# FOOTHILLS WATER NETWORK

December 23, 2008

COMMENTS ON PROPOSED STUDY PLANS
DRUM-SPAULDING PROJECT # 2310
AND YUBA-BEAR PROJECT # 2266

**Via Electronic Submittal**

Hon. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Dear Secretary Bose:

On September 25, 2008, Pacific Gas and Electric Company (PG&E) and Nevada Irrigation District (NID) issued their proposed study plans pursuant to the Integrated Licensing Process (ILP) for relicensing the Drum-Spaulding and Yuba-Bear (Projects), FERC #2310 and # 2266 respectively. These comments are being filed to meet the deadline of December 24, 2008 established by the Federal Energy Regulatory Commission (Commission).

**Foothills Water Network**
This response was jointly developed and signed by non-governmental organizations and by individuals participating in the Drum-Spaulding and Yuba-Bear Relicensings. The Foothills Water Network represents a broad group of non-governmental organizations and water resource stakeholders in the Yuba, Bear, and American Watersheds. The overall goal of the Foothills Water Network is to provide a forum that increases the effectiveness of non-profit conservation organizations to achieve river and watershed restoration and protection benefits for the Yuba, Bear, and American Rivers. This includes negotiations at the county, state, and federal levels, with an immediate focus on the FERC relicensing processes.

This document is organized and formatted in the following way:

## 1. COLLABORATIVE STUDY DEVELOPMENT

In general, the Foothills Water Network and its members consider the Licensee's Study Plan development process to be collaborative and based on consensus between stakeholders. We applaud PG&E and NID for starting well before the ILP process required in order to get priority study plans into the field in summer 2008. In many cases, we have been able to come to consensus on Study Plans with the licensees, resource agencies, and tribes. However, certain study elements requested by the non-governmental organizations and other stakeholders have not been incorporated into the Licensees' Study Plan. These will be addressed below.

## 2. CONSENSUS ON SELECT STUDY PLANS

The Foothills Water Network and its members have participated in the consensus-based process to collaborate on study plans in the PG&E and NID relicensing process. We have been party to consensus-based agreements on the following studies. We agree with these studies as included in the Licensees' Study Plan submitted on September 25, 2008.

- CESA-Listed and Fully Protected Wildlife – Bald Eagle
- CESA-Listed and Fully Protected Wildlife – CWHR
- CESA-Listed Plants
- ESA-Listed Amphibians – California Red-legged Frog
- ESA-Listed Plants
- ESA-Listed Wildlife – Valley Elderberry Longhorn Beetle
- Historic Properties
- Instream Flow
- Native American Traditional Cultural Properties
- Recreation Flow
- Recreation Use and Visitor Surveys
- Special Status Amphibians – Foothill Yellow-legged Frog Surveys
- Special Status Bats
- Special Status Mollusks
- Special Status Plants
- Special Status Reptiles – Western Pond Turtle
- Special Status Wildlife – CWHR
- Stream Fish Populations
- Terrestrial Wildlife Movement
- Water Quality

In addition, we agree with the following study plans that have been agreed to by relicensing participants since September 25, 2008:

- Bats
- Macroinvertebrates
- Reservoir Fish Populations
- Wildlife Movement

### 2.1. Interpretation of Study Results

It should be noted that the consensus to move forward with the above listed Study Plans does not affirm the accuracy of any conclusions drawn or interpretations made in those studies. The Foothills Water Network and its members may in the future disagree with interpretations of study results when such interpretations are offered by the licensees or other relicensing participants, but this response filing is not the appropriate place to address those differences.

## 3. DEFICIENT STUDY PLANS PROPOSED BY LICENSEES

This section summarizes the Foothill Water Network's review of the following 8 study plans addressed in the Study Plan filed by PG&E and NID on September 25, 2008. This review is based on the ILP's seven study criteria. The studies addressed are:

- Channel Morphology
- Fish Entrainment
- Fish Passage
- Habitat Suitability Criteria
- Hydrologic Alteration
- Water Temperature Modeling
- Western Placer Creeks (filed by PG&E only)
- Wetlands

### 3.1. Support for Resource Agency Modification of Study Plans

We note that the resource agencies are also submitting commentary on seven of the above eight studies, in which they directly address the ILP's seven study criteria in regards to those studies. With the exception of the Wetlands Study, the Foothills Water Network supports the agencies and defers to their comments for a detailed explanation of how proposed modifications meet the seven criteria. Our general comments below are supplemental to our support of Agency modifications. These comments are intended to bring focus to issues critical to our interests, and especially to provide additional clarity regarding disputed portions of respective study plans.

#### 3.1.1. Channel Morphology

3.1.1.1. Comments on Section 4.0 – Study Goals and Objectives

One of the stated goals and objectives is "Determine if channel morphology reflects an approximate equilibrium between gravel supply and bedload transport *sufficient to maintain existing alluvial features,"* (emphasis added). This goal/objective assumes that existing alluvial features are appropriate or desired. In addition, the objective is limited to only alluvial features, when we should be interested in other geomorphologic attributes, such as channel dimensions, shape, degree of incision, stability etc. This objective should be modified to reflect the interest to determine if channel morphology reflects proper functions and conditions. Proper functions and condition should include an approximate

equilibrium of sediment supply and transport, depositional and alluvial features, channel stability, connection between channel and floodplains etc.

An additional goal of the study should be to collect information regarding the history of human activity during the license period that could reasonably be thought to have permanently altered the geomorphology of stream reaches. These activities include flow alteration, cattle grazing, logging, OHV use, etc.

The purpose of this information, at this stage, would not be to analyze geomorphologic processes, or to attribute effects to causes, etc.; rather it would be to provide basic information that will be required to inform the analysis and PM&E definition phase of the relicensing process.

3.1.1.2. Comments on Section 5.0 – Existing Information

Human activities during the license period, throughout the Yuba-Bear Drum-Spaulding area, are sure to have been extensive. Of particular interest to FWN in this context is the affect of human activities on Bear River Reach # 2, also known as the Bear Valley Reach. FWN therefore provides detailed comments and information at this time that it believes need to be incorporated into the Section 5.0 (Existing Information) of the Geomorphology Study Plan. These comments and information with respect to the Bear River focus on flow alteration and cattle grazing.

Hydrology

Licensee's table 6.1, "Response Reaches", is substantially in error with respect to the hydrology of the Bear River through the Bear Valley. Please see the Licensee's hydrology data for Bear River Gauge YB198. As presented, the table provides an incomplete, inaccurate, and misleading impression of the hydrology. Corrections are listed below:

| **Category** | **Table 6.1 Value** | **Correct Value** |
|---|---|---|
| Water source | SY Canal, YB139 | SY Canal, YB139 and Drum C, YB137 |
| Exceedance Flows<br>50% September Reg & Unimp<br>50% March Reg & Unimp | No Data | While the record is incomplete, enough data exists to compute these values; they should be computed. |
| Stated Flow Capacity | 107 cfs | 707 cfs<br>(600 from Drum, 107 from SYC) |
| Maximum Flow | Not given | 582.5 |

An understanding of the hydrology in Bear River Reach #2 requires a basic understanding of how Spaulding Dam, the Drum Canal and the South Yuba Canal are operated. When PG&E determines that Spaulding is going to spill, some or all of the "destined to spill" water is diverted into the Drum Canal and South Yuba Canal, and then released to the Bear River at YB137 and YB139. This operational rule looks only upstream, and is triggered solely by the determination that Spaulding is going to spill, without apparent regard to what is going on downstream in the power, water and river systems. The mean flow from these releases into the Bear River through Bear Valley is about 150 cfs, with flows of 400 cfs not uncommon, and a maximum flow of nearly 600 cfs. These flows frequently fluctuate by hundreds of cfs in periods of a day or less. In spill years (7 years out of 10), the duration of the spiky, abnormally high flows is typically from late winter through late spring or early summer.

Cattle Grazing

The geomorphology of the river through the Bear Valley cannot be properly analyzed without an understanding of cattle grazing, any more than Sierra geology could be understood without a grasp of plate tectonics.

There is substantial written and oral history available regarding the history of cattle grazing in the Bear Valley during the period of the license. Briefly, the Van Vleck family of Rancho Murietta trucked cattle into the valley from 1963 until 1993, when PG&E terminated their lease. This was a substantial operation, including the use of a helicopter piloted by Mr. Stanley Van Vleck. During the period of the license, hundreds of cattle may have been in the valley, from snowmelt into October. According to eyewitness John Hiscox, the streambed exhibited the typical sorts of damage that cattle cause in Sierra streams,(personal communication).

Additional Existing Information

The existing information section should also include the history of the hydropower operations during the license period, particularly the decommissioning of the Old Boardman Canal. It should include information regarding the temperature study plan and 401 certification after the Boardman decommissioning, and the MOU between PG&E and CDFG to remove cattle from the Bear Valley, and for PG&E to assist in restoration activities.

A history of the restoration of 1000 feet or so of the stream that was restored through cooperation among CDFG, PG&E, and the Granite Bay Fly Casters should be included. The history and success of this restoration is important information that will inform, when the time comes, the evaluation of one of the potential license conditions listed in the study plan, "Channel restoration".

Additional Information Sources

FERC elibrary
PG&E Livestock Leasing documentation
Stanley Van Vleck Jr. – 916-743-3826
John Hiscox, California Department of Fish & Game
Gene Geary, Pacific Gas & Electric Co.

3.1.1.3. Comments on Section 6.3 – Study Methods

As described in comments on study goals above, the first step in this study should be to collect detailed information regarding human activities during the license period that can reasonably be believed to have altered the geomorphology of the reach, including controlled flows, cattle grazing, logging, OHV use, etc.

As written, the study methods describe a sequence whereby licensee consultants would flag a series of locations that could be included as survey sites, and relicensing participants would then visit these locations and help to collaboratively select sites for study. The methodology should allow for the possibility for sites not already identified as potential sites to be selected by the group in the field, if the group agrees that a new site is preferable to existing potential sites.

The methodology proposed for characterizing current conditions in project reaches is a Rosgen Level II analysis. We recommend including the gathering of information on streamflow at the time that water surface elevations (i.e., longitudinal water surface profile) are surveyed, to facilitate calibrating any subsequent stage/discharge or other analyses.

The general approach of this study is to perform up to seven different steps for each reach identified, including:

1. Determine Rosgen Level I, II, & III
2. Characterize Sediment Conditions
3. Determine Sediment Transport Capability
4. Determine Sediment Yield
5. Determine Flood Frequencies
6. Determine if Equilibrium between Gravel Supply and Bedload Transport
7. Evaluate LWD

These steps will certainly help describe the morphology and sediment transport dynamics of study reaches. However, these steps won't necessarily develop the information necessary to determine if the study reaches have the geomorphologic qualities to function properly. For example, many parts of the Bear River Reach #1, in what is known as Bear Valley west of the Hwy 20 crossing, could be classified as a canyon bottom type channel (B2) per the Rosgen system. However, one could argue that it should be a meadow type stream (B1), given that

it flows through a meadow, but the incised condition has changed its classification. The proposed methodology would not necessarily identify such situations where channel morphology is not what it should be.

Similarly, the proposed methodology would not necessarily identify reaches where existing morphology prevents channels from performing the proper function. Using the Bear Valley example again, the channel is completely cut off from the meadow floodplain because the channel capacity in most places far exceeds flows that are ever likely to occur in that reach. As a result, the meadow floodplain will never receive the benefits of regular inundation, which adversely affects most ecological values of the floodplain habitats.

The methodology should include an additional step to determine whether the study channel exhibits proper functioning conditions, such as appropriate discharge-channel capacity or channel-floodplain relationships etc.

Of the 75+ study reaches identified in Table 1, the study plan proposes to determine whether equilibrium between sediment supply and transport exists in only five locations. Given the number of dams, diversions, powerhouses, canal spill facilities and other project features that could affect channel geomorphology, determining whether a channel is potentially aggrading or degrading in only five locations seems unjustifiably low. Most of these five reaches are below significant storage reservoirs, which seems logical. However, other reaches, especially reaches that appear to be out of equilibrium, such as the Bear River through Bear Valley as discussed above, should be studied as well.

We also generally recommend that the selection of sites for detailed study should not be limited to reaches that are predominantly depositional/alluvial. A common perception is that bedrock channel morphology is static compared to alluvial channels, and therefore, relatively insensitive to flow and sediment supply changes. But bedrock channels are often highly dynamic depositional environments. The bedrock channels can function as a template of hydraulic controls that creates diverse nested depositional features ranging from aggregates of large boulders to fine sand deposits (McBain and Trush, 2004). Depositional stretches or features in bedrock reaches can serve as biological “hotspots” and support abundant aquatic and riparian habitat, off-channel amphibian habitat, and higher overall biological diversity and productivity. Therefore it is important not to overlook predominantly bedrock reaches when considering study locations.

### 3.1.2. Fish Entrainment

Entrainment into project canals, power intakes, and spillways can have serious effects on fish and fish populations. Addressing entrainment, moreover, is frequently contentious and potentially expensive.

Recent experience in the DeSabla – Centerville relicensing demonstrated the importance of monitoring that physically quantifies the entrance of fish into

project facilities. Use of an after-the-fact census of fish rescued from project canals as they were de-watered for maintenance evoked adamant disagreement about the accuracy of this form of quantification, and compounded a series of disagreements about the biological significance of the entrance of fish into project canals.

Partly in light of this experience, it is particularly important to relicensing participants in the Yuba-Bear/Drum-Spaulding proceeding to obtain a dataset regarding entrainment that has up-front buy-in from everyone.

The methods for collecting such data have been largely agreed upon. The outstanding disagreement between licensees and resource agencies deals with the duration of split beam sonar monitoring. FWN agrees with the resource agencies that it is critical to capture entrainment over an extended period of time, since there is no evidence to suggest that rates of entrainment are relatively uniform over the course of a year. The mid-April through mid-August timeframe proposed by the agencies captures the snowmelt period, extended periods of base flow, and a considerable range of project operations under, at least potentially, differing operating conditions.

In order to provide a credible dataset that will not itself become the object of debate, the Commission should approve the study plan as submitted by the resource agencies.

### 3.1.3. Fish Passage

Tributaries of mainstream west slope Sierra streams provide important spawning habitat for rainbow trout. As part of the effort to determine extent of trout spawning habitat in the streams affected by the projects, the resource agencies proposed a Fish Passage Study Plan. Agreement on this study is close for data collection methods and how best to determine the location of the downstream-most fish barrier on each stream. As revised, the study plan allows use of existing information where it is sufficient

Disagreement exists over the possible need to quantify fish barriers in order to verify if they are indeed barriers and, if so, whether they are complete barriers. Agencies proposed a collaborative determination of the need for such quantification, with a proviso that the agencies would ask for a consideration of a site only if it were reasonable to believe that the stream in question possessed significant spawning habitat. There is disagreement about how determination will be made over the nature and extent of studies to achieve that quantification.

FWN believes that the concern about a lack of explicitly-defined steps to quantify fish passage barriers is misplaced. The agencies have proposed a rational tiered approach that provides ample opportunity to the licensees to oppose any quantification they feel is not needed. Licensees also have the ability to advocate,

within a collaborative discussion, regarding the appropriate extent of study and study methods.

On several occasions in this proceeding, licensees have objected to lack of definition in a portion of a study plan, when an alternative might very well have been to impose a more extensive effort that might have proved excessive. Indeed, it was precisely to meet licensees' interests to avoid unnecessary studies that this tiered approach was proposed. The tiered approach also addresses the fact that under the ILP, a completely new study plan proposed after the designated time period is extremely unlikely to be approved by the Commission.

Finally, FWN notes that the Fish Passage Study Plan provides no information useful to determining project affects on passage of anadromous fish in the South Yuba and Middle Yuba. The study plan is designed entirely for rainbow trout and does not involve assessment of migration barriers in the mainstem of these rivers. The study plan cites existing information from fish passage assessment work by the Upper Yuba River Studies Program, but fails to note the preliminary quality of that assessment. When access for anadromous fish to the South and Middle Yuba Rivers becomes imminent, then the licensees must support a study designed to determine project effects on Spring-run Chinook and steelhead trout.

### 3.1.4. Habitat Suitability Criteria

Habitat Suitability Criteria (HSC) are necessary for the use of instream flow models in estimating amount and quality of fish habitat. HSC can be controversial because the datasets used to derive them typically suffer sampling insufficiencies or come from streams different than the ones under study. The California Department of Fish and Game and other resource agencies have proposed HSC's that were derived from an extensive set of data in the local region and which are currently being applied in the relicensing of PCWA's Middle Fork American Project. The licensees counter that their HSC are more conventional. FWN supports the HSC study plan proposed by the agencies because it represents the best available science. One aspect of this "better science" is the correction of bias associated with streams that are limited in depth and velocity.

HSC and Instream Flow are not the only studies important in determining Project effects and appropriate flows for aquatic life. Even with the better HSC proposed by the agencies, inherent problems associated with modeling habitat suitability may lead to inaccuracies in estimating availability or quality of fish habitat. Such concerns are greatest for the large rivers: Bear, Middle and South Yuba. Temperature and Hydrologic Alteration are equally, if not more important studies, for understanding project effects on aquatic resources including fish. Temperature and hydrologic patterns have very direct influences on fish habitat quality which are not addressed by HSC and Instream Flow studies.

### 3.1.5. Hydrologic Alteration

Foothills Water Network (FWN) believes that there is little substantive difference amongst licensees and other the relicensing participants regarding the proposed Hydrologic Alteration Study Plan. There is agreement on what will be studied, both in terms of content and location.

FWN was instrumental in moving forward Study steps 1 and 2 (see Section 6.3, Study Methods). Analysis of 15-minute data in three project conveyance reaches and a cataloguing of spill events on four major project reaches will provide data that is critical to improved reservoir management and spill prevention. Uncontrolled flow fluctuations often cause serious negative impacts to aquatic biota, including frogs and fish. The analysis provided by these two steps of this study will allow serious examination of how water that is otherwise destined to spill can be efficiently used for aquatic and recreational benefits, rather than detriments. There is consensus among relicensing participants that there is great value in these aspects of this study.

There is also agreement among relicensing participants that the Nature Conservancy's Indicators of Hydrologic Alteration (IHA) software program will form the basis of a substantial portion of this study. This is an off-the-shelf software package that has been used in several relicensings in California, as well as in numerous other venues.

Licensees and their consultant have objected to certain aspects the Environmental Flow Component of Version 7 of this program. Specifically, licensees and their consultant maintain that the off-the-shelf computer program's terminology in characterizing different flows and flow levels may not correspond to the in-river reality of the particular hydrology of the Yuba-Bear/Drum-Spaulding system. There also appears to be a vaguely-defined discomfort with the Environmental Flow Component. In order to address the terminological issue, and in some measure the rest of the discomfort, the resource agencies offered to include a caveat in the study plan: "Use of the IHA program does not imply that the licensees or stakeholders agree with the ecological descriptions associated with the parameters by the authors of the method."

This caveat was not accepted by the licensees, no suitable substitute was proposed by them, and consensus for this entire study appears to have stalled over this sticking point.

Licensees and their consultant will have not only one, but three opportunities to disclaim whatever portion of the IHA outcomes or descriptions they may choose: in the Study Report, in their Draft License Applications, and in their Final License Applications. This is on top of the proposed caveat within the Study Plan itself, as quoted above.

The Commission should approve the Agencies' study plan as written. Should the Commission feel it necessary, it could point out to the licensees that it is sufficiently sophisticated to consider the contested nature of the terminology and/or the descriptions contained in the IHA program.

### 3.1.6. Water Temperature Modeling

3.1.6.1. Overview, statement of interest, and general comments:

Understanding and managing cold water in the combined Yuba-Bear/Drum-Spaulding (YBDS) hydroelectric system is essential to meeting the most fundamental interests of a majority of the members of the Foothill Water Network (FWN).

The ability of the system to support cold freshwater habitat in the Middle Yuba and South Yuba rivers, in the Bear River, and in the West Placer Creeks, is dependent on this understanding and management.

For many FWN members, a major goal of the relicensing process is to ensure the provision of habitat suitable for anadromous fish habitat(salmon and steelhead), allowing the possibility of future restoration. Others see the issue simply as a matter of providing habitat according to the California Central Valley Regional Water Quality Control Board's Basin Plan. Whether it be for resident trout or for anadromous fish, cold water is the key to restoring fisheries.

Storage in the YBDS system is limited. This makes cold water storage in the system even more limited. Given this limited storage, and the multiplicity of hydropower, consumptive, instream aquatic, and recreational beneficial uses which all compete for water within this system; given, moreover, the uncertainty of the effects of climate change on the availability of cold water and the coldness of the water that is available, it is only prudent to use the best temperature modeling tools reasonably available to quantify and evaluate cold water in project reservoirs, not only during this relicensing process, but as building blocks for project management going forward for the next 30 to 50 years.

In the event that PM&Es require cooling of reaches, e.g. through use of temperature compliance points, cold water will take on an economic value that can actually be calculated. For purposes of meeting a target temperature at a compliance point, colder water will be more valuable. Good temperature monitoring and temperature modeling tools will enable the Licensees to store and distribute cold water in the most cost-effective manner.

3.1.6.2. Comments on the most recent licensee study proposal – points of agreement:

FWN is pleased that licensees and other relicensing participants have come to tentative agreement on substantial elements of the Water Temperature Modeling Study Plan, subject to achieving agreement on the outstanding issues.

FWN believes that consensus has been reached on the following major elements:

1) Revisions to the HSPF model, developed for the Upper Yuba River Studies Program, for the Middle Yuba, South Yuba and Canyon Creek, and use of that revised model for evaluating current conditions and proposed operational scenarios for those three water bodies.

2) Use of an SSTEMP model to enable characterization of water temperatures in three reaches of the Bear River, and to enable consideration of various operational changes on the Bear River.

3) CE-QUAL-W2 modeling of Spaulding Reservoir. This transit reservoir is the hub of the Yuba-Bear/Drum-Spaulding system. Use of CE-QUAL-W2 will enable a sophisticated understanding and quantification of the stratification of this reservoir, mixing of water of various temperatures within it, and the movement of cold water through it. This model will provide reliable inputs to the HSPF model for the South Yuba River under varying operating scenarios for Spaulding Reservoir itself, and assist in providing understanding the thermal regimes of water that is moved in the South Yuba and Drum Canals.

4. Analysis of the outlet works at Spaulding Dam that can be used to accurately define the outlet "boundary conditions" for the CE-QUAL-W2 model.

3.1.6.3. Remaining deficiencies in the licensees' proposed study plan:

Agreed upon elements of the Temperature Modeling Study Plan, coupled with a robust, agreed-upon Temperature Monitoring Study Plan, define most of the capabilities needed for a thorough understanding of a complex system that must support many beneficial uses. Unfortunately, however, the lack of hydrodynamic and thermodynamic modeling of the remaining major storage reservoirs (Bowman, Rollins, Fordyce, and Jackson Meadows) are "missing links" which will diminish the value and effectiveness of the rest of the temperature study effort.

Licensees have proposed spreadsheet analysis of these four remaining major storage reservoirs in the combined YBDS system. They have not provided examples of such an approach. Without such examples, it is impossible to evaluate the effectiveness and the potential usefulness of such a tool in analyzing operational options and scenarios.

In addition to being storage reservoirs, Bowman and Rollins are also transit reservoirs: similar in many ways to Spaulding, water is moved through them for most of the summer. The sheer number of variables presented by possible operational changes at Bowman and Rollins, or upstream or downstream of them, makes it particularly difficult to understand how a spreadsheet analysis could be an inefficient and robust tool for the purposes both of characterizing water temperatures in these reservoirs and evaluating, from a cold water perspective, changes that might be caused by proposed operational scenarios.

Upstream of Bowman Reservoir, there are reservoirs that contain over 20,000 acre feet of storage. Changes in the timing and magnitude and temperature of draft from these reservoirs could significantly affect water temperatures in Bowman. Of greater significance, Bowman Reservoir is fed by the Milton-Bowman tunnel, which is subject to changes in timing, magnitude and temperature of releases from Jackson Meadows Reservoir, and to and releases from Milton Diversion Dam to the Middle Yuba. It is difficult to imagine how the complex and interdependent variables of inputs, outputs and mixing could be adequately characterized using a spreadsheet analysis that attempts to quantify cold water storage and depletion over time without modeling actual hydrodynamic and thermodynamic processes.

Equally implausible is the notion that a spreadsheet analysis can adequately characterize proposed operational scenarios that would affect water temperatures in Rollins Reservoir. The majority of the YBDS system is upstream of Rollins. The number of changes from historic operation which might change thermal characteristics of Rollins Reservoir is thus legion. Licensees have noted that Rollins tends to almost entirely mix (de-stratify) by the end of the summer, and thus opined that a spreadsheet analysis would be sufficient. However, two major issues are not adequately considered in noting this historic trend: the timing of the mixing, and the possibility of increases in water temperature if less water is routed through this reservoir, as might be considered if additional water were to leave the system into the Middle and South Yuba Rivers.

Provision of a spreadsheet analysis for Fordyce and Jackson Meadows reservoirs has also been proposed by the licensees (provided no pumped storage facility is formally proposed at Fordyce Reservoir). The thermal regimes at these two reservoirs, while subject to naturally caused annual differences in timing and rate of filling, and man-made changes in outflow, are not subject to significant man-made variations in inflow attributable to project operations. (Jackson Meadows has no upstream storage; Fordyce is fed by three small reservoirs whose total storage is about one seventh that of Fordyce, and of which two are presently drawn down in the autumn). While the number of those variables is thus limited relative to the project's transit reservoirs, they would still be statically based on historic operations, putting into question their ability to provide inputs to time-series for temperature models downstream (in the case of Jackson Meadows, for

the Middle Yuba; in the case of Fordyce, for the Spaulding Reservoir CE-QUAL-W2 model).

3.1.6.4. Conclusions:

In the absence of a clear example of the spreadsheet analyses that the licensees propose to use for Bowman, Rollins, Jackson Meadows and Fordyce Reservoirs, the resource agencies have proposed that licensees produce these analyses, and also use the same type of analysis for Spaulding Reservoir. The spreadsheet analysis for Spaulding could then be compared to the CE-QUAL-W2 model for Spaulding, in order to assess the accuracy, adequacy and versatility of the spreadsheet analysis. Depending on the result, resource agencies would either approve the use of the spreadsheet analyses, or require development of CE-QUAL-W2 models at the remaining four reservoirs in question.

In the absence of examples which can demonstrate the effectiveness of the proposed spreadsheet analysis, and considering the critical nature of cold water in the combined Yuba-Bear/Drum-Spaulding system, this option seems to FWN to be necessary and fair. We thus support the study plan as written by the resource agencies.

### 3.1.7. Western Placer Creeks

3.1.7.1. Overview:

West Placer Streams are profoundly affected by operations of the Yuba-Bear and Drum-Spaulding Projects. Water supplied by the Projects influences several anadromous streams, including Coon, Doty and Auburn Ravine Creeks, and Miners and Secret Ravine Creeks within the separate Dry Creek system.

These streams have historical salmon and steelhead fisheries, which are protected by the Endangered Species Act (steelhead) and the Magnusen-Stevens Fishery Conservation and Management Act. Several ongoing restoration activities are currently taking place on these streams. The precipitous decline of Central Valley Chinook salmon and steelhead has been reported for several years, with a recent UC Davis study concluding that if short-term trends in wild Central Valley steelhead continue, steelhead in the Central Valley may face widespread extirpation in the next 50 years.

3.1.7.2. Agreed Upon Elements:

Drum-Spaulding Project licensee, Pacific Gas & Electric Company (PG&E), has agreed with relicensing participants that project operations have the potential to affect stream reaches in the Auburn Ravine and Coon Creek watersheds. PG&E has agreed to limited studies on stream reaches directly downstream of project facilities on Auburn Ravine and on Rock Creek and Dry Creek (tributaries of Coon Creek),

3.1.7.3. Flow Analysis Segment

PG&E has also proposed a stepwise follow-up based on analysis of the initial studies whose scope was limited to reaches directly downstream of project facilities.

However, it is not clear to Foothill Water Network how the agreed on study elements will inform analysis of the need for studies further downstream. Indeed, the approach proposed by PG&E appears to simply delay a difficult decision without providing a clear roadmap to decision points on further studies with extended downstream scope.

The goal of the Flow Analysis segment of the agencies' West Placer Creeks Study Plan is to more accurately determine the extent of direct project effects on Auburn Ravine and Coon Creek, especially during both outage periods (planned, and if they occur in the study period, unplanned) and periods of winter spill from Wise Powerhouse. Of particular interest are effects on salmonids and salmonid habitat in these two creeks.

Gauging history and information for the Auburn Ravine and Coon Creek watersheds has not been presented to relicensing participants in any sort of integrated fashion. It is not present in either PAD for the Yuba-Bear or the Drum-Spaulding Projects, even to the level of providing known gauging locations for these watersheds or the canals or other facilities which are connected to them. To our knowledge, no integrated analysis of gauging records on Auburn Ravine or Coon Creek has ever been made public, or even undertaken.

In order to determine the direct effects during outage periods and periods of spill, it is necessary to understand the hydrology of these creeks on a year-round basis, thus allowing consideration not only of what outage and spill conditions are, but also how fish may transition from various operations to outage and spill periods and thence to renewed (non-spill) operations. Year-round recording of hydrologic conditions will also allow consideration of the intersection of project operations with various lifestages and migration patterns of salmonids.

Further, in order to appropriately determine the extent of project effects, it is important to identify hydrologic inputs and withdrawals that can be identified as not being created by the projects. Licensees have presented the movement of water in the Auburn Ravine and Coon Creek watersheds as an impenetrable maze outside their control. The Flow Analysis segment of this study will assist relicensing participants in parsing out with simple gauging many of the most important hydrologic actions and natural events that through their combination and interaction make up the hydrologic reality of these watersheds. This will provide additional evidence concerning the extent of control by licensees and their projects.

Gauging sites have been identified as points of hydrologic interest on Auburn Ravine and Coon Creek. In general, these consist of locations of inflow and diversion from Auburn Ravine and Coon Creek, though not all points of inflow and diversion have been chosen. Sites selected are also among those which at some time of year might reasonably be thought to demonstrate biological impacts on salmonids. Among those impacts are flows that induce migration, and flow fluctuations that might result in the stranding of fish or in the movement of juvenile fish in and out of edgewater rearing habitat. Since existing, planned, or potential fish passage facilities may also have impacts on salmonids, sites under active consideration for such facilities may also have been considered points of interest for the purposes of this study. Sites upstream and downstream of wastewater treatment plants have also been identified as locations where it is important to understand how project operations and interact with other factors to produce impacts.

In consideration of the cost savings of using existing stream gauges, many current or soon-to-be-installed gauges on Auburn Ravine were proposed for use.

3.1.7.4. Radio-tracking segment

Essential to understanding Project impacts and conservation opportunities in the West Placer streams that receive Project water is better characterizing steelhead and resident trout (O. mykiss) migrations. The proposed radio frequency identification/RFID tag study segment of the agency-proposed West Placer Streams Study Plan would enable Licensees, Resource Agencies, FERC, and the public to better analyze the effects of Project operations on fish movement, anadromy, abundance, population relationships, rearing, use of habitat, migration and emigration, as well as possible passage barriers—all of which are fundamental to anadromous restoration efforts and to restoring fully functioning habitat conditions for W. Placer streams.

The particular focus of this study segment is on juvenile O. mykiss. Juvenile O. mykiss in the reach of Auburn Ravine below Wise Powerhouse are possible recruits as steelhead outmigrants. An abundant O. mykiss population was found in upper Auburn Ravine in 2004. If tracking shows that rearing conditions are creating large populations in the stream reach between Wise Powerhouse and Auburn Tunnel, this may increase the significance of the project outages upstream. On the other hand, higher flows may induce downstream migration or simply migration, and tracking the number of fish that leave the reach help to evaluate the effects of project in terms of recruitment.

Ben Furtado/Auburn Journal
Newcastle resident John Rabe uses his personal well water to fill parts of the dry creek bed in the Auburn Ravine which usually flows strong behind his home. Pictured back, Jack Sanchez, stands next to a boulder marked with previous water levels in the Auburn Ravine.
**By Jenna Nielsen Journal Staff Writer**

Of particular importance in this study is determining O mykiss movement before, during and after canal and other project facility outages. As shown in the photo above from the Oct. 16, 2008 Auburn Journal, a channel of Auburn Ravine was de-watered when project deliveries to Auburn Ravine ceased. The tracking component of the study will help to determine the location and movements of fish in the project-affected reach downstream of Wise Powerhouse during outage periods, and should also help to evaluate predation.

3.1.7.5. Instream Flow Segment:

While fish population and macroinvertebrate studies have been conducted on West Placer Creeks, no known instream flow studies have been performed on these creeks. Licensees, in their respective PAD's, mentioned none, and investigations by other relicensing participants have also turned none up.

In order to complete its Section 7 responsibilities, the National Marine Fisheries Service will need an instream flow study of the West Placer streams that are capable of supporting anadromous salmonids. NMFS will, at minimum, need to answer the question, How much is habitat reduced during outage periods? Further, if

management actions may be considered to provide water to these streams during outage periods, NMFS will require that an instream flow analysis be done to determine the amounts of water required to keep fish downstream of facilities owned by the licensees in good condition before, during and after these periods. Finally, NMFS will also have to examine what happens to critical habitat during higher flow operations.

### 3.2. Other Deficient Study Plans Agreed to by Agencies and Licensees

The joint resource agencies filing contains a **Wetlands Study Plan** on which the agencies and licensees have reached agreement. This agreement was apparently reached on or about December 15, 2008, and was distributed by the licensees' consultant on that date. No one from the Foothills Water Network was involved in discussions about the final version of this document that led to the "approved" study plan. After reviewing the document, Foothills Water Network still has concerns about certain aspects of the document's content and what FWN sees as omissions. Therefore, FWN cannot consider this document to be a collaboratively "approved" document. We look forward to discussions with other relicensing participants, including the licensees and the resource agencies, to resolve our issues of concern, which are presented in our comments below.

#### 3.2.1. FWN Comments on Wetlands Study Section 2.0 – Management Goals

While maintaining or restoring streamflow regimes is a critical component of sustaining desired conditions of native riparian, aquatic, wetland and meadow habitats, as stated in the draft study plan, it is possible that other management actions might be required to restore and sustain these habitats. It is possible that even with the restoration of desirable streamflow regimes that the hydrologic functions that maintain these habitats in healthy conditions will not achieve this objective. For example, in cases where a stream has incised into a wetland habitat, streamflow might be unable to inundate wetland floodplain habitat and provide the sediment deposition and groundwater recharge necessary for some healthy wetlands.

A more comprehensive goal would include "maintain or restore streamflow regimes, and other necessary actions, sufficient to….".

#### 3.2.2. FWN Comments on Wetlands Study Section 4.0 – Study Goals and Objectives

The stated goal for this study is to "characterize herbaceous and shrub dominated wetland habitats in the study area that may be affected by continued O&M of the projects." The objective is stated as "providing a description and Proper Functioning Condition (PFC) assessment of wetlands in the vicinity of the projects."

This goal and objective statement describes a study that is descriptive in nature, and not adequately analytical. As such, while the study might describe the condition of wetlands

in the project areas as currently, it will not develop information describing the direct or indirect effects of the project, or cumulative effects, on the condition of wetlands.

Additional study steps should be added to this study that would ask and answer questions related to the possible project-related causes of any suboptimal conditions or functions identified in the existing methods. Alternatively, this study could be explicitly linked to other studies, such as channel morphology, that could provide this information.

3.2.3. FWN Comments on Wetlands Study Section 6.3 – Study Methods

Step 2 of this section states that wetland habitats will be assessed using the Proper Functioning Condition protocols for lentic wetland habitats established by Prichard et al (1998). Prichard et al also established protocols for lotic wetlands habitats (1998). There are both lentic and lotic wetland habitats in the project area, and the protocol for lotic wetlands has certain steps that are necessary to determine function of lotic habitats that the lentic protocol does not. For example, the lotic protocol requires the determination of connectivity between the stream channel and floodplain wetland that the lentic protocol does not. Both protocols should be available for use in this study depending on the nature of the wetland habitat surveyed.

In addition, consistent with a previous comment, the study as currently written does not appear to include any post-field survey analysis. As such, the study will provide information describing the condition of wetland habitats, but potentially not the reason(s) for any impaired areas, except in those situations where a cause is obvious such as a road or recreational facility. An additional step should be added to this or another study, or additional details to Step 2 of this study, that would describe any necessary analysis to determine the cause of impaired functions identified in the field surveys.

## 4. REQUESTED ALTERNATIVE STUDIES

There are several potential project effects and/or operational alternatives not addressed by any of the study plans submitted by the Licensees in their September filing.

### 4.1. Support for Agency-Authored Studies

FWN supports the following studies as authored by the indicated resource agency and filed by them in their December 24th filing:

4.1.1. Anadromous Effects, NMFS
4.1.2. Water Use and Efficiency, NMFS
4.1.3. Bioaccumulation, Agencies

### 4.2. Supplemental General Comments for the Above Agency-Authored Studies

Foothills Water Network would like to emphasize the following important points about the above agency-requested studies:

#### 4.2.1. Anadromous Effects

FWN concurs with the National Marine Fisheries Service (NMFS) in their assertion (filed 8-11-08) that a study of Anadromous Ecosystem Effects is necessary to determine project affects on anadromous fish resources including those resources in the lower Yuba River, an area of particular importance to the recovery of three species of anadromous fish threatened with extinction: Central Valley Spring-run Chinook Salmon, Central Valley Steelhead, and the Southern Distinct Population of Green Sturgeon.

FWN members participated in discussions of the draft proposed study plan with staff from NMFS, FERC and licensees on November 18. We could identify no valid reason why licensees should not undertake this type of study, if certain revisions and clarifications to the proposal are provided. We defer to NMFS for the revised study plan, and herein provide our support for that proposal.

The essential objectives of the Anadromous Ecosystem Effects study are to a) determine the amount of water diverted by the Projects from anadromous waters, b) characterize how the Projects have modified the frequency and intensity of flows in the lower Yuba River and certain creeks in west Placer County, and c) characterize the consequent effects of flow alteration on habitat for native anadromous fishes. The original study request described a scope of analysis extending downstream of the lower Yuba River as far as the Golden Gate, and also involved estimation of effects on a variety of biotic and geomorphic parameters. The current scope of the study is minimal and appropriately focuses on flow and flow-related habitat parameters.

The Anadromous Ecosystem Effects study is of extremely high importance due to public interest considerations regarding threatened populations of salmon and steelhead. As evidenced by comments provided orally and written during the public scoping process, there is strong concern among the public that hydropower projects in the Yuba watershed are either contributing to the decline of salmon and steelhead populations or limiting their recovery. The Foothill Water Network has the goal of restoring native fish populations, yet the public interest in salmon and steelhead is much broader and diverse than our network. For example,

- SYRCL provides “Salmon Tours” (guided rafting of the lower Yuba River in the fall) to hundreds of adults and as many as 500 school children in the fall.
- The Salmonid Restoration Federation held their 3rd Annual Spring-run Salmon Symposium in the Yuba River Watershed in 2008, including field tours examining linkages between hydropower projects and salmon recovery.

- More than 200 people and representatives of multiple tribal groups participated in the Calling Back the Salmon ceremony on the Yuba River in October.
- Salmon protection and restoration is a goal of countless organizations active in the western United States but not represented in the Foothills Water Network.

In the interest of collaboration, relicensing participants have come to consensus on a variety of study plans, including Fish Populations, which recognize a limit of geographic scope to above Englebright Dam on the South Yuba River, Our House Dam on the Middle Yuba, and certain points on streams of western Placer Creek. Nonetheless, the FWN and many members of the public insist that the licensees study the effects of their projects to more reasonable downstream limits when it comes to the uniquely important resource of anadromous fish and the flow upon which their habitat depends.

Project effects most certainly do extend to the lower Yuba River. The fact is clearly stated in the EIR/EIS for the Yuba Accord (USBR 2007):

> *Total storage capacity of about 307 TAF on the Middle Yuba and South Yuba rivers and associated diversion facilities enable both NID and PG&E to export an average of approximately 410 TAF per year from the Yuba River Basin …. the described operations can significantly reduce the water supply available to the lower Yuba River, particularly during dry and critical water years.*

The fact is also evidenced by the operating flow schedule for the lower Yuba River and routine efforts by the Yuba County Water Agency to meet flow requirements by taking into consideration actual and projected inflow from the South and Middle Yuba Rivers, among other factors. In very dry years, flows in the lower Yuba River are lower and less optimum for salmon and steelhead than they could be if not for the Projects. Flow requirements in the lower Yuba River come from the Yuba Accord flow schedule which classifies conditions based on six "schedules" representing a range of water availability as measured by an index of water storage in New Bullards Bar Reservoir. When the index is very low, then assigned flows in the lower Yuba River are less than optimum for spawning and rearing according to available flow-habitat studies (Beak Consultants 1988, USFWS in prep). Even minor portions of the water diverted from the Yuba watershed by the Projects could, if passed into their natural channel, be significant enough improve anadromous fish habitat, by either directly enhancing flows or allowing storage accumulation in New Bullards Bar to the point of changing the flow schedule assignment for the Yuba Accord.

The Anadromous Ecosystem Effects Study involves no field work and can be completed at little cost to the licensees. Necessary data can be obtained from the Yuba County Water Agency (including operational flow models), public flow

records or available documents. No other studies will address the objectives described above. Licensees may argue against the study based on specific methods (or lack of detail) concerning the characterization of effects on flow-related habitat. We request that FERC require this study to be done to meet the objectives, knowing that the licensees have already hired scientists eminently qualified for the tasks.

### 4.2.2. Water Use and Efficiency

FWN members participated in discussions of this proposed study plan with staff from NMFS. We defer to NMFS for the revised study plan, and herein provide our support for that proposal.

Continued project operation and maintenance (O&M) of YBDS water supply and hydroelectric projects has the potential to affect flow attributes. These include the reduction of natural stream flows, the timing and temperature of flows, flow ramping rates, and pulse flows, which in turn have potential impacts on biological communities.

Scoping Document 1 states: "Although we note that reduction in streamflow is in most cases a function of consumptive water deliveries, Relicensing studies may identify instances where project diversions may directly or cumulatively affect downstream anadromous fishes." In the following, it is assumed that reduction in streamflow affects all downstream aquatic and riparian communities, not just anadromous fishes.

One of the objectives of the Water Use and Efficiency Study is to "identify instances where project diversions may directly or cumulatively affect downstream anadromous fishes." In particular, the study will focus on the extent to which water diverted solely for hydroelectric power generation reduces streamflow.

One "instance" that should be studied is the diversion of water into the Drum Canal.

During the period of record, about 40 % of the water diverted into the Drum Canal was (is) diverted solely for the purpose of power generation. This water was (is) not consumed, and was (is) discharged into Folsom Lake, where PG&E relinquishes all rights to the water. 40% of the approximate 400,000 acre feet diverted annually into the Drum Canal equals 160,000 acre feet, equivalent to a steady 225 cfs, year-round. This amounts to a year-round average flow reduction of 112 cfs in each of the Middle Yuba and South Yuba, and a 225 cfs reduction below Englebright.

This is an important "case" or "instance" where there is large "reduction in streamflow" that is the direct effect of hydropower generation and that is in no way "a function of consumptive water deliveries." The proportion of water that is used solely for power varies through the year, resulting in streamflow reductions from diversion solely for hydropower that varies through the year. Streamflow reduction from hydropower is greatest in the winter and early spring, during which period the system is more a hydro power system than a consumptive water delivery system. In

mid-Summer YBDS is mostly a water supply system, and nearly all of the water diverted into the Drum Canal is consumed (after generating substantial power).

A proper understanding of the distribution and use of diverted water between hydroelectric power generation and consumptive use is very important in considering FERC license conditions, because FERC has jurisdiction over the former, but not the latter.

Another objective of the study is to determine the efficiency of use of diverted water, particularly water that is diverted solely for hydroelectric power generation**.** Inspection of the regulated hydrology, particularly the regulated hydrology in Bear River reaches above Rollins Reservoir, indicates that water diverted into the Drum Canal often bypasses power generators at Drum, Dutch Flat and Chicago Park. Generally speaking, and specifically from 1995 to 1999, bypass of Drum occurs in winter through early summer; bypass of Dutch Flat occurs in the spring; bypass of Chicago Park occurs in late spring and summer. The pulse flows in these "bypass reaches" are usually in the hundreds of cfs.

In an engineering sense, bypassing a power plant with water that could have gone through the power plant is inefficiency. The causes of the inefficiencies noted above are unknown to relicensing participants.

This study will provide quantitative data that will assist in determining the extent to which hydropower water diversion potentially affects (reduces) flows in streams, and in turn affects aquatic communities.

Additionally the study will provide quantitative data that will assist in assessing the extent to which inefficiencies associated with hydropower generation potentially affect downstream aquatic communities and anadromous fishes through potentially diverting more water out of rivers than may be necessary for efficient power generation.

### 4.2.3 Bioaccumulation

There is little substantive difference amongst licensees and other relicensing participants regarding the proposed Bioaccumulation Study Plan. The licensee version differs from the agencies' version only in that PG&E and NID have added a footnote that disclaims responsibility for causing mercury-related problems:

"[1] In agreeing to perform this study, Licensees do not agree that any unique characteristics of these projects have directly caused heavy metals to be present in the area, or increased the bioaccumulation of such heavy metals in fish."

In part, this notice is redundant. In section 3 of every study plan, there is a standard disclaimer:

"Development of PM&E measures is not part of the study."

Section 6 of every study plan also has a clause that states:

"Licensees' performance of the study does not presume Licensees are responsible in whole or in part for resource management measures that may arise from that study."

No relicensing participant hopes to find that the projects exacerbate mercury-related conditions, but it is also not scientifically appropriate to make an up-front exclusion of the possibility. There is no presumption that the licensees are responsible for anything related to mercury, and there is no cause for pre-emptive exclusion of anything that scientific research and researchers might find.

The worst reason not to do a study is for fear of discovering something undesirable. FWN recommends that the Commission approve the study as submitted by the resource agencies, without a footnote disclaiming responsibility for something that has not yet been studied.

### 4.3. Additional Studies Requested by the Foothills Water Network

FWN further requests the addition of the following study authored by SYRCL, and attached to this document as Attachment A:

#### 4.3.1. Periphyton

The study proposal in Attachment A represents the final draft of a study developed by scientists from FWN member organizations, UC Davis and resource agency personnel. Algae (or periphyton) was identified as a potential study warranting discussion in the very first meetings of relicensing participants as the aquatic workgroup. Unfortunately, the time demands of other studies precluded adequate time for discussion and collaboration on this study proposal. The first draft of the study proposal was presented to the licensees on November 6. This final draft represents substantial down-scaling to the minimum necessary to determine project affects on periphyton.

Licensees have made it clear in recent meetings with participants that they are unwilling to conduct studies that seem excessively costly or involve research beyond what is necessary to determine documented affects of the projects on particular resources. We believe that with adequate time for review and discussion, this Periphyton study proposal would be accepted. Although the study proposal resembles research, it is carefully designed to determine the type and magnitude of project effects on periphyton and related impacts on aquatic habitat. The proposal will contribute to a better understanding of how changes in the project could affect recreation and habitat for all aquatic organisms. To most successfully implement the proposed study at low cost, FWN suggests that the licensees utilize academic researchers who have experience and matching resources for this kind of work.

## Concluding Comments

We appreciate this opportunity to provide comments on the Study Plan for Drum-Spaulding and Yuba-Bear Projects. We look forward to continued participation in the process to develop protection, mitigation, and enhancement measures once adequate information has been provided. If you have questions, please contact one of the two following Foothills Water Network representatives: Julie Leimbach, Foothills Water Network Coordinator (530)-622-8497 julie@foothillswaternetwork.org or Chris Shutes, California Sportfishing Protection Alliance blancapaloma@msn.com.

Sincerely,

Foothills Water Network Yuba-Bear Working Group

Allan Eberhart, Sierra Club - Mother Lode Chapter
Bill Jacobson, Social Alliance Network
Bob Center, American Whitewater
Brad Cavallo, Fisheries Scientist
Brian Johnson, Trout Unlimited
Chris Shutes, California Sportfishing Protecting Alliance
Dave Steindorf, American Whitewater
Elizabeth Soderstrom, American Rivers
Frank Rinella, Northern Cal Council Federation of Fly Fishers, Gold Country Flyfishers
Jason Rainey, South Yuba River Citizen's League
Gary Reedy, South Yuba River Citizen's League
Katrina Schneider, South Yuba River Citizen's League
Steve Rothert, American Rivers
Ron Otto, Auburn Ravine Preservation Committee and Ophir Property Owners Association
Gregg Bates, Dry Creek Conservancy

Cc:
Ron Nelson, Nevada Irrigation District
Steve Peirano, PG&E
Beth Paulson, USFS
Larry Thompson, NOAA

# Attachment A

# Study Proposal for Yuba-Bear/Drum-Spaulding PERIPHYTON

December 18, 2008

## 1.0 Project Nexus

Periphyton (or benthic algae[1]) are a very diverse group of organisms living on the substrate of any river. These organisms are not only an important energy source for aquatic organisms and regulators of stream metabolism but also highly sensitive indicators of environmental conditions because they are relatively non-motile, ubiquitous and their community composition, growth type and growth extent reflect the chemical, biological, and physical processes within a river system. Most importantly in managed rivers, increases in benthic algae growth can also negatively impact stream metabolism and chemistry and benthic macroinvertebrate abundance, species richness and functional roles in the ecosystem as consumers of organic material and prey to larger invertebrates and vertebrates (Collier, 2002; Nelson and Lieberman, 2002; Quinn et al., 1997; Robinson and Minshall, 1998; Suren et al., 2003). Management activities that exacerbate algal blooms incur downstream risks and impacts, including changes in the particulate and dissolved organic carbon budget, nutrient cycling, biological and chemical oxygen demand, pH, and methylation and accumulation of mercury in fish. Algal blooms in the South Yuba River have received attention from journalists and are reported to be a negative factor for river recreation.

Periphyton growth can be controlled by a range of chemical processes including nutrient-limitation (Cascallar et al. 2003; McCormick and Stevenson, 1998; Perrin and Richardson, 1997) and temperature (Francoeur et al., 1999; Morin et al., 1999; Robinson and Minshall, 1998). The biological processes, such as grazing disturbance from benthic macroinvertebrates (Pan and Lowe 1994), are also an important factors controlling periphyton growth. Despite the important roles of chemical and biological processes, physical processes associated with flow are critical to understanding and controlling periphyton community composition, growth type and extent (Biggs and Close 1989, Clausen and Biggs 1997, 2000, Peterson and Stevenson 1992). Hydrologic alteration combined with the reduction in scouring sediment due to dams can change the onset, growth rate and growth period of periphyton. In addition, some evidence exists to support the hypothesis that hydrologically altered streams are more susceptible to the invasion of atypical periphyton species or assemblages (Biggs and Kilroy 2000).

The continued operation and maintenance (O&M) of the Yuba-Bear Hydroelectric Project and Drum-Spaulding Project (projects) has the potential to dramatically affect periphyton growth directly affecting ecosystem function and recreational value in

[1] Periphyton is generally synonymous with benthic algae but may also include other attached plant material.

downstream reaches. This study focuses on determining project effects on periphyton in stream reaches affected by operation of the two projects. This study proposal does not apply to the Rollins Transmission Line Project (FERC Project No. 2784).

## 2.0 Resource Management Goals of Agencies with Jurisdiction Over the Resource to be Studied

The California Department of Fish and Game and the State Water Resources Control Board have management goals and objectives addressing benthic algae, as well as water quality and populations of aquatic invertebrates and fish which are influenced by periphyton/benthic algae. SWRCB's management goals are put forth in the Central Valley Regional Water Quality Control Board's (CVRWQCB's) Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin Rivers, the fourth edition of which was initially adopted in 1998 and most recently revised in 2007 (CVRWQCB 1998), The Basin Plan formally sets forth water quality standards that include the Middle and Yuba Rivers and Bear River, which are composed of designated existing and potential beneficial uses and water quality objectives.

## 3.0 Potential License Condition

The study may result in the development of protection, mitigation and enhancement (PM&E) measures relating to the effects of Licensees' facility operations on environmental resources. In particular, the information from this study proposal could be used to develop:

- Instream flow releases, quantities and timing
- Waterway-specific water quality measures

Development of PM&E measures is not part of the study.

## 4.0 Study Goals and Objectives

The goal of this study is to characterize periphyton in project affected reaches and to determine project effects on periphyton. The objectives will be to determine if and where there is excessive periphyton growth, which taxa (pollution tolerant vs. intolerant) are present and dominate the community, and whether the distribution of excessive growth in space and time can be managed by changes in the Project. Flow impairments from the operations in Yuba-Bear/Drum-Spaulding systems may exert considerable control on algal biomass and community composition. This study will determine the degree of that influence among other factors.

A secondary goal is to support analysis of ecological relationships, water quality conditions, macroinvertebrate communities and fish populations as may be collectively influenced by instream flows, water temperature and other project affected parameters.

Live algal mats can dramatically alter the dissolved oxygen concentration in the benthos and water column during the day (increase) and night (decrease) (Lavoie et al., 2003). Dying algae results in biological oxygen demand that will reduce benthic habitat quality and by increasing organic carbon availability and reducing oxygen concentrations create conditions for mercury methylation both in-stream and in downstream reservoirs and in aggrading systems. Live algae can also cause wide swings in pH due to the use of carbonic acid (carbon dioxide source) in the water for photosynthesis during the day. This phenomenon has been observed in Deer Creek (tributary to the Yuba River) where pH values have exceeded 10 during the day in algae-rich areas (Friends of Deer Creek, personal communication). Chlorophyll measurements during the first flush storms suggest that periphyton is easily dislodged and moved downstream (Dahlgren, personal communication). The objective will be to assess impairment (spatially and temporally) of benthic and water column habitats for benthic macroinvertebrates and fish as affected by periphyton growth and assemblages. This study is expected to contribute to the interpretation of results from other study plans including macroinvertebrates, fish populations and water quality.

Specific objectives of this study are to:

1) Quantify biomass of periphyton at project affected reaches and reference sites.

2) Characterize periphyton community structure including the determination of dominant taxa, tolerance to water pollution and hydrologic disturbance, and presence of species which represent abnormalities for natural waterways of the region.

3) Measure effects of periphyton on local water quality and habitat conditions for fish and macroinvertebrates.

4) Assess strength of relationship between algal biomass, water quality affects on aquatic habitat and project-related hydrologic characteristics.

# 5.0 Existing Information and Need for Additional Information

The project's Pre-Application Document (PAD) notes the *"During the summer months, heavy blooms of the green alga genus Cladophora can occur in unspecified sections of the South Yuba River and its tributary, Deer Creek (Cohen, 2001; Shilling, 2003). Additionally, the Dry Creek Conservancy has observed heavy algae growth in several areas of Coon Creek, which is probably associated with high nutrient loads during the summer (Dry Creek Conservancy, 2006) … PG&E and NID experienced problems with filamentous algae in the Bowman Spaulding Canal and Bear River Canal from approximately 1989 to 2003. The algae grew in water from the cold pool below Bowman, Spaulding and Rollins reservoirs (Nicholson, 2007)."*

Dr. Fraser Shilling of UC Davis conducted a preliminary study of periphyton in the North, Middle, and South Yuba Rivers in 2001 and 2002. Periphyton were collected from representative riffles in the South Yuba, Middle Yuba, North Yuba, and Deer Creek. The algae sampled in the Yuba system seems to be primarily of the division *Chlorophyta* (green algae) and the genus *Cladophora*, which forms branched or

unbranched filaments up to several meters long and has the common name “blanket weed”. The main finding was that there was a measured increase in attached algae during the summer that corresponded to increases in water temperature (Figure 1), while nutrient concentrations did not increase. Algal biomass measured in the South Yuba was among the highest in the USGS National Water Information System database. Above 15 degrees C the algae begins visibly growing, from about the beginning of June in the South Yuba, when attached green algae is first visible as small spots on cobble. The North Yuba did not get above 20.5 degrees C. The increase in periphyton biomass may be directly attributable to water temperature, and not nutrient concentrations, which were very low. Periphyton in the Yuba system seems to be temperature limited. However, this preliminary study included no analysis of hydrologic and disturbance factors on periphyton biomass.

In response to citizen concerns about observed algae blooms, the South Yuba’s River Citizens League initiated a benthic algae monitoring pilot project from July to October 2008 using protocols established in Biggs and Kilroy 2000 and Barbour et al 1999. At monthly intervals, monitors conducted surveys of benthic algae at three different sites along the South Yuba. The color, growth type, extent of growth and cover of benthic algae was documented at three to eight points along three to five transects (depending on study reach length and width) at each. Relevant physical habitat parameters were collected including canopy cover, substrate size class, and percentage substrate less then 2 cm (as index of disturbance). From this preliminary effort, an index of benthic biomass was calculated from extent of growth and cover. Changes in growth type and color were also documented to determine temporal as well as spatial trends in the South Yuba river. Preliminary results suggest that Lang’s crossing, where the greatest biomass was measured (Figure 2), is atypically dominated by brownish mats beginning in early summer.

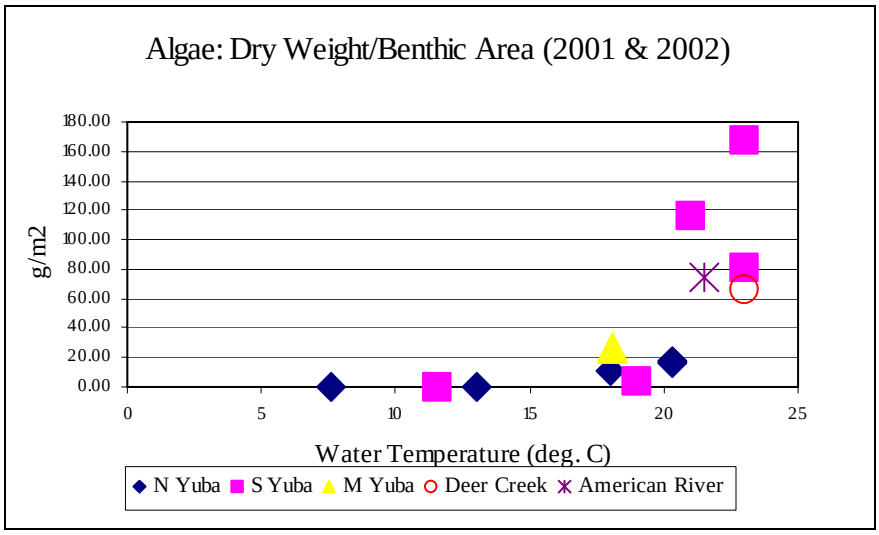


*Figure 1: Results from Shilling showing relative algal biomass in the Yuba Watershed.*

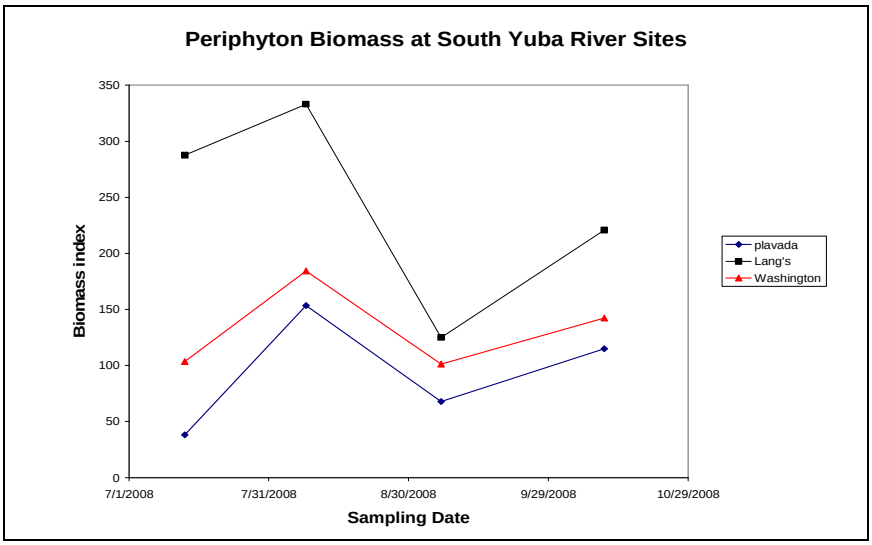


*Figure 2: Preliminary results from SYRCL showing estimated biomass of periphyton at three South Yuba sites in 2008.*

# 6.0 Study Methods and Analysis

## 6.1 Study Area

The study area includes projects-affected stream reaches where effects to aquatic macroinvertebrates and fish assemblages are possible and nearby reference reaches to control for other factors not-related to the projects.

## 6.2 General Concepts

Insert standard language for all study plans

## 6.3 Study Methods

The study will be completed in five steps, each of which is described below.

**Step 1 – Select Sampling Sites.** Table 6.3-1 provides a list of 12 reaches in which sampling will occur. These sampling sites are co-located with macroinvertebrate sampling sites which are in-turn mostly co-located with Fish Population Level II sampling sites. Prior to sampling, Licensees will invite interested Relicensing Participants into the field to comment on selected sampling sites. The North Yuba sites are intended to provide reference data for reaches of similar elevation and no project impacts.

Corresponding to each site, a reach will be selected which represents typical conditions and is approximately 250 meters in length and a minimum five times the channel width. These reaches should not be identical to reaches used for macroinvertebrate of fish population study plans, if sampling activities for those plans could disturb benthic habitat.

**Table 6.3-1. Locations periphyton sampling.**

| Reach | Number of Sampling Sites | Approximate Location |
|---|---|---|
| **MIDDLE YUBA RIVER** | | |
| Milton Diversion Dam Reach (NID) | 3 | • Co-located with Stream Fish Population Study Level II sampling site downstream of Milton Diversion Dam<br>• Co-located with Stream Fish Population Study Level II sampling site downstream of Box Canyon and upstream of Wolf Creek<br>• Co-located with Stream Fish Population Study Level II sampling site upstream of Our House Diversion Impoundment |
| **SOUTH YUBA RIVER** | | |
| South Yuba Reach # 1 (NID/PG&E) | 1 | • Co-located with Stream Fish Population Study Level II sampling site near YB-29 (Langs Crossing downstream of Jordan Creek) |
| South Yuba Reach # 4 (NID/PG&E) | 1 | • Co-located with Stream Fish Population Study Level II sampling site below confluence with Canyon Creek |
| South Yuba Reach # 6 (NID/PG&E) | 1 | • Co-located with Stream Fish Population Study Level II sampling site below the confluence with Spring Creek |
| **BEAR RIVER** | | |
| Bear River Reach #1 (PG&E) | 1 | • No co-location – Stream Fish Population Study is Level I sampling |
| Bear River Reach #2 (PG&E) | 1 | • Co-located with Stream Fish Population Study Level II sampling site |
| Drum Afterbay Dam Reach (NID/PG&E) | 1 | • Co-located with Stream Fish Population Study Level II sampling site in middle of reach |
| **NORTH YUBA RIVER** | | |
| North Yuba River[1] (NID/PG&E) | 3 | • Co-Located with Stream Fish Population Study Level II sampling sites |

[1] Reach is not affected by the Yuba-Bear Hydroelectric Project or the Drum-Spaulding Project but important for analysis of reference conditions.

**Step 2 – Collect Data**. Methods for data collections and analysis are described below.

### *Periphyton Field Sampling*

Data collection will occur at each site monthly, May to October, and may coincide on one occasion with macroinvertebrate study plan. Sampling of periphyton within a site will be very similar to the approach used for macroinvertebrates. Each study site will be about 250 m in length. Before sampling begins, the number of riffle habitat units contained in the site will be visually estimated. A total of eight samples will be taken to form a composite. If there are fewer than eight distinct riffles, sampling points will be spread throughout the site as much as possible. If there are more than eight riffles, one or more riffle units will be skipped at random. When possible, each riffle will have a "core area" defined, avoiding edges along channel margins and the upstream or downstream edges of the riffle. The core area of each riffle will be divided into nine equal quadrats in a 3 by 3 grid for random selection. If more than one sample must be collected from a particular riffle, a second quadrat will be randomly chosen and sampled. Samples will be taken moving upstream from the most downstream riffle unit to minimize instream disturbance.

Exact sample locations will be chosen using a random number chart to choose the distance in meters from the downstream end of the riffle (method used by Harrington et al., California Department of Fish and Game for benthic macroinvertebrate sampling). A 1/16 meter$^2$ quadrat will be used to delineate a collection area within which all cobble will be sampled. Rocks will be collected, scrubbed free of attached algal material, and returned to the riffle. The entire sample of collected periphtyon will be collected and stored on ice until processed. The sample will be crudely homogenized to allow accurate sub-sampling without causing cell wall disruption. Exactly 10% of the suspended algal material will be set-aside for the taxonomy step and biomass measurement. The taxonomy sample will be preserved in Lugol's Iodine Solution (KI/I in 10% Acetic Acid, 1% Lugol's in final sample). Collected physical habitat data and periphyton samples from each site will be analyzed to derive the following parameters:

***Physical habitat parameters***

- Reach-wide Parameters
  - Global positioning system (GPS) coordinates at each site.
  - Water temperature, specific conductance, pH, and dissolved oxygen using approved standardized procedures and instruments.
  - Total length and gradient (percent slope) and average width and depth will be measured and recorded at each site.

- Transect-specific Parameters
  - The wetted width of each riffle will be taken at a minimum of three cross-sectional transects and averaged.
  - Water velocity (using a topset rod and flowmeter) will be measured at each of the eight sample points.
  - Substrate composition will be visually estimated at each sample point (area disturbed in front of the net) using the following categories: fines (<0.25 cm), gravel (0.25 to 0.8 cm), cobble (0.8 to 25 cm), boulder (>25 cm), and bedrock. Substrate consolidation and percent embeddedness will also be characterized including reference to whether the substrate is lightly, moderately, or heavily surrounded by fine sediment.
  - Average canopy cover will be estimated at each riffle sampled using a densiometer four times from the center of habitat unit.
  - If field or analytical methods deviate from SWAMP protocols, reasons for the deviation and alternate methods will be explained and documented.

***Water quality parameters***

Dissolved oxygen and pH will be measured over a 24-hour cycle during peak biomass (late July or early August) at each site. Measuring devices will be positioned adjacent to the benthos and will occur at least twice per hour.

***Stream Flow parameters***

These data will be obtained as specified in the Hydrologic Alteration Study Plan. The nearest gaged site will be used as a proxy for flow parameters at each periphyton sampling site.

***Algal Biomass parameters***

*Ash free dry weight:*
Periphyton sample dry mass will be measured by filtering an aliquot from a periphyton sample on pre-weighed glass-fiber filters, drying and weighing the sample, ashing at 450$^{o}$C in a muffle furnace, then re-weighing.

*Algal chlorophyll a:*
An aliquout of suspended algae of known volume will be taken for chlorophyll-a measurement. The method is after that of Parsons et al. (1984) and is briefly described here. The aliquout of suspended algae will be filtered onto glass-fiber filters and pigments extracted with 90% acetone. The filter will be shaken in 90% acetone and the resulting aqueous sample centrifuged to remove particulate material. The absorption of the supernatant will be measured at 630, 647, and 664 nm, from which chlorophyll-a amounts and concentrations will be calculated. The amount of chlorophyll-a per square meter will be calculated based on the known sub-sample volumes.

***Algal Taxonomy parameters***

Algal samples collected in the field will be used to identify and count soft-bodied (e.g., *Cladophora* sp.) and diatom algae. All taxonomy and counting will be carried out by a qualified laboratory such as EcoAnalyst Inc. One sub-sample for each of the soft-bodied and diatom algae will be taken from the field samples. The methods used are adapted from two main protocols used for wadeable streams. The websites below describe the protocols and each has several references: a) EPA EMAP: http://www.epa.gov/owow/monitoring/rbp/ch06main.html
b) USGS NAWQA: http://water.usgs.gov/nawqa/protocols/OFR02-150/index.html.

*Soft-bodied algae:*
Algae samples are sub-sampled and the relative abundance of various macroalgae determined. The remainder of the sample is agitated to dislodge epiphytic algae and to randomly distribute individual cells and colonies. Exactly 0.1mL of the homogenized sample is placed in a Palmer-Maloney counting chamber using a micropipette. Algae in the Palmer-Maloney counting chamber will be examined at 400X magnification using a light microscope. Soft-bodied (non-diatom) algae are identified to genus. Filaments and colonies are counted as one unit.

*Diatom ID/Enumeration:*
The diatom ID/enumeration samples are homogenized and a 10mL subsample placed in a small glass beaker. The diatom sample is treated with a 1:1 ratio of concentrated nitric acid and 10 µg of potassium dichromate (to digest all organic matter). The sample is then rinsed with de-ionized water until the pH of the sample is neutral. The clean diatoms are

mounted on duplicate slides in a high-resolution resin (Naphrax®) for identification under a 1000X magnification light microscope. Relative concentration of diatom species for each sample are determined by choosing a commonly heterogeneous area of the slide and then identifying diatoms, one field of view at a time, until at least ≥600 diatom valves are counted and identified. A set of diatom association metrics is calculated for each of the sites:

- % sensitive individuals
- % very tolerant individuals
- % deformed or abnormal cells
- Shannon Species Diversity
- Pollution Tolerance Index
- Siltation Index (% *Navicula*, *Nitzschia*, and *Surirella*)
- Disturbance Index (% *Achnanthes minutissima*)

**Step 3 – Analyze Data.**

Multi-metric parameters (Table 6.3-2) will be calculated for each periphyton sample and metrics will be evaluated for their predicted response to impairment and evaluated for trends within and among sites. This will be followed by two multivariate analyses which will include a series of ordination techniques in an indirect and a direct gradient analysis. Indirect gradient analysis (Principal Component Analysis (PCA), Nonmetric Multidimensional Scaling (NMDS), or Correspondence Analysis (CA)) will examine the algal community composition data to determine trends and patterns within the community composition data. Following an indirect gradient analysis, a direct gradient analysis (Canonical Correspondence Analysis) will be used to determine which of the environmental variables (physical habitat, water quality, and flow parameters) exerts the greatest influence on the algal community composition and biomass.

**Table 6.3-2. Biological metrics calculated to assess periphyton assemblages and local water quality conditions**

| Metric | Description | Predicted Response to Impairment |
|---|---|---|
| **RICHNESS** | | |
| Species Richness | Total number of individual taxa | Decrease |
| Genus Richness | Total number of genera | Decrease |
| Division Richness | Total number of divisions | Decrease |
| | | |
| **COMPOSITION MEASURES** | | |
| Shannon Diversity Index | General measure of sample diversity that incorporates richness and evenness | Decrease |
| Siltation index | Index of tolerance to siltation | Increase in sensitive species |
| Pollution index | Index of tolerance to pollution | Unknown |
| Autotrophic index | Ratio of chl a to AFDW | Decrease |
| | | |
| **BIOMASS MEASURES** | | |
| Biomass | Chlorophyll a | Increase |
| | Ash Free Dry Weight | Increase |
| Peak biomass | Temporal indicator of ideal growing conditions | Change |
| Bio-volume | Cumulative volume of cell | Increase |
| | | |

Algal community composition and biomass can be sensitive to multiple environmental variables including nutrient enrichment and/or limitation, temperature, and disturbance (flow related and grazing by macroinvertebrates). This study will utilize proven analytical methods for determining autoecological relationships involving these variables (Porter 2008, Stevenson et al 2008) while incorporating flow alterations as an additional environmental variable that may affect algal biomass and community composition. Project effects will be determined by statistical analysis of multiple factors and comparison with reference sites in the North Yuba River.

If strong relationships are determined through the steps presented above direct univariate and multivariate regression will follow to isolate key environmental variables (independent variables) with algal community composition and biomass data (dependent variable).

**Step 4 – Prepare Format and Quality Assurance/Quality Control Data**. Following data collection and identification of taxa, Licensee will subject all data to quality assurance/quality control (QA/QC) procedures including, but not limited to, spot-checks of data and review of electronic data for completeness. If any datum seems inconsistent, Licensee will investigate the problem.

**Step 5 – Prepare Report.** Licensees will prepare a report that includes the following sections: 1) Study Goals and Objectives; 2) Methods and Analysis; 3) Discussion; 4) Conclusions; and 5) Description of Variances from the FERC-approved study proposal, if any. In addition, the report will compare the data collected with any historic data that are available. Licensees plans to make the report available to Relicensing Participants when completed. The report will be included in the License Application.

### 6.4 Study Proposal Consultation

This study proposal includes the following study-specific agency consultation:

- Prior to sampling, Licensees will invite interested Relicensing Participants into the field to comment on selected sampling sites.

Licensees will file with FERC and post on its Relicensing Website periodic progress reports as may be required by FERC in its Study Plan Determination. Each report will summarize work performed since the last report was filed and key findings, and will include study data that have been organized, compiled, and subject to QA/QC procedures.

As described in Section 6.2, Licensees will consult with other Relicensing Participants if it believes a modification to the study proposal is needed.

### 6.5 Schedule

Licensee anticipates the schedule to complete the study proposal assuming FERC's Study Plan Determination regarding this proposal is deemed final on March 12, 2009 is as follows:

Select Sampling Sites (Step 1).....March – April 2009
Collect Data (Step 2)..... May – October 2009
Analyze Data (Step 3)..... November – December 2009
QA/QC (Step 4) ..... January 2010
Prepare Report (Step 5)..... February-March 2010

## 7.0 Level of Effort and Cost

Several laboratories are available for completely processing algal samples at a cost of $350-500 per sample. This cost (12 samples x 6 months) would be no more than $36,000. Separate from field equipment needed for macroinvertebrate sampling, additional costs are rental (2 weeks) of meters for continuous DO and pH, and time for field collection and data analysis. The estimated cost to complete this entire study in 2008 dollars is $100,000. This cost has been confirmed by two separate academic consultants experienced with the particular field work and analysis in the study proposal.

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