data are presented to support that reservoir operations and Project-associated traffic have resulted in significant increases in wildlife mortality, including deer mortality.

SCE has, over the past several decades, worked in collaboration with CDFG to address mule deer mortality associated with Project reservoirs and spillways. Under the Proposed Action, as stated in the TERR-14 (SCE 2003; SCE 2004a; Volume 4, SD-C (Books 10 and 22) and SD-D (Book 17)), SCE has implemented all approved mitigation measures related to the construction and subsequent operation of Big Creek Nos. 2A, 8 and Eastwood to the satisfaction of the agencies and all mitigation measures were signed-off by the Habitat Area Planning (HAP) Team. Measures recommended by CDFG for Mammoth Pool have also been implemented. In fact, since the initiation of SCE's mitigation efforts, it has received only one report of the deaths of four deer in the vicinity of Big Creek No. 4 at Redinger Lake. CDFG stated at that time, in a meeting with SCE, that not only were they unable to determine the cause of these deer mortalities, but that they did not believe that the deaths were a result of Project activities.

While CDFG has seen increased traffic-related wildlife mortalities, it is not evident that these mortalities are Project-related. The four Big Creek Projects are located primarily on Sierra National Forest lands that are utilized by SCE, USDA-FS, and the public. SCE has identified and committed to road closures in the Mammoth Pool and Big Creek Nos. 2A, 8 and Eastwood Projects to prevent disturbance of mule deer and other wildlife species.

Additionally, under the Proposed Action, SCE will implement the Mule Deer License Article, which includes avoidance and protection measures, as well as long-term monitoring, to protect mule deer during the term of the license.

Therefore, given that wildlife mortalities in the Project have not been shown to result directly from reservoir operations and Project-related traffic, it is not anticipated that recommendations in the CDFG Alternative for the development of a Wildlife Mortality Mitigation Program would result in additional protection to wildlife or a reduction in wildlife mortality.

Bear Mitigation

Under the Proposed Action, the proposed Bear/Human Interaction License Article includes provisions to install and use bear proof dumpsters at the Big Creek No. 1 administrative offices and company housing, and other Project facilities where food waste may be disposed of or stored. The Bear Mitigation recommendations in the CDFG Alternative are consistent with the Bear/Human Interaction License Article and, therefore, provide no additional protection for bears in Project vicinity.

Department Access to Restricted FERC Project Areas

Under the Proposed Action, SCE will provide access to CDFG staff to Project roadways, controlled by SCE, that are currently closed to public access by locked gates. In order to continue safe operation of restricted areas, SCE will continue to maintain records of individuals accessing these areas. Therefore, CDFG must obtain keys from SCE to

access these areas on an as-needed basis. The CDFG Alternative is consistent with the Proposed Action and therefore, provides no additional access.

6.1.5.1 Unavoidable Adverse Impacts

Under the CDFG Alternative, it is anticipated that amphibian populations in the Project vicinity will be suppressed due to increased trout populations. Trout populations may increase due to additional aquatic habitat from MIF releases and from hatchery supported fish stocking activities.

6.1.6 Riparian Resources

This section provides an analysis of the potential impacts resulting from implementation of MIF recommended in the CDFG Alternative for each of the four Big Creek ALP Projects. The existing riparian resources and potential resource issues in each of the streams in the vicinity of the four Projects is described in Riparian Resources Section 5.2.6.2, Affected Environment and Section 5.2.6.3, Impacts of Proposed Action.

The CDFG Alternative does not propose any CRMF releases designed to benefit riparian resources. The proposal does include increases in MIF for all of the streams relative to the No Action Alternative, which would slightly increase water depths and wetted widths. However, although these flows will be protective of riparian resources, the proposed MIF changes will not likely have a substantial benefit to the existing riparian resources compared to the No Action Alternative. In addition, as the majority of the riparian resource issues identified along specific stream reaches were related to changes in the frequency and duration of high flows rather than by limited water availability under the No Action Alterative, riparian resource issues will likely continue under the proposed flows in the CDFG Alternative.

6.1.6.1 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts to riparian resources from implementing environmental measures in CDFG Alternative.

6.1.7 Aesthetic Resources/Land Management

This section provides an analysis of potential impacts on aesthetic resources and land management from implementing new MIF. Potential aesthetic and land management resources affected by environmental measures proposed in the CDFG Alternative include consistency with land management plans, changes in wilderness values, and changes in WSE in Project reservoirs.

6.1.7.1 Consistency with Land Management Plans

The CDFG Alternative includes MIF that developed to protect and enhance environmental resources, in accordance with the goals and guidelines contained in the Forest Service LRMP and the 2001 and 2004 Sierra Nevada Forest Plan Amendments. The CDFG also provides for continued Hydro generation, albeit a smaller amount of generation. The CDFG Alternative is therefore consistent with known land management plans.

6.1.7.2 Aesthetics

Changes in Water Surface Elevations (WSE) within Project reservoirs

Increases in MIF releases into bypass reaches under the CDFG Alternative may slightly impact WSE in the Project reservoirs (i.e., Florence, Huntington, Shaver, and Mammoth Pool). However, the Hydrobasin model results indicate that there will be only a minor shift in the timing when the reservoirs will be filled and when drawdown will begin under the CDFG Alternative (see Section 6.1.8, Recreation Resources), which should not interfere with peak recreation seasons, when the vast majority of visitors are present. Therefore, aesthetic resources at Project reservoirs associated with the four Big Creek ALP Projects will not be adversely impacted by environmental measures proposed in the CDFG Alternative.

6.1.7.3 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts to aesthetic resources from the CDFG Alternative.

6.1.8 Recreation Resources

This section provides an analysis of potential impacts on recreation resources from providing hatchery support for stocking of project impoundments and implementing new MIF releases for the four Big Creek ALP Projects (See Section 3.2). Potential recreation resources affected by these environmental measures include recreational angling opportunities and changes in WSE in Project reservoirs.

Hatchery Support for Stocking of Project Impoundments and Project-Affected Reaches

The CDFG Alternative recommends SCE reimburse the CDFG for the ongoing cost of fish stocking, along with efforts for fish production and monitoring. CDFG states that this funding is to reimburse the department for the ongoing cost of fish stocking, along with efforts for fish production and monitoring, that are necessary to sustain a high quality recreational fishery in Project impoundments, Project affected reaches and nearby waters in the upper San Joaquin River watershed. The implementation of the hatchery support measure will maintain the recreational fishery at its current level. The CDFG does not propose to increase stocking activities in the upper San Joaquin River

Watershed. The CDFG in their request, asked for reimbursement of the current programs, which they estimate at approximately $300,000 per year.

Reservoir Water Surface Elevations (WSE)

Low reservoir WSE reduces water surface area and may result in the loss of reservoir recreation use and a diminished recreational experience. In addition, when reservoir levels are lowered below the end of the boat ramps, boater access to the reservoirs becomes impaired. These factors are discussed in REC 15, Reservoir Water Surface Elevation Study (SCE 2004a, Volume 4, SD-D (Book 16)). However, increases in MIF releases into downstream reaches under the CDFG Alternative may only slightly impact WSE in the Project reservoirs (i.e., Florence, Huntington, Shaver, and Mammoth Pool) associated with the four Big Creek ALP Projects. Project operations under the CDFG Alternative would result in little or no change in reservoir surface elevations throughout the peak recreation season, as evaluated by the HydroBasin Model. Therefore, reservoir recreation and supporting facilities at Project reservoirs associated with the four Big Creek ALP Projects will not be adversely impacted by environmental measures proposed in the CDFG Alternative.

6.1.8.1 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts to recreation resources from the CDFG Alternative.

6.1.9 Hydroelectric Generation and Air Quality

Under the CDFG Alternative, the recommended MIF increases for the four Big Creek ALP Projects result in an annual loss of generation in the Big Creek System of approximately 5.3% (169 GWh) compared to the No Action Alternative. The increase in annual carbon dioxide air emissions associated with increased fossil-fuel generation required to offset the decrease in hydroelectric generation is approximately 79,386 tons. The overall effect will be a decrease in hydroelectric generation, higher electric rates, and an increase in global warming air emissions associated with increased fossil-fuel replacement generation.

6.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the four Big Creek ALP Projects would continue to operate under the current license conditions. SCE would also continue to implement existing environmental and cultural measures (i.e., programs, measures and facilities) for the protection and enhancement of the resources in the vicinity of the four Projects (see Section 3.1.6). However, new resource protection and enhancement measures recommended in the Proposed Action to enhance environmental and cultural resources would not be provided by SCE. Existing resource conditions and potential resource issues described in the Affected Environment and Environmental Impact sections for each resource category (see Section 5.2, Environmental Setting and Expected

Environmental Impacts of the Proposed Action) would continue under the No Action Alternative.

6.3 COMPARISON OF ALTERNATIVES

This section provides a comparison of the resource impacts that would likely result from implementation of the environmental measures related to MIF and CRMF in the Proposed Action and CDFG Alternative. The general framework for considering the environmental measures for each alternative is provided below. Next, a comparison of resultant resource impacts from the Proposed Action and the CDFG Alternative are described by Project.

The minimum instream flow recommendations should be consistent with the Federal Power Act (FPA) for the Commission's treatment of natural resources and power generation. FPA Section 4(e) provides for the Commission to take a broad look at all power and non-power issues prior to issuing a new license.

> "In deciding whether to issue any license under this Part for any project, the Commission, in addition to the power and development purpose for which licenses are issues, shall give equal consideration to the purposes of energy conservation, the protection, mitigation, of damage to, and enhancement of, fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality."

FPA Section 10(a)(1) gives the Commission similar direction and lists other beneficial public uses, such as irrigation, flood control, and water supply. Overall, this section requires:

"That the project adopted, …shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for the improving or developing a waterway…"

6.3.1 Proposed Action:

The Proposed Action addresses the resource issues that were identified in the extensive analysis of data performed for 67 separate Big Creek ALP technical studies. These recommendations provide protection and enhancement for the environmental resources within the Project (Proposed Action described in Section 5.0) while encompassing many of the measures identified in the CDFG Alternative, as described below.

The Proposed Action provides the best balance between the available developmental and environmental values by focusing on factors within the Basin that are limiting the existing natural resources. To the extent, those factors are Project-related, the Proposed Action provides minimum instream flow-based recommendations to enhance those resources while considering the effects on power generation. The Proposed Action recognizes that merely increasing flow-related habitat will not automatically result

in a resource benefit, such as a fish population increase. Specifically, flows are recommended at a magnitude, duration, and frequency appropriate to address the limiting factors so that the baseline natural resources are enhanced without resulting in an excessive amount of lost generation. In developing appropriate flow recommendations, careful consideration was given to evaluating the relationship between increases in flow and the resulting incremental increase in instream habitat, inundation area on channel bars or adjacent meadows, and summer water temperatures. In general, the recommended flow increases were capped when either a substantial increase in habitat was produced compared to existing conditions, thereby adequately addressing limiting factors, or the incremental rate of habitat enhancement with subsequent increases in flow decreased markedly (i.e., less "bang for the buck"). The Proposed Action includes actions for maintaining physical habitat and managing sediment. Monitoring plans also are included in the Proposed Action including those for water temperature, fish population trends, riparian conditions, and sediment.

6.3.2 CDFG Alternative

The CDFG Alternative proposes limited environmental measures that largely focus on an increase in MIFs for 23 stream reaches, monitoring and mitigation for fish entrainment, densities, and the potential bioaccumulation of silver in fish within Project reservoirs, extension of the Stream Bed Alteration Permit for the Projects, deer and bear protection and mitigation, and funding to support fish stocking and offset increased wildlife mortality. The Proposed Action and the CDFG Alternative are similar for many of the environmental measures, as described below. The MIF releases in CDFG Alternative and the Proposed Action are similar for a number of bypass reaches. Where the alternatives differ, the CDFG Alternative generally provides greater MIFs and aquatic habitat enhancement in the bypass reaches in wetter water year types. In drier water years, the CDFG Alternative may include months in which MIFs are equal to or less than the Proposed Action. Consequently, during some months of drier water years, the CDFG Alternative provides habitat less than or equal to Proposed Action. MIFs recommended in the CDFG Alternative, especially during wetter years, represent large increases over existing conditions, even though SCE believes that resource issues were not identified in the studies undertaken during the ALP that would support such increases.

6.3.3 No Action Alternative

The No Action Alternative maintains the existing baseline, with no enhancement to existing resources. Under an appropriate National Environmental Policy Act analysis, the No Action Alternative is acceptable because it does not result in any additional impacts to existing natural resources. The status quo is maintained and resources in the area will remain at today's baseline levels, and power generation would be unchanged. However, the alternative does not adequately consider the potential to improve natural resources in the Project Area. As the No Action Alternative is the

existing baseline, it shall not be discussed in any detail in the comparison below. Both the Proposed Action and the CDFG Alternative were previously compared to the No Action Alternative in Sections 5.2, Environmental Setting and Expected Environmental Impacts of the Proposed Action and 6.1, respectively. Table 3.1.7-1 illustrates the flows comprising the No Action, Proposed Action and the CDFG Alternative, so that they can be easily compared.

6.3.4 Similarities Between the Proposed Action and the CDFG Alternative

Both the Proposed Action and the CDFG Alternative provide for environmental measures that are intended to either protect or enhance existing resources, including aquatic habitat, terrestrial resources, and recreation. However, the resulting effects on hydroelectric generation differ markedly among the alternatives. A comparison of the similarities between the Proposed Action and the environmental measures included in the CDFG Alternative for each of these resources is provided below.

The Proposed Action and CDFG Alternative protect environmental resources by enhancing existing natural resources above that existing under current Project operations. They are both intended to meet Central Valley Regional Water Quality Control Board (CVRWQCB) Basin Plan objectives. An objective met by both alternatives under most conditions, which is not met under the No Action Alternative, is protection of a coldwater fishery by providing suitable water temperature for trout in all bypass reaches, where such water is available.

The Proposed Action and the CDFG Alternative both establish MIF where none currently exist, in some bypass reaches and increase MIF at others. These actions should increase the amount of flow-related physical habitat available for aquatic species. Both alternatives provide flows and habitat greater than needed to address limiting factors in many bypass reaches.

Both the Proposed Action and the CDFG Alternative propose reservoir fishery monitoring and support of angling through fish stocking, as well as an analysis to determine if fish in the Project reservoirs are bioaccumulating silver.

The Proposed Action has environmental measures that meet the request of the CDFG Alternative to provide deer and bear protection and mitigation.

The CDFG Alternative measure requesting an extension of the existing Stream Bed Alteration Permit is consistent with the Proposed Action sediment management prescriptions, which the CDFG Alternative states is a necessary portion of the new License.

Neither alternative is expected to impact reservoir aesthetics or recreation, because higher MIF and CRMF result in only a slight shift in the timing of reservoir filling and drawdown. In both cases, reservoir WSEs will remain relatively stable and boat ramps will be functional during the peak recreation season.

6.3.5 Differences Between the Proposed Action and CDFG Alternative

Many of the environmental issues identified in the CDFG Alternative are addressed in the Proposed Action, but the points where the two alternatives differ are summarized below.

The Proposed Action identifies specific CRMF and SMPs to address Project impacts to the riparian resources as well as impacts to the geomorphic resources within the Project. The CDFG Alternative does not identify any CRMF and adopts the sediment management prescriptions developed in the Proposed Action. Existing Project operations have reduced the frequency and magnitude of high flows in Mono Creek below the Mono Diversion associated with the Big Creek Project Nos. 2A, 8 and Eastwood Project, and have resulted in accumulation of fine sediment in pools and spawning gravels within the adjustable stream reaches. Under the Proposed Action, CRMF releases would be provided to enhance geomorphic processes and subsequently enhance aquatic resources in the bypass stream reach. The CRMF releases in Wet and Above Normal Water Years will transport and reduce accumulations of fine sediment in bypass reaches.

The CDFG Alternative requests that SCE install fish screens on the drop tube intakes on the Project diversions, primarily the diversions that supply water to the Ward Tunnel. However, there is no supporting information as a basis for this recommendation and it is contraindicated by studies conducted by the CAWG. The Proposed Action does not incorporate this recommendation, based on the results of the technical studies conducted in relation to the Project diversions, which determined that the risk of entrainment and mortality were low.

As noted above, the CDFG Alternative frequently includes higher flows than the Proposed Action, while providing little additional habitat enhancement and in drier water years, it may provide habitat enhancement equal to or less than that of the Proposed Action. Both of the alternatives provide flows and habitat amounts greater than identified as necessary to address limiting factors in many bypass reaches. Both alternatives also enhance temperature conditions to meet temperature criteria. In most cases, the Proposed Action provides this enhancement at a lower proposed flow release than the CDFG Alternative.

The CDFG Alternative proposes that SCE reimburse the CDFG for the entire cost of fish stocking in the watershed, which was felt by the parties to the Settlement Agreement to be excessive. The Proposed Action proposes a fifty percent level of funding.

The Proposed Action contains a Temperature Monitoring and Management Plan, not contained in the CDFG Alternative, which will help to ensure that water temperatures are maintained in compliance with the Basin Plan where practically controllable by the Project.

The Proposed Action would implement a fish trend monitoring plan that would include both bypass reaches and major Project Reservoirs. This plan also would provide for

fish and crayfish tissue sampling for bioaccumulation of silver in Mammoth Pool Reservoir and Huntington Lake. The CDFG Alternative would only implement fish monitoring in the several Project reservoirs and would include tissue sampling. Stream reaches would not be sampled under the CDFG Alternative.

Temperature monitoring and fish monitoring proposed under the Proposed Action for the Stevenson Reach of the SJR would help identify potential adverse impacts to hardhead. These monitoring programs will provide benefits to management of hardhead in this reach. Without such data (as would be the case under the CDFG Alternative) potential adverse impacts to this, and other native transition zone species, would likely be unavoidable.

The Proposed Action does not recommend a Wildlife Mitigation fund to be contributed by SCE for miscellaneous wildlife mortality in the watershed. This is proposed in the CDFG Alternative.

The CDFG Alternative would require a license re-opener condition that would allow consideration and adoption of additional revised license conditions/articles to address anadromous fish issues. SCE has not included this proposal since it is unclear whether Project operations have the potential to affect or contribute to the uncertain, future needs referred to by CDFG. Potential future proposals for new projects downstream of Friant Dam have not been sufficiently developed to analyze in this APDEA.

The use of unjustified environmental measures and higher than necessary flows to address limiting factors does not result in proper consideration of electricity generation and inequitably burdens the Project from an environmental enhancement standpoint. The discussion of the differences between the Proposed Action and CDFG Alternative is limited to those Project Areas where the difference between the two alternatives may have some adverse impact to Project generation, the environment, or other factors that the Commission is to consider when developing appropriate license conditions.

6.3.5.1 Mammoth Pool Project

Reservoir Operations

The release of additional MIFs downstream of Mammoth Pool Dam proposed in both alternatives would result in a change from the existing conditions. The Proposed Action MIFs, as shown in Table 3.1.7-1, are generally less than the CDFG Alternative MIFs. MIFs at the level recommended in the CDFG Alternative would cause a greater adverse impact to the reservoir due to the earlier depletion of the cool water supply in the reservoir during dry years with warm air temperatures. This could deplete cool water in the reservoir up to two weeks earlier than under the Proposed Action. This loss of a cool water supply may impact trout in the bypass reach. While the Proposed Action also contributes to this adverse impact, the acceleration of cool water depletion is somewhat smaller.

Mammoth Bypass Reach – Mammoth Pool Dam to Mammoth Pool Powerhouse

The CDFG Alternative would increase MIFs by an average of 26% in normal years, and 8% in dry years, compared to the Proposed Action. Comparisons of flows, WUA, number for trout potentially supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are compared in Tables Attachment D-17 through D-21. The greater MIFs proposed by the CDFG Alternative would not result in substantial habitat increases compared to those that would be provided by the Proposed Action for the species and lifestages analyzed (less than ±7 percent on average). The existing MIFs in the bypass reach also provide rearing habitat capable of supporting larger numbers of trout and Sacramento suckers than are currently present. The amount of habitat provided under either alternative would likely be sufficient to support more than ten times the adult trout reference density (Table Attachment J-1), and would provide at least twice the amount of spawning habitat needed to support trout populations at the reference population density.

However, at certain times of the year, depending upon ambient air temperatures and the amount of water available, water temperatures in the bypass reach may be warmer than appropriate for good trout health under existing conditions. Under the Proposed Action, daily mean water temperatures would be 20°C or less during most summer months at a reduced loss of generation compared to the CDFG Alternative. In dry and warm years, water temperatures would be 20°C or less until the thermally stratified water layers in Mammoth Pool Reservoir begins to mix in late-August to September. In September, the lower 0.86 miles of reach would exceed 20°C under both the Proposed Action and the CDFG Alternative. Under the CDFG Alternative, daily mean water temperatures in the bypass reach would be slightly cooler prior to the time when thermal stratification in the reservoir ends. However, the slightly cooler water temperatures would provide a small incremental benefit to the fishery that would hasten mixing in the reservoir and occur at higher loss of generation. Additionally, the CDFG Alternative would promote mixing in the reservoir up to two weeks earlier than the Proposed Action. This in turn would cause warmer water to be released into the bypass reach earlier than under the Proposed Action. Temperatures throughout the reach would be very similar to those of the Proposed Action in wetter water years.

The Proposed Action would implement water temperature monitoring in the bypass reach (Temperature Monitoring and Management Plan (SCE 2007b; Volume 4, SD-G (Books 19 and 24)), while the CDFG Alternative does not. For the Mammoth Pool Dam to Mammoth Pool Powerhouse bypass reach, the temperature monitoring and Management Plan would provide real-time monitoring of water temperatures during the summer and provide the capability of maintaining compliance with water temperature criteria, when temperature is a Project controllable factor. The Proposed Action also includes a Fish Monitoring Plan for this bypass reach and Mammoth Pool Reservoir. Tissue sampling for silver bioaccumulation would be carried out in conjunction with reservoir fish sampling (Fish Monitoring Plan. SCE 2007b; Volume 4, SD-G (Book 19)). The CDFG Alternative only provides for reservoir fish sampling and tissue sampling for silver. It does not provide for sampling of the bypass reach fishery.

Rock Creek Reach

Both the Proposed Action and CDFG Alternative would establish MIFs, where there was no MIF under existing conditions. Water temperatures in the bypass reach are warmer than desirable for trout growth near the confluence of Rock Creek with the SJR during summer months. The Proposed Action MIF would provide daily mean water temperatures of 20°C or less during the summer of normal years and during dry and warm years, when sufficient flow is available upstream of the diversion, at a lesser cost to generation than the CDFG Alternative. Under both the Proposed Action and the CDFG Alternative, daily mean water temperatures would be expected to exceed 20°C in the lower portion of the reach near the SJR confluence in July and August of normal and dry water years. Normally when summer water temperatures exceed 20°C, insufficient flow is present upstream of the Rock Creek diversion to reduce daily mean water temperatures to less than 20°C.

Both Alternatives would result in increased habitat during the spring and summer months, when fish are more active. The CDFG Alternative provides higher flows in the winter, when fish are less active. The increased flows of both alternatives may provide small benefits to habitat quality and quantity. Over two-thirds of the reach is cascade and bedrock sheet. The habitat structure below the diversion limits fish populations because fish habitat is primarily limited to plunge pools. The amount of habitat in plunge pools is not responsive to changes in flow. Therefore, the CDFG Alternative will likely not provide greater fish habitat benefits than the Proposed Action, but would result in greater losses in generation. Both alternatives may provide some benefit to other species than fish, including amphibians and reptiles.

Ross Creek

Both the Proposed Action and CDFG Alternative would establish MIFs, where there was no MIF under existing conditions. While the CDFG Alternative generally specifies higher MIFs than the Proposed Action, lack of summer base flows available upstream of the diversion and consequent unavailability of flow below the diversion would prevent MIFs from being met in much of the summer and fall. Therefore, the higher MIF requirement is of little value in addressing identified resource issues. During dry years under the Proposed Action, the diversion would be turned out during July through November, allowing all available flow to pass downstream. The lack of summer flows would continue to limit the value of this stream for fish for both alternatives. The provision of MIFs, when flow is available, may provide benefits to macroinvertebrates and to western pond turtles, Pacific tree frogs, and aquatic garter snakes, which are found in Ross Creek.

6.3.5.2 Big Creek Nos. 1 and 2

Reservoir and Impoundments

There would be no differences in effects on aquatic resources in Huntington Lake or other Project impoundments between the Proposed Action and the CDFG Alternative.

Furthermore, there would be no adverse impacts to aquatic resources, compared to existing conditions. Therefore, these impoundments are not discussed further in this section.

Big Creek Dam 1 to Powerhouse 1 Bypass Reach

The Proposed Action for this reach consists of instituting winter and spring flows (December 15 through April 15) and increasing late spring and summer flows. There is currently no required MIF from December 15 to April 15, although SCE releases flow during this period. A MIF requirement during that period is desirable for reliable incubation of brown trout embryos and overwinter survival of older life stages. Nevertheless, fish populations are abundant and healthy under current conditions. Increased spring and summer flows are proposed to provide enhancement for this reach in the spring and summer. The CDFG Alternative does not propose MIFs, and no change from existing conditions is expected.

Big Creek Dam 4 to Dam 5 Bypass Reach

The CDFG Alternative proposes higher MIFs than the Proposed Action for a number of months, particularly in wetter years, with flows up to 67% higher between April and June of wetter years. Comparisons of proposed flows, WUA, number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are compared in Tables Attachment D-35 through D-37. The CDFG Alternative MIFs would result in a small increase (11% to 12%) in adult rainbow trout rearing and spawning habitat in wetter years, but a similar amount of habitat to the Proposed Action in drier years. Habitat would remain similar to the Proposed Action for all other species and life stages under both water supply conditions.

PHABSIM results suggest spawning habitat is limited in this reach (Attachment C – Limiting Factors) and may contribute to limiting current rainbow and brown trout populations. Under existing conditions, there is no MIF requirement, and current available flows provide less than 15% of the maximum amount of available spawning habitat. The Proposed Action would provide a substantial increase, from 83% to 89% of the maximum available spawning habitat for rainbow and brown trout. The CDFG Alternative would provide 83% to 97%, which is only slightly greater than the Proposed Action, at a greater MIF (Table Attachment D-37). Given the substantial increase in spawning habitat provided under the Proposed Action the small, additional increase provided by the CDFG Alternative is unjustified. The Proposed Action will protect the existing resources and provide significant enhancement, without unnecessarily reducing power generation.

Both alternatives would provide summer water temperatures within the range that is suitable for trout growth and below water temperatures that might be stressful to fish. The Proposed Action would implement water temperature monitoring in the bypass reach (Temperature Monitoring and Management Plan, SCE 2007b; Volume 4, SD-G (Book 19)), while the CDFG Alternative does not. The Proposed Action includes a Fish

Monitoring Plan for this Reach (SCE 2007b; Volume 4, SD-G (Book 19)), while the CDFG Alternative does not.

Balsam Creek – Diversion to Big Creek Reach

The Proposed Action and CDFG Alternative would institute a MIF requirement, where currently there is none. MIF requirements are higher under the CDFG Alternative than the Proposed Action in all months except July through September of drier years (when they are the same). The Proposed Action would provide improved summer rearing conditions for trout, with flows that exceed the 0.6 cfs flow identified by the wetted perimeter analysis as being protective of fish and invertebrate habitat. During the winter, when habitat requirements are less due to cooler water temperatures, the Proposed Action MIF (0.5 cfs) is slightly lower than this flow, but would be sufficient to support trout at this time of year. Both alternatives would address current resource issues, including the lack of existing MIFs, and to the extent that trout density is not otherwise limited by the steep structure of the reach and numerous barriers.

Since the CDFG Alternative MIFs (1 to 3 cfs) would exceed the Proposed Action MIFs (0.5 to 1 cfs) and numerous structural barriers throughout the reach and the steepness of the habitat present would continue to limit upstream fish passage and the use of enhanced habitat (Attachment C – Limiting Factors), the CDFG Alternative MIFs may provide little additional benefit to the populations compared to the Proposed Action.

Adit No. 8 Creek

No actions are proposed under the Proposed Action or the CDFG Alternative. There would be no difference from the No Action Alternative.

Ely Creek Reach

The CDFG Alternative proposes higher MIFs than the Proposed Action throughout the year. Flows proposed under both alternatives exceed the flow derived from the wetted perimeter analysis. Both alternatives would result in a potential to strand young fish, due to reductions in flow during the April through June period, when stranding potential is greatest. The drop in MIFs on June 1 under the Proposed Action would result in a greater risk of stranding fry than the CDFG Alternative, particularly in drier years. Ely Creek has many structural barriers that limit passage and the natural stream flow is intermittent. Naturally low base flow conditions in the late summer, when the stream frequently goes dry above the diversion, would continue to create the same habitat bottleneck that occurs under existing conditions. Therefore, higher MIFs could not be met throughout the year and the greater MIFs proposed by the CDFG Alternative may not provide additional environmental benefits.

6.3.5.3 Big Creek Nos. 2A, 8 & Eastwood

Project Reservoirs and Impoundments

There would be no differences in effects on aquatic resources in Project impoundments or reservoirs between the Proposed Action and the CDFG Alternative. Furthermore, there would be no negative impacts compared to existing conditions. Therefore, the impoundments are not discussed further in this section.

South Fork San Joaquin River

The SFSJR is discussed in terms of the same four subreaches as in earlier sections. Some elements that affect all four subreaches are discussed in this section prior to the discussion of individual subreaches. Under the Proposed Action, but not under the CDFG Alternative, CRMFs would be released in Wet and Above Normal Water Years from Florence Dam and several tributaries to the SFSJR. Spills frequently occur in Wet Water Years under existing conditions. The CRM flows may help improve and maintain habitat for fish and macroinvertebrates. In Above Normal Water Years, spills generally do not occur from Florence Lake under existing conditions. CRMFs made under the Proposed Action in that water year type may increase stranding of rainbow trout redds and scour of gravels with damage to incubating trout embryos and alevins, but also may contribute to maintenance of habitat. However, both benefits and adverse impacts are expected to be small.

A Temperature Monitoring and Management Program would be implemented as part of the Proposed Action, but not the CDFG Alternative. This program will include measures to be taken to help SCE to meet water temperature objectives for the bypass reach, when water temperature is a Project controllable factor. This would provide a benefit to trout in the reaches downstream of Florence Lake. A Fish Monitoring Plan also would be implemented in the bypass reach and Florence Lake under the Proposed Action to monitor long-term trends in fish populations. Under the CDFG Alternative, only Florence Lake would be sampled.

Each of the four subreaches of the SFSJR is discussed below.

South Fork San Joaquin River - Florence Lake to Bear Creek

The Proposed Action would provide MIF and CRMF that increase the magnitude, duration, and frequency of inundation of Jackass and Hellhole meadows (located on SFSJR and Crater Creek, respectively) while the CDFG Alternative would not. Hellhole Meadow is known to support Yosemite toads.

The CDFG Alternative MIFs would be greater than the Proposed Action MIFs, with flows 19% higher on average during normal years, and 5% higher during dry years. During the summer months of drier years, MIFs would be the same for both alternatives. Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-103 through D-105. These flow

changes would not result in substantial habitat changes from the Proposed Action for any trout life stages (less than ±5 percent difference on average). The amount of habitat provided under either alternative would be similar and likely sufficient to support more than three times the adult trout reference density, and would provide spawning habitat in excess of the amount needed to support this density of trout (Table Attachment J-1).

South Fork San Joaquin River - Bear Creek to Mono Creek

Both the Proposed Action and CDFG Alternative would address warm water temperatures in the lower portion of this reach in dry water years with warm air temperatures. As described in previous sections and Table 3.1.7-1, increased MIFs from Florence Lake and Bear Creek diversion, and other small tributaries would contribute to higher flows in this reach. Resulting flows from the CDFG Alternative are 17% greater, on average, than results from the Proposed Action in wetter years and similar to those under the Proposed Action in drier years. Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-109 through D-111. Both alternatives would provide similar amounts of habitat for all trout life stages (less than ±6 percent difference on average). The amount of habitat provided under either alternative would likely be sufficient to support more than three times the adult trout reference density, and would increase the amount of spawning habitat available to support the trout population (Table Attachment J-1)[3]. However, the Proposed Action would provide the habitat enhancement with the release of less water.

South Fork San Joaquin River - Mono Creek to Rattlesnake Creek and Rattlesnake Creek to San Joaquin River Confluence Reach

Similar to the Mono Creek to Bear Creek bypass reach, the CDFG Alternative MIFs would be greater than the Proposed Action flows, averaging 16% more on average during wetter years. During drier water years, the flows provided under both alternatives would be similar (with a 2% difference on average). Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-115 through D-117. Both alternatives provide similar habitat for all trout rearing life stages (less than ±5 percent difference on average). In wetter years, the CDFG Alternative would provide more spawning habitat for both species: 16% more for rainbow trout, and 10% more for brown trout. In drier years the two alternatives would provide similar amounts of habitat. The amount of adult trout rearing habitat provided under either alternative would likely be sufficient to support more than the adult trout reference density. Either alternative could provide as little as 50% of the spawning habitat needed to support trout at the reference density at times

[3] Estimates of the adequacy of spawning habitat to support the reference adult trout density are conservative in that they assume that every female will spawn every year. This is generally not the case, as female trout will usually skip one or more years before spawning again (Moyle 2002).

(Table Attachment J-1). At other times, the Proposed Alternative would supply sufficient spawning habitat for the trout reference density, while the CDFG alternative would provide twice as much habitat as needed[4].

Both the Proposed Action and CDFG Alternative would address warm water temperatures in the lower portion of the SFSJR upstream of the confluence with the SJR. However, in July of warm, Dry and Critical Water Years, the Proposed Action would include greater MIFs from Mono Creek than under the CDFG Alternative. Modeled daily mean water temperatures for the Proposed Action would slightly exceed 20°C in the lower 0.74 miles and in the lower 1.7 miles under the CDFG Alternative. Thus, compared to the Proposed Action, the CDFG Alternative flows result in a greater loss of generation with less benefit to the fishery with respect to temperature.

As part of the Proposed Action, SCE would monitor water temperatures in the SFSJR and in Camp 61 and Mono creeks, as identified in the Temperature Monitoring and Management Program (Temperature Monitoring and Management Plan, SCE 2007b; Volume 4, SD-G (Book 19)), to confirm that the water temperatures in the SFSJR bypass reach, when controllable by Project operations, are in compliance with the Basin Plan (CVRWQCB 1998). In consultation with resource agencies, a Long-Term Operational Water Temperature Control Plan would be developed to implement actions to meet water temperature targets, when meeting water temperatures is feasibly under Project control. Water temperature monitoring is not proposed as part of the CDFG Alternative.

Bear Creek Reach

Although brown trout populations are abundant and in good condition in this bypass reach, the habitat is approaching levels that may be limiting fish. Both the Proposed Action and CDFG Alternative address this by proposing increased habitat through the release of larger MIFs.

The flows under both alternatives are similar, on average (±5 percent), but can reach a 20% difference between April and May of wetter years. In December of drier years, the Proposed Action flows are 17% greater than the CDFG Alternative. Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-120 and D-121. The proposed MIFs would not result in substantial habitat changes between the two alternatives for any trout life stage (less than ±8 percent difference at any time). Although the amount of habitat provided under either alternative would likely be sufficient to support more the adult trout reference population, only 3% of the amount of spawning habitat needed by this population would

[4] Estimates of the adequacy of spawning habitat to support the adult trout reference population density are conservative in that they assume that every female will spawn every year. This is generally not the case, as female trout will usually skip one or more years before spawning again (Moyle 2002)

be provided (Table Attachment J-1)[5]. The status of the existing population, which exceeds the reference population level (Table Attachment J-1), indicates that this apparent bottleneck is likely an artifact of the model, and that spawning habitat may be more abundant than indicated, since much of the spawning habitat occurs in small pockets of gravel that are not as amenable to measurement and modeling based on transects than may be found in other streams. As part of the Proposed Action, but not under the CDFG Alternative, large woody debris would be moved from the impoundment to the bypass reach, which would improve habitat for fish and macroinvertebrates. Fish monitoring under the Proposed Action, but not the CDFG Alternative, would provide information on population trends.

Mono Creek Reach

The CRM flows under the Proposed Action are intended to improve riparian habitat and address sedimentation of habitat, which has been identified as a potential limiting factor for trout populations in this bypass reach. The CRMFs under the Proposed Action would involve multi-day releases in Wet and Above Normal Water Years with monitoring to verify sediments have been transported from the reach. Although sediment management prescriptions would be implemented under both alternatives, specific CRM flows are not proposed under the CDFG Alternative, except for a 24-hour release, following a sediment management prescription in Wet Water Years. Therefore, the Proposed Action would likely provide a greater benefit to aquatic habitat in the bypass reach by directly addressing the key limiting factor.

The CDFG Alternative would require MIFs about 15% higher than the Proposed Action, on average, during wetter years and provide the same MIFs, on average, during dry years. Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-125 through D-127. The increased flows in wetter years proposed under the CDFG Alternative would not result in substantial habitat changes from the Proposed Action for any trout life stage (less than ±5 percent difference on average). The CDFG alternative provides 13% to 24% more adult rainbow trout rearing habitat than the Proposed Action in March through May, however this brief increase would occur while water temperatures are cool and trout are unlikely to need additional rearing habitat. The amount of habitat provided under either alternative would likely be sufficient to support nearly twice the adult trout reference population density of adult trout, and would provide at least six times the amount of spawning habitat needed by this population (Table Attachment J-1). Therefore, the Proposed Action would provide substantial enhancement of trout habitat and address the identified limiting factor with a more efficient use of flow releases.

[5] Estimates of the adequacy of spawning habitat to support the reference population density are conservative in that they assume that every female will spawn every year. This is generally not the case, as female trout will usually skip one or more years before spawning again (Moyle 2002).

As part of the Proposed Action, fish monitoring in the bypass reach would provide information on population trends in response to enhancement measures. Fish monitoring is not proposed under the CDFG Alternative.

Tombstone, North Slide and South Slide Creeks

These diversions are currently not in operation. Under the Proposed Action, these diversions would be removed from service and decommissioned. Under the CDFG Alternative, they would remain available for service and MIFs would be increased, if operated. Decommissioning under the Proposed Action may have a slightly greater benefit to aquatic habitat in North Slide and South Slide creeks, and to trout in the bypass reach of Tombstone Creek by ensuring that unimpaired flows continue to be available and the natural sediment transport be reestablished. In all three streams, however, late summer flows would continue to constrain flow available for fish and macroinvertebrate habitats, as well as potential MIFs. Any potential impacts to fish or other aquatic species that could result from the repair and operation of these diversions would be avoided under the Proposed Action.

Hooper Creek Reach

The higher MIFs specified in the CDFG Alternative over the Proposed Action during April through August and in October of wetter years would provide increased available habitat. However, habitat currently does not appear to be limiting. The MIFs under the Proposed Action and CDFG Alternative exceed the flows identified by the wetted perimeter analysis as being protective of fish and macroinvertebrates, as do the current MIFs. The Proposed Action flows of 4 cfs during April through June would allow for fish passage through typical riffles, as would flows proposed under the CDFG Alternative.

Crater Creek Reach

The Proposed Action calls for the decommissioning of this diversion. The CDFG Alternative does not. Greater habitat would be provided throughout year relative to the existing conditions under both the Proposed Action and the CDFG Alternative. However, under all three alternatives (No Action, Proposed Action and CDFG alternatives), late summer low flows would maintain a habitat bottleneck. The habitat bottleneck would still limit brook trout populations (a fall-spawning species), and passage would be unaffected, due to low base flows during the drier portion of the year and numerous natural, structural barriers. The CDFG Alternative would institute MIFs, where currently there are none, but these MIF requirements are such that water is unlikely to be available to meet them during much of the year (CAWG 6, Hydrology, SCE 2004a; Volume 4, SD-D (Books 13 and 23)), so may not effectively enhance conditions for brook trout.

Chinquapin, Camp 62, and Bolsillo Creeks

Under the CDFG Alternative, drop tube intakes on these three diversions would be screened. As the risk of entrainment is low under current conditions, little biological benefit would be expected. These diversions would not be screened under the

Proposed Action, and therefore costs related to the construction and operation of this unnecessary activity would be avoided.

The existing MIFs in these creeks approximates the flow indicated by wetted perimeter analysis to be protective of fish and macroinvertebrate habitat throughout the year, but MIFs are only met when sufficient flow is available. Both the Proposed Action and the CDFG Alternative MIFs exceed existing MIFs. The CDFG Alternative would increase MIF requirements more than the Proposed Action. As with the existing MIFs, the Proposed Action and CDFG MIFs would only be met when sufficient base flow is available upstream of the diversions. This generally is not the case during the driest portion of the year (or during spring of some years). The unimpaired summer and fall low flows likely impose the most severe habitat limitations on the existing brook trout populations (a fall-spawning species – See Attachment C – Limiting Factors), and during this time the diversions are usually not operated. Numerous, natural passage barriers prevent substantial upstream passage of fish at any flow. Natural flows are not sufficient to provide passage during the fall months when brook trout would be migrating. Therefore, the CDFG Alternative MIFs may provide little additional benefit to aquatic populations, compared to the Proposed Action.

Balsam Creek – Balsam Forebay to Balsam Creek Diversion

Existing MIFs in this augmented stream reach are greater than the flow identified by the wetted perimeter analysis as protective of fish and macroinvertebrate habitat during the summer months, and slightly less than this flow in the winter months, when habitat requirements are less. Both the Proposed Action and CDFG Alternative MIFs would exceed the 0.6 cfs flow identified by the wetted perimeter analysis as being protective of fish and macroinvertebrate habitat throughout the year, and would increase habitat for rainbow trout, including overwinter habitat. CDFG MIFs would be higher than the Proposed Action, but would not provide substantial additional benefit, as the primary identified resource issue, numerous physical passage barriers (waterfalls), would not be affected by increased flow. The higher MIFs under the CDFG Alternative would result in a greater loss to generation with little benefit to aquatic life.

Pitman Creek

Both the Proposed Action and the CDFG Alternative proposed MIFs exceeding the flows recommended by the wetted perimeter analysis. The CDFG Alternative would increase MIFs more than the Proposed Action, but would not likely provide a greater biological benefit. About half of the bypass reach is plunge pool and step pool habitat with bedrock controls. These provide the vast majority of usable habitat for fish and are not responsive to changes in flow. Upstream migration is prohibited by numerous, natural, structural barriers. Despite these constraints, under current conditions fish populations are abundant and healthy.

North Fork Stevenson Creek

The CDFG Alternative proposes to increase flows by an average of 19% in wetter years, and 8% in drier years, compared to the Proposed Action. The CDFG Alternative MIFs would be substantially higher in the spring than the Proposed Action MIFs, including flows twice as high in April and May. Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-131 through D-133. The additional magnitude of the CDFG Alternative MIFs would not result in substantial habitat changes from the Proposed Action for any species and life stages (less than ±10 percent difference on average). During the spring, the CDFG flows would provide greater habitat to adult trout (20% to 28% for rainbow trout, 15% for brown trout), but slightly decrease rainbow trout spawning habitat, compared to the Proposed Action flows. Both alternatives increase spawning habitat over existing conditions.

The amount of habitat provided under either alternative would likely be sufficient to support the adult trout reference population (Table Attachment J-1). Sufficient spawning habitat to support the reference population may not be available under either alternative. The Proposed Action results in slightly more (7% to 10%) spawning habitat for rainbow trout than the CDFG Alternative in wetter years. Both alternatives provide the same amount of brown trout spawning habitat. In addition, the proposed CDFG Alternative MIFs exceed the capacity of the existing infrastructure. There would be significant additional cost to modify the Tunnel 7 release to provide the CDFG MIFs.

The Proposed Action Fish Monitoring Plan would provide valuable information on population trends. Although water temperature was not identified as a resource issue, water temperatures would be monitored for a minimum of three years to confirm that water temperatures, when controllable by Project operations, are in compliance with the Basin Plan. Monitoring is not proposed under the CDFG Alternative.

Big Creek Dam 5 to Powerhouse No. 8

Both Alternatives would increase MIFs over existing conditions, but the CDFG Alternative proposes higher MIFs in some months, particularly in wetter water years.

The CDFG Alternative would increase flows by an average of 27% in wetter years, and 8% in drier years, compared to the Proposed Action. The CDFG MIF requirements would be substantially higher in the spring of wetter years than the Proposed Action MIFs (67% higher). Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-137 through D-139. The proposed CDFG Alternative flows would not result in substantial habitat changes from the Proposed Action for any species and life stages (less than ±9 percent difference on average, less than 13% at any time).

The amount of habitat provided under either alternative would likely be sufficient to support more than three times the adult trout reference population and would provide at least three times the amount of spawning habitat needed by this population (Table Attachment J-1).

Both alternatives would enhance stream temperatures in the lower portion of the bypass reach, providing suitable water temperatures for trout in drier water years with warm air temperatures. However, a Temperature Monitoring and Management Plan would only be conducted under the Proposed Action, which would help maintain water temperature objectives, when controllable by Project operations. Both alternatives would address resource issues related to sedimentation of habitat. Trends in trout populations will only be monitored as part of the Proposed Action to evaluate enhancement actions. The CDFG Alternative results in a greater loss of generation without a corresponding increase in habitat enhancement. Therefore, the Proposed Alternative represents a more effective use of flow.

Stevenson Creek below Shaver Lake Dam

Both the Proposed Action and the CDFG Alternative increase MIFs substantially over existing conditions. The CDFG Alternative proposes the same MIFs as the Proposed Action most of the time, but in wetter years proposes higher flows in the spring (April and May) and in October. Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-142 and D-143. These higher flows would increase habitat for adult rainbow trout (the only trout species present) by 16% to 24%, however at this time of year, adult rearing habitat is not critical. Fish are spawning during the spring months, and moving to over wintering habitat in October. The two alternatives provide the same amount of habitat in the summer months, when fish are most active. Spawning habitat has been identified as a potential resource issue under existing conditions. Current MIFs provide 18% of maximum WUA for spawning habitat. The Proposed Action would provide 88% of maximum WUA for spawning habitat in all water years, while the CDFG Alternative would provide 80% to 99%, depending on water year type (Table Attachment D-143). The CDFG Alternative would slightly increase spawning habitat (13%) relative to the Proposed Action during April and May in normal water years, but on average provides 3% less in dry water years. Both alternatives generally provide sufficient spawning habitat to support the adult trout reference population density (Table Attachment J-1). Both alternatives provide at least 88% of maximum spawning habitat during April through June although the CDFG Alternative provides more habitat in May and June in normal years.

Both alternatives provide sufficient passage flows, but numerous structural barriers would continue to restrict passage. The Proposed Action provides a substantial benefit to trout habitat, without the higher loss in generation that would occur under the CDFG Alternative. The Proposed Action would implement a fish monitoring plan, to monitor trout population trends, while the CDFG Alternative would not.

6.3.5.4 Big Creek No. 3

Powerhouse 3 Forebay (Dam 6)

No aquatic resource issues were identified under existing conditions and no negative impacts to aquatic resources in the forebay are expected under either action alternative. The potentially accelerated depletion of cool hypolimnetic water in Mammoth Pool Reservoir (upstream) would occur more quickly under the CDFG Alternative, which would result in warmer water temperatures in the Powerhouse 3 Forebay earlier than the Proposed Action and under existing conditions. While this may affect releases and downstream temperatures in the Stevenson Reach of the San Joaquin River, it should have relatively little effect on fish in the forebay, since some cool water will remain available for trout originating from Big Creek.

San Joaquin River – Stevenson Reach (Dam 6 Bypass Reach)

The San Joaquin River - Stevenson Reach (Dam 6 to Redinger Lake) is a transition zone between cold and warm water fisheries.

This reach lies within the transition zone between cold and warm water fisheries. In the San Joaquin River below Dam 6, the higher flows recommended in both the Proposed Action and CDFG Alternative may adversely affect hardhead, a native transition zone fish considered a sensitive species by USDA-FS and a species of concern by CDFG. This species has warmer temperature preferences than trout. Both the CDFG Alternative and the Proposed Action would provide water temperatures suitable for trout, when water temperatures are controllable by the Project. The CDFG Alternative would provide slightly cooler water temperatures than the Proposed Action. The slightly cooler temperatures provided under the CDFG Alternative are less desirable for hardhead than temperatures provided under the Proposed Action. Additionally, the CDFG Alternative MIFs have a greater adverse impact to generation than the Proposed Action.

The CDFG Alternative would increase flows by an average of 31% in normal water years compared to the Proposed Action, with flows up to 50% greater than the Proposed Action MIFs between August and October. During dry water years, both alternatives provide similar flows. Comparisons of proposed flows, WUA, potential number for fish supported, and percent of maximum WUA that would be provided by the Proposed Action and CDFG Alternative are provided in Tables Attachment D-165 through D-167 for trout, and Tables Attachment D-168 through D-171 for Sacramento pikeminnow, hardhead and Sacramento sucker. These MIFs would not result in substantial habitat changes from the Proposed Action for any species and life stages (less than ±10 percent at any time). The amount of habitat provided under either alternative would likely be sufficient to support more than the adult trout reference population (Attachment J – Regional Fish Densities Memo) and would provide more than the amount of spawning habitat needed to maintain trout densities at or above that level. The potential for redd loss due to stranding for brown trout would be slightly greater with CDFG Alternative MIFs between October and December, as compared with

the Proposed Action flows (Attachment E - Stranding Report). Thus, the increased flows under the CDFG Alternative will result in a greater loss in generation without additional benefits to the fisheries.

Under the Proposed Action, SCE proposes to conduct studies to determine if a change in beneficial use designation is warranted, based on the reach containing a native transition zone fish assembly as part of the Temperature Monitoring and Management Plan (Temperature Monitoring and Management Plan, SCE 2007b; Volume 4, SD-G (Book 19)). Water temperature conditions under both alternatives would be beneficial for trout but may be less suitable for the native transition zone community, especially hardhead. Water temperatures would be monitored, as discussed in the Temperature Monitoring and Management Program (SCE 2007b; Volume 4, SD-G (Book 19)) to confirm that effects predicted by water temperature modeling occur in the stream. A Long-Term Operational Water Temperature Control Plan would be developed to meet water temperature targets, when meeting water temperatures is feasibly under Project control. Hardhead population trends would be monitored in the bypass reach. These studies may provide information to better manage temperature and habitat for hardhead rather than trout, this study is not included in the CDFG Alternative.

6.3.5.5 Recreation

Both the Proposed Action and the CDFG Alternative provide recommendations for fish stocking activities. Under the Proposed Action SCE will continue to enhance angling opportunities on Project reservoirs and stream reaches in the vicinity of the Project, by equally matching the CDFG stocking of Project-related reservoirs and bypass stream reaches below Project diversions and upstream of Redinger Lake, up to the following amounts:

- Rainbow Trout
  - Fingerlings – up to 20,000 per year
  - Catchables – up to 60,000 per year
  - Subcatchables – up to 40,000 per year
- Kokanee:
  - Fingerlings – up to 30,000 per year

The fish stocking quantities proposed by SCE under the Proposed Action are based on a 50% match of CDFG's historical stocking based on a review of stocking records.

The CDFG Alternative requests that SCE reimburse the CDFG for the full ongoing cost of fish stocking, along with efforts for fish production and monitoring. CDFG states that this funding is to reimburse the department for the ongoing cost of fish stocking, along with efforts for fish production and monitoring, that are needed to sustain a high quality

recreational fishery in Project impoundments, Project affected reaches and nearby waters in the upper San Joaquin River watershed. The CDFG in their request estimated the annual cost at approximately $300,000 per year.

Both the Proposed Action and the CDFG Alternative will provide the same benefit to the recreational fishery in the Project impoundments and bypass reaches. However, the CDFG requests 100% reimbursement of their annual fish production and stocking cost. The SCE proposal, however, is in accordance with the Commission staff recommendations made in the Vermilion Valley Environmental Assessment (FERC 2004) regarding stocking, which stated that, "it was appropriate for SCE to contribute 50% of the fish production cost associated with project waters".

6.3.5.6 Conclusion

Environmental measures related to MIFs and CRMFs in the Proposed Action would result in substantial annual generation losses for the Big Creek System (BCS) of 5.89% (187 GWh) over the No Action Alternative.[6] This generation loss would require that other generation sources be utilized to meet current demand (e.g., fossil fuel). Use of this alternative method for generation would result in an increase in annual total carbon dioxide emissions estimated to range from 87,842 tons/yr based upon the use of natural gas as a substitute fuel. The annual generation loss in the BCS resulting from MIF recommendations under the CDFG Alternative would be 5.3% (169 GWh). The generation losses in the CDFG Alternative will result in an annual increase in carbon dioxide air emissions, estimated to range from 79,386 tons.

Alternative	Lost Generation (GWH per year)	Lost Generation (%)	Increased Air Emissions (CO^2 tons per year)
Proposed Action (includes MIF and CRMF)	187	5.89	87,842
CDFG Alternative (includes MIF only)	169	5.3	79,386

In summary, both the Proposed Action and the CDFG Alternative address impacts and enhance resources from current Project operations (No Action Alternative) and meet regulatory environmental objectives related to MIF. The Proposed Action has a broader benefit to the environmental resources and largely incorporates the requests of the CDFG Alternative. The environmental measures recommended in the Proposed Action represent a more reasonable approach for enhancing resources while balancing power generation with the protection and enhancement of the environmental resources encompassed within the Project watershed. In contrast, the MIF recommendations in the CDFG Alternative result in higher generation losses and reductions in air quality while not providing substantially greater natural resources enhancement. The State of

[6] The range in lost generation is dependent upon whether the Project operations can be performed fully to the capabilities of the Project facilities. The lower end of the range of lost generation was based upon how the project actually ran in certain representative water years as represented in SCE's HydroBasin model. The high end of the range reflects the Projects' ability to operate at its maximum permitted and designed capacity based on that scenario in the HydroBasin model.

California, in which the Project is located, is experiencing severe shortages of generation capacity in the summer and a longstanding inability to comply with clean air standards. Thus, unlike the CDFG Alternative, the Proposed Action gives equal consideration to both power generation and environmental values, and is best adapted to a comprehensive plan for developing the waterway for both the protection of the environmental resources and the beneficial public purposes.

FIGURES

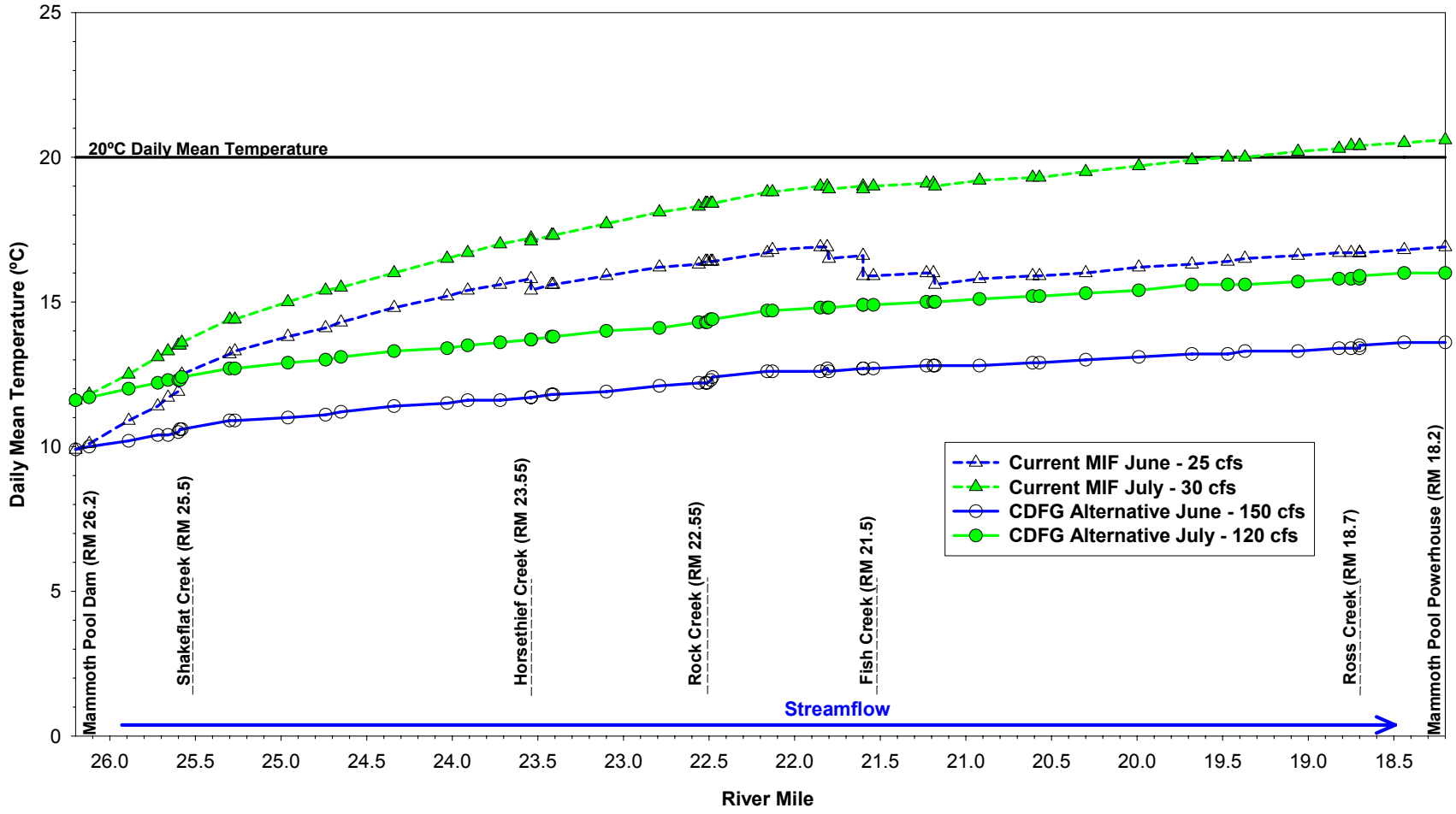


Figure 6.1.4-1. San Joaquin River Mammoth Reach Simulated Daily Mean Water Temperatures for CDFG Alternative and Current Minimum Instream Flows (MIF) for the Months of June and July in Above Normal Water Years with Normal Meteorology.

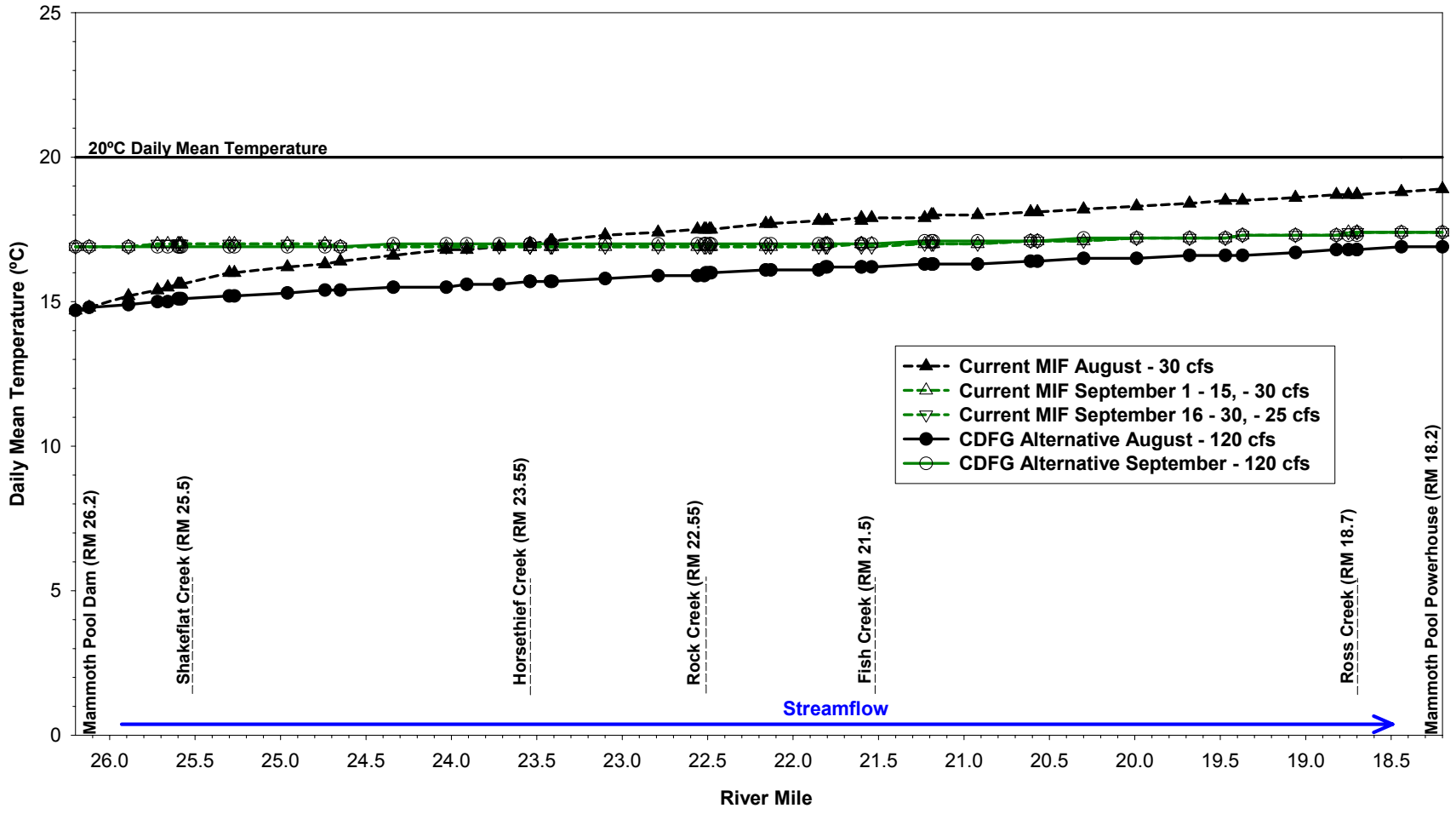


Figure 6.1.4-2. San Joaquin River Mammoth Reach Simulated Daily Mean Water Temperatures for CDFG Alternative and Current Minimum Instream Flows (MIF) for the Months of August and September in Above Normal Water Years with Normal Meteorology.

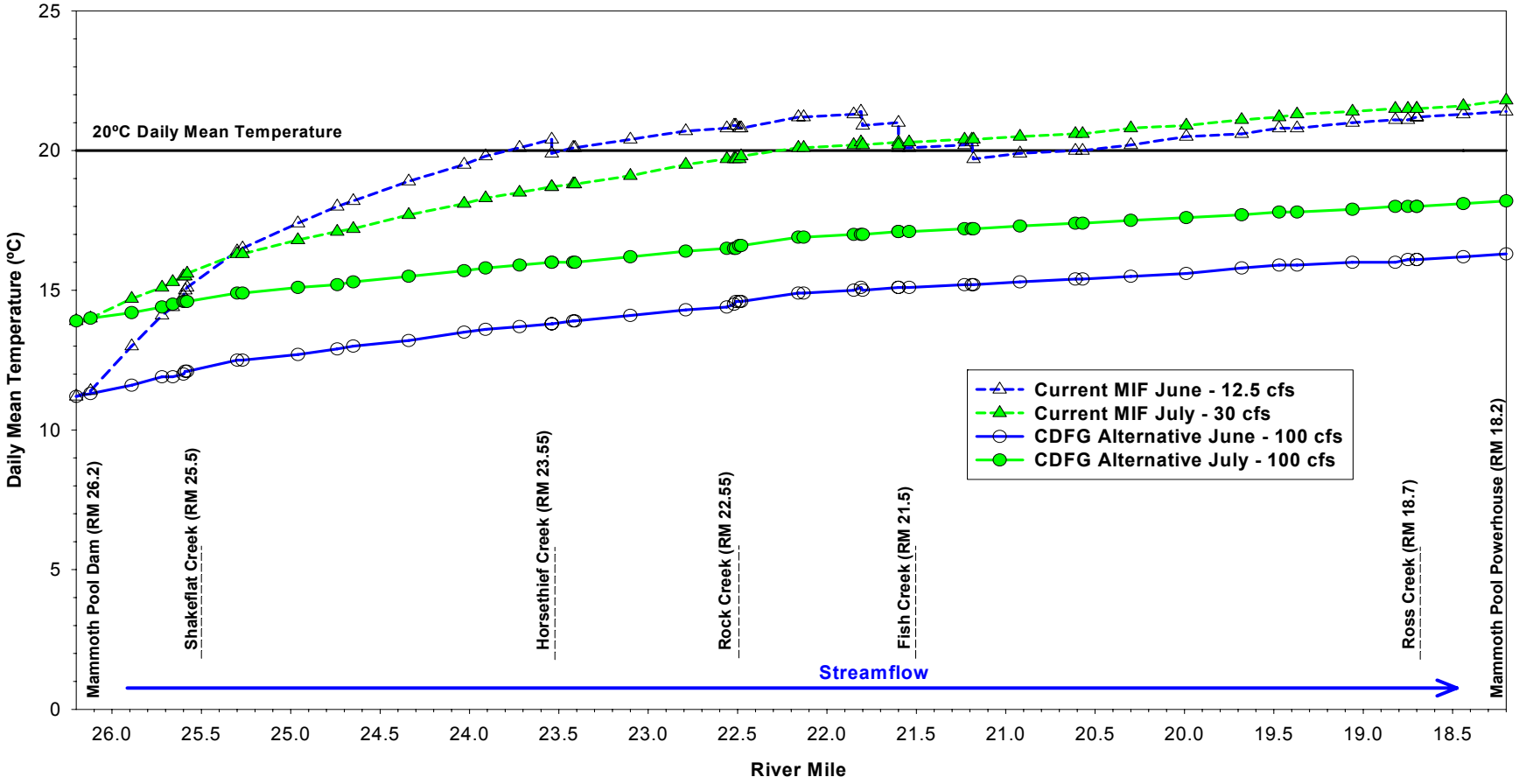


Figure 6.1.4-3. San Joaquin River Mammoth Reach Simulated Daily Mean Water Temperatures for CDFG Alternative and Current Minimum Instream Flows (MIF) for the Months of June and July in Dry Water Years with Warm Meteorology.

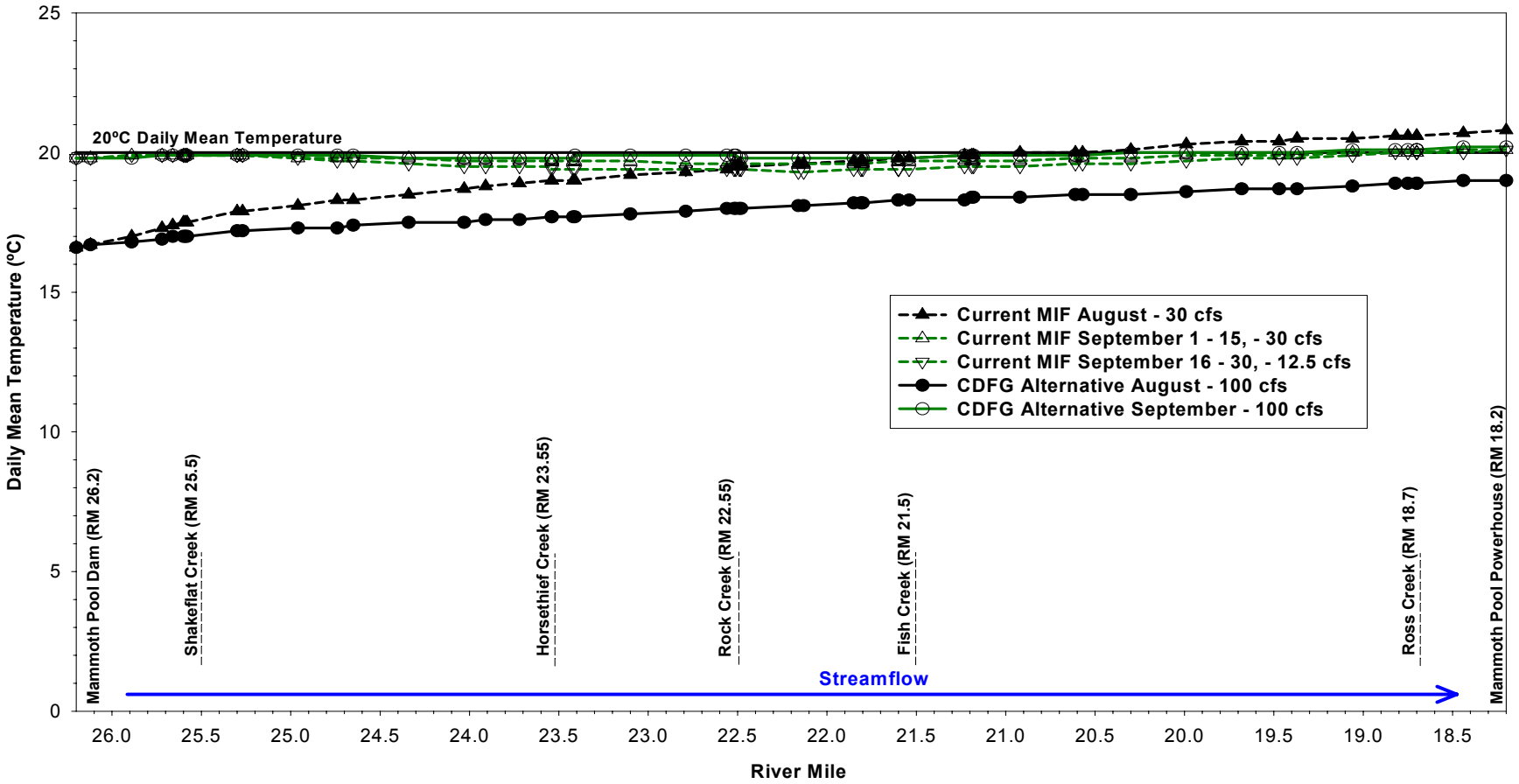
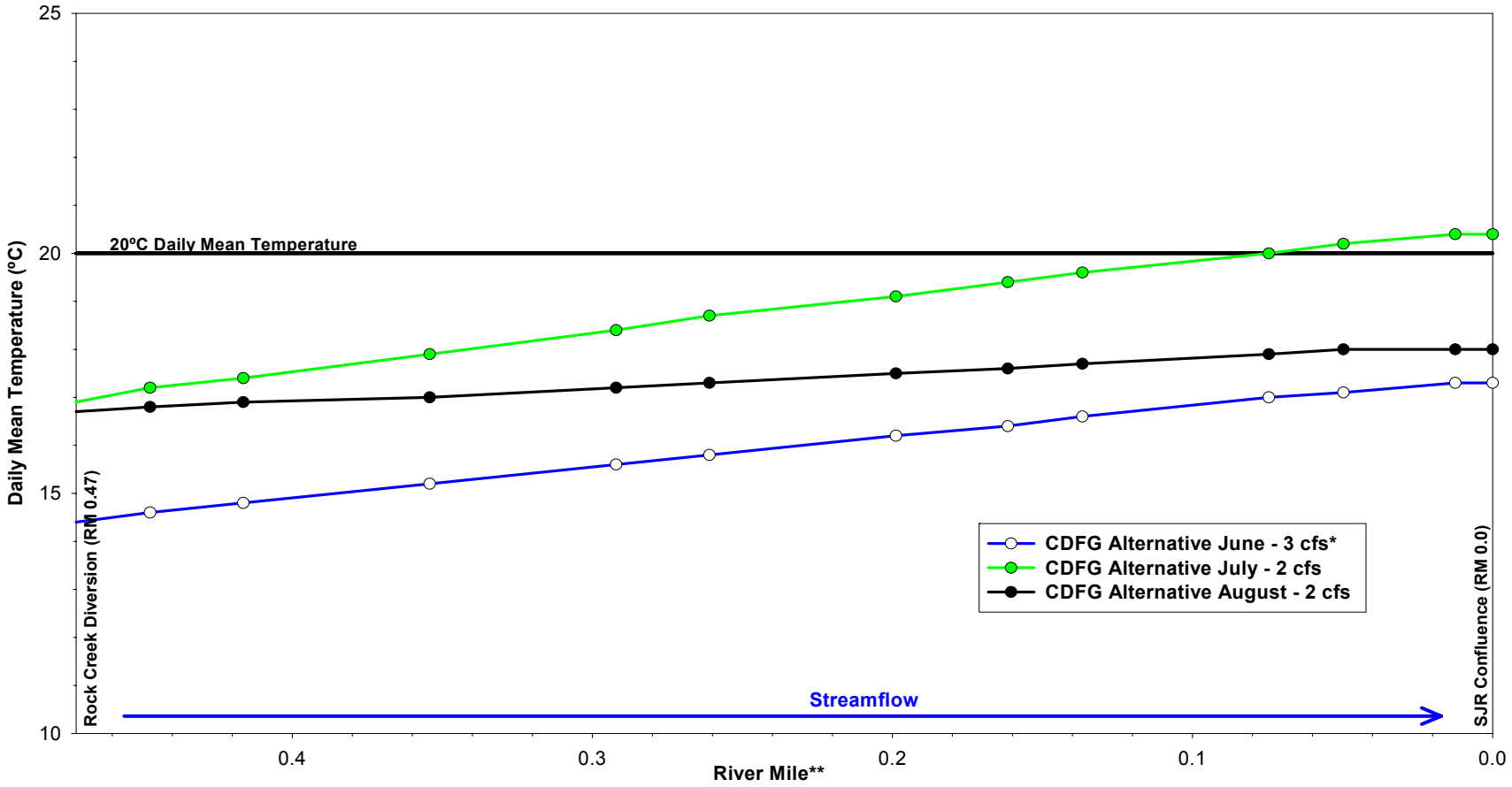


Figure 6.1.4-4. San Joaquin River Mammoth Reach Simulated Daily Mean Water Temperatures for CDFG Alternative and Current Minimum Instream Flows (MIF) for the Months of August and September in Dry Water Years with Warm Meteorology.



*CDFG Alternative flow of 3 cfs was not modeled; CDFG Alternative flow is represented by the closest modeled flow of 2.5 cfs.
**Distances relative to the San Joaquin River (upstream)

Figure 6.1.4-5. Rock Creek Simulated Daily Mean Water Temperatures for CDFG Alternative for the Months of June, July and August in Above Normal Water Years with Normal Meteorology.

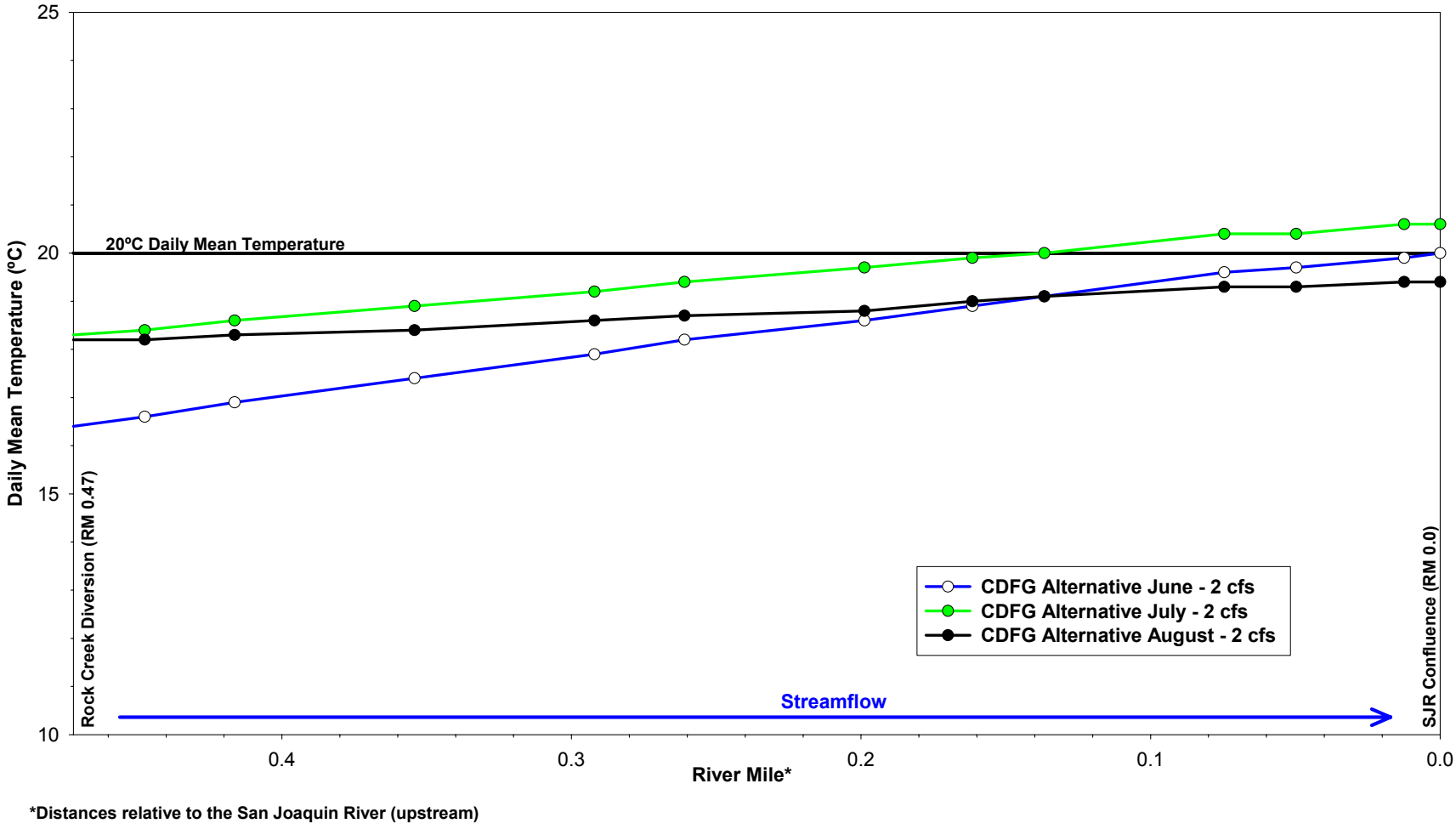


Figure 6.1.4-6. Rock Creek Simulated Daily Mean Water Temperatures for CDFG Alternative for the Months of June, July and August in Dry Water Years with Warm Meteorology.

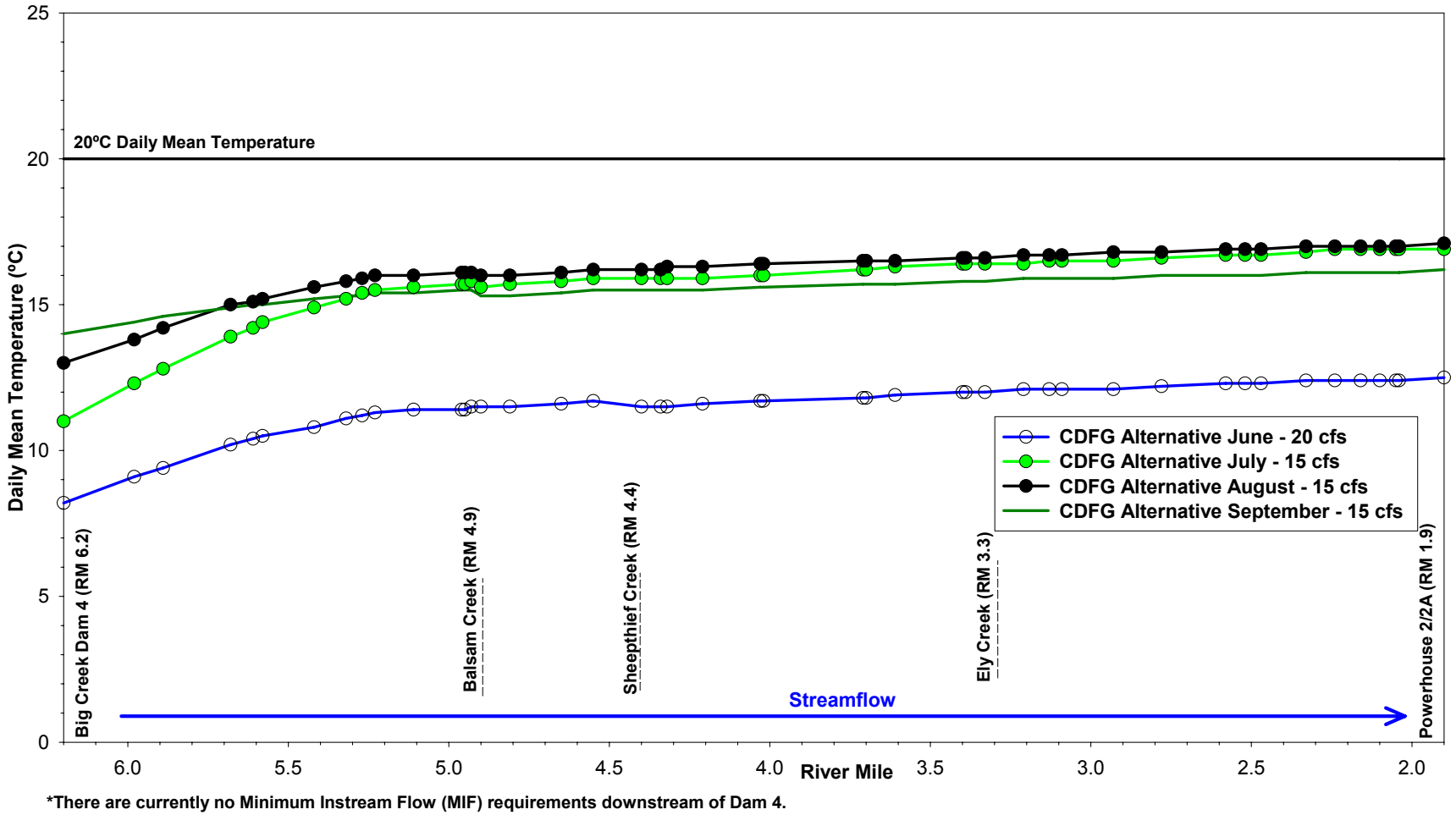
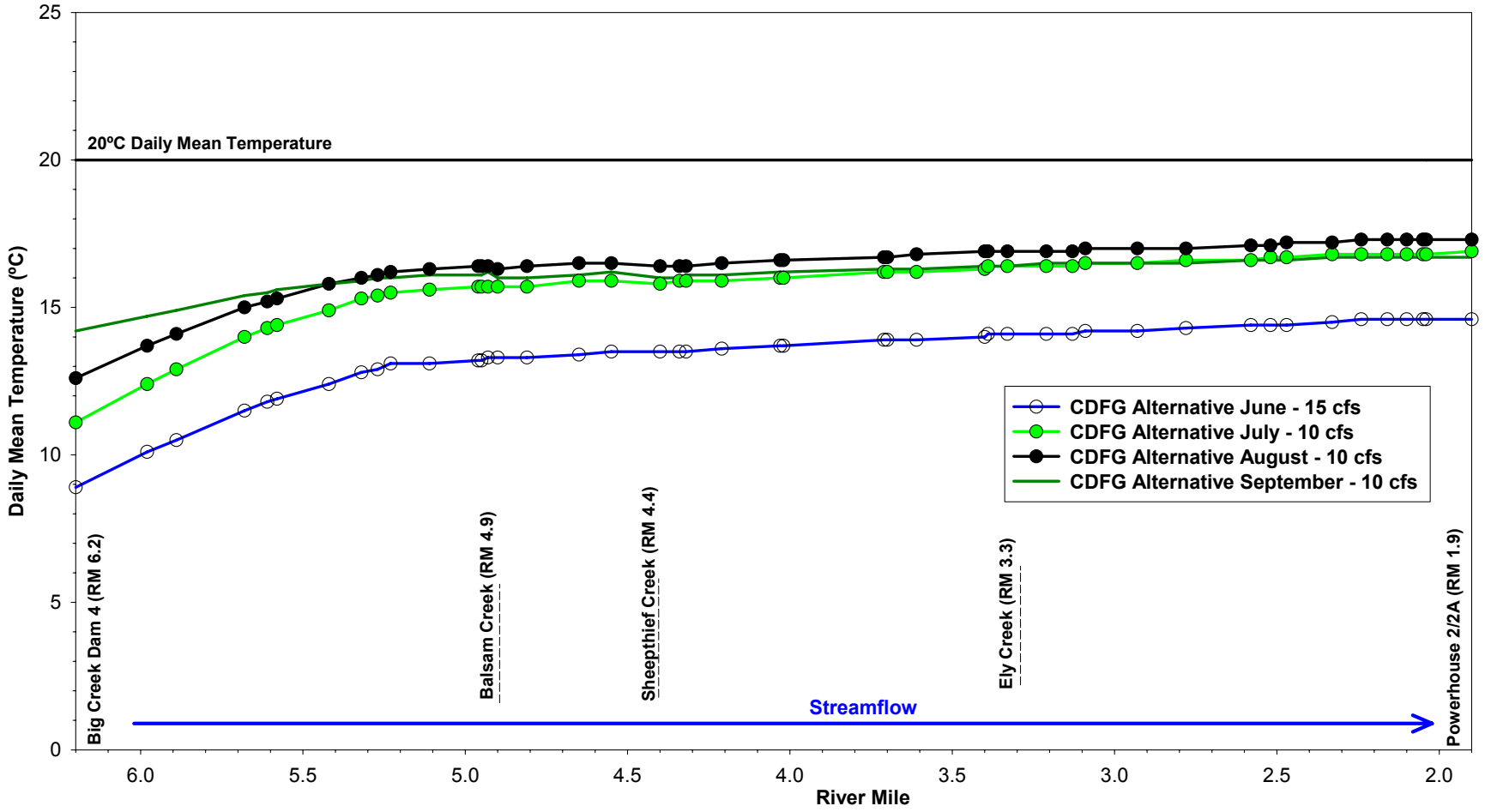
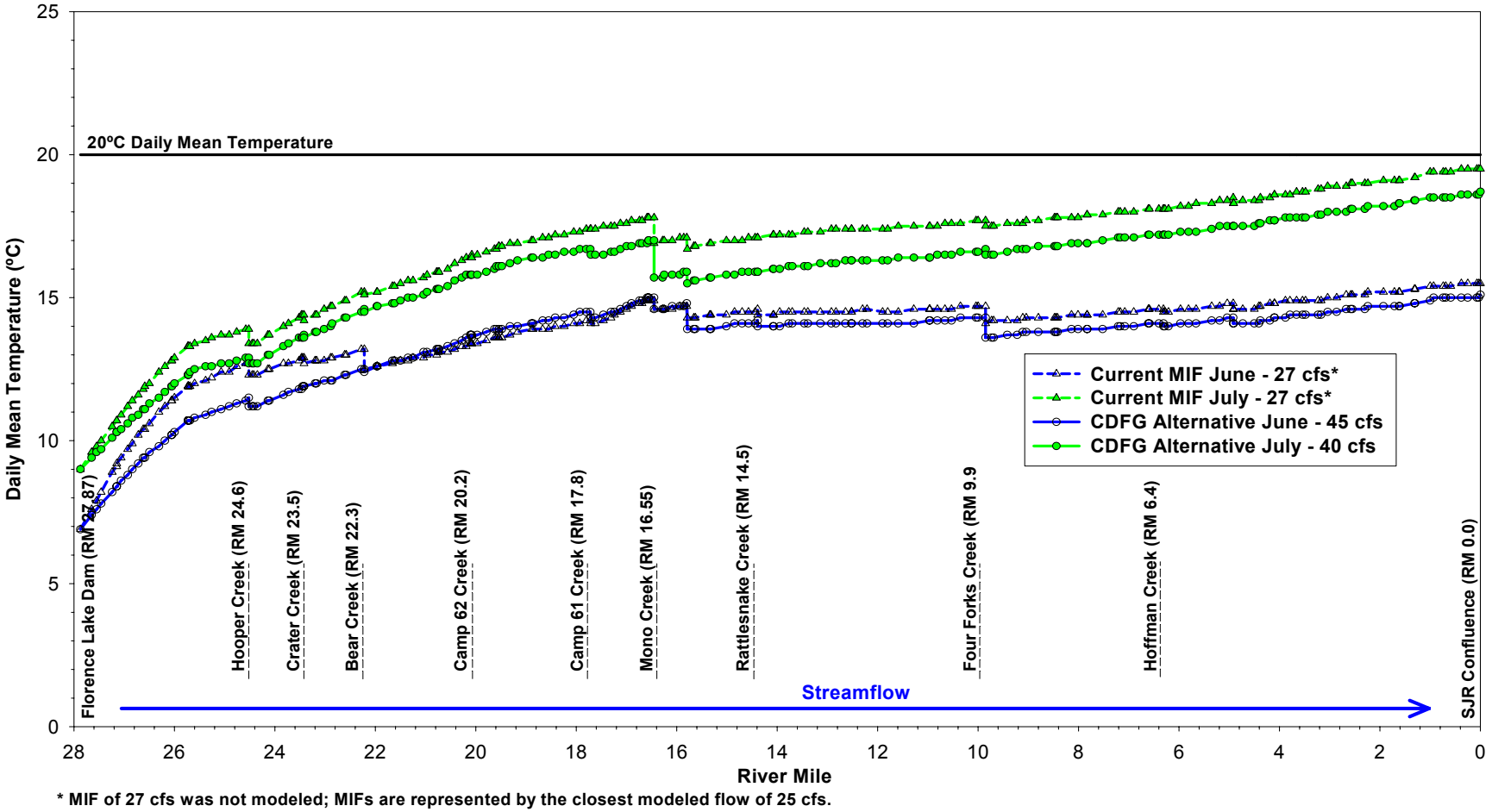


Figure 6.1.4-7. Big Creek (Dam 4 to Dam 5) Simulated Daily Mean Water Temperatures for CDFG Alternative for the Months of June, July, August and September in Above Normal Water Years with Normal Meteorology.



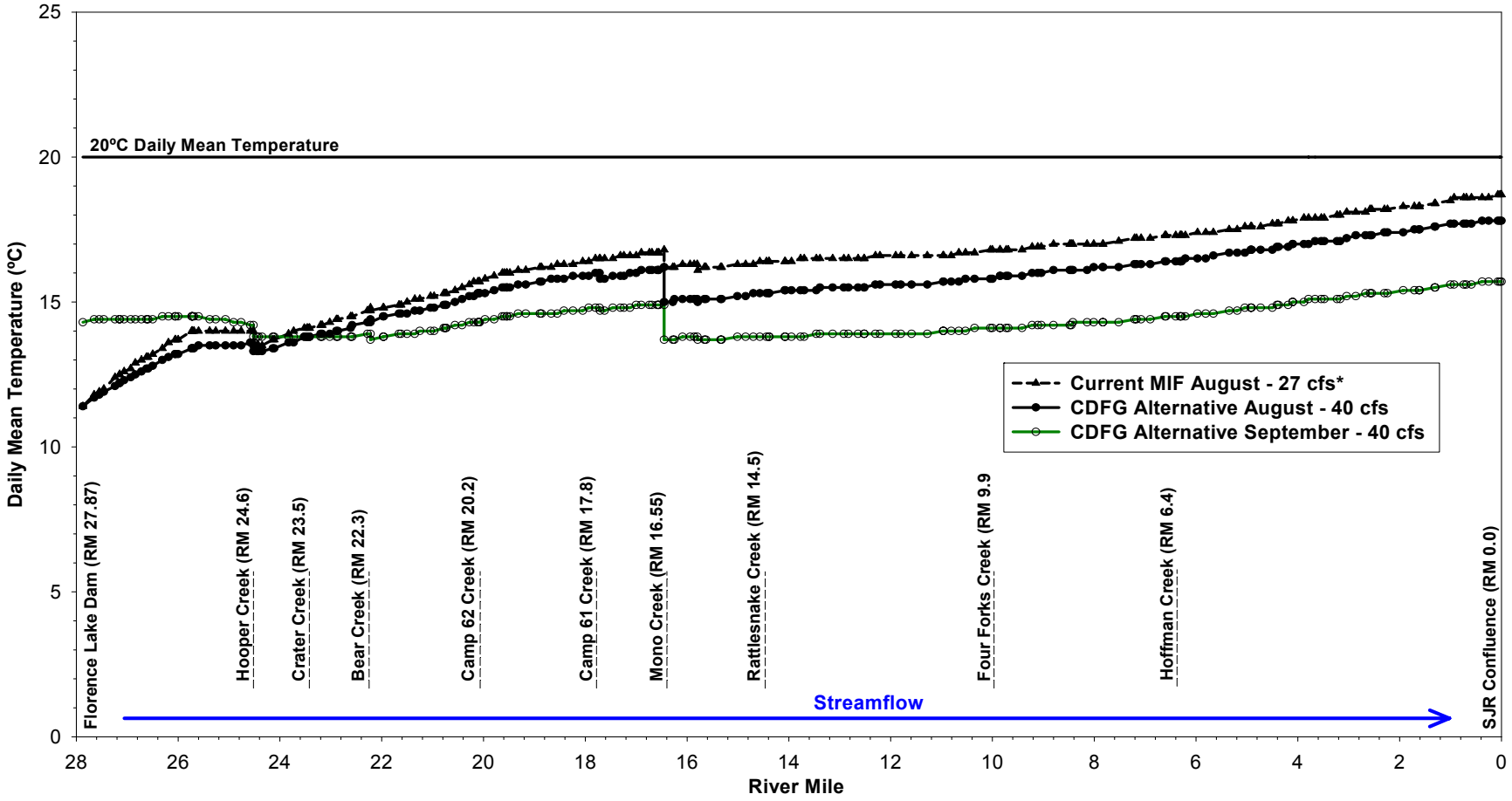
*There are currently no Minimum Instream Flow (MIF) requirements downstream of Dam 4.

Figure 6.1.4-8. Big Creek (Dam 4 to Dam 5) Simulated Daily Mean Water Temperatures for CDFG Alternative for the Months of June, July, August and September in Dry Water Years with Warm Meteorology.



* MIF of 27 cfs was not modeled; MIFs are represented by the closest modeled flow of 25 cfs.

Figure 6.1.4-9. South Fork San Joaquin River Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Months of June and July in Above Normal Water Years with Normal Meteorology.



* MIF of 27 cfs was not modeled; MIFs are represented by the closest modeled flow of 25 cfs.

Figure 6.1.4-10. South Fork San Joaquin River Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Months of August and September in Above Normal Water Years with Normal Meteorology.

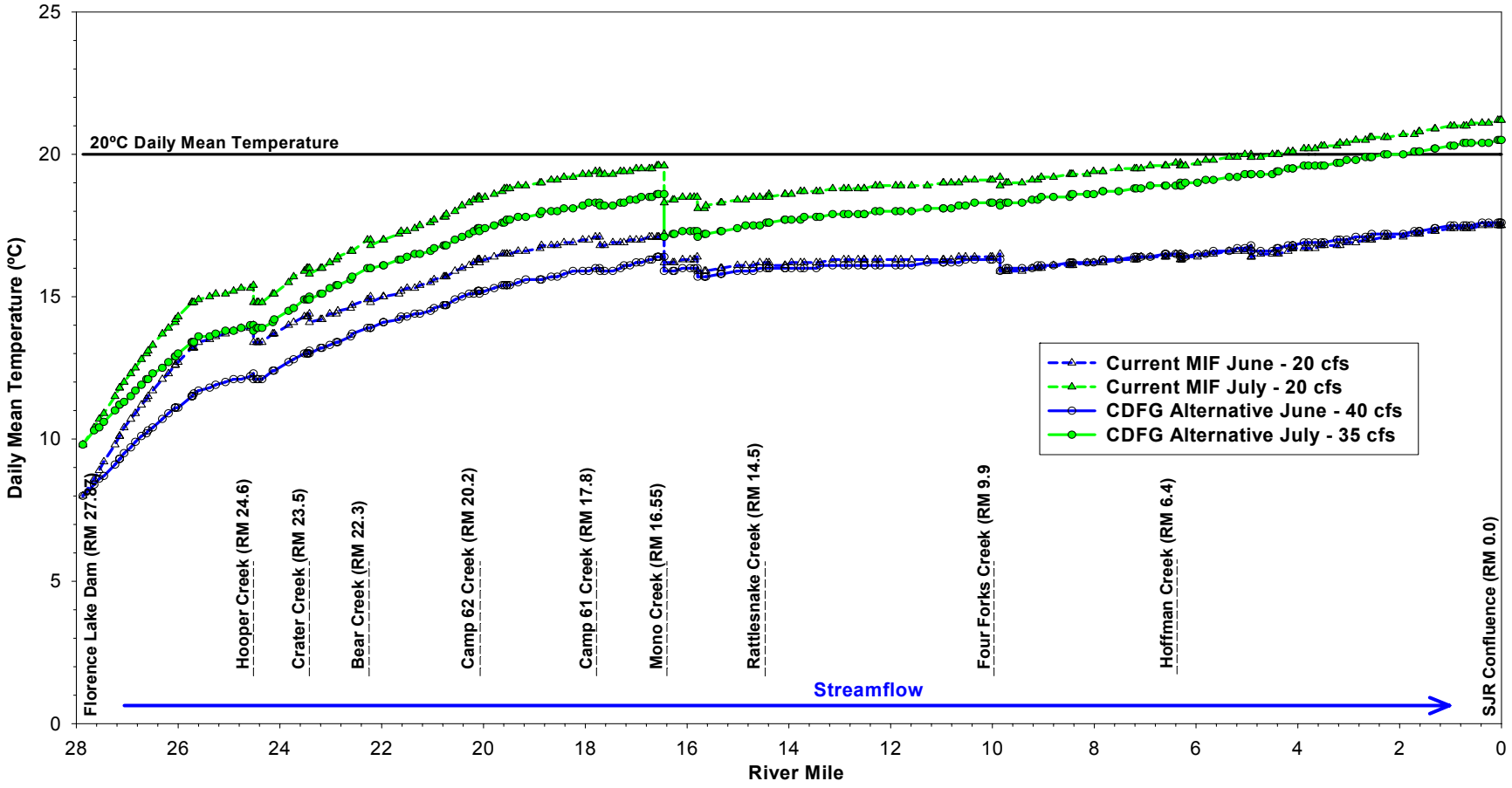


Figure 6.1.4-11. South Fork San Joaquin River Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Months of June and July in Dry Water Years with Warm Meteorology.

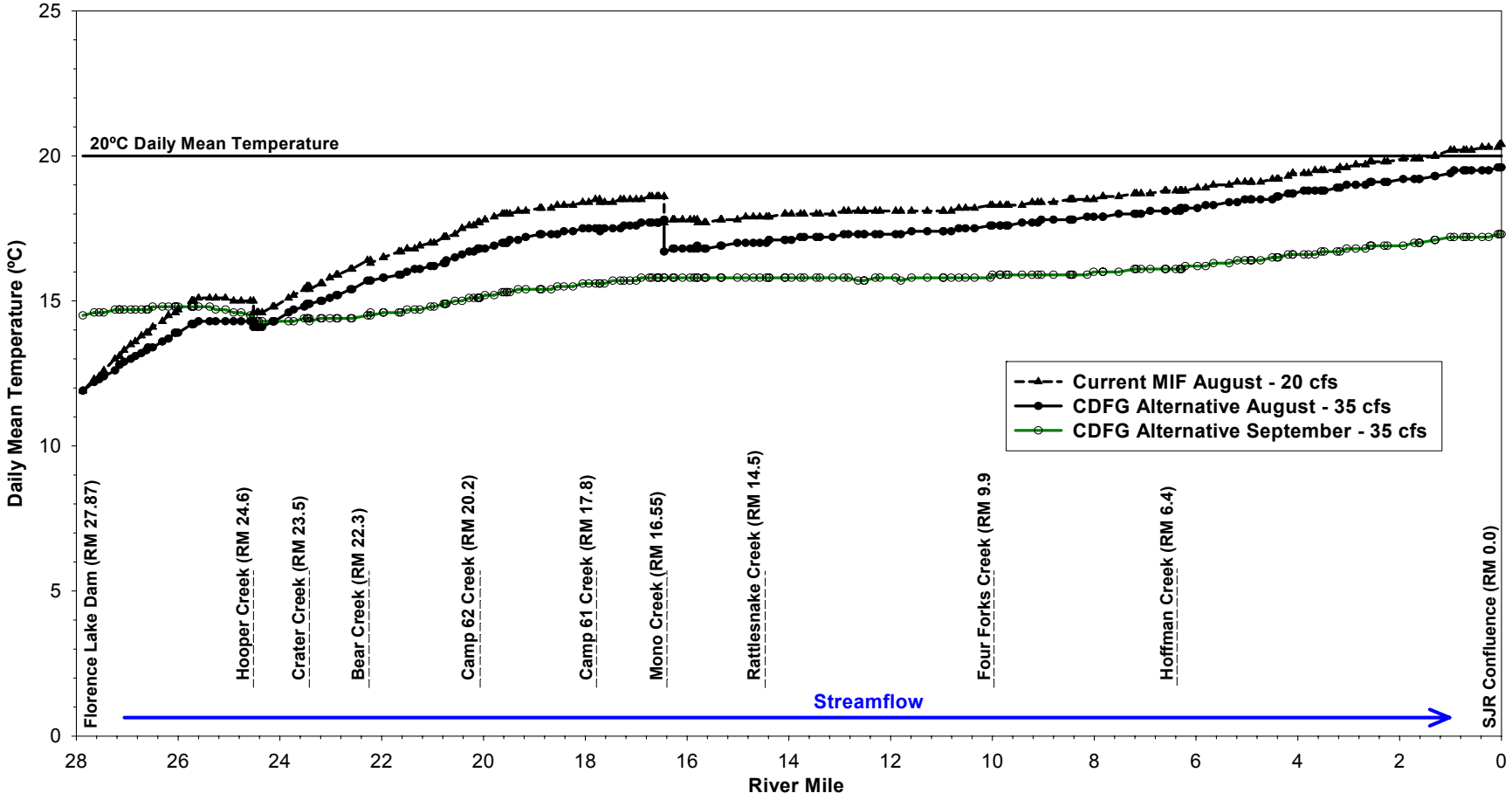


Figure 6.1.4-12. South Fork San Joaquin River Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Months of August and September in Dry Water Years with Warm Meteorology.

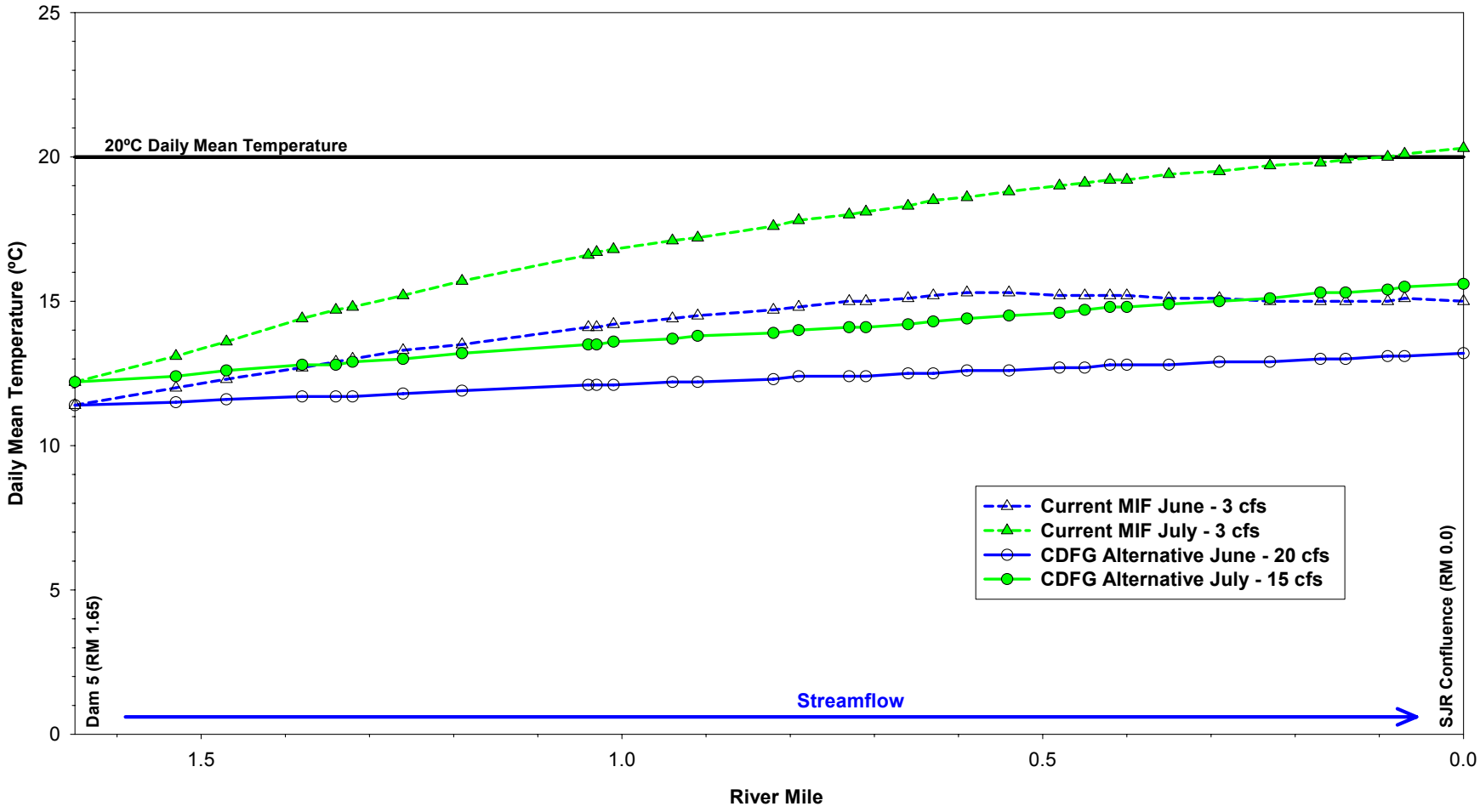


Figure 6.1.4-13. Big Creek (Dam 5 to San Joaquin River) Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Months of June and July in Above Normal Water Years with Normal Meteorology.

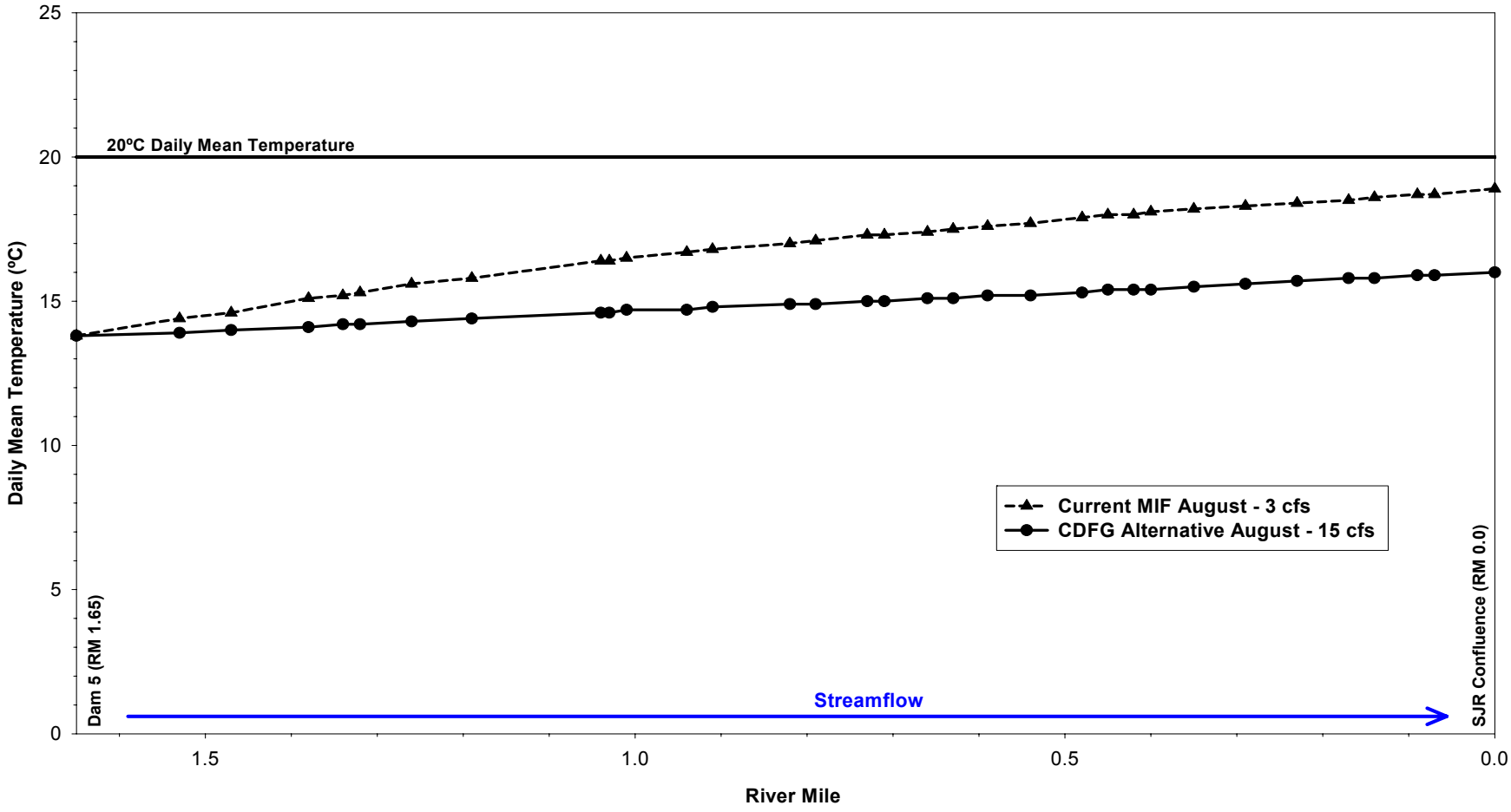


Figure 6.1.4-14. Big Creek (Dam 5 to San Joaquin River) Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Month of August in Above Normal Water Years with Normal Meteorology.

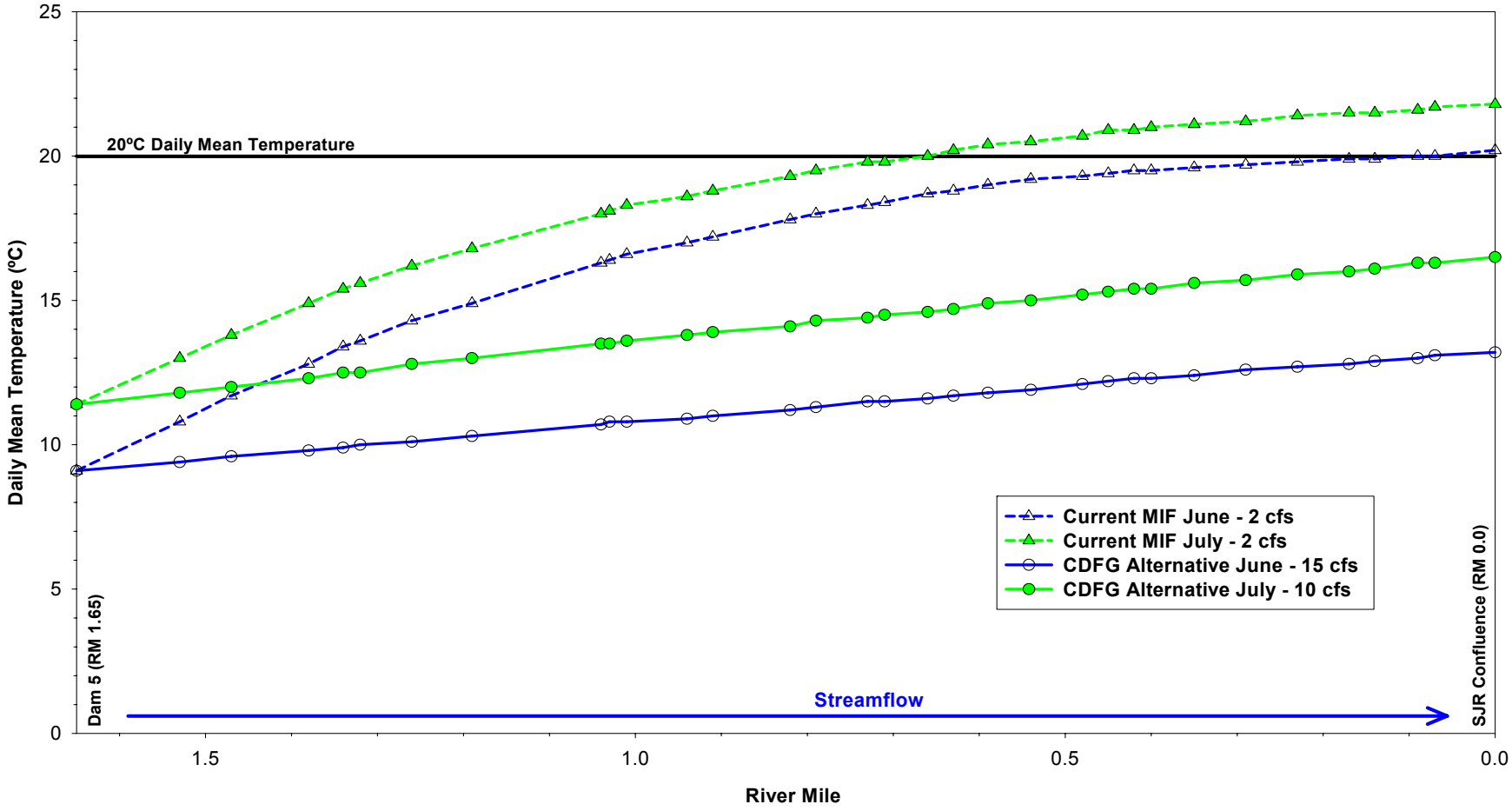


Figure 6.1.4-15. Big Creek (Dam 5 to San Joaquin River) Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Months of June and July in Dry Water Years with Warm Meteorology.

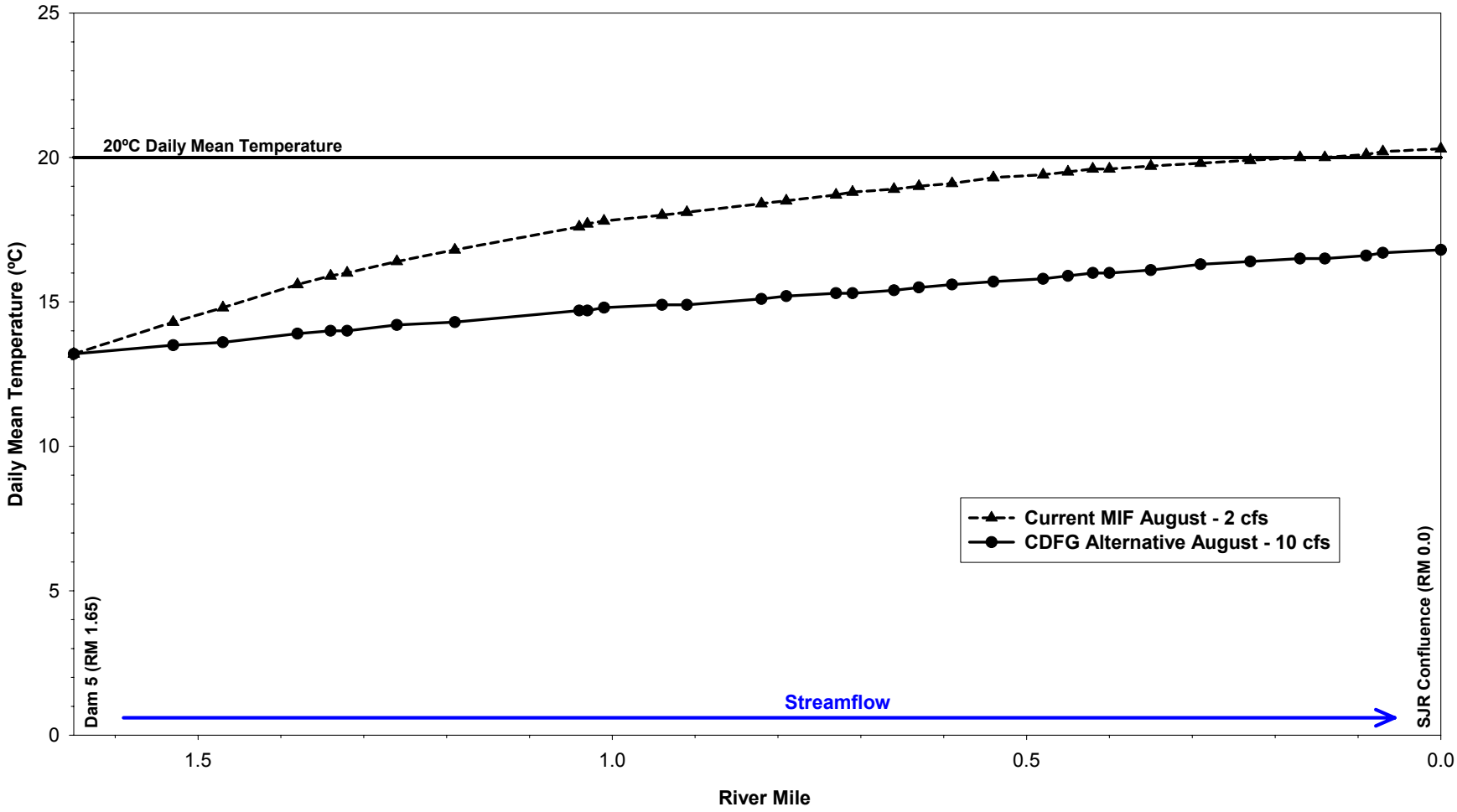
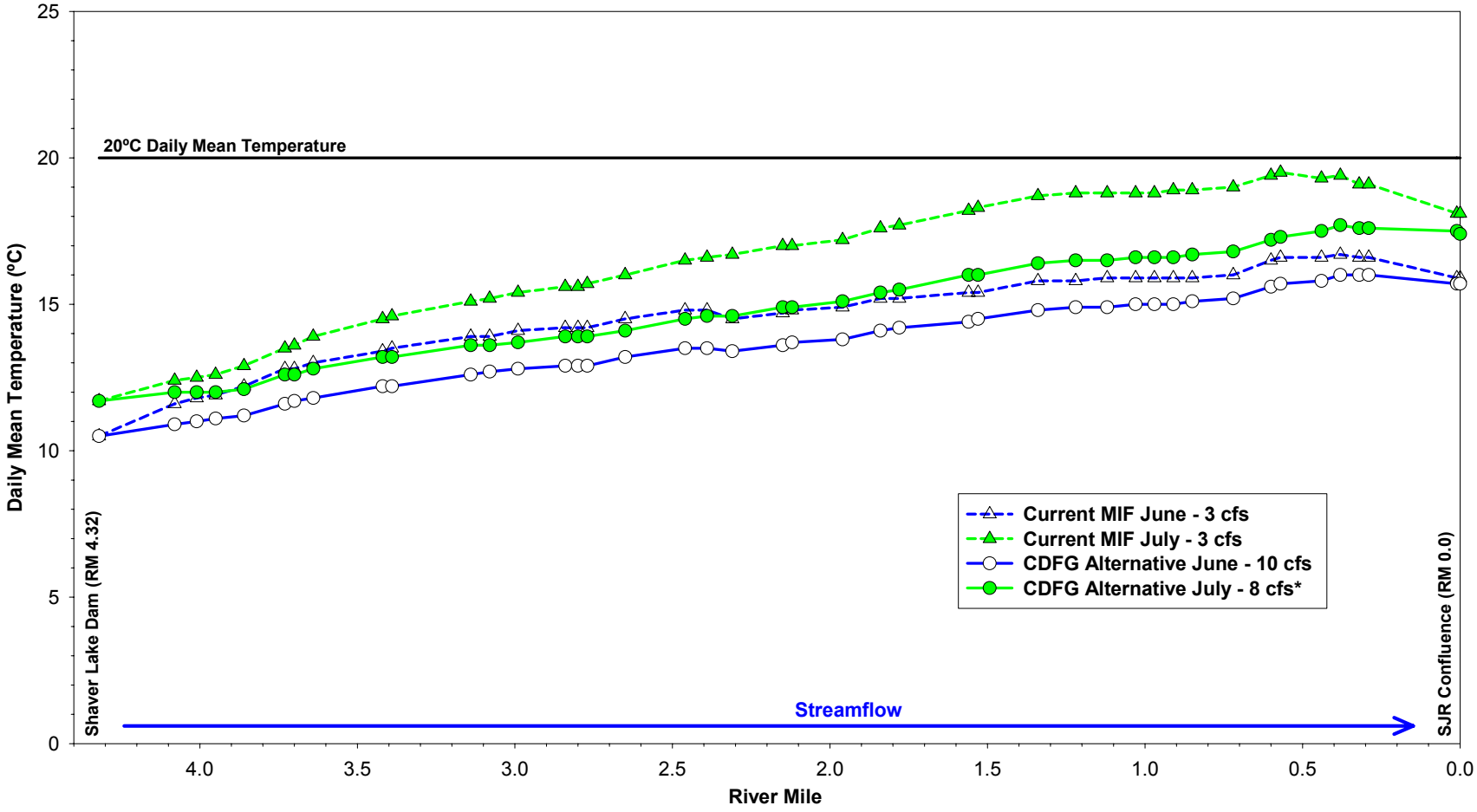
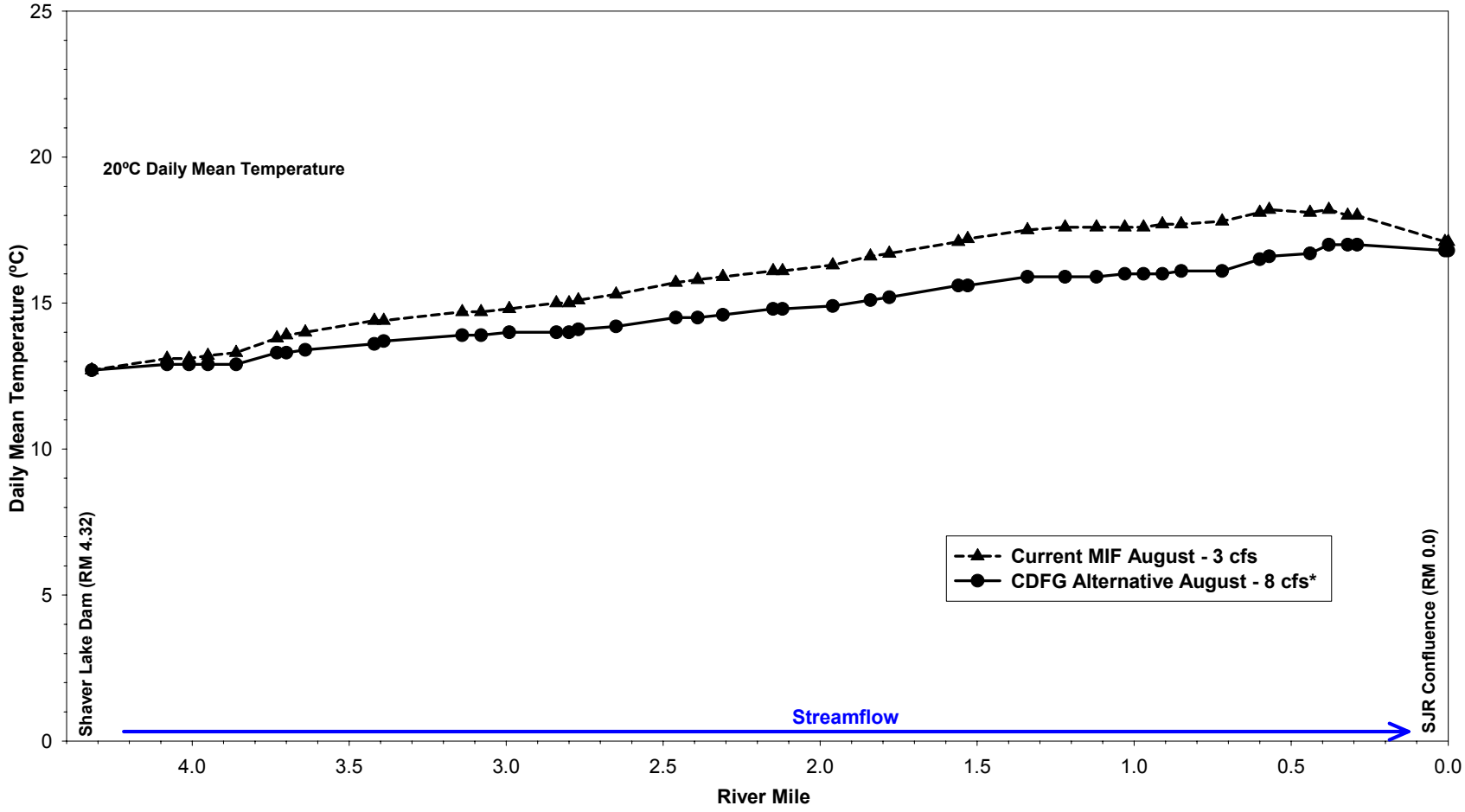


Figure 6.1.4-16. Big Creek (Dam 5 to San Joaquin River) Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Month of August in Dry Water Years with Warm Meteorology.



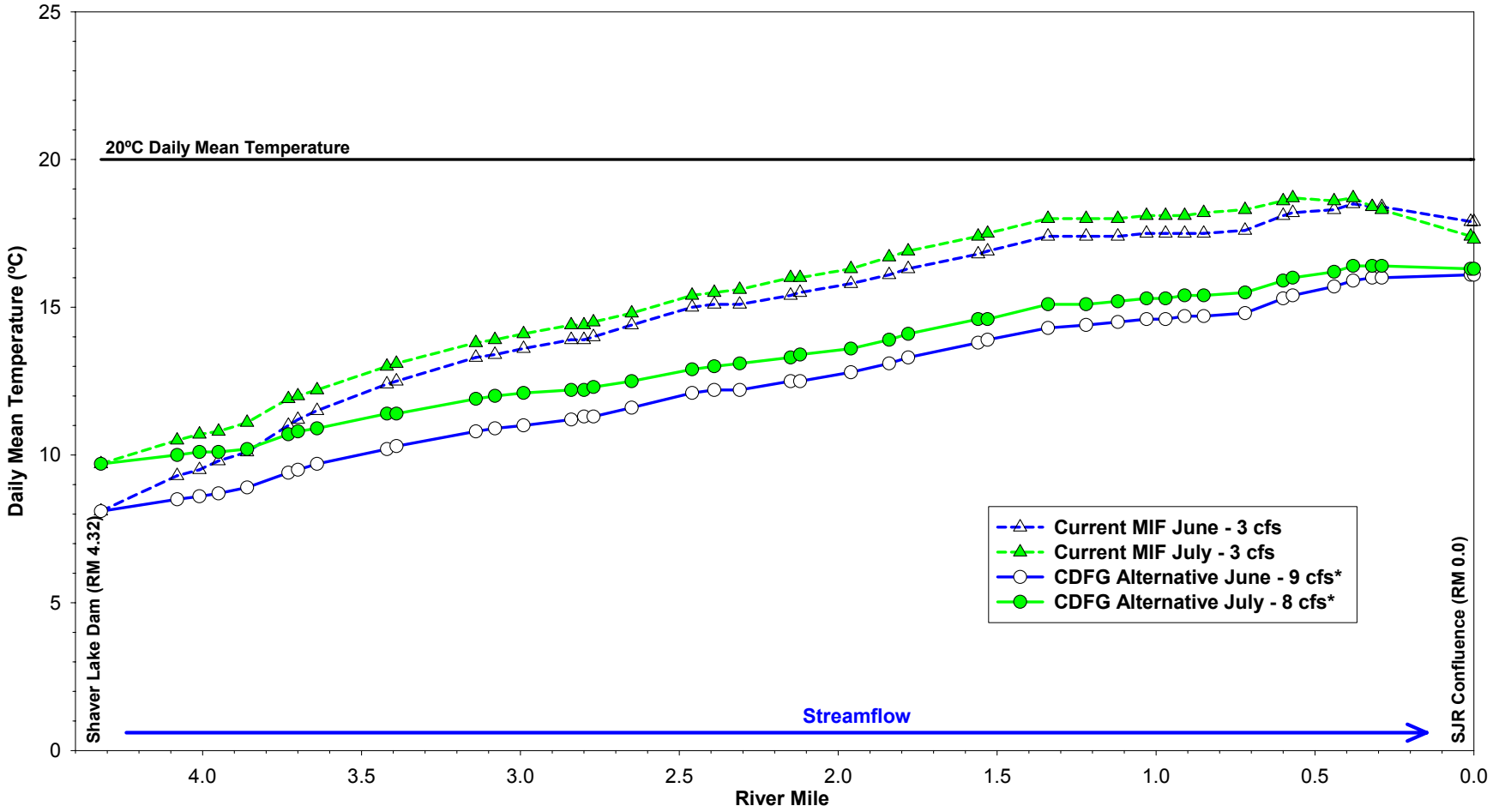
*** CDFG Alternative flow of 8 cfs was not modeled; CDFG Alternative flow is represented by the closest modeled flow of 10 cfs.**

Figure 6.1.4-17. Stevenson Creek Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Months of June and July in Above Normal Water Years with Normal Meteorology.



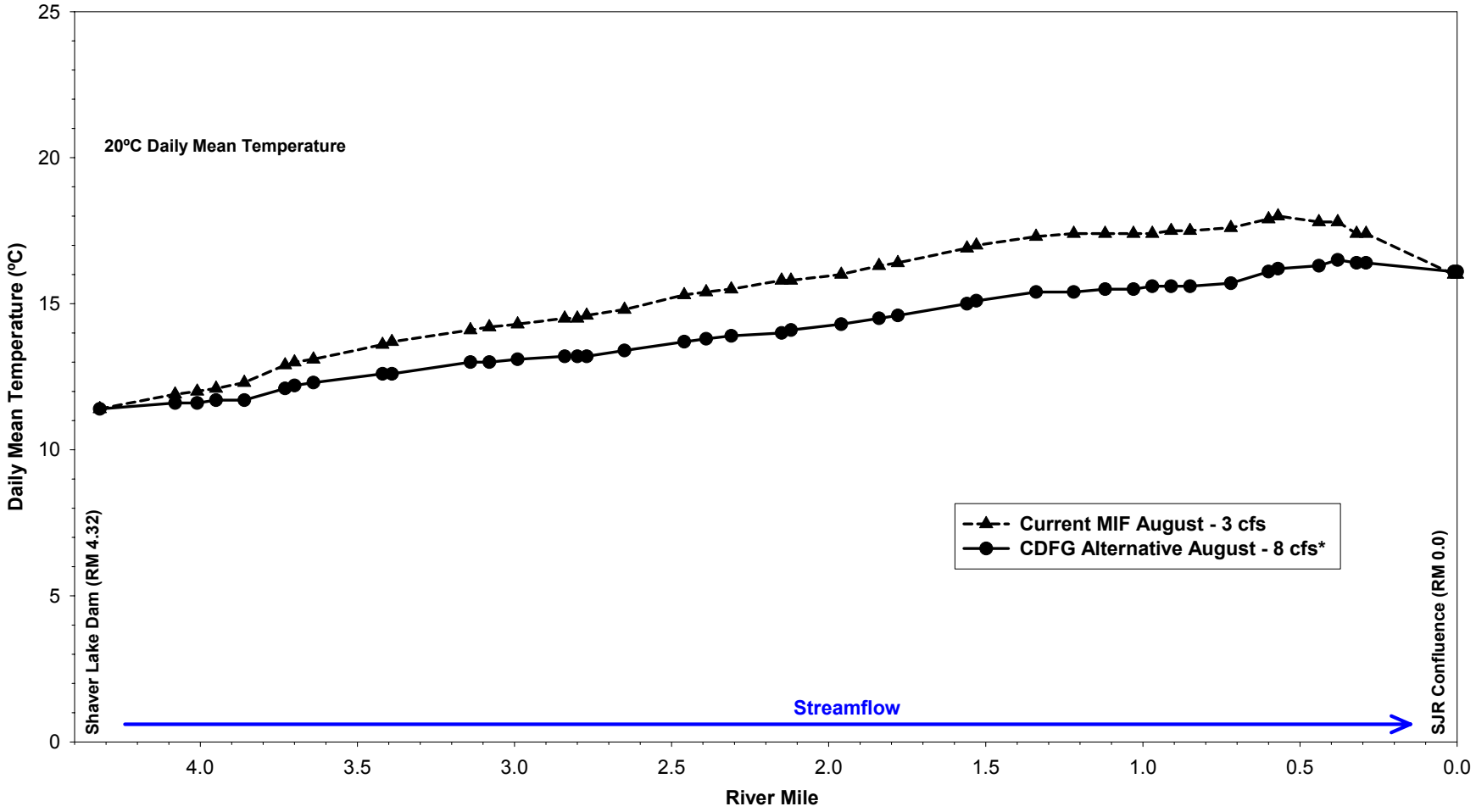
*CDFG Alternative flow of 8 cfs was not modeled; CDFG Alternative flow is represented by the closest modeled flow of 10 cfs.

Figure 6.1.4-18. Stevenson Creek Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Month of August in Above Normal Water Years with Normal Meteorology.



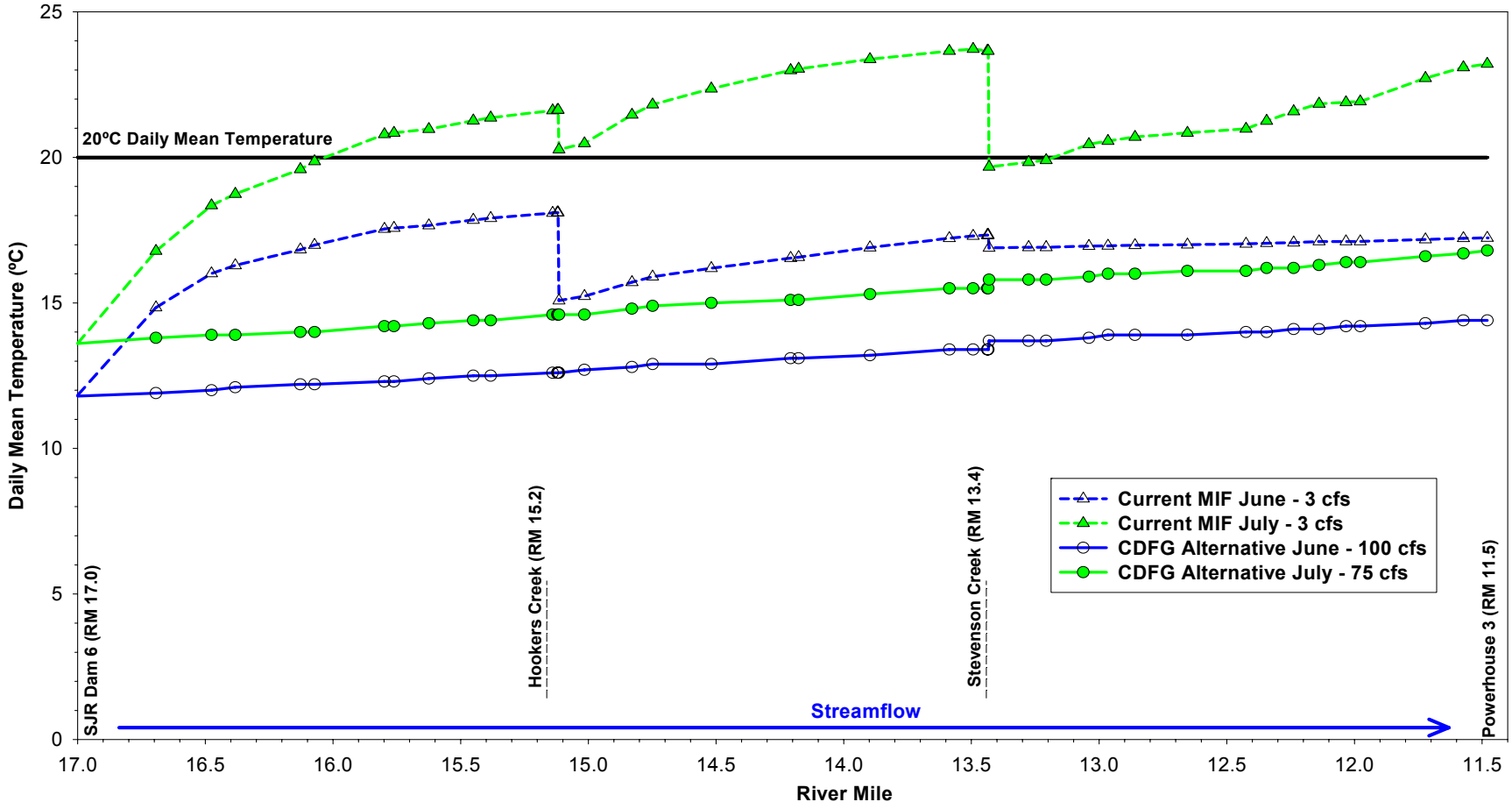
*** CDFG flows of 8 and 9 cfs were not modeled; These flows are represented by the closest modeled flow of 10 cfs.**

Figure 6.1.4-19. Stevenson Creek Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Months of June and July in Dry Water Years with Warm Meteorology.



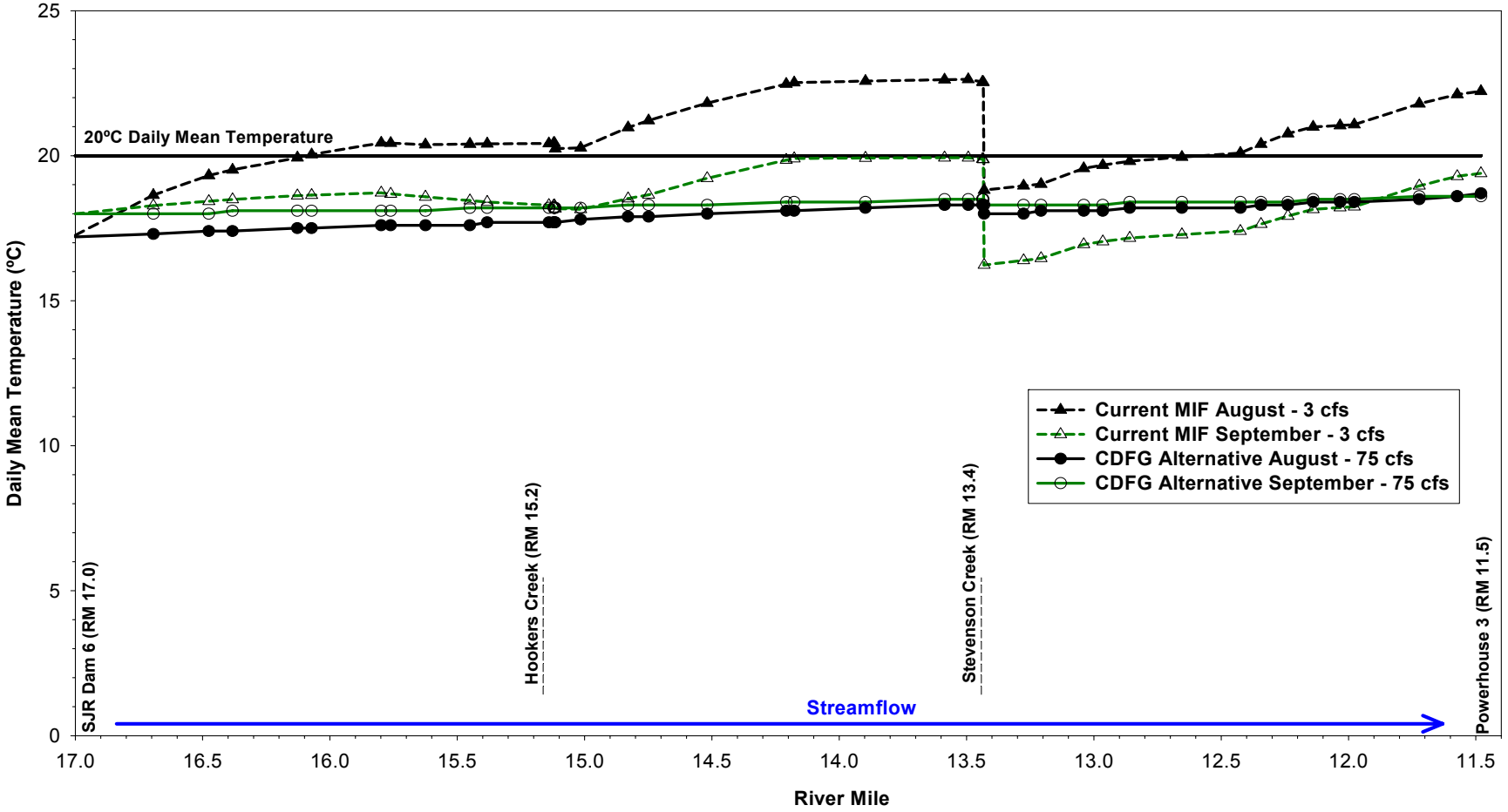
*** CDFG Alternative flow of 8 cfs was not modeled; CDFG Alternative flow is represented by the closest modeled flow of 10 cfs.**

Figure 6.1.4-20. Stevenson Creek Simulated Daily Mean Water Temperatures for CDFG Alternative and Minimum Instream Flows (MIF) for the Month of August in Dry Water Years with Warm Meteorology.



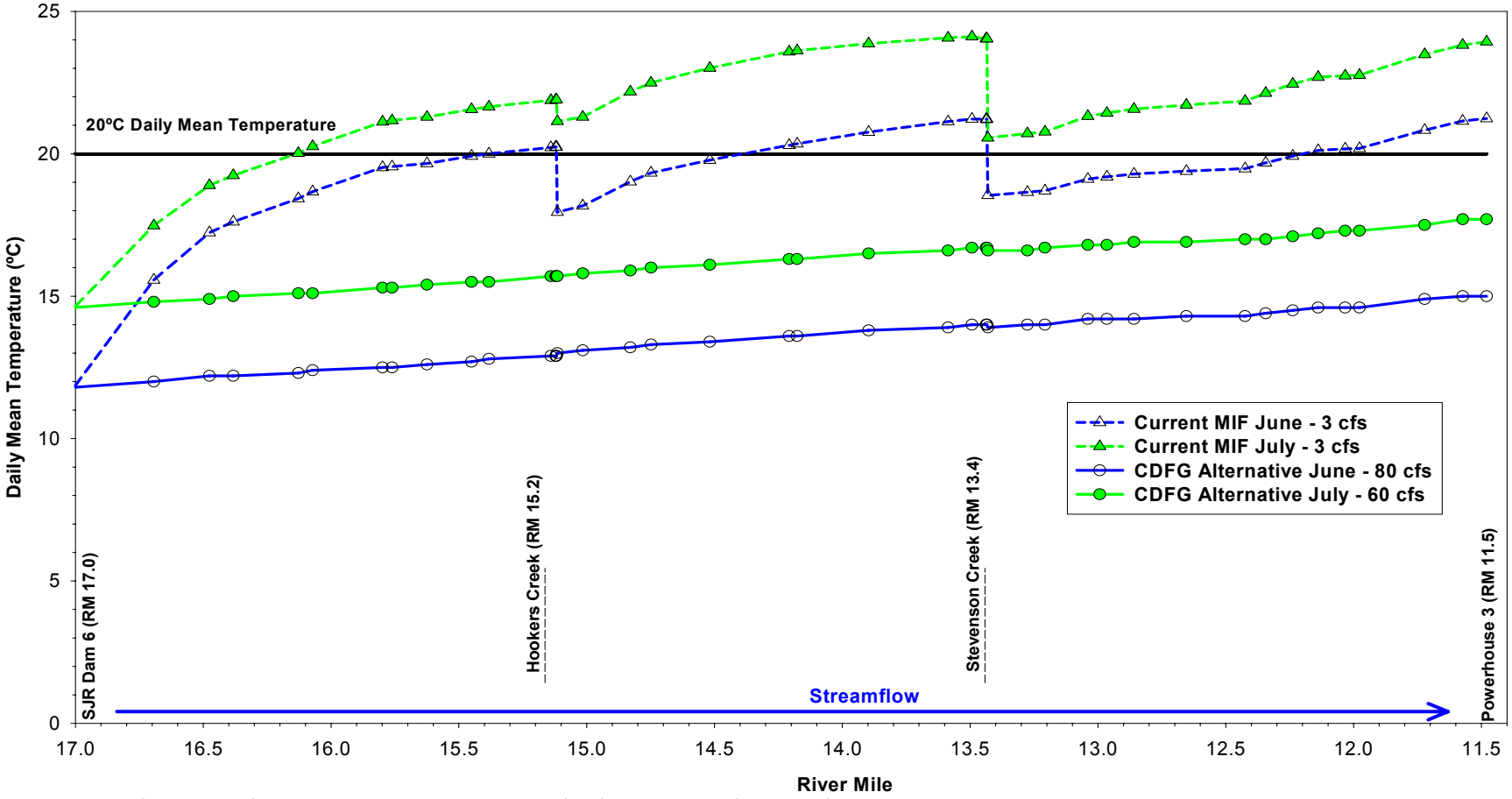
* Proposed flow released from Dam 6. Model includes proposed flow from Dam 6 and Stevenson Creek.

Figure 6.1.4-21. San Joaquin River Stevenson Reach Simulated Daily Mean Water Temperatures for CDFG Alternative and Current Minimum Instream Flows (MIF) for the Months of June and July in Above Normal Water Years with Normal Meteorology.



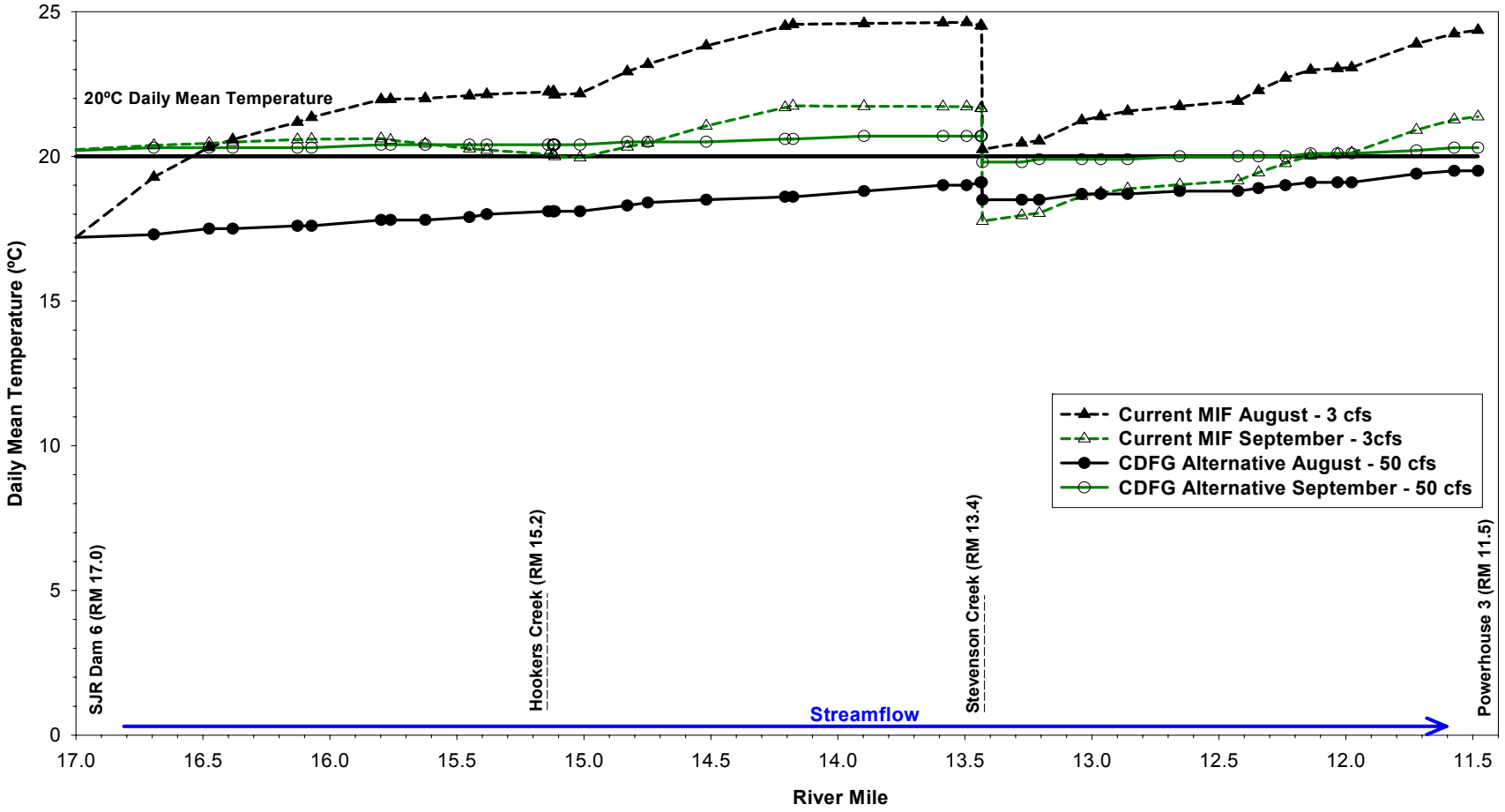
* Proposed flow released from Dam 6. Model includes proposed flow from Dam 6 and Stevenson Creek.

Figure 6.1.4-22. San Joaquin River Stevenson Reach Simulated Daily Mean Water Temperatures for CDFG Alternative and Current Minimum Instream Flows (MIF) for the Months of August and September in Above Normal Water Years with Normal Meteorology.



* Proposed flow released from Dam 6. Model includes proposed flow from Dam 6 and Stevenson Creek.

Figure 6.1.4-23. San Joaquin River Stevenson Reach Simulated Daily Mean Water Temperatures for CDFG Alternative and Current Minimum Instream Flows (MIF) for the Months of June and July in Dry Water Years with Warm Meteorology.



* Proposed flow released from Dam 6. Model includes proposed flow from Dam 6 and Stevenson Creek.

Figure 6.1.4-24. San Joaquin River Stevenson Reach Simulated Daily Mean Water Temperatures for CDFG Alternative and Current Minimum Instream Flows (MIF) for the Months of August and September in Dry Water Years with Warm Meteorology.