COVER SHEET

FEDERAL ENERGY REGULATORY COMMISSION

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE
UPPER NORTH FORK FEATHER RIVER PROJECT
Project No. 2105-089

APPENDIX D

ADVANTAGES AND DISADVANTAGES OF POTENTIAL MEASURES TO CONTROL WATER TEMPERATURES IN THE NORTH FORK FEATHER RIVER

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APPENDIX D

ADVANTAGES AND DISADVANTAGES OF POTENTIAL MEASURES TO CONTROL WATER TEMPERATURE IN THE NORTH FORK FEATHER RIVER

Table D-1. Summary of advantages and disadvantages of potential measures to control water temperature in the North Fork Feather River with the objective of providing daily mean water temperatures of less than 20°C, along with potential measures to address water quality and odor in the Seneca reach.

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
1. 2105 SA proposed MIFs with first 5-year required flows for Rock Creek and Cresta[a] (Sources: Bechtel and TRPA, 2004; PG&E, 2004a, 2003a)	• Minor temperature reductions in Seneca reach. • Negligible to minor temperature reduction in Belden reach in dry years.	• Negligible temperature reduction in Belden reach during average hydrologic conditions. • Frequent July/August temperatures >20°C in Belden, Rock Creek, and Cresta reaches. • Major reduction in Lake Almanor water surface elevations during dry years.	Yes

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
2. 600-cfs Seneca reach flows from low-level gates (PG&E, 2003a, 2002)	• Generally minor to moderate reductions in Belden reach temperatures.	• Generally moderate to major temperature increases in Seneca reach from July to September. • Generally minor to moderate temperature reductions with average hydrology in Seneca reach during June. • Negligible to minor temperature increases in Belden reach during September of dry years • Major depletion of <20°C water available for withdrawal from Lake Almanor by early August.	No
3. 900-cfs Belden reach flows with 75-cfs Seneca flows from low-level gates (PG&E, 2003a)	• Moderate to major temperature reductions in Belden reach during June. • Generally negligible to moderate temperature reductions in Belden reach during July.	• Negligible to minor temperature increases in Belden reach from August to September • Belden reach temperatures of >20°C frequently during July to August and occasionally during June and September.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
4. Required third 5-year Rock Creek and Cresta flow releases[a] along with proposed increases in Seneca and Belden reach flows (Source: PG&E, 2004a)	• Generally negligible to minor reductions of temperatures that exceed the 20°C criterion in Rock Creek and Cresta reaches in June to August compared to 2105 SA proposed flow releases.	None	No
5. Increase in Poe reach flows from 50 to 150 cfs, as proposed by PG&E (Source: PG&E, 2005a)	• Reduction of lower Poe reach temperatures by ~1.5ºC during July, ~1.0ºC during June and August, and ~0.5ºC during September	None	No
6. Increase in Poe reach flows to 500 cfs or greater (Source: PG&E, 2003b)	• Compliance with the 20ºC criterion at flows of 500 cfs and greater under wet and normal conditions.	• Flows of 1,250 cfs would not satisfy 20ºC criterion under extreme conditions.	No
7. Increase Canyon dam low-level flow releases to 200 cfs during July and 400 cfs during August, and reduce Butt Valley and Caribou powerhouse flows to compensate for differences from Project 2105 SA minimum flows (McGurk and Tu, 2005; PG&E and Bechtel, 2005)	• Increase in the frequency of ≤ 19°C at Belden dam during July and August compared to Project 2105 SA proposed flow releases (50% versus 18% during July and 30% versus 0% during August).	• Effects on Butt Valley and Caribou power generation and economics of Project 2105. • Effects on Butt Valley reservoir water temperatures and fishery.	Yes

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
8. Increase Canyon Dam low-level releases to 200 cfs during July and 400 cfs during August and reduce Butt Valley and Caribou powerhouse flows to compensate for differences from Project 2105 SA minimum flows along with an additional 260 cfs in July and 460 cfs in August (McGurk and Tu, 2005; PG&E and Bechtel, 2005)	• Increase in the frequency of ≤ 19°C at Belden dam during July and August compared to 2105 SA proposed flow releases (70% versus 18% during July and 70% versus 0% during August).	• Effects on power generation levels, schedules, and the economics of Projects 2105, 1962, and 2107. • Delayed filling of Lake Almanor to avoid effects on downstream water delivery schedule. • Effects on Butt Valley reservoir water temperatures and fishery.	No
9. Shut down Butt Valley and Caribou powerhouses and increase Canyon dam low-level releases to 325 cfs, while providing minimum flows proposed in the 2105 SA to the Belden reach, required by the second 5-year plan for Rock Creek and Cresta reaches,[a] and 150 cfs for the Poe reach (McGurk and Tu, 2005)	• Typical daily mean temperatures likely to satisfy the 20°C criterion throughout the Seneca, Belden, and Rock Creek reaches and in most of the Cresta reach.	• Effects on power generation and project economics. • Deeper Lake Almanor thermocline. • Effects on Butt Valley reservoir water temperatures, water quality, and fishery.	No
10. Preferential use of Caribou No. 1 over Caribou No. 2 development (Sources: PG&E, 2004a, 2003c)	• Short-term temperature reductions of ~4-6°C in Caribou complex discharges, 0.5–2.5°C in Belden reach, 1°C in Rock Creek reach, and 0.5°C in Cresta reach.	• Reduction of thermal stratification and cold water in Butt Valley reservoir.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
11. Preferential use of Cresta dam outlet gates (Source: PG&E, 2003c)	None	• Negligible benefit due to lack of stratification in Cresta forebay	No
12. Bottom sill with crest elevation of 4,450 feet (Source: Ettema et al., 2004)	• Promotes coldwater storage in Lake Almanor by drafting <1°C warmer water through the Prattville intake during June.	• Construction-related water quality effects.	No
13. Bottom sill with crest elevation of 4,460 feet (Source: Ettema et al., 2004)	• Promotes coldwater storage in Lake Almanor by drafting 1–2°C warmer water through the Prattville intake with levees in place during June and ~2°C warmer water with levees removed during June. • Larger temperature increases at lower flows.	• Construction-related water quality effects.	No
14. Curtain 1 (Source: Ettema et al., 2004)	• August Prattville outflow reduced ~1.0°C at 1,600 cfs.	• Visual effects. • Boating safety effects. • Reduction of coldwater habitat in Lake Almanor.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
15. Curtain 2 (Source: Ettema et al., 2004)	• August Prattville outflow reduced ~2.5°C at 1,600 cfs.	• Visual effects. • Boating safety effects. • Reduction of coldwater habitat in Lake Almanor.	No
16. Curtain 3 (Source: Ettema et al., 2004)	• August Prattville outflow reduced ~3.1°C at 1,600 cfs.	• Visual effects. • Boating safety effects. • Reduction of coldwater habitat in Lake Almanor.	No
17. Curtain 4 (Source: Ettema et al., 2004)	• Prattville outflow reduced ~3.5°C during August and ~4.3°C during June and July at 1,600 cfs.	• Visual effects. • Boating safety effects. • Reduction of coldwater habitat in Lake Almanor.	Yes

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
18. Curtain 4 with levees removed (Source: Ettema et al., 2004; PG&E, 2004b)	• Prattville outflow temperature reduction by an additional ~1.5–1.7°C at 1,600 cfs during July/August due to levee removal. • Caribou discharge-weighted temperature reduction of ~1.5–2°C during July and ~1.5–2.5°C during August compared to without Curtain 4.	• Visual effects. • Boating safety effects. • Dredging-related water quality effects. • Potential effects to Native American burial grounds. • Reduction of coldwater habitat in Lake Almanor.	Yes
19. Curtain 4, levees removed, and further excavation (Source: Ettema et al., 2004)	• Negligible additional temperature effects with further excavation.	• Visual effects. • Boating safety effects. • Dredging-related water quality effects. • Effects on Native American burial grounds. • Reduction of coldwater habitat in Lake Almanor.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
20. Curtain 5 (Source: Ettema et al., 2004)	• ~4.5°C temperature reduction in Prattville outflow of 1,600 cfs during August.	• Visual effects. • Boating safety effects. • Reduction of coldwater habitat in Lake Almanor.	No
21. Curtain 6 (Source: Ettema et al., 2004)	• ~3.0°C temperature reduction in Prattville outflow of 1,600 cfs during August	• Visual effects. • Boating safety effects. • Reduction of coldwater habitat in Lake Almanor.	No
22. Short pipe with hooded inlet, and levees removed (Source: Ettema et al., 2004)	• ~2.1°C temperature reduction in Prattville outflow of ~950–2,120 cfs during August.	• Geotechnical instability of sideslopes. • Cessation of Butt Valley powerhouse operations while connecting pipe to intake. • Dredging-related water quality effects. • Effects on Native American burial grounds. • Reduction of coldwater habitat in Lake Almanor.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
23. Long pipe with hooded inlet (Source: Ettema et al., 2004)	• ~2.0°C temperature reduction in Prattville outflow of ~1,000–2,120 cfs during August.	• Cessation of Butt Valley powerhouse operations while connecting pipe to intake. • Dredging-related water quality effects. • Effects on Native American burial grounds. • Reduction of coldwater habitat in Lake Almanor.	No
24. Long pipe with hooded inlet, and levees removed (Source: Ettema et al., 2004)	• ~3.8°C temperature reduction in Prattville outflow of ~1,000–2,120 cfs during August.	• Cessation of Butt Valley powerhouse operations while connecting pipe to intake • Dredging-related water quality effects. • Effects on Native American burial grounds. • Reduction of coldwater habitat in Lake Almanor.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
25. Very long pipe connected to Prattville intake (Source: Ettema et al., 2004)	• Anticipated major temperature reduction in Prattville outflow.	• Cessation of Butt Valley powerhouse operations while connecting pipe to intake. • Dredging-related water quality effects associated with installation of >3-mile-long submerged pipeline. • Effects on Native American burial grounds. • Reduction of coldwater habitat in Lake Almanor.	No
26. Skimmer wall in Butt Valley reservoir (Source: Bechtel, 2003)	• 900-foot-long skimmer wall up-reservoir of Caribou intakes likely a feasible means of routing cold water through Butt Valley reservoir.	• Increase in the thermal stratification in reservoir. • Construction-related water quality effects.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
27. Curtain 4 with levees removed at Prattville intake and a curtain at the lower end of Butt Valley reservoir (Source: PG&E, 2004b)	• Caribou weighted discharge reduction of ~1-2.5°C during July and ~0.5–1°C during August compared to without Butt Valley reservoir curtain.	• Visual effects at Lake Almanor and Butt Valley reservoir. • Boating safety effects on Lake Almanor and Butt Valley reservoir. • Reduction of coldwater habitat in Lake Almanor. • Increase in the Butt Valley reservoir near surface and mid-level summer temperatures.	No
28. Curtain 4 with levees removed at Prattville intake and curtains at the upper and lower ends of Butt Valley reservoir (Source: PG&E, 2004b)	• Caribou weighted discharge reduction of ~0.5°C during July and August compared to single Butt Valley reservoir curtain.	• Visual effects at Lake Almanor and Butt Valley reservoir. • Boating safety effects on Lake Almanor and Butt Valley reservoir. • Reduction of coldwater habitat in Lake Almanor. • Further increase of Butt Valley reservoir near surface and mid-level summer temperatures.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
29. 860-foot-long, 16-foot-diameter pipeline to invert elevation 4,072 feet connected to Caribou No. 2 intake (Source: Ryan, 2000)	None	• Would not selectively draw cooler water from Butt Valley reservoir; need to extend another ~10 feet lower to be effective.	No
30. Pipe UNFFR water from upstream of Caribou powerhouses to immediately downstream of the Belden dam (Source: PG&E, 2005b)	• Design for 2.5ºC temperature reduction at upper end of Belden reach.	• Major effects on Caribou powerhouses and Caribou road. • Risk of pipeline failure from auto collisions. • Fish passage issues at diversion dam. • Visual effects.	No
31. Pipe Yellow Creek water to immediately downstream of the Rock Creek dam (Source: PG&E, 2005b)	• Design for 1.2ºC temperature reduction at upper end of Rock Creek reach.	• Major effects on Highway 70. • Fish passage issues at diversion dam. • Visual effects.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
32. Pipe water from Bucks Creek powerhouse to immediately downstream of the Cresta dam (Source: PG&E, 2005b)	• Design for 1.2ºC temperature reduction at upper end of Cresta reach.	• Major effects on Highway 70. • Elimination of cool water refuge in 0.5-mile-long reach between Bucks Creek and Rock Creek powerhouses. • Visual effects.	No
33. Pipe Poe tunnel adit no. 1 water to near Bardees Bar (Source: PG&E, 2005b)	• Negligible to minor temperature reduction in lower Poe reach.	• Potential erosion associated with the 0.25-mile long pipeline.	No
34. Pump cool Lake Oroville water to Rock Creek, Cresta, and Poe dams (Source: PG&E, 2005b)	• Design for 3ºC temperature reduction at upper end of Rock Creek, Cresta, and/or Poe reaches.	• No feasible pipeline route. • Construction-related major disruption of railroad and Highway 70 traffic. • Potential water quality effects. • Visual effects.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
35. Delivery of well water to river downstream of Rock Creek, Cresta, and Poe dams (Source: PG&E, 2005b)	• Design for 3ºC temperature reduction at upper end of Rock Creek, Cresta, and Poe reaches.	• Aquifer in canyon likely inadequate. • Inadequate space available. • New electrical transmission lines and substations needed. • Potential adverse water quality effects.	No
36a. Mechanical cooling towers and water chiller systems for Belden reach (PG&E, 2005c; Project 2105 Committee, 2005)	• Two possible locations in Belden reach; 100-foot x 300-foot footprint available just downstream of Belden dam.	• Visual effects.	No
36b. Mechanical cooling towers downstream of Rock Creek, Cresta, and Poe dams (Source: PG&E, 2005b)	• Design for 1ºC temperature reduction at upper end of Rock Creek, Cresta, and Poe reaches.	• Inadequate space. • Auto safety issues. • Visual effects.	No
36c. Mechanical cooling tower along Rock Creek reach (PG&E, 2005c)	• Adequate space (200-foot x 900-foot footprint) at Rogers Flat.	• Visual effects.	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
37. Mechanical water chiller systems near Rock Creek, Cresta, and Poe dams (Source: P G&E, 2005b)	• Design for 1ºC temperature reduction at upper end of Rock Creek, Cresta, and Poe reaches.	• Inadequate space. • Auto safety issues. • Visual effects of cooling towers.	No
38. Enlarge Round Valley reservoir located about 3 miles south of Greenville, California (Source: PG&E, 2005b)	• Minor temperature reduction in lower portion of Belden reach	• Negligible temperature reduction downstream of Belden powerhouse. • Unlikely to obtain water right. • Unlikely annual refilling of reservoir.	No
39. Construction and operation of a large reservoir in a tributary to the NFFR (Source: PG&E, 2005b)	• Minor temperature reduction in lower portion of Belden reach.	• Negligible temperature reduction downstream of Belden powerhouse. • Unlikely to obtain water right. • Potential water quality effects due to hypolimnetic releases.	No
40. Management of streamside vegetation along the East Branch of the North Fork Feather River and its tributaries to promote river shading (Source: PG&E, 2005b)	• Local temperature reduction in EBNFFR and its tributaries.	• Negligible temperature reduction in NFFR	No

Potential Measure(s)	Advantages	Disadvantages	Further Evaluation
41. Blending of Canyon dam outflows (Sources: Bechtel and TRPA, 2004; PG&E, 2004a)	• Negligible to minor improvement in Seneca reach trace metal concentrations and odors.	• Increase in temperature throughout most of Seneca reach.	Yes
42. Use of Canyon dam upper-level gates in fall[b]	• Moderate improvement in Seneca reach trace metal concentrations and odors.	• Increase in temperature in Seneca reach.	Yes

[a] The Rock Creek-Cresta Project license requires different minimum instream flows (MIFs) during the license period depending on month, water year type, year of the license period, and testing results. The license requires that the MIFs set for the first and second 5-year periods be implemented during years 1 to 5 and years 6 to 10, respectively. If the second 5-year test period is interrupted by a critically dry year, implementation of the second 5-year MIFs shall be extended to complete the test period. After completion of the second 5-year test period, required MIFs will be adjusted based on test results, but will not exceed "cap flows" set in the license. The cap flows were used when modeling potential measure #4.

[b] The Project 2105 SA indicates use of the upper gates from September 15 to at least November 1; *Canyon Dam Outlet Tower Gate Rehabilitation Project Description* (November 22, 2004) indicates September 1–October 15.

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