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9.0 CUMULATIVE EFFECTS ANALYSIS

The regulations implementing the National Environmental Policy Act (NEPA) define a cumulative effect as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR § 1508.7). Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower development.

The Proposed Action is the issuance of a new license for the Middle Fork American River Project (MFP or Project), which includes modification and construction of MFP facilities, changes in routine operation and maintenance activities, and implementation of new environmental programs, measures, and facilities as described in Section 4.0 – Proposed Action. Implementation of the Proposed Action in conjunction with contributing effects of other past, present, and reasonably foreseeable future projects will benefit environmental (aquatic, terrestrial, and recreation), economic, and societal values in the vicinity of the MFP.

As shown on Map 9-1 other projects/actions considered in this cumulative effects analysis include:

- Sacramento Municipal Utility District's (SMUD) Upper American River Project (UARP) (FERC Project No. 2101) that influences flow into Hell Hole Reservoir and along the South Fork Rubicon River, a tributary to the Rubicon River entering downstream of Hell Hole Reservoir;

- El Dorado Water and Power Authority's (EDWPA) water rights application to store water in SMUD's UARP reservoirs;

- Georgetown Divide Public Utility District's (GDPUD) Stumpy Meadows Project (non- Federal Energy Regulatory Commission [FERC or Commission] project), which affects flows in Pilot Creek, a tributary to the Rubicon River entering downstream of Hell Hole Reservoir;

- Foresthill Public Utility District's (FPUD) Sugar Pine Dam Project, which diverts water from Shirttail Creek (a tributary to the North Fork American River) to provide consumptive water to the community of Foresthill;

- Pacific Gas & Electric's (PG&E) Drum-Spaulding Project (FERC No. 2310) that influences flow into the North Fork American River from the Towle Diversion on Canyon Creek and the Lake Valley Diversion on the North Fork of the North Fork American River;

- Operations and maintenance of recreational facilities on Auburn Project Lands (also referred to as Auburn State Recreation Area [ASRA] by United States Bureau of Reclamation [USBR or Reclamation]) in the Middle Fork American

River and North Fork American River downstream of Oxbow Powerhouse (peaking reach);

- Placer County Water Agency's (PCWA) Pulp Mill Canal Diversion Dam Project that diverts water for consumptive use from Canyon Creek (a tributary to the North Fork American River). PCWA's water rights allow for the diversion of up to 40 cubic feet per second (cfs) from Canyon Creek;

- PCWA's operation of the American River Pump Station diverts water from the North Fork American River near the city of Auburn to provide up to 35,500 acre-feet (ac-ft) of consumptive water (under full build-out) from the MFP to meet PCWA's consumptive demand;

- United States Department of Agriculture-Forest Service (USDA-FS or Forest Service) Eldorado National Forest (ENF) maintains recreation facilities and provides for recreational opportunities on Forest Service lands in the vicinity of the MFP in accordance with the ENF Land and Resource Management Plan (LRMP) (USDA-FS 1988);

- USDA-FS Tahoe National Forest (TNF) maintains recreation facilities and provides for recreational opportunities on Forest Service lands in the vicinity of the MFP in accordance with the TNF LRMP (USDA-FS 1990); and

- Operations of Folsom Reservoir by the USBR to provide releases for downstream water uses and to protect aquatic resources in the Lower American River and the Delta.

- USBR's Congressionally-authorized Auburn Dam and Reservoir Project that if built would inundate lands along the Middle Fork American River and North Fork American River downstream of Oxbow Powerhouse (peaking reach);

- National Marine Fisheries Service's (NMFS) Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and California State Water Project (OCAP BiOP) and Public Draft Recovery Plan for Central Valley Winter-run and Spring-run Chinook Salmon and Steelhead (Draft Recovery Plan) defines lower American River flow and temperature management standards, improvements to an existing temperature control structure on Folsom Dam, and, in the future, evaluation of potential passage at Nimbus and Folsom dams to restore Central Valley (CV) steelhead (*Oncorhynchus mykiss*) to native habitat within the American River basin, upstream of Folsom Reservoir.

9.1 TARGET RESOURCES

The target resources considered for inclusion in the cumulative impacts analysis were identified based on: a review of the technical information developed in support of this Application for New License (License Application); comments received during formal scoping meetings; comments received on the Draft License Application, as appropriate;

and discussions with resource agencies, Native American Tribes, local and regional authorities, non-governmental organizations, local communities and businesses, and members of the public.

For this analysis, target resources that may be affected cumulatively by the incremental actions of the MFP in combination with other past, present, and reasonably foreseeable future actions include: water use (hydrology); water quality (water temperature); aquatic resources (resident fish, native amphibians, and anadromous fish); recreation resources; and air quality.

9.1.1 Geographic Scope

The geographic scope for the cumulative impact analysis defines the physical limits or boundaries of the effects on target resources from implementation of the Proposed Action when considering effects from other projects/actions. The geographic scope appropriate for evaluating cumulative effects for the MFP is the North Fork American River from Folsom Reservoir upstream to the confluence of the Middle Fork American River and the Middle Fork American River, Rubicon River, and associated tributaries (Map 9-1). The rationale for limiting the geographic scope of this analysis to upstream of Folsom Reservoir is that Folsom Reservoir (independently operated by the USBR) has sufficient storage capacity (approximately 975,000 ac-ft) to control the timing and volume of discharge from Folsom Dam under the Proposed Project and No-Action Alternative. Therefore, any shift in the timing or volume of flows downstream of Folsom Dam is considered to be under the management of the USBR, and not a consequence of the operation of the MFP. However, this analysis does include an evaluation of the effect from changes in MFP operations under the Proposed Action in combination with other projects/actions on the timing, volume, and temperature of flows into Folsom Reservoir.

9.1.2 Temporal Scope

The temporal scope for the cumulative impact analysis defines the length of time analyzed when evaluating resource effects of the Proposed Action in the context of past, present, and reasonably foreseeable future actions. Evaluations of past and future actions are limited by the amount of available information for each target resource and by information defining future projects and actions. Based on the anticipated term of the new license for the MFP, the temporal scope used for the analysis of reasonably foreseeable future actions is 50 years.

9.2 CUMULATIVE EFFECTS ON WATER RESOURCES

9.2.1 Water Use (Hydrology)

Other water projects/actions, in addition to the MFP, that affect hydrology in the North and Middle Fork American River watersheds include: SMUD's UARP; EDWPA's Water Rights Application; GDPUD's Stumpy Meadows Reservoir; FPUD's Sugar Pine Project; PG&E's Drum-Spaulding Project; PCWA's Pulp Mill Canal Diversion Dam Project; and PCWA's American River Pump Station Project. These projects have resulted or will

result in modification to the timing and magnitude of natural flows in the bypass and peaking reaches associated with the MFP. Information on the hydrologic effects of operations of the MFP (that include the hydrology effects of these projects) is provided in Sections 7.3 – Water Use Affected Environment and 8.3 – Water Use Environmental Effects, and in PCWA's Pre-Application Document (PAD), Supporting Document (SD) F, Section 4.0 (PCWA 2007). A summary of these project effects is highlighted below.

PCWA's MFP operations as modified under the Proposed Action, affect flows in the bypass and peaking reaches and water surface elevation/storage in Project reservoirs. In addition, increased water delivery from the MFP (to meet future consumptive demand under full build-out) will modify operations and affects instream flows and reservoir elevations. These changes are evaluated using the MFP Operations Simulation Model (Model) (Section 8.1 – Analytical Approach for a description of the model runs). The Model incorporates both existing and future operations of the MFP and other water projects/actions in the Middle Fork American River Watershed (Watershed), as described in the following:

- SMUD's UARP historical operations will be altered by the issuance of a new FERC license. The No-Action Alternative and Proposed Action model runs incorporate the revised flow measures for the UARP, as described in the 2007 Settlement Agreement between stakeholders and SMUD and FERC's Final Environmental Impact Statement (FEIS) for the UARP (FERC 2008).

- EDWPA's water rights application to store water for consumptive uses in SMUD's UARP reservoirs will not change SMUD's rate of diversion from the upper Rubicon River or South Fork Rubicon River. Therefore, modeling of UARP Settlement Agreement flows adequately describes the project's impact in the Watershed.

- GDPUD's Stumpy Meadows Reservoir Project historical diversions from Pilot Creek are included in the No-Action Alternative and Proposed Action model runs. Future Stumpy Meadows Project operations are not expected to differ from historic operations.

- FPUD's Sugar Pine Dam Project historical diversions are incorporated in model runs for both the No-Action Alternative and Proposed Action. Future Sugar Pine Dam Project operations are not expected to differ from historic operations.

- PG&E's Drum-Spaulding Project historical operations (under the existing FERC license conditions) are included in the No-Action Alternative and Proposed Action model runs. The Drum-Spaulding Project is currently undergoing FERC relicensing, however, it is unknown at this time, or to what extent, the existing license conditions will change.

- PCWA's Pulp Mill Canal Diversion Dam Project is included in the No-Action Alternative and Proposed Action model runs. Future operations of the diversion are not expected to differ from historic operations.

- PCWA's American River Pump Station Project operations are included in the No-Action Alternative, Proposed Action – Existing Demand model run, and the Proposed Action – Future Demand model run.

Under the Proposed Action, new instream flow releases were developed in the bypass and peaking reaches to maintain and/or enhance fish and aquatic resources, geomorphic channel processes, riparian resources, and whitewater recreational opportunities (Instream Flow and Reservoir Minimum Pool Measure [IFRM] PCWA 2011a; SD A). These changes in MFP operations, in combination with other projects/actions in the North and Middle Fork American River watersheds, contribute to an incremental improvement in beneficial uses from current conditions.

The timing and magnitude of average monthly flow entering Folsom Reservoir under the Proposed Action, in combination with other projects/actions, is similar to the No-Action Alternative (Figure 9-1). Figure 9-1 compares model runs of average monthly inflow into Folsom Reservoir in different water years under the No-Action Alternative and Proposed Action – Future Demand. Unimpaired inflow into Folsom Reservoir is included in Figure 9-1 for reference. Implementation of measures in the Proposed Action in combination with other projects/actions in the Watershed will have a negligible effect on flows entering Folsom Reservoir from current conditions. Overall, past development in the Watershed has substantially altered inflow below the confluence of the North Fork American River and Middle Fork American River (inflow into Folsom Reservoir, Figure 9-1). In addition, if the Auburn Dam and Reservoir Project was constructed, the peaking reach would be inundated and Folsom Reservoir inflow would be substantially altered.

9.2.2 Water Quality (Temperature)

Overall, operations of the MFP substantially reduce summer instream temperatures in the Rubicon River, Middle Fork American River, and North Fork American River compared to pre-project (unimpaired) conditions. Maps 7.5-3a and 7.5-3b illustrate modeled August water temperature in these rivers prior to the construction of the MFP (unimpaired conditions) and under the Proposed Action.

Two projects, in addition to the MFP, have the potential to cumulatively affect water temperature in the Rubicon River. SMUD's UARP has the potential to affect temperature in the South Fork Rubicon River and, therefore, affect temperature in the Rubicon River below the confluence of the South Fork Rubicon River. GDPUD's Stumpy Meadows Project has the ability to affect temperature in Pilot Creek and, therefore, affect temperature in the Rubicon River below the confluence of Pilot Creek.

In developing new instream flow measures in the Proposed Action for the MFP, summer water temperatures in the Rubicon River, at several locations under the No-Action Alternative and the Proposed Action, were compared to evaluate potential cumulative impacts. PCWA considered the effects of the SMUD and GDPUD projects on flows and resulting water temperatures in the Rubicon River, with particular emphasis on rainbow trout, hardhead, and foothill yellow-legged frog (FYLF) habitat. PCWA's water

temperature model was used to identify potential cumulative effects on these resources and the instream flows were modified such that those included in the Proposed Action maintain water temperatures relative to these species. Table 8.5-3b shows that during the drier water year types, when Project flows could have the largest effect on summer water temperature, the Proposed Action maintains water temperatures similar to existing conditions (AQ 4 – Water Temperature Modeling Technical Study Report [TSR] [AQ 4 – TSR], Addendum 1, [PCWA 2011b; SD B]).

In the North Fork American River, below the confluence of the Middle Fork American River, several projects/actions may affect the temperature of water flowing into Folsom Reservoir. These include modified operation of the MFP under the Proposed Action, increases in water deliveries from the MFP to meet future demand, PCWA's Pulp Mill Diversion, PG&E's Drum Spaulding Project and operations of Sugar Pine Dam by FPUD. The water temperature model developed for the MFP in the North Fork American River incorporates accretion flows and current hydrologic and water temperature effects of other projects in the Watershed.

The mean monthly water temperatures of Folsom Reservoir inflow under the Proposed Action, in combination with other projects/actions in the North and Middle Fork American River watersheds, are similar compared to the No-Action Alternative in wet years and slightly cooler in dry years (Figure 9-2). Figure 9-2 compares model runs of average monthly temperatures of Folsom Reservoir inflows in two different water year types (wet and dry) under the No-Action Alternative and Proposed Action – Future Demand. Results of the model demonstrate that the water temperatures of Folsom Reservoir inflow are maintained or slightly enhanced (cooler) under the Proposed Action and remain substantially cooler than water temperatures under unimpaired conditions.

9.3 CUMULATIVE EFFECTS ON AQUATIC RESOURCES

9.3.1 Resident Fish and Native Amphibians

Resident fish (e.g., rainbow trout, hardhead) and FYLF distribution and abundance in the Rubicon River downstream of the confluence with the South Fork Rubicon River and downstream of Pilot Creek could be cumulatively affected by changes in instream flows considering the Proposed Action, SMUD's UARP, and GDPUD's Stumpy Meadows Project.

Instream flows included under the Proposed Action consider the effects of the UARP and Stumpy Meadows Projects on hydrology and are designed to maintain the current distribution of cold water fish and warmer water FYLF and hardhead in the Rubicon River. The distribution of water temperature in the Rubicon River will remain similar under the Proposed Action (Section 9.2.2); therefore, the distribution of fish and FYLF will remain the same under the Proposed Action as compared to baseline conditions (No-Action Alternative). There will be no cumulative effect of the Proposed Action on aquatic species distributions.

Under the Proposed Action, higher minimum instream flows in the Rubicon River are proposed in the winter and spring to enhance aquatic resources (including resident fish). Also, higher minimum instream flows are included in the wet and above normal years during the summer (years when water temperature modeling indicated that minimum flows would not alter temperature conditions due to high accretions). These instream flow recommendations for the MFP were developed and analyzed in Section 8.5 – Fish and Aquatic Resources Environmental Effects. The analysis included the incremental contribution of UARP higher instream flow releases in the South Fork Rubicon River and the effects of Stumpy Meadows Project on Pilot Creek. The analysis shows that fish habitat in the Rubicon River is maintained, and FYLF are maintained with implementation of the instream flows included under the Proposed Action. In addition, the Fish Population Monitoring Plan (FPMP) (PCWA 2011c; SD A) and Foothill Yellow-Legged Frog Monitoring Plan (FYLFMP) (PCWA 2011d; SD A) include monitoring fish (e.g., fish species composition, abundance, condition factor, and population age class structure data) and FYLF (e.g., abundance, distribution, and timing of initiation of breeding) in the bypass and peaking reach during the term of the new license. Overall, the cumulative effect of the Proposed Action, considering other projects/actions in the Watershed, maintains aquatic resources.

9.3.2 Anadromous Fish

The Sacramento – San Joaquin drainage, which includes the American River and tributaries that drain the west slope of the Sierra Nevada, historically contained the richest native fish fauna of the Sierra Nevada, with 22 taxa (Moyle et al. 1996). Fourteen of these native fishes (including four runs of Chinook salmon) historically may have occurred in the streams associated with the MFP. Table 9-1 lists these native fish, their potential to occur in the Watershed, and their current management status.

Three native anadromous species (winter steelhead, Pacific lamprey, and Chinook salmon) historically migrated into the Watershed. Both steelhead and Chinook salmon reportedly ascended the Middle Fork American River past the Rubicon River confluence, and the Rubicon River as far as the Pilot Creek confluence, which is approximately 5 miles upstream of the Middle Fork American River confluence (Yoshiyama, et al. 1996). There are no catadromous or other migratory species present. In addition, the Watershed does not include essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act.

No anadromous species are currently present in bypass or peaking reaches associated with the MFP. Anadromous species were extirpated in the vicinity of the MFP as a result of the construction of impassable dams on the lower American River (Nimbus and Folsom dams were constructed by the USBR in approximately 1955 and 1956, respectively). Additionally, two new fish passage barriers (unrelated to the MFP) are present in the peaking reach including Tunnel Chute (RM22.9), which was created by miners in the 1880s and Ruck-a-Chucky rapids (RM10.8), which was created by a landslide in the 1940s. Therefore, anadromous fish are not present upstream of Folsom Reservoir or affected by operations of the MFP.

Under the Proposed Action, the timing and magnitude of flows from the MFP into Folsom Reservoir are similar to the No-Action Alternative (Section 9.2.1). In addition, the temperature of water inflow into Folsom Reservoir under the Proposed Action is similar to the No-Action Alternative (Section 9.2.2). Therefore, operation of the MFP under the Proposed Action, in combination with other past, present, and reasonably foreseeable projects will not affect anadromous fish populations.

The NMFS's OCAP BiOP and Draft Recovery Plan describes future evaluation of potential passage at Nimbus and Folsom dams to restore CV steelhead to native habitat within the American River Basin, upstream of Folsom Reservoir. There are a number of actions that would need to be completed prior to reintroduction of CV steelhead above Folsom Dam, including planning and scheduling, permitting, evaluations, and funding. These include, but are not limited to:

- Evaluation of potential habitat in all three forks of the American River above Folsom and Nimbus dams;
- Development of fish passage pilot plan;
- Development of a 3-year pilot program;
- Implementation of the pilot program, including construction and collection of handling facilities, adult release sites above dams, trapping of juvenile downstream migrating fish, etc.; and
- Pilot Program Effectiveness Monitoring and Evaluation.

However, to date, most of the actions associated with this evaluation have not been implemented. Elements of the potential reintroduction are "virtually untested" and "prototype" (NMFS 2009, pg. 666). The results of the pilot program will be used to determine the feasibility of long-term passage alternatives and evaluate whether comprehensive fish passage programs should be pursued. During the pilot program, CV steelhead introduced above Folsom Reservoir would likely be designated as an experimental population under Section 10 [16 U.S.C. 1539] (a)(1)(j) of the Endangered Species Act. PCWA is committed to collaborate with the NMFS regarding potential reintroductions into the American River Basin, including the Fish Passage Committee. PCWA acknowledges the potential need to reevaluate the new License Order if a viable population of CV steelhead is established in reaches of the North Fork American River or Middle Fork American River affected by MFP operations and the population is determined to be essential for the continued existence of CV steelhead.

9.4 CUMULATIVE EFFECTS ON RECREATION

The Proposed Action in combination with actions taken by ENF and TNF on Forest Service lands and USBR on Auburn Project Lands cumulatively affect recreation resources in the Middle Fork American River and North Fork American River watersheds, as described in the following.

9.4.1 Eldorado and Tahoe National Forests

The Proposed Action in combination with actions taken by USDA-FS has the potential to affect recreation resources in the Watershed on Eldorado and Tahoe National Forests. The Eldorado and Tahoe National Forests include approximately 603,701 acres and 829,204 acres, respectively, of which the MFP occupies approximately 1,306 acres within the ENF and 1,746 acres within the TNF.

USDA-FS maintains recreation facilities and provides recreation opportunities on Eldorado and Tahoe national forests, in accordance with the ENF LRMP (USDA-FS 1988) and the TNF LRMP (USDA-FS 1990).

Implementation of the Proposed Action as described in the Recreation Plan (PCWA 2011e; SD A) will enhance recreation opportunities in the Eldorado and Tahoe National Forests, as summarized in the following:

- Increased recreational boating opportunities in the bypass and peaking reaches;
- Provides information that will allow recreational visitors to better utilize existing opportunities;
- Improved stream-based angling experience (enhances aquatic habitat and aquatic species);
- Greater access to Project reservoirs;
- Facilitates trip planning by providing publicly available real-time flow and reservoir water surface elevation information, and brochures and maps;
- Enhanced recreation opportunities by providing additional group camping;
- Relieves congestion and improves recreational experience at Indian Bar Rafter Access; and
- Improves dispersed recreation opportunities (new facilities and trail signage).

It is anticipated that the USDA-FS will continue to maintain or enhance the current level of recreational facility development and recreation opportunities within Eldorado and Tahoe National Forests in the future. Therefore, the Proposed Action in combination with other actions taken by the ENF and TNF will cumulatively enhance recreation in the national forests.

9.4.2 Auburn Project Lands (Peaking Reach)

The Proposed Action in combination with actions taken by USBR has the potential to affect recreation resources in the Middle Fork American River and North Fork American River downstream of Oxbow Powerhouse (peaking reach). The peaking reach bisects Auburn Project Lands, which consist of federal lands and private lands reserved for the

Auburn Dam and Reservoir Project (totaling 41,000 acres) that was Congressionally-authorized in 1965. Construction of the Auburn Dam and Reservoir Project, initiated by the USBR in 1967, was halted in the 1980s. In 2008, the State Water Resources Control Board (State Water Board) revoked the USBR's water rights permits for the Auburn Dam and Reservoir Project. However, the Auburn Dam and Reservoir Project remains a Congressionally-authorized project.

The Auburn Project Lands include USBR fee title lands (26,000 acres), and other lands (15,000 acres) owned by Bureau of Land Management (BLM), USDA-FS, United States Army Corps of Engineers (USACE), and private land owners (USBR 1992). Land use planning and resource management on all federal lands within Auburn Project Lands has been granted to the USBR in accordance with interagency agreements (Section 7.1 – Description of the River Basin, Attachment 7.1-1). The Auburn Project Lands boundary is shown on Map 9.1.

In 1977, the USBR entered into an interim agreement with California State Parks to assume responsibility for management of public use on Auburn Project Lands. California State Parks continues management of public use on these lands at the direction and discretion of USBR. Funding to manage public use and provide recreational opportunities and service within the Auburn Project Lands is provided in part from USBR, State of California, and user fees. Funding by USBR and the State of California has declined in recent years.

In 1978, the USBR developed a General Plan for the Auburn Project Lands, which designated that the area be managed as a reservoir-based recreation area, following construction of the Auburn Dam and reservoir. In 1979, the State of California incorporated Auburn Project Lands into the State park system as Auburn State Recreation Area (ASRA) (USBR 1992). Lands reserved for the Auburn Dam and Reservoir Project (Auburn Project Lands), as managed by California State Parks, are referred to in this License Application as ASRA.

In 1992, due to the delays in constructing Auburn Dam and Reservoir Project, the USBR developed an Interim Management Plan (IRMP), which was designed to guide use of ASRA, consistent with its "interim status" as a river-based recreation area. In 2006, USBR and California State Parks began collaborating on a joint Updated General Plan and Resource Management Plan for ASRA. However, in a letter dated May 11, 2010, California State Parks notified the stakeholders involved in the planning process that the "planning process to develop a new General Plan and Interim Resource Management Plan (GP/IRMP) for ASRA and the Auburn Dam Project Lands has been suspended indefinitely at the request of the U.S. Bureau of Reclamation (Reclamation)". California State Parks also stated in the letter that, "Reclamation had indicated that it would not be prudent to proceed with the preparation of the GP/IRMP until the future management is resolved, therefore the GP/IRMP process is suspended" (DPR 2010). Therefore, public use in ASRA is currently managed in accordance with the Interim Resource Management Plan (USBR 1992).

Implementation of the Proposed Action will maintain and enhance stream-based recreation opportunities and experience along the peaking reach and on Auburn Project Lands, as summarized in the following:

- The IFRM (PCWA 2011a; SD A) contains a provision that formalizes a release schedule that maintains existing whitewater boating in the Tunnel Chute Run in all water years and enhances recreational boating opportunities downstream on three additional runs in wet and above normal water years, as described in Section 8.9 – Recreation Resources Environmental Effects.

- The Proposed Action increases minimum instream flows in the peaking reach compared to the No-Action Alternative in most water-year types. In addition, the Proposed Action includes a reduction in the ramping rate of Oxbow Powerhouse flow releases, and during the driest water year types, a 900 cfs maximum release from Oxbow Powerhouse from Memorial Day weekend to Labor Day. Reducing the magnitude of flow fluctuations will improve food production for fish (aquatic macroinvertebrates), increase effective spawning habitat, reduce potential stranding, benefit young-of-the-year fish, and increase the abundance of fish in the peaking reach. The Proposed Action will enhance the fishery and; therefore, enhance the angling experience compared to the No-Action Alternative.

- The Proposed Action reduces the ramping rate of Oxbow Powerhouse compared to the No-Action Alternative. Reducing the ramping rate will enhance recreation in the peaking reach by slowing the rate at which flows change; thereby, providing recreationists more time to modify their activities to changing flow conditions.

- The Recreation Plan (PCWA 2011e; SD A) contains measures to enhance recreation experience at the Indian Bar Rafting Access by relieving congestion in the unloading area and at the boat ramps, and by improving sanitation conditions.

- The Recreation Plan (PCWA 2011e; SD A) contains measures to: (1) provide real-time flow information to the public from two stream gages on the peaking reach; and (2) provide the public with a matrix showing when recreation flows released from Oxbow Powerhouse will arrive at Fords Bar, Ruck-a-Chucky Recreation Area, Mammoth Bar, Poverty Bar, the Confluence, Birdsall Access, and Oregon Bar Access Point.

- The Recreation Plan (PCWA 2011e; SD A) also includes commitments by PCWA to fund resource agency administrative oversight activities, and routine operation and maintenance activities at the Indian Bar Rafter Access.

In general, for most recreational users in the peaking reach, the Proposed Action maintains existing stream-based recreation opportunities but enhances the overall recreational experience. Only early scheduled flow releases in wet and above normal water years (Saturdays only) between the first Saturday prior to Memorial Day and

Labor Day increases recreational opportunities (recreational boating) in the lower portion of the peaking reach. This represents only a minor change in overall recreation use. Currently, the USBR has established a kiosk to collect an entry fee (user fee) from recreationists boating the lower portions of the peaking reach and taking out at Oregon Bar to offset administrative costs. The USBR manages overall public use on Auburn Project Lands, including the peaking reach. It is the responsibility of the USBR to manage recreation use along the peaking reach commensurate with available funding. Funding to manage public use and provide recreational opportunities and service within the Auburn Project Lands is provided in part from USBR, State of California, and user fees. It is solely the discretion of the USBR whether increased opportunities provided by the Proposed Action in the lower portions of the peaking reach are available to the public. Therefore, the Proposed Action in combination with other actions on Auburn Project Lands cumulatively have the potential to increase the recreational experience of existing users in the peaking reach as well as slightly increasing recreational boating opportunities. However, if the Auburn Dam and Reservoir Project was constructed, the peaking reach would be inundated and future recreation in the area would be reservoir-based.

9.5 CUMULATIVE EFFECTS ON GLOBAL CLIMATE CHANGE (GREENHOUSE GAS EMISSIONS)

Global climate change is the common nomenclature used to describe an increase in the average temperature of the Earth's atmosphere and oceans, and its projected continuation. The causes of global change have been linked to both natural processes and human actions. According to the Intergovernmental Panel on Climate Change (IPCC), increasing greenhouse gas (GHG) concentrations resulting from human activity, such as fossil fuel combustion and deforestation without adequate revegetation, have been largely responsible for human-induced global warming (IPCC 2007). Increases in the concentrations of GHGs in the atmosphere decrease the amount of solar radiation reflected back into space, intensifying the natural "greenhouse effect" and resulting in the increase of global average temperatures. The most common GHGs are carbon dioxide (CO_2) and water vapor, but there are also several others, including methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), as described in Section 7.15 – Air Quality Affected Environment.

The potential heat trapping ability of each of the GHGs varies substantially. To account for these differences in warming effect, GHGs are defined by their global warming potential (GWP). The GWP value for a GHG depends on the time span over which it is calculated and on how the gas concentration decays in the atmosphere over time. For that reason, slightly different GWP values appear in scientific literature. This assessment is based on the use of the widely accepted IPCC GWP values for a 100-year period. Under this methodology, the GWP of CO_2 is set to 1, the GWP of CH_4 is 23, and the GWP of N_2O is 296 (IPCC 2007). In this analysis, GHGs are reported as carbon dioxide equivalents (CO_2e) to measure their relative potency. CO_2e takes into account the relative potency of the non-CO_2 GHGs and converts quantities to an equivalent amount of CO_2, so that all emissions are reported as a single quantity.

This analysis focuses on the potential incremental (cumulative) effects of the Proposed Action on GHG emissions within California considering legislation developed in the state to address global warming from past and current projects and reasonably foreseeable future projects. At present, the State of California is the controlling legal authority on GHG emissions within the Project area. The following compares GHG emission between the Proposed Action and No-Action Alternative in context with overall GHG emission in California.

The MFP, under the No-Action Alternative, generates electricity via renewable, hydroelectric power. Hydroelectric power from the MFP is produced at five Project powerhouses with a total installed capacity of 223.7 megawatts (MW) and an annual average energy production of 1,039,078 megawatt-hours (MWh)[1] under the No-Action Alternative. PCWA owns and operates the MFP and is an independent generator (wholesaler of electricity) that sells electricity to California's electrical retailers via the California electricity grid.

Conventional hydroelectric generation is a reliable, efficient, economical, and less-polluting source of energy resulting in low air emissions. Energy from the MFP is used to meet California's energy demand, renewable energy goals, and provide a source of energy with low GHG emissions (refer to Section 7.15 – Air Quality Affected Environment for a description of applicable GHG statutes and programs). The MFP hydroelectric facilities do not produce net emissions of GHGs, rather the MFP produces an "offset" in terms of the GHGs that would otherwise be generated on the grid. Existing MFP generation results in a total offset of 342,749 metric tons (MT) CO_2e annually.

Under the Proposed Action, several construction projects will improve operations and maintenance of the MFP, enhance environmental resources, and/or provide for implementation of new environmental programs and measures. GHG emissions resulting from the construction activities associated with the Proposed Action are provided in Section 8.15 – Air Quality Environmental Effects and Appendix C2 – Construction Air Quality Emissions Model. In summary, short-term construction activities associated with implementation of the Proposed Action will increase the state's overall GHG emissions by 758 tons per year, which represents an increase of only 0.0002% (California's current GHG emissions are 461,000,000 tons of CO_2e per year). These construction emissions will be temporary and intermittent, and will cease upon completion of work. Therefore, impacts of MFP construction activities on global climate change are negligible.

Further, under the Proposed Action, annual electric generation from the MFP will decrease by an average of 4.59% due to higher instream flow releases identified in the

[1]Generation from French Meadows, Middle Fork, Ralston, and Oxbow powerhouses is averaged over a 40-year period of record (1967–2006). Hell Hole Powerhouse began operation in 1983; therefore, annual net generation is averaged over a 24-year period of record (1983–2006). The total average annual energy production represents the sum of the average net generation for the five Project powerhouses based on their respective period of record (refer to Table 3-16).

IFRM (PCWA 2011a; SD A). This equates to an annual generation loss of 47,694 MWh and results in an overall annual average energy production of 991,384 MWh.

Under the Proposed Action, the reduction in generation decreases total GHG offset by 15,732 MT CO_2e annually (from 342,749 MT of CO_2e to 327,016 MT of CO_2e) (refer to Table 9-2). Attachment 9-1 provides a description of the methodology used to determine the effect of this loss in generation on GHGs. Despite this reduction, the net beneficial effect of the MFP is considerable in terms of GHGs emissions.

The slight reduction in net GHG emissions offsets under the Proposed Action has a negligible effect on global climate change for several reasons. PCWA is an independent generator (wholesaler of electricity) of power produced from the MFP. Electric energy retailers will have to replace the loss of generation. It is unknown what source will provide the replacement generation as this is dependent on a retailer's individual system-wide generation portfolio. However, any replacement generation acquired by the retailers must be consistent with the legislative mandates adopted by the State of California requiring reductions in statewide GHG emissions from current levels. These include:

- **Assembly Bill 32** (AB 32) that codifies California's goal of reducing statewide emissions of GHGs by 2020 to 1990 levels. This reduction will be accomplished through an enforceable statewide cap on global warming emissions; and

- **Executive Order S-3-05** that establishes GHG emission reduction targets: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; and by 2050, reduce GHG emissions to 80% below 1990 levels.

Despite the loss of generation associated with implementation of the Proposed Action, the MFP will continue to produce electric energy with low GHG emissions and operation of the MFP will continue to provide a valuable offset for GHGs. The MFP's continued operation, even considering the loss of generation, helps California move toward a lower carbon future and meet the goals of AB 32 and Executive Order S-3-05. In addition, electric retailers will have to replace any loss of generation from the MFP with an alternative source that has low GHG emissions to comply with current legislative requirements. Therefore, impacts of the Proposed Action on GHG emissions and the resulting effect on global warming, when considering other projects/actions, are negligible.

9.6 UNAVOIDABLE ADVERSE EFFECTS

No unavoidable cumulative adverse effects have been identified under the Proposed Action.

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TABLES

Table 9-1. Fish Native to the Middle Fork American River Watershed.[1]

Name	Habitat	Presence	Management Status[2]
Lampreys, *Petromyzontide*			
Pacific lamprey, *Lampetra tridentata*	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	
Salmon, *Salmonidae*			
Chinook salmon, *Oncorhynchus tshawytscha*			
Chinook salmon, Spring-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	ST, FT
Chinook salmon, Winter-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	SE, FE
Chinook salmon, Fall-run	Anadromous, lowlands	Extirpated (Nimbus/Folsom)	CSC, FSS
Chinook salmon, Late fall-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	CSC, FSS
Trout, *Salmonidae*			
Resident rainbow trout, *O. mykiss irideus*	Foothills, High elevations	Present	
Winter steelhead, *O. mykiss irideus*	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	FT
Minnows, *Cyprinidae*			
Sacramento hitch, *Lavinia exilicauda excilicauda*	Lowlands, foothills	Presence not documented	
California roach, *Lavinia symmetricus*	Foothills	Present	
Sacramento blackfish, *Orthodon microlepidotus*	Lowlands	Presence not documented	
Hardhead, *Mylopharodon conocephalus*	Lowlands, foothills	Present	CSC, FSS
Sacramento pikeminnow, *Ptychocheilus grandis*	Lowlands, foothills	Present	
Sacramento speckled dace, *Rhinichthys osculus ssp.*	Lowlands, foothills	Present	

Table 9-1. Fish Native to the Middle Fork American River Watershed (continued).[1]

Name	Habitat	Presence	Management Status[2]
Suckers, *Catostomidae*			
Sacramento sucker, *Catostomous occidentalis*	Lowlands, foothills, high elevations	Present	
Surf Perches, *Embiotocidae*			
Sacramento tule perch, *Hysterocarpus t. traski*	Lowlands, foothills	Presence not documented	
Sculpins, *Cottidae*			
Prickly sculpin, *Cottus asper*	Lowlands, foothills	Present	
Riffle Sculpin, *Cottus gulosus*	Foothills, high elevations	Present	

[1]Table adapted from Moyle et al. 1996

[2]Status

FT = Federal Threatened
FE = Federal Endangered
ST = State Threatened
SE = State Endangered
CSC = CDFG Species of Special Concern
FSS = USFS Sensitive Species
FSC = USFWS Species of Concern

Table 9-2. MFP – Hydroelectric Operations Offsets.

Hydroelectric Generation (MWh/Yr)	Equivalent Emission Rate			Emissions (Metric Tons/yr)	Global Warming Potential[b]	CO_2 Equivalent Emissions (Metric Tons CO_2 e/yr)
	CO_2 (lbs CO_2/MWh)[a]	N_2O (lbs CO_2/GWh)[a]	CH_4 (lbs CH_4/GWh)[a]			
Existing Generation 1,039,078						
	724.12			341,291.1	1	341,291
		8.1		3.8	296	1,130
			30.2	14.2	23	327
					Total Offsets	342,749
Generation with Project 991,384						
	724.12			325,625.7	1	325,626
		8.1		3.6	296	1,078
			30.2	13.6	23	312
					Total Offsets	327,016
				Difference With Project (CO_2 e/yr)		-15,732

NOTES:

[a]Emissions for equivalent power production on the California grid. Factors from: eGRID 2007 Subregion CAMX/WECC-California Climate Registry General Reporting Protocol 3.1 Updates and Clarifications (January 2009).

[b]IPCC Third Assessment Report 2001 - Table C.1 Comparison of GWPs from the IPCC's Second and Third Assessment Reports

California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009)

FIGURES

Figure 9-1. Average Monthly Flow Into Folsom Reservoir Under the Proposed Action - Future Demand, No-Action Alternative, and Unimpaired Hydrology by Water Year Type.

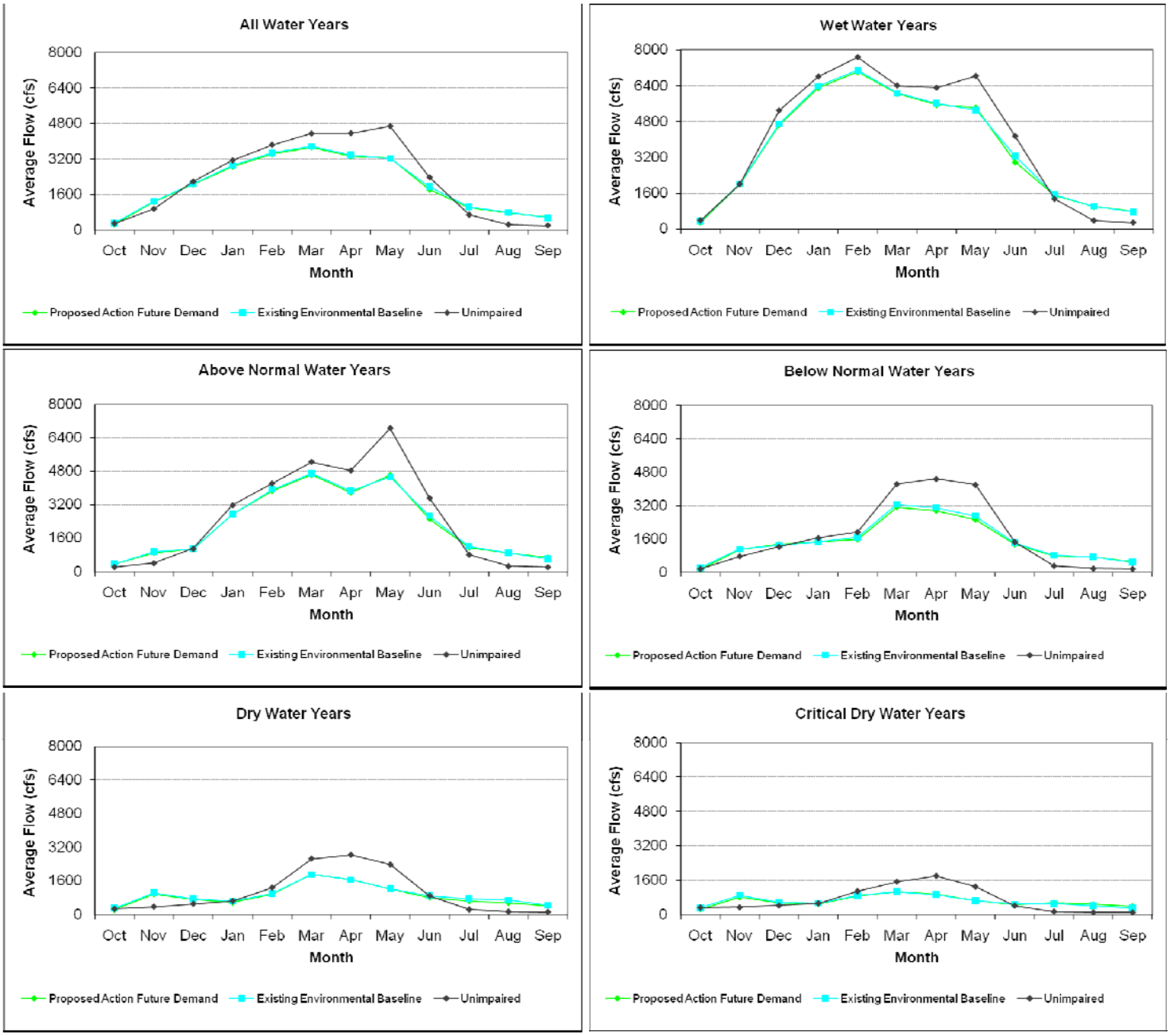
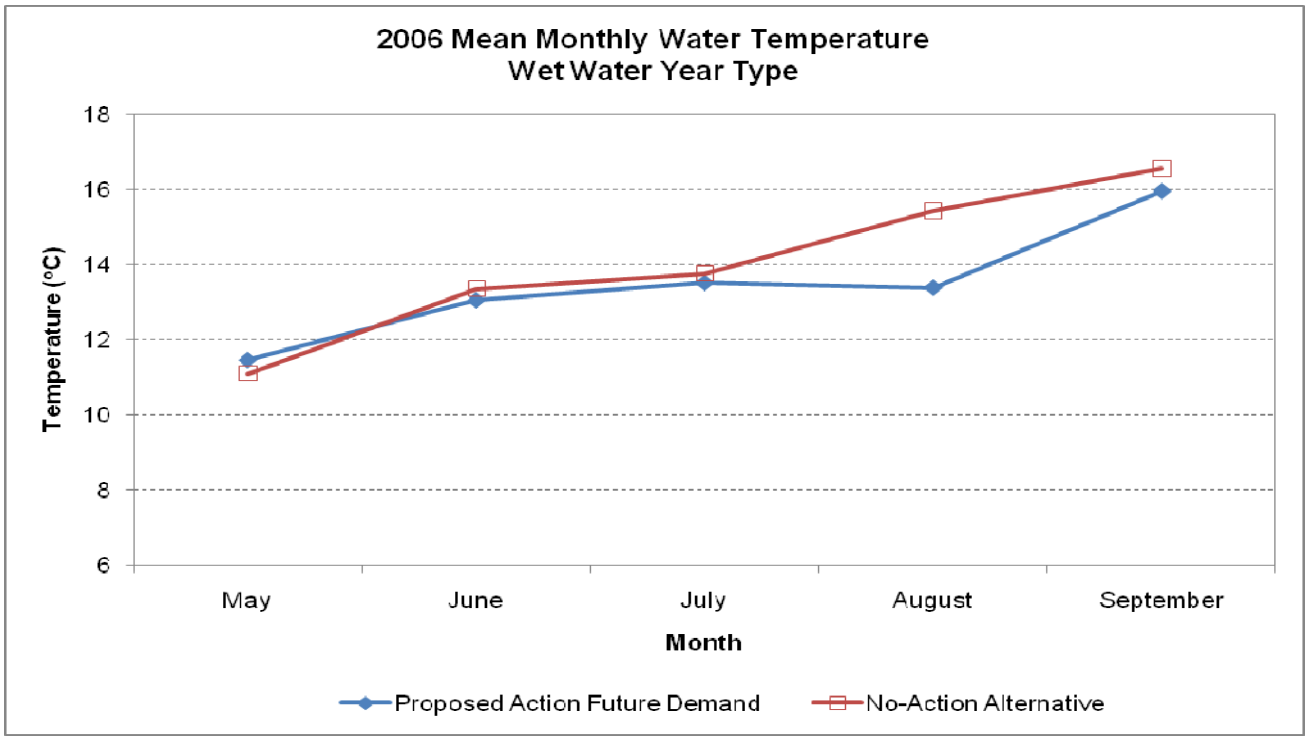
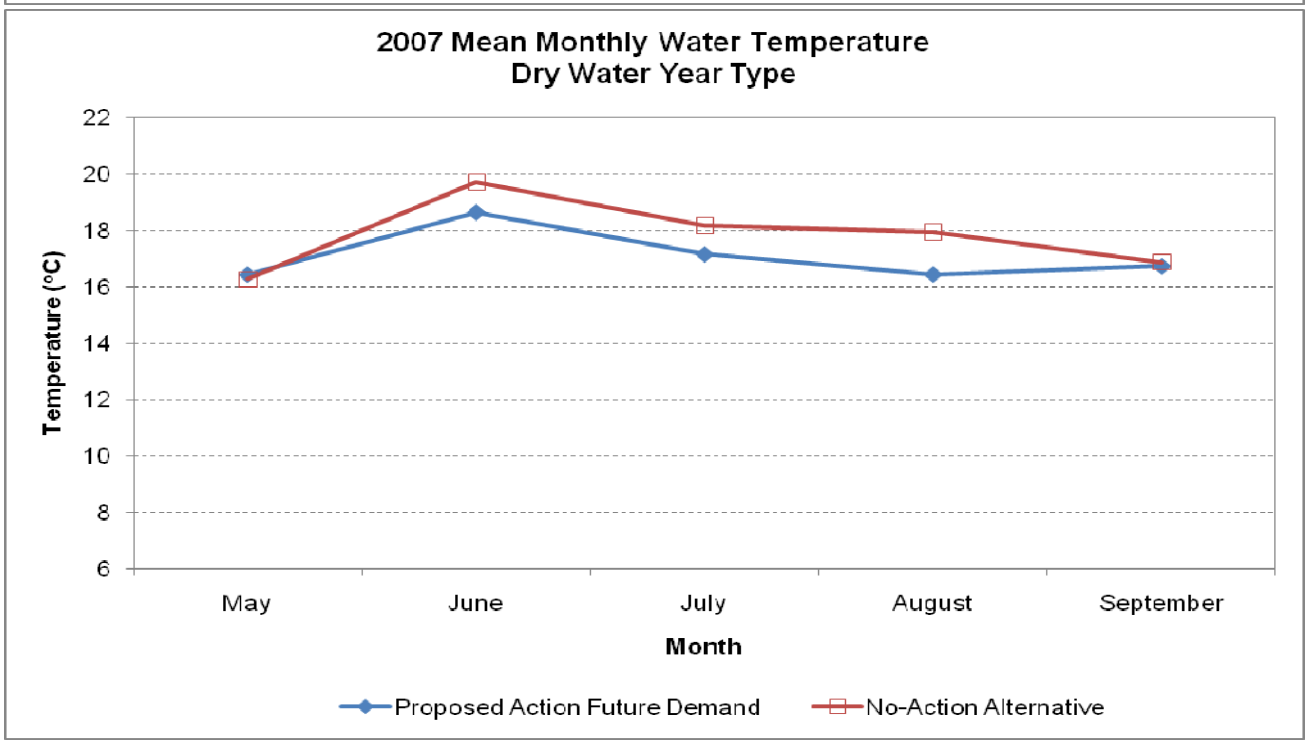


Figure 9-2. North Fork American River Modeled Mean Monthly Water Temperature at the Folsom Reservoir High Water Mark in a Wet Water Year Type (2006) and Dry Water Year Type (2007) Under the Proposed Action - Future Demand and No-Action Alternative.





MAPS

ATTACHMENT 9-1

Methodology to Determine Effect of Loss of Generation on Greenhouse Gases

The following describes the methodology used to determine the effect of this loss in generation on GHGs. A loss of generation capacity would have to be made up for by other electric energy retailers (i.e., purchased on the market) to meet demand. Electricity purchased on the California grid could include a variety of generation sources, including non-renewable (fossil fuel) sources, which generate GHGs, as well as renewable sources with negligible GHG emissions. To estimate the equivalent amount of GHGs produced by replacement electric generation, the methodology presented in the California Climate Action Registry (CCAR 2009) was used. This methodology is based on a database for GHGs associated with electric production (Emissions and Generation Resource Integrated Database, or eGRID) developed for the United States Environmental Protection Agency (EPA). The eGRID database is a globally recognized source of emissions data for electric power generated in the United States. eGRID is widely used for many other applications, such as EPA's Power Profiler and Carbon Footprint Tools, indirect emissions under the World Resources Institute, the Climate Registry, California Climate Action Registry, EPA Climate Leaders protocols, and many non-governmental organization tools and methodologies.

The eGrid divides the United States into regions and sub-regions. The region for California (CAMX) is a sub-region within the Western Electricity Coordination Council (WECC) area. The eGrid contains the most recent emissions operating data for California from all electricity providers, including coal and gas-fired power plants, cogeneration, biomass, solar, geothermal, nuclear, wind, hydroelectric, and other sources. Emissions are reported for three GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O). The eGRID provides total output emission rates, as pounds per megawatt hour (lb/MWh), for CO_2, CH_4, and N_2O. The total output emission rates are the appropriate value to use for carbon foot printing and to assign an emissions value from the consumption of purchased electricity (EPA 2011). These output emissions rates were then converted to carbon dioxide equivalents, using the global warming potential (GWP) factors presented in CCAR (2009) and as described previously.