ATTACHMENT 3

NOTICE OF INTENT PARTIES' PROPOSED STUDIES

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STUDY AQ 1
Hydrology and Project Operations Modeling

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Modification of hydrology.

PROJECT NEXUS

- Existing Project operations primarily modify the hydrology in river reaches, including Eel River from Scott Dam to Van Arsdale Reservoir, Eel River from Cape Horn Dam to Middle Fork Eel River, and East Branch Russian River from Potter Valley Powerhouse Tailrace to and including Lake Mendocino.
- Proposed changes in Project facilities and operations would affect flow regimes from Lake Pillsbury to Van Arsdale Reservoir and Cape Horn Dam to Middle Fork Eel River.

RELEVANT INFORMATION

The following information is available and was reviewed to determine hydrology and Project operations modeling study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 4.0 for a summary of the existing Project and Project operations, and also Section 5.1 for a summary of water use and hydrology [PG&E 2017]):

- U.S. Geological Survey (USGS) gaging data.
- PG&E Annual Performance Reports (PG&E 2006–2016).
- PG&E operations and facilities.
- PG&E reservoir storage versus elevation data.
- National Marine Fisheries Service (NMFS) Biological Opinion for the Proposed License Amendment for the Potter Valley Project (NMFS 2002) (includes Reasonable and Prudent Alternative [RPA] instream flow requirements).
- Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, Proposed Changes in Minimum Flow Requirements at the Potter Valley Project (FERC 2000).
- Water balance models used during the 2004 FERC license amendment process.
- Long-term Trends in Streamflow and Precipitation in Northwest California and Southwest Oregon, 1953–2012 (Asarian and Walker 2016).
- U.S. Army Corps of Engineers, Lake Mendocino Storage Levels.

- Unimpaired and existing operations hydrology for a representative hydrological period of record (POR) based on HEC-ResSim modeling (1911–2017), with and without anticipated future climate change (Addley et al. 2019).

POTENTIAL INFORMATION GAPS

- Project water balance/operations model for the POR (1911–2017) to simulate existing operations and potential alternative Project operations, including future operations without Scott Dam and a modified Van Arsdale Diversion capacity increasing to 300 cubic feet per second (cfs).
- Operational scenario(s) for Project Operations with removal of Scott Dam and a modified Van Arsdale Diversion with and without anticipated future climate change.

PROPOSED STUDIES / ANALYSIS TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Use the existing stream, reservoir gage data, and HEC-ResSim model output to generate daily unimpaired and regulated hydrology for the affected river reaches during a representative hydrological POR (1911–2017).
- If feasible, obtain empirical flow data in the Eel River and the Rice Fork above Lake Pillsbury, and in Tomki Creek to assist in the development of unimpaired hydrology.

EXTENT OF STUDY AREA

The Study Area for the hydrology and Project operations study includes Project-affected reaches and reservoirs:

- Lake Pillsbury, including Lake Pillsbury inflows.
- Eel River from Scott Dam to immediately below Middle Fork Eel River confluence (including Van Arsdale Reservoir, which is primarily riverine in character).
- East Branch Russian River between Potter Valley Powerhouse and the ordinary high-water mark of Lake Mendocino.

The Study Area was expanded to include selected river reaches upstream of Lake Pillsbury to characterize inflow hydrology to Lake Pillsbury, and for specific hydrology analyses (e.g., low fall flows), the study area has been extended farther downstream.

STUDY METHODS AND ANALYSIS

On-going Potter Valley Project Monitoring Studies

The following on-going Project reservoir storage and streamflow gaging data collection will continue throughout relicensing.

- Collect reservoir, stream, and/or diversion gaging information including flow and stage where available at Lake Pillsbury (USGS Gage 11470000, water surface elevation), Eel River below Scott Dam (USGS Gage 11470500), Eel River below Van Arsdale (Cape Horn) Dam (USGS Gage 11471500), Potter Valley Powerhouse Intake (USGS Gage 11471000), powerhouse release locations within the East Branch Russian River watershed (USGS gages 11471105, 11471106, 11471100, and 11471099) (e.g., PG&E 2016a), and Lake Mendocino reservoir storage levels (California Data Exchange Center [CDEC] gage COY).

Hydrology Characterization

Hydrology Datasets

- Create a database of historical gage data (USGS and PG&E gage data). To the extent data is available, historical gage data for the 1911—2017 POR will be used for various purposes such as developing unimpaired hydrology and some retrospective resource analyses (e.g., Study AQ 4 – Fluvial Processes and Geomorphology). Note, however, that the historical gage data includes a variety of Project operations (old FERC license conditions prior to 1979, transition Project conditions from 1979 to 2006, and current FERC license conditions from 2007 to the present) and will be used selectively, as appropriate. The dataset will not be used to evaluate existing or future operational scenarios; modeled data will be used for that purpose (see Water Balance/Operations Model below).
- Develop an unimpaired[1] hydrology daily flow dataset for the Project for the 1911–2017 POR using the historical gage data and/or mass balance or proration to generate data where gage data are missing. Mass balance includes using gaged data and adding inflows, subtracting outflows (including reservoir evaporation), and/or accounting for changes in reservoir storage to generate daily hydrology at a location. Where necessary, such as at Lake Pillsbury, mass balance calculations will be smoothed to remove spurious flow fluctuations related to the calculation method and reservoir storage gage inaccuracies. Proration involves using gaged data from a reference watershed with similar physical characteristics (e.g., climate,

[1] Note that the unimpaired hydrology will be unimpaired with respect to Potter Valley Project operations. No attempt will be made to remove other forms of flow impairment (e.g., legal or illegal diversion by other water users) from the hydrology.

topography, elevation, geology) to generate hydrology at a location that has missing data (e.g., applying a drainage area ratio as described by Mann et al. 2004). Note that these methods lend themselves to development of mean daily hydrology, but are not readily applicable to sub-daily hydrology analysis. Where applicable, investigate the use of existing unimpaired flow data sets developed for the upper Eel River based on rainfall-runoff modeling (e.g., Flint et al. 2015).

- Generate climate change inflow hydrology for approximately the year 2050 by adjusting the unimpaired hydrology using the climate change data products developed by the California Water Commission in 2016 (CWC 2016) (or other equivalent climate change products, if appropriate). These climate change data products were developed for use in the Water Storage Investment Program and include Variable Infiltration Capacity (VIC) hydrological modeling results for climate change hydrology data centered in the years 2030 and 2070 and historical detrended hydrology data centered at 1995. The ratio of averaged 2030 and 2070 VIC model results to historical VIC model results will be applied to the developed unimpaired hydrology to obtain climate change adjusted unimpaired hydrology. The VIC model data has been developed through 2011. For years outside of the VIC datasets, years with similar magnitude and pattern will be selected for use in the climate change hydrology development. Where applicable, investigate the use of other available climate change data sets developed for the upper Eel River (e.g., Flint et al. 2015).
- An Existing Operations daily flow dataset for the Project (1911-2017 POR) will be developed using the Project Operations Model (see Water Balance/Operations Model below).
- In a suitable location, install a temporary stage recorder (e.g., Solinist Levelogger) and generate a rating curve in the Eel River and the Rice Fork above Lake Pillsbury and in Tomki Creek to collect flow data that can be used to inform the development of unimpaired hydrology. Collect flow data for 2 years. A suitable location would have both access and a stable hydraulic control (e.g., coarse substrate or bedrock) that would facilitate accurate flow gaging. If difficulty arises locating a suitable gaging site at any of the locations, Notice of Intent (NOI) Parties will consult with stakeholders to identify suitable gaging options. Stage data (15-minute) will be collected at all flows; however, discharge data for developing rating curves at the sites will only be collected over the range of flows that are safe for wading or using a shore-based, tethered acoustic Doppler current meter (bridges or cableways are not available at these locations). Therefore, high flow data will be generated by extrapolating the rating curves, as necessary. Also, collection of high flow stage data may be subject to limitations related to the temporary stage recording equipment and the quality of the monitoring sites.

Indicators of Hydrological Alterations or Equivalent

- Compare unimpaired hydrology, modeled Existing Operations hydrology, and Project Operations with Scott Dam removal (see the Water Balance/Operations Model section) using an Indicators of Hydrological Alterations (IHA) analysis (Richter et al. 1996, 1997, 1998) or a similar hydrologic alterations method (e.g., McBain and Trush 1997, Yarnell et al. 2020) at key locations in the Study Area including Scott Dam, above and below Cape Horn Dam, and above and below major tributaries in the Eel River (Tomki Creek, Outlet Creek, and the Middle Fork Eel River), in the lower Eel River at the USGS 11477000 Eel R A Scotia CA and USGS 11475000 Eel R A Fort Seward gage locations, and in the East Branch Russian River (USGS 11461500 EF Russian R NR Calpella CA gage location). Identify seasonal patterns of daily average flow, including summer baseflows, winter flood peaks, winter baseflows, snowmelt peak runoff, and snowmelt recession. Characterize each hydrograph component by its duration, magnitude, frequency, seasonal timing, and inter-annual variability. The analysis will allow linkages between hydrologic change and potential biological effects based on life history of focal species.

Flood Frequency

Generate a flood frequency analysis for the unimpaired hydrology, modeled Existing Operations hydrology, and Project Operations with Scott Dam removal using annual peak daily average flow data at key locations in the Study Area including Scott Dam, above and below Cape Horn Dam, and above and below major tributaries in the Eel River (Tomki Creek, Outlet Creek, and the Middle Fork Eel River), and in the East Branch Russian River (USGS 11461500 EF Russian R NR Calpella CA gage location). Generate a flood frequency analysis of the historical gage data at the Eel River below Scott Dam (USGS Gage 11470500), Eel River below Van Arsdale (Cape Horn) Dam (USGS Gage 11471500), and East Branch Russian River (USGS 11461500) using 15-minute flow data (if available). The flood frequency curves will be generated using PeakFQ, a software package developed by the USGS which provides estimates of annual maximum peak flows for a range of recurrence intervals using a Pearson Type III (logarithmic) frequency distribution.

Lake Pillsbury Spills[2] and River Ramping Rates

- Characterize Lake Pillsbury spills (spills through the gates), including antecedent reservoir storage conditions, for the historical gage dataset, for modeled Existing Operations hydrology, and for Project Operations with Scott Dam removal (i.e., no

[2] Note that Van Arsdale Reservoir is operated as a run-of-the-river diversion facility rather than a storage reservoir; therefore, "spills" do not occur at the facility.

spills without the dam). Evaluation of alternative future Project scenarios will occur during PM&E discussions (see Water Balance/Operations Model below).

- Ramping rates will be characterized for the unimpaired hydrology, the historical gage dataset, new hydrology data collected upstream of Lake Pillsbury, modeled Existing Operations hydrology, and modeled Project Operations with Scott Dam removal. Evaluation of alternative future Project scenarios will occur during PM&E discussions. Ramping rate analyses will be both hourly and daily for the gaged data at Eel River below Scott Dam (USGS 11470500), Eel River below Cape Horn Dam (USGS 11471500), the Potter Valley Powerhouse tailrace release (USGS 11471099), and new data collected upstream of Lake Pillsbury. For the daily average flow datasets (unimpaired hydrology and modeled Existing Operations) ramping rate analyses will be daily. Locations for ramping rate analyses include key locations in the Study Area: Scott Dam, above and below Cape Horn Dam, and above and below major tributaries in the Eel River (Tomki Creek, Outlet Creek, and the Middle Fork Eel River).
- Coordinate with Study AQ 5 – Instream Flow to identify biologically suitable stage change and flow ramping rates.

Water Balance/Operations Model

Develop, Calibrate/Validate, and Run Existing Project Operations Model

- The Ad-Hoc Committee used the U.S. Army Corps of Engineers-Hydrologic Engineering Center (USACE-HEC) Reservoir Simulation Version 3.1 model (HEC-ResSim model; USACE-HEC 2013) to develop, calibrate/validate, and run the Existing Project Operations model in collaboration with relicensing participants (Addley et al., 2019). This model will be used to simulate future Project operations for the proposed Project Plan.

Project Simulation Runs

- NOI Parties and the technical modeling group will use the calibrated/validated HEC-ResSim model for simulating proposed operations and evaluating other operational alternatives, including climate change. Simulation outcomes will be provided to stakeholders and also presented at relicensing in stakeholder meetings, where discussion of the model configuration and output will be conducted. An electronic copy of the validated model will be provided to the technical modeling group for their review/use. To manage version control, NOI Parties will maintain a master database version of the operations model that incorporates the suite of alternatives developed by the relicensing participants.

Coordination with Sonoma County Water Agency

- NOI Parties will coordinate with the Sonoma County Water Agency (SCWA) to provide modeling to the FERC proceeding to quantify how existing and proposed future operations affect Lake Mendocino storage and Russian River flows downstream of Lake Mendocino (e.g., downstream to Dry Creek). Quantification of alternative operation scenarios will occur during PM&E discussions.

Lower Eel River Low Flow Hydrology Analysis

- A method will be developed to characterize Project hydrology effects on the lower Eel River at the furthest downstream gage location (USGS 11477000 Eel River at Scotia, CA), particularly with respect to the fall low flow season (adult salmon upstream passage) or early spring (juvenile outmigration). Generally, the daily historical 1911–2017 POR accretion flow for the Eel River from the Middle Fork Eel River confluence to the Scotia Gage will be developed. This data, in combination with the Operations Model for the Project (Lake Pillsbury to the Middle Fork Eel River) will provide an analysis tool. The data may be incorporated directly into the Operations Model or analyzed external to the Operations Model. A flow lag-time will be estimated for flows released from the Project to Scotia and incorporated into the analysis.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE.

The proposed methodologies to generate hydrology datasets and develop a Project water balance/operations model (HEC-ResSim) are widely used and accepted in the scientific and engineering communities. These methods have been used in other relicensing proceedings and are designed to meet the needs of the relicensing participants.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

This study will provide hydrology data that will be used in many of the aquatic studies and analyses related to aquatic habitat, water supply, and power generation.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $300,000.

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STUDY AQ 2
Water Temperature

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Aquatic habitat quantity and quality.
- Regional Water Quality Control Board (RWQCB) Basin Plan Objectives.

PROJECT NEXUS

- Existing Project operations modify the flow and temperature regimes in the river reaches (Eel River from Scott Dam to Van Arsdale Reservoir, Eel River from Cape Horn Dam to Middle Fork Eel River, and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino) and storage levels in Lake Pillsbury.
- Proposed changes in Project facilities and operations would affect flow and temperature regimes from Lake Pillsbury to Van Arsdale Reservoir and Cape Horn Dam to Middle Fork Eel River.

RELEVANT INFORMATION

The following information is available and was reviewed to determine water temperature study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.2 for a summary of water temperature information [PG&E 2017a]):

- Lake Pillsbury water surface elevation gage records (USGS Gage 11470000).
- Available streamflow data for river reaches and powerhouse discharge records (USGS records and PG&E Annual Performance Reports [2006a–2016a]).
- Available Lake Pillsbury water temperature profiles (VTN 1982; SEC 1998; PG&E 2006b–2017b).
- Available summer water temperature data for the Eel River from above Lake Pillsbury to the Middle Fork Eel River (VTN 1982; SEC 1998; PG&E 2006b-2016b).
- Stream temperature data collected by the Mendocino National Forest (MNF) (1996–2004).
- California Environmental Data Exchange Network (CEDEN 2016) database queries of available water quality data.
- Upper Main Eel River and Tributaries (including Tomki Creek, Outlet Creek, and Lake Pillsbury) total maximum daily loads for sediment and temperature (USEPA 2004).
- Lake Pillsbury bathymetric data (PG&E 2016c, 2017c).

- Temperature monitoring data collected by the Native Fish Society in the Eel River and Rice Fork watersheds above Lake Pillsbury (Native Fish Society 2017).
- Stream Temperatures in the Eel River Basin 1980–2015 Phase 1: Compilation and Preliminary Analysis (Asarian et al. 2016).
- Airborne Thermal Infrared Remote Sensing Eel River, California (Watershed Sciences 2005).
- Eel-Russian Rivers Streamflow Augmentation Study (CDFG 1975).
- Soda Creek Remote Automatic Weather Station (RAWS).

POTENTIAL INFORMATION GAPS

- Empirical relationships and/or calibrated physical models to analyze water temperature under alternative operations scenarios.
- Changes in Eel River water temperatures following Scott Dam removal.
- Changes in Eel River water temperatures in the future due to projected global climate effects upon hydrology and meteorology.
- Year-round water temperature data for Lake Pillsbury inflow locations (Eel River and Rice Fork) to develop boundary conditions for both Lake Pillsbury as well as Eel River Water Temperature Modeling.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Lake Pillsbury. Additional water temperature data collection is planned to supplement existing data. Use the existing reservoir storage, streamflow, water temperature and meteorological data in combination with a CE-QUAL-W2 (Cole and Wells 2006; Cole and Wells 2015) model to characterize the relationship between storage in Lake Pillsbury, cold water pool availability, and water temperature releases under existing operations and meteorological conditions. Evaluation of future alternative streamflow will be conducted during discussions of potential protection, mitigation, and enhancement (PM&E) measures.
- Eel River Below Scott Dam. Additional water temperature data collection is planned to supplement existing data. Use the existing water temperature, streamflow, and meteorological data in combination with a multiple regression approach (or physical model, as necessary) to characterize water temperature conditions in the affected river reaches under existing operations and meteorological conditions, as well as conditions with Scott Dam removal and modified Van Arsdale Diversion. Evaluation of future alternative streamflow will be conducted during discussions of potential PM&E measures.

- East Branch Russian River. Collect seasonal water temperature data on the East Branch Russian River over a range of Project operations.
- Tributaries Upstream of Lake Pillsbury. Synthesize available water temperature data below anadromous fish barriers to characterize potential habitat.

EXTENT OF STUDY AREA

The Study Area for Study AQ 2 – Water Temperature includes Project-affected reaches and reservoirs, including:

- Lake Pillsbury.
- Eel River between Scott Dam and the Middle Fork Eel River confluence (including Van Arsdale Reservoir, which is primarily riverine in character).
- East Branch Russian River between Potter Valley Powerhouse and the ordinary high water mark of Lake Mendocino.

The Study Area was expanded to include selected river reaches upstream of Lake Pillsbury to characterize potential anadromous fish habitat downstream of existing fish barriers.

STUDY METHODS AND ANALYSIS

On-going Potter Valley Project Monitoring Studies

The following on-going Project water temperature monitoring will continue through the relicensing study period as part of the existing Federal Energy Regulatory Commission (FERC) license and/or National Marine Fisheries Service (NMFS) Biological Opinion requirements.

- Collect May to October water temperature data (60-minute interval) for the Eel River from above Lake Pillsbury to below the confluence with the Middle Fork Eel River at 25 locations as part of FERC License Article 57 and NMFS Reasonable and Prudent Measure (RPM) 8 (PG&E 2005, 2006b–2017b) (Table AQ 2-1, Map AQ 2-1).

Table AQ 2-1 On-going River Water Temperature Monitoring Locations and Time Periods and New Monitoring Time Periods.

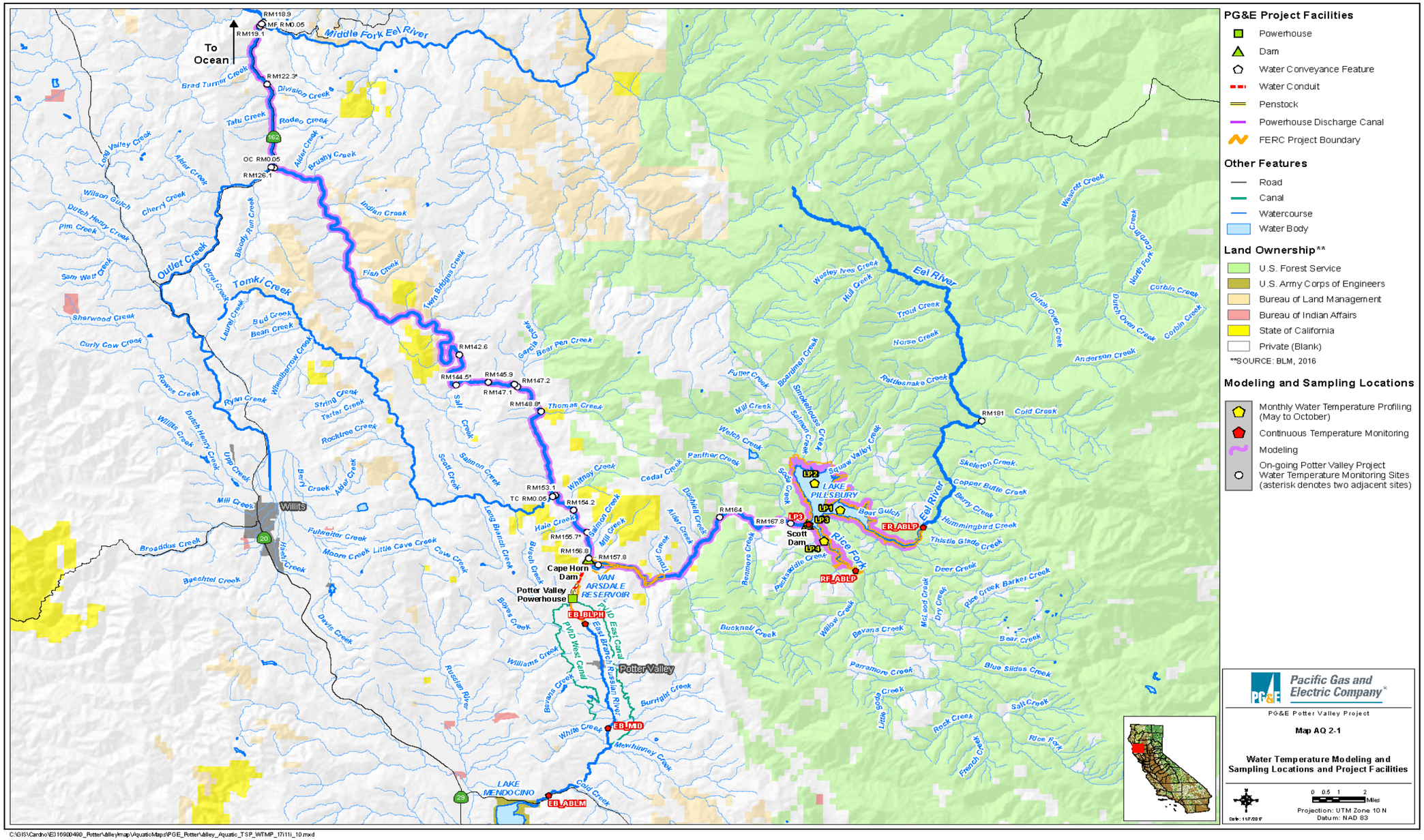
Site	River Mile	Pool Stratification Site?	Ongoing (May to October)	New (November to April)
Eel above L. Pillsbury (Bloody Rock)	181.0	No	Yes	Yes
Eel below Scott Dam (PG&E E2 gage site)	167.8	No	Yes	Yes
Eel between the dams (Monkey Rock)	164.0	No	Yes	Yes
Eel above Cape Horn Dam	157.8	No	Yes	Yes
Eel at VAFS pool	156.8	No	Yes	Yes
Eel below Cape Horn Dam (pool/riffle) (2 sites)	155.7	Yes	Yes	Yes[1]
Eel above Whitney Cr.	154.2	Yes	Yes	No
Eel above Tomki Creek confluence (pool)	153.1	No	Yes	Yes
Tomki Creek near mouth	0.05	No	Yes	Yes
Eel Below Thomas Creek (riffle/pool) (2 sites)	148.8	Yes	Yes	Yes[1]
Eel above Garcia Creek confluence	147.2	No	Yes	Yes
Eel below Garcia Creek confluence	147.1	No	Yes	Yes
Eel below Emandal	145.9	No	Yes	Yes
Eel near Hearst Bridge (poo/riffle) (2 sites)	144.5	Yes	Yes	Yes[1]
Eel at Ramsing Ranch	142.6	No	Yes	Yes
Eel above Outlet Creek	126.1	No	Yes	Yes
Outlet Creek near mouth	0.05	No	Yes	Yes
Eel between Outlet Creek and Middle Fork (pool/riffle) (2 sites)	122.3	Yes	Yes	Yes[1]
Eel above Middle Fork Eel	119.1	No	Yes	Yes
Middle Fork Eel mouth at Rowland Bar	0.05	No	Yes	Yes
Eel below Middle Fork	118.9	No	Yes	Yes

[1] Only riffle sites.

- As part of the monitoring effort described in the previous bullet, water temperature data will be collected at five pools (RM 155.7, 154.2, 148.8, 144.5, and 122.3; Table AQ 2-1; Map AQ 2-1) using multiple thermographs (either in pool/riffle pairs or utilizing a vertical array) to assess the presence of temperature stratification in pools (note: from 2006 to 2016, eight pools were monitored for stratification; however, three of the sites were eliminated in 2017 in consultation with NMFS.

Water Temperature Additional Data Collection

- In addition to the required Project temperature monitoring data collection referenced above, water temperature will be monitored at inflow locations to Lake Pillsbury (Eel River and Rice Fork), in Lake Pillsbury (profiles), and in the East Branch Russian River (Table AQ 2-2 and Map AQ 2-1). Water temperature data for Eel River and Rice Fork above Lake Pillsbury and the East Branch Russian River will be collected year-around using thermographs (hourly) (Table AQ 2-2 and Map AQ 2-1). Monthly water temperature profiling information will be collected at four locations in Lake Pillsbury from approximately April (prior to stratification) to October and in January; additionally, at one location in Lake Pillsbury (i.e., near Scott Dam), water temperature will be monitored continuously from approximately April (prior to stratification) to October using a vertical array of thermographs (see Study AQ 3 – Water Quality for additional water quality parameters collected at these sites). Water temperature data in the East Branch Russian River will be collected at three locations using thermographs (hourly) from May to October (Table AQ 2-2 and Map AQ 2-1).
- In addition to the on-going river temperature monitoring program conducted from May to October, as part of the relicensing efforts, water temperature data will also be collected November to April at the Eel River monitoring sites located in riffle habitat (see Table AQ 2-1). Thermographs will be attached to the riverbanks and left in place through the late fall, winter, and early spring. Data will be retrieved in May when thermographs are reset for the May to October sampling. Because extreme high flow events can occur during this time period, data collection may be subject to interruption due to buried, damaged, or lost thermographs.
- Due to the importance of collecting temperature data in Lake Pillsbury near the dam and in the river downstream of Lake Pillsbury, redundant temperature recording devices will be installed at ER-ABLP, RF-ABLP, LP3, and at the on-going monitoring site at ER167.8.



Map AQ 2-1 Map of Water Temperature Modeling and Sampling Locations and Project Facilities

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Table AQ 2-2 New Data Collection and Modeling Site Locations for the Water Temperature Study

Station ID	Station Description	Monthly Water Temperature Profiling (April to October)[1]	Continuous Temperature Monitoring (Reservoir Profile or Stream Location)	Modeling (Regression or Physical Model)
Eel River Watershed				
ER-ABLP	Eel River above Lake Pillsbury		X (year-round)	
RF-ABLP	Rice Fork above Lake Pillsbury		X (year-round)	
--	Lake Pillsbury			X
LP1	Lake Pillsbury in the Eel River Arm	X		
LP2	Lake Pillsbury in the North Arm	X		
LP3	Lake Pillsbury near Scott Dam	X[1]	X (April-October)	
LP4	Lake Pillsbury in the Rice Fork Arm	X		
--	Eel River (Scott Dam to Middle Fork Eel River)			X
East Branch Russian River Watershed				
EB-BLPH	East Branch Russian River below Potter Valley Powerhouse		X (year-round)	
EB-MID	East Branch Russian River mid-reach		X (year-round)	
EB-ABLM	East Branch Russian River above Lake Mendocino		X (year-round)	

[1] The LP3 Lake Pillsbury sampling location near Scott Dam will also be temperature profiled in January.

Water Temperature Data Synthesis

Eel River (Inflow to Lake Pillsbury to Middle Fork Eel River)

- Consolidate the existing water temperature monitoring data for the Eel River from above Lake Pillsbury to the Middle Fork Eel River (VTN 1982; SEC 1998; PG&E 2006b–2017b) into a database (Excel spreadsheet and/or HEC-DSS) and summarize/characterize the temperature data (e.g., mean, minimum, maximum monthly values, 7-day mean and maximum daily averages, time series) in relation to meteorological data, discharge data, and Lake Pillsbury storage.

- Analyze the Eel River pool stratification data collected as part of PG&E's FERC license compliance monitoring (PG&E 2006b–2017b) and any other historical pool stratification data (e.g., California Department of Fish and Game [CDFG] and California Department of Water Resources historical data; CDFG 1975) with respect to timing of stratification and flow effects on stratification. Coordinate with studies AQ 1 – Hydrology and Operations Modeling, AQ 5 – Instream Flow, and AQ 9 – Fish Populations to evaluate the relationships between streamflow and pool stratification, and between pool stratification and fish populations.

Eel River and Rice Fork above Lake Pillsbury

- A summary of existing water temperature monitoring data and potential collection of limited additional data in the Eel River, Rice Fork, and associated tributaries above Lake Pillsbury below anadromous fish barriers will be conducted in Study AQ 7 – Fish Passage to assist in identification of potential anadromous species habitat upstream of Lake Pillsbury.

Eel River Water Temperature Modeling

- In combination with one dimensional hydraulic modeling being conducted as part of Study AQ 12 – Scott Dam Removal, develop a physical-based temperature model (e.g., HEC-RAS, or comparable model) in consultation with the stakeholders. Modeled reach shall include the Eel River from Scott Dam to immediately below the Middle Fork Eel River confluence. Water temperature model shall be developed using commonly accepted practices and include model grid set-up, model calibration, model validation, and scenario evaluation. Data sources for the model shall include both newly collected water temperature, stream flow and meteorological data, as well as historical data sets which may be used for validation if needed. Meteorological (MET) data would be developed as part of the Lake Pillsbury Water Temperature Modeling (see below). The upstream boundary condition for river temperature modeling (i.e., Lake Pillsbury outflow) will be provided by the reservoir temperature model (see Lake Pillsbury Water Temperature Modeling).
- In combination with Study AQ 1 – Hydrology and Project Operations Modeling and the Lake Pillsbury Water Temperature Modeling (see below), model the Existing Operations water temperature scenario (e.g., 1975–2016). Model unimpaired water temperature for a representative period of time when Eel River water temperature data above Lake Pillsbury are available (e.g., 2005–2016). Also, in combination with Study AQ 12 – Scott Dam Removal, extend water temperature model upstream of Lake Pillsbury, as appropriate, to allow modeling of Eel River water temperatures for a scenario reflecting Scott Dam removal and revised Project operations for water diversion timing under current hydrology/meteorology as well as under future climate change conditions. Compare operational scenarios to compute potential changes in river water temperatures under climate change hydrology and meteorology.

- If Project-related water temperature effects in the Eel River are found to extend below the Middle Fork Eel River confluence, Notice of Intent (NOI) Parties will collaborate with stakeholders to identify methods to address the issue (e.g., collect additional empirical data or extend water temperature modeling downstream).

Lake Pillsbury Water Temperature Modeling

- Develop a MET data set for the 1975–2016 period or for the period of record that can be reasonably generated based on available data. A Remote Automatic Weather Station (RAWS) (i.e., MET station) exists nearby at Soda Creek that has a data set from May 1992 to present (solar radiation, wind speed and direction, air temperature, relative humidity, dew point). Other weather stations in the broader geographical area may be have longer data sets that can be used to extend the Soda Creek MET data set. Also develop a climate change MET data set for approximately 2050 by using the California Water Commission 2030 and 2070 Climate model results (averaging them) to adjust air temperature and dew point temperature in the MET data set (CWC 2016).
- Develop a CE-QUAL-W2 hydrodynamic and water temperature model of Lake Pillsbury. Establish a technical modeling group to review and provide recommendations regarding the model development (reservoir infrastructure, topography, modeling grid, meteorological data, and outputs). CE-QUAL-W2 is a publicly available model that was originally developed by the Army Corps of Engineers (Cole and Wells 2006) and is now supported by Portland State University (Cole and Wells 2015).
- Calibrate and validate the CE-QUAL-W2 model using the existing water temperature, reservoir storage, streamflow, and meteorological data.
- In combination with Study AQ 1 – Hydrology and Project Operations Modeling, and the meteorological data described above (e.g., air temperature, wind speed and direction, solar radiation, relative humidity), develop an Existing Operations water temperature scenario that provides an analysis of the Lake Pillsbury cold water pool and release water temperatures (i.e., how PG&E currently operates the Project, including all physical, regulatory, and contractual requirements). Also, model Existing Operations under future climate change meteorological conditions (using climate change MET data set).
- In conjunction with Eel River Water Temperature Modeling (see above), model future water temperatures for a scenario reflecting Scott Dam removal and revised Project operations for water diversion timing under current hydrology/meteorology as well as under future climate change conditions.
- As appropriate, model water temperatures for alternative Project operations under available existing meteorological conditions and under climate change meteorological conditions during discussions on potential PM&E measures.

- Water temperature simulations will be provided to stakeholders and also presented in stakeholder meetings, where a discussion of the model configuration and output will be conducted. The validated model and model runs will be provided to the technical modeling group for their review. To manage version control, NOI Parties will maintain a master database version of the water temperature model that incorporates the suite of alternatives developed by the relicensing participants.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies proposed to analyze and predict water temperature over a range of conditions (CE-QUAL-W2 model and multivariate regression models) are widely used and accepted in the scientific and engineering communities. These methods have been used in other relicensing proceedings and are designed to meet the needs of the relicensing participants.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

This study will provide water temperature data that will be used in many of the aquatic studies and analyses related to aquatic habitat. This study will coordinate with the Study AQ 1 – Hydrology and Project Operations Modeling to obtain Project operations data for Lake Pillsbury (inflow, storage, outflows). This study will coordinate with Study AQ 3 – Water Quality to incorporate water temperature profiles within Lake Pillsbury as well as at pool locations in the Eel River. This study will coordinate with Study AQ 5 – Instream Flow and Study AQ 9 – Fish Populations to evaluate the relationships between streamflow and pool stratification, and between pool stratification and fish populations. Lastly, this study will coordinate with Study AQ 12 – Scott Dam Removal to incorporate one dimensional hydraulic modeling with water temperature modeling conducted under this study.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $370,000.

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STUDY AQ 3
Water Quality

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Water quality compliance.
- Mercury in fish tissue (potential public health concern).

PROJECT NEXUS

- Existing Project operations and maintenance activities could affect water quality in Project waters.
- Proposed changes to Project facilities and operations could affect water quality in Project waters.

RELEVANT INFORMATION

The following information is available and was reviewed to determine water quality study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.2 for a summary of water quality information and references [PG&E 2017a]):

- Water quality and water temperature data collected in the Project vicinity by VTN (1982) and SEC (1998).
- Annual PG&E stream temperature monitoring reports for data collected from 2005 to 2016 (PG&E 2005, 2006a, 2007-2016, 2017b).
- Stream temperature data collected by the Mendocino National Forest (MNF) (1996–2004).
- California Environmental Data Exchange Network (CEDEN 2016) database queries of available water quality data.
- Upper Main Eel River and Tributaries (including Tomki Creek, Outlet Creek, and Lake Pillsbury) total maximum daily loads for sediment and temperature (USEPA 2004).
- North Coast Regional Water Quality Control Board (NCRWQCB) staff reports on pathogen monitoring (NCRWQCB 2015).
- State Water Resources Control Board (SWRCB) reports prepared for the Surface Water Ambient Monitoring Program (SWAMP) (CEDEN 2016).
- Available reports on Cyanobacteria and algal toxins from the NCRWQCB and PG&E (Ganda 2016).
- Technical Approach to Develop Nutrient Numeric Endpoints for California (Creager et al. 2006).

POTENTIAL INFORMATION GAPS

- Water quality data for Project reservoir and affected river reaches covering parameters included in the Water Quality Control Plan for the North Coast Region (Basin Plan) (NCRWQCB 2018) or other water quality standards (e.g., Aquatic Conservation Strategy of the Northwest Forest Plan) that might be affected by Project operations.
- Changes in Eel River water quality due to removal of Scott Dam.
- Current mercury levels in fish inhabiting Lake Pillsbury.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Characterize physical, chemical, and bacterial water quality conditions in Project reservoirs and affected river reaches through the collection of seasonal water quality data, and compare to the objectives of the Basin Plan and other water quality standards.
- Characterize mercury levels in Lake Pillsbury fish by analyzing tissue from fish collected as part of Study AQ 9 – Fish Populations and compare to appropriate fish consumption standards for humans and wildlife.[1]
- Evaluate the effects of Scott Dam removal on water quality by using results from reference sites upstream of Lake Pillsbury as well as water temperature modeling from Study AQ 2 – Water Temperature to inform potential changes to water quality parameters in the Eel River.

EXTENT OF STUDY AREA

The Study Area for the Water Quality Assessment includes Project reservoirs and affected river reaches, including some reference study sites:

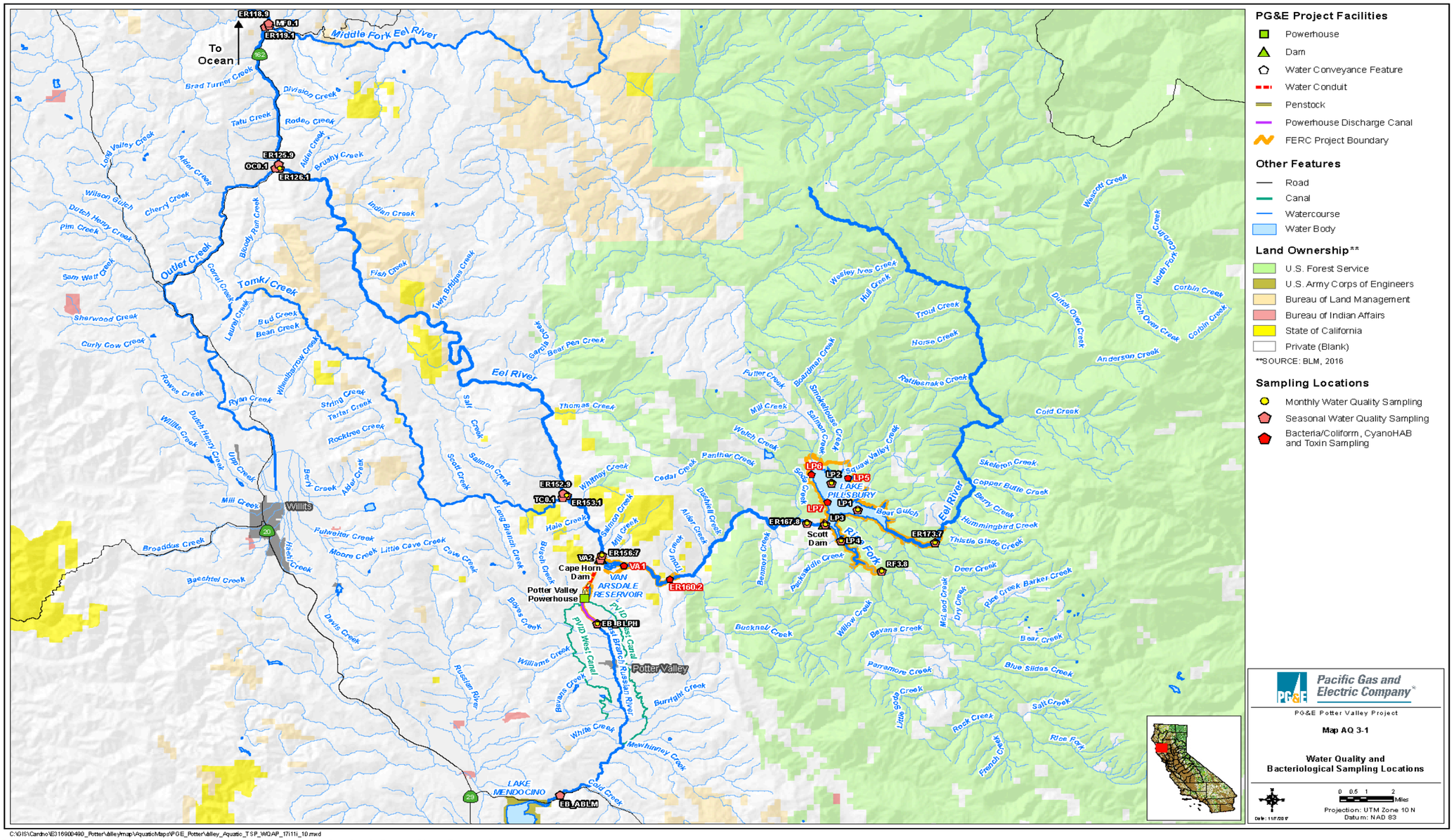
- Lake Pillsbury.
- Eel River between Scott Dam and the Middle Fork Eel River confluence (including Van Arsdale Reservoir, which is primarily riverine in character).
- East Branch Russian River between Potter Valley Powerhouse and the ordinary high water mark of Lake Mendocino.
- Reference study sites upstream of Lake Pillsbury.

[1] Project operation and maintenance activities do not involve disturbance of reservoir sediments or use of mercury. This analysis could be used to identify the need for public health warning signs regarding the consumption of fish.

STUDY METHODS AND ANALYSIS

Study Sites

- Study sites for general water quality sampling and for bacteriological sampling are shown in Map AQ 3-1 and Table AQ 3-1. The sites were selected to represent water quality in the Study Area, including selected tributary inputs into Lake Pillsbury and into the mainstem Eel River.



Map AQ 3-1 Water Quality and Bacteriological Sampling Locations

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Table AQ 3-1 Proposed Site Locations and Timing for the Water Quality Assessment Program

Station ID	Station Description	Seasonal Water Quality Sampling (APR, SEP, JAN)[1]	Monthly Water Quality Sampling (Apr-Oct, see text)	Monthly CyanoHAB and Toxin Sampling (Apr-Oct, see text)	Bacteria Sampling (Jun-Jul)[2]
EEL RIVER WATERSHED					
Inflow to Lake Pillsbury					
ER173.7	Eel River above Lake Pillsbury near Thistle Glade Creek	X	X		
RF3.8	Rice Fork above Lake Pillsbury near Willow Creek	X	X		
Lake Pillsbury					
LP1	Lake Pillsbury in the Eel River Arm	X	X		
LP2	Lake Pillsbury in the North Arm	X	X		
LP3	Lake Pillsbury near Scott Dam	X	X		
LP4	Lake Pillsbury in the Rice Fork Arm	X	X		
LP5	Lake Pillsbury near Pillsbury Pines Boat Ramp			X	X
LP6	Lake Pillsbury near Fuller Grove Boat Ramp			X	X
LP7	Lake Pillsbury Resort Boat Ramp/Swimming Area			X	X
Eel River Scott Dam to Van Arsdale Reservoir					
ER167.8	Eel River below Scott Dam near USGS Gage	X	X		
ER160.2	Eel River below Trout Creek Campground			X	X
VA1	Van Arsdale beach below the bridge			X	X
VA2	Van Arsdale Reservoir near Cape Horn Dam	X			
Eel River Cape Horn Dam to Middle Fork Eel River					
ER156.7	Eel River below Cape Horn Dam (PG&E E11 gage site)	X	X[3]		
ER153.1	Eel River above Tomki Creek confluence	X			
TC0.1	Tomki Creek above Eel River confluence	X			
ER152.9	Eel River below Tomki Creek confluence	X			
ER126.1	Eel River above Outlet Creek confluence	X			
OC0.1	Outlet Creek above Eel River confluence	X			
ER125.9	Eel River below Outlet Creek confluence	X			
ER119.4	Eel River above Middle Fork confluence	X			
MF0.1	Middle Fork Eel River above Eel River confluence	X			
ER119.2	Eel River below Middle Fork Eel River confluence	X			
EAST BRANCH RUSSIAN RIVER WATERSHED					

Table AQ 3-1 Proposed Site Locations and Timing for the Water Quality Assessment Program

Station ID	Station Description	Seasonal Water Quality Sampling (APR, SEP, JAN)[1]	Monthly Water Quality Sampling (Apr-Oct, see text)	Monthly CyanoHAB and Toxin Sampling (Apr-Oct, see text)	Bacteria Sampling (Jun-Jul)[2]
EB-BLPH	East Branch Russian River below Potter Valley	X			
EB-ABLM	East Branch Russian River above Lake Mendocino	X			

[1] January sampling will occur only for the Nutrient parameters and *in situ* parameters listed in Table AQ 3-2 at ER173.7, RF3.8, LP 1-4, and ER167.8.

[2] Five samples in a 30-day period. Thirty-day period roughly will be June 15 to July 15 to capture peak recreation usage.

[3] River monthly water quality sampling location(s) will be sampled for *in situ* parameters temperature, DO, pH, specific conductance, and turbidity only (see text), except during the Seasonal Water Quality Sampling when all seasonal parameters will be collected.

- Exact locations of the monitoring stations will be determined in the field based on sampling suitability (i.e., well-mixed and deep enough for representative sampling) and accessibility. Specifically excluded from the Study Area are areas where access is unsafe (very steep terrain or high water flows) or on private property for which NOI Parties has not received specific approval from the landowner to enter the property to perform the study. Notice of Intent (NOI) Parties will make a good faith effort to obtain access to private property to conduct the study.
- Locations for bacteriological sampling represent areas with more intensive recreational use (boat ramps, campsites), but will be updated after consultation with appropriate resource agencies to ensure study sites are appropriate for evaluation of conditions at contact recreation locations.
- Site coordinates will be obtained with a hand-held global positioning system (GPS) unit (approximately ±35 feet accuracy), where possible, or marked on a 7.5 minute USGS quadrangle map. Established station locations will either be marked (e.g., rebar and flagging) or located near an easily identifiable landmark (e.g., bridge) and then be re-occupied during subsequent water quality monitoring efforts.

Seasonal Water Quality Sampling

- Conduct *in situ* water quality measurements and collect general water quality samples at the sampling locations listed in Map AQ 3-1 and Table AQ 3-1. Measurements will be made and samples collected once during the spring runoff (April or May and once during the summer low-flow period (August or September). Nutrient and *in situ* parameters will

also be collected in January in Lake Pillsbury and at the Lake Pillsbury inflows and outflow (LP 1-4, ER173.7, RF3.8, ER167.8; Table AQ 3-1).

- A multi-parameter water quality meter (HydroLab, YSI, or similar DataSonde) will be used to collect *in situ* measurements of water temperature, dissolved oxygen (DO) (mg/l and percent saturation), specific conductance, pH, Chlorophyll-a, Phycocyanin, and turbidity at all stations (Table AQ 3-2). *In situ* water quality profiles in the reservoirs will be based on a 1-meter (m) sampling interval through the entire water column. Secchi disk measurements of water clarity will also be collected in each reservoir. At stream stations, measurements will be made approximately 0.3 m beneath the surface in flowing, well-mixed riffle, or run areas. Pre- and post-sampling calibration checks of the water quality meter, following the manufacturer instructions, will be conducted on-site for each day of sampling or as appropriate for each sensor.
- Collect water grab samples for analysis of parameters listed in Table AQ 3-2 from each station during the seasonal sampling events in spring (April or May), summer (August or September), and January nutrient samplings (see Map AQ 3-1 and Table AQ 3-1). Water samples for mercury and other trace metals analysis will be collected using the "clean hands/dirty hands" procedure (EPA 1669) to minimize risk of contamination. At stream stations, a grab sample will be taken from the riverbank in flowing water. At reservoir sites, samples will be collected from just beneath the surface, the middle of the water column, and 0.5 m above the reservoir bottom. A Teflon® Kemmerer-style sampling bottle will be used to collect reservoir samples.

Table AQ 3-2 Parameters for the Water Quality Assessment Program

Parameter/Constituent	Methods[1]	Seasonal Water Quality	Monthly Water Quality	Monthly CyanoHAB /Toxins	Bacteria
In Situ					
Temperature	EPA 170.1	X	X		
Dissolved oxygen	SM 4500-O	X	X		
pH	SM 4500-H	X	X		
Specific conductance	SM 2510A	X	X		
Chlorophyll-a, Phycocyanin	EPA 445.0	X	X		
Turbidity	SM 2130 B	X	X		
Secchi disk	USGS NFM	X	X		
General Chemistry					
Total alkalinity	EPA 310.1	X			
BOD (5-day, ultimate)	EPA 5210 B,C	X	X		
TOC and DOC	EPA 415.2		X		
Hardness	EPA 200.7	X			

Parameter/Constituent	Methods[1]	Seasonal Water Quality	Monthly Water Quality	Monthly CyanoHAB /Toxins	Bacteria
Total dissolved solids	EPA 160.1	X			
Total suspended solids	EPA 160.2	X			
Total sulfide	SM 4500-S2- (C & D)	X2	X2		
H_2S Gas	Handheld Meter	X2	X2		
Nutrients					
Nitrate+Nitrite-N	EPA 300.0	X	X		
Total Ammonia-N	EPA 350.3	X	X		
Total Kjeldahl Nitrogen	EPA 351.3	X	X		
Orthophosphate	EPA 365.3	X	X		
Total Phosphorous	EPA 365.3	X	X		
Algae and Algal Toxins					
Chlorophyll-a	SM 10200H	X	X		
Algae Species ID	SM 10200E	X3	X3	X4	
Cylindrospermopsin	EPA 545			X4	
Anatoxin-a	EPA 545			X4	
Total Microcystins	EPA 546			X4	
Bacteriological					
Total coliform	SM 9223B	X			X
Fecal coliform	SM 9222D	X			X
Hydrocarbons					
Hydrocarbon samples	EPA 418.1	X			
Metals (Total except as noted)					
Iron	EPA 200.7	X	X		
Manganese	EPA 200.7	X			
Mercury5	EPA 1631	X5	X		
Methylmercury5	EPA 1630	X5	X		
CAM 17 Metals (Title 22 Metals)6 and Aluminum	EPA 200.8	X6			

1 Method sources: APHA (2012), USEPA (2017), and USGS National Field Manual (Wilde et al 2014).

2 Total sulfide and H2S gas will only be collected at Lake Pillsbury (sites LP1 – 4) and immediately downstream (site ER167.8).

3 Algal ID to genus level will be conducted at two depths during May, July, and September only (one in epilimnion and one metalimnion) for application to understanding Lake Pillsbury limnology.

[4] Algae ID to genus level. Toxin monitoring will be conducted only in months when cyanobacteria blooms are present (see text for discussion), and at locations identified for contact recreation algae sampling. Samples will be taken from surface water.

[5] Mercury sampling is at lower detection limits with these methods than EPA 200.8 used for the CAM 17 metals below.

[6] CAM 17 metals includes total and dissolved metals: As, Hg, Sb, Ba, Be, Cd, Cr, Co, Cu, Pb, Mo, Ni, Se, Ag, TI, V, Zn

- Date, time, station ID, and other pertinent information will be recorded in the field. Each grab sample container will be labeled, preserved, stored, and delivered to a state-certified water quality laboratory, and the contents will be analyzed by the methods indicated in Table AQ 3-2. A chain-of-custody record will be maintained for each sample container.
- Prior to conducting this study, NOI Parties will contact the state-certified water quality laboratory that will analyze the samples to confirm the following: proper sampling methods, sample container sizes, preservation, filtration, and method detection limits that are below current regulatory standards to achieve the goals of this study.
- All water quality parameters measured will be compared to Basin Plan water quality objectives and the Aquatic Conservation Strategy Objectives of the Northwest Forest Plan.

Monthly Lake Pillsbury Water Quality Sampling

- Collect monthly samples to assist in understanding Lake Pillsbury limnology (inflow, reservoir, and outflow samples) (see Table AQ 3-2). Collect samples prior to Lake Pillsbury stratification and monthly thereafter until fall turnover occurs (approximately April to October). Note that additional samples may be collected more frequently to capture summer oxygen dynamics.
- Collect monthly water quality samples using the same methods outlined in the Seasonal Water Quality Sampling section above (e.g., multi-parameter water quality meter vertical profiles, grab samples, etc.).
- Obtain inflow data at the time of sampling in the Eel River (Site ER173.7) and Rice Fork (RF3.8) tributaries to Lake Pillsbury either using the temporary gages (Study AQ 1 – Hydrology and Project Operations Modeling), if available, or by measurement when possible (low flow); otherwise, use the daily mass balance of reservoir storage and outflow to estimate flow (coordinate with Study AQ 1 – Hydrology and Project Operations Modeling).
- Coordinate with Study AQ 2 – Water Temperature to collect the in situ water temperature profiles during the monthly sampling to support development of the CE-QUAL-W2 water temperature model.
- Contingency Sampling: If after Year One sampling, additional data is required to understand Lake Pillsbury dissolved oxygen (DO) dynamics and to model DO accurately (see Lake Pillsbury Analysis below), collect additional DO data in Year Two. This would be determined in coordination with stakeholders.

- All water quality parameters measured will be compared to Basin Plan water quality objectives and the Aquatic Conservation Strategy Objectives of the Northwest Forest Plan.

In Situ River Water Quality Sampling

- *In situ* turbidity, DO, pH, temperature, and specific conductance data will be collected at two key locations in the Eel River, below Lake Pillsbury (ER167.8[2]) and below Van Arsdale Reservoir (ER156.7). Turbidity meters will be installed at these locations year-round (15-minute sample interval). DO, pH, temperature and specific conductance will be collected at these locations once each month (May – October) for a 24-hour cycle (15-minute sample interval) to identify if diel DO sags or other diel water quality issues exist. If the data indicate the presence of DO, turbidity, or other *in situ* water quality issues, follow-up sampling will occur in coordination with stakeholders. Note that DO, turbidity, and other *in situ* water quality data below Van Arsdale Reservoir (ER156.7) are representative of water diverted to the East Branch Russian River at the Van Arsdale Diversion.
- Turbidity grab sample data is being collected upstream of Lake Pillsbury in the Eel River and Rice Fork as part of the seasonal and monthly sampling (Table AQ 3-2) that will provide reference conditions for the turbidity data being collected downstream of Lake Pillsbury. At the temporary flow gaging locations upstream of Lake Pillsbury (Eel River and Rice Fork; see Study AQ 1 Hydrology and Operations Modeling), a turbidity meter will be installed. Turbidity will be monitored year-round (15-minute sample interval) (note: extreme natural variability in flows, high to low, and sediment load conditions in these locations may make year-around monitoring difficult and some data gaps should be expected).

Bacteriological Monitoring

- Conduct bacteriological sampling (total and fecal coliform) at sampling locations listed in Table AQ 3-1 and Map AQ 3-1, and analyze as indicated in Table AQ 3-2. Sampling will occur during the 30-day period surrounding the July 4th holiday (roughly, June 15 to July 15) to coincide with moderate-to-high levels of recreational activity. A total of five surface water grab samples will be collected from each site during this 30-day period. Samples will be collected targeting areas with the highest recreational use (e.g., near boat launch and swimming areas).
- Samples will be immediately preserved and delivered/shipped to a state-certified laboratory in a manner suitable with meeting the most restrictive hold time criteria. A chain-of-custody record will be maintained for each sample container.

[2] Note that this location is being sampled monthly as part of the Lake Pillsbury monthly sampling (April – October).

- Bacteriological sample results will be compared to Basin Plan water quality objectives and the Aquatic Conservation Strategy Objectives of the Northwest Forest Plan.

Cyanobacteria and Toxins (Harmful Algal Blooms)

- Visit monthly (approximately June to October), each cyanobacteria (cyanoHAB) study location in Table AQ 3-1 and Map AQ 3-1 and assess the presence/absence of cyanoHABs. At each visit, collect samples and analyze for algae ID, Anatoxin-a, microcystins, and cylindrospermopsin using standard laboratory procedures (Table AQ 3-1 and AQ 3-2). Algae ID will be completed if toxins are detected.
- Note that PG&E maintains an independent cyanoHAB detection program intended to determine if public health risks are present in waters near recreational facilities for the purpose of posting appropriate signage (e.g., Caution, Warning, or Danger) per CA CyanoHAB Network protocols.

Fish Tissue Mercury Sampling

- Analyze fish tissue samples from Lake Pillsbury for total mercury using modified EPA Method 1638. Various species of sportfish that may include rainbow trout, largemouth bass, bluegill, and catfish from the reservoir gill netting survey (Study AQ 9 – Fish Populations) will be utilized to determine edible tissue concentrations. At least 10 individuals of varying length of each species will be analyzed.
- Analyze pikeminnow fish tissue samples (edible tissue) from the Eel River downstream of Lake Pillsbury for total mercury using modified EPA Method 1638. Sample at least 10 larger pikeminnow individuals (e.g., ≥250 mm) collected as part of the annual Pikeminnow monitoring in the Eel River between Lake Pillsbury and Van Arsdale Reservoir (PG&E 2017c).

Lake Pillsbury Water Quality Analysis

Nutrient Balance

- Characterize the nutrient balance of Lake Pillsbury (using mass balance principles) by analyzing the inflow, outflow, and within Lake Pillsbury nutrient concentrations collected monthly/seasonally at sampling stations ER173.7, RF3.8, LP1, LP2, LP3, LP4, and ER167.8 (Tables AQ 3-1 and AQ 3-2) (e.g., see Creager et al. 2006). Analyze seasonal variations in nutrients in Lake Pillsbury.

Dissolved Oxygen

- Develop empirical relationships between observed water column DO, DO depletion rates, nutrient levels, and monthly changes in algal community indicators (e.g., relative algae abundance by species) within Lake Pillsbury. Coordinate with Study AQ 6 – Fish Habitat to provide a time series analysis of Lake Pillsbury hypolimnion oxygen depletion incorporating reservoir elevation and temperature stratification data (AQ 1 –

Hydrology and Operations Modeling, and AQ 2 – Water Temperature). Coordinate with Study AQ 4 Fluvial Processes and Geomorphology to incorporate potential future changes in Lake Pillsbury storage capacity into the modeling, as appropriate.

- If DO depletion modeling in Lake Pillsbury requires more sophisticated treatment (e.g., predictive empirical relationships cannot be established), include DO modeling in the CE-QUAL-W2 model and calibrate the model to observed data.

Turbidity

- Analyze the turbidity of water released from Lake Pillsbury into the Eel River using turbidity data collected monthly/seasonally at sampling stations ER173.7, RF3.8, LP1, LP2, LP3, LP4, and ER167.8 (Tables AQ 3-1 and AQ 3-2). Also, incorporate into the analysis the available bed topography and water surface elevations at the time of sampling. Analyze seasonal variations in turbidity and the source of turbidity, if turbidity is present (reservoir inflows, water column, or bed material).

Hydrogen Sulfide

- If hydrogen sulfide gas is detected downstream of Lake Pillsbury (e.g., site ER167.8) during monthly sampling, or by PG&E operators near the base of the dam, conduct additional sampling analysis, as needed, to determine if the source of the gas is hypolimnion release water from the low level outlet needle valve. Sample a water temperature and DO profile in the lake near the dam (site LP3) and sample for sulfides in the water column (epilimnion, metalimnion, and hypolimnion). Also, if appropriate, investigate possible sources of organic decomposition near the base of the dam (e.g., spillway flip bucket area).
- Analyze hydrogen sulfide concentrations in the hypolimnion of Lake Pillsbury and in the reservoir outflow. Characterize the hydrogen sulfide levels in relation to seasonal variation in reservoir stratification and oxygen dynamics (and other water quality parameters, as appropriate)

General Water Quality and Basin Plan Comparisons

- Characterize the water quality dynamics in Lake Pillsbury and its outflow using empirical data collected monthly/seasonally at sampling stations ER173.7, RF3.8, LP1, LP2, LP3, LP4, and ER167.8 (Tables AQ 3-1 and AQ 3-2). This analysis includes the issues listed above (nutrients, DO, turbidity, hydrogen sulfide) and other important reservoir water quality processes and parameters, particularly thermal stratification, mercury methylation, algae dynamics (e.g., green algae, cyanobacteria), dissolved metals, pH, alkalinity, and organic carbon.
- Water quality measurements will be compared to water quality objectives, beneficial uses, and Basin Plan criteria including appropriate screening levels pertaining to human health and ecological receptor thresholds.

Contingency Benthic Macroinvertebrate Sampling

- At locations where river water quality sampling results exceed Basin Plan standards and state or federal resource agencies with management responsibility related to water quality request benthic macroinvertebrate (BMI) sampling, then BMI sampling will be conducted at those locations and at appropriate reference locations. BMI sampling will be performed using the reach-wide benthos (RWB) method for documenting and describing benthic macroinvertebrate assemblages and physical habitat described by SWAMP (Ode et al. 2016). Site length, data collection, habitat quality measurements, and data processing will follow the SWAMP protocols.

Invasive Species Avoidance Field Sampling Protocols

- To minimize the potential for spread of invasive species (e.g., New Zealand Mud Snail [NZMS], quagga/zebra mussel, Chytrid fungus), appropriate decontamination protocols will be followed prior to each aquatic-based field effort or moving between watersheds. Procedures may include, but not be limited to, freezing or soaking all field gear (including waders, boots, wetsuits) with a commercial 409® cleaner, spraying equipment with a bleach and water solution, and inspecting all field equipment (including boats) for evidence of invasive species. To minimize the spread of non-native invasive plant species during field activities, applicable measures, including inspection and cleaning of clothing and vehicles, will be conducted.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies listed here are widely used and accepted in the scientific and engineering communities. These methods have been used in other relicensing proceedings and are designed to meet the needs of, and be consistent with, SWRCB requirements.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

This study will incorporate water quality data collected by PG&E prior to release of the PAD and will support other studies for analysis, including Study AQ 2 – Water Temperature and Study AQ 6 – Lake Pillsbury Fish Habitat. Fish collected during Study AQ 9 – Fish Populations will be used for fish tissue mercury analysis in this study and discharge data from Study AQ 1 – Hydrology and Project Operations Modeling will be used in this study.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $480,000.

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STUDY AQ 4

Fluvial Processes and Geomorphology

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Erosion and sedimentation associated with Project facilities and operations.
- Unstable hillslopes within the rim of Lake Pillsbury.
- Sediment supply to the upper mainstem Eel River.
- Fluvial processes that create and maintain aquatic and riparian habitat.
- Quantity or quality of spawning gravel and fine sediment.
- Quantity and function of large woody debris (LWD).

PROJECT NEXUS

- Project operations and maintenance could potentially affect aquatic and riparian habitats by modifying the flow regime; sediment supply, transport, and storage; channel morphology; and substrate in affected river reaches under existing operations and proposed changes to Project facilities and operations.
- Project operations and maintenance could affect the supply and transport of LWD that can be important in creating and maintaining aquatic habitat under existing operations and proposed changes to Project facilities and operations.

RELEVANT INFORMATION

The following information is available and was reviewed to determine geomorphology study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.7 for a summary of fluvial processes and geomorphology information [PG&E 2017a]):

- U.S. Geological Survey (USGS) gaging data.
- Hydrology information as described in Study AQ 1 – Hydrology and Project Operations Modeling.
- PG&E reservoir storage versus elevation data.
- PG&E Lake Pillsbury Bathymetry Survey – 2015/2016 Data (PG&E 2016, 2017b), and previous bathymetric information.
- Van Arsdale Reservoir Sedimentation Investigation Report (PG&E 2005).
- Lake Pillsbury sediment sampling data collected by Geosyntec (2020) on behalf of the California Coastal Conservancy.
- Sedimentation of Lake Pillsbury (Porterfield and Dunnam 1964).

- Total maximum daily loads for sediment in the Eel River watershed (USEPA 1999a, 1999b, 2002, 2003, 2004, 2007), including sediment source analyses.
- Sediment yield, spatial characteristics, and the long-term evolution of active earthflows determined from airborne LiDAR and historical aerial photographs, Eel River, California (Mackey and Roering 2011)
- Trends in the suspended-sediment yields of coastal rivers of northern California, 1955–2010 (Warrick et al. 2013).
- Eel River margin source-to-sink sediment budgets: revisited (Warrick 2014).
- River sediment flux and shelf sediment accumulation rates on the Pacific Northwest margin (Wheatcroft and Sommerfield 2005).
- Sediment transport and turbidity in the Eel River Basin, California (Brown and Ritter 1971).
- Watershed analysis report for the Upper Main Eel River (USFS-MNF 1995).
- PG&E current large woody debris management practices.
- Spawning habitat information (VTN 1982; SEC 1998).
- Historical Aerial Photographs and LiDAR data (Mendocino National Forest, Natural Resource Conservation Service, Lake County).

POTENTIAL INFORMATION GAPS

- Sources of Project-related erosion and sedimentation.
- Location, type, and activity level of mass wasting features and potentially unstable slopes within the rim of Lake Pillsbury.
- Stratigraphy and physical properties (e.g., grain size distribution and density) of sediment deposits in Lake Pillsbury.
- Sediment supply to the upper mainstem Eel River.
- Geomorphology and fluvial processes in affected river reaches.
- Substrate conditions in affected river reaches (e.g., amount and quality of spawning gravel).
- Presence and functions of LWD in affected river reaches.
- Relationships between hydrology, geomorphology, and riparian vegetation.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be conducted to augment existing information:

- Identify sources of erosion and sedimentation related to Project operations and maintenance.
- Identify mass wasting features and potentially unstable slopes within the rim of Lake Pillsbury.
- Characterize the grain size distribution of the sediment supplied to Lake Pillsbury based on bulk samples of bed material in the mainstem Eel River and Rice Fork Eel River channels.
- Characterize reservoir sediment (in coordination with analyses and results from Study AQ 12– Scott Dam Removal, deposits):
- Characterize hydrology in the Project-affected river reaches in relation to geomorphic processes and riparian vegetation (in coordination with AQ 1 – Hydrology and Project Operations Modeling).
- Develop a sediment budget that estimates average annual sediment supply rate and sediment transport capacity at key locations in the mainstem channel from Scott Dam to the Middle Fork Eel River (i.e., sediment budget nodes) and at select downstream long-term gaging sites (Dos Rios, Fort Seward, and Scotia) under existing conditions (in coordination with hydrodynamic and sediment transport modeling conducted in AQ 12 – Scott Dam Removal Assessment).
- Characterize the amount and quality of spawning substrate in Project-affected river reaches.
- Characterize fine sediment in spawning substrates and in pools in Project-affected river reaches.
- Estimate initiation of motion for spawning sized gravel substrate in Project-affected river reaches under existing conditions (in coordination with hydrodynamic and sediment transport modeling conducted in AQ 12 – Scott Dam Removal Assessment).
- Characterize the size, amount, and function of LWD that occurs in Project reservoirs and in the Eel River downstream of Project dams to identify potential Project effects on LWD.
- Characterize woody riparian vegetation (in coordination with Study TERR 1 – Botanical Resources) at selected study sites in the Project-affected reaches.

EXTENT OF STUDY AREA

The Study Area includes the following Project reservoirs and affected river reaches:

- Lake Pillsbury, including sediment supply from areas upstream;

- Eel River between Scott Dam and the Middle Fork Eel River confluence (including Van Arsdale Reservoir); and
- East Branch Russian River between Potter Valley Powerhouse and the ordinary high water mark of Lake Mendocino.

The Study Area includes: (1) a comparison site in the Eel River upstream of Lake Pillsbury and in the lower Middle Fork Eel River; and (2) an analysis of potential spawning gravel in selected river reaches upstream of Lake Pillsbury (see Study AQ 7 – Fish Passage), and (3) an analysis of sediment supply to Lake Pillsbury from areas upstream.

STUDY METHODS AND ANALYSIS

Identify Project-related sources of erosion and sedimentation

- Review existing data and geotechnical reports to evaluate the cause, extent, and previous treatment of erosion and sediment sources in the Study Area. Preliminary information regarding regional geology and geomorphology, unstable areas, and historical background for Project-related facilities will be compiled to inform field inventory and assessment priorities and approaches. Information from PG&E personnel with institutional knowledge of maintenance history of Project roads and facilities will also be incorporated.
- Field survey Project roads, Project structures, Project recreational use areas (including access roads), and any spoil sites to identify and describe active and/or past erosion. Field methods will be adapted from relevant guidance documents regarding erosion inventory and sediment control in California and the Pacific Northwest (CDFG 2010; USFS 2012; Weaver et al. 2014).
- Identify areas of erosion and sediment related to dispersed recreation that may have a nexus to Project roads or Project recreational facilities.

Identify mass wasting features and unstable slopes within the rim of Lake Pillsbury

- Review existing bedrock and surficial geologic mapping in the vicinity of Lake Pillsbury.
- Identify geologic map units and stratigraphic relationships that are prone to instability and/or may be destabilized by rapid reservoir drawdown.
- Map existing and historical mass wasting features and potentially unstable slopes from available topography, LiDAR, and aerial photography.
- Field verify mapping of mass wasting features and potential unstable slopes, as necessary and appropriate.

***Characterize reservoir* sedimentation (in coordination with analyses and results from Study AQ 12– Scott Dam Removal):**

- Estimate the current volume and spatially distributed thickness of reservoir sediment deposits.
- Characterize the current stratigraphy and physical properties (e.g., grains size distribution and density) of reservoir sediment deposits.
- Calculate reservoir sedimentation rates.

Characterize hydrology in Project-affected river reaches

- Characterize unimpaired and Project hydrology (high and low flow magnitude, duration, and frequency) in the Project-affected river reaches at key locations (Eel River at Scott Dam, Cape Horn Dam, Tomki Creek, Outlet Creek, and Middle Fork Eel River; and East Branch Russian River below Potter Valley Powerhouse) using hydrology data from Study AQ 1 – Hydrology and Project Operations Modeling. Hydrology metrics will include daily time series, mean annual discharge, flow exceedance, and annual flood frequencies.
- Relate key hydrologic characteristics to fluvial processes and geomorphology (e.g., channel width and depth, flow inundation, sediment mass balance) and riparian conditions (riparian vegetation recruitment and establishment), as appropriate.

Develop a sediment budget that estimates average annual sediment supply rate and sediment transport capacity at key locations

- Estimate total average annual sediment yield to Lake Pillsbury based on reservoir sedimentation rates through time (1959, 1984, 2005, and 2015). Use information obtained from investigation of reservoir sediment deposits and bulk sampling of channel bed material to partition the total sediment yield into relevant grain size fractions.
- Estimate sediment supply by relevant grain size fractions to select locations (i.e., sediment budget nodes) in affected reaches of the Eel River (Scott Dam to the Middle Fork Eel River confluence) based on reservoir sediment yield, sediment source inventories, sediment loads measured at select mainstem gaging stations, and information about the bed material grain size distribution in the mainstem Eel River and major tributaries.
- Estimate sediment transport capacity at select locations (i.e., sediment budget nodes) in affected reaches of the Eel River (Scott Dam to the Middle Fork Eel River confluence), in coordination with hydrodynamic and sediment transport modeling conducted as part of AQ12– Scott Dam Removal Assessment.
- Compute annual mass balance at key locations in the mainstem channel from Scott Dam to the Middle Fork Eel River (i.e., sediment budget nodes) and at select

downstream long-term gaging sites (Dos Rios, Fort Seward, and Scotia) under existing conditions.

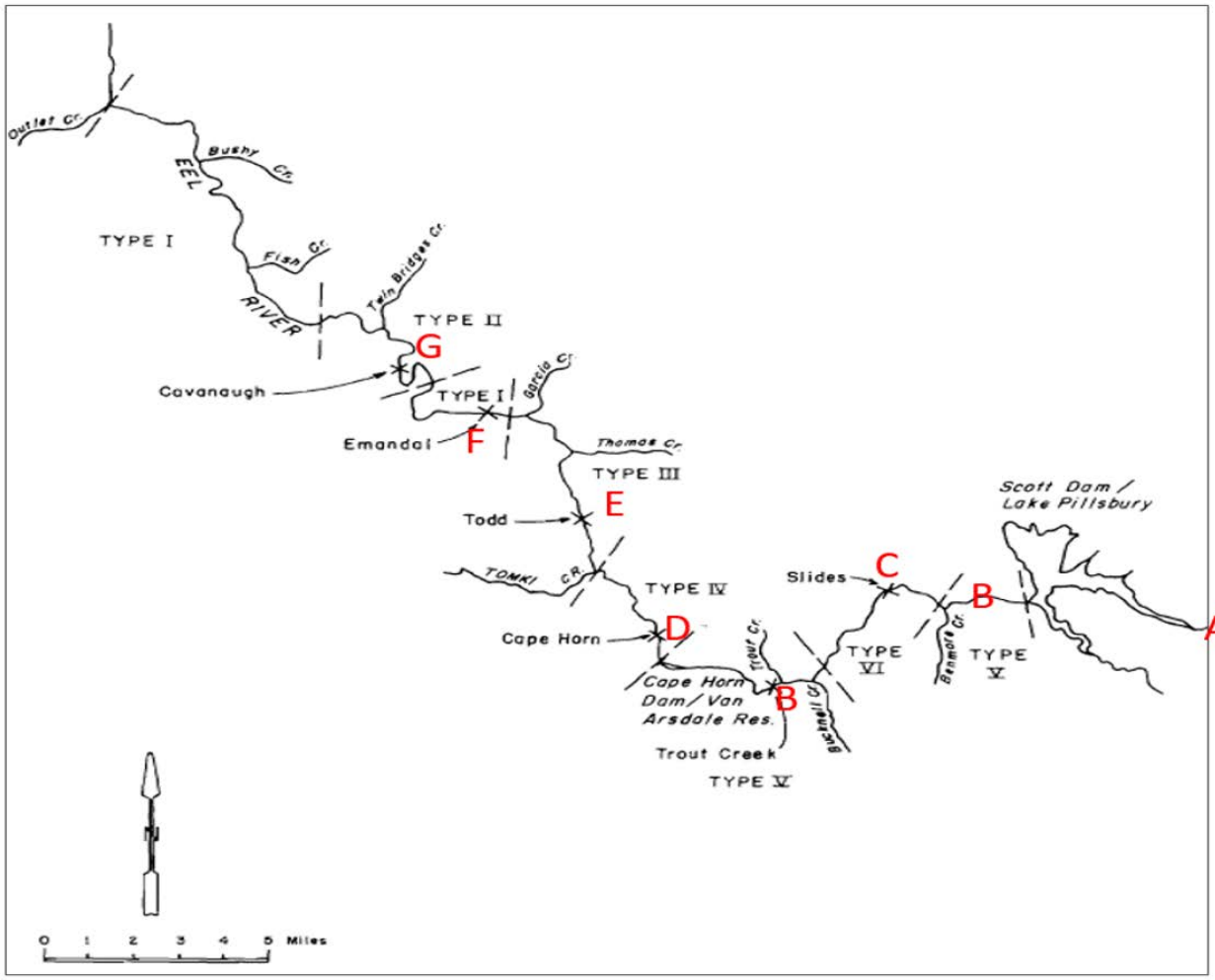
Map spawning gravel and LWD

- Develop criteria for suitable spawning gravel (particle size, minimum mapping size, channel location) for Chinook salmon and steelhead in the Eel River and for trout in the East Branch Russian River in coordination with Study AQ 5 – Instream Flow.
- Map salmon and steelhead spawning gravel deposits and LWD within the bankfull channel throughout the mainstem Eel River from Scott Dam to Middle Fork Eel River using current high-resolution aerial photography (approximately 1:3,600 scale) and GIS. Field verify desktop mapping from Scott Dam (RM 168.5) to Ramsing Ranch (RM 142.6). Field verify desktop mapping in select locations downstream of Ramsing Ranch, as appropriate.
- Field map trout spawning gravels and LWD in the East Branch Russian River at fish population snorkeling locations (see Study AQ 9 – Fish Populations).
- Map salmon and steelhead spawning gravel and LWD downstream of passage barriers in the Eel River Upstream of Lake Pillsbury using high-resolution aerial photography and field verification (see Study AQ 7 – Fish Passage).
- Characterize the amount of spawning gravel and LWD in Project-affected reaches in relation to sediment supply, LWD loading, channel geometry (i.e., width, slope, and confinement), and geomorphic reach type.

Delineate geomorphic reaches

- Classify the mainstem Eel River into functionally similar geomorphic reaches based on channel gradient, relative confinement, morphology, alluvial sediment storage, bed surface texture, and tributary confluences. Consider geomorphic reaches used in the VTN (1982) instream flow study (Map AQ 4-1). Potentially responsive reaches within lower gradient channel segments will be identified through further analysis of historical aerial photography.

Map AQ 4-1. Proposed Eel River Study Reaches and Geomorphology/Riparian Study Sites (VTN 1982).



Select intensive geomorphic and riparian study sites

- Select representative Eel River study sites to develop integrated geomorphology, hydrology, and riparian relationships in the Study Area. Eight study sites are proposed in the Project area: six sites in the Eel River from Scott Dam to the Middle Fork Eel River and two sites in comparison reaches (Table AQ 4-1) based on review of channel morphology in aerial imagery and historical reach delineations (VTN 1982). This includes a representative study site in each major geomorphic reach. Each study site will be approximately 20 to 40 active channel widths long. Study sites will be adjusted, as appropriate, in collaboration with stakeholders to be representative of the larger geomorphic reach.

Table AQ 4-1. Proposed Eel River Geomorphic Reaches and Geomorphology / Riparian Study Sites

River Miles	Reach	Historical VTN (1982) Reaches	Study Sites
Eel River			
173.4 – 176.6	Below Thistle Glade Creek to Copper Butte Creek	--	Comparison A
166.4 – 168.5	Benmore Creek to Scott Dam (with a sub-reach from Soda Creek to Scott Dam for spawning gravel availability)	V	B*
162.0 – 166.4	One mile above Bucknell Creek to Benmore Creek	VI	C
156.8 – 162.0	Cape Horn Dam to canyon one mile above Bucknell Creek (near Alder Creek)	V	B*
153.0 – 156.8	Tomki Creek to Cape Horn Dam	IV	D
146.2 – 153.0	Emandal Resort to Tomki Creek	III	E
142.2 – 146.2	Ramsing Ranch to Emandal Resort	I	F
136.2 – 142.2	Three miles above Fish Creek to Ramsing Ranch	II	G
126.0 – 136.2	Outlet Creek to canyon 3 miles above Fish Creek	I	--
Middle Fork Eel River			
TBD	Lower Middle Fork Eel River (location to be determined in consultation with stakeholders)	--	Comparison H

*Note study site B may be located in one of the two similar reaches or split between the two reaches. Select three cross-sections to represent geomorphology and riparian resources at each of the Eel River geomorphic/riparian study sites. Cross-sections should be co-located with Study TERR 1 – Botanical Resources transects and extend through the channel and floodplain (upland to upland) and be semi-permanently monumented and documented with GPS coordinates.

Geomorphology and riparian vegetation at Eel River study sites

Spawning gravel particle size distribution and fine sediment content

- Determine particle size distribution and fine sediment content of spawning gravel at three representative locations in each Eel River geomorphic/riparian study site (Map AQ 4-1, Table AQ 4-1) using bulk sampling techniques. Integrated surface and subsurface bulk samples will be collected from mapped spawning gravel deposits using a McNeil sampler (Bunte and Abt 2001). Bulk samples will be sieved and weighed in the field, with the finer fraction (e.g., ≤11 mm) undergoing laboratory particle-size analysis (Bunte and Abt 2001). Cumulative distribution curves and other distribution statistics will be developed for each sample.

Fine sediment in pools

- Conduct a reconnaissance level assessment of fine sediment volume in three representative pools within each geomorphic/riparian study site. Estimate the ratio

of fine sediment volume to residual pool volume using visual mapping of fine sediment, estimated depth of fine sediment, and measurements of pool volume (e.g., modified V*).

Geomorphology and bed material

- At the geomorphology/riparian study sites, map geomorphic features and bed surface texture/substrate in coordination with the riparian vegetation mapping (Study TERR 1 – Botanical Resources).
- Characterize substrate facies into sand, gravel, cobble, and boulder categories including dominant and subdominant textural classes. For each sediment facies, estimate the median particle size (D_{50}) and the D_{84} (that particle size at which 84% of the grain size distribution is finer).
- Survey three cross-sections at each study site to represent geomorphology and riparian vegetation characteristics (include longitudinal thalweg profiles at each cross-section). Identify bankfull indicators and other features denoting flood inundation. Survey intervals will capture all breaks in slope and prominent morphological features. Annotations of morphological features along the cross-section will be recoded, including water surface edges, indicators of bankfull elevations, floodplain edges, thalweg, channel bed surface texture, vegetation (in coordination Study TERR 1 – Botanical Resources), and high water marks.
- Conduct pebble counts (Wolman 1954) at cross-sections to determine particle size distribution and estimate channel roughness.
- Correct or modify, as needed, the spawning gravel mapping and/or LWD mapping developed from aerial photography (see Map Spawning Gravels and LWD above).
- Estimate the discharge related to initiation of motion for spawning sized gravel substrate under existing conditions at study sites, in coordination with hydrodynamic and sediment transport modeling conducted as part of AQ12– Scott Dam Removal Assessment. Create a time series analysis of initiation of motion for the 1975-2016 POR using Project Existing Conditions Hydrology and Unimpaired Hydrology (Study AQ 1 – Hydrology and Project Operations Modeling). Evaluation of alternative Project flow scenarios, including climate change where applicable, will occur during PM&E discussions.

Woody riparian vegetation

- Relate vegetation characteristics to flow inundation and geomorphic surfaces. Use the Project hydrologic data (Study AQ 1 – Hydrology and Project Operations Modeling) and study site cross-section hydraulics (e.g., frequency, duration, and timing of inundation; rate of flow recession; and water availability in summer months) and to identify recruitment events. Evaluation of alternative Project flow scenarios will occur during PM&E discussions.

East Branch Russian River geomorphology

- Use the Study AQ 9 – Fish Populations snorkeling sites to conduct geomorphic evaluations on the East Branch Russian River.
- Survey stream banks to identify erosion or geomorphic issues (e.g., channel instability) related to high-flow releases into the channel.

Large woody debris in project reservoirs and affected river reaches

The amount of LWD captured in Project reservoirs (Lake Pillsbury and Van Arsdale Reservoir) and the relative effect on recruitment of LWD in downstream reaches will be characterized, as follows:

- Describe historical and existing large woody debris management by PG&E.
- Quantify LWD (size and volume) captured in Project reservoirs (aerial photograph analysis, field measurements, PG&E wood removal records) using a combination of field observations, Project records, operator interviews, and historical water level records. Identify how LWD is managed in Lake Pillsbury (i.e., collection, removal, and disposal).
- Compare LWD loading and functions above and below reservoirs (see Mapping Spawning Gravel and LWD).
- Identify LWD management issues that may affect aquatic resources for potential discussion during PM&E discussions.

Project effects on fluvial processes, geomorphology, and riparian vegetation

- Based on a review of existing information and results of field studies, identify resource issues, if present, that may be related to Project hydrology or sediment supply (e.g., spawning gravel, aquatic habitat, riparian vegetation encroachment).
- Identify the causal mechanism of any potential issue with available resource data (aerial imagery, hydrology, sediment yield, gravel location and amount, riparian vegetation, channel data, initiation of motion analyses, and riparian hydrology analyses).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies listed here to characterize fluvial process and geomorphology and riparian vegetation are widely used and accepted in the scientific and engineering communities. These methods have been used in other relicensing proceedings and are designed to meet the needs of the relicensing stakeholders.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

This study will provide information about fluvial process and geomorphology and riparian resources that will be used by other studies and analyses related to fish, aquatic, and botanical resources. Study AQ 1 – Hydrology and Project Operations Modeling will provide hydrology for this study, and Study AQ 5 – Instream Flow will provide hydraulics modeling. Study TERR 1 – Botanical Resources will provide information on the abundance, distribution, and condition of riparian vegetation.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $427,000.

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STUDY AQ 5
Instream Flow

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Modification of aquatic habitat.

PROJECT NEXUS

- Existing Project operations modify the flow regime in the river reaches (Eel River from Scott Dam to Van Arsdale Reservoir, Eel River from Cape Horn Dam to Middle Fork Eel River, and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino). The modified flow regime affects the amount (quantity and quality) and distribution (temporal and spatial) of aquatic habitat.
- Changes in Project facilities and operations would modify the flow regime in river reaches (Scott Dam to Van Arsdale Reservoir, Cape Horn Dam to Middle Fork Eel River, and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino) and under Lake Pillsbury for Scott Dam removal.

RELEVANT INFORMATION

- The following information is available and was reviewed to determine instream flow needs (refer to (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.3 for a summary of instream flow information [PG&E 2017]):
  - Potter Valley Project (FERC Project No. 77) Fisheries Study (VTN 1982) (includes the initial Project Instream Flow Study).
  - Effects of Operations on Upper Eel River Anadromous Salmonids (SEC 1998) (which includes river segment and mesohabitat mapping in the Project vicinity and an update of the Project instream flow study for Chinook salmon spawning).
  - Biological Opinion for the Proposed License Amendment for the Potter Valley Project (NMFS 2002) (includes Reasonable and Prudent Alternative [RPA] instream flow requirements).
  - Hydrology information as described in Study AQ 1 – Hydrology and Project Operations Modeling.

POTENTIAL INFORMATION GAPS

- Current Eel River geomorphic river segment delineation and mesohabitat mapping (e.g., run, pool, riffle).
- Review of the previously used Chinook salmon and steelhead spawning habitat suitability criteria (HSC) and update, if appropriate.

- Review of the previously used juvenile steelhead physical habitat and water temperature HSC, and update, if appropriate.
- Reanalysis of habitat modeling with updated geomorphic segments / mesohabitat mapping and species HSC, as appropriate.
- Foothill yellow-legged frog (FYLF) habitat and reproduction as a function of flow and ramping rates.
- Review of East Branch Russian River minimum flow.

PROPOSED STUDIES / ANALYSIS TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Review and update, if appropriate, the current Eel River geomorphic segments and mesohabitat.
- Review existing instream flow hydraulic model to verify modeling approach and calibration.
- Review and update, if appropriate, anadromous species and lifestage HSC (including juvenile steelhead water temperature HSC).
- Remodel habitat versus flow relationships for anadromous species / lifestages using updated information, if appropriate.
- Model FYLF habitat and reproduction as a function of flow, water temperature, and ramping rates.
- Observations of East Branch Russian River minimum flows.

EXTENT OF STUDY AREA

The Study Area for the instream flow study includes Project-affected river reaches:

- Eel River between Scott Dam and the Middle Fork Eel River confluence (including Van Arsdale Reservoir, which is primarily riverine in character).
- East Branch Russian River between Potter Valley Powerhouse and the ordinary high water mark of Lake Mendocino.

STUDY METHODS AND ANALYSIS

Eel River Geomorphic Segments and Mesohabitat

- Coordinate with Study AQ 4 – Geomorphology to review the historical geomorphic segment delineation (VTN 1982) and, if necessary, modify for application in stratifying and weighting instream flow study results.

- Review the mesohabitat types used in the SEC (1998) instream flow study (SEC 1987) (low gradient riffle, moderate gradient riffle, riffle/run, shallow pool, deep pool). Review the habitat mapping (SEC 1987). Evaluate the applicability of the previous mapping and instream flow transect locations to current conditions using historical and current aerial photography, if available, or by conducting mapping in representative river reach locations. If the historical mapping is applicable, use the historical mapping for instream flow modeling; otherwise, update mesohabitat using a combination of aerial photography, helicopter flights, aerial drone imagery, and/or ground truthing.

Selection of Target Species and/or Guilds

- The species and life stages (and/or guilds) to be used for instream flow habitat modeling will be selected in collaboration with stakeholders based on management importance and/or sensitivity to Project operations. The recommended approach is to model Chinook salmon spawning, steelhead spawning, and juvenile rearing, FYLF breeding (eggs) and larval development (tadpoles), and wetted perimeter / productive benthic invertebrate habitat. Stakeholders have also identified pikeminnow, Pacific lamprey, and green sturgeon as potential species for modeling. If other species / life stages are identified, the use of a guild approach will be investigated for application, if appropriate.
- Existing information (literature and qualified biologist observations) and pertinent study results (Study AQ 9 – Fish Populations) will be used to develop a life stage periodicity chart (i.e., season of occurrence) for the aquatic species / life stages.

Species and Life stage Habitat Suitability

- HSC for each selected species/life stage will be identified in collaboration with stakeholders. For fish species, HSC criteria will be identified using a two-stage approach. First, the existing HSC data used in the previous instream flow study (SEC 1998) will be evaluated. If the existing HSC are applicable, no modification of the HSC will be needed. If HSC need to be adjusted, they will be modified in collaboration with stakeholders.
- Water temperature HSC for juvenile steelhead will be developed using a combination of observed growth data, literature data, and bioenergetics (Hokanson et al. 1977; Kubicek 1977; Sullivan et al. 2000; Myrick and Cech 2001; USEPA 2003; Addley 2006) in collaboration with stakeholders.
- HSC for FYLF breeding and larval development (tadpoles) will be developed using habitat use information for eggs and tadpoles from existing studies (Kupferberg 1996; PCWA 2011; Bondi et al. 2013; Lind et al. 2016). HSC data will be developed in coordination with stakeholders and Study AQ 10 – Special-Status Amphibians and Aquatic Reptiles.

Instream Flow Modeling

Eel River 1D Physical Habitat Simulation (PHABSIM) Modeling

- Review the historical PHABSIM hydraulics modeling and cross-sections (VTN 1982; SEC 1998). Identify the number of water surface elevation measurements and the water surface modeling approach (Manning's equation, step-backwater model, stage-discharge). Update the water surface elevation hydraulics modeling approach, if appropriate. Evaluate the velocity modeling including the number of velocity data sets and the velocity modeling approach (velocity regression, single velocity set, or multiple velocity sets). Update the velocity modeling approach, if necessary.
- Determine the proper habitat weighting for PHABSIM transects using the geomorphic segments and the mesohabitat mapping.
- Remodel habitat versus flow relationships using the updated hydraulics modeling, habitat weighting, and species-specific HSC, as appropriate. Based on FERC's 2/15/2018 Study Plan Determination, if any historical transect having hydraulic data is replaced with a new transect, then the new transect will also have hydraulic data.
- Develop a habitat time-series analysis for each river segment using the habitat versus flow relationships and the Project hydrology scenarios (Study AQ 1 – Hydrology and Project Operations Modeling). For juvenile steelhead, incorporate water temperature into the time-series analysis (Study AQ 2 – Water Temperature).
- Run the PHABSIM model using new hydrology scenarios results (AQ-1) developed to reflect Scott Dam removal and modified Van Arsdale Diversion, and produce habitat time series analysis using the new hydrology and water temperature scenarios.
- Utilize 2-D hydraulic modeling sites developed under the FYLF instream flow study to evaluate habitat and productivity of juvenile salmonids in relation to streamflow.

Fish Stranding and Stage-Change / Ramping Rates

- At each of the instream flow transects and each of the Eel River gaging locations (Eel River below Scott Dam USGS Gage 11470500 and Eel River below Cape Horn Dam USGS Gage 11471500) develop stage-change versus flow-change relationships for a wide range of flows applicable to Project operations. Develop these rating curves in relation to the riffle crest thalweg elevation.
- Review the available fish stranding literature and natural ramping rates in the Project area and, in collaboration with stakeholders, identify stage-change ramping rate criteria for fish species for different mobile lifestages (e.g., adult, juvenile, fry).
- Identify hourly ramping rates (stage-change and flow-change) at the Project gages (Eel River below Scott Dam USGS Gage 11470500 and Eel River below Cape Horn Dam USGS Gage 11471500) for fish lifestages in the Project area below Cape Horn Dam to the Middle Fork Eel River based on criteria developed above. Incorporate accretion

hydrology in the analysis, as appropriate (see Study AQ 1 - Hydrology and Project Operations Modeling).

- As necessary, re-produce the fish stranding and stage change analysis from Cape Horn Dam to Middle Fork Eel River using new hydrology scenarios results (AQ-1) developed to reflect Scott Dam removal.

Effective Spawning Habitat

- Model effective spawning habitat at each instream flow study site using the PHABSIM model, a time series of hydrology (e.g., Study AQ 1 Hydrology and Project Operations Modeling), historical spawning periodicity information, and a time series of water temperature (Study AQ 2 Water Temperature at each site). For modeled Existing Conditions, determine the amount of spawning habitat each fall (Chinook salmon) and each winter (steelhead) that remains suitable from spawning through incubation and emergence (i.e., not scoured or dewatered). Use the spawning periodicity data and modeled water temperature data to identify the beginning of spawning and emergence each year based on developmental time for eggs. Use the hydrology data and the PHABSIM model to quantify effective habitat each year. Compare this to spawning habitat available upstream of Scott dam. Coordinate with stakeholders on the details of the modeling. Model alternative Project flow scenarios as part of PM&E discussions.
- Re-model the effective spawning habitat at each instream flow study site using the new hydrology scenarios with Scott Dam removal.
- Utilize 2-D hydraulic modeling at appropriate sites developed under the FYFL instream flow study to evaluate spawning habitat (and fish passage in AQ7) of adult salmonids in relation to streamflow.

Eel River Juvenile Out-Migration

- Use historical and updated data (see Study AQ 9 Fish Populations) to identify existing and potential future steelhead and Chinook salmon out-migration timing and associated cues in relation to time-of-year, hydrology, fish size/growth, and water temperature.
- Use historical and updated water temperature data to identify potential thermal barriers in the lower Eel River during juvenile outmigration (timing, location, flows, and meteorological conditions).
- Assess a time series of modeled Existing Project operations and future Project Operations hydrology and water temperature (Study AQ 1 Hydrology and Project Operations Modeling; Study AQ 2 Water Temperature) to identify out-migration environmental conditions. Also, evaluate unimpaired hydrology conditions over the time period that unimpaired water temperature data is available (2005–2016).

- Compare results of PHABSIM modeling with the Indicators of Hydrologic Alteration or equivalent analysis conducted as part of Study AQ 1 - Hydrology and Project Operations Modeling.

FYLF Habitat Modeling

- Select four Eel River FYLF breeding study sites (Study AQ 10 – Special Status Amphibians and Aquatic Reptiles; Map AQ 10-1) to model habitat versus flow and ramping rate relationships (i.e., co-locate the FYLF survey sites and modeling sites). Proposed sites are ER 166.4, ER 161.2, ER 157.9, and ER 153.0; however, sites may be modified based on coordination with stakeholders and field visits.
- Use the Habitat Suitability Criteria (HSC) developed in Study AQ 10 - Special-Status Amphibians and Aquatic Reptiles.
- Model habitat versus flow relationships over a range of flows applicable to the April/May breeding and early rearing season.
- Develop, calibrate, and run a 2D model to provide hydraulic input to the Foothill Yellow-legged Frog Assessment Model (FYFAM; Railsback et al. 2016), then run FYFAM for existing and future (with Scott Dam removal) hydrology and water temperature scenarios. A field visit will be coordinated with agency staff and other stakeholders to delineate the extent of each modeling site. For 2D modeling, collect three calibration water surface versus flow calibration data sets. Model the sites so bed topography, water surface elevation, and velocity are available over a wide range of flow applicable to Project hydrology to accomplish the following:
  - Determine which flows support breeding habitat and rearing habitat by modeling suitable depth, velocity, and substrate at the study sites over a wide range of flows.
  - Using FYFAM, assess the potential effects of seasonal flow changes (e.g., ramping rates) on breeding and rearing habitat and recruitment by considering timing of oviposition, stability of breeding/incubation habitat with changing flows, and the relationship between water temperature and growth/development.
  - Model effective breeding/rearing habitat at each site using the physical habitat model and FYFAM, a time series of hydrology (e.g., Study AQ 1 – Hydrology and Project Operations Modeling), and a time series of water temperature (Study AQ 2 – Water Temperature at each site). For modeled Existing Conditions, determine the amount of initial breeding habitat each spring that remains suitable through egg hatching (i.e., not scoured or dewatered) and early tadpole rearing. Use the modeled water temperature data to identify the beginning of breeding and the end of the effective habitat modeling time period each year based on developmental time for eggs and tadpoles. Use the hydrology data and the physical habitat model to quantify effective habitat each year. Coordinate with stakeholders on the details of the modeling. Also, evaluate unimpaired conditions over the time period that that

unimpaired water temperature data is available (2005-2016). Model alternative Project flow scenarios as part of PM&E discussions.

– Identify hourly and daily stage change and flow ramping rates that protect sensitive life stages (eggs, tadpoles, and metamorphs).

East Branch Russian River Minimum Flows

- Conduct a site visit during the summer to provide stakeholders with an opportunity to assess the adequacy of the minimum flows. Assess both summer and winter minimum flows during 2018. Collect qualitative data at the fish snorkeling study sites (Study AQ 9 – Fish Populations) to characterize pool depth and pool-to-pool connectivity at the minimum flow.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The proposed methodologies to generate instream flow information (e.g., habitat versus flow relationships) are widely used and accepted in the scientific and engineering communities. These methods have been used in other relicensing proceedings, including the previous relicensing of this Project, and are designed to meet the needs of the relicensing participants.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

This study will provide hydraulics modeling data that will be used in Study AQ 4 – Fluvial Processes and Geomorphology and Study AQ 10 – Special-Status Amphibians and Aquatic Reptiles. This study will use data from Study AQ 1 – Hydrology and Project Operations Modeling.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $687,000.

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STUDY AQ 7
Fish Passage

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Chinook salmon, steelhead, lamprey, and potentially Coho salmon passage/migration can be affected by Project operations.
- Impairment of migration at Cape Horn Dam.

PROJECT NEXUS

- Existing Project facilities and operations may affect fish passage/migration.
- Proposed changes to Project facilities and operations may affect fish passage/migration.

RELEVANT INFORMATION

The following information is available and was reviewed to determine fish passage study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.3 for a summary of fish passage information [PG&E 2017a]):

- Potter Valley Project (FERC Project No. 77) Fisheries Study (VTN 1982) (includes a summary of fish passage information below Scott Dam and fish habitat availability above Lake Pillsbury).
- Effects of Operations on Upper Eel River Anadromous Salmonids (SEC 1998) (includes a summary of fish passage information).
- Evaluation of Barriers to Pacific Lamprey Migration in the Eel River Basin (Stillwater Sciences 2014).
- Pacific lamprey passage research at Cape Horn Dam (Reid and Goodman 2016; Goodman and Reid 2017).
- U.S. Geological Survey (USGS) and PG&E gaging data.
- PG&E Annual Performance Reports (PG&E 2006–2017b).
- Academic studies of anadromous salmonid habitat above Lake Pillsbury (Cooper 2017, Cooper et al. 2020).
- Water temperature monitoring above Lake Pillsbury conducted by Native Fish Society in 2015 and 2016 (Native Fish Society 2017).

POTENTIAL INFORMATION GAPS

- An updated critical riffle analysis in the Eel River between Scott Dam and the confluence of the Middle Fork Eel River. The location and nature of fish passage barriers below Scott Dam may have changed since the VTN studies.
- Tributary access at river confluences affected by Project operations (Eel River from Scott Dam to the Middle Fork Eel River).
- Upstream and downstream anadromous fish species passage at Cape Horn Dam.
- Potential anadromous fish species habitat upstream of Scott Dam/Lake Pillsbury.
- Identification of potential means for providing upstream and downstream fish passage at Scott Dam/Lake Pillsbury.

PROPOSED STUDIES / ANALYSIS TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Convene a Fish Passage Technical Working Group
- Document the location, nature, and characteristics of potential critical riffle fish barriers in the Eel River between the Middle Fork Eel River and Scott Dam.
- Document tributary confluence access in the Eel River between the Middle Fork Eel River and Scott Dam.
- Characterize adult anadromous species upstream passage at Cape Horn Dam.
- Evaluate potential anadromous fish habitat upstream of Scott Dam/Lake Pillsbury.
- Evaluate improved upstream and downstream fish passage alternatives (including conceptual designs, costs and estimated efficacy) at Cape Horn Dam.

EXTENT OF STUDY AREA

The Study Area for AQ 7 – Fish Passage includes:

- Scott Dam, Lake Pillsbury, and anadromous salmonid habitat upstream of Lake Pillsbury.
- Eel River between Scott Dam and the Middle Fork Eel River confluence (including the Cape Horn Dam fish ladder and the Van Arsdale intake facilities).

The Study Area was expanded to include selected river reaches upstream of Lake Pillsbury to characterize potential anadromous fish habitat downstream of existing fish barriers.

STUDY METHODS AND ANALYSIS

Passage Technical Working Group

- Establish a fish passage technical working group composed of stakeholders knowledgeable in issues related to fish passage.

Critical Riffle Fish Passage

- Review and synthesize the extensive critical riffle analyses conducted previously on the Eel River between Cape Horn Dam and Outlet Creek confluence (VTN 1982; SEC 1998) (e.g., critical riffle locations, and passage evaluation methods and results) including migration timing windows and the accretion hydrology used in the analysis. Also, review the empirical data set at Hearst riffle that showed how salmonids traversed this riffle based on flow pattern/direction, the flow pattern below the riffle, and the depth of water on the riffle (VTN 1982).
- Reassess the location of critical riffles from Scott Dam to the Middle Fork Eel River. In coordination with stakeholders, select the most flow limiting critical riffles based on conditions at the riffle, accretion hydrology, and migration timing windows.
- Identify passage criteria for anadromous species (e.g., Chinook salmon, steelhead, Pacific lamprey, and potentially Coho salmon, as appropriate) in coordination with stakeholders, Study AQ 5 – Instream Flow, and results from Study AQ 9 – Fish Populations.
- Empirically map passage opportunities at the selected critical riffles over a range of flows applicable to migration timing windows and hydrology/accretions.
- Identify bypass flows below Cape Horn Dam necessary to provide riffle passage (incorporating accretion flows).

Tributary Confluence Fish Passage

- In coordination with stakeholders, identify important tributaries (relative to anadromous fish habitat) flowing into the Eel River from Scott Dam to the Middle Fork Eel River.
- Visit each tributary and identify any potential tributary access issues related to Eel River discharge based on the geomorphology at the tributary confluence (critical riffle or jump barrier passage issues).
- Evaluate tributary fish passage based on field visits and application of Powers and Orsborn (1985) methods, over a range of flows, applicable to Project operations, migration timing windows, and hydrology.
- In coordination with studies AQ 9 Fish Populations and AQ 1 Hydrology and Project Operations Modeling, use historical spawn timing, redd counts, and hydrology to

investigate the relationship between Tomki Creek flows and Eel River flows and the potential effects on Chinook salmon access to Tomki Creek, migratory behavior, and spawning distribution.

Adult Anadromous Species Upstream Passage at Cape Horn Dam

Review and Characterize Adult Anadromous Salmonid Passage

- Review and synthesize the upstream adult passage telemetry studies at the Cape Horn Dam Fish Ladder post-1987 ladder modifications (SEC 1989, 1990, 1998).
- Identify and evaluate issues related to functionality of the Cape Horn Dam fish ladder for adult anadromous salmonids (e.g., operational flow ranges in the fish ladder, attraction flows, sediment issues in the ladder following high flow events).
- Characterize the existing fish ladder and compare to current NMFS and CDFW fish ladder design criteria, including the entrance, exit, and ladder pools (hydraulic drop, flow depth, pool dimensions, pool volume, freeboard, orifice dimensions, lighting, and change in flow direction).
- Review operational records and interview CDFW and PG&E staff related to Cape Horn Dam fish ladder operations. Synthesize records and information obtained from interviews.
- Evaluate improved upstream and downstream fish passage alternatives (including conceptual designs, costs, and estimated efficacy) at Cape Horn Dam in collaboration with the fish passage technical working group. Designs will consider potential short-term and long-term effects of Scott Dam removal and associated changes to sediment supply on Cape Horn Dam fish ladder. Designs considerations will include consideration of working under extreme sediment and woody debris loads.

Review and Characterize Pacific Lamprey Passage

- Review and synthesize recent work and experiments at the Cape Horn Dam Fish Ladder relative to providing Pacific lamprey passage (ladder modification, PVC pipe bypass, etc.) (Reid and Goodman 2016, Goodman and Reid 2017).
- Evaluate improved upstream and downstream fish passage alternatives (including conceptual designs, costs, and estimated efficacy) for providing permanent Pacific lamprey passage at Cape Horn Dam in collaboration with the fish passage technical working group. Designs will consider potential short-term and long-term effects of Scott Dam removal and associated sediment supply on Cape Horn Dam fish ladder. Designs considerations will include consideration of working under extreme sediment and woody debris loads.

Downstream Juvenile Anadromous Fish Passage at Cape Horn Dam

- Review and synthesize timing of downstream juvenile migration and flow ranges using historical data (VTN 1982; SEC 1998).

Anadromous Fish Habitat Upstream of Lake Pillsbury

- Review and synthesize existing information related to natural and man-made anadromous fish passage barriers and habitat upstream of Lake Pillsbury (VTN 1982; CDFW habitat assessment reports; Cooper 2017).
- Identify fish passage data (e.g., barriers) on the Eel River, Rice Fork, and/or tributary streams that require verification or data gaps that should be addressed (e.g., missing information on particular tributary streams) and field verify upstream passage barriers and data gaps, as appropriate.
- Summarize existing water temperature monitoring data in the Eel River, Rice Fork, and associated tributaries above Lake Pillsbury below anadromous fish barriers to assist in identification of potential anadromous species habitat. If data gaps exist, coordinate with stakeholders to obtain supplemental information using a few strategically placed temperature probes (thermographs) to monitor temperature from May to October. This study will coordinate with Study AQ 2 – Water Temperature, as appropriate.
- Use high-resolution aerial photography and GIS to map gravel deposits and LWD downstream of barriers. Use field validation at fish snorkeling locations to verify /correct mapping. This study will coordinate with the gravel/LWD mapping being conducted downstream of Lake Pillsbury in Study AQ 4 – Fluvial Processes and Geomorphology
- Synthesize components of potential anadromous habitat upstream of Lake Pillsbury with respect to passage barriers, spawning gravel/LWD, water temperature, and pikeminnow distribution, to estimate/verify available anadromous fish species habitat.
- Using the amount of potential anadromous habitat (stream length) upstream of Lake Pillsbury for adult Chinook salmon, steelhead, and Pacific lamprey and estimate the total amount of potential marine derived nutrients (e.g., annually).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The proposed methodologies to evaluate fish passage at the Project are widely used and accepted in the scientific and engineering communities. These methods have been used in other relicensing proceedings, including previous relicensing studies related to this Project, and are designed to meet the needs of the relicensing participants.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

This study will coordinate, as appropriate, with three other studies: Study AQ 2 – Water Temperature, Study AQ 4 – Fluvial Processes and Geomorphology, Study AQ 9 – Fish Populations, and Study AQ 12 – Scott Dam Removal.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $557,000.

REFERENCES

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STUDY AQ 8
Fish Entrainment

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Fish mortality or translocation associated with flow diversion, intake structures, or powerhouse facilities.

PROJECT NEXUS

- Existing Project diversions could result in non-lethal or lethal entrainment of fish species.
- Proposed changes to Project facilities and operations could affect fish entrainment.

RELEVANT INFORMATION

The following information is available and was reviewed to determine entrainment study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.3 for a summary of entrainment information [PG&E 2017a]):

- Potter Valley Project (FERC No. 77) Fisheries Study (VTN 1982) (includes a summary of historical entrainment information).
- Effects of Operations on Upper Eel River Anadromous Salmonids (SEC 1998) (includes a summary of historical entrainment information).
- Potter Valley Fish Screen Testing (SEC 1996) (includes test results for the new screens).
- Van Arsdale Fish Screen Annual Reports (PG&E 2011–2015, 2016a, 2017b).
- Van Arsdale Fish Screen Operations Plan Including Emergency Fish Screen Plan (PG&E 2016b).
- Threshold Effects of Electric Voltage Gradients on Fish: A Literature Review for a Proposed Cathodic Protection System for the Van Arsdale Fish Screen Project (Burger et al. 2016).

POTENTIAL INFORMATION GAPS

- Synthesis of existing information related to the potential for fish entrainment.
- Comparison of the current Van Arsdale fish screen operational specifications to current fish screening criteria.
- Potential effects of revised diversion patterns on potential fish entrainment risk at Van Arsdale Diversion.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Use information from historical reports (e.g., fish screen test reports and annual fish screen reports) and ongoing implementation of the Van Arsdale Fish Screen Operations Plan to characterize the potential for fish entrainment during operation and maintenance of the Van Arsdale Diversion.
- Characterize the Van Arsdale Fish Screen operational specifications and compare to current fish screening criteria.
- Evaluate revised diversion patterns (seasonal diversions based on the results of Study AQ 1 – Hydrology and Study AQ 5 – Instream Flow), on potential fish entrainment risk at Van Arsdale Diversion.

EXTENT OF STUDY AREA

The Study Area includes Van Arsdale Fish Screens and Van Arsdale Reservoir in the vicinity of the screens.

STUDY METHODS AND ANALYSIS

Considerable historical and recent data exist to characterize potential fish entrainment at the Van Arsdale Fish Screen. These data are briefly summarized in Section 5.3.6.3 Fish Entrainment in the PAD (PG&E 2017a), and the reports from which the data originate are cited. In addition to the historical entrainment data, annual fish screen operation reports are submitted each year to the Federal Energy Regulatory Commission (FERC) (draft reports are submitted to National Marine Fisheries Service [NMFS], California Department of Fish and Wildlife [CDFW], U.S. Fish and Wildlife Service [USFWS] and Round Valley Indian Tribes [RVIT] for comment prior to submittal) (PG&E 2011–2015, 2016a, 2017b).

Additional data syntheses and analyses of the historical and current operations data will be conducted to augment existing understanding of potential entrainment. In addition, the fish screen will be evaluated and compared to current fish screening criteria.

Historical and Recent Data Synthesis

- Identify fish distribution, timing, and abundance near the fish screen (see Study AQ 9 – Fish Populations).
- Synthesize the Van Arsdale Diversion entrainment information in historical reports with respect to fish timing, species, entrainment, mortality, and operations (VTN 1982, SEC 1998, CDFW unpublished data, and associated annual reports, PG&E 2011–2015, 2016a, 2017b).

- Summarize the existing fish screen operations plan and emergency fish screen plan with respect to existing and future potential for entrainment (PG&E 2016b).

Screen Evaluation

- Characterize the Van Arsdale Fish Screen approach velocity, sweeping velocity, screen face material, fish bypass (entrance, conduit, and outflow), and operation and maintenance of the fish screen, and compare to the current NMFS and CDFW fish screening criteria. Coordinate with NMFS engineers regarding the screen evaluation.
- Characterize other potential Van Arsdale Fish Screen issues, for example, cathodic protection system and its electric field, screen framework and seals, and algae buildup.
- Evaluate diversion patterns (seasonal diversions based on the results of Study AQ 1 – Hydrology and Study AQ 5 – Instream Flow), on potential fish entrainment risk at Van Arsdale Diversion utilizing a 2-D hydraulic model developed in Study AQ 12 – Scott Dam Removal Assessment.
- The results of the fish screen evaluation will be used to inform design of the modified Van Arsdale Diversion.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies listed here are consistent with generally accepted scientific and engineering principles and practice.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

The fish entrainment study described in this plan relies on existing data, reports, and data synthesized in Study AQ 9 – Fish Populations and will also utilize a 2-D hydraulic model developed in Study AQ 12 – Scott Dam Removal Assessment.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $62,000.

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STUDY AQ 9
Fish Populations

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Fish species composition, distribution, timing, and abundance.
- Sacramento pikeminnow predation.

PROJECT NEXUS

- Existing Project operations modify the flow and temperature regimes and fish habitat in the river reaches (Eel River from Scott Dam to Van Arsdale Reservoir, Eel River from Cape Horn Dam to Middle Fork Eel River, and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino).
- Existing Project operations modify Lake Pillsbury water surface elevations and water temperatures and may affect coldwater and warmwater fish habitat availability.
- Proposed changes in Project facilities and operations would modify fish habitat in Lake Pillsbury and may affect river reaches downstream.

RELEVANT INFORMATION

The following information is available and was reviewed to determine fish population study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.3 for a summary of fish population information [PG&E 2017a]):

- Summary of fish resource studies and historical population monitoring in the Eel River 1979–1982 (VTN 1982).
- Summary of fish resource studies and historical population monitoring 1985–1996 (SEC 1998).
- Historical and current annual fish counts conducted by the California Department of Fish and Wildlife (CDFW) at Van Arsdale Fisheries Station.
- Ongoing annual fish monitoring conducted by PG&E since 2005, which includes:
  - Sacramento pikeminnow monitoring and suppression (PG&E 2005a-2016a, 2017b, 2020a).
  - Summer fish rearing monitoring (PG&E 2005b-2016b, 2017c).
  - Chinook salmon carcass surveys (PG&E 2004, 2006c-2016c, 2017d).
- Studies estimating anadromous fish habitat upstream of Scott Dam and Lake Pillsbury (VTN 1982; Cooper 2017).

- National Marine Fisheries Service (NMFS) Final Coastal Multispecies Recovery Plan (NMFS 2016);
- Eel River Action Plan (Eel River Forum Members 2016);
- Steelhead Restoration and Management Plan for California (CDFW 1996); and
- Status, Distribution, and Population of Origin of Green Sturgeon in the Eel River: Results of 2014-2016 Studies (Stillwater Sciences and Wiyot Tribe 2017).

POTENTIAL INFORMATION GAPS

- Synthesis of fish population data sets, including results of ongoing monitoring, in the Eel River between Scott Dam and the Middle Fork Eel River.
- Fish populations in Lake Pillsbury and the East Branch Russian River.
- Pikeminnow distribution and relative abundance upstream of Lake Pillsbury.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Use the extensive fish population data sets, including results of ongoing monitoring, to characterize fish species composition, distribution, timing, and abundance (including trends over time) in the Eel River between Scott Dam and the Middle Fork Eel River.
- Synthesize information on Sacramento Pikeminnow (and other non-native predatory fish) predation hotspots, suppression techniques, life history, habitat requirements, and distribution to inform development of population suppression and Project operation strategies that reduce impacts on native aquatic species.
- Evaluate the distribution and relative abundance of pikeminnow upstream of Lake Pillsbury.
- Characterize fish species composition, relative abundance, and size in Lake Pillsbury by use of gillnets, electrofishing, and/or minnow traps. Fish collected during this sampling effort will also be used for fish tissue mercury analysis in Study AQ 3 – Water Quality.
- Characterize fish populations in the East Branch Russian River between the Potter Valley Powerhouse and Lake Mendocino, using snorkeling or electrofishing.
- Integrate historical fish population data, new fish population data, and other ecological data, analyses, and tools developed as part of the relicensing studies (hydrology, water temperature, water quality, geomorphology, instream flow, fish passage, entrainment) into a conceptual life cycle model and analysis framework to identify limiting factors,

formulate and compare alternative operations scenarios, and develop protection, mitigation, and enhancement (PM&E) measures.

EXTENT OF STUDY AREA

The fish populations Study Area includes the following Project-affected reaches and reservoirs:

- Eel River between Scott Dam and the Middle Fork Eel River confluence (including Van Arsdale Reservoir, which is primarily riverine in character).
- East Branch Russian River between Potter Valley Powerhouse and the ordinary high water mark of Lake Mendocino.
- Lake Pillsbury.

The Study Area was expanded to include an analysis of predatory fish upstream of Lake Pillsbury below anadromous fish barriers, and available fish data from lower in the Eel River, as applicable to the Project.

STUDY METHODS AND ANALYSIS

Ongoing Potter Valley Project Monitoring Studies

The following ongoing Project monitoring by PG&E will continue through relicensing as part of the Federal Energy Regulatory Commission (FERC) license and/or the NMFS Biological Opinion requirements.

- **Sacramento Pikeminnow Monitoring and Suppression.** Sacramento pikeminnow monitoring will be conducted annually during late summer by raft electrofishing at established sites in the Eel River between Scott Dam and Cape Horn Dam according to the *Pikeminnow Adaptive Management and Suppression Operation Plan*and may be modified through consultation with NMFS (PG&E 2005a-2016a, 2017b). After being suspended from 2017–2018, targeted efforts to remove pikeminnow and other non-native predators from (1) reaches of the Upper Eel River between Scott Dam and Van Arsdale Reservoir, (2) Van Arsdale Reservoir, and (3) the pool below Cape Horn Dam were reinitiated in 2019 and 2020 (PG&E 2020a).
- **Summer Fish Rearing Monitoring.** Summer fish rearing monitoring will be conducted annually in late summer by backpack electrofishing and snorkeling at established sites in the mainstem Eel River between Cape Horn Dam and the Middle Fork Eel River according to the *Summer Rearing Monitoring Plan* and may be modified through consultation with NMFS (PG&E 2005b-2016b, 2017c).
- **Chinook Salmon Carcass Surveys.** Chinook salmon carcass surveys will be conducted annually in the fall/winter at one index section in the upper mainstem Eel River and five index sections in the Tomki Creek drainage according to the *Salmon*

Carcass Surveys and Stock Rescue Program Funding and Implementation Plan (PG&E 2004, 2006c-2016c, 2017d).

- **Fish Counts at Van Arsdale Fisheries Station.** Adult fish counts at the Van Arsdale Fisheries Station will be performed and reported according to the *Annual Performance Reporting Plan* (PG&E 2006d-2016d, 2017e, 2006e).

Eel River Fish Species Composition, Distribution, Timing, and Abundance Synthesis

Considerable historical and recent data exist to characterize the fish populations in the Eel River between Scott Dam and the Middle Fork Eel River confluence (including Van Arsdale Reservoir, which is riverine in character). These data are compiled and summarized in Section 5.3.2 and Section 5.3.4.2 of the PAD, and the numerous reports from which the data originate are cited. However, additional data syntheses and analyses will be conducted to augment existing understanding of species composition, distribution, timing, and abundance (including trends over time). The analyses and syntheses will focus on fish species of interest —summer-run and winter-run steelhead, Chinook salmon, Pacific lamprey, Sacramento pikeminnow, and, where applicable, Coho salmon and green sturgeon. The analyses and syntheses will use the current recovery plan for context and will include:

- Distribution. Develop a distribution map for steelhead, Chinook salmon, Pacific lamprey, Sacramento pikeminnow, Coho salmon, and green sturgeon by life stage and life history (e.g., summer and winter run steelhead), primarily focused in the upper Eel River basin upstream of the Middle Fork, including tributaries. Develop maps in context of the current recovery plan. Identify, if possible, locations where pikeminnow and salmonids do not overlap. These maps will be developed based on existing information and in consultation with knowledgeable fisheries biologists and stakeholders.
- Timing. Develop life history timing tables (e.g., life history chronology chart by month) and narrative for steelhead, Chinook salmon, Pacific lamprey, Sacramento pikeminnow, Coho salmon, and green sturgeon in the mainstem Eel River Study Area based on available literature, data from the upper Eel River watershed, and consultation with knowledgeable fisheries biologists and stakeholders.
- Abundance. Compile available Van Arsdale Fisheries Station adult count data for Chinook salmon, steelhead, Pacific lamprey, and Coho salmon in consistently formatted tables and figures, and conduct analyses of trends in abundance over time to better understand factors affecting population status in the upper Eel River. Also, synthesize all years of consistently collected data from Chinook salmon carcass surveys in index reaches of the Eel River and Tomki Creek (PG&E 2017d) to help assess population trends in the upper Eel River watershed.

  Create tables and figures that synthesize all years of fish density data (fish/kilometer) for juvenile steelhead and pikeminnow (and other species) from summer surveys at

sites and reaches both above and below Cape Horn Dam and conduct associated analyses of trends in abundance over time. This synthesis may require obtaining the raw data or entering data from available report tables. The primary data sources for this task are from ongoing annual monitoring conducted by PG&E, in particular: (1) annual Sacramento pikeminnow monitoring in the Eel River between Scott Dam and Cape Horn Dam (PG&E 2017b); and (2) summer fish rearing monitoring in the Eel River between Cape Horn Dam and the Middle Fork Eel River (PG&E 2017c).

Correlate trends in salmonid species abundance with trends in pikeminnow abundance.

- Age Structure. Describe the age-structure of juvenile steelhead by reach and by sample site using length frequency data from summer surveys and other existing information. The primary data sources for this task are: (1) annual Sacramento pikeminnow monitoring in the Eel River between Scott Dam and Cape Horn Dam (PG&E 2016a); and (2) summer fish rearing monitoring in the Eel River between Cape Horn Dam and the Middle Fork Eel River (PG&E 2016b).
- Stocking. Summarize historical fish stocking and current practices in the upper Eel River.
- Creel Census. Summarize historical creel census information for the upper Eel River.

Pikeminnow (and other Predatory Fish) Suppression and Predation Hotspots

- The Notice of Intent (NOI) Parties propose to continue convening a Predatory Fish Working Group to review and identify potentially viable and cost-effective suppression techniques for pikeminnow and other non-native predatory fish populations in the upper Eel River. This group would provide input on and discuss the summary of information on predatory fish suppression techniques (decribed below). The group would also review and provide input on the pikeminnow conceptual model (described below).
- Summarize information on predatory fish suppression techniques, effectiveness, and cost relevant to non-native species in the upper Eel River watershed. The review will include information obtained through the Predatory Fish Working Group meetings, PG&E's ongoing pikeminnow monitoring and suppression efforts, and other non-predatory fish removal efforts in the Eel River basin and region.
- Snorkel locations of potential pikeminnow predation "hotspots" (or other predatory species) in the vicinity of Van Arsdale Reservoir facilities (fish screen, fish ladder, Cape Horn Dam), and identify if concentrations of predatory species exist. Snorkel as soon as water clarity allows in the late spring/early summer (i.e., as close to the juvenile outmigration time period as possible).
- Review literature related to turbidity and predation success by pikeminnow and bass.

- Develop a conceptual model that integrates life history, habitat requirements, and distribution of non-native pikeminnow with those of salmonids, Pacific Lamprey, and Sacramento Suckers to identify prey vulnerabilities and predator hot spots to inform effective suppression. The model will draw from relevant information compiled in the *Eel River Fish Species Composition, Distribution, Timing, and Abundance Synthesis* task and integrate information collected through this study (i.e., pikeminnow hotspot surveys, turbidity review, and distribution surveys upstream of Lake Pillsbury), input from the Predatory Fish Working Group, and relevant scientific literature.

Pikeminnow (and other Predatory Fish) Distribution and Relative Abundance Upstream of Lake Pillsbury

- Identify the distribution and relative abundance of pikeminnow in tributaries upstream of Lake Pillsbury based on snorkeling at selected locations downstream of existing fish barriers. Identify locations where pikeminnow and salmonids do not overlap. Snorkeling will be qualitative to identify distribution; however, at two representative snorkeling locations in the Eel River and two in the Rice Fork, snorkeling will include estimates of the number and size of pikeminnow (and other species) in pools (e.g., 2 pools at each site, 8 pools total) to provide qualitative estimates of predation potential. The sampling locations will be identified following barrier assessment.

Lake Pillsbury Fish Species Composition, Relative Abundance, and Size

- Characterize fish species composition, relative abundance, and size in Lake Pillsbury by use of gillnets, electrofishing, and/or minnow traps.
- Lake Pillsbury will be sampled once during the late summer using variable mesh gillnets at four sampling locations (including sampling locations in the Eel River and Rice Fork arms of the reservoir). Two nets will be placed vertically or sloping along the gradient of the reservoir bottom, depending on the depth of water, at each sampling location. The sampling locations will be distributed along the length of the reservoir and in the main arms of the reservoir with the goal of sampling both deep water and littoral zone habitats. If possible, historical CDFW sampling sites and methods will be included. In general, nets will be set in the afternoon of one day, and retrieved and processed the morning of the following day. Fish will be enumerated, weighed, and measured (fork length). Where possible, wild and hatchery trout will be differentiated/identified based on fin wear. Fin clips of 30-50 wild trout will be collected and preserved in ethanol (80-95%) for potential genetic analysis.
- Conduct shoreline electrofishing (1 night) and trapping (10 minnow traps set for 24/hr each) along the reservoir edge habitat to identify and enumerate small species and/or young-of-the-year fishes. Sampling will be conducted in coordination with gillnetting (late summer).
- Collect fish for mercury fish tissue testing as identified in Study AQ 3 – Water Quality.

- Summarize historical fish stocking and current stocking practices in Lake Pillsbury.
- Summarize historical creel census information for Lake Pillsbury.

Van Arsdale Reservoir

- General fish sampling is not proposed in Van Arsdale Reservoir (however see Predation Hotspot sampling above). Van Arsdale Reservoir is riverine in character, and the assessment of fish populations will be completed as part of the Eel River analysis/synthesis described above.

East Branch Russian River Fish Population Characterization

The species composition, distribution, and relative abundance of the fish community in the East Branch Russian River between Potter Valley Powerhouse and high-water mark of Lake Mendocino will be characterized primarily using snorkel surveys as described below.

- The approximately 11-mile study reach is comprised of two sub-reaches with different geomorphic channel characteristics (e.g., channel gradient and confinement). The upper sub-reach encompasses Potter Valley where the channel is relatively low-gradient and within an unconfined valley. The lower sub-reach encompasses the channel between Potter Valley and Lake Mendocino and is of higher gradient and within a confined valley. Fish population sampling locations will be selected using a spatially stratified sampling approach.
- One spatially stratified site will be selected for conducting habitat type classification and snorkel surveys in each sub-reach, for a total of two sites. Sites will be selected in consultation with the resource agencies. Each site will include habitat that is representative of the larger sub-reach. Site locations will take into account potential access constraints related to private property and other limitations. The lengths of snorkel study sites will be approximately 200 to 250 meters, with the exact length depending on length, type, and frequency of habitat units. Global Position System (GPS) coordinates will be recorded at the upstream and downstream end of each study site.
- Habitat units will be delineated using habitat types described in CDFW's California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2010). Habitat units will be classified as main- or off-channel habitat and delineated based on the CDFW Level IV habitat types; however, for presenting snorkeling results, habitat units will be based on CDFW Level II habitat types (pool, riffle, and flatwater).
- Snorkeling will be conducted in a single-pass during the daytime in the early fall, when releases from the Potter Valley Powerhouse are expected to be relatively low and young-of-year fish are visually identifiable, and before the first significant rainfall events. A three-person field crew, including two snorkelers and one note-taker/safety-observer will conduct snorkel surveys. Each habitat unit will be systematically surveyed in the

downstream to upstream direction, with snorkelers generally staying in evenly-spaced "lanes" and communicating as needed to avoid double-counting or miscounting fish. Habitat units too shallow to effectively sample using snorkeling will be omitted. Fish will be identified to species where possible, counted, and assigned to 50-millimeter (mm) length categories (e.g., ≤50 mm, 51–100 mm, 101–150 mm, etc.). Numbers of fish of each species observed in each length category will be tallied separately for each habitat unit surveyed. Very small fish that cannot be identified to species will be recorded as fry within family. Maximum sight distance for accurate identification of fish species will be estimated and recorded at each study site. The time of the survey, water temperature, and air temperature will be measured and recorded at each site prior to snorkeling. All data will be recorded on a standardized snorkel survey data form including GPS location.

General Procedures

- Field data will be entered into an Excel spreadsheet for reduction, tabulation, and summary. All field data will be reviewed by the field lead after the survey, and all data entry will be reviewed for quality control. Analyses will include quantifying and describing fish species composition and distribution by size class for each habitat type, site, and sub-reach. If warranted, length-frequency histograms will be developed for fish species of interest.
- To minimize the potential spread of invasive species (e.g., New Zealand Mud Snail [NZMS], quagga/zebra mussel, Chytrid fungus), appropriate decontamination protocols will be followed prior to each aquatic-based field effort or moving between watersheds. Procedures may include, but will not be limited to, freezing or soaking of all field gear (including waders, boots, wetsuits) with a commercial Formula 409® cleaner, spraying equipment with a bleach and water solution, and inspecting all field equipment (including boats). To minimize the spread of weed species during field activities, applicable measures, including inspection and cleaning of clothing and vehicles, will be conducted to reduce the potential for the spread of invasive plants.

Conceptual Life Cycle Model and Analysis Framework for Anadromous Salmonids

- A technical working group comprised of relicensing participants with anadromous salmonid life cycle and ecological analyses expertise will be formed to collaborate on the conceptual life cycle model and analysis framework.
- The conceptual life cycle model and analysis framework will be designed to integrate historical fish population data (e.g., abundance trends, timing), new fish population data (e.g., escapement data, habitat upstream of Lake Pillsbury), and other ecological data, analyses, and tools developed as part of the relicensing studies (hydrology, water temperature, water quality, geomorphology, instream flow, fish passage, entrainment) to identify life stage specific limiting factors, formulate and compare alternative operations scenarios, and develop PM&E measures.

- The conceptual life cycle model and analysis framework integration tools must be ready for use within the relicensing timeframe, be based on tools developed as part of the relicensing studies, and be focused on best available science related to factors within the Project's control.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies listed here are consistent with generally accepted scientific and engineering principles and practice, including CDFW protocols in CDFW's California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2010) and snorkeling methods in O'Neal (2007).

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

- Fish collected in this study will be used in Study AQ 3 – Water Quality for analyzing mercury concentrations in fish tissue.
- The distribution and relative abundance of pikeminnow in tributaries upstream of Lake Pillsbury will be evaluated in Study AQ 7 – Fish Passage.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $375,000.

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STUDY AQ 10
Special-Status Amphibians and Aquatic Reptiles

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Special-status amphibians and aquatic reptiles, and their habitat.

PROJECT NEXUS

- Project operations and maintenance activities could result in direct and indirect effects on special-status amphibians and aquatic reptiles, and their habitat.
- For foothill yellow-legged frog (FYLF), flow conditions in the river reaches (Eel River from Scott Dam to Van Arsdale Reservoir, Eel River from Cape Horn Dam to Middle Fork Eel River, and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino) could affect habitat availability and suitability for all life stages. Project operations that result in flow fluctuations could create changes in water stage and velocity that may scour or strand egg masses and tadpoles. Water temperature regimes downstream of Project facilities could alter the timing of breeding, subsequent tadpole development and growth rates, and survival to metamorphosis.
- For western pond turtle (WPT), flow conditions in the river reaches (Eel River from Scott Dam to Van Arsdale Reservoir, Eel River from Cape Horn Dam to Middle Fork Eel River, and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino) and water surface elevations in Lake Pillsbury could affect habitat availability and suitability. Water temperature regimes downstream of Project facilities could alter growth rates and the size/age structure of the WPT population.
- Proposed changes in Project facilities and operations (hydrology and channel morphology) could affect special-status amphibian and aquatic reptiles from Lake Pillsbury to Van Arsdale Reservoir and Cape Horn Dam to Middle Fork Eel River.

RELEVANT INFORMATION

The following information is available and was reviewed to determine special-status amphibian and aquatic reptile study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.3 for a summary of special-status amphibian and aquatic reptile information [PG&E 2017]):

- California Freshwater Species Database.
- California Natural Diversity Database (CNDDB 2016).
- University of California Museum of Vertebrate Zoology database (UCMVZ 2016).
- 1995 Aquatic Amphibian Surveys, MNF (Fellers 1996 and pers. comm. with Pat Kleeman, USGS).

- Incidental observations of amphibians and aquatic reptiles in the Project vicinity.
- Breeding surveys conducted in the Eel River between Scott Creek confluence and upstream end of Van Arsdale Reservoir (Catenazzi and Kupferberg 2013).

POTENTIAL INFORMATION GAPS

- Distribution of FYLF and WPT in Project reservoirs and river reaches.
- Timing and length of breeding and rearing season for FYLF in the river reaches.
- Effects of flows on FYLF and WPT habitat availability.

POTENTIAL STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Identify and map potential habitat for FYLF in the affected Project reaches.
- Document the distribution and abundance of FYLF populations in the affected river reaches.
- Document the timing and length of FYLF breeding season, where FYLF are present.
- Characterize the habitat (water stage, velocity, and temperature) at various flow regimes as it relates to FYLF habitat through coordination with Study AQ 5 – Instream Flow and Study AQ 2 – Water Temperature.
- Document the presence of WPT in the affected Project reaches.
- Characterize the habitat (e.g., water temperature) at various flow regimes as it relates to WPT habitat through coordination with Study AQ 2 – Water Temperature and Study AQ 4 – Fluvial Processes and Geomorphology.

EXTENT OF STUDY AREA

The Study Area for FYLF and WPT includes the following:

- Eel River and tributary confluences from Lake Pillsbury to the Middle Fork Eel River confluence, including two comparison sites above Lake Pillsbury.
- East Branch Russian River from the Potter Valley Powerhouse to Lake Mendocino.
- The Study Area for WPT also includes off-channel ponds and wetlands that may be present around Project facilities where maintenance activities occur and in Lake Pillsbury and Van Arsdale Reservoir near Project facilities.

STUDY METHODS AND ANALYSIS

The study approach for each species is provided below.

Foothill Yellow-legged Frog (FYLF)

Study Sites

- To assess the distribution and abundance of FYLF breeding populations, 1-kilometer representative study sites were selected that provide spatial coverage of the Study Area. Map AQ 10-1 and Table AQ 10-1 show the locations of proposed study sites. Study sites include historically occupied locations, general locations representative of project-affected river reaches, and unregulated reference locations (i.e., non-Project affected reaches). Study sites were selected at the confluences of accessible perennial tributaries across a range of watershed sizes (areas) because populations of FYLF in the greater Eel River basin are geographically centered and genetically structured around tributaries (Kupferberg 1996, Dever 2007). Furthermore, breeding population size is in large part determined by the upstream drainage area (Catenazzi and Kupferberg 2013; Catenazzi and Kupferberg 2017), so a range of tributary sizes was included.
- Based on initial review of the study sites, discussions with resource agencies, and mapping of FYLF habitat, the location of proposed study sites may be modified.
- Incidental/qualitative FYLF (and WPT) observations will be recorded during other studies (Study AQ 2 – Water Temperature, Study AQ 3 – Water Quality, Study AQ 4 – Fluvial Processes and Geomorphology, Study AQ 5 – Instream Flow, Study AQ 7 – Fish Passage, Study AQ 9 – Fish Populations, and Study AQ 11 – Special-Status and Invasive Aquatic Mollusks).

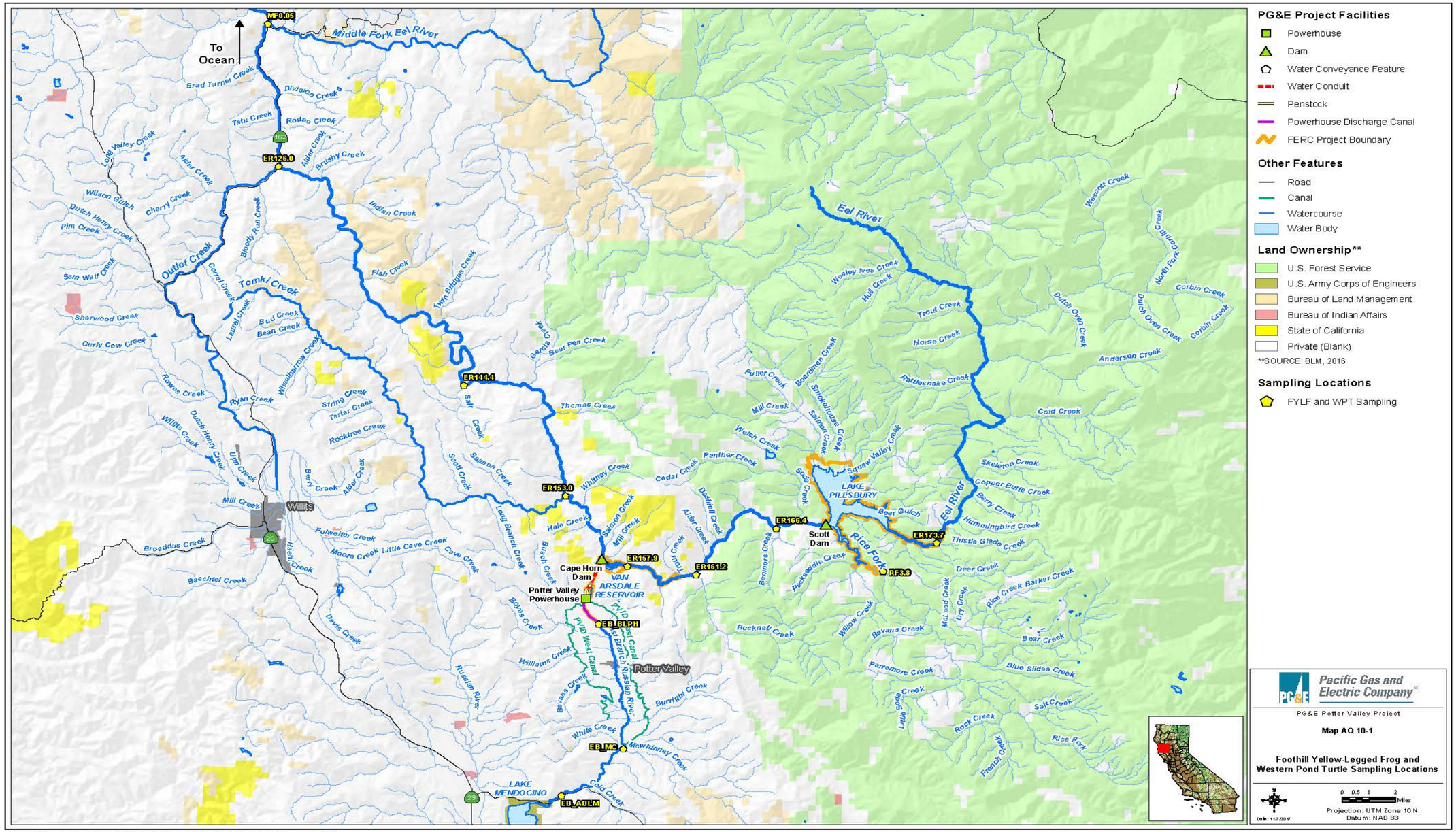
Habitat Characterization

- Identify and map potential breeding and rearing habitat for FYLF in the river reaches based on review of aerial photography and/or an aerial flight. Potential breeding and rearing habitats are defined as:
  - Breeding Habitat – Shallow, near-shore areas of low velocity with cobble/boulder substrate in open, sunny areas with little riparian vegetation; often adjacent to low gradient cobble/boulder bars, tributary confluences, side and backwater pools, or pool tail-outs with coarse substrates.
  - Rearing Habitat – Similar to breeding habitats early in the season; but tadpoles may distribute to shallow, warm, low-velocity near-shore habitats with smaller substrate as the season progresses, or persist in isolated sidepools that remain wet through the summer.
- Complete a habitat characterization of the study sites and comparison sites (see Map AQ 10-1) in the field during distribution and abundance surveys. Characterization will include gathering information on the presence of predators (native and non-native), and assessing thermal suitability. This information will be used to extrapolate observed habitat conditions to potential habitats identified from aerial photography and/or aerial flights.

- Following completion of habitat mapping, develop a Geographic Information System (GIS) map of potential FYLF habitat.

Distribution and Abundance Surveys

- Identify and map known occurrences of FYLF within the Study Area based on agency consultation and a review of existing information. Interview biologists that were historically or are currently active in the area (e.g., on-going fish sampling) and identify areas where FYLF are typically observed.
- Monitor for initiation of breeding in the Project area, and when breeding has commenced, conduct two surveys for breeding in the spring (adults congregated at breeding sites, egg masses, and/or hatched larvae) at each study site (Map AQ 10-1 and Table AQ 10-1). Conduct one survey for metamorphosed young-of-the-year (YOY) in late summer/early fall at each study site. At a subset of four study sites along the water temperature gradient that exists in the Eel River from Scott Dam to Tomki Creek (ER166.4, ER161.2, ER157.9, ER153.0), visit the sites during early summer and qualitatively identify if tadpole growth and abundance trends exist related to water temperature.
- Prior to breeding, install temperature data loggers in the thalweg and in representative channel margin breeding areas at the study sites. Maintain the temperature loggers through the end of the late summer/early fall surveys.
- Surveys will follow the general Visual Encounter Protocol described in Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians (Heyer et al. 1994; Appendix AQ 10-A) as well as modifications developed specifically for FYLF (Seltenrich and Pool 2002, Kupferberg et al. 2012). Surveyors will follow United States Fish and Wildlife Service (USFWS) decontamination guidelines (USFWS 2005 [Appendix B]). Specifically, two surveyors will search stream banks, back channel areas, and potential instream habitats for FYLF progressing in a slow, methodical fashion. To aid in the detection of eggs and tadpoles, surveyors will use a viewing box in shallow margin areas and snorkel in deeper water where needed and possible. During surveys, a minimum of 1,000 meters (m) will be covered to identify the alluvial surfaces likely to be utilized for breeding. For sites located at tributary confluences, a minimum of 1,000 m will be surveyed in the mainstem as well as 1,000 m up the tributary where possible. Data to be collected during each survey includes:
  - Sampling Site: time of survey (start, end, and total search effort), GPS locations (start and end), weather conditions, and water and air temperatures (at start, mid-day, and end of survey) in both the channel margin and main channel; and Observation: number, lifestage, gender, size, habitat characteristics, and GPS location.



Map AQ 10-1 Foothill Yellow-Legged Frog and Western Pond Turtle Sampling Locations

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Table AQ 10-1 Proposed 1-km Study Sites for FYLF Sampling and WPT Visual Encounter Surveys.

Station ID	Station Description	Sampling Site Type	Existing Information - Density Estimates (#/km) Tributary (T) Mainstem (M)
Eel River Watershed			
ER173.7	Eel River above Lake Pillsbury near Thistle Glade Creek	Comparison	--
RF3.8	Rice Fork above Lake Pillsbury near Willow Creek	Comparison	--
ER166.4	Eel River at Benmore Creek	Historical	84.1 (T) 4.5 (M)
ER161.2	Eel River at Bucknell Creek, Bucknell Creek	Historical and Comparison	130.9 (T) 9.5 (M)
ER157.9	Eel River at Van Arsdale Reservoir near bridge	Historical	n/a (T) 10 (M)
ER153.0	Eel River at Tomki Creek, Tomki Creek	Tributary	--
ER144.4	Eel River at Salt Creek	General	--
ER126.0	Eel River at Outlet Creek, Outlet Creek	Tributary	--
ER119.3	Eel River at Middle Fork Eel River, Middle Fork Eel	Tributary	--
East Branch Russian River Watershed[1]			
EB_BLPH	East Branch Russian River below Potter Valley Powerhouse at Busch Creek. For FYLF this will include the confluence of Busch and Williams creeks with the East Branch Russian River. For WPT this also includes the PVID West Canal in the vicinity of Busch and Williams creeks.	General	--
EB_MC	East Branch Russian River at Mewhinney Creek	Tributary	--
EB_ABLM	East Branch Russian River above Lake Mendocino	General	--

Notes: Comparison - reach unaffected by Project
General - mainstem without tributary in close proximity or tributary too small to support breeding
Historical - site sampled 2009–2011 (Catenazzi and Kupferberg 2013)
Tributary - sampling of mainstem and tributary large enough to support breeding

[1] Qualitative sampling for presence/absence in spring and summer, quantitative sampling only at sites if presence is confirmed

- Prepare and submit a California Native Species Field Survey Form for all FYLF recorded to the California Natural Diversity Database (CNDDB).
- Provide an electronic database (Excel spreadsheet) of FYLF sampling data (date, location, species) to resource agencies and interested stakeholders.

Timing and Length of Breeding Season

- If FYLF are found breeding during the spring/early summer surveys (described above) and breeding does not appear to be finished following completion of the two distribution and abundance surveys (i.e., fresh 1- to 2-day old eggs are found during the second survey), then a third visit will be completed at up to three sites to identify the end of the breeding season. The third survey visit at the selected breeding sites will follow the same survey methods as described above under *Distribution and Abundance Surveys*.
- Because the timing and length of breeding can vary from year to year, depending on climatic and hydrologic factors, data collected during the study will be compared to historic and long-term studies in adjacent watersheds. These efforts include citizen science monitoring (http://www.eelriverrecovery.org/frogs.html, accessed August 22, 2017) and monitoring on the South Fork Eel River on the Angelo Reserve (Kupferberg 1996, Kupferberg et al. 2012). The observed breeding data (timing and length) and comparison of the data with long-term data sets at other locations will be used develop a forecast of the range of dates when breeding is likely to occur over the term of the license.

Coordination to Determine Stage, Velocity, and Temperature Effects

- Use Habitat Suitability Criteria (HSC) information for eggs and tadpoles from existing studies (Kupferberg 1996, PCWA 2011, Bondi et al. 2013, Lind et al. 2016) to develop HSC, in coordination with stakeholders, for habitat versus flow modeling in Study AQ 5 – Instream Flow.
- Develop a life stage periodicity chart for FYLF that identifies the season of the year (time period) when each life stage is likely to be present within the Study Area. This data will be used for evaluating effects of flow alterations on potential FYLF habitat in Study AQ 5 – Instream Flow.
- Coordinate with the instream flow analysis effort (Study AQ 5 – Instream Flow) to evaluate habitat suitability for FYLF egg masses and tadpoles under existing and alternative flow regimes and ramping rates, as appropriate. An empirical mapping or 2D modeling approach conducted over a range of flows will be used to evaluate breeding sites (see study AQ 5 Instream Flow). Specific objectives for the FYLF instream flow analysis include:

- Determine which flows support breeding habitat and rearing habitat by mapping or modeling suitable depth, velocity, and substrate at the study sites across a wide range of flows.
- Assess the potential effects of seasonal flow changes (e.g., ramping rates) on breeding and rearing habitat and recruitment by considering timing of oviposition, stability of breeding/incubation habitat with changing flows, and the relationship between water temperature and growth/development.
- Model effective breeding/rearing habitat at each site using the physical habitat model, a time series of hydrology (e.g., Study AQ 1 – Hydrology and Project Operations Modeling), and a time series of water temperature (Study AQ 2 – Water Temperature at each site). For modeled Existing Conditions, determine the amount of initial breeding habitat each spring that remains suitable through egg hatching (i.e., not scoured or dewatered) and early tadpole rearing. Use the modeled water temperature data to identify the beginning of breeding and the end of effective habitat modeling each year based on developmental time for eggs and tadpoles. Use the hydrology data and the physical habitat model to quantify effective habitat each year. Coordinate with stakeholders on the details of the modeling. Also, evaluate unimpaired conditions over the time period that that unimpaired water temperature data is available (2005–2016). Model alternative Project flow scenarios as part of PM&E discussions.
- Identify hourly and daily stage change and flow ramping rates that protect sensitive life stages (eggs, tadpoles, metamorphs).

- Coordinate with Study AQ 2 – Water Temperature modeling to determine the best way to model water temperature at FYLF breeding and rearing sites by comparing main channel water temperature to data loggers placed at select FYLF breeding sites. Use FYLF thermal preferences and performance with respect to growth and susceptibility to predation in combination with water temperature modeling to analyze the effects of existing and alternative Project operation scenarios on FYLF.

Coordination with Geomorphological Studies

- Coordinate with Study AQ 4 – Fluvial Processes and Geomorphology and Study AQ 12 – Scott Dam Removal to identify potential changes to FYLF habitat downstream of Scott Dam (e.g., riparian vegetation, breeding bars and pool tailout habitats).

Western Pond Turtle (WPT)

Study Sites

- Study sites for WPT will be co-located with the FYLF study sites (see Map AQ 10-1 and Table AQ 10-1). WPT surveys will be conducted in the pools and backwaters within each study site. The study site at the upstream end of Van Arsdale Reservoir

(ER 157.9), will include habitat downstream in Van Arsdale Reservoir for WPT surveys.

- Two WPT survey sites will be selected in Lake Pillsbury, in coordination with stakeholders. The location of nesting habitat at the sites will be compared to seasonal changes in reservoir elevations.
- Additional WPT presence information will be obtained from recording incidental sightings made during implementation other aquatic technical studies (e.g., Study AQ 2 – Water Temperature, Study AQ 3 – Water Quality, Study AQ 4 – Fluvial Processes and Geomorphology, Study AQ 5 – Instream Flow, Study AQ 7 – Fish Passage, Study AQ 9 – Fish Populations, and Study AQ 11 – Special-Status and Invasive Aquatic Mollusks).

Habitat Characterization

- Develop a GIS map of potential WPT nesting habitat locations in the Study Area. GIS selection criteria include:
  - 100-m buffer around perennial streams and reservoirs;
  - Slope of 2 to 15 degrees with southeast, south or southwest aspect;
  - Slope of 1 to 7 degrees for areas greater than 1 acre with east, south or west aspects;
  - Canopy cover of less than 10% (this criterion will be used if suitable vegetation maps exists);
  - Compacted soils of clay or loam (this criterion will be used if suitable soil maps exist); and
  - Identify portions of habitat near Project facilities or Project areas where ground-disturbing activities may occur.
- Conduct a field reconnaissance survey of potential nesting locations identified in the GIS map near Project facilities where Project maintenance activities occur.

Distribution and Abundance

- Identify and map known occurrences of WPT within the Study Area based on agency consultation and a review of existing information.
- Conduct visual encounter surveys at pool or backwater habitats at the survey sites using the protocol of Bury et al. (2012). The protocol involves scanning (with and without binoculars) pool habitats for basking turtles and edge habitats for turtles either on shore or entering the water. This includes searching banks and willowy areas, especially at sites where there is a dearth of LWD to create basking islands (coordinate with Study AQ 4 – Fluvial Processes and Geomorphology). Also, identify and document any red-eared slider turtles encountered (competitors) or predators.

- Surveys will be conducted in June-July and an attempt will be made to sample during a time (e.g., day of the week) when minimal disturbance exists at the study site (e.g., recreational).
- Coordinate with Study AQ 4 – Fluvial Processes and Geomorphology to identify the amount of large woody debris (LWD) available for basking habitat as part of the geomorphology LWD analysis of Lake Pillsbury and the Eel River downstream of Scott Dam to the Middle Fork Eel River (e.g., identify the emergent logs either connected to shore or surrounded by water that are large enough to provide perches for turtles).
- Prepare and submit a California Native Species Field Survey Form for all WPT recorded to the CNDDB.
- Provide an electronic database (Excel spreadsheet) of WPT sampling data (date, location, species) to resource agencies and interested stakeholders.

Water Temperature

- Evaluate output from Study AQ 2 – Water Temperature to compare WPT habitat conditions and/or growth under existing and alternative Project operations (Ashton et al. 2015, Snover et al. 2015).
- Correct visual encounter survey (VES) observations for biases in detectability that occur due to the proportion of time turtles spend basking and are visible to surveyors based on water temperature (Ruso et al. 2017) (inverse relationship between water temperature and detectability).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies listed here are consistent with generally accepted scientific and engineering principles and practice and consistent with methods used in other relicensings.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

This study will incorporate water temperature data from Study AQ 2 – Water Temperature; hydrology data from Study AQ 1 – Hydrology and Project Operations Modeling; stage and velocity evaluations from Study AQ 5 – Instream Flow; geomorphology evaluations from Study AQ 4 – Fluvial Processes and Geomorphology and Study AQ 12 – Scott Dam Removal; and incidental species sightings from other aquatic field studies. Study AQ 5 – Instream Flow is dependent on information and results from this study.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $338,000.

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STUDY AQ 11
Special-Status and Invasive Aquatic Mollusks

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Special-status aquatic mollusk species.
- Invasive aquatic mollusk species.

PROJECT NEXUS

- Existing Project operations have the potential to affect water quality and environmental conditions by modifying the flow regimes in the river reaches (Eel River from Scott Dam to Van Arsdale Reservoir, Eel River from Cape Horn Dam to Middle Fork Eel River, and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino), potentially affecting special-status aquatic mollusk species, if present.
- Existing recreational activities at Lake Pillsbury have the potential to introduce invasive mollusks (e.g., zebra and quagga mussels, New Zealand mud snail).
- Proposed changes in Project facilities and operations could affect special-status aquatic mollusk species from Lake Pillsbury to Van Arsdale Reservoir and Cape Horn Dam to Middle Fork Eel River.

RELEVANT INFORMATION

The following information is available and was reviewed to determine special-status aquatic mollusk study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.3 for a summary of aquatic mollusk information [PG&E 2017]):

- Guide to Sensitive Aquatic Mollusks of the U.S. Forest Service (USFS) Pacific Southwest Region (Furnish 2007).
- USFS Region 5 Regional Forester's 2013 Sensitive Animal Species List https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5435266.xlsx (USFS 2013).
- Query of the California Freshwater Species Database (Howard et al. 2015a; Klausmeyer et al. 2015) and California Department of Fish and Wildlife (CDFW) BIOS interface (https://map.dfg.ca.gov/bios).
- Query of the California Environmental Data Exchange Network (CEDEN) operated by the State Water Resources Control Board (SWRCB) (http://www.ceden.org/) (CEDEN 2016).
- Pacific Gas and Electric Company 2015. Quagga/Zebra Mussel Prevention Program (PG&E 2011, 2016).

- Literature on aquatic mollusks in Northern California and the Eel River (Howard and Cuffey 2003; Howard and Cuffey 2006; Howard et al. 2015b).

POTENTIAL INFORMATION GAPS

- Presence and distribution of special-status aquatic mollusk species in the river reaches.
- Potential introduction of invasive mollusk species.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Identify potentially suitable habitat for special-status aquatic mollusk species in Project-affected river reaches and determine their presence and distribution (Furnish 2007).
- Continue the Quagga/Zebra Mussel Prevention Program at Lake Pillsbury.
- Collect eDNA samples for Quagga and Zebra mussels in Lake Pillsbury, Eel River below Lake Pillsbury, and Eel River below Van Arsdale Reservoir.

EXTENT OF STUDY AREA

The Study Area for special-status mollusks includes the following river reaches:

- Eel River from Scott Dam to Van Arsdale Reservoir;
- Eel River from Cape Horn Dam to Middle Fork Eel River; and
- East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino.

The Study Area for the ongoing Quagga/Zebra Mussel Prevention Program is Lake Pillsbury.

STUDY METHODS AND ANALYSIS

On-going Potter Valley Project Invasive Mussel Monitoring Studies

- PG&E has an ongoing Quagga/Zebra Mussel Prevention Program for Lake Pillsbury, which began in 2009 (PG&E 2011, 2016) which may inform this study. This program includes the following:
  - Phase 1 (completed): Vulnerability assessment of PG&E's lakes and reservoirs to determine the potential for mussel infestation;
  - Phase 2 (ongoing): Public education program to inform reservoir users of the infestation risk and measures to prevent an infestation;
  - Phase 2 (ongoing): Monitoring for early detection of these mussels; and

  - Phase 3 (if needed, in consultation with CDFW): Management of recreational, boating, and fishing activities.

- Monitoring is performed monthly between May and October as weather and road conditions permit. The monitoring includes shoreline surveys, inspection of artificial substrate (settling plates), vertical plankton tows, and in-situ water quality (temperature, pH, and dissolved oxygen). For the shoreline survey, surfaces of docks, cables, concrete or logs, and shorelines are inspected for attached or dead mussels (CDFW 2008). Inspection of artificial substrate (settling plates) (CDFW 2009a), consists of an assembly of small plastic plates suspended in the water by a cable and inspected during site visits for attached mussels. The vertical plankton tow consists of a 12-inch diameter 63 µm net pulled through the water a specified distance (CDFW 2009b). Plankton net samples are composited, preserved, and sent in for laboratory analysis. The methods were adapted by CDFW from the California Department of Water Resources (CDWR) instructions for monitoring Quagga and Zebra mussels.

Special-Status Aquatic Mollusk Study Sites

- The proposed study sites for special-status aquatic mollusks are co-located with the foothill yellow-legged frog (FYLF) sampling sites in Study AQ 10 – Special-Status Amphibians and Aquatic Reptiles. Mollusks are often found where boundary shear stress conditions are low (Howard and Cuffey 2003), similar to FYLF breeding sites. However, they may also be found in areas that are protected from high flows (e.g. downstream of bedrock outcrops). Twelve sites are proposed: 3 sites in the Eel River from Scott Dam to Van Arsdale Reservoir; 4 sites in the Eel River from Cape Horn Dam to Middle Fork Eel River; 3 sites in the East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino; and 2 comparison sites upstream of Lake Pillsbury (Table AQ 11-1 and Map AQ 11-1).
- Resource agency staff will be invited to participate in the "on the ground" study site selection. Specifically excluded from the study are areas where access is unsafe (very steep terrain or high water flows) or private property for which the Notice of Intent (NOI) Parties has not received approval from the landowner to enter the property to perform the study. The NOI Parties will make a good faith effort to obtain access to private property to conduct the study.

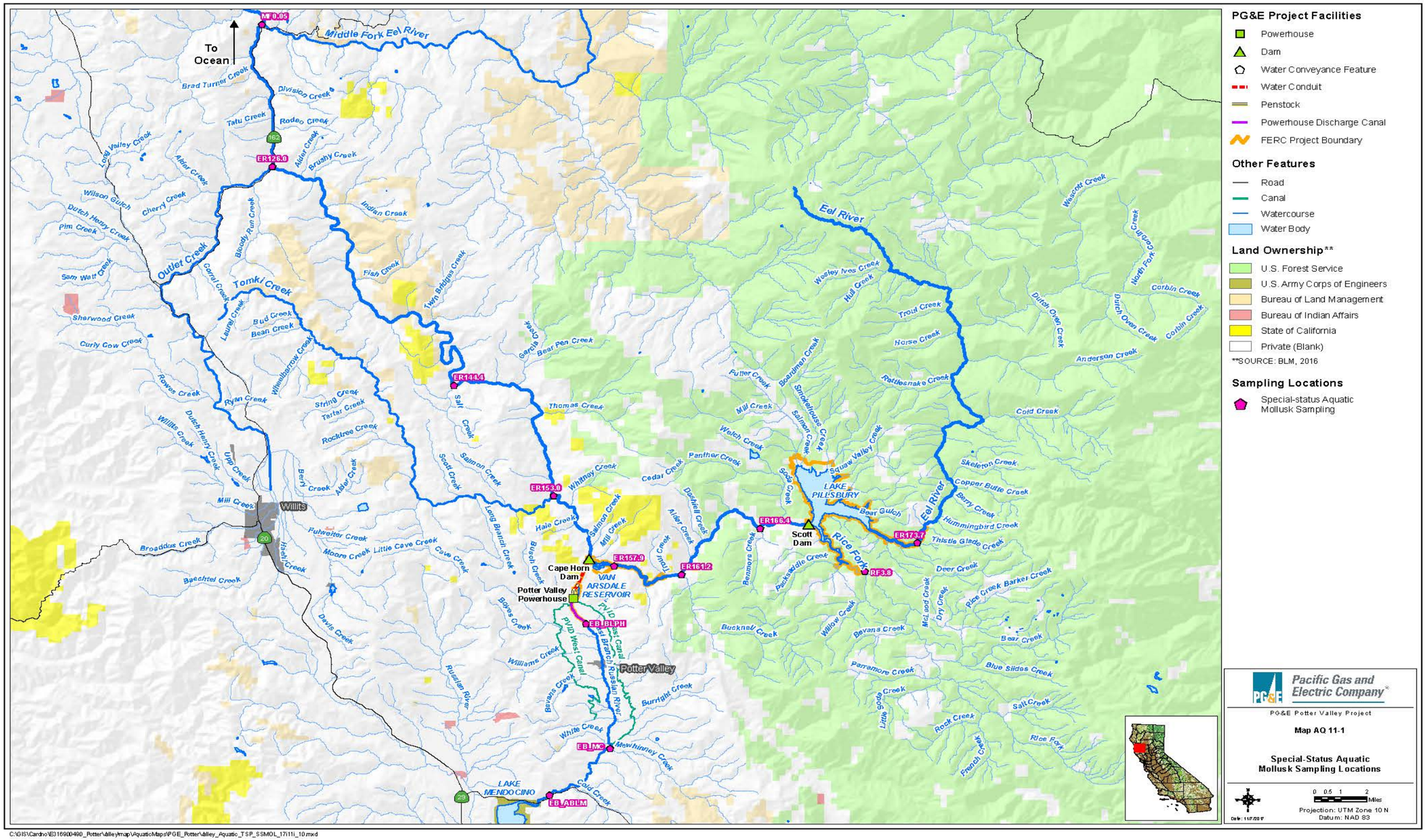
Table AQ 11-1 Proposed Special-Status Aquatic Mollusk Sites

Station ID	Station Description
Eel River Watershed	
ER173.7	Eel River above Lake Pillsbury near Thistle Glade Creek
RF3.8	Rice Fork above Lake Pillsbury near Willow Creek
ER166.4	Eel River at Benmore Creek
ER161.2	Eel River at Bucknell Creek
ER157.9	Eel River at Van Arsdale Reservoir near bridge
ER153.0	Eel River at Tomki Creek
ER144.4	Eel River at Salt Creek
ER126.0	Eel River at Outlet Creek
ER119.3	Eel River at Middle Fork Eel River
East Branch Russian River Watershed	
EB_BLPH	East Branch Russian River below Potter Valley Powerhouse at Busch Creek
EB_MC	East Branch Russian River at Mewhinney Creek
EB_ABLM	East Branch Russian River above Lake Mendocino

Notes: Sites are co-located with Study AQ 10 – Special-Status Amphibians and Aquatic Reptiles.

Special-Status Aquatic Mollusks Sampling

- USFS sensitive aquatic mollusk species are the subject of this study (13 potential species) (USFS 2013). Two of the species, California floater (*Anodonta californiensis*) and western pearlshell (*Margaritifera falcata*) are known to be extant in the Eel River watershed (Howard and Cuffey 2003). Some of the species are unlikely to be present due to specific habitat requirements or known historical distributions that do not include the Eel River. A target list of special-status aquatic mollusk species that could potentially be found in the Study Area will be developed through a literature review and consultation with knowledgeable parties. In addition, non-native species such as Asian clam (*Corbicula fluminea*) will also be identified.
- Potential habitat for the target species will be identified and mapped using aerial photographs, Project maps, United States Geological Survey (USGS) 7.5-minute topographic maps and existing literature.
- The number and location of representative survey sites (see Table AQ 11-1 and Map AQ 11-1) may be modified based on the extent of identified suitable habitat.
- If mollusks are observed during other field surveys (e.g., mussels in channel or mussel shells out of channel), then sites may be shifted in coordination with stakeholders to encompass these areas, as appropriate.



Map AQ 11-1 Special-Status Aquatic Mollusk Sampling Locations

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- Survey sites will be a minimum of 100 meters (m) in length and surveyed in an upstream direction on each side of the river. River edges will be surveyed by wading. A viewing tube or snorkeling will be used to survey the deeper water. All substrates will be sampled. Sub-sampling will be used, as necessary. If mud or silt substrate is present, then it will be sub-sampled at several locations using sieving.
- All sites will be surveyed during the low flow summer/early fall period (e.g., July to October) for a minimum of two hours.
- Physical habitat characteristics will be collected (mesohabitat type, water temperature, substrate composition, water velocity, and estimated channel gradient, width, and mean depth) at each study site.
- To identify potential New Zealand mud snail presence, aquatic gastropods will be collected and preserved for laboratory identification.
- Mussels will be field identified using keys in Burch (1975a, b) and McMahon (1991) or other appropriate keys, and empty shells will be collected if present for future reference.

Environmental DNA

- At three locations, Lake Pillsbury, Eel River below Lake Pillsbury, and Eel River below Van Arsdale Reservoir, sample for environmental DNA during the summer/early fall period using the protocols of the USFS National Genomics Center for Wildlife and Fish Conservation eDNA Program. Process the samples for up to seven aquatic mollusk species (invasive or sensitive) identified by the Mendocino National Forest that have existing markers developed for DNA identification.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies listed here are consistent with generally accepted scientific and engineering principles and practice. The aquatic mollusk sampling method is a standard approach used in other relicensing programs.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

The proposed study sites are co-located with the Study AQ 10 – Special-Status Amphibians and Aquatic Reptiles study sites.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $100,000.

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STUDY CUL 1
Cultural Resources

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Unidentified cultural resources.
- Previously recorded, unevaluated cultural resources.
- Formal evaluation of cultural resources for National Register of Historic Places (NRHP) eligibility.
- Potential effects on historic properties.

PROJECT NEXUS

- Existing operation and maintenance of the Potter Valley Hydroelectric Project could potentially affect cultural resources or historic properties.
- The Federal Energy Regulatory Commission's (FERC) decision to issue a new license is considered an "undertaking" pursuant to 36 CFR § 800.16(y). The National Historic Preservation Act (NHPA) requires Federal agencies to take into account the effects of undertakings on historic properties[1] and to provide the Advisory Council a reasonable opportunity to comment on those undertakings.
- Proposed Project operations and maintenance and proposed changes to Project facilities including removal of Scott Dam and Lake Pillsbury, modifications to Van Arsdale Diversion, and construction of any associated facilities (e.g. access roads, staging areas) potentially affect historic or archeological resources, or traditional cultural properties that may be listed on or eligible for inclusion in the National Register of Historic Places.

RELEVANT INFORMATION

The following databases and information are available or were reviewed to determine cultural resources study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.11 for a summary of available cultural resource information and Section 5.12 for a summary of tribal information [PG&E 2017]):

- Numerous cultural resource survey, inventory, and evaluation reports that document cultural resources in the vicinity of the Project are available from PG&E and the Mendocino National Forest (MNF), as documented in PAD Section 5.11.

[1] As defined under 36 CFR § 800.16(l), "historic properties" are prehistoric or historic archaeological sites, buildings, structures, objects, districts, or locations of traditional use or beliefs that are included in, or eligible for inclusion in, the NRHP. Historic properties are identified through a process of evaluation against specific criteria found at 36 CFR § 60.4.

- Site records for known prehistoric and historic-era resources located within or adjacent to the FERC Project boundary are available from the Northwest Information Center (NWIC) of the California Historical Resources Information System (CHRIS), the MNF, and PG&E.
- Historic mapping of the Project vicinity is available through the U.S. Geological Survey (USGS) Historical Topographic Map Collection, and the U.S. Bureau of Land Management (BLM) General Land Office (GLO).
- Records of early purchases and grants of public lands in the Project vicinity are available through the BLM GLO.
- Information about the history of the Potter Valley Project and select Project facilities is available in four evaluation reports, as follows: Scott Dam 60 kV Transmission Line (David Chavez & Associates 1982); Van Arsdale Dam, fish ladder, and egg-collecting station (Lawrence H. Shoup Archaeological Consultants 1987); Potter Valley Penstock and Powerhouse (PAR Environmental Services 2008); and the Potter Valley Penstock (JRP Historical Consulting 2013).

POTENTIAL INFORMATION GAPS

- Information regarding locations of unidentified resources, defined areas of high sensitivity, and historical context.
- Updated information on known cultural resources including archaeological resources, historic-era built environment resources, and historic properties.
- Intensive surveys under current documentation standards including those of Section 106 of the NHPA (as codified in 36 CFR § 800), the Secretary of the Interior's Standards for Archaeology and Historic Preservation (48 Federal Register 44716 as amended and annotated), and the current documentation and technical standards of the California Office of Historic Preservation (OHP).
- NRHP evaluations or updated evaluations of all historic-era and prehistoric archaeological resources and traditional cultural properties that could be potentially affected by Project operation and maintenance activities.
- NRHP evaluations of individual historic-era built environment resources, which also consider the Project system as a district.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

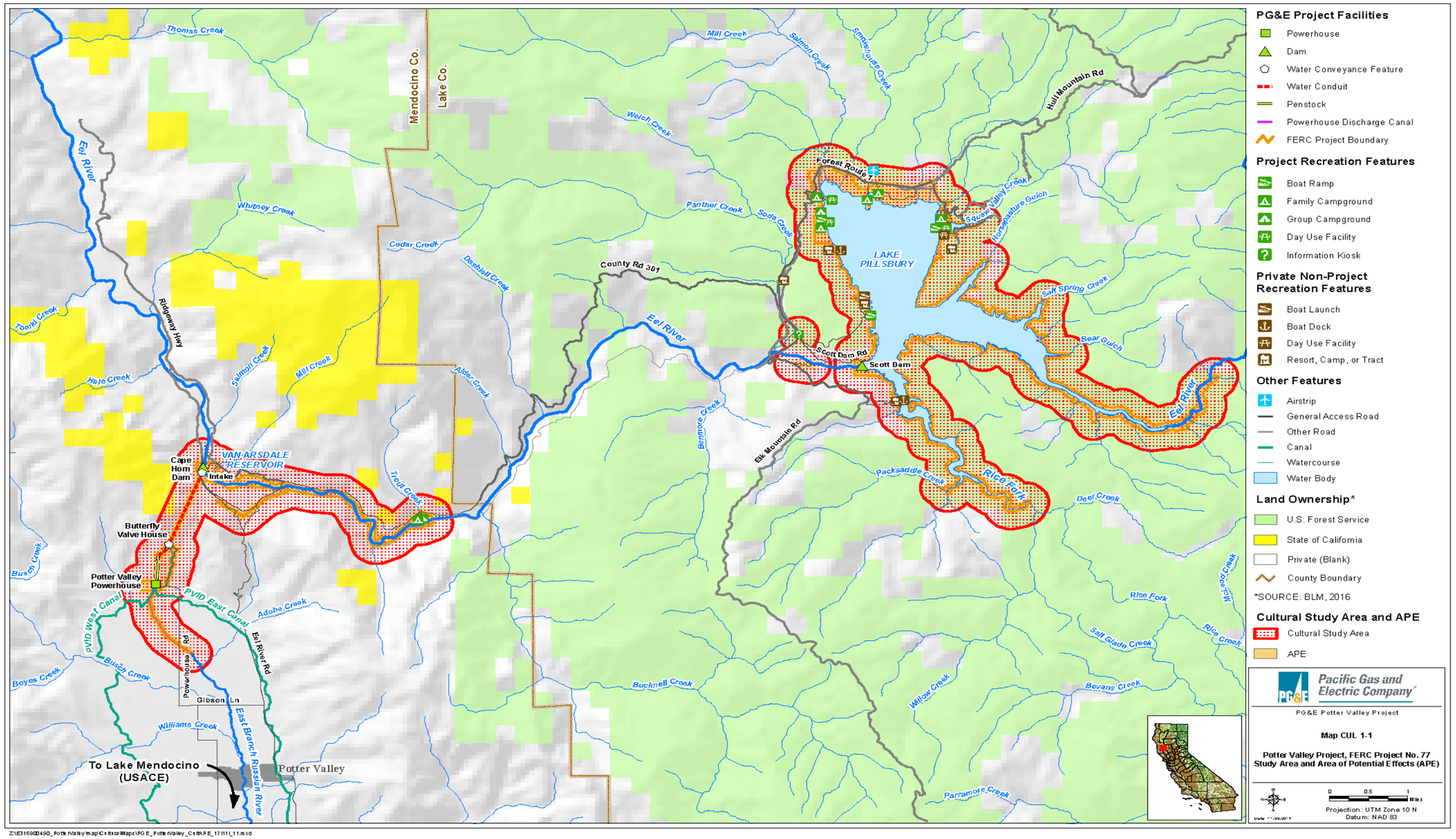
The following studies / analyses will be used to augment existing information:

- Establish an Area of Potential Effects (APE) for the Project through implementation of this Study Plan in consultation with the State Historic Preservation Officer (SHPO), MNF, and tribes.

- Identify and map areas within the APE that have been previously surveyed and summarize associated survey protocols and methods.
- Work with the USFS and tribes to identify areas within the APE that were not surveyed using current standards. The same general principals guiding the USFS's benchmarks of adequacy will be used to guide survey efforts in portions of the APE that are not under USFS or tribal jurisdiction.
- Conduct detailed and fine-grained, background research and interested parties consultation to define possible locations of unidentified resources, sites and properties, determine areas of high sensitivity, and establish the historic and cultural context.
- Map the locations of all known prehistoric and historic-era cultural resources, and historic properties and traditional cultural properties in the APE, including NRHP eligibility status.
- While PG&E has records regarding the NRHP eligibility of many of the previously recorded resources in the APE (i.e., the Historic Properties Directory and Archaeological Determinations of Eligibility as well as formal letters from the SHPO offering consensus determinations) and has included a summary of that information in the PAD, coordination with the OHP will be completed to supplement existing formal eligibility determination information.
- Visit known cultural resources (including unevaluated archaeological resources, historic-era built environment resources, historic properties, and traditional cultural properties) located within the APE to verify their location, condition, and boundaries, and update the existing site records, if necessary, including condition assessments of each resource.
- Conduct intensive surveys of the APE (using current protocols) in unsurveyed areas and in areas where previous surveys do not meet current standards, or where surveys occurred more than 10 years ago, to identify, map, and record currently unknown cultural resources, including traditional cultural properties, and conduct condition assessments of each resource.
- Complete NRHP evaluations of historic-era and prehistoric archaeological and cultural resources that could potentially be affected by Project operation and maintenance activities. Older or outdated evaluations that have received consensus determinations may be re-evaluated based on the findings of updated inventory and documentation on an individual basis.
- Complete NRHP evaluations of historic-era built environment resources. Such evaluations will consider the Project system as a whole and in terms of a district. Older or outdated evaluations that have received consensus determinations may be re-evaluated based on the findings of updated inventory and documentation on an individual basis.

PROPOSED AREA OF POTENTIAL EFFECTS

- The proposed APE for the purpose of this Proposed Study Plan is defined as: (1) the area within the FERC Project boundary plus a buffer of 200 feet; (2) any Project facility located outside the current FERC Project boundary plus a 200-foot buffer around that facility, (3) and the inundated portion of Lake Pillsbury (when accessible) (refer to Map CUL 1-1). The proposed APE will be buffered by a 0.5-mile record search radius that will be used to develop contextual and background information to support inventory and evaluation of cultural resources in the APE. This proposed APE will be submitted to the OHP for formal consultation as part of implementation of this Study Plan.
- For reference, all Project facilities, Project roads and trails, and Project recreation facilities are identified on Tables CUL 1-1, CUL 1-2, and CUL 1-3, respectively. Detailed maps showing the location of all Project facilities, Project roads and trails, and Project recreation facilities are available in Section 4.0 of PG&E's PAD for the Potter Valley Project (PG&E 2017).



Map CUL 1-1 Area of Potential Effects

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Table CUL 1-1 Project Facilities and Features

Dams and Reservoirs
Dams
Scott Dam
Cape Horn Dam
Reservoirs
Lake Pillsbury (storage reservoir)
Van Arsdale Reservoir (forebay)
Diversion System
Intake Structures
Van Arsdale Diversion Intake
Tunnels and Adits
Tunnel No. 1
Tunnel No. 2
Tunnel No. 1 Slide Gate and Adit
Tunnel No. 1 Gage Shaft
Conduits, Penstocks, Control and Valve Houses
Cape Horn Dam Instream Flow Release
Scott Dam 72-inch Butterfly Valve Control House
Scott Dam 42-inch Needle Valve Control House (Instream Flow Release)
Conduit No. 1 (Upper Wood Stave, Steel Pipe and Components)
Conduit No. 2 (Lower Wood Stave, Steel Pipe and Components)
Conduit No. 1, 72-inch Butterfly Valve House, Standpipe and Surge Chamber Vent
Penstock No. 1
Penstock No. 2
Penstock Nos. 1 and 2, 60-inch Gate Valves (2)
Penstock Bypass Channel
Powerhouse Bypass System
Powerhouse, Switchyard, and Tailrace
Potter Valley Powerhouse
Potter Valley Powerhouse Switchyard
Potter Valley Powerhouse Tailrace, Radial Gate, and Venturi Flume
Potter Valley Powerhouse Discharge Canal

Gaging Stations, Weirs, and Piezometers
Reservoir Gage
E1 - Lk Pillsbury NR Potter Valley CA (11470000)
Diversion Gages
E5 - Potter Valley Irrig CN E5 NR Potter Valley CA (11471105)
E6 - Potter Valley Irrig CN E6 NR Potter Valley CA (11471106)
EC6 - Potter Valley Irrig CN 5+6 NR Potter Valley CA (11471100) (calculated gage)
E7 - Potter Valley PH (TR only) NR Potter Valley CA (11471099) (calculated gage)
E16 - Potter Valley PH Intake near Potter Valley CA (11471000)
River Gages
E2 - Eel R BL Scott Dam NR Potter Valley CA (11470500)
E11 - Eel River at Van Arsdale Dam near Potter Valley CA (11471500)
Leakage Weirs
Cape Horn Dam Leakage Weirs
Scott Dam Leakage Weirs
Piezometers
Cape Horn Dam Piezometers
Scott Dam Piezometers
Project Communication/Power Lines
Conduit No. 1, 72-inch Butterfly Valve House Communication/Power Line
Scott Dam Block Building Communication/Power Line
Cape Horn Dam Control Building Communication/Power Line
Fish Screen Facility Communication/Power Line
Penstock Nos. 1 and 2, 60-inch Stop Valves Communication/Power Line
Tunnel No. 1 Slide Gate and Adit Communication/Power Line
Fish Screen, Fish Ladder, and Associated Facilities
Cape Horn Dam Fish Ladder Inlet / Outlet
Van Arsdale Fish Screen Facility
Van Arsdale Fish Screen Facility Back-up Generator Building
Van Arsdale Fish Screen Facility Motor Control Building
Van Arsdale Fish Return Channel

Table CUL 1-2 Project Roads and Trails

Project Facility Access Roads
Cape Horn Dam East Access Rd
Gage E2 Access Rd
Intake Access Rd
Penstock, Pipeline and Butterfly Valve House Access Rd
Powerhouse Main Access Rd
Scott Dam Rd
Upper Scott Dam Access Rd
Recreation Facility Access Roads
Fuller Grove Campground Rd
Fuller Grove Day Use Area and Boat Launch Access Rd
Fuller Grove Group Campground Access Rd
Navy Campground Access Rd (18N50)
Navy Campground Loop Rd
Oak Flat Campground Rd
Pillsbury Pines Day Use Area and Boat Launch Access Rd
Pogie Point Campground and Day Use Area Access Rd (18N75)
Pogie Point Campground Loop Rd
Sunset Point Campground East Loop Rd
Sunset Point Campground West Loop Rd
Trout Creek Campground Loop Rd
Trout Creek Campground Rd
Project Facility Access Trails
Gage E11 Access Trail
Scott Dam Piezometers and Leakage Weirs Access Trail
Project Recreation Trails
Sunset Nature Trail (10W60)

Table CUL 1-3 Project Recreation Facilities

Family Campgrounds
Fuller Grove Campground
Navy Campground
Oak Flat Campground
Pogie Point Campground
Sunset Point Campground
Trout Creek Campground
Group Campgrounds
Fuller Grove Group Campground
Trout Creek Group Campground
Day Use Facilities
Eel River Visitor Information Kiosk
Fuller Grove Day Use Area and Boat Launch
Pillsbury Pines Day Use Area and Boat Launch
Pogie Point Day Use Area
Lake Pillsbury Low Level Boat Launch

STUDY METHODS AND ANALYSIS

Study Objectives and Goals

The primary objectives of this study are to: (1) identify cultural resources within the APE that is established for the study; and (2) evaluate built environment resources as well as evaluate archeological resources if it appears that Project operation and maintenance activities could affect or threaten those resources. Any evaluations of archaeological resources will only be conducted provided they are reasonable and would not cause an unwarranted disturbance.

Study Approach

The Cultural Resources Study will involve a multi-step process that includes: (1) establishing the APE; (2) a detailed review of previous studies and site records; (3) archival research; (4) field surveys, including recording and mapping resource locations and initial condition assessments; (5) NRHP/California Register of Historical Resources (CRHR) evaluations, as appropriate; and (6) reporting as outlined under the "Products" section below. Specific tasks that will be implemented during each step are described below.

Establish APE

- Consult with the SHPO regarding the adequacy of the proposed APE and develop a formal established APE for the study.

Review of Previous Studies and Site Records

- Upon formal establishment of the APE, review previous investigations, survey reports, and site records to identify the methods and protocols that were used to survey the APE.
- Coordinate with the USFS to determine whether there are areas within the APE that should be resurveyed using more current survey protocols.

Archival Research

- Conduct background research to develop a fine-grained historical context for the Project, including a general history of the area within and in close proximity to the APE that is established for the study. This information will be used to develop a meaningful research design for evaluating the significance of historic properties as well as determining the presence of potential resources. Literature research will examine historical photographs, past NRHP evaluations, and literature on prehistoric, ethnographic, and historical sources. Information available from the NWIC, MNF, and PG&E MapGuide data base was compiled and reviewed in support of the PAD. However, information that may be available from the following sources will be acquired and reviewed to augment the information that was compiled for the PAD:
  - BLM GLO land patent and grant records
  - BLM GLO plat maps and survey notes
  - BLM Ukiah Office
  - California State Library, California History Room
  - California State Library, Government Publications
  - California State University, Chico, Meriam Library Special Collections
  - California State University, Sonoma, Northwest Information Center
  - Federal Archives
  - Lake County Historical Society
  - Mendocino County Historical Society
  - Office of Historic Preservation
  - PG&E Archives, San Bruno
  - PG&E Photo Archives, San Francisco

- Sonoma, Lake and Mendocino County Museums
- State and local archaeological societies including but not limited to Society for California Archaeology and Mendocino County Archaeological Commission
- University of California, Berkeley, Bancroft Library
- University of California, Berkeley, Water Resources Collection Center
- USFS Mendocino Forest Office
- USGS Historical Topographic Map Collection

Field Surveys

- Revisit previously recorded cultural resources and historic properties and update existing site records, as necessary. In all instances of previously recorded resources (unless determined ineligible for listing on the NRHP formally), a condition assessment will be performed and recorded on a condition assessment form.
- Conduct intensive pedestrian surveys in those portions of the established APE that may not have been adequately surveyed for archaeological resources during previous investigations or that have not been subject to survey in the past 10 years. Private land within the APE will be surveyed if permission from the landowner can be obtained or if required notifications are made. For archaeological surveys that occur on National Forest lands, all necessary permits will be obtained.
  - Surveys will be conducted on transects spaced no greater than 15-30 meters apart, depending upon the terrain.
  - All diagnostic artifacts, features, artifact concentrations, and modern physical disturbances that are identified in the field will be inspected, recorded, and described in field notebooks, photographed, and plotted (with GPS and tape and compass methods).
  - Site boundaries, features, artifact scatters and deposits, and landscape elements will be mapped using a GPS unit with sub-meter accuracy.
  - Surface features and artifacts, building or structure remains, and the surrounding environment and setting will be photo-documented using a digital camera.
  - Survey areas will include all Project facilities, Project roads and trails, and Project recreation facilities identified in Tables CUL 1-1, CUL 1-2, and CUL 1-3.
  - All newly identified resources and update records will be recorded on the appropriate California Department of Parks and Recreation (DPR) Series 523 forms. A site sketch map to scale, GPS derived site location maps utilizing UTM NAD 1983 datum on 7.5-minute quadrangle maps, and a full complement of appropriate DPR 523 forms will accompany each site record. Locations of

all previously recorded sites within and adjacent to the APE will be verified and site records updated as needed to meet current standards. All site location information will be recorded using sub-meter accuracy GPS technology.

- All resources will be provided a preliminary site condition assessment and recorded on a standardized site condition assessment form that may be used for the purposes of outlining project or other effects on resources.
- All field surveys will be directly supervised by archaeologists who meet the Secretary of the Interior's Professional Qualification Standards in the field of Archeology (36 CFR § 61).
- Any cultural resource identified in the established APE whose boundary extends beyond that of the APE will be documented adequately enough to establish sufficient historic context that enables any reviewing party to understand the basis of determinations and findings made by the agency official.
- It may not be possible to conduct pedestrian surveys in areas where steep slopes and/or dense vegetation preclude safe access. In these cases, an alternative survey strategy will be developed in consultation with the USFS Heritage Program Manager (HPM).
- Record updates and condition assessments for resources that are archaeological in nature will be developed for all resources already determined eligible.
- An initial and informal field report will be submitted to the USFS, which enumerates re-recorded and newly recorded resources within 90 days of a completion of inventory efforts. Within 15 days after submittal, the USFS will provide pertinent USFS site designations to newly recorded sites on lands under their jurisdiction.

Built Environment Inventory

- A field inspection and documentation of historic-era (i.e., 50 years old or older) built environment resources (i.e., buildings, structures, and objects) or resources that will be historic in age at the time of licensing (i.e., minimally 45 years old at the time of the study) located within the established APE will be undertaken by qualified, professional individuals meeting the Secretary of the Interior's Professional Qualification Standards for Architectural History and History, as codified in 36 CFR § 61.
- Historic-era built-environment resources will be recorded or re-recorded to meet current DPR standards, including DPR 523 A, B, I, J, K, L, and if necessary D and E sheets, for all documented resources. This will include digital color photography and sketch maps of individual features that show the relationship between buildings and structures.

- The historic-era built-environment resources identified during the study will be assessed together, as a system/district, as well as on an individual basis, as appropriate.
- Record updates and condition assessments will be created for all resources already determined eligible..
- During the identification and recordation phases outlined above, any Project-related effects identified at cultural resources located within the established APE will be documented.

NRHP and CRHR Evaluations

Cultural resources affected by operation and maintenance of the Project, that have not been previously evaluated, will be evaluated for the NRHP as required by Section 106 of the NHPA or provisions for future evaluation will be provided in the summary and management recommendations of reports. Resources will also be evaluated utilizing CRHR criteria. Additionally, all cultural resources that are subject to NRHP and CRHR evaluation will be evaluated utilizing frameworks provided by relevant research themes and associated research designs. If evaluation occurred over 5 years ago, those resources will be subject to updated documentation efforts, including re-recording, updated research, and site record update. In instances where, those resources have clearly experienced a change in condition, those resources may be re-evaluated on a case-by-case basis and in consultation with pertinent tribes, other interested parties, and agency staff. Evaluation of resources of tribal interest will be evaluated for significance using National Register criteria (36 CFR § 63) and the California Register criteria (PRC 5024.1, CCR 4852, CCR 15064.5) as well as incorporating information gathered as part of and findings of the tribal resources study. Historic-era built-environment features of the Project will be evaluated for the NRHP and the CRHR. All unevaluated resources located within the established APE will be treated as NRHP-eligible until formally evaluated.

Evaluation of cultural resources will be conducted using the following general procedures:

- Evaluation of resources on USFS administered lands will be completed in coordination with the HPM or the HPM's appointed representative.
- Treatment plans, which in addition to a research design, will include provisions for curation or repatriation, as well as Native American consultation/coordination when appropriate. Treatment plans for resources on USFS administered lands will be completed in coordination with the HPM or HPM's appointed representatives. These plans will be submitted to the USFS for review and comment for a 30-day review period. Additionally, all evaluation reports presenting findings will be submitted for review and comment for a 30-day review period prior to SHPO submittal.
- All necessary permits will be obtained before completing any evaluation efforts on USFS lands.

- Test excavations within prehistoric sites will be monitored or completed with the aid of participating tribes.
- Where archaeological test excavation of prehistoric or historic-era sites is deemed appropriate for NRHP evaluations, evaluations may include standard archaeological test excavation procedures. Alternatively, the California Archaeological Resources Identification and Data Acquisition Program for Sparse Lithic Scatters (CARIDAP) (Jackson et al. 1988) protocol may be applied, as appropriate.
- NRHP eligibility recommendations will be developed in coordination with participating tribes; the USFS; individuals or organizations with a demonstrated interest or concern with the undertaking's effect on historic properties; and appropriate members of the public identified through research.
- Any cultural resources that have been previously evaluated but not submitted for concurrence will be subject to updated documentation efforts, including re-recording, updated research, and site record update, with updated material submitted to SHPO for concurrence as part of the CUL 1 Study, as appropriate and necessary.
- Study will include consultation with SHPO regarding adequacy of identification efforts and eligibility findings, in accordance with 36 CFR § 800.4(b)(1).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

- All phases of the cultural resources investigation will be conducted in accordance with the requirements and documentation standards of Section 106, as codified in 36 CFR § 800. The investigation will also adhere to the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 Federal Register 44716, as amended and annotated) and the current documentation and technical standards of the California OHP.
- All NRHP evaluations will be conducted in adherence to National Register Bulletin No.15, *How to Apply the National Register Criteria for Evaluation* (NPS 1995).

PRODUCTS

- Information developed as part of this study will be documented in three separate technical study reports (TSRs), as follows:
  - CUL 1a TSR – This report will document the archaeological resource identification efforts, including methods and results.
  - CUL 1b TSR – This report will document the NRHP and the CRHR evaluation efforts of archaeological resources, including methods and eligibility findings.
  - CUL 1c TSR – This report will document the historic-era built-environment study efforts, including methods and NRHP and CRHR eligibility findings.

- To ensure compliance with FERC reporting requirements, all of the TSRs will include the following sections: (1) Study Goals and Objectives; (2) Study Methods; (3) Study Results (including eligibility recommendations); and (4) Variances from the FERC-approved Study Plan. In addition, all of the TSRs will include the following information, as appropriate:
  - Project location and description;
  - Regulatory setting;
  - APE definition and justification that details the methodology that was used to define the APE, the areas included and excluded, and level of identification, beyond the record search and survey buffers, to account for the effects;
  - Prehistoric, ethnographic, and historic-era context;
  - Generalized maps showing the location of cultural resources;
  - Detailed maps that depict the following on USGS 1:24,000 topographic maps: survey area and coverage types (intensity); and the locations of all resources identified during the Study; and
  - An appendix containing updated and/or new DPR Series 523 forms for each documented cultural resource.
- The Draft TSRs will be distributed for review and comment . All confidential material associated with archaeological resources will be filed as confidential documents.
- Comments on the Draft TSRs will be addressed, as appropriate, in Final TSRs. .

RELATIONSHIP TO OTHER STUDIES

- Information developed as part of Study CUL 2 – Tribal Resources will be utilized to inform Study CUL 1 – Cultural Resources, as appropriate, and vice versa.
- Contextual and ethnographic information developed as part of Study CUL 2 – Tribal Resources will be used to inform Study CUL 1 – Cultural Resources NRHP/CRHR Evaluations (as appropriate), and vice versa.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is as follows: $268,000

REFERENCES

David Chavez & Associates. 1982. Cultural Resources Evaluation for the Scott Dam 60 KV Transmission Line.

JRP Historical Consulting, LLC. 2013. Technical Report: Historical Resources Inventory and Evaluation, Pacific Gas & Electric Company Potter Valley Penstock, Mendocino County, CA.

Lawrence H. Shoup Archaeological Consultants. 1987. An Historic Overview and Significance Evaluation of the Van Arsdale (Cape Horn) Dam, Fish Ladder, and Egg Collecting Station, Mendocino County, CA.

NPS (National Park Service). 1995. *National Register Bulletin Number 15 – How to Apply the National Register Criteria for Evaluation*.

PAR Environmental Services, Inc. 2008. Cultural Resources Inventory and National Register of Historic Places Evaluation for the Potter Valley (FERC 77) Penstock and Powerhouse Bypass Project Mendocino County, CA.

PG&E (Pacific Gas and Electric Company). 2017. Pre-Application Document. Volume I: Public Information, Sections 1-7. April.

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STUDY CUL 2
Tribal Resources

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Previously-recorded and currently unidentified tribal resources, which for the purposes of this study are defined as: Traditional Cultural Properties (TCPs); resource procurement areas subject to traditional use (e.g., traditional fishing or gathering locations); and other resources of traditional, cultural, or religious importance to Native Americans such as cultural and/or ethnographic landscapes.
- Previously-recorded, unevaluated cultural and tribal resources.
- Formal evaluation of tribal resources for National Register of Historic Places (NRHP) eligibility.
- Potential effects on historic properties and tribal resources.

PROJECT NEXUS

- Existing operation and maintenance of the Potter Valley Hydroelectric Project (Project) could potentially affect tribal resources.
- The Federal Energy Regulatory Commission's (FERC) decision to issue a new license is considered an "undertaking" pursuant to 36 CFR § 800.16(y). The National Historic Preservation Act (NHPA) requires federal agencies to take into account the effect of their undertakings on historic properties[1], including tribal resources that may be listed in or eligible for listing in the NRHP and to provide the Advisory Council a reasonable opportunity to comment on those undertakings.
- Proposed Project operation and maintenance and proposed changes to Project facilities including removal of Scott Dam and Lake Pillsbury, modifications to Van Arsdale Diversion, and construction of any associated facilities (e.g. access roads, staging areas) potentially affect historic or archeological resources, or traditional cultural properties that may be listed on or eligible for inclusion in the National Register of Historic Places.

RELEVANT INFORMATION

The following databases and information were reviewed to determine tribal resources study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD]

[1] As defined under 36 CFR § 800.16(l), "historic properties" are prehistoric or historic archaeological sites, buildings, structures, objects, districts, or locations of traditional use or beliefs that are included in, or eligible for inclusion in, the NRHP. Historic properties are identified through a process of evaluation against specific criteria found at 36 CFR § 60.4.

Section 5.11 for a summary of available cultural resource information and Section 5.12 for a summary of tribal information [PG&E 2017]):

- Databases maintained by the Native American Heritage Commission (NAHC), which include known TCPs, Tribal Cultural Resources, other culturally sensitive properties and sites, and contact information for tribal representatives, governments, and other Native American organization.
- Records on Indian Trust Assets (ITAs) held in trust for tribes and individual Native Americans maintained by the Bureau of Indian Affairs (BIA).
- Records of potentially culturally sensitive archaeological and ethnographic-period sites and properties maintained by the Northwest Information Center (NWIC) of the California Historical Resources Information System (CHRIS).
- Stakeholder questionnaire responses (provided in PAD Appendix A).
- Numerous site records and cultural resource survey, inventory, and evaluation reports available from PG&E and the Mendocino National Forest (MNF), as documented in PAD Section 5.11.

POTENTIAL INFORMATION GAPS[2]

- Information regarding locations and significance of unidentified tribal resources, defined areas of high sensitivity, and historical and cultural context.
- Existing information and interviews held in archives or maintained by participating tribes regarding tribal resources, including cultural/ethnographic landscapes and their cultural significance.
- Information provided by participating tribes on tribal resources, including cultural/ethnographic landscapes and their cultural significance.
- NRHP evaluations of tribal resources.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Establish an Area of Potential Effects (APE) for the Project through implementation of this Study Plan in consultation with the State Historic Preservation Officer (SHPO), MNF, and tribes.

[2] Several tribal groups have expressed concerns regarding Project impacts to culturally important fish species, including salmonids, Pacific lamprey and green sturgeon. These species are also addressed in the aquatic study plans. Information developed through the aquatic resource studies will be utilized, as appropriate, to address the concerns identified by the tribes.

- Consult with tribes to identify, analyze, and map tribal resources within the APE established for the study that could be affected by Project operation and/or maintenance activities.
- Conduct an inventory and tribal/ethnographic study to determine the presence of tribal resources within the established APE, evaluate those resources to determine if they are eligible for listing in the NRHP. The inventory and tribal/ethnographic study will include an expanded contextual study area to augment and contextualize the data gathering within the APE.

PROPOSED AREA OF POTENTIAL EFFECTS

- The proposed APE for the purposes of this study is defined as: (1) any areas within the FERC Project boundary, plus a buffer of 200 feet; (2) any Project facility outside the current FERC Project boundary, plus a 200-foot buffer around that facility; and (3) the inundated portion of Lake Pillsbury (when accessible) (refer to Map CUL 2-1). The proposed APE will be buffered by a five mile contextual study area around the FERC Project boundary and any Project facility outside the FERC Project boundary, as well as the stretch of Eel River between Cape Horn Dam and the mouth of the river at the Pacific Ocean. The contextual study area will be used to develop contextual ethnographic and background research to support the inventory and evaluation of tribal resources in the APE. The contextual study area will be subject to research and ethnographic background review, with NRHP inventory and evaluation limited to the proposed APE. The proposed APE and contextual study area methodology will be submitted to the OHP for formal consultation as part of implementation of this Study Plan.
- Project facilities, Project roads and trails, and Project recreation facilities are identified on Tables CUL 2-1, CUL 2-2, and CUL 2-3, respectively. Detailed maps showing the location of Project facilities, Project roads and trails, and Project recreation facilities are available in Section 4.0 of PG&E's PAD for the Potter Valley Project (PG&E 2017).

STUDY METHODS AND ANALYSIS

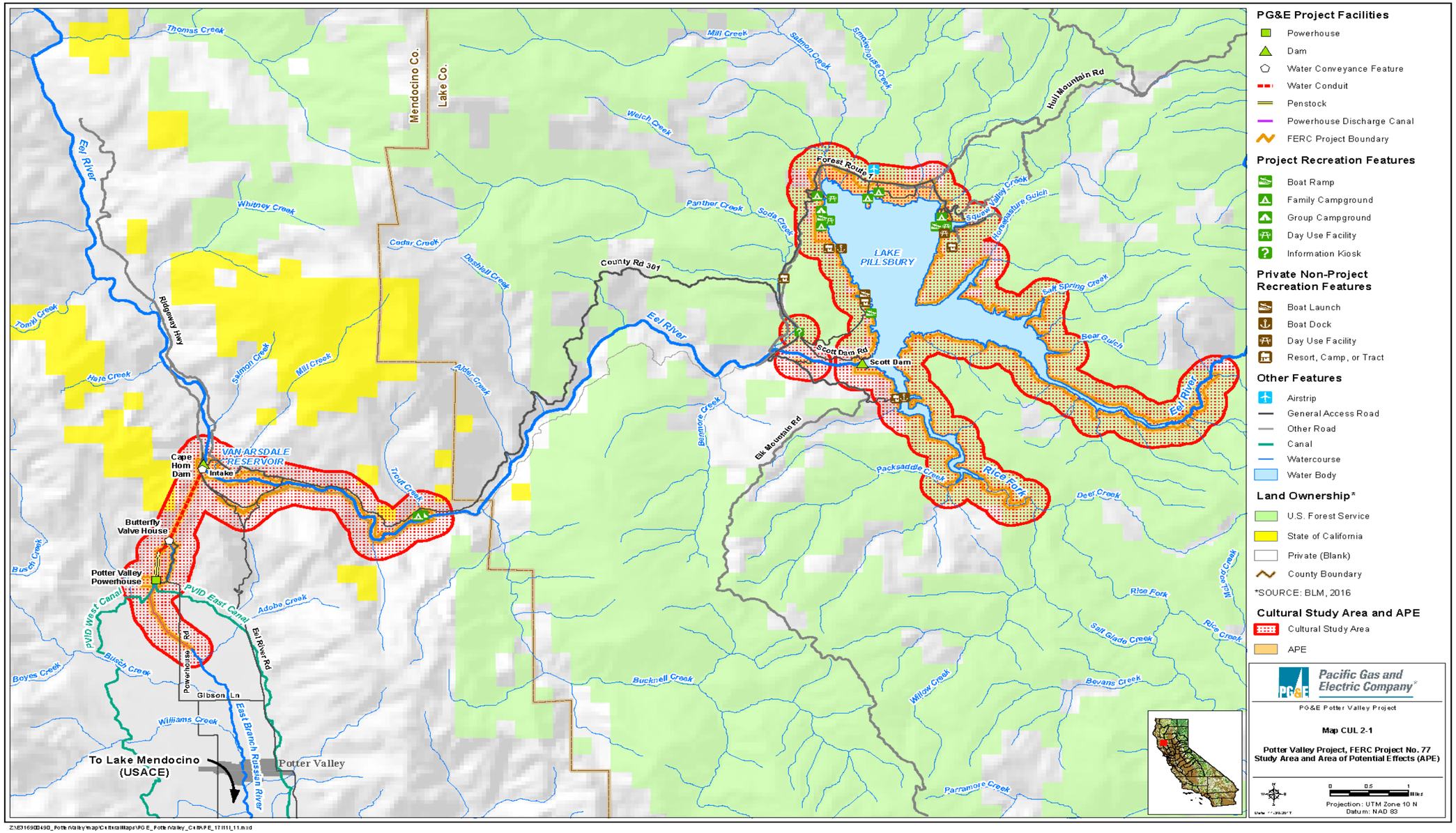
Operation and maintenance (O&M) of the Project has the potential to affect tribal resources. To comply with Section 106 of the NHPA, as amended, the FERC as the lead federal agency, must take into account the effects of issuing a new license on historic properties, including tribal resources that may be listed in or eligible for listing in the NRHP. Some tribal resources may be unidentified and some may be known or recorded but unevaluated and may require evaluation. The goal of this study is to identify resources the tribes identify and evaluate those resources. For the purposes of this study, tribal resources include TCPs, traditional cultural landscapes and sites, and other cultural resources identified by tribes that may not have an archaeological component[3] (including but not limited to traditional fishing or gathering locations) within the APE that is established as part of implementation of this Study Plan. Study methods and analysis will acknowledge and be implemented on the principle that tribal resources as defined herein are not limited to physical manifestations.

The study will involve a multi-step process that includes: (1) establishing the APE in consultation with tribes, SHPO, and USFS; (2) tribal and non-tribal archival research which will include a review of existing tribal interviews and archives for the purpose of extracting, with tribal consent as appropriate, relevant information and/or other data sources; (3) meaningful tribal consultation and identification of resources through tribal interviews conducted by a qualified ethnographer who is selected in consultation with the tribes; (4) site visits with tribal representatives if requested by the tribes; (5) an ethnographic study of the tribal resources present within the APE and their cultural significance to the tribes; (6) NRHP and California Register of Historical Resources (CRHR) evaluations of tribal resources located within the APE; and (7) reporting as discussed under the “Products” section of this study plan. Each of these steps is described below.

Establish APE

Consult with the tribes, SHPO, and USFS in the establishment of the APE for the CUL 2 Tribal Resources Study.

[3] This Study Plan does not address other cultural resources, which are addressed in Study CUL 1 – Cultural Resources.



Map CUL 2-1 Map of the Area of Potential Effects

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Archival Research

Information has been obtained from existing, relevant, and reasonably available sources to assist in identifying data gaps relevant to identifying tribal interests. Additional archival research will be conducted to augment the existing data and may include the following repositories, if appropriate:

- Conduct archival research to identify previous studies and ethnographic information that can be used to establish TCPs and other resources of traditional, cultural, or religious importance to Native Americans to be evaluated. Potential information sources include but are not limited to the following:
  - California Native American Heritage Commission
  - California State Library, California History Room
  - California State Library, Government Publications
  - California State University, Chico, Meriam Library Special Collections
  - California State University, Sonoma, NWIC
  - Grace Hudson/Sun House Museum
  - Held-Poage Research Library
  - Humboldt State University
  - Lake County Library, Lakeport
  - Merriam and Harrington notes available online through the University of California, Berkeley, Bancroft Museum
  - Phoebe Hearst Museum of Anthropology
  - Published and unpublished ethnographic references
  - Sonoma, Lake and Mendocino County Museums
  - State and local archaeological societies including but not limited to Society for California Archaeology and Mendocino County Archaeological Commission.
  - Tribal archives and repositories
  - Ukiah Museum
  - University of California, Berkeley, Bancroft Library

Table CUL 2-1 Project Facilities and Features

Dams and Reservoirs
Dams
Scott Dam
Cape Horn Dam
Reservoirs
Lake Pillsbury (storage reservoir)
Van Arsdale Reservoir (forebay)
Diversion System
Intake Structures
Van Arsdale Diversion Intake
Tunnels and Adits
Tunnel No. 1
Tunnel No. 2
Tunnel No. 1 Slide Gate and Adit
Tunnel No. 1 Gage Shaft
Conduits, Penstocks, Control and Valve Houses
Cape Horn Dam Instream Flow Release
Scott Dam 72-inch Butterfly Valve Control House
Scott Dam 42-inch Needle Valve Control House (Instream Flow Release)
Conduit No. 1 (Upper Wood Stave, Steel Pipe and Components)
Conduit No. 2 (Lower Wood Stave, Steel Pipe and Components)
Conduit No. 1, 72-inch Butterfly Valve House, Standpipe and Surge Chamber Vent
Penstock No. 1
Penstock No. 2
Penstock Nos. 1 and 2, 60-inch Gate Valves (2)
Penstock Bypass Channel
Powerhouse Bypass System
Powerhouse, Switchyard, and Tailrace
Potter Valley Powerhouse
Potter Valley Powerhouse Switchyard
Potter Valley Powerhouse Tailrace, Radial Gate, and Venturi Flume
Potter Valley Powerhouse Discharge Canal

Gaging Stations, Weirs, and Piezometers
Reservoir Gage
E1 - Lk Pillsbury NR Potter Valley CA (11470000)
Diversion Gages
E5 - Potter Valley Irrig CN E5 NR Potter Valley CA (11471105)
E6 - Potter Valley Irrig CN E6 NR Potter Valley CA (11471106)
EC6 - Potter Valley Irrig CN 5+6 NR Potter Valley CA (11471100) (calculated gage)
E7 - Potter Valley PH (TR only) NR Potter Valley CA (11471099) (calculated gage)
E16 - Potter Valley PH Intake near Potter Valley CA (11471000)
River Gages
E2 - Eel R BL Scott Dam NR Potter Valley CA (11470500)
E11 - Eel River at Van Arsdale Dam near Potter Valley CA (11471500)
Leakage Weirs
Cape Horn Dam Leakage Weirs
Scott Dam Leakage Weirs
Piezometers
Cape Horn Dam Piezometers
Scott Dam Piezometers
Project Communication/Power Lines
Conduit No. 1, 72-inch Butterfly Valve House Communication/Power Line
Scott Dam Block Building Communication/Power Line
Cape Horn Dam Control Building Communication/Power Line
Fish Screen Facility Communication/Power Line
Penstock Nos. 1 and 2, 60-inch Stop Valves Communication/Power Line
Tunnel No. 1 Slide Gate and Adit Communication/Power Line
Fish Screen, Fish Ladder, and Associated Facilities
Cape Horn Dam Fish Ladder Inlet / Outlet
Van Arsdale Fish Screen Facility
Van Arsdale Fish Screen Facility Back-up Generator Building
Van Arsdale Fish Screen Facility Motor Control Building
Van Arsdale Fish Return Channel

Table CUL 2-2 Project Roads and Trails

Project Facility Access Roads
Cape Horn Dam East Access Rd
Gage E2 Access Rd
Intake Access Rd
Penstock, Pipeline and Butterfly Valve House Access Rd
Powerhouse Main Access Rd
Scott Dam Rd
Upper Scott Dam Access Rd
Recreation Facility Access Roads
Fuller Grove Campground Rd
Fuller Grove Day Use Area and Boat Launch Access Rd
Fuller Grove Group Campground Access Rd
Navy Campground Access Rd (18N50)
Navy Campground Loop Rd
Oak Flat Campground Rd
Pillsbury Pines Day Use Area and Boat Launch Access Rd
Pogie Point Campground and Day Use Area Access Rd (18N75)
Pogie Point Campground Loop Rd
Sunset Point Campground East Loop Rd
Sunset Point Campground West Loop Rd
Trout Creek Campground Loop Rd
Trout Creek Campground Rd
Project Facility Access Trails
Gage E11 Access Trail
Scott Dam Piezometers and Leakage Weirs Access Trail
Project Recreation Trails
Sunset Nature Trail (10W60)

Table CUL 2-3 Project Recreation Facilities

Family Campgrounds
Fuller Grove Campground
Navy Campground
Oak Flat Campground
Pogie Point Campground
Sunset Point Campground
Trout Creek Campground
Group Campgrounds
Fuller Grove Group Campground
Trout Creek Group Campground
Day Use Facilities
Eel River Visitor Information Kiosk
Fuller Grove Day Use Area and Boat Launch
Pillsbury Pines Day Use Area and Boat Launch
Pogie Point Day Use Area
Lake Pillsbury Low Level Boat Launch

Tribal Consultation and Resource Identification

- Consult with the Native American Tribes to identify tribal resources. In order to facilitate consultation, an ethnographer will be retained, with the professional qualifications for ethnography as defined in Appendix II of National Register Bulletin No. 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1998) to solicit and collect traditional tribal knowledge of the area.
- Interviews will be conducted by an ethnographer with tribal citizens and elders a to identify and define culturally important resources located within the APE and to establish the significance of those resources to the tribes. The ethnographer will coordinate with the NOI Parties and tribal representatives (i.e., tribal chairs, tribal councils, and elders, as authorized and directed by the tribes) to define the scope and breadth of interviews. The ethnographer will arrange for interviews with identified tribal citizens to establish times and locations acceptable to the tribal interviewees. Tribal interviewees and the ethnographer may visit the APE together to accurately define potential tribal resources.
- With the consent of the tribes, interviews may be conducted on a one-on-one basis with the ethnographer. The oral traditions and information collected during the interviews will be used to help define potential tribal resources in the APE.

  - If participating Native American Tribes do not wish to disclose the locations of potential resources due to religious, cultural, or confidentiality reasons, the NOI Parties will work with the tribes to identify the general issues and concerns that the tribe(s) may have regarding potential Project effects as well as the locations where those effects are occurring.

- Existing tribal archives and recorded interviews, if available, will be utilized by the ethnographer to delineate and identify tribal resources.

Site Visits

- If requested by the tribes, tribal interviewees, and/or physically capable tribal representatives, and the ethnographer along with a representative of the NOI Parties will visit the locations identified by tribal representatives as areas where tribal resources are located, including places cultural practices. If any ethnographic sites (e.g., locations of tribal resources, cultural activities or sites are identified in the APE during background research, the ethnographer will visit those locations with tribal representatives if they request. Any surveys (e.g. site visits) on private land within the APE will only be conducted if permission from the landowner can be obtained.

Evaluation of Resources of Tribal Interest in the APE

- Tribal resources located in the APE will be evaluated for the NRHP as required by Section 106 of the NHPA. Resources will also be evaluated utilizing CRHR criteria (PRC 5024.1, CCR 4852, CCR 15064.5). The NRHP evaluation of tribal resources will be evaluated for significance using National Register criteria (36 CFR § 63) and the guidelines provided by National Register Bulletin No. 38 *Guidelines for Evaluating and Documenting Traditional Cultural Properties*.

- Individuals who prepare reports on tribal resource investigations will meet the Professional Qualification Standards at 36 CFR § 61 in the field of Archaeology and meet the qualifications detailed in Appendix II of National Register Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1998).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

- All phases of the tribal resources investigation will be conducted in accordance with the Native American community consultation standards outlined in Section 106 of the NHPA and discussed in the following publication: *Consultation with Indian Tribes in the Section 106 Review Process: A Handbook* (ACHP 2012).

- Consultation, any necessary fieldwork, and potential TCP documentation will be implemented in accordance with Section 106 of the NHPA and shall take into consideration National Register Bulletin No. 38, *Guidelines for Evaluating and Documenting Identification of Traditional Cultural Properties* (Parker and King 1998)

as well as The National Park Service's Preservation Brief No. 36, *Protecting Cultural Landscapes* (Birnbaum 1994).

- All NRHP evaluations will be conducted in adherence to National Register Bulletin No.15, *How to Apply the National Register Criteria for Evaluation* (NPS 1995).

PRODUCTS

Information developed as part of this study will be documented in one technical study report (TSR), as follows:

- CUL 2 TSR – This report will document the tribal resource identification efforts and findings, including methods and results. This report will also incorporate pertinent information about the cultural/ethnographic landscape, excluding information considered confidential by the tribes. In addition, this report will summarize the efforts and findings of any TCP or landscape NRHP/CRHR evaluations if TCPs or ethnographic/cultural landscapes are identified in the APE. The CUL 2 TSR will document the contextual development of the APE and will detail the historical development and usage of the landscape in the APE, including analysis of the landscape's geographical context, cultural features, materials, and use. In addition, it will elaborate on the tribe's traditional use of the Eel River in the APE and contextual study area, as documented by the ethnographer in consultation with the tribes. NPS Preservation Brief 36, *Protecting Cultural Landscapes* (Birnbaum 1994) will be utilized to inform a landscape level of analysis.
- To ensure compliance with FERC reporting requirements, the TSR will include the following sections: (1) Study Goals and Objectives; (2) Study Methods; (3) Study Results and Findings; and (4) Variances from the FERC-approved Study Plan. In addition, the TSR will include the following information, as appropriate:
  - Project location and description;
  - Regulatory setting;
  - APE definition and justification that details the methodology that was used to define the APE, the areas included and excluded, and level of identification, beyond the record search and survey buffers, to account for the effects;
  - Prehistoric, ethnographic, and historic-era context for the Study APE;
  - Generalized maps showing the location of tribal and cultural resources;
  - Detailed maps that depict the following on U.S. Geological Survey 1:24,000 topographic maps: survey area and coverage types (intensity); and the locations of all resources identified during the study; and
  - An appendix containing updated and/or new California Department of Parks and Recreation (DPR) Series 523 forms for each cultural resource documented.

- Information that depicts the location of tribal resources, or is otherwise considered sensitive by the tribes, will be identified as "Privileged" and will not be distributed in the public version of the TSR. Confidential or sensitive information will be included under separate cover, which will be marked and filed as "Privileged" with FERC.
  - A draft of the report will be provided to the tribes and the USFS for a 90-day review and comment period, and after incorporation of comments provided by tribes and agency staff, it will then be submitted to the SHPO for 30-day review and request for concurrence on the report.
  - With the tribes' approval, the report will be submitted to the NWIC.
  - Any written comments received within the review period will be addressed in the final reports to be filed with FERC.
  - Any TCPs identified during the study will be evaluated for potential listing in the NRHP in the report to be filed with FERC. Resources will also be evaluated for CRHR eligibility in the report.

RELATIONSHIP TO OTHER STUDIES

- Information developed as part of Study CUL 1 – Cultural Resources will be utilized to inform Study CUL 2 – Tribal Resources, as appropriate, and vice versa.
- Contextual and ethnographic information developed as part of Study CUL 2 – Tribal Resources will be used to inform Study CUL 1 – Cultural Resources NRHP/CRHR Evaluations (as appropriate), and vice versa.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is as follows: $175,000

REFERENCES

ACHP (Advisory Council on Historic Preservation). 2012. Consultation with Indian Tribes in the Section 106 Review Process: A Handbook.

Birnbaum, Charles A., ASLA. 1994. Preservation Brief 36 – *Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes.* National Park Service Cultural Resources, Preservation Assistance. September 1994. Available at: https://www.nps.gov/tps/how-to-preserve/briefs/36-cultural-landscapes.htm

NPS (National Park Service). 1995. National Register Bulletin Number 15 – *How to Apply the National Register Criteria for Evaluation.*

Parker, P.L., and T.F. King. 1990, rev. 1992, 1998. National Register Bulletin 38—*Guidelines for Evaluating and Documenting Traditional Cultural Properties.* Revised. U.S. Department of the Interior, National Park Service, National Register, History, and Education Division, Washington, DC.

PG&E (Pacific Gas and Electric Company). 2017. Pre-Application Document. Volume I: Public Information, Sections 1-7. April.

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STUDY LAND 1
Roads and Trails Assessment

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Project road and trail maintenance.
- Protection of environmental and cultural resources adjacent to Project roads and trails.

PROJECT NEXUS

- The Licensee is responsible for maintaining Project roads and trails.

RELEVANT INFORMATION

The following information is available and was reviewed to determine Project road and trail study needs (refer to PG&E's Pre-Application Document [PAD] Section 4.0 for a summary of the existing Project roads and trails [PG&E 2017]):

- The list of Project Facility Access Roads, Recreation Facility Access Roads, Project Facility Access Trails, and Project Recreation Trail identified in Table LAND 1-1.
- Maintenance activities associated with Project roads and trails as summarized in PAD Section 4.0.
- Federal Energy Regulatory Commission (FERC) Project boundary information as shown on Exhibit K (now referred to as Exhibit G) of the Project license, as amended.
- PG&E's rights on Project lands as shown on Exhibit F of the Project license.
- Rights-of-way and lease agreements between PG&E and private parties and PG&E and the U.S. Forest Service (USFS), Mendocino National Forest (MNF).
- MNF Motor Vehicle Use Map, South Central Map and Insets (USFS 2012a).
- MNF, Upper Lake Ranger District Motor Vehicle Opportunity Guide. (USFS 2013a).

POTENTIAL INFORMATION GAPS

- Information on existing Project road and trail conditions in relation to applicable maintenance standards.
- Information on potential user-created roads and trails located adjacent to Lake Pillsbury, within the FERC Project boundary.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Conduct focused surveys to identify current Project road and trail conditions in relation to applicable maintenance standards.
- Identify and characterize current Project road and trail use, maintenance practices, and agreements.
- Identify and characterize user-created roads and trails located adjacent to Lake Pillsbury, within the FERC Project boundary.

EXTENT OF STUDY AREA

The Study Area includes the Project Facility Access Roads, Recreation Facility Access Roads, Project Facility Access Trails, and Project Recreation Trail identified on Table LAND 1-1, including the area along the Project roads and trails that is subject to maintenance activities, specifically:

- a 10-foot wide buffer on either side of Project Facility Access Roads and Recreation Facility Access Roads; and
- a 5-foot wide buffer on either side of Project Facility Access Trails and Project Recreation Trail.

The Study Area also includes user created roads and trails located within the existing FERC Project boundary that surrounds Lake Pillsbury. The Study Area may be expanded to include user-created roads and trails that extend beyond the FERC Project boundary, pending the results of the dispersed use assessment to be conducted as part of Study REC 1, Study REC 2 and consultation efforts with the USFS.

Table LAND 1-1 Project Roads and Trails

Project Facility Access Roads
Cape Horn Dam East Access Rd
Gage E2 Access Rd
Intake Access Rd
Penstock, Pipeline and Butterfly Valve House Access Rd
Powerhouse Main Access Rd
Scott Dam Rd
Upper Scott Dam Access Rd
Recreation Facility Access Roads
Fuller Grove Campground Rd
Fuller Grove Day Use Area and Boat Launch Access Rd

Fuller Grove Group Campground Access Rd
Navy Campground Access Rd (18N50)
Navy Campground Loop Rd
Oak Flat Campground Rd
Pillsbury Pines Day Use Area and Boat Launch Access Rd
Pogie Point Campground and Day Use Area Access Rd (18N75)
Pogie Point Campground Loop Rd
Sunset Point Campground East Loop Rd
Sunset Point Campground West Loop Rd
Trout Creek Campground Loop Rd
Trout Creek Campground Rd
Project Facility Access Trails
Gage E11 Access Trail
Scott Dam Piezometers and Leakage Weirs Access Trail
Project Recreation Trails
Sunset Nature Trail (10W60)

Certain segments of the Project roads and trails identified above are located outside of the current FERC Project boundary. For surveys along Project roads or trails that are located outside of the current FERC Project boundary and on private land, Notice of Intent (NOI) Parties will take the following steps to obtain approval to survey on private property:

- Notify the landowner of Project relicensing and request authorization to enter the property to conduct surveys.
- If authorization is obtained, NOI Parties will complete surveys as described in this technical study plan.
- If authorization is not obtained, NOI Parties will not complete surveys at these locations.

STUDY METHODS AND ANALYSIS

Road Condition Assessment

- Identify current maintenance levels and associated maintenance standards for each of the Project Facility Access Roads and Recreation Facility Access Roads, identified on Table LAND 1-1, in consultation with USFS and Lake and Mendocino county road specialists.

- Assess the current condition of the Project Facility Access Roads and Recreation Facility Access Roads relative to prescribed maintenance levels and standards. The following information will be collected as part of the road condition assessment:
  - Asset type (improved road, primitive road);
  - Land ownership/jurisdiction;
  - Route, road, or spur number (and common name, if applicable);
  - Beginning and end points, and overall length;
  - Average width;
  - Segments, if applicable;
  - Surface type (e.g., paved, gravel, dirt);
  - Overall road condition, including identification of issues pertaining to condition such as potholes, ruts, loose aggregate, missing aggregate, cracking, debris, and excessive vegetation;
  - Location of perennial, intermittent, or ephemeral streams relative to Project Roads and Recreation Facility Access Roads;
  - Location, size , and condition of culverts and other drainage features;
  - Location, length, width, and condition of bridge crossings or fords;
  - The location of areas experiencing erosion;
  - Estimate of useful remaining life span of surface treatments and erosion and drainage features;
  - Location and condition of safety, traffic control, and informational signs;
  - Location and condition of access control features and barriers such as gates and other closure methods (e.g. boulders, bollards, logs); and
  - Potential traffic safety concerns such as blind spots, poor sight distance, inadequate signage, and hazard trees.
- All road features will be photographed and located using a sub-meter Global Positioning System (GPS) unit and the data will be incorporated into the Project Geographic Information System (GIS) database for tabulation, analysis, and mapping.
- Identify and map the location of environmental and/or cultural resources that may occur along the Project roads in coordination with Study TERR 1 – Botanical Resources, Study CUL 1 – Cultural Resources, and Study CUL 2 – Tribal Resources.
  - Note that the location of protected biological resources and cultural resources is considered confidential information and will not be included in the LAND 1 Technical Study Report (TSR).

Trail Condition Assessment

- Assess the current condition of the Project Facility Access Trails and Project Recreation Trails relative to trail management objectives and standards, including the Forest Service Trail Accessibility Guidelines (FSTAG) (USFS 2013b), where applicable. At a minimum, the following information will be collected as part of the trail condition assessment:
  - Land ownership/jurisdiction;
  - Trail number (if applicable);
  - Location and condition of trailhead(s);
  - Beginning and end points, and overall length;
  - Average width;
  - Average slope;
  - Presence/absence of safety features such as hand rails;
  - Overall condition, including identification of issues pertaining to condition such as rutting, loose aggregate, obstacles, and excessive vegetation;
  - Location, size, and condition of culverts and other drainage features, if applicable;
  - Location of areas experiencing erosion, if any;
  - Location and condition of access control features and barriers such as gates and other closure methods (e.g. boulders, bollards, logs); and
  - Location of bridge crossings or fords, if applicable.
- All trail features will be photographed and located using a sub-meter GPS unit and the data will be incorporated into the Project GIS database for tabulation, analysis, and mapping.
- Identify and map the location of environmental and/or cultural resources that occur along the Project trails in coordination with Study TERR 1 – Botanical Resources, Study TERR 2 – Wildlife Resources, Study CUL 1 – Cultural Resources, and Study CUL 2 – Tribal Resources.
  - Note that the location of sensitive biological and cultural resources is considered confidential information and will not be included in the LAND 1 Technical Study Report (TSR).

Maintenance and Use Characterization

- Identify and characterize PG&E's maintenance practices and activities, including for example culvert clearing and vegetation management.

- Characterize PG&E's and the public's use of Project roads and trails, including season of use and level of use.
- Identify and characterize current maintenance agreements (e.g., maintenance agreements, easements, rights-of-way, special use permits) between PG&E, the USFS, Mendocino and Lake Counties, and private property owners, as applicable, including associated termination dates.
- Identify Best Management Practices (BMPs) that PG&E currently implements to protect water quality and other resources along the Project roads and trails.

User-Created Roads and Trails

- Identify and map the location of user-created roads and trails located adjacent to Lake Pillsbury, within the FERC Project boundary.
- Document the following information associated with user-created roads and trails located within the FERC boundary:
  - Land ownership/jurisdiction;
  - Beginning and end points, and overall length.
  - Average width;
  - Overall condition;
  - Location of stream crossings, if applicable;
  - Possible uses (e.g., hiking, biking, equestrian, or motorized); and
  - Resource concerns.
- User-created roads and trails will be photographed and located using a sub-meter GPS unit and the data will be incorporated into the Project GIS database for tabulation, analysis, and mapping.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

- The roads and trails data will be collected using standardized forms that are designed to document road condition and features with respect to USFS standards and State and county standards, as applicable.
  - Roads and trails that cross National Forest System Lands will be surveyed and assessed with respect to USFS criteria for the assigned maintenance level (USFS 2005, 2014).
  - Roads and trails that cross private land will be surveyed with respect to State of California road maintenance standards, and/or applicable Lake and Mendocino county standards (Mendocino County 2017).

– Traffic signage, barriers, and gates will be assessed relative to standards contained in the Manual of Uniform Traffic Control Devises (MUTCD) (FHA 2009, with 2012 revisions).

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

- Information regarding Recreation Facility Access Roads will be used in coordination with Study REC 1 – Recreation Facility Assessment to characterize overall Project recreation facility condition and functionality.
- Information about culvert size and condition may be used to identify potential issues related to fish and amphibian passage, if applicable.
- Information collected as part of Study TERR 1 – Botanical Resources, Study CUL 1 – Cultural Resources, and Study CUL 2 – Tribal Resources will be used to help document the location of sensitive plant and cultural resources located along the Project Facility Access Roads, Recreation Facility Access Roads, and Project Facility Access Trails.
- Information developed as par to Study TERR 2 – Wildlife Resources will be used to document the locations of sensitive animals.
- Information developed as part of Study AQ 4 – Geomorphology will be used to identify erosion sources and potential issues related to sedimentation.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $121,000.

REFERENCES

Federal Highway Administration (FHA). 2009. Manual on Uniform Traffic Control Devices (MUTCD). 2009 Edition, including Revisions 1 and 2 dated May 2012.

Mendocino County. 2017. Road Standards. Available at www.co.mendocino.ca.us/dot/roadStandards.htm.

PG&E (Pacific Gas and Electric Company). 2017. Pre-Application Document. Volume I: Public Information, Sections 1-7. April.

USFS (U.S. Forest Service). 2005. Guidelines for Road Maintenance Levels. 7700-Transportation Management 0577 1205-SCTDC. December.

USFS. 2012a. Motor Vehicle Use Map, South Central Map and Insets. Available at www.fs.usda.gov/detailfull/mendocino/maps-pubs.

USFS. 2012b. National Best Management Practices for Water Quality Management on National Forest System Lands. Volume 1: National Core BMP Technical Guide.

USFS. 2013a. Mendocino National Forest, Upper Lake Ranger District Motor Vehicle Opportunity Guide. 2013.

USFS. 2013b. Forest Service Trail Accessibility Guidelines (FSTAG). 2013 Update.

USFS. 2014. Forest Service Manual (FSM) 7700. Travel Management, Chapter 7730 – Transportation System Operation and Maintenance. Amendment No. 7700-2014-1. Effective November 20, 2014.

STUDY LAND 2
Visual Resource Assessment

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Conformance of Project facilities with visual quality standards.

PROJECT NEXUS

- The presence of Project facilities could affect visual resources.

RELEVANT INFORMATION

The following information is available and was reviewed to determine visual resource study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.10 for a summary of visual resource information [PG&E 2017]):

- U.S. Forest Service (USFS) Visual Quality Objectives (VQOs) (USFS 1974, 1995).
- USFS management prescriptions and direction included in the Mendocino National Forest (MNF) Land and Resource Management Plan (LRMP) (USFS-MNF 1995) as amended (USFS-MNF 2007), which pertain to Project facilities located on National Forest System Lands (NFSL).
- Visual resource management objectives identified in the Mendocino County General Plan (PMC 2009) and Lake County General Plan (Matrix Design Group et al. 2008), which pertain to Project facilities located on private land.
- Built Environment Image Guide (BEIG) for the National Forests and Grasslands (USFS 2001).

POTENTIAL INFORMATION GAPS

- Information on existing visual condition (EVC) of Project facilities compared to surrounding landscape conditions and established visual resource management objectives.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Document the EVC of Project facilities from Key Observation Points (KOP) located along primary travel corridors, recreation areas, and water bodies.

- Assess the compatibility of Project facilities with surrounding landscape conditions and determine whether the Project facilities conform to established USFS and/or Lake and Mendocino County visual resource management objectives.
- Document visual conditions at Lake Pillsbury at various water levels from Memorial Day through Labor Day.

EXTENT OF STUDY AREA

The Study Area for the visual resource assessment includes the Project facilities and the Project Recreation Facilities identified in Table LAND 2-1 and Table LAND 2-2, and their associated viewsheds. In addition, the Study Area includes the Pine Point Day Use Area. The viewsheds include the primary travel routes, recreation areas, and water bodies from which the existing Project facilities are visible to the public.

Table LAND 2-1 Project Facilities and Features

Dams and Reservoirs
Dams
Scott Dam
Cape Horn Dam
Reservoirs
Lake Pillsbury (storage reservoir)
Van Arsdale Reservoir (forebay)
Diversion System
Intake Structures
Van Arsdale Diversion Intake
Tunnels and Adits
Tunnel No. 1
Tunnel No. 2
Tunnel No. 1 Slide Gate and Adit
Tunnel No. 1 Gage Shaft
Conduits, Penstocks, Control and Valve Houses
Cape Horn Dam Instream Flow Release
Scott Dam 72-inch Butterfly Valve Control House
Scott Dam 42-inch Needle Valve Control House (Instream Flow Release)
Conduit No. 1 (Upper Wood Stave, Steel Pipe and Components)
Conduit No. 2 (Lower Wood Stave, Steel Pipe and Components)
Conduit No. 1, 72-inch Butterfly Valve House, Standpipe and Surge Chamber Vent

Penstock No. 1
Penstock No. 2
Penstock Nos. 1 and 2, 60-inch Gate Valves (2)
Penstock Bypass Channel
Powerhouse Bypass System
Powerhouse, Switchyard, and Tailrace
Potter Valley Powerhouse
Potter Valley Powerhouse Switchyard
Potter Valley Powerhouse Tailrace, Radial Gate, and Venturi Flume
Potter Valley Powerhouse Discharge Canal
Gaging Stations, Weirs, and Piezometers
Reservoir Gage
E1 - Lk Pillsbury NR Potter Valley CA (11470000)
Diversion Gages
E5 - Potter Valley Irrig CN E5 NR Potter Valley CA (11471105)
E6 - Potter Valley Irrig CN E6 NR Potter Valley CA (11471106)
EC6 - Potter Valley Irrig CN 5+6 NR Potter Valley CA (11471100) (calculated gage)
E7 - Potter Valley PH (TR only) NR Potter Valley CA (11471099) (calculated gage)
E16 - Potter Valley PH Intake near Potter Valley CA (11471000)
River Gages
E2 - Eel R BL Scott Dam NR Potter Valley CA (11470500)
E11 - Eel River at Van Arsdale Dam near Potter Valley CA (11471500)
Leakage Weirs
Cape Horn Dam Leakage Weirs
Scott Dam Leakage Weirs
Piezometers
Cape Horn Dam Piezometers
Scott Dam Piezometers
Project Communication/Power Lines
Conduit No. 1, 72-inch Butterfly Valve House Communication/Power Line
Scott Dam Block Building Communication/Power Line
Cape Horn Dam Control Building Communication/Power Line
Fish Screen Facility Communication/Power Line
Penstock Nos. 1 and 2, 60-inch Stop Valves Communication/Power Line

Tunnel No. 1 Slide Gate and Adit Communication/Power Line
Fish Screen, Fish Ladder, and Associated Facilities
Cape Horn Dam Fish Ladder Inlet / Outlet
Van Arsdale Fish Screen Facility
Van Arsdale Fish Screen Facility Back-up Generator Building
Van Arsdale Fish Screen Facility Motor Control Building
Van Arsdale Fish Return Channel

Table LAND 2-2 Project Recreation Facilities

Family Campgrounds
Fuller Grove Campground
Navy Campground
Oak Flat Campground
Pogie Point Campground
Sunset Point Campground
Trout Creek Campground
Group Campgrounds
Fuller Grove Group Campground
Trout Creek Group Campground
Day Use Facilities
Eel River Visitor Information Kiosk
Fuller Grove Day Use Area and Boat Launch
Pillsbury Pines Day Use Area and Boat Launch
Pogie Point Day Use Area
Lake Pillsbury Low Level Boat Launch

STUDY METHODS AND ANALYSIS

The Project facilities are located on private land managed by Mendocino County and Lake County and on public land managed by the USFS-MNF. Therefore, aesthetic resources will be assessed with respect to management objectives established by Mendocino County, Lake County, and the MNF, as appropriate.

The following methods will be utilized to inventory visual resources in the Project vicinity and to assess the EVC and compatibility of Project facilities with respect to the surrounding landscape.

Identify Relevant Visual Quality Objectives, Viewsheds, and KOPs

- Compile and summarize pertinent Mendocino County, Lake County, and MNF management direction and objectives regarding visual resources, including direction contained in the following documents:
  - Mendocino County General Plan
  - Lake County General Plan
  - MNF LRMP
  - USFS BEIG
  - USFS Visual Management System (VMS) guidance documents
  - USFS Scenery Management System (SMS) guidance documents, including recommended refinements made in 2007 (USFS 2007).
- Identify and compile existing VMS and/or SMS inventory and mapping information that has been developed by the MNF for the Lake Pillsbury area.
- Identify primary viewsheds and representative KOPs in consultation with relevant public/resource agencies.
  - The viewsheds will include primary travel routes, recreation areas, and water bodies from which the existing Project facilities are visible to the public, limited to lands with public access.
  - KOPs will be selected at locations from which the Project facilities are visible to the public and will consider view distance and duration.
- Prepare maps showing the location of Project facilities and their associated viewsheds, KOPs, and resource agency visual resource management objectives. Maps that encompass NFSL will include additional relevant VMS inventory information, such as, variety class, sensitivity level, distance zones, and Recreation Opportunity Spectrum (ROS) information, or similar SMS inventory information, if available.

Inventory and Assess Existing Visual Conditions

- Identify and document the locations within the MNF from where the Project facilities can be seen from the primary travel routes and recreation areas.
- Inventory and document the EVC and visual compatibility or contrast of the Project facilities from established KOPs using VMS and/or SMS principles, as appropriate.
- Photograph the Project facilities from established KOPs.
- Compare EVC of Project facilities with established visual resource management objectives, including USFS VQOs and those identified in the USFS BEIG.

- Determine visual compatibility with the surrounding landscape, based on visual resource inventory information (e.g., visual sensitivity and distance zones from KOPs).
- Utilize the recreation visitor surveys to be conducted as part of Study REC 1 to develop information about visitor satisfaction, preferences, and concern levels related to landscape and scenic character.

Photo-Document Visual Conditions at Lake Pillsbury at Various Water Levels

- Identify locations (i.e., KOPs) from which water levels at Lake Pillsbury should be photographed, in consultation with the USFS.
- Photograph Lake Pillsbury at a range of waters levels from each KOP.
  - Photographs will be taken on a regular basis between Memorial Day and Labor Day to coincide with periods of moderate to high recreation use and a range of water levels.
  - Photographs will be taken in conjunction with visitor surveys to be conducted as part of Study REC 1 – Recreation Facility Assessment so that the photographs can be correlated to responses regarding water surface elevation (WSE). Refer to Study REC 1 for additional information about survey frequency and timing.
  - To facilitate comparison of the photographs over time, the location of each KOP will be marked and documented using a sub-meter GPS unit and all photographs will be taken from the exact same location, using the same camera equipment and settings.
- Utilize the photographs to characterize changes in landscape character under various water levels at Lake Pillsbury.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

- The study approach presented in this plan is based on generally accepted practices for conducting visual quality studies associated with the relicensing of hydroelectric projects.
- For consistency, the visual quality assessment will be conducted using standardized forms.
- Project facilities that are visible from viewsheds located within the MNF will be assessed with respect to USFS visual quality objectives and the BEIG.
- Project facilities that are visible from viewsheds that are located outside of the MNF (e.g., from County roads) will be assessed with respect to Mendocino and Lake County objectives, as appropriate.
- For consistency, all Project facilities will be assessed using USFS visual assessment protocols, regardless of jurisdiction.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

Survey responses collected as part of Study REC 1 – Recreation Facility Assessment will be reviewed to identify potential issues related to visual resources, including visitor sensitivity to landscape characteristics and changes. Issues related to visual quality will be documented in the LAND 2 TSR.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study by major tasks is $148,000.

REFERENCES

Matrix Design Group, et al. 2008. Lake County General Plan. September. Available at http://www.co.lake.ca.us/Government/Directory/Community_Development/Planning_Division/2008FinGP.htm.

PG&E (Pacific Gas and Electric Company). 2017. Pre-Application Document. Volume I: Public Information, Sections 1-7. April.

PMC. 2009. The County of Mendocino General Plan. August. Available at http://www.co.mendocino.ca.us/planning/plans/planGeneralTOC.htm.

USFS (U.S. Forest Service). 1974. Visual Management System (VMS).

USFS. 1995. Landscape Aesthetics: A Handbook for Scenery Management. December.

USFS. 2001. Built Environment Image Guide (BEIG) for the National Forests and Grasslands. FS-710. September 2001. Available at https://www.fs.fed.us/recreation/programs/beig/.

USFS. 2007. Appendix J: Recommended SMS Refinements. Available at http://www.reclink.us/page/sms-appendix-j.

USFS-MNF (U.S. Forest Service, Mendocino National Forest). 1995. Mendocino National Forest Land and Resource Management Plan (LRMP). February. Available at http://www.fs.usda.gov/detailfull/mendocino/landmanagement/.

USFS-MNF. 2007. LRMP Amendment 2007-01. Available at http://www.fs.usda.gov/detailfull/mendocino/landmanagement/.

STUDY LAND 3
Hazardous Fuels Reduction Assessment

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Hazardous fuel loads could increase the intensity and severity of fires in the vicinity of the Project.

PROJECT NEXUS

- Article 27 of the existing Project license requires Pacific Gas and Electric Company (PG&E) to prevent, control, and suppress fires on Project lands.
- Proposed changes to Project facilities could affect the ability to prevent, control, and suppress fires on Project lands.

RELEVANT INFORMATION

The following information is available and was reviewed to determine hazardous fuels reduction study needs (refer to PG&E's Pre-Application Document [PAD] Section 5.8 for a summary of fire history, fire management, and fire suppression [PG&E 2017]):

- In accordance with Article 27, PG&E implements various measures to reduce fire risk, including actively managing vegetation in proximity to Project facilities and features. All fire prevention measures are implemented in accordance with pertinent state rules and regulations, including:
  - Public Resources Code 4292
  - Public Resources Code 4293
  - General Order 95
  - North American Electric Reliability Council [NERC] Standard FAC-003-100
- Management activities on National Forest System Land (NFSL) are performed in accordance with the Mendocino National Forest (MNF) Land and Resource Management Plan (USFS-MNF 1995), as amended 2007, which specifies forest-wide standards and guidelines as well as area-specific guidelines. Fire hazards and fuel treatments are addressed in Section IV-Management Direction: Fire and Fuels, pages 20-21.
- Information about the major fires that have occurred in the Project vicinity, including acreages and ignition sources, is available from the Fire and Resource Assessment Program (FRAP 2018), which is managed by CalFire.

POTENTIAL INFORMATION GAPS

- Information about fuel loads on lands located within the Federal Energy Regulatory Commission (FERC) Project boundary.
- Information about PG&E's fuel reduction and prevention measures associated with lands within the FERC Project boundary.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Conduct a hazardous fuels assessment to identify fuel loads and fuel reduction opportunities within the FERC Project boundary.
- Identify PG&E's existing fuel reduction measures associated with lands within the FERC Project Boundary.
- Include information on water availability for fire suppression activities in the absence of Lake Pillsbury, including during extreme drought years.

EXTENT OF STUDY AREA

The Study Area includes the land within the FERC Project boundary Private land located within the FERC Project boundary that is not owned by PG&E is not included in the Study Area.

STUDY METHODS AND ANALYSIS

Hazard Fuel Assessment

- Consult with the U.S. Forest Service (USFS) regarding preferred methods/models to map and characterize fuel loads (i.e., biomass, BehavePlus 5.0.5) in the Study Area.
- Identify and map fuel conditions in the Study Area at sample sites (identified by a GPS-derived latitude/longitude location), focusing on areas in the immediate vicinity of Project facilities, including Project roads and trails, and developed Project recreation facilities. This mapping effort will be conducted by a qualified forester and will address basal area, canopy cover, forest floor components (including duff), ladder fuels, woody debris, shrub component, other information (crown base height, canopy height, crown bulk density, diameter at breast height), slope, and aspect. Run selected model to analyze and predict fire behavior in Study Area.
- Utilize information developed as part of Study TERR 1 – Botanical Resources to describe vegetation in the Study Area, including vegetation communities and density (percent canopy).

Existing Fuel Reduction and Fire Prevention Measures

- In consultation with the USFS, identify and map existing defense zones (fuel treatment areas) around Project facilities and developed Project recreation facilities.
- Describe current vegetation management practices as they pertain to fuel reduction, and other fuel reduction measures that PG&E implements at Project facilities, including clearance distances around facilities and power poles.
- Summarize fuel reduction measures that PG&E and/or the USFS implement at the Project recreation facilities.
- Identify existing fire prevention measures at Project facilities and developed Project recreation facilities (e.g., PG&E worker training and awareness programs, informational signage and campfire restrictions).
- Identify potential for Project structures, operation, and maintenance procedures, and visitors to be sources of fire ignitions within the FERC Project boundary to inform the need for additional preventative measures.

Water Availability

- Identify alternative water drafting sites for fires that might be used in the Study Area in the absence of Lake Pillsbury. Specify those that can be used during years of extreme drought.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods described in this study plan are consistent with generally accepted practices for assessing and documenting hazard fuels and reduction measures.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible, as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

- Information developed as part of Study TERR 1 – Botanical Resources will be used to describe vegetation in the Study Area, including vegetation communities and density in terms of canopy cover.
- Information developed as part of Study LAND 1 – Project Roads and Trails will be used to identify Project-related user created trails.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $237,000.

REFERENCES

CalFire. 2018. Fire and Resource Assessment Program (FRAP). August.

PG&E (Pacific Gas and Electric Company). 2017. Pre-Application Document. Volume I: Public Information, Sections 1-7. April.

USFS-MNF (U.S. Forest Service, Mendocino National Forest). 1995, as amended 2007. Mendocino National Forest Land and Resource Management Plan (LRMP). February. Available at https://www.fs.usda.gov/detailfull/mendocino/landmanagement/planning/?cid=fsbdev3_004518&width=full

STUDY REC 1
Recreation Facility Assessment

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Recreation use and opportunities in the vicinity of the Project.
- Public safety.

PROJECT NEXUS

- Pacific Gas and Electric Company (PG&E) is currently responsible for addressing Project-related recreational needs and maintaining public safety associated with operation and maintenance of the Project.
- Proposed changes in Project facilities and operations could affect Project-related recreational and public safety needs.

RELEVANT INFORMATION

The following information is available and was reviewed to determine recreation facility study needs (refer to PG&E's Pre-Application Document [PAD] Section 5.9 for a summary of recreation resource information [PG&E 2017]):

- Information regarding recreation opportunities that is available in maps, pamphlets, and other documents published by the U.S. Forest Service (USFS).
- Recreation facility maps, drawings, and schematics developed and maintained by PG&E and/or the USFS.
- Recreation facility inventory and condition assessments, which are periodically completed and updated by PG&E staff.
- Description of PG&E's existing public safety measures as identified in PAD Section 4.0 and Section 5.9 (PG&E 2017).
- Recreation use estimates and visitor survey data for the Mendocino National Forest (MNF) that were developed by the USFS as part of the National Visitor Use Monitoring (NVUM) program and reported in the MNF Visitor Use Report (USFS-MNF 2016).
- Project-specific recreation use data collected seasonally by PG&E currently with the assistance of American Land and Leisure (ALL).
- Recreation use estimates developed by PG&E and filed with the Federal Energy Regulatory Commission (FERC) every 6 years as part of the Form 80 recreation use reporting cycle, including reports for the 2002, 2008, and 2014 reporting years (PG&E 2003, 2009, and 2015).

- Demographic information and recreation use and trend data contained in various statewide comprehensive plans and supporting visitor survey information, including: the California Department of Parks and Recreation (CDPR) 2015 Statewide Comprehensive Outdoor Recreation Plan (CDPR 2015); Outdoor Recreation in California's Regions 2013 Report (CDPR 2013); and Survey on Public Opinions and Attitudes on Outdoor Recreation in California 2012, Complete Findings (CDPR 2014).

POTENTIAL INFORMATION GAPS

- Updated Project recreation facility condition assessment at select facilities;
- Information about visitor needs, preferences, and perceptions regarding Project recreation facilities and opportunities; Information regarding recreation use and demand; and
- Information about existing and future recreation needs compared to existing recreation facility features and capacities.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Conduct focused assessments at the developed Project recreation facilities to update information on facility capacity, condition, and consistency with applicable accessibility standards.
- Conduct focused visitor surveys at the Project recreation facilities to identify visitor needs, preferences, and perceptions regarding Project recreation facilities and opportunities.
- Estimate existing recreation use using available information sources and information developed through vehicle counts.
- Identify recreation trends, needs, and potential future recreation demand.
- Conduct surveys of the Native American tribes who use the Eel River below Cape Horn Dam to identify and nature and scope of recreational use of the River.

EXTENT OF STUDY AREA

The Study Area includes the developed Project recreation facilities identified in Table REC 1-1. In addition, the Study Area was expanded to include an assessment of the Pine Point Day Use Area.

Table REC 1-1 Project Recreation Facilities

Family Campgrounds
Fuller Grove Campground
Navy Campground
Oak Flat Campground
Pogie Point Campground
Sunset Point Campground
Trout Creek Campground
Group Campgrounds
Fuller Grove Group Campground
Trout Creek Group Campground
Day Use Facilities
Eel River Visitor Information Kiosk
Fuller Grove Day Use Area and Boat Launch
Pillsbury Pines Day Use Area and Boat Launch
Pogie Point Day Use Area
Lake Pillsbury Low Level Boat Launch
Recreation Access Roads
Fuller Grove Campground Rd
Fuller Grove Day Use Area and Boat Launch Access Rd
Fuller Grove Group Campground Access Rd
Navy Campground Access Rd (18N50)
Navy Campground Loop Rd
Oak Flat Campground Rd
Pillsbury Pines Day Use Area and Boat Launch Access Rd
Pogie Point Campground and Day Use Area Access Rd (18N75)
Pogie Point Campground Loop Rd
Sunset Point Campground East Loop Rd
Sunset Point Campground West Loop Rd
Trout Creek Campground Loop Rd
Trout Creek Campground Rd
Project Recreation Trails
Sunset Nature Trail (10W60)

STUDY METHODS AND ANALYSIS

The Notice of Intent (NOI) Parties will inventory and assess the Project recreation facilities and the Pine Point Day Use Area (hereafter incorporated by reference) to verify and update existing information regarding facility capacity, facility condition, and consistency with design and accessibility standards, as applicable. This information will be used in conjunction with recreation use data and recreation trend information to: (1) document current recreation use with respect to current facility capacity; and (2) identify whether the existing recreation facilities can accommodate future needs; and (3) identify visitor needs, preferences, and perceptions regarding Project recreation facilities and associated opportunities.

Recreation Facility Inventory and Assessment

- Develop a Geographic Information System (GIS)-based map showing the location of existing Project recreation facilities identified in Table REC 1-1 and associated parking areas.
- Develop footprints showing the approximate boundaries of developed Project recreation facilities. These footprints will be developed by either: (1) digitizing existing PG&E or USFS footprint maps; or (2) taking measurements in the field using a portable Global Positioning System (GPS). In either case, the information will be incorporated into the GIS database.
- Obtain and review current USFS and PG&E recreation facility inventory information. Determine how the existing inventory information should be augmented in consultation with the USFS.
- Obtain and review current USFS design and accessibility standards.
- Compile, review, and summarize information developed through the FERC inspection process.
- Identify current operation and maintenance activities at Project recreation facilities and responsible parties.
- Develop a Facility Inventory Form in consultation with the USFS.
- Conduct an inventory of each facility identified on Table REC 1-1 to verify the number of camp sites, number of picnic sites, and number of parking stalls, as applicable. This information will be used to document and verify the capacity of each facility, including parking capacity.
- Inventory and assess the condition of the following facility and site features and amenities relative to the following design and accessibility standards: the Architectural Barriers Act Accessible Standards (ABAAS), the Forest Service Outdoor Recreation Area Guidelines (FSORAG), the Forest Service Trail Accessibility Guidelines (FSTAG), the USFS Built Environment Image Guide (BEIG), the USFS Recreation Opportunity Spectrum (ROS), and the USFS Sign and Poster Guidelines.

  - Bathroom buildings, including type and location;
  - Water distribution system, including location and functionality (e.g., height, handles, sumps, approach);
  - Garbage containers, including location and functionality (e.g., lids/handles);
  - Signage and information boards;
  - Pathways;
  - Parking areas;
  - Boat ramps;
  - Camp site and picnic site amenities such as picnic tables, grills, and fire rings;
  - Camp site and picnic accessibility, including overall size, clearance distances between amenities, presence/absence of obstacles and protrusions;
  - Parking spurs, including dimensions and condition of surface treatments;
  - Presence of hazard trees and/or excessive vegetation; and
  - Drainage features such as culverts and water bars.
- Photograph select features at Project recreation facilities to illustrate current facility condition.
- Map vegetation, including canopy cover, within the boundaries of the developed Project recreation facilities using guidelines to be provided by the USFS. This effort will be conducted in coordination with Study TERR 1 – Botanical Resources.
- Document site conditions pertaining to erosion and sedimentation within the developed recreation facility boundaries. This effort will be conducted in coordination with Study AQ 4 – Geomorphology.

Focused Visitor Surveys

- Conduct recreation visitor surveys at the developed Project recreation facilities listed in Table REC 1-1 to identify visitor demographics, needs, preferences, and perceptions.
- The survey instrument will be developed in consultation with the USFS but in general will be designed to develop information about visitor demographics, needs, preferences, and perceptions regarding the Project recreation facilities. In addition, the surveys will be designed to:
  - Identify activities visitors participate in when visiting a Project recreation facility;
  - Identify other areas in the vicinity of the Project recreation visitors utilize (dispersed use);
  - Identify why people visit Lake Pillsbury, including reasons that may involve landscape character and scenic integrity;

  - Identify motorized and non-motorized recreation opportunities;
  - Collect the following information, which will be used for Study REC 2 – Reservoir Recreation Opportunities:
    - Adequacy and maintenance of reservoir recreation support facilities, including boat ramps, parking areas, bathrooms, beaches, picnic areas, campgrounds;
    - Relationship between water surface elevation (WSE), user satisfaction, ability to participate in activities, and timing of visitation;
    - Adequacy of shoreline access from developed facilities for specific recreation activities;
    - Potential user conflicts (i.e., overall crowding or conflicts between competing recreation uses); and
    - Adequacy of publicly available WSE information.
    - Visitation trends related to water year types.

- The recreation visitor surveys will be conducted on randomly selected weekdays (one day per week), weekend days (one day per week), and all holidays (Memorial Day, July 4th, and Labor Day) throughout the peak recreation season (Memorial Day through Labor Day) according to a pre-established schedule, as water levels decline so that visitor responses can be correlated to specific WSEs. The schedule and specific survey implementation protocols will be developed in consultation with the USFS and other interested stakeholders.
- The survey instrument will be administered in both English and Spanish (or up to one other language).

Oak Flat Campground Surveys

- Unlike the other Project recreation facilities, Oak Flat Campground is open year- round. Therefore, additional surveys will be conducted at Oak Flat Campground to obtain information about recreation visitors and use between September and May.
- The extended surveys at Oak Flat Campground will be administered by the campground caretaker on one week day and one weekend day per week during the survey period using the aforementioned survey instrument.

Recreation Use Assessment

- PG&E collects recreation use data and provides the FERC with recreation use estimates for the Potter Valley Project every 6 years in conjunction with the Form 80 reporting cycle. PG&E's recreational use estimates for reporting years 2002, 2008, and 2014 will be used to summarize overall recreation use in the Van Arsdale Reservoir and Lake Pillsbury areas, and to characterize changes in use over time.

- PG&E contracts with a concessionaire (currently ALL) to operate and maintain the Project recreation facilities identified on Table REC 1-1. The concessionaire is responsible for operating and maintaining the Project recreation facilities, for collecting day and overnight use fees at the Project campgrounds and day use areas, and for documenting and reporting recreation use levels based on fee receipts.
  - The data collected by the concessionaire will be compiled and used to tabulate and document daily site occupancy at the Project recreation facilities.
  - The data collected by the concessionaire will be used in combination with the information developed through the visitor surveys (e.g. average number of people per vehicle and average length of stay) to estimate recreation use at the Project campgrounds and day use facilities in recreation days (a unit used by the FERC) and in recreation visitor days (a unit used by the USFS).
- The fee collection and recreation use data collection procedures will be reviewed prior to the start of the recreation season to identify potential gaps and to identify procedures for augmenting the data, if necessary, in coordination with the concessionaire.
- The concessionaire does not collect fees or use data at the Eel River Visitor Information Kiosk, the Pine Point Day Use Area, or at undeveloped parking areas and turn-outs that may be present along the roads adjacent to Lake Pillsbury. Therefore, recreation use estimates for these areas will be developed through vehicle counts, to be conducted in conjunction with, and on the same schedule as the visitor surveys discussed above.
  - Data derived through the visitor surveys (e.g. average number of people per vehicle and average length of stay) will be used along with the vehicle count data to estimate day use at the at the Eel River Visitor Information Kiosk, the Pine Point Day Use Area, and at the undeveloped parking areas and turn-outs that may be present along the roads adjacent to Lake Pillsbury.
- Utilize recreation use data along with recreation facility capacity information collected as part of the facility assessment described above to determine if current facility capacity is sufficient to meet current use levels.

Recreation Trends, Needs, and Demand Assessment

- Obtain and summarize information regarding future recreation needs and trends contained in the following documents:
  - Statewide Comprehensive Outdoor Recreation Plan and supporting survey information (CDPR 2015);
  - MNF Land and Resource Management Plan (LRMP) (USFS-MNF 1995);
  - MNF LRMP Amendment 2007-01 (USFS-MNF 2007); and
  - MNF Visitor Use Report (USFS-MNF 2016).

- Utilize the recreation needs and trends information contained in the above reports, along with recreation use data and pertinent information collected through the visitor surveys, to identify whether the existing Project recreation facilities will meet future recreation needs and demand.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

As shown on Table REC 1-1, some of the Project recreation facilities are located on land owned by PG&E and some are located on National Forest System Land managed by the MNF. For consistency, all of the developed recreation facilities will be assessed relative to USFS design and accessibility criteria, which are described in the following documents:

- Forest Service Outdoor Accessibility Guidelines (FSORAG) (USFS 2013a)
- Forest Service Trail Accessibility Guidelines (FSTAG) (USFS 2013b)

These guidelines include accessibility standards required under the Americans with Disabilities Act (ABA) and Architectural Barriers Act (ABS).

Traffic signage, barriers, and gates will be assessed relative to standards contained in the Manual of Uniform Traffic Control Devises (MUTCD) (FHA 2009, with 2012 revisions).

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

- The condition of Recreation Facility Access Roads, including roads within the boundaries of each of the developed recreation facilities, will be assessed as part of the LAND 1 –Roads and Trails Assessment.
- Survey information developed as part of Study REC 1 – Recreation Facility Assessment will be used to support and inform Study REC 2 – Reservoir Recreation Opportunities.
- Information regarding erosion and sedimentation at Project recreation facilities will be developed as part of Study AQ 4 – Geomorphology.
- Information regarding vegetation and tree canopy within the Project recreation facility boundaries will be developed as part of Study TERR 1 – Botanical Resources.
- Fuel conditions within the Project Recreation facility boundaries will be developed as part of LAND 3 – Hazardous Fuels Assessment.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $359,000.

REFERENCES

CDPR (California Department of Parks and Recreation). 2013. Outdoor Recreation in California's Regions 2013. Available at www.parks.ca.gov/.

CDPR. 2014. Survey on Public Opinions and Attitudes on Outdoor Recreation in California (SPOA) 2012, Complete Findings. January. Available at www.parks.ca.gov/.

CDPR. 2015. 2015 Statewide Comprehensive Outdoor Recreation Plan (SCORP). Available at www.parksforcalifornia.org/scorp.

FHA (Federal Highway Administration). 2009. Manual on Uniform Traffic Control Devices (MUTCD). 2009 Edition, including Revisions 1 and 2 dated May 2012. PG&E (Pacific Gas and Electric Company). 2003. Form 80 Recreation Use Reports for the Van Arsdale Reservoir and Lake Pillsbury Developments.

PG&E (Pacific Gas and Electric). 2009. Form 80 Recreation Use Reports for the Van Arsdale Reservoir and Lake Pillsbury Developments.

PG&E. 2015. Form 80 Recreation Use Reports for the Van Arsdale Reservoir and Lake Pillsbury Developments.

PG&E. 2017. Pre-Application Document. Volume I: Public Information, Sections 1-7. April.

United States Access Board. 2015. Architectural Barriers Act (ABA) Standards (2015). Available at: https://www.access-board.gov/attachments/article/1029/ABAstandards.pdf

USFS (U.S. Forest Service). 2001. Built Environment Image Guide (BEIG) for the National Forests and Grasslands. FS-710. September 2001.

USFS. 2013a. Forest Service Outdoor Accessibility Guidelines (FSORAG).

USFS. 2013b. Forest Service Trail Accessibility Guidelines (FSTAG).

USFS. 2013c. Sign and Poster Guidelines for the Forest Service. EM7100-15. Revised October 2013.

USFS-MNF (U.S. Forest Service, Mendocino National Forest). 1995. Mendocino National Forest Land and Resource Management Plan (LRMP). February. Available at http://www.fs.usda.gov/detailfull/mendocino/landmanagement/.

USFS-MNF. 2007. LRMP Amendment 2007-01. Available at http://www.fs.usda.gov/detailfull/mendocino/landmanagement/.

USFS-MNF. 2016. Visitor Use Report. National Visitor Use Monitoring Data Collected FY 2013. September.

STUDY REC 2
Reservoir Recreation Opportunities

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Reservoir-based recreational opportunities.

PROJECT NEXUS

- Pacific Gas and Electric Company (PG&E) is currently responsible for providing for public access to Project reservoirs, consistent with recreational needs.
- Project operations result in water surface elevation (WSE) changes at Lake Pillsbury that may affect reservoir recreation opportunities and use.
- Proposed changes in Project facilities and operations would affect reservoir recreation opportunities and use at Lake Pillsbury.

RELEVANT INFORMATION

The following information is available and was reviewed to determine reservoir-based recreation opportunity study needs (refer to PG&E's Pre-Application Document [PAD] Section 5.9 for a summary of recreation resource information [PG&E 2017]):

- Daily WSE data for Lake Pillsbury from U.S. Geological Survey (USGS) Gage 1147000 (Lake Pillsbury near Potter Valley, CA).
- Lake Pillsbury WSE versus surface acreage relationship.
- Information developed during meetings between PG&E and the owners of recreation residences and resorts in the vicinity of Lake Pillsbury regarding reservoir-based recreation opportunities and use.
- Information on recreational opportunities on Lake Pillsbury available in maps, pamphlets, and other documents published by the U.S. Forest Service (USFS), PG&E, and private resort owners.
- Recreation visitor survey data for the Mendocino National Forest (MNF), which were developed by the USFS as part of the National Visitor Use Monitoring (NVUM) program and reported in the MNF Visitor Use Report (USFS-MNF 2016).
- Description of existing PG&E shoreline management practices and public safety measures at Project reservoirs as identified in PAD Section 4.0 and PAD Section 5.9.
- Stakeholder questionnaire responses, which are summarized in PAD Appendix A.
- Maps and drawings of the developed recreation facilities surrounding Lake Pillsbury, including boat ramps.

POTENTIAL INFORMATION GAPS

- Specific information about reservoir-based recreation opportunities at Lake Pillsbury;
- Specific information about the relationship between WSE and recreation opportunities and visitor experience/preference at Lake Pillsbury; and
- Information about dispersed recreation use in the vicinity of Lake Pillsbury.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Characterize reservoir recreation opportunities and operational constraints at Lake Pillsbury.
- Conduct a focus group meeting/workshop with the Lake Pillsbury homeowners to identify potential issues and concerns related to WSE at Lake Pillsbury and possible solutions.
- Conduct recreation visitor surveys at the developed recreation facilities surrounding Lake Pillsbury to identify potential issues related to reservoir WSE (see Study REC-1 visitor surveys).
- Identify dispersed recreation use areas that are be located within the FERC Project boundary surrounding Lake Pillsbury.

EXTENT OF STUDY AREA

The Study Area includes Lake Pillsbury and the area within the FERC Project boundary surrounding the reservoir. In addition, the Study Area includes the developed Project recreation facilities.

STUDY METHODS AND ANALYSIS

Identify Reservoir Recreation Opportunities and Operational Constraints

- Identify and characterize reservoir recreation opportunities at Lake Pillsbury, including organized fishing events such as the annual pike minnow derby.
- Based on current license conditions, characterize reservoir operations and constraints at Lake Pillsbury.
- Based on recreation facility design drawings and analysis of historical reservoir WSE data at Lake Pillsbury, characterize seasonal functionality of boat ramps and other Project recreation facilities (e.g., campgrounds and day use areas).

Focus Group Meeting/Workshop

- Conduct a focus group meeting/workshop with the Lake Pillsbury homeowners and local users to identify potential issues and concerns related to WSE at Lake Pillsbury and possible solutions.
  - The focus group discussion will be guided by a professional facilitator and a recreation specialist.
  - For consistency, and to help facilitate the analysis, feedback from the homeowners will be solicited using a survey instrument developed in consultation with stakeholders, focusing on specific concerns related to WSE at Lake Pillsbury.

Visitor Surveys

- Conduct recreation visitor surveys at the developed recreation facilities surrounding Lake Pillsbury to assess visitor satisfaction and demand as it relates to Lake Pillsbury, and to identify potential issues related to reservoir WSE, including for example:
  - Adequacy and maintenance of recreation support facilities (e.g., boat ramps, parking areas, bathrooms, beaches, picnic areas, campgrounds);
  - Adequacy of safety signage and other public safety features;
  - Relationship between WSE, user satisfaction, ability to participate in activities, and timing of visitation;
  - Adequacy of shoreline access from developed facilities for specific recreation activities;
  - Potential user conflicts (i.e., overall crowding or conflicts between competing recreation uses);
  - Adequacy of publicly available WSE information;
  - Availability of angling opportunities and angling satisfaction,
  - Water quality concerns; and
  - Satisfaction and preferences.
- These visitor surveys will be conducted as part of the Study REC 1 – Recreation Facility Assessment.
- The recreation visitor survey instrument and survey protocols will be developed in consultation with the USFS.
- The recreation visitor surveys will be conducted on randomly selected weekdays, weekend days, and holidays throughout the peak recreation season (Memorial Day through Labor Day), according to a pre-established schedule, as water levels decline so that visitor responses can be correlated to specific WSE. The survey instrument and schedule will be developed in consultation with stakeholders. Refer to Study REC 1 for

additional information about how the surveys will be implemented. In addition, the visitor survey will be mailed to recreation groups and associations that frequent the area.

- The survey instrument will be administered in both English and Spanish (or up to one other language).

Dispersed Recreation Use

- Identify dispersed use areas located within the FERC Project boundary surrounding Lake Pillsbury in consultation with the USFS and through observational surveys.
  - Observational surveys will be conducted from nearby roads and/or by boat.
  - Observational surveys will occur once a week between Memorial Day and Labor Day in conjunction with visitor surveys to ascertain whether the location and/or extent of dispersed use areas change as reservoir WSEs decline.
  - The numbers of users present at each dispersed use area will be counted and activities will be recorded to the extent discernable from the road and/or a boat (i.e., without visitor contact).
- Develop footprints showing the approximate boundaries of dispersed use areas where footprints are discernable, using a portable Global Positioning System (GPS) unit. All data will be incorporated into the Geographic Information System (GIS) database for future reference and analysis.
- Photograph dispersed recreation use areas to illustrate current condition. For safety reasons, photographs will only be taken when recreation users are not present.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The focus group session and visitor surveys to be conducted as part of this study are commonly used in relicensing studies.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

- Recreation facility inventory and assessment information developed as part of Study REC 1 – Recreation Facility Assessment will be used to describe the recreation facilities in the vicinity of Lake Pillsbury.
- The visitor surveys to be conducted for Study REC 1 – Recreation Facility Assessment will be used for Study REC 2 – Reservoir Recreation Opportunities.

- Project operations information developed for Study AQ 1 – Hydrology and Project Operations Modeling will be used to describe reservoir operations and constraints.
- Information developed as part of Study AQ 6 – Lake Pillsbury Fish Habitat and Study AQ 9 – Fish Populations will be used to describe potential fishing opportunities at Lake Pillsbury.
- Information regarding Project-related user-created roads and trails developed as part of Study LAND 1 – Project Roads and Trails will be used to identify dispersed use areas around Lake Pillsbury.
- Information about Project-related dispersed use developed as part of Study REC 2 – Reservoir Recreation Opportunities will be used to determine the Study Area extent for the LAND 3 – Hazardous Fuels Assessment.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $185,000.

REFERENCES

PG&E (Pacific Gas and Electric Company). 2017. Pre-Application Document. Volume I: Public Information, Sections 1-7. April.

USFS-MNF (U.S. Forest Service, Mendocino National Forest). 2016. Visitor Use Report. National Visitor Use Monitoring Data Collected FY 2013. September.

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STUDY REC 3
Whitewater Boating

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Whitewater boating flows.

PROJECT NEXUS

- Existing Project operations modify the flow regime in the Eel River, potentially affecting whitewater boating flows (timing and/or duration).
- Potential changes in Project facilities and operations could affect whitewater boating flows.

RELEVANT INFORMATION

The following information is available and was reviewed to determine whitewater boating study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.9 for a summary of recreation resource information and to Section 4.5 for gage information [PG&E 2017]):

- Descriptions of whitewater boating runs on the Eel River, including access points (put-ins, take-outs), difficulty ratings, hazards, and boatable flow ranges are available on the internet and in published whitewater boating guides.
- Flow data is available for the Eel River from various gages maintained by PG&E and/or the U.S. Geological Survey (USGS), including two Project gages identified as USGS Gage 11470500 (Eel R BL Scott Dam NR Potter Valley, CA) and USGS Gage 11471500 (Eel R Van Arsdale Dam NR Potter Valley, CA).

POTENTIAL INFORMATION GAPS

- Additional information about whitewater boating resources and boatable flow ranges on the Eel River.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Conduct a whitewater boating assessment to develop additional information about whitewater resources and opportunities on the Eel River upstream of the Middle Fork Eel River confluence. The study will utilize existing information, augmented by information collected through: a hydrology analysis; interviews and/or Focus Group

sessions with knowledge boaters; a site visit; and a contingency whitewater boating flow study, if warranted.

EXTENT OF STUDY AREA

The Study Area includes the following four whitewater boating runs located on the Eel River between Scott Dam and the Middle Fork Eel River confluence, the locations of which are shown on Map REC 3-1:

- Eel River from below Scott Dam to Trout Creek Campground (Pillsbury Run)
- Eel River from below Cape Horn Dam to Hearst (Van Arsdale to Hearst Run)
- Eel River from Hearst to Highway 162 Bridge over the Eel (Hearst Run)
- Highway 162 Bridge over the Eel to Highway 162 Milepost 14.5 above the Middle Fork Eel River (Outlet Creek Run)

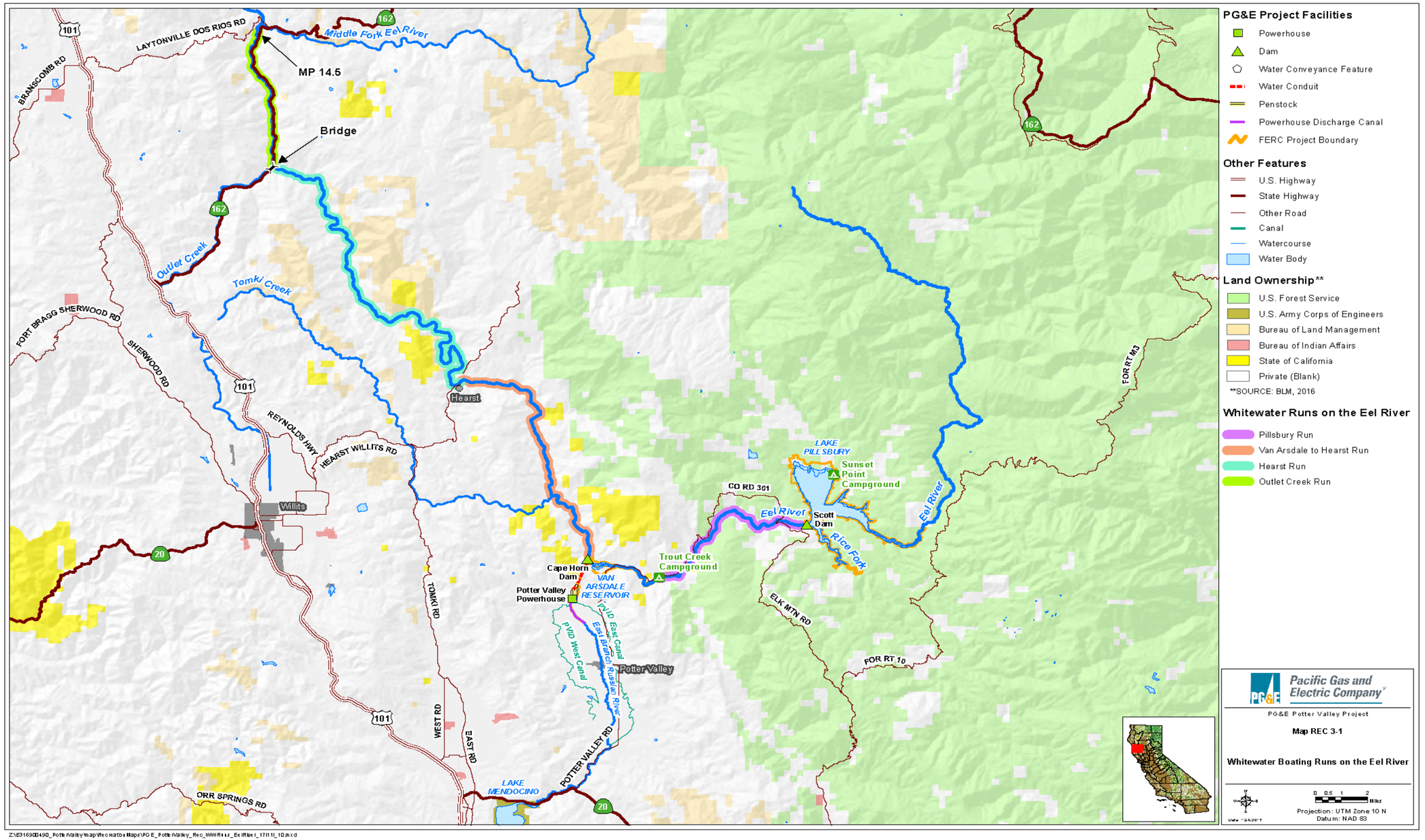
In addition, the Study Area includes areas along Lake Pillsbury used as take-outs for the Upper Main Eel River Run (e.g. Sunset Point Campground).

STUDY METHODS AND ANALYSIS

The whitewater boating assessment will be conducted following the general methods contained in the following document: Flows and Recreation: A Guide to Studies for River Professionals (Whittaker et al. 2005). This document outlines a phased approach, with each phase building on information developed during the previous phase.

Hydrology Assessment

- Identify, map, and characterize existing stream gaging stations in the Eel River, including location, equipment, and data collection capabilities.
- Summarize the hydrology of the Eel River using data available from existing gages.
- Describe how Project operations modify flows on the Eel River, including hourly, daily, and monthly flows, to the extent possible utilizing existing data.
- Characterize historic spill and cessation rates.
- Summarize water surface elevations (WSE) in Lake Pillsbury in relation to flows in the Eel River upstream of Lake Pillsbury.



Map REC 3-1 Whitewater Boating Runs on the Eel River

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Interviews and Focus Group Session

- Develop information about whitewater boating resources on the Eel River upstream of the Middle Fork Eel River confluence using existing information contained in published whitewater guide books and available on the internet (e.g., at www.cacreeks.com, www.awa.org, and www.awetstate.com), augmented by information collected through targeted phone interviews with experienced commercial boating outfitters and private boaters.
- Conduct a Focus Group meeting with whitewater boaters with experience on the Eel River to develop additional information about boating opportunities on the Eel River. The Focus Group will include commercial and private whitewater boaters, non-governmental agencies (NGOs), and resource agency recreation staff. Recreation Technical Working Group (TWG) participants will be invited to participate in the Focus Group meeting.
- The meeting will include a presentation that summarizes existing information about the four runs on the Eel River and the results of the hydrologic assessment.
- This discussion will focus on developing additional details about the boating runs (including areas on Lake Pillsbury that are used as take outs for the Upper Main Eel River Run), existing and potential uses, formal and potential put-ins and take-outs, including access conditions or constraints, boatable flow ranges, types of watercraft used, and timing (i.e., boating season).
- Based on collaboration with the Recreation TWG and the Focus Group, determine whether a site visit and/or whitewater flow study is necessary to develop additional information.

Site Visit

- Conduct a site visit with experienced commercial and private whitewater boaters, as appropriate, to develop an enhanced understanding of Project operations, the quality and characteristics of the boating runs, discuss boatable flow ranges, identify obvious hazards, and determine whether a whitewater boating flow study(ies) is necessary. Recreation TWG participants will be invited to participate in the site visit.
- The site visit would be completed during the winter/spring 2019 when boatable flows are present on the river.

Potential Whitewater Boating Flow Study(s) – Contingency Study

- If determined necessary, based on collaboration with the Recreation TWG and the Focus Group, conduct a whitewater boating flow study on the Eel River between Scott Dam and the Middle Fork Eel River confluence (up to four runs).
  - Develop a whitewater boating survey instrument in collaboration with the Recreation TWG and the Focus Group. The survey instrument will be used to

obtain information on physical logistics and the experiential values of whitewater boating runs under different flows.

- Conduct whitewater flow studies to refine boatable flow ranges for a variety of watercraft used by both commercial and private boaters, representing a range of interests and skill levels.
- The types of watercraft used in the whitewater boating study(s) will be based on the types of watercraft identified by the focus group participants.
- PG&E's ability to manage flows for a controlled flow studies are limited due to infrastructure, operational and regulatory constraints. Accordingly, if flow studies are necessary, the studies would be conducted on natural flows, or on a spill event, depending upon the target flow ranges that are identified in consultation with the Focus Group.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The whitewater boating study methods will generally follow the methods outlined in the following document: Flows and Recreation: A Guide to Studies for River Professionals (Whittaker et al. 2005). The methods described in this document are consistent with generally accepted practices for assessing whitewater boating opportunities and flows.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible, as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

Information developed as part of Study AQ 1 – Hydrology and Project Operations Modeling will be used to conduct the hydrology assessment, including the spill cessation analysis.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is as follows: $169,000.

REFERENCES

PG&E (Pacific Gas and Electric Company). 2017. Pre-Application Document. Volume I: Public Information, Sections 1-7. April.

Whittaker, Doug, B. Shelby, and J. Gangemi. 2005. Flows and Recreation: A Guide to Studies for River Professionals. October 2005. Available at: http://www.hydroreform.org/sites/default/files/flowrec.pdf.

STUDY TERR 1
Botanical Resources

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Vegetation communities and associated wildlife habitats, including sensitive natural communities and riparian/wetland communities.
- Special-status vascular plants.
- Introduction or spread of invasive plants.

PROJECT NEXUS

- Existing Project operations modify the flow regime in river reaches, including the Eel River from Scott Dam to Van Arsdale Reservoir; Eel River from Cape Horn Dam to Middle Fork Eel River; and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino. The modified flow regime may affect the amount and distribution (temporal and spatial) of riparian vegetation.
- Project maintenance activities could result in direct loss or degradation of vegetation communities, including communities afforded special recognition by state and federal agencies (e.g., rare natural communities, riparian, and jurisdictional Waters of the United States).
- Project maintenance activities could result in removal or disturbance of special-status vascular plant populations.
- Project maintenance activities could result in the introduction or spread of invasive plants.
- Proposed changes in Project facilities could affect riparian and wetland communities from Lake Pillsbury to the Middle Fork Eel River.

RELEVANT INFORMATION

The following information is available and was reviewed to determine botanical resource study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.4 for a summary of botanical resource information [PG&E 2017]):

- Vegetation alliances present within 1 mile of the Federal Energy Regulatory Commission (FERC) Project boundary and river reaches potentially affected by Project operations based on U.S. Forest Service (USFS) Classification and Assessment with Landsat of Visible Ecological Groupings (CALVEG) (USFS 2016a).
- Special-status plant species known or expected to occur within 5 miles of the FERC Project boundary and river reaches potentially affected by Project operation based on

the California Native Plant Society (CNPS) online inventory, California Department of Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB), USFS Pacific Southwest Region 5 Mendocino National Forest (MNF) sensitive animal and special interest plant list (CNPS 2016; CDFW 2016a, CDFW 2016b; USFS 2016b), and U.S. Fish and Wildlife Service (USFWS) federal endangered and threatened species spatial data (USFWS 2016).

- Invasive plants known to occur within 5 miles of Project facilities potentially affected by Project maintenance activities based on MNF invasive species data, and California Department of Food and Agriculture (CDFA) and California Invasive Plant Council (Cal-IPC) invasive plant lists (USFS 2016b; CDFA 2016; Cal-IPC 2016).

POTENTIAL INFORMATION GAPS

- Updated information on vegetation communities, including communities afforded special recognition by state and federal agencies, adjacent to Project facilities and features (Table TERR 1-1, Table TERR 1-2, and Table TERR 1-3).
- Distribution, abundance, and condition of riparian and wetland resources in Project-affected river reaches.
- Information on special-status vascular plant populations at Project facilities and features.
- Information on invasive plant locations at Project facilities and features.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Through field surveys, update vegetation community mapping, including locations of communities afforded special recognition by state and federal agencies (e.g., rare natural communities, riparian, and jurisdictional Waters of the United States), adjacent to Project facilities and features.
- Conduct field surveys to characterize riparian and wetland vegetation communities in Project-affected river reaches.
- Conduct field surveys for special-status vascular plant populations at Project facilities and features.
- Conduct field surveys for invasive plants at Project facilities and features.

Table TERR 1-1 Project Facilities and Features

Dams and Reservoirs
Dams
Scott Dam
Cape Horn Dam
Reservoirs
Lake Pillsbury (storage reservoir)
Van Arsdale Reservoir (forebay)
Diversion System
Intake Structures
Van Arsdale Diversion Intake
Tunnels and Adits
Tunnel No. 1
Tunnel No. 2
Tunnel No. 1 Slide Gate and Adit
Tunnel No. 1 Gage Shaft
Conduits, Penstocks, Control and Valve Houses
Cape Horn Dam Instream Flow Release
Scott Dam 72-inch Butterfly Valve Control House
Scott Dam 42-inch Needle Valve Control House (Instream Flow Release)
Conduit No. 1 (Upper Wood Stave, Steel Pipe and Components)
Conduit No. 2 (Lower Wood Stave, Steel Pipe and Components)
Conduit No. 1, 72-inch Butterfly Valve House, Standpipe and Surge Chamber Vent
Penstock No. 1
Penstock No. 2
Penstock Nos. 1 and 2, 60-inch Gate Valves (2)
Penstock Bypass Channel
Powerhouse Bypass System
Powerhouse, Switchyard, and Tailrace
Potter Valley Powerhouse
Potter Valley Powerhouse Switchyard
Potter Valley Powerhouse Tailrace, Radial Gate, and Venturi Flume
Potter Valley Powerhouse Discharge Canal

Gaging Stations, Weirs, and Piezometers
Reservoir Gage
E1 - Lk Pillsbury NR Potter Valley CA (11470000)
Diversion Gages
E5 - Potter Valley Irrig CN E5 NR Potter Valley CA (11471105)
E6 - Potter Valley Irrig CN E6 NR Potter Valley CA (11471106)
EC6 - Potter Valley Irrig CN 5+6 NR Potter Valley CA (11471100) (calculated gage)
E7 - Potter Valley PH (TR only) NR Potter Valley CA (11471099) (calculated gage)
E16 - Potter Valley PH Intake near Potter Valley CA (11471000)
River Gages
E2 - Eel R BL Scott Dam NR Potter Valley CA (11470500)
E11 - Eel River at Van Arsdale Dam near Potter Valley CA (11471500)
Leakage Weirs
Cape Horn Dam Leakage Weirs
Scott Dam Leakage Weirs
Piezometers
Cape Horn Dam Piezometers
Scott Dam Piezometers
Project Communication/Power Lines
Conduit No. 1, 72-inch Butterfly Valve House Communication/Power Line
Scott Dam Block Building Communication/Power Line
Cape Horn Dam Control Building Communication/Power Line
Fish Screen Facility Communication/Power Line
Penstock Nos. 1 and 2, 60-inch Stop Valves Communication/Power Line
Tunnel No. 1 Slide Gate and Adit Communication/Power Line
Fish Screen, Fish Ladder, and Associated Facilities
Cape Horn Dam Fish Ladder Inlet / Outlet
Van Arsdale Fish Screen Facility
Van Arsdale Fish Screen Facility Back-up Generator Building
Van Arsdale Fish Screen Facility Motor Control Building
Van Arsdale Fish Return Channel

Table TERR 1-2 Project Roads and Trails

Project Facility Access Roads
Cape Horn Dam East Access Rd
Gage E2 Access Rd
Intake Access Rd
Penstock, Pipeline and Butterfly Valve House Access Rd
Powerhouse Main Access Rd
Scott Dam Rd
Upper Scott Dam Access Rd
Recreation Facility Access Roads
Fuller Grove Campground Rd
Fuller Grove Day Use Area and Boat Launch Access Rd
Fuller Grove Group Campground Access Rd
Navy Campground Access Rd (18N50)
Navy Campground Loop Rd
Oak Flat Campground Rd
Pillsbury Pines Day Use Area and Boat Launch Access Rd
Pogie Point Campground and Day Use Area Access Rd (18N75)
Pogie Point Campground Loop Rd
Sunset Point Campground East Loop Rd
Sunset Point Campground West Loop Rd
Trout Creek Campground Loop Rd
Trout Creek Campground Rd
Project Facility Access Trails
Gage E11 Access Trail
Scott Dam Piezometers and Leakage Weirs Access Trail
Project Recreation Trails
Sunset Nature Trail (10W60)

Table TERR 1-3 Project Recreation Facilities

Family Campgrounds
Fuller Grove Campground
Navy Campground
Oak Flat Campground
Pogie Point Campground
Sunset Point Campground
Trout Creek Campground
Group Campgrounds
Fuller Grove Group Campground
Trout Creek Group Campground
Day Use Facilities
Eel River Visitor Information Kiosk
Fuller Grove Day Use Area and Boat Launch
Pillsbury Pines Day Use Area and Boat Launch
Pogie Point Day Use Area
Lake Pillsbury Low Level Boat Launch

EXTENT OF STUDY AREA

- The Study Area for vegetation community mapping includes areas within FERC Project boundary (plus a 0.5-mile buffer), and areas within 0.5 mile of Project facilities currently outside the FERC Project boundary.
- The Study Area for riparian and wetland surveys includes the following:
  - Eel River between Scott Dam and the Middle Fork Eel River confluence;
  - East Branch Russian River between Potter Valley Powerhouse and Lake Mendocino; and
  - Two comparison river reaches approximately three miles long each: (1) Eel River upstream of Lake Pillsbury (approximately from below Thistle Glade Creek to Copper Butte Creek, RM 173.4–176.6); and (2) Middle Fork Eel River (approximately from the Eel River confluence to Little Water Canyon, RM 0.0-3.0). The location of the comparison reaches may be modified in coordination with Study AQ 4 – Fluvial Processes and Geomorphology.
- The Study Area for special-status and invasive plants includes areas within the FERC Project boundary (plus a 200-foot buffer), and areas adjacent to Project facilities currently outside the FERC Project boundary (plus a 200-foot buffer).

- Specifically excluded from the Study Area are areas where access is unsafe (very steep terrain or high water flows) or private property for which Notice of Intent (NOI) Parties have not received specific approval from the landowner to enter the property to perform the study. NOI Parties will make a good faith effort to obtain access to private property to conduct the study. Lands where ground-truthing cannot be conducted because of safety concerns or the lands are privately owned will be classified and mapped based on aerial photographs and best professional judgment, and identified as such in the final map products.

STUDY METHODS AND ANALYSIS

Vegetation Community Mapping

Preliminary Vegetation Mapping

- To develop a preliminary vegetation map, existing vegetation types mapped by USFS CALVEG will be reviewed in a geographic information system (GIS) using publicly available aerial photography. CALVEG polygon boundaries will be revised based on desktop interpretation of the imagery in addition to reconnaissance surveys which will allow for signatures of the various vegetation types to be assessed. All general vegetation plant communities will be mapped at a minimum mapping unit size of 1.0 acre except where sensitive natural communities are identified, in which case, the area will be mapped to 0.1 acre.
- Each polygon will be assigned a vegetation alliance based on the Manual of California Vegetation, Online Edition (CNPS 2018). Where the classification scheme as defined in the Manual of California Vegetation (2018) is not suitable, there will be coordination with the agencies, and the classification description will be adjusted. Methods will be consistent with the CNPS/CDFW standards and protocols for vegetation sampling and mapping (CNPS/CDFW 2014). In addition, documented locations of sensitive natural communities (Isle 2003; USACE 2015; SCWA 2016) will be overlaid on the map to ensure accurate mapping of these community types.

Field Validation

- The vegetation mapping will be field-verified to ensure correct interpretation of vegetation types. Ground-truthing of riparian vegetation will be conducted primarily at the intensive riparian study sites, and ground-truthing of wetlands will be conducted primarily at the wetland study sites (see Riparian and Wetland Surveys below).
- Three areas of each CALVEG upland community types will be ground-truthed, with the ecotones between community types receiving the greatest scrutiny. To the extent feasible, given access constraints and safety concerns, ground-truthing will be distributed throughout the upland vegetation types' ranges in the Study Area. Locations that may support sensitive natural communities will be included in ground-truthing surveys to ensure these vegetation communities are accurately documented. Any area

in the aerial imagery deemed to be ambiguous will be examined on the ground to confirm the mapping type.

- Incidental observations of any special-status plant, fungi species, or invasive plants will be documented on field data sheets or specific incidental species observation forms, and compiled into a single database of incidental observations that can be used as a reference for other analyses. Incidental observation will be recorded with a GPS.

Final Vegetation Mapping

- Upon completion of field ground-truthing, boundaries of vegetation community polygons will be revised in GIS, and vegetation types will be revised as necessary.

Analysis

- The total acreage will be determined for each vegetation type within the Study Area. To determine if any sensitive natural communities are present in the Study Area, mapped vegetation alliances will be compared against the most recent CDFW List of Vegetation Alliances and Associations. All sensitive natural communities will be included in the final map products.

Riparian and Wetland Surveys

A preliminary visit to the Study Area will be made to: (1) assess general physical and access conditions in riparian and wetland vegetation communities; (2) refine the preliminary map of riparian and wetland vegetation communities (see Vegetation Community Mapping); and (3) select riparian and wetland study sites by identifying representative locations in accessible portions of the Study Area.

Riparian Existing Information Review

- Summarize life history information on the dominant riparian communities, particularly woody riparian species, including recruitment processes, seed windows, and root growth/recruitment flow recession rates.

Riparian Field Surveys

- The selection of riparian study sites will be coordinated with the geomorphic study site selection (Study AQ 4 – Fluvial Processes and Geomorphology) to develop integrated riparian, hydrology, and geomorphology relationships in the Study Area. Six riparian/geomorphology study sites are proposed in the Eel River from Scott Dam to the Middle Fork Eel River and two study sites are proposed in comparison reaches (one in the Eel River upstream of Lake Pillsbury and one in the lower Middle Fork Eel River). Study sites will be approximately 20 to 40 active channel widths long and co-located with the geomorphology study sites (see proposed sites Study AQ 4 – Fluvial Processes and Geomorphology).

- At each riparian/geomorphology study site, three representative cross-sections (transects) perpendicular to the channel will be selected to provide hydraulics and hydrology information (e.g., inundation frequency) and channel geomorphology information (geomorphic surfaces) in coordination with the Study AQ 4 – Fluvial Processes and Geomorphology. Transects will cover the entire riparian corridor, from the boundary with upland vegetation on one side to the boundary on the other side (transects will extend into the uplands so the riparian/uplands boundaries are clear). The ends of each transect will be marked (e.g., rock bolt, rebar stake), recorded with a GPS unit with sub-meter accuracy, and photo-documented with at least one stable reference point (e.g., a large boulder or tree).
- The riparian community along the cross-section will be characterized using a combination of line-point intercept (USFS 2014) and line intercept (Winward 2000) surveys. Riparian communities (e.g., type and age) parallel to the channel will be mapped/recorded along each transect.
    - Along each transect, a line-point intercept survey will be conducted as described in USFS (2014). The vertical layer class occupied by each species that is intercepted will be recorded including: (1) low/understory vegetation (<1 meter [m]), (2) mid-story vegetation (1 to 5 m), and (3) canopy (>5 m). This will be repeated for all species that intercept the points on each transect until the ground is reached, and a ground category (e.g., bare soil, gravel, cobble, boulder, bedrock, or water) will be recorded.
    - Along each transect (including 1 m on either side of the center line), the following additional information will be recorded:
        - Location of the "greenline" as defined by Winward (2000) (i.e., the first perennial vegetation that forms a lineal grouping of community types on or near the water's edge).
        - Location and species of woody seedlings and saplings to track whether recruitment is occurring.
        - Location/boundaries of key geomorphic features such as terraces, floodplain, streambanks, active channel, and in-channel bars (in coordination with Study AQ 4 – Fluvial Processes and Geomorphology).
        - Indications of alteration, bank instability, recreation or other land use impacts, or unusual plant stress or mortality.
        - Invasive or unusual/rare species not detected from the line-point intercept survey.
        - Photo documentation of each transect from four directions (e.g., upstream, downstream, streamside, upslope).
    - Tree and shrub frequency, size, age, and vigor will be assessed at points along each transect using the point-centered quarter method as described in USFS (2014). For

each tree, diameter at breast height (DBH) will be measured, and an age and vigor class will be recorded using the codes in Table TERR 1-4 and Table TERR 1-5. For each shrub, the age and vigor class will be recorded (Table TERR 1-4 and Table TERR 1-5).

- Riparian tree cores will be collected, as appropriate, to assist in ageing trees and identifying recruitment events (i.e., water years with large recruitment).

Table TERR 1-4 Tree and Shrub Age Classes[1]

Tree Age Classes		Shrub Age Classes	
Code	**Age Class**	**Code**	**Age Class**
T1	Seedling (1 year old)	S1	Seedling (≤1 year old)
T2	Recruit/Sapling (2-4 years old)	S2	Recruit (2-4 years old)
T3	Young Tree (4-10 years old)	S3	Mature (>4 years old and <20% dead)
T4	Mature (>10 years old and <20% dead)	S4	Decadent (>4 years old and ≥20% dead)
T5	Decadent (>10 years old and ≥20% dead)		

Notes: Typically age classes will be estimated using best professional judgment including indicators such as the number of branch whorls (in conifers) and reproductive status.

Table TERR 1-5 Tree and Shrub Vigor Classes

Vigor Class	Description
1. Dead	Complete leaf death (that is not attributable to normal winter or summer deciduous species)
2. Critically stressed	Major leaf death and/or branch die back (>50% of canopy affected)
3. Significantly stressed	Prominent leaf death and/or branch die back (21–50% of canopy affected)
4. Stressed	Minimal leaf death and/or branch die back (11–20% of canopy affected)
5. Normal	Little or no sign of leaf stress (5–10% of canopy affected)
6. Vigorous	No sign of leaf stress/very healthy looking canopy (< 5% of canopy affected)

Source: USFS 2014

Wetlands Field Surveys

- Based on the initial vegetation mapping of wetlands, wetland ground-truthing sites will be selected, in consultation with resource agencies, at Lake Pillsbury and Van Arsdale Reservoir (e.g., three at Lake Pillsbury and two at Van Arsdale Reservoir). After the perimeter/extent of the wetland is delineated, the line-point intercept method described above for riparian vegetation (including three transects per site) will be used to characterize the vegetation. The transects will extend from the edge of the reservoir to the upland extent of the wetland to be surveyed, or to the FERC Project boundary, whichever is shortest. Incidental observations of plants and wildlife including special-status and/or invasive species will be documented on field data sheets or specific incidental species observation forms, and compiled into a single database of incidental observations that can be used as a reference for other studies and analyses.

Analysis

- Vegetation types at the survey sites and data collected along each transect will be used to verify and, as necessary, correct the vegetation mapping described in Vegetation Community Mapping.
- The relationship between riparian vegetation processes, hydrologic regime (e.g., frequency, duration, and timing of inundation and flow recession rates), and geomorphic processes as they relate to Project operations will be developed in Study AQ 4 – Fluvial Processes and Geomorphology.
- The line-point intercept survey results will be used to calculate the percent cover of key species (e.g., dominant, representative, and/or invasive species), species diversity (e.g., total number of species), and each vegetation layer across the transects. The wetland indicator status for all plant species encountered will be summarized. This analysis will be used to assess vegetation composition and canopy complexity, and will be reported separately for each transect or averaged across transects to assess each study site.
- The point-centered quarter data (i.e., tree and shrub species, DBH, age, and vigor) will be tabulated and averaged/summarized for each transect. This analysis will be used to assess tree and shrub composition, density, successional stage, and overall health. Depending on the study site characteristics, this data may be reported separately for each transect, averaged across transects, or averaged across vegetation types, to assess each study site.

Special-Status and Invasive Plant Surveys

Existing Information Review

- Special-status plant, lichen, and fungi species will be defined as follows: those listed, proposed, or candidates for listing as rare, threatened, or endangered by the federal government and/or the state of California; those included on the CDFW's most recent *Special Vascular Plants, Bryophytes, and Lichens List* with a California Rare Plant

Rank of 1, 2, 3, or 4; and those designated by USFS as sensitive or watch list within MNF. The target special-status species lists developed for the PAD will be updated by querying the following: USFWS list of federally listed and proposed endangered, threatened, and candidate species; CDFW's CNDDB; CNPS's online Inventory of Rare and Endangered Vascular Plants of California; and USFS's Region 5 MNF documented occurrences of sensitive and watch list plants.

- The target invasive plants list will be reviewed and updated based on the most recent MNF database of invasive plant species documented for the region. Invasive plant species will be defined as noxious by state and federal regulation (i.e., California Code of Regulations Section 4500 A-, B-, and C-rated species as well as Federal Noxious Weed Act noxious species, respectively) and classified by the MNF and Cal-IPC (i.e., high, moderate, and red alert species). The list will be updated based on agency consultation.
- Information on known occurrences of special-status and invasive plant species will be compiled and mapped. Herbaria investigations will be conducted to gather information on each special-status plant, lichen, and fungi species that is documented or may occur in the Study Area. To obtain additional taxonomic and habitat information, field visits (where possible) will be made to reference sites of special-status plant, lichen, and fungi species in the Project vicinity.

Field Surveys

- Conduct field surveys to document the occurrence and distribution of special-status plants and targeted invasive plant species. Field surveys will be floristic in nature; taxonomy and nomenclature will be based on The Jepson Manual (Jepson Flora Project, editors. 2020). Surveys will be conducted during the appropriate blooming periods to accurately determine status of all species encountered (either special-status or invasive status); therefore, two surveys (spring and summer) may be necessary to locate all potential special-status plant species. The survey protocol will follow the *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 1996) and *Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities* (CDFW 2018). Specifically, surveys will be comprehensive for vascular and non-vascular plant species such that "every plant taxon that occurs on site is identified to the taxonomic level necessary to determine rarity and listing status" (CDFW 2018). Surveys for fungi species will be incidental and species observed will be identified only to the extent necessary to determine if they are special-status fungi species.
- Field surveys will be conducted by qualified botanists with: (1) experience conducting floristic surveys; (2) knowledge of plant taxonomy and plant community ecology and classification; (3) familiarity with the plant species of the area; and (4) familiarity with appropriate state and federal statutes related to plants and plant collecting.

- Special-status plant populations identified within the Study Area that continue onto public and/or private lands will be documented so as to inform resource agencies of the presence and general extent of resources of interest that lie beyond the area of reasonable direct impact by the Project. Proposed survey locations on property under private ownership will only be surveyed with the approval of the respective land owner.
- The location and population boundaries of any identified special-status species will be digitally mapped in the field with a GPS receiver capable of not less than 5-m accuracy, and a CNDDB data form or MNF form (in cases where the species is not inventoried by CNPS or CNDDB) will be filled out. Populations less than 0.1 acre in extent will be mapped as points, populations larger than this will be mapped as polygons. Information collected for each population will include the following:
    - number of individuals
    - phenology
    - habitat description (e.g., plant community, dominant species, associated species, substrates/soils, aspect/slope)
    - relative condition of the population (i.e., a qualitative assessment of site quality based upon evident threats [excellent, good, fair, or poor])
    - recognizable risk factors
- Photographs will be taken to document diagnostic floral characteristics, growth forms, and habitat characteristics of special-status species and voucher specimens for verification will be collected in accordance with government collecting regulations.
- The location and population boundaries of targeted invasive plant species greater than 0.1 acre in extent will be digitally mapped in the field and information on the gross area of infestation (i.e., overall patch size), percent cover, and an estimate of the number of individuals per gross area infested will be collected.
- A comprehensive species list will be compiled and produced for individual survey areas to provide a better sense of the distribution of various plant species in the Study Area.
- During all field surveys, appropriate decontamination protocols will be followed prior to each aquatic-based field effort or moving between watersheds to minimize the potential spread of invasive species (e.g., New Zealand Mud Snail, quagga/zebra mussel, Chytrid fungus). Procedures may include, but may not be limited to, freezing or soaking all field gear (including waders, boots, wetsuits) with a commercial 409® cleaner, spraying equipment with a bleach and water solution, and inspecting all field equipment (including boats). To minimize the spread of invasive plant species during field activities, applicable measures, including inspection and cleaning of clothing and vehicles, will be conducted.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods described above are consistent with generally accepted techniques for landscape-level resource mapping and will yield geo-referenced imagery to support the Project's GIS platform.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

Studies necessary to evaluate effects of Project operations (flows) on riparian habitat will be completed under Study AQ 4 – Fluvial Process and Geomorphology and Study AQ 5 – Instream Flow. This study will provide data necessary for the evaluation of revegetation design as described under Study AQ 12 - Scott Dam Removal.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $90,000.

REFERENCES

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STUDY TERR 2
Wildlife Resources

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Special-status wildlife species and their habitats.

PROJECT NEXUS

- Existing Project operations modify the flow regime in river reaches, including the Eel River from Scott Dam to Van Arsdale Reservoir; Eel River from Cape Horn Dam to Middle Fork Eel River; and East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino. The modified flow regime may affect the amount and distribution (temporal and spatial) of riparian habitat potentially supporting special-status wildlife species.
- Project maintenance activities could directly disturb special-status wildlife species and/or result in loss of their habitat.

PROPOSED CHANGES IN PROJECT FACILITIES AND OPERATIONS COULD AFFECT SPECIAL-STATUS WILDLIFE FROM LAKE PILLSBURY TO VAN ARSDALE RESERVOIR AND CAPE HORN DAM TO MIDDLE FORK EEL RIVER.RELEVANT INFORMATION

The following information is available and was reviewed to determine wildlife resource study needs (refer to Pacific Gas and Electric Company's [PG&E] Pre-Application Document [PAD] Section 5.5 for a summary of wildlife resource information [PG&E 2017]):

- Wildlife habitats and common wildlife species present within 1 mile of the Project area and river reaches potentially affected by Project operation based on based on a crosswalk from U.S. Forest Service's (USFS) CALVEG alliances to California Department of Fish and Wildlife's (CDFW) California Wildlife Habitat Relationship (CWHR) wildlife habitats (USFS 2016; CDFW 2016a).
- Known occurrences of special-status wildlife in the vicinity of the Project based on the CDFW California Natural Diversity Database (CNDDB), USFS Pacific Southwest Region 5 Mendocino National Forest (MNF) sensitive animal and special interest plant list, U.S. Fish and Wildlife Service (USFWS) list of Birds of Conservation Concern (BCC), and the USFWS IPaC Report (CDFW 2016b; USFS 2013; USFWS 2008; USFWS 2016b).
- Bald eagle habitat use, including documentation of: perching, foraging, breeding, and wintering locations; and winter waterfowl occurrences and other prey sources in the Project vicinity (2004–2009) (PG&E 2009; 2014).
- Ongoing annual bald eagle nesting surveys (2004–2020).

POTENTIAL INFORMATION GAPS

- Updated information on wildlife habitats adjacent to Project facilities and riparian habitat associated with river reaches potentially affected by Project operation.
- Detailed habitat data for special-status wildlife species in the vicinity of Project maintenance sites.
- Information on the location of special-status bat roost in Project facilities and Project recreation facilities.
- Information on tule elk foraging habitat availability in the seasonal inundation zone of Lake Pillsbury.

PROPOSED STUDIES / ANALYSES TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Identify special-status wildlife species potentially occurring in CWHR habitats documented as part of the Study TERR 1 – Botanical Resources.
- Complete additional agency consultation to obtain recent information on the location of special-status wildlife species (e.g., nests, dens, Protected Activity Centers [PAC], Home Range Core Areas [HRCA]) in the Project vicinity, if available.
- Conduct a special-status wildlife reconnaissance survey to document incidental observations of special-status wildlife species.
- Conduct a habitat assessment to determine the presence of nesting habitat within a 0.5-mile buffer of Project facilities where maintenance activities have the potential to affect nesting northern goshawk and northern spotted owl. Identify Project maintenance activities implemented in areas of potential nesting habitat.
- Conduct bald eagle nesting surveys consistent with the Potter Valley Project Bald Eagle Management Plan (PG&E 2004).
- Conduct a habitat assessment to document potential denning habitat for special-status furbearers, specifically fisher and Pacific marten. Identify Project maintenance activities implemented in areas of potential denning habitat.
- Conduct an evaluation of Project facilities and Project recreation facilities to identify facilities potentially supporting special-status bat roosts (i.e., areas for focused surveys). In areas identified as potentially supporting special-status bats, use multiple survey techniques to determine the presence/absence and document the general assemblage of bats present. Surveys would consist of visual surveys, acoustic surveys, mist netting, or other approved method necessary to identify special-status species.

- Conduct an evaluation to determine the availability of tule elk foraging habitat within the seasonal inundation zone of Lake Pillsbury under existing Project operations in different water years.

EXTENT OF STUDY AREA

Study areas are defined below. Excluded from the Study Area are areas where access is unsafe (e.g., very steep terrain) and private property for which the Notice of Intent (NOI) Parties have not received specific approval from the landowner to enter the property to perform the study. The NOI Parties will make a good faith effort to obtain access to private property to conduct the study.

Special-Status Wildlife

- For CWHR habitats, the Study Area includes areas within the Federal Energy Regulatory Commission (FERC) Project boundary (including a 0.5-mile buffer) and areas within 0.5 mile of Project facilities currently outside of the FERC Project boundary.
- For wildlife reconnaissance surveys, the Study Area includes the FERC Project boundary, focused on high disturbance areas around Project facilities and Project recreation facilities.

Special-Status Birds

- The Study Area for northern goshawk and northern spotted owl includes potentially suitable habitat within a 0.5-mile buffer of existing Project facilities.
- The Study Area for bald eagle includes known nesting territories in the vicinity of Lake Pillsbury and Van Arsdale Reservoir as defined in the Potter Valley Project Bald Eagle Monitoring Plan (PG&E 2004).

Special-Status Furbearers

- The Study Area for fisher and Pacific marten habitat mapping includes potentially suitable habitat within a 0.5-mile buffer of existing Project facilities.

Special-Status Bats

- The Study Area for special-status bats includes Project facilities and Project recreation facilities.

Tule Elk

- The Study Area for tule elk includes the seasonal inundation zone of Lake Pillsbury.

STUDY METHODS AND ANALYSIS

For the purposes of this study, a special-status wildlife species is defined as any animal species that is granted status by a federal, state, or local agency. Federally listed species granted status by

USFWS under the Endangered Species Act (ESA) include Federally listed as Endangered (FE), Federally listed as Threatened (FT), Federally Proposed Endangered (FPE), Federally Proposed Threatened (FPT), Federal Candidate (FC), or Federally Delisted (FD). The definition also includes species designated by the USFS as Forest Service Sensitive (FSS).

Also included are those species listed by USFWS as Birds of Conservation Concern (BCC), which include "species, subspecies, and populations of all migratory non-game birds that, without additional conservation action, are likely to become candidates for listing under the ESA of 1973" (USFWS 2008).

State of California listed wildlife species, which are granted status by the CDFW under the California Endangered Species Act (CESA), include State listed as Endangered (SE), State listed as Threatened (ST), California Fully Protected (CFP), and California Species of Special Concern (CSC).

The study approach for special-status wildlife, special-status birds, special-status furbearers, and special-status bats (as identified in PAD Table 5.5-3) is provided below.

Special-Status Wildlife

- Conduct a special-status wildlife reconnaissance survey to document incidental observations of special-status wildlife species.
  - Species will be recorded as present if species-specific vocalizations are heard or if diagnostic field signs are found (e.g., scat, tracks, pellets). Some species that are known to occur, or for which appropriate habitat is present, will be recorded as "expected, but not observed".
  - Wildlife taxonomy will be based on California's Wildlife, Volumes I, II, and III (Zeiner et al. 1988-1990).
  - Survey methods will include both zigzag and linear transects depending on the survey area and terrain. Zigzag transects cover more ground and work well in larger habitat areas (e.g., mixed conifer forest), while linear transects work well in narrow habitats (e.g., riparian).
  - For each special-status species observed, a CNDDB field survey form will be completed and submitted to CDFW.
- Record incidental observations of any special-status species during all field surveys completed in support of the relicensing of the Potter Valley Project.

Special-Status Birds

Northern Goshawk and Northern Spotted Owl

- Complete additional agency consultation to obtain recent information on the location of northern goshawk and northern spotted owl (e.g., nests, PACs, HRCAs) in the Project vicinity.

- Conduct a detailed habitat assessment to determine potential nesting habitat within a 0.5-mile buffer of Project facilities where maintenance activities could potentially affect nesting northern goshawk or northern spotted owl. Available information from the following sources will be evaluated to determine the location of potentially suitable habitat for each species: relevant information obtained from additional agency consultation, vegetation maps generated from studies completed under Study TERR 1 – Botanical Resources, topographic maps, aerial photographs, and satellite imagery. A site visit will be conducted to ground-truth the potentially suitable habitat identified with respect to the criteria described below for each species.
    - *Northern goshawk:* Determination of potential northern goshawk nesting habitat will consider information described in the *Sierra Nevada Forest Plan Amendment: Record of Decision* (USFS 2001) and other relevant sources (e.g., USFS 2006 and Hargis et al. 1994). Northern goshawk typically nest in mixed-age forest habitats (both conifer and occasionally hardwood) with an old-growth component, dense canopy cover, and sparse shrub/sapling cover.
    - *Northern spotted owl*: Determination of potential northern spotted owl nesting habitat will consider information described in the *Revised Recovery Plan for the Northern Spotted Owl* (USFWS 2011) and other relevant sources (e.g., Courtney et al. 2004 and USFWS 2012). Northern spotted owl typically nest in multi-layered, mixed coniferous and hardwood stands with high canopy closure and dense canopy cover.

Bald Eagle

- Annual bald eagle nesting surveys are currently conducted at nesting territories in the vicinity of Lake Pillsbury (four) and Van Arsdale Reservoir (one) under Potter Valley Project License Article 54 and the Bald Eagle Monitoring Plan (PG&E 2004).
- Information collected during annual surveys will provide data on the location of bald eagle nests that may be affected by Project operations and maintenance activities.
- Bald eagle nest site data will be incorporated into a Geographic Information System (GIS) data layer.
- GIS information will be overlaid on Project facilities and Project recreation facilities.

Special-Status Furbearers

- Complete additional agency consultation to obtain recent information on the location of fisher and Pacific marten (e.g., den sites) in the Project vicinity.
- If recent information on the location of special-status furbearers is not available, conduct habitat mapping to identify potential fisher and Pacific marten denning habitat within a 0.5-mile buffer of Project facilities where maintenance activities could potentially affect denning. Available information from the following sources will be

evaluated to determine the location of potentially suitable denning habitat for fisher and Pacific marten:

- Relevant information obtained from additional agency consultation, vegetation maps generated from studies completed under Study TERR 1 – Botanical Resources, topographic maps, aerial photographs, and satellite imagery. A site visit will be conducted to ground-truth the potentially suitable habitat identified with respect to the criteria described below.
- Determination of potential fisher and Pacific marten den habitat will consider information described by the *Sierra Nevada Forest Plan Amendment: Record of Decision* (USFS 2001) and other relevant sources (e.g., USFWS 2004; USFWS 2014, USFWS 2016b, and CDFW 2016a).

- Develop a GIS map of known occurrences and appropriate denning habitat within 0.5 mile of Project facilities and overlay information on Project facilities and Project recreation facilities.

Special-Status Bats

- Conduct an evaluation of Project facilities and Project recreation facilities to identify locations potentially supporting special-status bat roosts (i.e., areas for focused surveys).
- Use multiple survey techniques to determine the presence/absence of special-status bat species at Project facilities and Project recreation facilities. Sampling methods will include visual assessment, acoustic sampling, and potentially, mist netting, if visual and acoustic methods are unsuccessful. If mist netting is required, it will only be implemented outside of the maternal season. Each of these is described below.
- Conduct reproductive roost surveys at Project facilities and Project recreation facilities identified through agency consultation and qualified bat expert opinion as potentially supporting special-status bats during the summer reproductive season (July through September) when maternal colonies may be present. Survey locations will be selected near potential roost sites and/or within flight corridors between roost sites and potential foraging habitat (e.g., within stream channels or adjacent to reservoirs).

Visual Assessment

- Each selected location will be searched for bats or bat sign (i.e., guano, characteristic staining, and culled insect parts). Any location where bat species cannot be determined from the visual assessment will be monitored at emergence time using acoustic equipment and/or mist netting.

Acoustic Sampling

- Acoustic sampling will be conducted using a Wildlife Acoustic bat detector system to identify bat species. The Wildlife Acoustic system detects bat ultrasonic echolocation

calls (sonograms) in the field. Acoustic units will be placed in appropriate settings to collect bat calls.

- Two acoustic units will be placed at each site.
- Acoustic sonograms will be downloaded from the bat detection system and analyzed to determine species present. The sonograms will be compared with a sonogram library with confirmed species determinations. Sonograms will also be manually vetted to provide additional clarity on species determinations.

Mist Net Sampling

- If acoustic sonograms are unable to differentiate between species, nighttime mist net sampling will be conducted as follows:
  - Mist nets or similar equipment will be set up for one night, from sunset to 1:00 a.m., in locations where active roosts are identified.
  - Captured bats will be identified to species. Other information collected will include gender, age (juvenile or adult), reproductive status, and forearm measurements.
  - Captured bats will be released on-site and echolocation calls recorded at the time of release.
- Develop a GIS map of special-status bat occurrences and reproductive roosts and overlay information on Project facilities and Project recreation facilities.

Tule Elk

In consultation with resource agencies, determine appropriate modifications to methodologies for evaluation of Tule Elk habitat under the proposed removal of Scott Dam and Lake Pillsbury. The following approaches outlined below will be considered and refined or augmented as appropriate considering that under the proposed Project the seasonal inundation zone of Lake Pillsbury will no longer exist; therefore, changes in vegetation composition and available Tule Elk habitat associated with reservoir fluctuation may not suitably inform an effects assessment:

- Use historical reservoir gaging data to characterize water surface elevations in Lake Pillsbury under existing Project operations over the Period of Record (1911–2020).
- Incorporate the existing topographic data in Lake Pillsbury into GIS to allow detailed characterization of the amount, location, and timing of the lakebed exposed (potential elk foraging habitat) under existing reservoir operations.
- In consultation with resource agencies, establish three representative transects within the seasonal inundation zone on the north side of Lake Pillsbury (near Gravelly Valley) to characterize potential forage for the tule elk. Transects will be established in March prior to filling of the reservoir and extend from the maximum reservoir pool elevation to the existing pool.

- Transects will be extended during the summer and fall as the reservoir level drops and more lakebed becomes exposed.
- During each survey, both ends of the transect will be marked (e.g., rebar stake), recorded with a GPS unit with sub-meter accuracy, and photo-documented. A compass bearing of the transect will be recorded to assist with alignment of the transect during subsequent surveys.
- The topography of each transect will be surveyed (i.e., survey level/total station) to allow correlation of vegetation data along the transects to Lake Pillsbury water surface elevations.

- Vegetation data will be collected using the line-intercept method along each transect. The lake elevation will also be recorded along the transect on the date of the survey. Vegetation data collected along the transect will be used to calculate percent cover of each species and species diversity. Species distributions will be graphed in relation to the topography along the transects. The survey information will also allow determination of the timing for establishment of vegetation and growth rates after the lakebed is dewatered.
- Vegetation along the transects will be surveyed three times, in March (prior to filling of the reservoir, July, and September. Data described above will be collected during each survey period.
- Information from the historical reservoir gaging data, GIS, topographic data, and transect vegetation data will be used to identify changes in potential elk foraging habitat along the shoreline of Lake Pillsbury under existing Project operations.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Special-Status Wildlife

The methods described above are consistent with the generally accepted scientific techniques used to conduct wildlife reconnaissance surveys.

Special-Status Birds

The methodology described above is based are consistent with the generally accepted scientific techniques used to identify appropriate habitat for northern goshawk and northern spotted owl.

Special-Status Furbearers

The methods described above are consistent with the generally accepted scientific techniques used to identify appropriate habitat for special-status furbearers.

Special-Status Bats

The methods described above are consistent with the generally accepted scientific techniques used to identify special-status bats and bat use. These techniques have been used successfully during other relicensing efforts.

Tule Elk

The methods described above are consistent with the generally accepted scientific techniques.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

The wildlife studies will rely on vegetation maps generated from Study TERR 1 – Botanical Resources, as well as other available information, to determine the location of potentially suitable habitat for each species. Information on riparian vegetation that is collected as part of Study AQ 4 – Fluvial Processes and Geomorphology and Study AQ 5 – Instream Flow will also be used to determine potential effects on habitat for riparian dependent wildlife species.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $198,000.

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STUDY AQ 12
Scott Dam Removal

September 2020

POTENTIAL RESOURCE ISSUE(S)

- Erosion of reservoir sediment deposits resulting from reservoir drawdown and removal of Scott Dam.
- Changes to channel morphology and bed mobilization in reaches downstream of Scott Dam following dam removal and release of reservoir sediment deposits.
- Impacts to aquatic species and riparian habitat from changes in bed substrate and morphology associated with channel sedimentation and/or erosion following Scott Dam removal.
- Sedimentation of downstream Project facilities following Scott Dam removal.
- Impacts to water diversions, including water intakes and groundwater wells adjacent to Lake Pillsbury, following Scott Dam removal.
- Fish passage impacts during and following Scott Dam removal activities.

PROJECT NEXUS

- Removal of Scott Dam will modify the short-term and long-term sediment supply and transport rates in river reaches located downstream of Scott Dam.
- Removal of Scott Dam will cause short term and potentially long-term changes to channel morphology and associated impacts to aquatic and riparian habitats downstream of Scott Dam.
- Drawdown of Lake Pillsbury and removal of Scott Dam will modify groundwater elevations in the Project vicinity.

RELEVANT INFORMATION

The following information is available and was reviewed to determine dam removal study needs:

- U.S. Geological Survey (USGS) gaging data.
- PG&E Annual Performance Reports (PG&E 2006-2016).
- PG&E operations and facilities.
- PG&E reservoir storage versus elevation data.

- National Marine Fisheries Service (NMFS) Biological Opinion for the Proposed License Amendment for the Potter Valley Project (NMFS 2002) (includes Reasonable and Prudent Alternative [RPA] instream flow requirements).
- Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, Proposed Changes in Minimum Flow Requirements at the Potter Valley Project (FERC 2000).
- Water balance models used during the 2004 FERC license amendment process.
- Water balance models developed and used during the 2019 Ad-Hoc Water Supply Working Group process.
- Long-term Trends in Streamflow and Precipitation in Northwest California and Southwest Oregon, 1953-2012 (Asarian and Walker 2016).
- Potter Valley Project Evaluation of Sediment Stabilization Measures for Alternative 4 - Full Decommissioning with Sediment Management. EnviroAnalytics Group (EAG). 2018.
- Lake Pillsbury Bathymetric Survey. Prepared for Pacific Gas and Electric Company, Electric Supply Aquatic and Natural Resources, Report No.: 026.11-16.3. Pacific Gas and Electric (PG&E) Applied Technology Services. 2016.
- Sedimentation of Lake Pillsbury, Lake County, California. U.S. Geological Survey Water-Supply Paper 1619-EE. Prepared in Cooperation with the State of California Department of Water Resources. Porterfield, G. and Dunnam C. (USGS). 1959.
- Historical Aerial Photographs and LiDAR data (Mendocino National Forest, Natural Resource Conservation Service, Lake County).
- Lake Pillsbury sediment sampling data collected by Geosyntec (2020) on behalf of the California Coastal Conservancy.

POTENTIAL INFORMATION GAPS

- Information about the geotechnical, physical, and chemical properties of sediment deposits in Lake Pillsbury.
- Erosion of lake sediment deposits following reservoir drawdown and removal of Scott Dam.
- Suspended sediment concentrations resulting from erosion and transport of lake sediment deposits following removal of Scott Dam.
- Potential for sedimentation or erosion to affect the Van Arsdale Diversion infrastructure and diversion capacity following removal of Scott Dam.

- Potential for sedimentation or erosion to affect downstream flood risk following removal of Scott Dam due to dam removal (hydrologic effect) and downstream sedimentation/erosion (geomorphic effect).
- Potential for sedimentation or erosion to affect water diversion intakes in the lower Eel River following removal of Scott Dam.
- Potential impacts to water supplies (wells) in the vicinity of Lake Pillsbury.
- Potential for sedimentation or erosion to affect aquatic and riparian habitats in the Eel River following removal of Scott Dam.

PROPOSED STUDIES / ANALYSIS TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used to augment existing information:

- Survey channel bathymetry (cross sections) to supplement available LiDAR from Scott Dam downstream to the Middle Fork Eel River confluence for use in hydrodynamic and sediment transport modeling.
- Characterize the current volume, spatial distribution, thickness, and properties (physical, geotechnical, and chemical) of reservoir sediment deposits in coordination with Study AQ 4 – Geomorphology.
- Conduct one-dimensional (1-D) hydrodynamic and sediment transport modeling to characterize the fate and transport of sediment deposits eroded from Lake Pillsbury during reservoir drawdown and dam removal.
- Estimate changes in sediment supply and transport capacity resulting from removal of Scott Dam relative to existing sediment supply and transport capacity at key locations (i.e., sediment budget nodes) in the mainstem channel from Scott Dam to the Middle Fork Eel River, and comparisons of potential sediment supply changes at several nodes downstream, in coordination with Study AQ 4 - Geomorphology.
- Estimate short-term suspended sediment concentrations and durations in the Eel River resulting from removal of Scott Dam.
- Estimate the biological impacts of future suspended sediment concentration and duration resulting from removal of Scott Dam and compare with background concentrations.
- Estimate the potential effects of sediment deposition following Scott Dam removal on downstream infrastructure (Van Arsdale Diversion, bridges, low-lying homes, Van Arsdale Fish Ladder).
- Evaluate the potential effects of sediment deposition on channel morphology and stability, bed particle size, flooding, aquatic habitat conditions, Van Arsdale Diversion,

and Cape Horn Dam Fish Ladder resulting from removal of Scott Dam by developing two dimensional (2-D) morphodynamic models at select sites. Information from the 1-D hydrodynamic model will provide input to the 2-D models.

- Using sediment transport model results, work with resource agencies and stakeholders to develop a preferred approach for managing Lake Pillsbury sediment and vegetation, and refine engineering designs for the preferred approach.
- Refine evaluation of Scott Dam removal options based on sediment transport modeling, suspended sediment concentrations, analyses of sediment mass balance, and compile information that will enable development of a preferred sediment management approach.
- Evaluate the need for downstream biological mitigation and/or contingency measures during the dam removal and sediment management process (e.g., off-stream rearing, creating refugia from high suspended sediment concentrations, and temporary supplemental fish propagation) based on analyses of (1) predicted suspended sediment concentrations and durations for different dam decommissioning and sediment management options, (2) comparisons with background sediment supply from the upper Eel River watershed, and (3) discussions with resource agencies.
- Evaluate the potential effects of sediment transport on downstream tributary access for fish and fish passage generally to inform the need for mitigation measures.
- Identify potential changes to water table elevations at existing groundwater wells adjacent to Lake Pillsbury.
- Evaluate the potential for sediment export to inhibit water diversions (private and public systems) on the Eel River downstream of Scott Dam.

EXTENT OF STUDY AREA

The Study Area for Study AQ 12 – Scott Dam Removal includes Project-affected reaches and reservoirs:

- Lake Pillsbury, including Lake Pillsbury inflows.
- Eel River from Scott Dam to Van Arsdale Reservoir and from Cape Horn Dam to Middle Fork Eel River confluence.
- Specific AQ 12 study elements will include selected river reaches upstream of Lake Pillsbury to characterize inflow hydrology to Lake Pillsbury and average annual sediment supply entering Lake Pillsbury. Specific hydrologic and sediment supply analyses will include reaches downstream of the Middle Fork Eel River confluence.

STUDY METHODS AND ANALYSIS

The Scott Dam Removal Assessment consists of six study elements:

- Hydrodynamic Modeling
- Sediment Transport Modeling
  - Characterization of Reservoir Sediment
  - Change in Sediment Supply and Mass Balance
  - Change in Channel Morphology
- Change in Suspended Sediment Concentrations
- Lake Pillsbury Sediment Management Assessment
- Lake Pillsbury Vegetation Management Assessment
- Lake Pillsbury Water Diversion and Groundwater Supply Review

A Scott Dam removal technical working group will be established, composed of stakeholders knowledgeable in issues related to sediment transport, sediment management, vegetation management, hydraulic modeling, and dam removal.

Hydrodynamic Modeling

- Survey channel bathymetry (cross sections) to supplement available LiDAR from Scott Dam downstream to the Middle Fork Eel River confluence for use in hydrodynamic and sediment transport modeling.
- Develop one-dimensional (1-D) hydrodynamic model (e.g., HEC-RAS) for the Eel River from Scott Dam to the Middle Fork Eel River. The hydrodynamic model is intended to support sediment transport described below and water temperature modeling (Study AQ 2 – Water Temperature).

Sediment Transport Modeling

- Characterize reservoir sediment (in coordination with analyses and results from Study AQ 12– Scott Dam Removal):
  - Compile historical information about pre-dam topography, reservoir bathymetry, and reservoir sediment.
  - Estimate the current volume and spatially distributed thickness of reservoir sediment deposits.
  - Characterize the current stratigraphy and physical properties (e.g., grains size distribution and density) of reservoir sediment deposits.
- Estimate particle abrasion to inform the rate at which coarse substrates are expected to break down (fracture into smaller particles) during transport to inform sediment transport modeling.

- Conduct 1-D sediment transport modeling (DREAM-2, and potentially DREAM-1) to assess the fate and transport of coarse sediment (gravel, and potentially sand, if it is deemed necessary). Sediment transport modeling is intended to characterize the downstream propagation of dam-released coarse sediment based on modeled hydrology. Modeling results will describe potential reach and cross-sectionally averaged changes in bed elevation due to erosion or aggradation in the mainstem Eel River between Scott Dam and the Middle Fork Eel River confluence under different hydrologic scenarios.
- Develop 2-D morphodynamic models at select sites to better understand potential short-term and long-term geomorphic effects of erosion and sediment deposition on channel morphology, bank stability, flooding, aquatic habitat conditions, and fish passage resulting from removal of Scott Dam. Information from the 1-D model will provide input to the 2-D models. 2-D modeling will also be used to estimate potential effects of sedimentation at Van Arsdale Diversion, potential effects on water supply reliability, and to inform improved upstream and downstream fish passage alternatives at Cape Horn Dam. 2-D modeling may be conducted at up to two additional sites to evaluate changes in channel morphology, flood inundation, and aquatic habitat.

Change in Sediment Supply and Mass Balance

- In coordination with Study AQ 4 - Geomorphology, estimate changes in average annual sediment supply and sediment transport capacity resulting from dam removal relative to existing conditions.
- Computations of annual sediment mass balance under dam removal scenarios will be compared with estimates of mass balance under existing conditions (results from Study AQ 4 – Fluvial Processes and Geomorphology) at key locations in the mainstem channel from Scott Dam to the Middle Fork Eel River (i.e., sediment budget nodes) and at select downstream long-term gaging sites (Dos Rios, Fort Seward, and Scotia).

Change in Channel Morphology and Aquatic Habitat

- Estimate potential changes to channel morphology and aquatic habitat conditions based on sediment transport modeling in the reach between Scott Dam and Middle Fork Eel River (e.g., spatially distributed changes in bed elevation and bed particle size within mapped habitat units).
- Estimate potential for sediment transport and deposition to affect tributary access for fish and fish passage in the Eel River between Scott Dam and the Middle Fork Eel River, and compile data to inform the need for mitigation measures, including discussion on anticipated depths of sediment deposition at tributary deltas.

Change in Suspended Sediment Concentrations

- Estimate how fine sediment will be released from Lake Pillsbury under two Scott Dam removal options (one-time and phased notching), with specific focus on predicting suspended sediment duration and concentrations released downstream into the Eel River. Estimates will be based on concentration and duration directly downstream of the Scott Dam, and predictions will be extended further downstream based on consideration of potential for dilution from tributary accretion.
- Compare predicted suspended sediment concentrations to applicable water quality objectives and total maximum daily load (TMDL) limitations in the downstream environments (e.g., North Coast Regional Water Quality Control Board Basin Plan).
- Evaluate the potential biological impacts of suspended sediment releases resulting from Scott Dam removal and compare with background concentrations. Suspended sediment predictions described above will be used to evaluate severity of ill effects on steelhead and fall-run Chinook salmon adults, incubating eggs, and juveniles (Newcombe and Jensen 1996). The predictions of suspended sediment concentrations and durations will be compared to literature values of stressful and lethal thresholds (based on predicted concentration and duration) for each life stage to assess a range of potential impacts from the two Scott Dam removal options. The evaluation will be focused on steelhead and fall-run Chinook salmon within the Eel River downstream of Scott Dam, but will also take into consideration locations within the Eel River farther downstream. This analysis will also inform whether short-term fishery mitigation and/or conservation efforts may be appropriate for these options.

Lake Pillsbury Sediment Management Assessment

A Lake Pillsbury sediment management assessment will be developed as part of the dam removal study task to inform the development of Scott Dam removal design plans, Lake Pillsbury revegetation plans, and long-term monitoring and adaptive management plan for the project. The Lake Pillsbury sediment management assessment will be guided by the USBR Dam Removal Analysis Guidelines for Sediment (USBR, 2017). The specific tasks needed to develop the Lake Pillsbury sediment management assessment are as follows:

- Provide further review, analysis, and understanding of contaminants and risk associated with partial release of sediment informed by recent sediment sampling project conducted by the California Coastal Conservancy (Geosyntec 2020).
- Review potential Scott Dam removal and Lake Pillsbury sediment management strategies developed to date.
- Use 1-D and 2-D sediment transport modeling and suspended sediment evaluation results to inform the potential need for management of Lake Pillsbury sediments to reduce downstream impacts. Work with resource agencies and stakeholders to identify

and discuss potential preferred approaches and timelines for managing Lake Pillsbury sediment.

- Based on potential preferred approaches for managing Lake Pillsbury sediment, develop potential geotechnical engineering approaches and unit costs for the potential sediment management approaches.
- Depending on (1) predictions of suspended sediment concentrations for different dam decommissioning and sediment management options, (2) comparisons with background sediment supply from the upper Eel River watershed, and (3) discussions with resource agencies:
  - Collect information needed to inform downstream biological mitigation measures during the dam removal and sediment management process (e.g., off-stream rearing, creating refugia from high suspended sediment concentrations, temporary supplemental fish propagation).
  - Collect information needed to inform downstream geomorphic/geotechnical mitigation measures during the dam removal and sediment management process (e.g., slope stabilization within Lake Pillsbury inundation zone, bridge/road protection, infrastructure protection).

Lake Pillsbury Vegetation Management Assessment

Some proportion of the Lake Pillsbury inundation footprint (approximately 2,000 acres) will be revegetated (natural regeneration + plantings) following removal of Scott Dam and permanent draining of Lake Pillsbury. The purpose of revegetation is to recover the disturbance footprint within and around Lake Pillsbury with ecologically functioning vegetation that provides terrestrial and aquatic habitat and will meet agency requirements for post-dam removal land condition. The specific tasks needed to develop the Lake Pillsbury vegetation management assessment are as follows:

- Compile existing information on other revegetation efforts post dam removal, including Elwha Dam on Washington's Elwha River, and Marmot Dam on the Sandy River, Oregon.
- Compile historical records of pre-dam conditions in the Study Area, including aerial and/or ground photographs, plat maps, and historical accounts of the Eel River and vegetation. The historical vegetation evaluation will be combined with existing conditions vegetation mapping as provided in TERR-1 to define reference conditions and desired restoration conditions, especially cover types.
- Collect data on sun exposure and groundwater levels of existing plant cover types to inform future species selection. Conduct a solar radiation evaluation to identify locations of higher and lower solar radiation. Additionally, develop height above river relationships for each existing cover type using the vegetation map, a low-flow water surface elevation, and topography of Lake Pillsbury to inform future revegetation plan.

- Conduct lakebed sediment experiments to determine the species present in the existing seedbed, the particle size distribution of the sediments, and the nutrient profile of the soil. The particle size distribution of the sediments has implications for water holding capacity and species survival. Growth experiments in a greenhouse setting will inform which species in the existing seedbed can be expected to naturally grow once sediments are exposed following removal of Scott Dam. Any nutrient deficiencies in the lakebed sediments can further inform species selection and anticipated revegetation outcomes.
- Compile information and applicable best management practices on how to manage invasive species, based on mapping identified as part of Study TERR 1 – Botanical.
- Collect riparian species phenology data (seed dispersal distribution) used to inform expected riparian vegetation response to Scott Dam removal, including opportunities for passive revegetation. Sampling will occur from March 15 through August 31 to capture the start, peak, and end seed dispersal dates for selected riparian species.
- Identify appropriate plant species based on the data collected above, planting locations, planting methods and unit costs. The list will be created in consultation with resource agencies and interested stakeholders to include common and widespread species, as well as less common species to be promoted. The plant species list will consider native and special-status plants and vegetation communities, as well as species that are expected to compete well against non-native invasive species.

Water Diversion and Groundwater Supply Review

The NOI Parties will gather data regarding groundwater adjacent to Lake Pillsbury, including groundwater well construction records from Lake County and the USFS (for groundwater well depth and screening intervals), and will work with Lake County, USFS, and local agencies to obtain groundwater elevations in existing wells over time. This information, as well as the changes in water surface elevation of Lake Pillsbury, and publicly available soil texture and aquifer information, can be used to identify a range of potential changes to water table elevations at existing groundwater wells adjacent to Lake Pillsbury.

In addition to the groundwater analysis described above, the NOI Parties will evaluate the potential for sediment export to inhibit water diversions (private and public systems) on the Eel River downstream of Scott Dam. Sediment aggradation calculated from the sediment transport modeling described above will be compared to the location and elevation of existing surface water diversions between Scott Dam and Tomki Creek.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The proposed methodologies to generate representative reservoir sediment storage and yield rates and develop hydrodynamic and sediment transport models are widely used and accepted in the scientific and engineering communities. The proposed methodologies to assess reservoir sediment management will be based on standard engineering and geotechnical methods. The proposed methodologies to assess revegetation within the Lake Pillsbury inundation area will use standard

botanical methods, and rely on experience gained on other applicable reservoir revegetation efforts (e.g., Elwha River, Sandy River, Klamath River). These methods have been used in other relicensing proceedings and are designed to meet the needs of the relicensing participants.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as they are completed throughout study implementation. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

This study will coordinate with the Study AQ 1 – Hydrology and Project Operations Modeling to incorporate hydrology for unimpaired and potential future operations to inform sediment transport modeling. This study will coordinate with Study AQ 2 – Water Temperature to support development of the river water temperature model. This study will coordinate with Study AQ 3 – Water Quality to incorporate existing turbidity information into the suspended sediment assessment. This study will coordinate with Study AQ 4 – Fluvial Processes and Geomorphology to estimate changes in sediment supply and sediment transport capacity, as well as changes to channel morphology following Scott Dam removal, and comparing existing annual sediment mass balance to dam removal scenarios. This study will coordinate with Study AQ 5 – Instream Flows to inform changes from flows, recession rates, water temperatures, riparian vegetation, and channel morphology to fish habitat and FYLF flow-habitat relationships following Scott Dam removal. This study will coordinate with Study AQ 10 – Special Status Amphibians and Aquatic Reptiles to inform changes from flows, riparian vegetation, and channel morphology on FYLF and WPT physical habitat following Scott Dam removal. This study will coordinate with Study TERR 1 – Botanical to inform potential vegetation response following Scott Dam removal and target restoration cover types.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $1,975,000.

REFERENCES

Geosyntec. 2020. Review of Conceptual Approach to Scott Dam Removal and Sediment Management. Prepared for California Coastal Conservancy by Geosyntec Consultants, Portland Oregon.

PG&E (Pacific Gas and Electric Company) Applied Technology Services. 2016. *Lake Pillsbury Bathymetric Survey*. Prepared for Pacific Gas and Electric Company, Electric Supply Aquatic and Natural Resources, Report No.: 026.11-16.3.

Porterfield, G. and Dunnam C. (USGS). 1959. *Sedimentation of Lake Pillsbury, Lake County, California.* U.S. Geological Survey Water-Supply Paper 1619-EE. Prepared in Cooperation with the State of California Department of Water Resources.

Randle, T. and Bountry, J. 2017. *Dam Removal Analysis Guidelines for Sediment*. Advisory Committee on Water Information, Subcommittee on Sedimentation. Bureau of Reclamation, Technical Service Center, Denver, CA. http://rsm.usace.army.mil/initiatives/other/DamRemovalAnalysisGuidelines2017_508.pdf

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STUDY SE 1
Socioeconomics

September 2020

POTENTIAL RESOURCE ISSUE(S)

These potential resource issues include the direct value of changes in the base case (which will be defined in the future in with Federal Energy Regulatory Commission [FERC]) and the proposed Potter Valley Hydroelectric Project (Project) on the direct and indirect effects of water use and financial use on the wider economy, including but not limited to water volume available for consumptive or fishery use, tourism, employment, income, tribal resources, non-market values, and local government. These resource issues are grouped by major category which represent changes in:

Water Supply

- Operation impacts to agricultural producers due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.
- Operation impacts to municipal and industrial (M&I) water users due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.
- Operation impacts to domestic water users (including non-commercial agriculture) due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.
- Water supply reliability value to agricultural producers due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.
- Water supply reliability value to M&I water users due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.
- Water supply reliability value to domestic water users (including non-commercial agriculture) due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.
- Seasonal fire-fighting water storage value due to reduced water storage capacity in Lake Pillsbury, Van Arsdale Reservoir, Ponds in Potter Valley, and Eel River.

Flood Hazard Reduction

- Potential flood damage impacts to agricultural production by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.
- Potential flood damage impacts to commercial structures by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Potential flood damage impacts to residential structures by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.
- Potential flood damage impacts to transportation & infrastructure by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

Fisheries

- Pacific Ocean commercial fisheries value due to changes in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.
- Tribal commercial fisheries value due to change in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.
- Pacific Ocean sport fisheries value due to change in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.
- Eel River and Russian River sport fisheries value due to change in river flows, water temperature regimes, and fish habitats, on both river systems.
- Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma sport fisheries value due to the removal of the Scotts Dam and Cape Horn Dam, and change in the lakes' water surface elevations including complete drainage, water temperature regimes, and fish habitats.
- Eel River and Russian River Tribal non-commercial/subsistence value of a healthy fishery for food and subsistence living due to change in river flows, temperature regimes, and fish habitats, on both river systems.
- Eel River and Russian River Tribal cultural value (to non-fishers) of anadromous fish due to change in river flows, temperature regimes, and fish habitats, on both river systems.
- Eel River and Russian River existence value (to non-fishers) of anadromous fish due to change in river flows, temperature regimes, and fish habitats, on both river systems.

Other Recreation (non-fishing)

- Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma recreation value due to changes in lake water levels, including complete drainage.
- Eel River and Russian River recreation value due to changes in river water flows, water temperatures, water quality, riparian vegetation, and channel morphology, on both river systems.

Property

- Lakeside property value adjacent to Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma due to elimination of Scott Dam and drainage of Lake Pillsbury.

- Change in property tax revenue to local jurisdictions for property to be owned/operated by public entities near Lake Pillsbury, Van Arsdale Reservoir, and Potter Valley.

Tribal Interests (non-fishing)

- Eel River and Russian River Tribal cultural value of water flows other than directly related to fisheries due to changes in river flows, water temperature regimes, water quality, riparian vegetation, and channel morphology on both river systems.

Infrastructure Construction

- Impacts of construction spending on the regional economy (e.g. income, employment) due to changes in construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.
- Air, water, and noise pollution impacts value due to construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.
- Motoring public traffic impact impacts value due to construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.

PROJECT NEXUS

- Existing and proposed changes to Project operations modify the flow, flooding frequency, water temperature, water quality, riparian vegetation, and channel morphology regimes in the Eel River and Russian River, specifically Eel River from Scott Dam to Van Arsdale Reservoir, Eel River from Cape Horn Dam to Middle Fork Eel River, Middle Fork Eel River to the Pacific Ocean, East Branch Russian River from Potter Valley Powerhouse Tailrace to Lake Mendocino, and Lake Mendocino to the Pacific Ocean.

- Existing and proposed changes to Project operations modify Lake Pillsbury, Van Arsdale Reservoir, and Lake Mendocino water surface elevations and water temperatures, and may impact Lake Sonoma.

- These changes to flows, water temperatures, water quality, water surface elevations, riparian vegetation, and channel morphology may impact water supply, flood hazard reduction, fisheries, recreation (non-fisheries), lakeside property, Tribal interests, and infrastructure construction.

- Proposed changes to Project ownership and facilities include change of ownership of facilities and modifications at Lake Pillsbury, Van Arsdale Reservoir, and Potter Valley, which will have impacts on property and sales taxes, construction, and operations revenues.

- These impact categories may then have direct effects (positive or negative) on the affected population (e.g. the value of water supply reliability, Tribal interests, and/or fishing in the rivers, or overall economic activities, e.g. on agriculture).

- The direct effects may have additional indirect effects (e.g. impacts to tourism, local government revenues and services, employment, and income).

RELEVANT INFORMATION

Previous FERC studies for the Project did not include a socioeconomic (SE) component. The SE study report will be using information gathered from Highlands Economics (2020), Stillwater Sciences et al. 2020a, and other studies in the FERC application and literature reviews. Some indirect effects (regional economic effects) will be determined using IMPLAN economic modeling software.

POTENTIAL INFORMATION GAPS

The potential information gaps for individual resource issues are listed below. In some cases, the gaps will remain, not allowing for a full quantitative analysis of direct impacts. In others, only the change between scenarios and the base case can be easily determined. The potential information gaps for indirect impacts are discussed separately.

Operation impacts to agricultural producers due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.

- Agricultural producer water intake system use on Eel River and how change in downstream release of sediments would affect the intake systems.
- Additional operation impacts per agricultural production water intake system for handling sedimentation.

Operation impacts to M&I water users due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.

- M&I water intake system use on Eel River and how change in downstream release of sediments would affect the intake systems.
- Additional operation impacts per M&I water intake system for handling sedimentation.

Operation impacts to domestic water users (including non-commercial agriculture) due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.

- Domestic water intake system use on Eel River and how change in downstream release of sediments would affect the intake systems.
- Additional operation impacts per domestic water intake system for handling sedimentation.

Water supply reliability value to agricultural producers due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.

- Change in water supply reliability for agricultural producers from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino, accounting for appropriative water rights (e.g. includes river diversions, groundwater from alluvial aquifer), resulting from removal of water storage capacity and change in river flows.
- Change in water supply timing for agricultural producers from the Eel River and Russian River, resulting from removal of water storage capacity and change to seasonal diversion operations and river flows.
- Water value (per acre-foot) for different hydrology (e.g. wet vs. dry) with considerations for fixed & variable costs (reliability), potential adjudication costs, and seasonality for use by agricultural producers.

Water supply reliability value to M&I water users due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.

- Change in water supply reliability for M&I water users using water from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino, accounting for appropriative water rights resulting from removal of water storage capacity and change in river flows.
- Change in water supply timing for municipal water agencies from the Eel River and Russian River, resulting from removal of water storage capacity and change to seasonal diversion operations and river flows.
- Water value (per acre-foot) for different hydrology (e.g. wet vs. dry) with considerations for fixed & variable costs (reliability), potential adjudication costs, and seasonality for use by M&I users.

Water supply reliability value to domestic water users (including non-commercial agriculture) due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.

- Change in water supply reliability for domestic water users from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino, accounting for appropriative water rights (e.g. includes river diversions, groundwater from alluvial aquifer), resulting from removal of water storage capacity and change in river flows.
- Water value (per acre-foot) for different hydrology (e.g. wet vs. dry) with considerations for fixed & variable costs (reliability), potential adjudication costs, and seasonality for use by domestic water users.

Seasonal fire-fighting water storage value due to reduced water storage capacity in Lake Pillsbury, Lake Van Arsdale, Ponds in Potter Valley, and Eel River.

- Change in volume of available water in Lake Pillsbury, Van Arsdale Reservoir, Ponds in Potter Valley, and Eel River for use in fighting fires. Water value (per acre-foot) for different hydrology (e.g. wet vs. dry) with considerations for fixed & variable costs (reliability), potential adjudication costs, and seasonality for use in fighting fires.

Potential flood damage impacts to agricultural production by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Change in flood frequencies for different depths of flooding by the Eel River below Scotts Dam.
- Type of agricultural land near the Eel River below Scotts Dam.
- Value of agricultural production per acre.

Potential flood damage impacts to commercial structures by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Change in flood frequencies for different depths of flooding by the Eel River below Scotts Dam.
- Type of commercial structures near the Eel River below Scotts Dam.
- Value of commercial structures and inventory per square foot.

Potential flood damage impacts to residential structures by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Change in flood frequencies for different depths of flooding by the Eel River below Scotts Dam.
- Type of residential structures (e.g. floor number) near the Eel River below Scotts Dam.
- Value of residential structures per square foot.

Potential flood damage impacts to transportation & infrastructure by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Change in flood modeling during different year events with depth of flooding by the Eel River below Scotts Dam.
- Type of transportation & infrastructure near the Eel River below Scotts Dam.
- Value of transportation & infrastructure dependent on number of users.

Pacific Ocean commercial fisheries value due to changes in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.

- Change in population of anadromous fish produced from the Eel River and Russian River.
- Expected percentage of anadromous fish caught by ocean commercial fishery. There is no expected change in fishery operation decisions.
- Commercial value for each anadromous fish sold at market.
- Harvesting costs on a dollar per fish basis.

Tribal commercial fisheries value due to change in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.

- Change in population of commercial fish (by type) produced from the Eel River and Russian River.
- Expected percentage of commercial fish (by type) caught by Tribal commercial fishery.
- Tribal commercial value for each fish sold at market.
- Harvesting costs on a dollar per fish basis.

Pacific Ocean sport fisheries value due to change in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.

- Change in population of anadromous fish produced from the Eel River and Russian River.
- Expected percentage of anadromous fish caught by ocean sport fishery.
- Sport fisheries value for each anadromous fish.

Eel River and Russian River sport fisheries value due to change in river flows, water temperature regimes, and fish habitats, on both river systems.

- Change in population of river sport fish (by type) produced from the Eel River and Russian River.
- Expected percentage of river sport fish (by type) caught by river sport fishery.
- Sport fisheries value for each fish.

Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma sport fisheries value due to the removal of the Scotts Dam and Cape Horn Dam, and change in the lakes' water surface elevations including complete drainage, water temperature regimes, and fish habitats.

- Change in population of lake sport fish (by type) produced from Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma.

- Expected percentage of lake sport fish (by type) caught by lake sport fishery.
- Lake fisheries value for each fish.

Eel River and Russian River Tribal non-commercial/subsistence value of a healthy fishery for food and subsistence living due to change in river flows, temperature regimes, and fish habitats, on both river systems.

- Change in population of fish (by type) produced from the Eel River and Russian River.
- Expected percentage of fish (by type) caught by Tribal non-commercial/subsistence fishery.
- Linkage between fish population available for subsistence and incidence of health effects such as obesity and diabetes.
- Costs of health care effects associated with dietary changes.

Eel River and Russian River Tribal cultural value (to non-fishers) of anadromous fish due to change in river flows, temperature regimes, and fish habitats, on both river systems.

- Change in population of anadromous fish produced from the Eel River and Russian River.
- Tribal cultural existence value for each anadromous fish.

Eel River and Russian River existence value (to non-fishers) of anadromous fish due to change in river flows, temperature regimes, and fish habitats, on both river systems.

- Change in population of anadromous fish produced from the Eel River and Russian River.
- Societal existence value for each anadromous fish.

Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma recreation value due to changes in lake water levels, including complete drainage.

- Change in number of recreational visitor days due to Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma by type (e.g. picnicking, camping, sightseeing, swimming/beach use, walking, boating/water skiing, hunting)
- Value of recreational visitor day by type.

Eel River and Russian River recreation value due to changes in river water flows, water temperatures, water quality, riparian vegetation, and channel morphology, on both river systems.

- Change in number of recreational visitor days due to Eel River and Russian River by type (e.g. whitewater rafting, picnicking, camping, sightseeing, swimming/beach use, walking, hunting)
- Value of recreational visitor day by type.

Lakeside property value adjacent to Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma due to elimination of Scott Dam and drainage of Lake Pillsbury.

- Number and type of residential and commercial property (e.g. accommodations) associated with being next to Lake Pillsbury.
- Change in property value per square foot by type of property.

Change in property tax revenue to local jurisdictions for property to be owned/operated by public entities near Lake Pillsbury, Van Arsdale Reservoir, and Potter Valley.

- Quantity of acres/ square footage of structures Project transfers from PG&E (corporate) ownership to local government or entity and total acres and squire footage of structures owned by PG&E near Lake Pillsbury, Van Arsdale Reservoir, and Potter Valley.
- Property taxes paid by PG&E (corporate) for property (land and structures) to local jurisdictions near Lake Pillsbury, Van Arsdale Reservoir, and Potter Valley.

Eel River and Russian River Tribal cultural value of water flows other than directly related to fisheries due to changes in river flows, water temperature regimes, water quality, riparian vegetation, and channel morphology on both river systems.

- Change in water flows on the Eel River and Russian River.
- Changes in flood inundation frequency and duration on the Eel River
- Tribal value of water flows, including seasonal impacts and recreation.

Impacts of construction spending on the regional economy (e.g., income, employment.) due to changes in construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.

- Change in construction spending near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.
- Indirect impacts are further discussed in the indirect impact section below.

Air, water, and noise pollution impacts due to construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.

- Change in construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.
- Quantity of air, water, and noise pollution produced from construction activity.
- Value of air, water, and noise pollution impacts per unit.

Motoring public traffic impact impacts due to construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.

- Change in construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.

- Quantity of truck traffic produced from construction activity and impact to traffic.
- Value of traffic impacts per unit (e.g. vehicle hours traveled and vehicle miles traveled).

Indirect impacts from the direct resource issues.

This section includes the indirect impacts from the potential resource issues discussed above. The indirect impacts are grouped which represent changes in:

- Impacts on wineries, tourism, local government revenues and services, employment, and income due to agricultural production water reliability and flood risks on agricultural production.
- Regional impacts to businesses due to marginal changes in the value and availability of water, local government revenues and services, employment and income due to M&I water reliability.
- Business & employee income and employment due to flooding risks on commercial property.
- Change in displacement and relocation costs, NFIP payments due to flooding risks on residential property.
- Impacts to value added sectors, employment, and income due to ocean commercial fisheries and Tribal commercial fisheries.
- Impacts to tourism, local government revenues and services, employment, and income due to ocean sport fisheries, river sport fisheries, lake sport fisheries, lake recreation (non-fisheries) and river recreation (non-fisheries).
- Impacts on Tribal health from diet and nutrition due to Tribal non-commercial/subsistence fishery.
- Regional spending from seasonal property owners due to lakeside property use.
- Local government impacts (revenues and services) due to lakeside property values and property ownership.
- Employment and income due to construction activity.
- Property values, employment, and income due to change in air, water, and noise pollution as well as truck traffic.

PROPOSED STUDIES / ANALYSIS TO ADDRESS IDENTIFIED SIGNIFICANT INFORMATION GAPS

The following studies / analyses will be used:

- Review the other economic impact studies relevant to the FERC Project No. 77 (e.g. Highlands Economics 2020 Stillwater Sciences et al. 2020a, and the proposed amended Studies) to provide as much data as possible to SE 1 and augment with other data sets.
- Conduct primary data collection (survey) of water users (agricultural production, M&I and domestic water users) who have water intake systems on the Eel River below Scotts Dam... This survey will collect data on quantity and quality of water use per user, including seasonal use and appropriative water rights in addition to understanding the type of water intake systems used.
- Water reliability cost assessment focused on the Reliability Cost Assessment loss of storage and the ability to supplement summer and fall flows with stored water.
- Water reliability cost assessment focused on Reliability Cost Assessment sediment impact and increased maintenance on the Eel River.
- Perform literature reviews and research to collect data for multiple resource issues to identify the appropriate economic values. A sample of potential studies are included in the reference section. This includes reviewing similar dam removal EIR/EIS socioeconomic studies as well as studies on water values, fisheries values, property values near a lake, and recreation values to perform benefits transfer calculations.
- Conduct market study of commercial fisheries to determine catch and market values. There is no expected change in fishery operation decisions.
- Perform interviews with Tribal members to document the qualitative and quantitative (where available) unit values for Tribal resource issues.
- Implement flood damage analysis to understand which land (agricultural) and structures could experience differences in flooding under different project conditions below Scotts Dam.
- Conduct map review to understand the number, type and location of residential and commercial property (e.g. accommodations) associated with being next to Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma.
- Determine property tax impacts associated with removal of Scotts Dam and Cape Horn Dam.
- Determine agricultural production types using county data sets and assess crop values to evaluate additional indirect impacts on wineries, tourism, local government revenues and services, employment, and income due to agricultural production water reliability and flood risks on agricultural production.

- Estimate additional operating impacts for the water intake systems below Scotts Dam.
- As necessary, use least cost approach to determine the next available water supply source. In this approach, the next least costly alternative for the water would be identified and a cost for acre foot would be determined and utilized.
- Determine indirect values with IMPLAN where possible.

EXTENT OF STUDY AREA

The socioeconomics Study Area includes Project-affected reaches and reservoirs:

- Lake Pillsbury, including Lake Pillsbury inflows.
- Lake Mendocino, including Lake Mendocino inflows.
- Lake Sonoma.
- Van Arsdale Reservoir, including Van Arsdale Reservoir inflows.
- Eel River from Scott Dam to immediately below Middle Fork Eel River confluence (including Van Arsdale Reservoir, which is primarily riverine in character) and continuing downstream to the Pacific Ocean.
- East Branch Russian River between Potter Valley Powerhouse and the ordinary high-water mark of Lake Mendocino and continuing downstream to the Pacific Ocean.

In addition, the commercial and sport fisheries impacts are part of the Pacific Ocean. Tribes along the Eel River and Russian River are Project-affected, as well as residents, businesses, and local government in Mendocino County, Humboldt County, Lake County and Sonoma County. People outside of these areas may still be affected if they travel to these areas or have passive use values.

The Potential Information Gaps section includes details on the study area for each resource issue.

STUDY METHODS AND ANALYSIS

Operation impacts to agricultural producers due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 12 – Scott Dam Removal) to provide as much data as possible to SE 1 in regards to sedimentation risks below Scotts Dam.
- Conduct primary data collection (survey) of water users who have water intake systems on the Eel River below Scotts Dam.
- Estimate additional operating costs for the water intake systems.
- Develop cost curve for operational changes associated with river levels and sedimentation conditions.

- Consider if it's better to accept a lower level of production and revenue compared to paying a higher cost for additional water.
- Evaluate operational impacts from sedimentation risks to agriculture water users below Scotts Dam.

Operation impacts to M&I water users due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 12 – Scott Dam Removal) to provide as much data as possible to SE 1 in regard to sedimentation risks below Scotts Dam.
- Conduct primary data collection (survey) of water users who have water intake systems on the Eel River at or below Scotts Dam.
- Estimate additional operating costs for the water intake systems.
- Develop cost curve for operational changes associated with river levels and sedimentation conditions.
- Evaluate operational impacts from sedimentation risks to M&I water users below Scotts Dam.

Operation impacts to domestic water users (including non-commercial agriculture) due to the risk of sedimentation below Scotts Dam with the removal of Scott Dam, Cape Horn Dam, and downstream release of sediments.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 12 – Scott Dam Removal) to provide as much data as possible to SE 1 in regard to sedimentation risks below Scotts Dam.
- Conduct primary data collection (survey) of water users who have water intake systems on the Eel River below Scotts Dam.
- Estimate additional operating costs for the water intake systems.
- Develop cost curve for operational changes associated with river levels and sedimentation conditions.
- Evaluate operational impacts from sedimentation risks to domestic water users below Scotts Dam.

Water supply reliability value to agricultural producers due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.

- Review the other studies of the FERC Project No. 77 (e.g.. Study AQ 1 – Hydrology and Study AQ 5 – Instream Flows) to provide as much data as possible to SE 1 in regards to change in water volume from Eel River and Russian River for different

hydrology (e.g. wet vs. dry) with considerations for seasonality and augment as needed with other data sets.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 5 – Instream Flows) to provide as much data as possible to SE 1 in regards to water supply for agricultural production from Eel River and Russian River with considerations for appropriative water rights and augment with other data sets.
- Perform study of local agricultural production to identify the appropriate economic values to determine contribution of water to value of agricultural production for different hydrology (e.g. wet vs. dry) with considerations for fixed and variable costs (reliability), potential adjudication costs, and seasonality.
- As necessary, use least cost approach to determine the next available water supply source. Consider if it's better to accept a lower level of production and net-revenue compared to paying a higher cost for additional water.
- Evaluate water supply reliability value to agriculture water users on the Eel River and Russian River.
- Determine indirect values with IMPLAN, county data sets and literature: value of impacts associated with water reliability for agriculture on wineries, tourism, local government revenues and services, employment, and income. This is highly dependent on input variables and must be thoroughly vetted.

Water supply reliability value to M&I water users due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 5 – Instream Flows) to provide as much data as possible to SE 1 in regards to change in water volume from Eel River and Russian River for different hydrology (e.g. wet vs. dry) with considerations for seasonality and augment as needed with other data sets.
- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 5 – Instream Flows) to provide as much data as possible to SE 1 in regards to water supply for M&I use from Eel River and Russian River with considerations for appropriative water rights and augment with other data sets.
- Perform literature review to identify the appropriate economic values to determine contribution of water to value of M&I use for different hydrology (e.g. wet vs. dry) with considerations for fixed and variable costs (reliability), potential adjudication costs, and seasonality.
- As necessary, use least cost approach to determine the next available water supply source. Consider if it's better to accept a lower level of production and use compared to paying a higher cost for additional water.

- Evaluate water supply reliability value to M&I water users on the Eel River and Russian River.
- Determine indirect values with IMPLAN: regional impacts to businesses due to marginal changes in the value and availability of water, local government revenues and services, employment and income due to M&I water reliability.

Water supply reliability value to domestic water users (including non-commercial agriculture) due to a reduction in water supply from the Eel River, Russian River, Lake Pillsbury, and Lake Mendocino.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 5 – Instream Flows) to provide as much data as possible to SE 1 in regards to change in water volume from Eel River and Russian River for different hydrology (e.g. wet vs. dry) with considerations for seasonality and augment as needed with other data sets.
- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 5 – Instream Flows) to provide as much data as possible to SE 1 in regards to water supply for domestic use from Eel River and Russian River with considerations for appropriative water rights and augment with other data sets.
- Perform literature review to identify the appropriate economic values to determine contribution of water to value of domestic use (including non-commercial agriculture) for different hydrology (e.g. wet vs. dry) with considerations for fixed and variable costs (reliability), potential adjudication costs, and seasonality.
- As necessary, use least cost approach to determine the next available water supply source. Consider if it's better to accept a lower level of production and use compared to paying a higher cost for additional water.
- Evaluate water supply reliability value to fire fighting on the Eel River and Russian River.

Seasonal fire-fighting water storage value due to reduced water storage capacity in Lake Pillsbury, Van Arsdale Reservoir, Ponds in Potter Valley, and Eel River.

- Review the other studies of the FERC Project No. 77 (e.g. Study LAND 3 – Hazardous Fuels Assessment) to provide as much data as possible to SE 1 in regards to quantity of water storage used for fighting fires in Lake Pillsbury, Van Arsdale Reservoir, Ponds in Potter Valley, and Eel River and augment with other data sets.
- Perform literature review to identify the appropriate economic values to determine value per acre-foot for different hydrology (e.g. wet vs. dry) with considerations for fixed and variable costs (reliability), potential adjudication costs, and seasonality for use by fighting fires.

- As necessary, use least cost approach to determine the next available water supply source. Consider if it's better to accept increased risks of fires compared to paying a higher cost for additional water.
- Evaluate value of available water for use in fighting fires stored in Lake Pillsbury, Van Arsdale Reservoir, Ponds in Potter Valley, and Eel River.

Potential flood damage impacts to agricultural production by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 12 – Scott Dam Removal) to provide as much data as possible to SE 1 in regard to flood hazards to agricultural production below Scotts Dam.
- Implement flood damage analysis to understand what type of agricultural land would be flooded in the different conditions.
- Perform study of local agricultural production to determine type of agricultural land near the Eel River below Scotts Dam as well as to identify the appropriate economic value of agricultural production per acre.
- Evaluate flood hazard reduction value to agricultural production below Scotts Dam.
- Determine indirect values with IMPLAN: value of impacts associated with water reliability for agriculture on wineries, tourism, local government revenues and services, employment and income.

Potential flood damage impacts to commercial structures by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 12 – Scott Dam Removal) to provide as much data as possible to SE 1 in regard to flood hazards to commercial structures below Scotts Dam.
- Implement flood damage analysis to understand what commercial structures would be flooded in the different conditions.
- Perform literature reviews and study of local buildings to determine type of commercial structures near the Eel River below Scotts Dam as well as to identify the appropriate economic values of commercial structures and inventory per square foot.
- Evaluate flood hazard reduction value to commercial structures below Scotts Dam.
- Determine indirect values with IMPLAN: business & employee income and employment due to flooding.

Potential flood damage impacts to residential structures by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 12 – Scott Dam Removal) to provide as much data as possible to SE 1 in regard to flood hazards to residential structures below Scotts Dam.
- Implement flood damage analysis to understand what residential structures would be flooded in the different conditions.
- Perform literature reviews and study of local buildings to determine type of residential structures (e.g. floor number) near the Eel River below Scotts Dam as well as and to identify the appropriate economic values of residential structures per square foot and ratios to consider indirect value calculations.
- Evaluate flood hazard reduction value to residential structures below Scotts Dam.
- Determine indirect values using literature review factors: displacement and relocation costs, NFIP payments.

Potential flood damage impacts to transportation & infrastructure by the Eel River due to the removal of the Scotts Dam and Cape Horn Dam.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 1 – Hydrology and Study AQ 12 – Scott Dam Removal) to provide as much data as possible to SE 1 in regard to flood hazards to transportation & infrastructure below Scotts Dam.
- Implement flood damage analysis to understand what transportation & infrastructure structures would be flooded in the different conditions.
- Perform literature reviews and study of local infrastructure to determine type of transportation & infrastructure structures near the Eel River below Scotts Dam as well as number of users and to identify the appropriate economic values.
- Evaluate flood hazard reduction value to transportation & infrastructure below Scotts Dam.

Pacific Ocean commercial fisheries value due to changes in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 9 – Fish Populations) to provide as much data as possible to SE 1 in regards to population of anadromous fish (by type) produced from the Eel River and Russian River.
- Perform literature reviews to estimate impact of Eel and Russian River runs on ocean commercial fisheries given dominance of other rivers and market data on the commercial value for each anadromous fish sold at market from the other rivers' fisheries.

- Perform literature reviews to determine expected percentage of anadromous fish caught by ocean commercial fisheries and market data on the commercial value for each anadromous fish sold at market and to identify the appropriate economic values on harvesting costs.
- Evaluate value of ocean commercial fisheries for anadromous fish produced from the Eel River and Russian River.
- Determine indirect values with IMPLAN: impacts to value added sectors, employment, and income due to ocean commercial fisheries.

Tribal commercial fisheries value due to change in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 9 – Fish Populations) to provide as much data as possible to SE 1 in regards to population of commercial fish (by type) produced from the Eel River and Russian River.
- Perform literature reviews to estimate impact of Eel and Russian River runs on Tribal commercial fisheries given dominance of other rivers and market data on the commercial value for each anadromous fish sold at market from the other rivers' fisheries.
- Perform literature reviews to determine expected percentage of commercial fish caught by Tribal commercial fisheries and market data on the Tribal commercial value for each fish sold at market and to identify the appropriate economic values on harvesting costs.
- Evaluate value of Tribal commercial fisheries for fish produced from the Eel River and Russian River.
- Determine indirect values with IMPLAN: impacts to value added sectors, employment, and income due to tribal commercial fisheries.

Pacific Ocean sport fisheries value due to change in river flows, water temperature regimes, and fish habitats on the Eel River and Russian River.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 9 – Fish Populations) to provide as much data as possible to SE 1 in regards to population of anadromous fish (by type) produced from the Eel River and Russian River.
- Perform literature reviews to determine value of ocean sport fisheries in nearby basins and benefits transfer on the sport value for each anadromous fish.
- Perform literature reviews to determine expected percentage of anadromous fish caught by ocean sport fisheries.
- Evaluate value of ocean sport fisheries for anadromous fish produced from the Eel River and Russian River.

- Determine indirect values with IMPLAN: impacts to tourism, local government revenues and services, employment, and income due to ocean sport fisheries.

Eel River and Russian River sport fisheries value due to change in river flows, water temperature regimes, and fish habitats, on both river systems.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 9 – Fish Populations) to provide as much data as possible to SE 1 in regards to population of river fish (by type) produced from the Eel River and Russian River.
- Perform literature reviews to determine value of river sport fisheries in nearby basins and benefits transfer on the sport value for each fish.
- Perform literature reviews to determine expected percentage of river fish caught by river sport fisheries.
- Evaluate value of river sport fisheries for fish produced from the Eel River and Russian River.
- Determine indirect values with IMPLAN: impacts to tourism, local government revenues and services, employment, and income due to river sport fisheries.

Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma sport fisheries value due to the removal of the Scotts Dam and Cape Horn Dam, and change in the lakes' water surface elevations including complete drainage, water temperature regimes, and fish habitats.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 9 – Fish Populations) to provide as much data as possible to SE 1 in regard to population of lake fish (by type) produced from Lake Pillsbury.
- Perform literature reviews to determine value of lake sport fisheries in nearby basins and benefits transfer on the sport value for each fish.
- Perform literature reviews to determine expected percentage of lake fish caught by lake sport fisheries...
- Evaluate value of lake sport fisheries for fish produced from Lake Pillsbury.
- Determine indirect values with IMPLAN: impacts to tourism, local government revenues and services, employment, and income due to lake sport fisheries.

Eel River and Russian River Tribal non-commercial/subsistence value of a healthy fishery for food and subsistence living due to change in river flows, temperature regimes, and fish habitats, on both river systems.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 9 – Fish Populations) to provide as much data as possible to SE 1 in regard to population of fish (by type) produced from the Eel River and Russian River.

- Evaluate value to the Tribes on Russian River and Eel River of a healthy fishery for food, culture, and subsistence living. This analysis will most be qualitative and may be estimated indirectly via measures such as healthcare costs associated with changes in long-term health effects from changes in diet.
- Use a fishery model to determine expected percentage of fish (by type) which can be caught for Tribal subsistence fishery.
- Determine values through literature reviews, discussions with Tribal members and qualitative analysis: health impacts from change in diet and nutrition (healthy diet from eating fish).

Eel River and Russian River Tribal cultural value (to non-fishers) of anadromous fish due to change in river flows, temperature regimes, and fish habitats, on both river systems.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 9 – Fish Populations) to provide as much data as possible to SE 1 in regards to population of anadromous fish (by type) produced from the Eel River and Russian River.
- Perform literature reviews and interview members of the Tribes to help and to identify (where possible) the appropriate economic values to be used to determine Tribal cultural value for each anadromous fish (by type).
- Evaluate Tribal cultural value of anadromous fish produced from the Eel River and Russian River. This analysis will most likely be qualitative, if possible, the value may be estimated indirectly via cost-effectiveness methods.

Eel River and Russian River existence value (to non-fishers) of anadromous fish due to change in river flows, temperature regimes, and fish habitats, on both river systems.

- Review the other studies of the FERC Project No. 77 (e.g. Study AQ 9 – Fish Populations) to provide as much data as possible to SE 1 in regards to population of anadromous fish (by type) produced from the Eel River and Russian River.
- Perform literature reviews to identify the appropriate economic values to be used to determine benefits transfer value for each anadromous fish (by type) from nearby basins, e.g., Klamath River.
- Evaluate societal value of anadromous fish produced from the Eel River and Russian River.

Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma recreation value due to changes in lake water levels, including complete drainage.

- Review the other studies of the FERC Project No. 77 (e.g. LAND 1 – Roads and Trails Assessment, REC 1 – Recreation Facility Assessment, REC 2 – Reservoir Recreation Opportunities, TERR 1 - Botanical, and TERR 2 – Wildlife Resources) to provide as much data as possible to SE 1 in regards to number of recreational visitor days from

lake recreation (non-fisheries) produced from Lake Pillsbury, Lake Mendocino, and Van Arsdale Reservoir by type (e.g. picnicking, camping, sightseeing, swimming/beach use, walking, boating/water skiing, hunting). This will be impacted form greater seasonal changes in water level elevation.

- Perform literature reviews to identify the appropriate economic values to be used to determine benefits transfer value of recreational visitor days by type.
- Evaluate value of lake recreation (non-fisheries) for Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma.
- Determine indirect values with IMPLAN: impacts to tourism, support services, local government revenues and services, employment, and income due to lake recreation.

Eel River and Russian River recreation value due to changes in river water flows, water temperatures, water quality, riparian vegetation, and channel morphology, on both river systems.

- Review the other studies of the FERC Project No. 77 (e.g. LAND 1 – Roads and Trails Assessment, REC 1 – Recreation Facility Assessment, REC 2 – Reservoir Recreation Opportunities, REC 3 – Whitewater Boating, TERR 1 - Botanical, and TERR 2 – Wildlife Resources) to provide as much data as possible to SE 1 in regards to number of recreational visitor days from river recreation (non-fisheries) produced from Eel River and Russian River by type (e.g. whitewater rafting, picnicking, camping, sightseeing, swimming/beach use, walking, hunting).
- Perform literature reviews to identify the appropriate economic values to be used to determine benefits transfer value of recreational visitor days by type.
- Evaluate value of river recreation (non-fisheries) for Eel River and Russian River.
- Determine indirect values with IMPLAN: impacts to tourism, support services, local government revenues and services, employment, and income due to river recreation.

Lakeside property value adjacent to Lake Pillsbury, Lake Mendocino, Van Arsdale Reservoir, and Lake Sonoma due to elimination of Scott Dam and drainage of Lake Pillsbury.

- Conduct map review to understand the number, type, and location of residential and commercial property (e.g. accommodations) associated with being next to Lake Pillsbury.
- Perform literature review to identify the appropriate economic values to be used to determine property value per square foot, and to research property tax payments.
- Use benefits transfer to consider how the lake impacts property values and local government payments (property taxes).
- Evaluate property values associated with being next to Lake Pillsbury and local government impacts.

- Determine indirect values with IMPLAN: regional spending from seasonal property owners.

Change in property tax revenue to local jurisdictions for property to be owned/operated by public entities near Lake Pillsbury, Van Arsdale Reservoir, and Potter Valley.

- Review the other studies of the FERC Project No. 77 to provide as much data as possible to SE 1 in regards to land owned by PG&E that may transferred to local government or entity near Lake Pillsbury, Van Arsdale Reservoir, and Potter Valley.
- Perform literature reviews, discussions with county tax assessors and interviews with PG&E (as necessary) to determine property value per square foot, property tax payments and quantity of land to be transferred.
- Estimate change of property taxes paid by PG&E to local jurisdictions near Lake Pillsbury, Van Arsdale Reservoir, and Potter Valley.
- Determine indirect values with IMPLAN: local government impacts (services).

Eel River and Russian River Tribal cultural value of water flows other than directly related to fisheries due to changes in river flows, water temperature regimes, water quality, riparian vegetation, and channel morphology on both river systems.

- Review the other studies of the FERC Project No. 77 (e.g. AQ 1 – Hydrology, AQ 2 – Water Temperature, AQ 3 – Water Quality, AQ 5 – Instream Flow, CUL 2 – Tribal Resources) to provide as much data as possible to SE 1 in regards to water flows on the Eel River and Russian River to the Tribes (including flows, temperature, quality, and inundation frequency and duration).
- Perform literature reviews and interview members of the Tribes to identify the appropriate economic values (if possible) to be used to determine Tribal cultural value of water flows. This may include recreation and seasonal impacts.
- Evaluate Tribal cultural value of water flows beyond fisheries produced from the Eel River and Russian River. This analysis will most likely be qualitative, if possible, the value may be estimated indirectly via cost-effectiveness methods.

Impacts of construction spending on the regional economy (e.g., income, employment) due to changes in construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.

- Review the other studies of the FERC Project No. 77 to provide as much data as possible to SE 1 in regard to construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.
- Determine indirect values with IMPLAN: employment and income due to construction spending.

Air, water, and noise pollution impacts due to construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.

- Review the other studies of the FERC Project No. 77 to provide as much data as possible to SE 1 in regards to air, water, and noise pollution near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.
- Perform literature reviews to identify the appropriate economic values to be used to determine benefits transfer value of air, water, and noise pollution impacts per unit.
- Evaluate cost of air, water, and noise pollution due to construction activity produced near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley. This analysis will most likely be qualitative, if possible the value may be estimated indirectly via cost-effectiveness methods.
- Determine indirect values with IMPLAN Indirect: property values, employment, and income due to change in pollution.

Motoring public traffic impact impacts due to construction activity near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.

- Review the other studies of the FERC Project No. 77 to provide as much data as possible to SE 1 in regard to truck traffic and traffic impacts near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.
- Perform literature reviews to identify the appropriate economic values to be used to determine benefits transfer value of traffic impacts per unit (e.g. vehicle hours traveled and vehicle miles traveled). (US Department of Transportation 2020)
- Evaluate cost to motoring public of traffic impacts during construction near Lake Pillsbury, Van Arsdale Reservoir, Lake Mendocino (pump back facility), and Potter Valley.
- Determine indirect values with IMPLAN Indirect: property values, employment and income due to change in truck traffic.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE.

The methodologies listed here are consistent with generally accepted scientific, engineering and economics principles and practice. However, as noted above, there are a number of assumptions built into the various analyses. The input variables (not only into IMPLAN but also other analyses) need to be thoroughly vetted.

PRODUCTS

Technical Study Reports will document data and results for individual study elements and will be distributed as soon as possible, as they are completed. Analysis and interpretation of Project effects will be provided in the License Application.

RELATIONSHIP TO OTHER STUDIES

Information developed as part of other studies will be used to help determine the anticipated socioeconomic impacts. They include:

- Study AQ 1 – Hydrology and Project Operations Modeling will provide information related to property locations in reference to water, water supply reliability, flood hazards, and cultural values.
- Study AQ 2 – Water Temperature may provide information related to Tribal cultural values.
- Study AQ 3 – Water Quality may provide information related to Tribal cultural values.
- Study AQ 5 – Instream Flow may help provide detailed information related to water supply reliability and cultural values.
- Study AQ 9 – Fish Populations may provide information related to fish population changes.
- Study AQ 12 – Dam Removal will provide information related to downstream sediment transport and deposition, and associated risk to water supply reliability below Scotts Dam and other water supply needs.
- Study LAND 1 – Roads and Trails Assessment may provide information related to recreation.
- Study LAND 3 – Hazardous Fuels Reduction Assessment may provide information related to water supply for fighting fires.
- Study REC 1 – Recreation Facility Assessment may provide information related to recreation.
- Study REC 2 – Reservoir Recreation Opportunities may provide information related to recreation.
- Study REC 3 – Whitewater Boating may provide information related to recreation.
- Study TERR 1 – Botanical Resources may provide information related to recreation.
- Study TERR 2 – Wildlife Resources may provide information related to recreation.
- Study CUL 2 – Tribal Resources may provide information related to Tribal cultural values.

LEVEL OF EFFORT AND COST

The estimated cost (2020 dollars) for the study is $550,000

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