LEVEL 1 AND 2 REPORT

DEVELOPMENT AND SCREENING OF POTENTIALLY EFFECTIVE AND FEASIBLE ALTERNATIVES
TO ACHIEVE THE BASIN PLAN OBJECTIVE FOR WATER TEMPERATURE AND
PROTECT COLD FRESHWATER HABITAT BENEFICIAL USE ALONG THE
NORTH FORK FEATHER RIVER

EXECUTIVE SUMMARY

Pacific Gas and Electric Company (PG&E) has submitted an application to the Federal Energy Regulatory Commission for relicensing of the Upper North Fork Feather River Project (FERC Project #2105). Prior to issuance of a new federal license, PG&E must obtain Clean Water Act (CWA) section 401 water quality certification that the project will be in compliance with specified provisions of the CWA (33 U.S.C.§ 1341), including State water quality standards as contained in the applicable water quality control plan. Portions of the North Fork Feather River (NFFR) do not meet the water quality objective for temperature as set forth in the Water Quality Control Plan for the Central Valley Region (Basin Plan). The State Water Resources Control Board has determined that elevated water temperatures are impairing the cold freshwater habitat beneficial use of the NFFR, and has cited hydromodification and flow regulation as potential sources of the impairment (State Water Board Resolution No. 2006-0079). Water quality certification of the project is subject to the California Environmental Quality Act (CEQA), and an Environmental Impact Report (EIR) with CEQA alternatives that include water temperature reduction proposals will be prepared to meet this requirement.

Consistent with requirements of CEQA, alternatives to be evaluated in the EIR should be reasonable, feasible and implementable. This Level 1 and 2 Report documents initial progress on the development and screening of a wide range of potentially feasible alternatives for seasonal cooling of water temperature along the NFFR. Each of the "water temperature reduction alternatives" considered consists of a combination of measures, such as modifications to hydropower facilities or operations, which collectively reduce mean daily water temperatures during the summer to 20°C along the approximate 50 river miles of the NFFR, from Lake Almanor's Canyon Dam to the discharge from the Poe Powerhouse afterbay at Big Bend into Lake Oroville.

ES.1 THREE-PHASED APPROACH

CEQA guidelines require that the State Water Board base its findings concerning alternatives and project approval on "substantial evidence." With this in mind, a systematic, three-phased approach to the development and screening of water temperature reduction measures has been developed. The three-phased approach provides transparency and a logical elimination of those less effective or less reasonable measures, allowing the more realistic solutions to remain as potential comprehensive watershed alternatives. This Level 1 and 2 Report documents the first two phases of the three-phased approach used to develop a reasonable range of feasible water temperature reduction alternatives for achieving the water temperature objective and protection of the cold freshwater habitat beneficial use of the NFFR. A subsequent report will document the refined Level 3 analysis and final screening of water temperature alternatives suitable for

analysis in the EIR prepared for the CEQA process. Figure ES-1 illustrates the three-phased approach as a flow diagram and presents the results of Level 1 and Level 2 screening.

To facilitate the development and analysis of water temperature reduction alternatives that could address the temperature objectives established by the Basin Plan, a numerical value for the water temperature objective was deemed necessary (water temperature objective target or "temperature target"). In setting the temperature target value, it was recognized that it must be feasibly attainable through physical or operational modifications of the UNFFR Project, since the alternatives being developed are intended for support of the State Water Board's 401 certification decision for relicensing of the FERC No. 2105 Project. Accordingly, for purposes of developing and screening water temperature reduction alternatives in this Level 1 and 2 Report, *a numerical value of 20°C maximum mean daily NFFR-wide was set as the water temperature objective target*.[1,2] This initial numerical value could be modified in the subsequent Level 3 effort if, at that time, a different and more appropriate temperature target is determined to be feasibly attainable through modification or re-operation of the UNFFR Project.

Level 1 casts a "wide net" that captures most all of the possible water temperature reduction alternatives and then subjects these possible alternatives to the following coarse screening criteria:

- Effectiveness and reliability – Is there a reasonable potential that the alternative can effectively and reliably achieve the preliminary temperature target or, is the effectiveness and reliability of the alternative overly speculative?

- Technological feasibility and constructability – Can the alternative be implemented with currently available technology and construction methods?

- Logistics – Can the alternative be implemented when considering current legal obligations, regulatory permitting requirements, public safety needs, right-of-way and access needs, and other real world logistical constraints?

- Reasonability[3] – Are there clearly more reasonable or superior alternatives available based on the other criteria? Is implementation of the alternative remote or highly speculative?

The set of alternative measures passing Level 1 screening represents a reasonable range of potentially effective and feasible water temperature reduction alternative measures that are carried forward to Level 2.

Level 2 screens-out (eliminates) those water temperature reduction alternatives passing Level 1 screening that, after closer examination, are ineffective, infeasible, or are clearly inferior to other alternatives. In Level 2 the alternatives are analyzed using the best resource information currently available. Water temperature reduction alternatives are modified or refined based on

[1] This water temperature objective target was set only for purposes of developing and screening alternatives, and should not be construed as the numeric temperature requirement necessary to achieve compliance with the Basin Plan. The State Water Board will determine the appropriate numeric temperature requirement in its 401 certification decision.
[2] The basis for this temperature target is explained in Chapter 3.
[3] An EIR need not consider an alternative whose effect cannot be reasonably ascertained and whose implementation is remote and speculative (CEQA Guidelines, § 15126, subd. (d)).

the analysis, and rough engineering designs and cost estimates are developed. The alternatives are subjected to the same screening criteria used in Level 1, plus the following additional criteria:

- Substantial Further Study - Is there sufficient information currently available or can it be readily developed in order to evaluate the potential effectiveness and feasibility of the alternative, or is substantial further investigation or study required?

- Environmental challenges – Are there obvious environmental consequences or problems associated with the alternative that would pose a major challenge to overcome?

- Economic feasibility – Can the alternative be implemented at a reasonable cost, including capital, O&M, and considering energy replacement costs?

The resulting Level 2 alternatives represent *the set of potentially effective and feasible water temperature reduction alternatives* that are advanced to Level 3. A separate report will be prepared to document the Level 3 water temperature reduction alternatives analysis and screening efforts.

Prior to completing the Level 3 analysis and screening, additional detailed modeling, engineering design, and cost estimate work will be completed. This work will involve application of new water quality models and the newly modified existing hydrologic and temperature models in a detailed technical analysis. During Level 3 screening, these data and models will be used to carefully analyze the effectiveness, sustainability, and reliability of the water temperature reduction alternatives that advanced from Level 2. The temperature reduction alternatives may be further modified or refined based on the analysis, particularly if a new water temperature target is developed. The water temperature reduction alternatives verified to be effective, sustainable, and reliable will be designed to a feasibility-level of detail. The alternatives will then be screened based on the same screening criteria used in Level 1 and 2. The resulting set of water temperature reduction alternatives passing the Level 3 screening will represent *the set of effective and feasible water temperature reduction alternatives*. These water temperature reduction alternatives will be carried forward into the EIR as elements of the CEQA alternatives, where they may be augmented and/or modified to address potentially significant environmental impacts identified through the CEQA process.

ES.2 FRAMEWORK

The complexity of the NFFR system hydrology and thermal regime and the large number of potential water temperature reduction measures under consideration (41 measures) demands that a systematic approach be followed to develop and screen potential water temperature reduction alternatives[4]. Recognizing this need, a "framework concept" was formulated that approaches the problem of reducing water temperatures along the entire NFFR by developing solutions on a reach-by-reach scale. Solutions identified in each reach become available as interchangeable

[4] Refer to Appendix C for presentation of potential water temperature reduction measures. These potential water temperature reduction measures were derived from those described in PG&E's 24 Alternatives Report (PG&E, 2005b) as well as others developed by the State Water Board team. These measures mainly consist of physical and operational changes to existing UNFFR Project facilities, but changes to other PG&E-owned and non-PG&E-owned facilities in the NFFR basin are considered as well. Watershed management actions that may potentially reduce temperature are also included.

measures that can be combined as necessary to create a comprehensive water temperature reduction alternative for the NFFR. The framework provides alternatives that focus on reducing the temperature of water delivered to and discharged from Belden Reservoir, then builds from this point by adding measures as necessary to satisfy the temperature needs in all reaches of the NFFR. Water temperature reduction at Belden Reservoir is central to achieving temperature reduction in the downstream reaches and, the cooler the water available for discharge from Belden Reservoir, the less the water needs to be cooled downstream to meet the target. Use of the framework concept allows for the formulation, analysis, and evaluation of a full range of alternative ways to reduce the temperature of water in Belden Reservoir and combines additional cooling along individual or multiple downstream reaches, as necessary for comprehensive watershed solutions.

Because the temperature of water discharged from Belden Reservoir drives the amount of cooling required in the downstream reaches, an analysis was performed to determine, over a range of starting water temperatures in Belden Reservoir, the additional cooling that would be needed to achieve the temperature target in all downstream reaches. The month of July 2002 was used as the analysis period[5] in the framework to estimate NFFR water temperature profiles for a range of starting water temperatures in Belden Reservoir. The profiles were estimated based on July 2002 meteorological conditions, observed temperature changes in the Belden and Rock Creek Reservoirs during the July 2003 Caribou special test for the infusion of cold water, and use of stream temperature modeling of the Belden, Rock Creek, Cresta, and Poe Reaches. Results of the modeling work formed the basis for the formulation of six categories of water temperature reduction alternatives as shown in Table ES.1. The categories are differentiated by the amount of temperature reduction provided at Belden Reservoir. A higher numbered category means that more temperature reduction is required in reaches downstream.

ES.3 FINAL LEVEL 2 WATER TEMPERATURE REDUCTION ALTERNATIVES

Through the Level 1 and Level 2 water temperature reduction alternatives development and screening process, the set of comprehensive, potentially feasible water temperature reduction alternatives was generated. The set of potentially feasible water temperature reduction alternatives, including variations of the alternatives, are summarized in Table ES-2. The following 16 alternatives and alternative variations remain and will advance to Level 3 for further refinement, analysis, and screening.

- ***Alternative Category 2*** – one alternative (Alternative 2c) with one variation for the Poe Reach. No water temperature reduction measures are needed for the Belden, Rock Creek, and Cresta Reaches. This Category has *one alternative variation* (i.e., $1 \times 1 = 1$).

- ***Alternative Category 3*** – one alternative (Alternative 3) with one variation for each of the Belden, Cresta, and Poe Reaches. No water temperature reduction measures are needed for the Rock Creek Reach. This Category has *one alternative variation* (i.e., $1 \times 1 \times 1 \times 1 = 1$).

[5] Data from July 2002 represents the most adverse conditions for achieving the temperature target, as compared to all months during PG&E's summer 2002 – 2004 monitoring period. Any water temperature reduction alternative that could achieve the target during July 2002 could likely do so during the summer months of any wet, normal, and most dry years. The thermal regime of the NFFR during PG&E's summer 2002 – 2004 monitoring period and, in particular, during July 2002 is explained in Chapter 2.

- ***Alternative Category 4*** – three alternatives (Alternatives 4a, 4b, and 4c) with one variation for the Belden Reach, one variation for the Rock Creek Reach, two variations for the Cresta Reach, and one variation for the Poe Reach, totaling *6 alternative variations* (i.e., $3 \times 1 \times 1 \times 2 \times 1 = 6$).

- ***Alternative Category 5*** – two alternatives (Alternatives 5a and 5b) with one variation for the Belden Reach, one variation for the Rock Creek Reach, two variations for the Cresta Reach, and two variations for the Poe Reach, totaling *8 alternative variations* (i.e., $2 \times 1 \times 1 \times 2 \times 2 = 8$).

These water temperature reduction alternatives were developed using the best available data and analytical tools generated through years of effort, including:

- PG&E's temperature modeling results for 33-years of the hydrologic record (Bechtel Corporation and Thomas R. Payne and Associates 2006);

- PG&E's physical-prototype hydraulic modeling results for the Prattville Intake thermal curtain (IIHR 2004);

- PG&E's 2002-2004 temperature monitoring data reports (PG&E 2003; PG&E 2004; PG&E 2005a);

- PG&E's 2006 NFFR special testing data (Stetson and PG&E 2007); and

- Stream water temperature modeling analysis and water temperature mixing analysis (refer to Chapter 3).

Particularly noteworthy is PG&E's 2006 NFFR special test which demonstrated cold water plunging and stratification in Butt Valley and Belden Reservoirs, suggesting that new measures for cooling may be effective, sustainable, and reliable, including:

- Reduced rate of withdrawal from the Prattville Intake for thermal selection;

- Re-operation of the Caribou Powerhouses through preferential or exclusive use of Caribou Powerhouse No. 1 or strict extended peaking procedures; and

- Enhanced submerged flow of cool water along the bottom of Butt Valley and Belden Reservoirs.

Further analysis is proposed in future Level 3 to verify the effectiveness, sustainability, reliability, and feasibility of the water temperature reduction alternatives to be carried forward from Level 2. New water quality models of Butt Valley Reservoir and Belden Reservoir have been developed and existing models of Lake Almanor have been improved. These models will enable engineers to simulate water temperatures in the lakes, reservoirs and flowing reaches of the NFFR and test the effectiveness, sustainability, and long-term reliability of the alternatives at reducing water temperatures. More detailed engineering design and cost estimating work will examine the feasibility and costs associated with the alternatives, including initial capital cost, recurring annual cost, and foregone power cost. All of this further work will be documented in the Level 3 report, which will set forth the water temperature alternatives to be carried forward into the EIR for broader environmental analysis.

Table ES-1 Summary of Alternative Categories and Requirements

Alternative Category		Belden Reach	Rock Creek Reach	Cresta Reach	Poe Reach
1	Cold Water from Lake Almanor/Butt Valley Reservoir	Reduce inflow temperature at Belden Forebay to 12.5°C			
	Additional Cold Water Needed?	No	No	No	No
2	Cold Water from Lake Almanor/Butt Valley Reservoir	Reduce inflow temperature at Belden Forebay to 14.5°C			
	Additional Cold Water Needed?	No	No	No	Yes
3	Cold Water from Lake Almanor/Butt Valley Reservoir	Reduce inflow temperature at Belden Forebay to 16.0°C			
	Additional Cold Water Needed?	No (except for lower Belden reach)	No	Yes	Yes
4	Cold Water from Lake Almanor/Butt Valley Reservoir	Reduce inflow temperature at Belden Forebay to 18.0°C			
	Additional Cold Water Needed?	No (except for lower Belden reach)	Yes	Yes	Yes
5	Cold Water from Lake Almanor/Butt Valley Reservoir	Reduce inflow temperature at Belden Forebay to 19.5°C			
	Additional Cold Water Needed?	Yes	Yes	Yes	Yes
6	Cold Water from Lake Almanor/Butt Valley Reservoir	No			
	Additional Cold Water Needed?	Yes	Yes	Yes	Yes

Table ES-2 ***Final Level 2 Alternatives to Achieve the 20℃ Objective Target for Water Temperature along the NFFR***

(Green highlighted measures remain as final Level 2 Alternatives and will advance to Level 3; Bright green highlighted measures represent variations for cooling downstream reaches)

Alternative Category	Alternative		Variations for Cooling Downstream Reaches			
	Alt.	Measures in reducing source water temperature to Belden Forebay	Additional measures for Belden Reach	Additional measures for Rock Creek Reach	Additional measures for Cresta Reach	Additional measures for Poe Reach
1. Reduce the temperature in Belden Forebay to 12.5 ºC. (eliminated)	**1**	• Install Prattville thermal curtain with levee removed • ~~Collect and convey cold spring water (215 cfs, 8°C) to Prattville Intake~~ • Convey Butt Valley PH discharges to Butt Valley Reservoir near Caribou Intake	No	No	No	No
2. Reduce the temperature in Belden Forebay to 14.5 ºC. **(1 variation)**	**2a**	• Install Prattville thermal curtain with levee removed • ~~Convey Butt Valley PH discharges **to 2,000 cfs** to Butt Valley Reservoir near Caribou Intake~~	No	No	No	• Increase shading along Poe Reach
	2b	• Install Prattville thermal curtain with levee removed • Install a thermal curtain near Caribou Intake in Butt Valley Reservoir • ~~Collect and convey cold spring water (215 cfs, 8°C) to Prattville Intake~~				• Increase Poe Dam release **to 360 cfs**
	2c	• Decrease Prattville Intake release **to 500 cfs** to cause cold water selective withdrawal • Extend the existing deeper channel of Butt Valley Reservoir by dredging • Use Caribou #1 exclusively with reduced release to cause cold water selective withdrawal from Butt Valley Reservoir • Repair/modify Canyon Dam low level outlet and increase release to 600 cfs				• Construct outlet/pipeline from the Poe Adit and release **to 180 cfs** of cooler water to the Poe Reach
3. Reduce the temperature in Belden Forebay to 16.0 ºC. **(1 variation)**	**3**	• Install Prattville thermal curtain with levee removed • Install a thermal curtain near Caribou Intake in Butt Valley Reservoir • Increase Canyon Dam release **to 250 cfs** (and decrease Prattville Intake release commensurately)	• Convey warm water **to 100 cfs** from East Branch NFFR to Rock Creek Reservoir by diversion/pipeline Note: This measure is designed to protect the lower Belden Reach	No	• Increase Cresta Dam release **to 390 cfs** • Increase Grizzly Creek release **to 50 cfs**	• Increase Poe Dam release **to 300 cfs** • Construct outlet/pipeline from the Poe Adit and release **to 400 cfs** the cooler water to the Poe Reach

Note: All alternatives will have no affect on Lake Almanor water levels except Alternative 2c which would result in higher than historical lake levels due to significant flow reduction at the Prattville Intake.

Table ES-2 Final Level 2 Alternatives to Achieve the 20°C Objective Target for Water Temperature along the NFFR (Continued)

Alternative Category	Alternative		Variations for Cooling Downstream Reaches			
	Alt.	Measures in reducing source water temperature to Belden Forebay	Additional measures for Belden Reach	Additional measures for Rock Creek Reach	Additional measures for Cresta Reach	Additional measures for Poe Reach
4. Reduce the temperature in Belden Forebay to 18.0 °C. **(6 variations)**	**4a**	• Install Prattville thermal curtain • Install a thermal curtain near Caribou Intake in Butt Valley Reservoir	• Convey warm water **to 100 cfs** from East Branch NFFR to Rock Creek Reservoir by diversion/pipeline Note: This measure is designed to protect the lower Belden Reach.	• ~~Construct Yellow Cr/ Belden PH bifurcation or,~~ Convey Yellow Creek flows **to 60 cfs** by pipeline to Rock Creek Reservoir for plunging • Construct low level outlet at Rock Creek Dam • Dredge a submerged channel in Rock Creek Reservoir	• Convey cold Bucks Creek PH flows **to 140 cfs** to Cresta Reservoir for plunging by pipeline • Construct low level outlet at Cresta Dam	• Increase Poe Dam release **to 400 cfs** • Construct outlet/pipeline from the Poe Adit and release **to 450 cfs** of cooler water to the Poe Reach
				• Bypass Yellow Creek flows **to 60 cfs** around Rock Creek Reservoir by diversion/pipeline	• Bypass cold Bucks Creek PH flows **to 95 cfs** around Cresta Reservoir by diversion/pipeline	
	4b	• Install Prattville thermal curtain • Use Caribou #1 preferentially over Caribou #2		• Increase Rock Creek Dam release **to 400 cfs**	• Increase Cresta Dam release **to 500 cfs**	
					• Increase Grizzly Creek releases to **80 cfs**	
	4c	• Repair/modify Canyon Dam low level outlet and increase release to 600 cfs (and decrease Prattville Intake release commensurately) • Use Caribou #1 preferentially over Caribou #2		• Construct **150 cfs capacity** water chiller at Rock Creek Dam	• Construct **175 cfs capacity** water chiller at Cresta Dam	• Construct **200 cfs capacity** water chiller at Poe Dam
5. Reduce the temperature in Belden Forebay to 19.5 °C. **(8 variations)**	**5a**	• Use Caribou #1 preferentially over Caribou #2 • Repair/modify Canyon Dam low level outlet and increase release to 250 cfs or higher (and decrease Prattville Intake release commensurately)	• Convey cold Seneca Reach flows **to 250 cfs** to Belden Reservoir for plunging by diversion/pipeline • Install a thermal curtain near Belden PH Intake • Convey warm water **to 100 cfs** from East Branch NFFR to Rock Creek Reservoir by diversion/pipeline	• ~~Construct Yellow Cr/ Belden PH bifurcation or,~~ Convey Yellow Creek flows **to 60 cfs** by pipeline to Rock Creek Reservoir for plunging • Convey lower Belden Reach flows **to 140 cfs** to Rock Creek Reservoir for plunging • Dredge a submerged channel in Rock Creek Reservoir • Construct low level outlet at Rock Creek Dam	• Convey cold Bucks Creek PH flows **to 140 cfs** to Cresta Reservoir for plunging by diversion/pipeline • Dredge a submerged channel in Cresta Reservoir • Construct low level outlet at Cresta Dam	• Increase Poe Dam release • Construct outlet/pipeline from the Poe Adit and release the cooler water to the Poe Reach
	5b	• Install thermal curtain near Caribou Intake in Butt Valley Reservoir • Repair/modify Canyon Dam low level outlet and increase release to 250 cfs or higher (and decrease Prattville Intake release commensurately)			• Bypass cold Bucks Creek PH flows **to 110 cfs** around Cresta Reservoir by pipeline	
			• Operate Caribou PHs in strict peaking mode with several hours shut down • Convey warm water **to 100 cfs** from East Branch NFFR to Rock Creek Reservoir by diversion/pipeline	• Bypass Yellow Creek/Chips Creek flows **to 80 cfs** around Rock Creek Reservoir by diversion/pipeline	• Increase Cresta Dam release to **700 cfs**	• Construct **200 cfs capacity** water chiller at Poe Dam
	5c	• ~~Convey Butt Valley PH discharges **to 2,000 cfs** by pipeline to Butt Valley Res. near the Caribou Intake~~ • Repair/modify Canyon Dam low level outlet and increase release to 250 cfs or higher (and decrease Prattville Intake release commensurately)		• Increase Rock Creek Dam release **to 600 cfs**	• Increase Grizzly Creek releases **to 100 cfs**	
				• Construct **150 cfs capacity** water chiller at Rock Creek Dam	• Construct **175 cfs capacity** water chiller at Cresta Dam	

Table ES-2 Final Level 2 Alternatives to Achieve the 20°C Objective Target for Water Temperature along the NFFR (Continued)

Alternative Category	Alternative		Variations for Cooling Downstream Reaches			
	Alt.	Measures in reducing source water temperature to Belden Forebay	Additional measures for Belden Reach	Additional measures for Rock Creek Reach	Additional measures for Cresta Reach	Additional measures for Poe Reach
6. Reduce temperatures in all downstream reaches. **(eliminated)**	**6a**	No	• Repair/modify Canyon Dam low level outlet and increase release to 250 cfs • Convey cold Seneca Reach flows to Belden Reservoir for plunging by diversion/pipeline • **Increase Belden Dam/Oak Flat PH release to 250 cfs** • Convey warm water **to 100 cfs** in East Branch NFFR to Rock Creek Reservoir by diversion/pipeline	• Bypass lower Belden Reach flows **to 250 cfs** around Rock Creek Reservoir by diversion/pipeline Note: Must be combined with bypassing Seneca flows around Belden Reservoir.	• Bypass lower Rock Creek Reach flows **to 250 cfs** around Cresta Reservoir by diversion/pipeline Note: Must be combined with bypassing Seneca flows around Belden Reservoir.	• Bypass lower Cresta Reach flows **to 250 cfs** around Poe Reservoir by diversion/ pipeline Note: Must be combined with bypassing Seneca flows around Belden Reservoir.
	6b		• Increase Canyon Dam low level outlet release to 90 cfs or higher • Operate Caribou PHs in strict peaking mode with several hours shut down • Convey warm water **to 100 cfs** in East Branch NFFR to Rock Creek Reservoir by diversion/pipeline	• Construct **150 cfs capacity** water chiller at Rock Creek Dam	• Construct **175 cfs capacity** water chiller at Cresta Dam	• Construct **200 cfs capacity** water chiller at Poe Dam
	6c		• ~~Convey cold water from Lake Oroville to below Belden Dam~~	• ~~Convey cold water from Lake Oroville to below Rock Creek Dam~~	• ~~Convey cold water from Lake Oroville to below Cresta Dam~~	• ~~Convey cold Lake Oroville to below Poe D.~~