UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST REGION
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

September 1, 2011

In response refer to:
FERC 2246-058:LT

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

Subject: NOAA's National Marine Fisheries Service's Comments on the applicant's Revised Proposed Study Plan for the Yuba River Development Project, Project No. 2246-058

Dear Secretary:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the Revised Proposed Study Plan (PSP), filed August 17, 2011, by the Yuba County Water Agency (Applicant), applicant for a new license for the Yuba River Development Project, P-2246-058 (Project). NMFS finds the Revised PSP does not adequately incorporate several elements of its (eight) information requests filed March 7, 2011. NMFS previously filed (July 18, 2010) extensive comments highlighting the several deficiencies in the Applicant's PSP (submitted April 19, 2011). Unfortunately, the Applicant's Revised PSP continues to fall short of satisfying NMFS' filed information requests. NMFS suggests the Commission, in its Study Plan Determination, will also find areas where the Revised PSP does not meet the content requirements (18 CFR 5.11(d)) of the Integrated Licensing Process (ILP) regulations. NMFS recommends the Commission give special attention to the Applicant's decision to not incorporate methods for evaluating Project effects. NMFS strongly disagrees with the Applicant's view on this, and urges the Commission, in its Study Plan Determination, to require the Applicant to repair this and other deficiencies.

The attached Enclosure A contains NMFS' responses to the Applicant's replies to NMFS' requests for information or study, as well as NMFS' comments regarding aspects of its submitted requests that were not incorporated by the Applicant in the Revised PSP.

In each of its filed requests, NMFS is seeking information or study <u>of the Project's effects</u> on the resources under its jurisdiction. The resources to be studied (anadromous fishes, critical habitats, and essential fish habitats) are clearly identified in NMFS' filing of March 7, 2011. NMFS submitted all of its requests for information or study according to the ILP regulations. 18 CFR §5.9 (a); 18 CFR §5.9 (b).

The results of NMFS' requests for information collection or study <u>of the Project's effects</u> are intended to be used to:

- Inform NMFS about the Project's effects on the anadromous species that are of direct concern to, and under the jurisdiction of, NMFS;
- Inform NMFS about the Project's effects on the primary constituent elements of anadromous fish critical habitat in the lower Yuba River and areas downstream, including freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas (in the Bay/Delta);
- Inform NMFS about the Project's effects on the <u>functions</u> of essential fish habitat (EFH) for Chinook salmon spawning, incubation, juvenile rearing, juvenile migration, adult migration, and adult holding in the Yuba River (including in areas upstream of Englebright Dam), and in areas downstream to the Bay/Delta;
- Inform NMFS regarding how it may properly exercise its Federal Power Act (FPA) Section 18 authority, to either prescribe fishways at the Project or to reserve its prescriptive authority;
- Inform NMFS' future FPA Section 10(j) and 10(a) recommendations for protection, mitigation, and enhancement measures;
- Inform NMFS' recommended measures in Magnuson-Stevens Fishery Conservation and Management Act (MSA) consultation regarding the effects of Project on EFH; and
- Inform Endangered Species Act (ESA) Section 7 consultation (informal and, potentially, formal) between the Commission and NMFS regarding Project effects on threatened species and designated critical habitats in the Yuba River, and in areas downstream.

NMFS reiterates the anticipated need for consultations under section 7 of the ESA and the MSA over potential effects to anadromous species and their habitats. NMFS recommends avoiding inefficiencies and delays that might result from insufficient study or information gathering.

If you have questions about NMFS' response, please contact Mr. Richard Wantuck, NMFS Regional Hydropower Program Coordinator, at 707-575-6063.

Sincerely,

Richard L. Wantuck
Hydropower Program Supervisor
Habitat Conservation Division

cc: Maria Rea, Howard Brown, Gary Sprague, Brian Ellrott, NMFS Sacramento, CA
Steve Edmondson, NMFS Santa Rosa, CA

Enclosure A

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Yuba County Water Agency	**)**	**FERC Project No. P-2246-058**
Yuba River Hydroelectric Project	**)**	
________________________________	**)**	

COMMENTS OF NOAA's NATIONAL MARINE FISHERIES SERVICE ON THE APPLICANT'S REVISED PROPOSED STUDY PLAN

Introduction:

The Integrated Licensing Process should, to the extent reasonably possible, serve to establish an evidentiary record upon which the Commission and agencies with mandatory conditioning authority can carry out their responsibilities. 68 FR 13988, 13995; March 21, 2003. Through its study and information requests, as emphasized in the comments below, NMFS seeks to determine whether and how the Project's facilities and operations will affect NMFS' trust resources. These are basic determinations that form the foundation for the Commission's licensing order. NMFS has shown how each of its requests for information or study (March 7, 2010) reasonably relates to the development of potential prescriptions or protection, mitigation or enhancement measures (PM&E's) within its regulatory jurisdiction, or the fulfillment of consultation obligations between the Commission and NMFS. These results of NMFS' study requests, if incorporated in the Applicant's Study Plan and properly implemented, will add appreciable evidentiary value to the record, are reasonable within the large-scale economic context of the Project, and should be ordered by the Commission to be completed. NMFS recommends the Commission give special attention to the Applicant's decision to not incorporate, in its Revised PSP, methods for evaluating Project effects. NMFS strongly disagrees with the Applicant's view, and urges the Commission in its Study Plan Determination to require the Applicant to repair this and other deficiencies.

As with the earlier PSP, NMFS finds the Revised PSP does not incorporate many of the elements of its 8 information or study requests, filed March 7, 2011. NMFS filed the following information/study requests:

1. Effects of the Project and Related Activities on Fish Passage for Anadromous Fish;
2. Effects of the Project and Related Activities on Hydrology for Anadromous Fish;
3. Effects of the Project and Related Activities on Water Temperatures for Anadromous Fish Migration, Holding, Spawning, and Rearing Needs;
4. Effects of the Project and Related Activities on Coarse Substrate for Anadromous Fish: Sediment Supply, Transport and Storage;
5. Effects of the Project and Related Activities on Large Wood and Riparian Habitat for Anadromous Fish;
6. Effects of the Project and Related Activities on the Loss of Marine-Derived Nutrients in the Yuba River;
7. Effects of the Project and Related Activities on Aquatic Benthic Macroinvertebrates for Anadromous Fish; and
8. Anadromous Fish Ecosystem Effects Analysis: Synthesis of the Direct, Indirect, and Cumulative Effects of the Project and Related Facilities on Anadromous Fish.

NMFS refers the Commission to that filing, which includes detailed explanations of its rationale for the requests, following the ILP regulations. 18 CFR §5.9 (a) and (b). NMFS also refers the Commission to NMFS' responses (filed July 18, 2011) to the Applicant's PSP, which did not adequately address NMFS' requests. As with the PSP, the Revised PSP continues to fall short of adequately addressing NMFS' requests and, therefore, will not adequately collect information or perform study to evaluate the Project's effects.

In Section 3 of the Revised Proposed Study Plan (PSP), the Applicant provides that it does not intend to incorporate methods for evaluating Project effects. Replying to a NMFS request for information or study, the Applicant states:

> *NMFS requests assessment of Project effects. YCWA does not intend to incorporate into the study proposal methods for evaluating Project effects since Relicensing Participants have expressly stated that they view the relicensing studies as data gathering, not an impacts evaluation, and prefer the study reports provide the study data only. Relicensing Participants said they prefer that an assessment of Project effects not be included in the study, but that each Relicensing Participant is free to conduct its own assessment using the data from the study. YCWA has honored that request in its study proposals.* (p. 3-20). [underline emphasis added].

The Revised PSP contains similar or nearly identical statements regarding NMFS' Requests on pages 3-24 and 3-49; they also occur on page 3-7 (regarding a request by the U.S. Fish and Wildlife Service), and page 3-20 (regarding a request by the Foothills Water Network). The Applicant's stated intention appears contrary to the purpose of the licensing study phases and to the ILP regulations. The core purpose of the Applicant's Study Plan is to lay out a plan for how it intends to evaluate the effects of the Project on the resources affected by its facilities and/or operations. The Applicant is correct that NMFS is requesting assessments of Project effects – as all of its requests were submitted according to the ILP regulations that require NMFS to explain any nexus between project operations and effects on the resource to be studied. 18 CFR §5.9(b)(5). Corresponding ILP regulations govern the content requirements of the Applicant's Proposed Study Plan, which must:

> *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied* . 18 CFR §5.11(d)(4).

From this requirement, it logically follows that any such study should result in an evaluation of Project effects on the resource to be studied. Given that the Applicant has now stated it does not intend to incorporate methods for evaluating Project effects, NMFS recommends the Commission take a very hard look at the content of the Revised PSP during its Study Plan Determination review. NMFS recommends the Commission require the Applicant to follow the ILP regulations with regard to Revised PSP content requirements. NMFS urges the Commission to approve a Study Plan only if it incorporates evaluations of Project's effects.

The Applicant bases its approach on a process it created outside the bounds of the Commission's regulations, which it now seeks to substitute for the ILP. The Applicant's rationale for its stated intentions appears in the text above (p. 3-20). Applicant made agreements with parties (not including NMFS) who adopted the Applicant's licensing process (termed "integrated relicensing process") first proposed in Section 2 of the PAD. The Applicant names the parties who agreed to follow the Applicant's proposed relicensing process the "Relicensing Participants". The Applicant claims it does not intend to incorporate evaluations of Project effects because the Relicensing Participants:

a) requested that the Applicant not evaluate Project effects;
b) view licensing studies as data gathering, not effects evaluations;
c) prefer reports that provide data only; and
d) prefer that each Relicensing Participant is free to conduct its own effects assessments.

NMFS notes that the Applicant's Revised PSP can both incorporate methods for its assessments of Project effects, and make available the data resulting from a study, for review and/or for additional assessment by Relicensing Participants (or others, such as NMFS). Providing study result data is not mutually exclusive with assessing Project effects, which is required by the ILP. The Applicant stated in its Notice of Intent (and NMFS understood) the ILP would be used in this licensing proceeding. However, the Preliminary Application Document (PAD) contained the Applicant's proposal for conducting a relicensing process that NMFS described as "outside the ILP" and potentially contrary to ILP regulations. NMFS refers the Commission to its comments (Enclosure D, pp. 10-12, filed March 7, 2011) regarding Section 2 of the PAD, wherein NMFS disagrees with the proposed deviations from the ILP. At the Commission's ILP Effectiveness Evaluation Technical Conference (November 3, 2010), NMFS also detailed its views that excessive deviations from the ILP are becoming common in California. NMFS warned of "creating processes", and "making it up as we go along" (FERC 2010 transcript (tr.), p. 79). NMFS explained it is now seeing (in California) the creation of "work arounds" due to the shortcomings of the ILP (tr., p. 150). NMFS cautioned these "parallel processes" are outside the ILP (tr., p. 150). In the case here, the Applicant should not be allowed to circumvent the ILP regulations with respect to the Study Plan content and cast aside incorporation of the ILP "nexus requirement" in its Revised PSP. NMFS is seeking (from Applicant study) information about the Project's effects on the anadromous resources (species and habitats) under NMFS' jurisdiction. The Commission should carefully review the Applicant's Revised PSP to verify that it meets the content requirements of the ILP, including the most important "nexus" requirement that a study must evaluate Project effects. If raw study data are requested by an interested party, they can and should be provided by the Applicant. In the Commission's Study Plan Determination, NMFS recommends disapproval of any Study Plan that does not incorporate methods to evaluate Project effects.

NMFS' Request #1:

"Effects of the Project and Related Activities on Fish Passage for Anadromous Fish"

The Applicant's Revised PSP comments regarding NMFS' Request #1 are discussed in Section 3.2.2 "Replies to Comment Letters That Requested New Studies", sub-section 3.2.2.1.

Applicant comment:

> *NMFS requested a new study named Effects of the Project and Related Activities on Fish Passage for Anadromous Fish (NMFS, Enclosure A, pp. 2 through 10).* (p. 3-31).

NMFS' reply:

It is incorrect that NMFS requested a <u>new</u> study in Enclosure A, pp. 2 through 10 of its July 18, 2011, filing. Enclosure A is not a new Request #1, but rather contains NMFS' comments on the Applicants PSP (per 18 CFR §5.12, "Comments on proposed study plan"). NMFS' Request #1 was submitted along with other requests for information or study earlier in the ILP (per 18 CFR §5.9, "Comments and information or study requests"). As all other requests filed in this ILP, NMFS' Requests were "new" when filed on March 7, 2011. Whether termed "new" or otherwise by the Applicant, all submitted requests for information or study should be given adequate consideration for incorporation into the Revised PSP.

Applicant comment:

> *NMFS did not include a detailed study proposal in its comment letter, but referred to the study proposal with the same name that NMFS included in its March 7, 2011 comments on YCWA's PAD.* (p. 3-31).

NMFS' response:

Study plans are the responsibility of the Applicant, not NMFS or another resource agency. Under the ILP, the Applicant assembles and submits them, first as a PSP and then a Revised PSP. Prior to the development of the PSP, resource agencies and other parties submit requests for information or study (see 18 CFR §5.9), with the intent of having the Applicant incorporate the requests into its PSP and Revised PSP. This approach provides applicants with the flexibility to design an approach most efficient given its own resources and knowledge of its project, while still providing the information needed by the resource agency.

NMFS requested information regarding fish passage that it anticipated would require development of a detailed PSP by the Applicant. In its Request #1 NMFS included Table 1, "Project facilities and related activities affecting anadromous Yuba River fish passage", to identify for the Applicant the several (over 30) facilities that could affect upstream or downstream anadromous fish passage, and that should be considered for information gathering or study by the Applicant. Table 1 also identified the (5) target anadromous species that could be subject to potential passage effects, and (13) potential passage effects or issues (*e.g.*, passage barriers, facilities capable of entraining fish, peaking facilities/operations that could cause stranding, predation effects, etc.). Having stated its requests, NMFS' task herein is to review the Revised PSP to determine the degree to which information requested by NMFS would be fulfilled, in detail, by the Applicant's Revised PSP. NMFS' Request #1 should be given adequate consideration for incorporation into the Revised PSP, regardless of the views of the Applicant that it is not a "detailed study proposal." The regulations (§5.11(b)(4)) require that if the Applicant does not adopt a requested study, it must explain why the request was not adopted, with reference to the criteria set forth in §5.9(b). Nowhere in the criteria set forth in §5.9(b) do the regulations indicate that an agency requesting information or study must develop a "detailed study proposal"; this task is the responsibility of the Applicant.

Applicant comment:

> *YCWA has adopted some portions of NMFS's requested study in its Revised Study Plan's new study to address the incremental effects of the Project's Narrows 2 Powerhouse on the upstream migration of anadromous fish (Study 3.12).* (p. 3-32).

NMFS' response:

The treatment of NMFS' Request #1 in the RSP differs only slightly from the PSP, by proposing Study 7.11, to "address the incremental effects of the Project's Narrows 2 Powerhouse on the upstream migration of anadromous fish" (p. 3-32). NMFS disagrees that Study 7.11 will yield information adequate for assessing conditions in the vicinity of the Narrows 2 Powerhouse or the full effects of the Narrows 2 Development on fish passage, and notes Study 7.11 falls far short of fulfilling adequately addressing NMFS' Request #1 (NMFS provides additional comment on this point later in this Enclosure).

Applicant comment:

> *YCWA contends that relicensing studies regarding potential anadromous fish passage at Englebright Dam and Project dams are not needed for two reasons. First, no anadromous fish have occurred upstream of Englebright Dam since 1941, when Englebright Dam was constructed. Therefore, under the existing Project (i.e., the relicensing No-action Alternative and baseline), the Project has no effect on anadromous fish upstream of Englebright Dam because there are no anadromous fish upstream of Englebright Dam now and there never have been any such fish upstream of Englebright Dam since before the YRDP Project was constructed. The second reason is that it is unlikely any anadromous fish will be present upstream of Englebright Dam in the reasonably foreseeable future. This is because there are no proceedings in progress that are reasonably likely to result in anadromous fish being introduced into the Yuba River or its tributaries upstream of Englebright Dam by any future date certain.* (p. 3-33).

NMFS' response:

The Applicant's first reason ignores the presence of anadromous fishes in the lower Yuba River and the existing (present) fish passage effects of the Project's Narrows 2 Development, which NMFS' Request #1 seeks to have the Applicant investigate. The lack of the presence of anadromous species upstream of Englebright Dam (since 1941) has nothing to do with study of the Narrows 2 Development, which is downstream of Englebright Dam.

The Applicant's second reason provides there are no proceedings in progress that are reasonably likely to result in anadromous fish being introduced into the Yuba River or its tributaries upstream of Englebright Dam by any future certain date. The Applicant does not cite any support for a requirement that there be proceedings in progress that are reasonably likely to result in anadromous fish upstream of Englebright Dam by a certain date, and there is no such requirement in the Commission's regulations. As long as it is reasonably foreseeable that there will be anadromous fish passage during the term of the new license, then the study should be relevant to NMFS' mandatory fishway authority under FPA section 18. The Applicant uses a standard with no support in order to artificially limit the scope of studies which would be needed for a proper licensing order to issue.

The Applicant incorrectly asserts that because NMFS stated at the FERC Scoping Meeting no definite schedule for anadromous fish reintroduction to areas upstream of Englebright Dam, this reintroduction is not a reasonably foreseeable action. The Applicant incorrectly asserts that because no firm date exists for finalizing the "Public Review Draft Recovery Plan for Sacramento River Winter-Run Chinook Salmon, Central Valley Spring-Run

Chinook", anadromous fish reintroduction is not a reasonably foreseeable action. The Applicant incorrectly asserts that if a final Plan provides only conceptual recovery scenarios for upper Yuba reintroductions and not "concrete measures", then this is not a reasonably foreseeable action. The Applicant asserts that until the Plan is final, approved, and signed, it does not describe reasonably foreseeable actions, and even then the Plan is subject to future changes. The Applicant finds no proceedings in progress to reintroduce anadromous fish upstream of Englebright Dam by any certain date (and, therefore, does not consider it reasonably foreseeable that such proceedings could occur). The facts remain, however, that NMFS has a Draft Recovery Plan which is moving through the finalization process, and that the Plan includes conceptual recovery scenarios for reintroductions of anadromous fishes to the upper Yuba, into candidate watersheds of the North Yuba, Middle Yuba, and South Yuba rivers. The Plan contains the following recovery actions identified to re-colonize historic habitats above the Project's facilities and Englebright Dam:

1) enhance habitat conditions, including providing flows and suitable water temperatures for successful upstream and downstream passage, holding, spawning and rearing; and
2) improve access within the area above Englebright Dam, including increasing minimum flows, providing passage at Our House, New Bullards Bar, and Log Cabin dams, and assessing feasibility of passage improvement at natural barriers.

NMFS urges the Commission to review NMFS' Draft Plan, its comments and resource goals and objectives for the Yuba River (filed March 7, 2010; see especially Enclosures A and G), and the existing evaluation of conceptual fish passage options for the Yuba River (MWH 2010). With this evidence in mind, the foundation of the Applicant's arguments crumbles: reintroduction is "reasonably foreseeable" and need not be certain to be studied.

Applicant comment:

> *Recovery plans are not regulatory documents and successful implementation and recovery of listed species will require the support, efforts and resources of many entities, from Federal and state agencies to individual members of the public. Another goal will be to encourage and support effective partnerships with regional stakeholders to meet the objectives and criteria of the Recovery Plan.* (p. 3-38).

NMFS' response:

NMFS agrees that successful implementation and recovery of listed species in the Yuba watershed will require the support, efforts and resources of many entities, including NMFS, other Federal agencies, State of California agencies, the Applicant and other (Yuba) licensees, and the public. In the face of ongoing efforts (*e.g.*, the Yuba Salmon Forum) the Applicant has not provided a credible reason why cooperation for desired results would not happen. Mere assertions that Yuba River recovery is not reasonably foreseeable ignore evidence of the cooperation already underway to achieve or promote that recovery.

Applicant comment:

> *Until USACE's new Biological Assessment (BA) for the referenced consultation and NMFS's new BO are prepared and available for review, it would not be reasonable for FERC to assume that this new consultation will result in upstream anadromous salmonid passage at Englebright Dam in the reasonably foreseeable future, as NMFS suggests.* (p. 3-38).

NMFS' response:

NMFS is not assuming or predetermining any particular outcome for a new biological opinion on the effects of U.S. Army Corps of Engineer's operation of Englebright and Daguerre Point Dams on the Yuba River. However, under Court order, completion of a NMFS Biological Opinion is to occur in late 2011; therefore, the new biological opinion will be completed within a reasonably foreseeable future timeframe.

Applicant comment:

> *However, for the reasons discussed in the following paragraphs, the existence of the Yuba Salmon Forum process (and the North Yuba Reintroduction Initiative, which also is discussed below) does not support NMFS's argument that FERC should order YCWA to conduct fish passage studies as part of the relicensing process*. (p. 3-39).

NMFS' response:

The Applicant goes to great lengths to discuss the complexity of the effort and the challenges facing the initiatives (*e.g.*, Yuba Salmon Forum) underway to investigate reintroduction efforts in the upper Yuba River watershed. NMFS agrees reintroduction will not be easy, in part due to the existence of the Project's facilities (and other hydroelectric facilities and operations) in the watershed. NMFS does not understand how these challenges are reasons that FERC should not order the Applicant to conduct studies of the Project's effects on anadromous fish passage. Restricting information collection or study by the Applicant risks depriving the Commission of a solid foundation for its licensing order.

Applicant comment:

> *It also is clear that responsibilities for the current situation and abilities to contribute to potential solutions must be shared among many parties, and should not be imposed on one upstream licensee. The existences of Yuba Salmon Forum and the North Yuba Reintroduction Initiative, therefore, do not support NMFS's argument that FERC should order YCWA to conduct fish passage studies*. (p. 3-40).

NMFS' response:

In the Yuba River Project licensing proceeding, NMFS has requested the Applicant conduct fish passage studies to assess the effects of its Project facilities, and of facilities closely related. NMFS has also requested others to provide fish passage and anadromous habitat study in the Yuba watershed. In the Yuba-Bear and Drum-Spaulding licensing proceedings, NMFS requested an "Anadromous Ecosystem Effects Study", but the Commission's Study Plan Determination approved the licensees' study plan without it (subsequently, NMFS contracted the development of a RIPPLE salmonid habitat and population model to partly fill the information gap). The Court and NMFS have requested the U.S. Army Corps of Engineers evaluate fish passage effects in its biological assessment of the effects of the operations of Englebright and Daguerre dams. NMFS originated the Yuba Salmon Forum under the name "Multi-party Forum" to emphasize the need for multiple entities to participate and contribute to potential solutions, including the U.S. Army Corps of Engineers and other Yuba watershed FERC licensees. The Commission should not accept arguments that allow each party to avoid study of anadromous fish passage by claiming it is not the only responsible entity; if accepted, the result would be no study of the issue by anyone. It is ironic that NMFS' attempts to fill the data gaps in the Yuba River watershed with information from its own investigations of fish passage (MWH 2010), anadromous habitat potential (RIPPLE model) and reintroduction planning have been criticized as independent and non-collaborative by entities refusing to perform similar investigations of their projects' effects.

Applicant comment:

> *In its July 18, 2011 letter, NMFS also states that it is undertaking certain independent investigations and is developing an anadromous fish introduction plan that should be available in early 2012 (NMFS, p. 10). However, NMFS has not provided any details regarding the likelihood that this plan will result in the introduction of anadromous fish into the Yuba River or any of its tributaries upstream of Englebright Dam, or any schedule for such introduction. This proposed plan, therefore, does not support NMFS's argument that FERC should order YCWA to conduct studies regarding fish passage* (p. 3-40).

NMFS' response:

NMFS has contracted with consultants experienced with salmon reintroductions to inform the agency about how to best move forward with reintroduction efforts, and the early results suggest an approach of pilot reintroductions accompanied by adaptive management. The Applicant appears to misunderstand this initiative, which is aimed at determining how to move forward by taking reasonable actions, monitoring the results, and adapting accordingly. The MWH Report (2010), which the Applicant may consider a NMFS independent action, provides some conceptual-level engineering regarding fish passage. NMFS is requesting additional information to continue to build the base of information, and to complement future reintroduction planning.

Applicant comment:

> *NMFS's study request also asks FERC to order YCWA to study fish passage conditions at dams and diversions (including Daguerre Point Dam and the Hallwood-Cordua and South Yuba-Brophy diversions) and powerhouses (including PG&E's Narrows Powerhouse) that are not Project facilities and that are located downstream of all*

> *Project facilities (NMFS July 18, 2011 letter, Encl. A, pp. 7-9). YCWA believes NMFS has not provided any evidence concerning Project nexus for these elements of its study request, other than to note that the facilities are downstream of the Project, and the issue here is whether existing information is adequate to address the incremental effects of the Project, in combination with these non-Project facilities, on anadromous fish*. (p. 3-40).

NMFS' response:

NMFS has done more than noted that the non-Project facilities mentioned above are downstream of the Project. In its comments on the PSP, NMFS pointed out that simply stating that NMFS' Request #1 involves dams and diversions that are non-Project facilities does not undercut their nexus to Project facilities or operations. NMFS established a reasonable nexus by stating that water stored in New Bullards Reservoir, impounded by New Bullards Dam, and released through the New Colgate Powerhouse and Narrows 2 Powerhouse (all Project facilities) can be diverted at points downstream through the (non-Project) Hallwood-Cordua and/or South Yuba-Brophy facilities, operating in concert with (non-Project) Daguerre Point Dam. NMFS also explained that upstream and downstream passage of anadromous fishes is a concern at these non-Project facilities. NMFS' Request #1 seeks information about how the Project's influences on flow volumes and release timing could influence the effectiveness of fish screens at the diversions, and the functionality of the fish ladders at Daguerre Point Dam. In NMFS' view, it is unreasonable to deny any nexus (connection between) these Project and non-Project facilities and operations prior to information collection or study. It is also unreasonable to presume that no future license requirements could be informed by adopting NMFS' Request #1, as it seems reasonable that Project flow releases (*e.g.,* their magnitude, timing, duration, rate-of-change, etc.) that affect downstream fish screens and ladders could be the subject of license conditions. NMFS' Request #1 is reasonably proposed to gain additional information about the Project's effects on anadromous fish passage, and to inform future PM&E's. The Applicant maintains that existing information is adequate to assess fish passage effects at these non-Project facilities, but did not explain the Project's effects in its PAD. It is the responsibility of the Applicant's Revised PSP to show how it will assess its Project's effects.

Applicant comment:

YCWA has developed and included in its Revised Study Plan a proposed new study (Study 7.11, Assessment of Narrows 2 Powerhouse as a Barrier to Anadromous Fish Upstream Migration), which will study the incremental effects of the Narrows 2 Powerhouse on the upstream migration of anadromous fish. This study will provide information necessary for the development of license conditions regarding mitigating any Narrows 2 Powerhouse incremental effects on the upstream migration of anadromous fish, and address many of the elements in NMFS's requested study. (p. 3-41).

NMFS' response:

NMFS disagrees that the results of the proposed study 7.11, "Assessment of Narrows 2 Powerhouse as a Barrier to Anadromous Fish Upstream Migration" will "address many of the elements in NMFS requested study." In its Request #1 (filed March 7, 2011), NMFS identified (Enclosure F, Request #1, Table 1, p. 2) several Project facilities/operations in need of study of their potential to affect passage for anadromous fishes, as well as several non-Project facilities where Project operations could affect fish passage at these facilities. With regard to upstream fish passage assessments, the Revised PSP contains only proposed Study 7.11 "Assessment of Narrows 2 Powerhouse as a Barrier to Anadromous Fish Upstream Migration". Study 7.11is unlikely to yield information adequate for assessing conditions in the vicinity of the Narrows 2 Powerhouse, or the full effects of the Narrows 2 Development on upstream fish passage. As described by FERC (1992; 1995), and summarized previously by NMFS, the full flow of the Yuba River is routed through the Project's Narrows 2 and Pacific Gas and Electric Company's Narrows 1 FERC-licensed hydroelectric developments, except when flows (in winter or spring) in excess of the combined Narrows 1 and Narrows 2 flow capacities pass over the crest of Englebright Dam (FERC 1992; 2005). At these times, the flows through Narrows 2 and Narrows 1 hydroelectric facilities represent the only waterways for anadromous fishes to swim from the lower Yuba River to points upstream, or from the upper Yuba to points downstream. Because the Narrows 2 Development flow capacity is nearly 5 times the outflow of Narrows 1, the dominant re-routing of the Yuba River flow around the Englebright Dam occurs at the Narrows 2 Development. NMFS refers the Commission to Attachment A to this Enclosure, an aerial photo extracted from the Applicant's PAD (p. 6-48); this photo illustrates that when flows are not passing over the crest of Englebright Dam, no attraction flow exists at the base of the Dam, and also that Narrows 2 represents the dominant upstream passage waterway compared with the Narrows 1 facility.

NMFS requested the Applicant investigate the physical characteristics around and within the Narrows 2 Powerhouse and related facilities (including, flow, velocity turbulence, temperature, etc.) to determine the effects of Project facilities and operations on attraction and passage of anadromous fish. It appears the Study 7.11 attempts to circumvent the NMFS Request #1 by ignoring evaluation of upstream fish passage conditions via the dominant flow path (via the Narrows 2 Development waterway) in favor of evaluating passage conditions near the Narrows 2 Powerhouse outfall only, for fish that could theoretically migrate past the Powerhouse another 400 feet to the toe of Englebright Dam; this approach misunderstands common anadromous fish behavior. Spring-run Chinook salmon have been observed congregating at the base of Narrows 2 Powerhouse (FERC 2005, p. 15), evidently holding in this location because they are attracted to the Powerhouse outflow, but cannot ascend this waterway.

NMFS has requested information about the mechanical and hydraulic conditions within the Narrows 2 Development, which cause its waterway to be impassable in the upstream direction. Experienced fishway design engineers (MWH 2011) have identified a potential site for an upstream passageway entrance directly adjacent to and below the Narrows 2 Powerhouse (MWH 2011, p. 6-2, 6-3, 6-5, Plates 3, 4, 6); the engineers did not identify the toe of Englebright Dam as a likely site for a successful upstream fishway entrance. Again, no attraction flows exist at the toe of Englebright Dam when water is not passing over its crest. Therefore, the Commission should consider that the Applicant's proposed Study 7.11 will provide little useful information. In the area of the Narrows 2 Powerhouse, NMFS requested a detailed plan to investigate anadromous and resident fishes (see element 8.2 in NMFS Request #8) using DIDSON technology. The requested information would directly inform whether fish are attracted to the Narrows 2 outfall and how they behave in the vicinity of the Powerhouse outfall. The physical parameters investigated in elements 8.1 and 8.3 (in NMFS Request #8) could then be directly linked to fish behavior. This information would directly inform potential protection, mitigation, and enhancement measures. The Applicant's Study 7.11 will not adequately address NMFS' Request #1 as it pertains to Project effects on upstream passage at the Narrows 2 Development.

In addition, the Applicant's proposed study 7.11 is insufficient due to technical flaws, inconsistencies between stated goals and objectives (section 3.0) compared to methods (section 5.3), proposed methods that are unclear and lack sufficient detail to understand what the Applicant is proposing (failure to meet criteria 18 CFR §5.11(d)(5)) and how the results will be used to assess impacts to anadromous fishes (as the objectives claim). Goals and objectives #3 and #4 state that temperature will be analyzed (pg. 2 of Study Plan 7.11); however, temperature is not mentioned again in the study plan. No methods are provided that described where and what temperatures will be analyzed, or how data will be assessed to quantify thermal gradients that could cause passage impediments/ barriers and/or attractions due to thermal differences upstream and downstream of the Narrows 2 Outfall. This is a failure to meet criteria 18 CFR §5.11(d)(5) with regard to temperature analyses. Similarly, objective #5 states the study will "*describe the historical incidence, or potential future likelihood, of fish stranding, mortality, or injury resulting from "false attraction" into the powerplant structure"*, but no methods are presented to describe how fish stranding or false attraction will be determined or assessed as a Project effect, or the historical occurrences of these potential effects.

The primary field data collection proposed consists of one transect (potentially more, but not committed to) where velocities will be measured with a flow meter and wading rod, if safely feasible. The Applicant does not specify whether depth-averaged velocities will be collected or if multiple velocities at different depths will be collected at each station, or whether data collection will be done from a boat or by wading. Since the equipment mentioned included a wading rod and flow meter will be used, NMFS assumes the measurements are intended to be collected by wading. If so, this choice of measurement technique may result in little to no data collections, since it is highly likely that it will be unsafe to wade near the Narrows 2 Powerhouse outfall. If the intent is to collect depth-averaged velocities (*e.g.*, a velocity at 0.6 times total depth or an average of 0.2 times total depth and 0.8 times total depth), then the velocity data may be of little use for assessing how a fish will behave or pass a given location; fish are able to swim at multiple depths within a vertical velocity column and, therefore, assessing the ability of fish to pass through a vertical column using depth-averaged velocity is a poor method. While these study design limitations are substantial, the primary flaw with the study design is proposing to collect depth and velocity data only at one transect within the entire upstream, downstream, and Powerhouse outfall vicinities. Questions surrounding how discharges through Narrows 2 outfall influences fish movement is an inherently complex depth and flow problem that needs to be analyzed in 3-dimensions; velocities need to analyzed throughout the vertical water column [one dimension] and cover the entire planform area [two additional dimensions, in the x and y directions] at Narrows 2 Outfall and the entire upstream and downstream reaches near the Powerhouse. Surveying depths and velocities along one transect will do little to characterize the flow conditions resulting from Narrows 2 Outfall that effect fish movements. Thus, depths and velocities need to be collected with an Acoustic Doppler Current Profiler (ADCP) (or similar instrument) that collects the entire vertical velocity field, and where the ADCP is positioned to measure velocity throughout the entire study area (x and y dimensions). This will require deploying the ADCP from a boat or from an unmanned craft that is controlled from the riverbanks (via remote control or with tag lines).

Within the methods section, the Conduct Analyses Section (section 5.3.4 pg. 7) is composed of two paragraphs, and the second is particularly unclear about what the Applicant is proposing to do, and about what methods will be used to calculate the stated parameters. The second paragraph does not meet ILP criteria 18 CFR §5.11(d)(5). Text from this second paragraph is quoted below in italics, and NMFS' questions and concerns about uncertainties are noted in brackets following each sentence:

The other component will consist of comparing water depths and velocities collected during the first component along the flow pathway from the Narrows 2 turbine and the full-flow bypass valve to proximally downstream. [Where proximally downstream is the Applicant comparing the velocities from the one transect near the turbines? How far downstream, and is the Applicant comparing against one downstream location only? Where is the velocity and depth data downstream coming from? From a measurement? From a model? Further explanation is clearly required].

Water velocities for the flow pathway will be calculated under both steady state and flow change. [Based on the words "calculated" and "steady state", it appears the Applicant is referring to modeled parameters. What model is the Applicant referring to, and what are the inputs and assumptions? Are the water velocities to be compared depth-averaged velocities, or velocities at multiple depth stages?]

Under a flow change, three measurements would be done to document the change (i.e., start up, ramp up, and shut down). [Based on the word "measurements", it appears the Applicant is referring to documenting flow depths and velocities in the field for the startup, ramp up, and shut down, but no description of this field work is provided. Will these measurements occur at both the single established transect near the turbine and at the unspecified proximal downstream location?]

Flow pathway depth and velocity characteristics will be compared to burst and sustained swimming speeds of anadromous salmonids to evaluate the potential for injury to adult *salmonids in the vicinity of the Narrows 2 powerhouse and bypass as a result of project operations.* [Are these velocity characteristics depth-averaged parameters, or velocities at specified depths? How will comparing depths and velocities to bursts and swimming speeds of anadromous fish be used to determine if injury will occur near Narrows 2? How will this information be used to assess false attraction into the Narrows 2 Powerhouse structure, as stated in the objectives?]

In summary, in the Applicant's proposed analyses, NMFS finds the proposed methods vague and unclear regarding how data will be generated (modeled or measurement?), where data collection/calculation will occur (where is the downstream comparison point?), what kind of data is being compared (is the Applicant using depth-averaged velocities?), or how the data will be combined/synthesized to assess potential injury and/or attraction into the Narrows 2 Powerhouse. The proposed analyses do not comply with 18 CFR §5.11(d)(5), and do not fulfill the portion of NMFS Study Request #1 that pertains to Narrows 2 Powerhouse evaluations.

The Revised PSP is deficient in meeting NMFS' Request #1 with regard to fish entrainment:

As in the PSP, in the Revised PSP the Applicant does not propose adequate information gathering or study of the effects of the Project (and related activities) on entrainment of anadromous species. The Applicant proposes Study 3.11, but the Commission should compare this plan for study with NMFS' Request #1, Table 1, which lists each facility that potentially affects anadromous Yuba River fish passage (including entrainment). The following sites were identified for their potential to entrain juvenile salmonids: Hallwood-Cordua diversion, South

Yuba-Brophy diversion, Brown's Valley diversion, Narrows 1 Powerhouse, Narrows 2 Powerhouse, Narrows 2 Flow Bypass, Narrows 1 Intake, Narrows 2 Intake, New Colgate Powerhouse, New Colgate Power Intake, Lohman Diversion Intake, Camptonville Diversion Intake. The following were identified for their potential to entrain adult salmonids: Daguerre Point Dam, Narrows 1 Powerhouse, Narrows 2 Powerhouse, Narrows 2 Flow Bypass, Narrows 1 Intake, Narrows 2 Intake, Lohman Diversion Intake, Camptonville Diversion Intake, and New Colgate Power Intake.

In contrast, proposed Study 3.11 provides Table 3.1-1 that lists five "low-level" Project intakes that could entrain fish, in terms of their conduit sizes, minimum releases, and maximum capacities. The Table is followed by brief text stating the trash rack spacing in front of the Our House and Log Cabin intakes. Following a brief discussion of the "transition fishery" in the Middle Yuba near Our House Dam, the lack of fishery information in Oregon Creek, and recent fish studies of New Bullards Reservoir, the Applicant concludes:

> *Based on the above information, the potential affects to fish populations due to possible entrainment into one or more of the above low-level intakes is low*. (p. 4).

It is unclear how the information preceding this conclusion supports it. Rather, it appears the Applicant has asserted that no Project-related entrainment effects associated with the Project's low-level intakes worthy of study. Claims that potential entrainment effects on fish populations are low are not supported because the Applicant provides no actual evidence that entrainment is not occurring or that potential effects of entrainment are low. NMFS acknowledges that the New Bullards Bar Dam low-level intake (at ~ 500 feet) is very deep, but study of the Our House and Log Cabin intakes (depth unclear) appear to be ruled out based on the limited fishery data available or the trash rack spacing. The current standard in California for fish screen mesh size for positive barrier screens is 1.75 mm (wedge wire) and 3/32" for round or square mesh configurations. These fish screening criteria are promulgated by both NMFS and the California Department of Fish and Game (CDFG) where steelhead (*Oncorhynchus mykiss*) fry are a target species for entrainment protection. Trash Racks with bar spacing at 8.75 inches (Our House and Log Cabin low-level intakes) and 12.375 inches (Our House and Log Cabin auxiliary low-level intakes) offer no meaningful protection for adult and juvenile fish from entrainment, which can lead to a significantly high rate of injury or death to fish. Section 3.1.1, p.4 states:

> *"Second, any fish entrained into either Our House or Log Cabin diversion dam low-level intakes would not be damaged since they would simply pass unimpeded (i.e., not pass through any valves) to the river downstream of the dam. Potential entrainment effects related to Our House and Log Cabin diversion dam auxiliary intakes and the New Bullards Bar Dam low-level intake would be very short-term since these intakes are used on a very infrequent basis."*

These statements do not take into account the fact that these Project facilities can create extreme hydraulic conditions that are adverse to fish by causing injury or death upon passage. Typical conditions caused by Project facilities include: high velocity, high pressure and rapid pressure changes, high turbulence. While auxiliary intakes are used infrequently, the low level intakes are used more often, and entrainment through any or all of these structures is a direct Project effect.

As with the low-level intakes, the Applicant concludes with regard to the Project's power tunnel intakes that the potential entrainment effects to fish populations is low. Thus, entrainment studies are not included at either the Upper or Lower New Colgate Power Tunnel and Penstock Intakes or the Narrows 2 Powerhouse Penstock Intake. Section 3.1.2, p. 10, states:

> *Based on the above information, the potential effects to fish populations due to entrainment into one or more of the above power tunnels intakes is low. First, the native fish populations that would be affected are primarily stocked fish used to support a put-and-take fishery. There is a reported occurrence of hardhead in Englebright Reservoir,*

> *but hardhead are not a deepwater species and their life history describes them being in much shallower depths. There are no reported occurrences of, ESA-listed or CESA-listed fishes in the reservoirs. Second, the intakes occur deep in each reservoir where it is unlikely that fish congregate. However, fish population assessments have not been conducted to identify the species and age classes of this reservoir community.*

This is not an acceptable plan of entrainment study, and does not adequately address NMFS' Request #1. The statement that "[potential entrainment effects on fish populations are low…"] cannot be substantiated because the Applicant provided no actual evidence that entrainment is not occurring – only subjective opinions that the intakes are deeper than the strata where fish live in each reservoir. The Upper New Colgate Power Tunnel and Penstock Intake is at a depth of 148 feet, the Lower New Colgate Intake is at a depth of 336 feet, and the Narrows 2 Powerhouse Penstock Intake is at a depth of 86 feet (all measured from full pool elevations). NMFS notes this full pool vs. low level intake measurement can be misleading. First, the reservoir may frequently fluctuate well below the "full pool" elevation, especially during drought periods. Second, the Upper New Colgate Intake is at a much higher elevation, and its withdrawal capability may need to be used to better balance downstream water temperatures; this possibility cannot be ruled out at the study phase, and the information obtained could be essential to the development of new license conditions. When one analyzes actual dry-season reservoir pool depths relative to intake elevations, there may be frequent periods when fish can be influenced by the hydraulic attraction of the intakes, and thus may be entrained in substantial numbers. Third, the Applicant overlooks the fact that the New Colgate Intake is the dominant flow path (at nearly all times, unless the dam is spilling). This means that - normally - the vast majority of North Yuba River downstream flow is through the New Colgate Power Tunnel and Penstock Intake, and the action of water flowing into the Intake creates a significant zone of hydraulic influence that could attract fish deep into the water column – thus making them susceptible to entrainment in Project facilities. NMFS has observed fish entrained into deep water intakes at high head dam projects, including those on the Columbia River. Because of the height of this particular dam, and the juxtaposition of the intake locations, entrainment studies must be conducted to verify whether or not entrainment is occurring, and at what level.

Criteria for screening the Project's power tunnel intakes may be altered on a project-by-project basis but there is no likelihood that the current Project facilities (trash racks) will acceptably protect fish. Project trash racks with bar spacing at 2.25 inches (New Colgate Power Tunnel and Penstock Intake) and 4.1875 inches (Narrows 2 Powerhouse Penstock Intake) offer no meaningful protection for adult or juvenile fish from entrainment, which can lead to a significantly high rate of injury or death to fish (including delayed mortality). NMFS notes that experienced fishway engineers who evaluated Englebright Reservoir for potential downstream fishway options have recommended screening the Narrows 2 Powerhouse Penstock Intake (MWH 2011, p. 7-4).

With regard to the Narrows 2 Bypass Valve Facilities, Applicant statements underscore the need for hydraulic and biological entrainment studies to determine Project effects. Section 3.1.1, p.9, states:

> *The 36-inch diameter valve was included in the original powerhouse design and the 78-inch diameter valve was added in 2007 to provide the capability to bypass flows of up to 3,000 cubic feet per second (cfs) around the Narrows 2 Powerhouse during times of full or partial powerhouse shutdown. Use of the bypass valves vary by year. Prior to installation of the 72-inch diameter valve in 2007, the 36-inch diameter valve was used for 34 days in 2005 (average flow of 103 cfs) and 15 days in 2006 (130 cfs). Since 2006, the two bypass valves were used, either separately or in combination, for 89 days in 2007 (combined average flow of 695 cfs), 166 days in 2008 (177 cfs) and 201 days in 2009 (193 cfs).* (p. 9).

NMFS notes the historical usage of bypass valves indicates a pattern where flows are suddenly and significantly shifted from power plant to bypass discharge and vice versa, during emergencies or maintenance outages. While the Applicant states that use of bypasses varies from year to year, it is acknowledged that bypasses are routinely used, causing a flow split, or sudden shift in flows when non-steady state plant operations occur. In 2009, for example, the two bypasses were used separately or in conjunction for a total of 201 days, or 55% of the year. There is much opportunity, therefore, for shifting flows to affect fish immediately downstream, and this is ample evidence of the need for detailed study of the near-field hydraulics at the Narrows 2 Powerhouse and Flow Bypass outlets, and also to determine and whether or not fish are entrained, injured, or exhibit behaviors of concern (*e.g.*, attempt to swim into the Powerhouse during start-ups and shutdowns, or whether fish are prevented from swimming freely upstream by the fast-moving water exiting from power plant or associated bypasses).

To assess the Project's entrainment effects, the Applicant's Revised PSP proposes only to study "if the withdrawal of water at the Project's Lohman Ridge and Camptonville Diversion tunnel intakes are likely to have adverse effects on native fish populations." (p. 12). NMFS notes a study of entrainment should be conducted first to determine the degree of entrainment, second to determine the mortality of entrained fish, and then to estimate the population-level effect. In this case, the Applicant appears to bypass direct entrainment and mortality evaluations, and instead will evaluate the likelihood that the Project would theoretically cause a population-level effect. This thinking reflects the "surplus fish" approach common in FERC licensing study with regard to entrainment study (*i.e.*, assume that entraining fish is acceptable because the mortalities are "surplus" to the population—and their loss would have no population-level effect). NMFS disagrees with this approach, and notes that if/when ESA-listed anadromous fishes are the species potentially entrained by Project facilities/operations, "take" of those individuals must be authorized. Section 3.2.1, p. 12 states:

> *While the two tunnels […Lohman Ridge and Camptonville diversion tunnel intakes…] generally do not divert water from around mid July through October, significant amounts of water are diverted at other times of the year. Given the volume of water diverted by the two intakes, the potential for fish to be entrained is high when the diversions occur, which could affect local fish populations.*

While Applicant concludes, in these two instances, that there are local entrainment effects of their facilities, it's proposed study methodology if insufficient to document and quantify the entrainment. Section 5.0 (Study Methods and Analysis) includes:

- *Field crews may make minor variances to the FERC-approved study in the field to accommodate actual field conditions and unforeseen problems…*

- *When Licensee becomes aware of major variances to the FERC-approved study, Licensee will issue an e-mail to the Relicensing Contact List describing the variance and reason for the variance. Licensee will contact by phone the Forest Service (if the variance is on National Forest System land), USFWS, SWRCB and CDFG to provide an opportunity for input regarding how to address the variance. Licensee will issue an e-mail to the Relicensing Contact List advising them of the resolution of the variance. Licensee will summarize in the final study report all variances and resolutions.*

- *Licensee's performance of the study does not presume that Licensee is responsible in whole or in part for measures that may arise from the study.*

Here the Applicant confers upon itself the ability to establish variances from FERC-approved study protocol simply by notifying relicensing participants, and providing USFS, USFWS, and CDFG "…an opportunity for input." Notably, the Applicant seeks to separate FERC from its authority to mandate and oversee study protocols by establishing an "off-ramp provision" that does not include consultation with FERC staff. In addition, the Applicant seeks to indemnify itself from any responsibility for entrainment impacts on fish and wildlife by simply stating that the results of a study do not presume responsibility on the part of the Licensee. As stated before, entrainment into Project facilities are manifestations of direct Project effects on fish and wildlife as a result of the Applicant's water diversions for hydropower operations. As such, entrainment effects must be regarded as the sole responsibility of the Applicant.

The Applicant's proposed study methodology is insufficient to yield satisfactory results. Section 5.3: Study Methods, p. 14 states:

> *…YCWA will conduct four field efforts in March 2011, two each in Our House Diversion Dam and Log Cabin Diversion Dam impoundments, to collect up to 30 8 inch or longer rainbow trout in each impoundment….\and\...If YCWA is unable to capture the target fish in the impoundment in the two sampling events, YCWA will seek permission from CDFG to tag and release hatchery fish to meet the target number of 30 fish in the impoundment in the same time frame.*

This sample size is insufficient to provide statistically valid results. NMFS recommends FERC engage the assistance of a qualified bio-statistician to assist in set-up of the study protocol and the statistical design of the experiments.

The Applicant's Study Proposal does not identify a specific period when entrainment monitoring will occur, and fails to ensure that a fixed monitoring capability at the primary entrainment points will occur. Section 5.3.2, Step 2- Track Fish Movement, p.15 states:

> *YCWA will begin tracking the movement of radio tagged fish as soon as they are released and continue tracking for the term of the expected life of the radio tag (~24 days). It is not currently known if a fixed monitoring station will be able to be fitted into the tunnel intakes and outlets, but the logistics of that installations will be investigated. Both fixed monitoring stations and mobile monitoring will occur. The configuration of the monitoring will be determined after a logistical assessment is completed, but the configuration will be able to determine movement in the impoundment and entrainment into the tunnel, if it occurs. Mobile tracking will be conducted 5 days a week for the monitoring period to identify fish positions. If it is determined that fixed monitoring*

> *stations are feasible, monitoring at those stations would likely occur over 24hour periods.*
>
> *<u>If a transmitter does not move for more than one day, the fish will be considered deceased and removed from the monitoring effort</u>*. [underline emphasis added].

The proposal involves surgical implantation of radio-tracking devices. This must be done under a strict Quality Assurance / Quality Control (QA/QC) protocol because the stress of surgery, particularly if done incorrectly or haphazardly, could easily result in serious injury or mortality of test fish. Consequently, these mortalities would not then be attributed to entrainment, but most likely be attributed to mortality of "unknown causes." FERC must insist on strict scrutiny of such procedures, and appropriate QA/QC. Section 5.3.3- Step 3 – QA/QC and Analyze Data, p.15, states:

> *…YCWA will perform a quality assurance/quality control review of the data. The fish radio tracking data will be analyzed in combination with the results of YCWA's Stream Fish Populations Study data to assess the potential for effects to rainbow trout stream populations due entrainment into the two diversion tunnels.*

The Applicant describes the vital QA/QC program that is essential to validate results in only one sentence, and provides no details. NMFS suggests to FERC that this sort of QA/QC description is materially insufficient, and thus scientifically unacceptable. The results of such an effort cannot be scientifically accepted unless a detailed QA/QC plan is adequately developed and applied. NMFS recommends that fisheries scientists from UC Davis, who have experience in these areas, be retained by the Applicant to develop a statistically-valid experimental protocol and a QA/QC program that is transparent and accountable to FERC and all interested stakeholders. The Applicant intends to use radio-tacking methods on a statistical sample group of only 30 individuals of only rainbow trout, 8" inched or longer – The sample group (30) is too small and the minimum fish size (8”) is too large to produce a valid depiction of overall entrainment activity at the project facilities.

Section 7.0, p.15-16, provides the following schedule:

- Collect, Tag and Release Fish (Step 1) (March 2012)
- Track Fish Movement (Step 2) (March - April 2012
- QA/QC and Analyze Data (Step 3) (August 2012)
- Prepare Report (Step 4) (September 2012)

The Applicant reports its intent to release fish on some unspecified day in March of 2012, and to track fish movement until some unspecified day in April 2012. Taken literally, this could potentially allow for fish to be released on March 31st and tracked until April 1st, while still technically meeting the schedule. FERC should insist on a more definitive schedule and a longer-lasting experiment. NMFS recommends monitoring occur over two years at a minimum of six months duration, each year. Monitoring via conventional methods can be combined with an expanded radio-tracking protocol to gain more reliable information about multi-species entrainment at project facilities over time.

Lastly, a more standard method of entrainment monitoring is by use of fyke nets at or near the point of diversion. This standard technique is not proposed here. NMFS advocates for use of conventional entrainment monitoring as a more direct observational check on the results of radio-tracking assessments.

The Revised PSP is deficient in meeting NMFS' Request #1 with regard to green sturgeon evaluations downstream of DaGuerre Dam:

In its Request #1, NMFS included Table 1, "Project facilities and related activities affecting anadromous Yuba River fish passage", to identify for the Applicant the several facilities that could affect upstream or downstream anadromous fish passage, and that should be considered for information gathering or study by the Applicant. Table 1 also identified the target anadromous species, including green sturgeon, that could be subject to potential passage effects, and several potential passage effects or issues (*e.g.*, passage barriers, facilities capable of entraining fish, peaking facilities/operations that could cause stranding, predation effects, etc.). In addition, Request #1, Element #3 requests information or study of fish passage specifically at DaGuerre Point Dam. Element #8 requests information or study of fish passage conditions over the length of Daguerre Reservoir, and in areas downstream. NMFS' comments on the PSP requested the Applicant to expand its monitoring activities in the Yuba River downstream of Daguerre Dam, based on recent investigations of green sturgeon presence in the Yuba River (funded by the Anadromous Fish Restoration Program).

As in the PSP, the Revised PSP (Study 7.9) expends a great deal of effort to explain the paucity of evidence of green sturgeon in the Yuba River (and to some extent the Feather), and the lack of spawning activity outside of the main stem Sacramento River. NMFS notes there is ample observational evidence of adult green sturgeon in the Yuba River, and further study is warranted:

1) continuation of video-based study to detect adults in the Daguerre Dam pool and in additional lower Yuba locations;
2) new study to detect juveniles, larvae, or eggs; and
3) determination of the number and approximate area of deep (~ 10 feet) pools upstream of Daguerre Dam that represent potential habitat for adult green sturgeon.

The Revised PSP proposes a Phase 1 to "compile available information" regarding the number and location of acoustically tagged North American green sturgeon in the Yuba River. NMFS notes this task could have been fulfilled by the Applicant's PAD, but if performed now could provide useful information to determine use of lower Yuba River areas by adult green sturgeon. Phase 2 is to assess potential habitat areas in the lower Yuba, downstream of Daguerre Point Dam, characterized by water depths of greater than 10 feet, as a function of flow (using a SRH2D 2-dimensional model), along with temperature suitability assessment. This information will be helpful to address NMFS' recommendation #3 above, but NMFS has also requested this information be gathered upstream to Englebright Dam (which would inform about the potentially available green sturgeon habitat blocked by Daguerre Dam).

NMFS disagrees with the Applicant's decision to not devise a plan for the field study recommended by NMFS (and others) to detect juveniles, larvae or eggs in the lower Yuba River. Flow regimes under the Lower Yuba Accord are clearly under the influence of the Project's facilities and operations, and scheduled Accord flows are measured at points (Marysville gage) downstream of Daguerre Dam, where green sturgeon have been observed and critical habitat has been designated. Information from thorough study could provide information for the development of protection, mitigation, and enhancement measures for green sturgeon habitat in the lower Yuba River.

NMFS' Request #2:

"Effect of the Project and Related Activities on Hydrology for Anadromous Fish"

Element #1 "Data Development" was not adopted by Applicant in the Revised PSP. The Applicant states the additional data set requested by NMFS will be developed through the Water Balance/Operations Model Study (Study 2.2). The Applicant states:

"*The information needed for the Hydrologic Alterations Study is the third data set proposed in the Water Balance/Operations Model Study (Study 2.2), which is the hydrology absent the Project, which will be compared with the simulated hydrology below Project facilities with historical inflow*." (p. 3-42).

However, the Water Balance/Operations Model study plan (study 2.2) does not explicitly include developing this data set, and merely states that they will *"consider all reasonable model run requests…outside of that study"*. It is unclear why the Applicant cannot determine if this run request is reasonable, and proceed to build a model which is capable of providing the requested information, especially if the information is needed for inclusion in other studies. NMFS requested this information so that the Project effects on hydrology can be directly compared to the unimpaired condition, without the confounding influences of upstream projects, which also alter hydrology in the basin. NMFS believes it is imperative to evaluate the specific Project hydrologic effects within this licensing proceeding, as well as the cumulative effects of all flow regulation within the Yuba basin. In addition, the Applicant's study 2.1 does not include many of the hydrology nodes of interest listed in NMFS in Request element #1, which are essential for understanding the Project's hydrological effects throughout the basin.

Element #2 "Peak Flows" requests a comparison of altered hydrology at tributary confluences and its effects on salmonid attraction and immigration. This Request is addressed by the Applicant in the Revised PSP:

, "*…this would be a fisheries resources study for the lower Yuba River, and the hydrology data sets and Water Balance/Operations Modeling Study (Study 2.2) will inform the fisheries studies. NMFS has not stated why this information is not adequate (criterion 7)*" (p. 3-42).

The reason why this information is not adequate is because the information is not proposed to be collected in either Study 2.2 or a "fisheries resources study", the latter of which is not a proposed study by the Applicant. Irrespective of the debate as to whether the requested element belongs in a hydrology or fisheries study, the Applicant is not proposing to provide information pertaining to hydrologic impacts as they relate to salmonid attraction and immigration (as NMFS outlined in Element #2 in Study Request #2). The Revised PSP as proposed does not satisfy this element.

Element #4 "Ramping" requests a 2-dimensional hydraulic model of the reach below New Colgate powerhouse to determine effects of ramping on essential fish habitat. The Applicant's Revised PSP does not satisfy this study Request. The Revised PSP does not adequately address how the spatial and velocity components of Project ramping effects to essential fish habitat will be quantified. The Applicant does propose in Study 2.1 to calculate some statistical analyses of ramping rates of change in stage and discharge, but no metrics are provided to translate how these rates correlate with fish stranding risks, changes in flow velocities, or changes in wetted area or inundated habitats – all of which are necessary to quantify and evaluate given the level of extreme ramping observed at New Colgate Powerhouse.

Element #5 "Floodplains": The Applicant provides this element was "Adopted with Modification" in the Revised PSP:

"*YCWA has adopted with modification NMFS's request for YCWA to perform a 2D habitat model. The model will not be developed to the Feather River since backwater conditions make modeling that section of river problematic. The model will be able to assess various flow conditions. The adequacy of this study and response to NMFS for this element is addressed in YCWA's response to comments for Instream Flow Downstream of Englebright Dam Study (Study 7.10) in Section 3.2.1.26*." (p. 3-43).

However, the Revised PSP does not include any language mentioning this study in section 3.2.1.26 (pg. 3-25 Revised PSP), or in study proposal 7.10. Study 7.10 focuses on using a 2D habitat model to develop WUA versus flow relationships for the target species and life stages, but does not mention using the 2D habitat model to assess floodplain inundation flows and determine their associated frequency. The Applicant also incorrectly asserts that NMFS asked for a 2D habitat model, NMFS requested that a 2D **hydraulic** model be used for assessing floodplain inundation flows. Therefore, NMFS does not consider Request #5 to be satisfied nor do we agree that the request has been adopted with modification.

Element #6: Natural Gradient Impediment/Barriers was not adopted by the Applicant because it "applies to the river upstream of Englebright Dam." However, flow releases from Project dams affect the hydraulic characteristics of potential anadromous fish migration impediments, and alter habitat connectivity within identified Essential Fish Habitat (EFH). This potential negative effect to EFH is a direct result of Project operations. This Request for study is not satisfied by the Applicant's Revised PSP.

Element #8: Quantification of Hydrograph Components. The Applicant states this element was adopted with modification, and Study 2.1 was revised to include some of the requested information. However, the modifications to study 2.1 should also include average rate of change (cfs/day) for the snowmelt recession limb period of the hydrograph. The Applicant states the reason for not adopting the snowmelt recession analysis is because:

> *Items not included but requested by NMFS are the Project only hydrology data set, for reasons explained in Request Element #1 response above, and the average rate of change of flow during the snowmelt recession, because NMFS does not provide sufficient detail about this information to determine what is being requested (Criterion 6).*
> (pg. 3-43 Revised PSP).

In NMFS comments on the PSP (filed July 18, 2011) NMFS provided the following guidelines for what data to collect/calculate pertaining to the snowmelt recession limb of the annual hydrograph (italicized words are new relative to the PSP guidance, inserted in an effort to provide additional clarification):

- median Julian date of *snowmelt runoff* peak;
- seasonal duration of snowmelt runoff *period* (number of days and Julian date of *beginning and* end of snowmelt runoff period); and
- average *daily* rate of change in flow *(cfs)* during snowmelt recession (cfs/day).

NMFS provides the following information quoted from Yarnell *et al.* (2010) for additional clarification as to what is meant by the snowmelt recession and the parameters requested to be quantified:

> *Changes to the shape of the spring snowmelt recession hydrograph can be quantified using three primary components of the natural flow regime (Poff et al. 1997): magnitude, timing, and rate of change (figure 2). The magnitude is the level of discharge (often denoted Q) at the start of the recession, most simply defined as the last significant flow peak of the runoff season. The timing is the date at which the recession starts (ts), and the*

> *rate of change is how quickly the flow changes from one discharge to the next (dQ/dt). Each of these components is easily quantified, and each can have independent effects on stream condition.* (p. 115).

NMFS refers the Applicant and the Commission to the Yarnell *et al.* (2010) article *Ecology and Management of the Spring Snowmelt Recession* for additional detail on how to calculate the requested parameters pertaining to the spring snowmelt recession. This article is included as Enclosure C of this filing. NMFS maintains its request that an analysis be conducted of the snowmelt recession under existing and unimpaired conditions, using methods detailed above and in Yarnell *et al.* (2010), in order to fulfill Request Element #8. This information is necessary to fully understand and evaluate the Project's effects on the annual hydrograph, and on the associated aquatic ecosystems that include anadromous fishes, critical habitats, and essential fish habitats.

NMFS' Request #3:
"Effects of the Project and Related Activities on Water Temperatures For Anadromous Fish Migration, Holding, Spawning, and Rearing Needs"

NMFS Request #3 was not adopted by the Applicant.

Element #2 Temperature Refugia was not adopted by the Applicant because it applies to the river upstream of Englebright Dam. However, the Applicant's operation of the Project alters water temperatures of designated essential fish habitat such that temperature refugia are an important consideration for effects on this habitat. Tributary inputs, hyporheic flows, and stratified pools can create thermal refugia in streams with temperatures otherwise inhospitable for salmonids (Neilsen et al 1994). This important element of essential fish habitat is not addressed in the Revised PSP, therefore NMFS does not consider this request for study to be satisfied.

Element #3 Water Temperature Modeling was not adopted by the Applicant. The Applicant's Water Temperature Model (study 2.6) states that Englebright reservoir *may* be modeled using a 2D approach. The vague language in the study proposal does not ensure that a 2D approach will be used, nor does the study plan detail how the decision will be made whether or not to adopt a 2D approach or the rational for such a decision. NMFS has requested that both Englebright and New Bullards Bar reservoirs be modeled in both a vertical and longitudinal direction (2D). A detailed justification for this Request was provided in our response to PAD filed on March 7, 2011.

NMFS' Request #4:
"Effects of the Project and Related Activities on Coarse Substrate for Anadromous Fish: Sediment Supply, Transport and Storage"

Below, NMFS separates its comments pertaining to Study Request #4 into a geographical division upstream and downstream of Englebright Dam because the Applicant's Proposed Study Plan separates the geomorphology/channel morphology resource area into two separate study plans with substantially different approaches: Study Plan 1.1 Channel Morphology Above Englebright and Study Plan 1.2 Channel Morphology Below Englebright.

Upstream of Englebright Dam

Request Element #4: Calculation of Bed Mobility and Sediment Transport Capacity

The Applicant proposes to satisfy this request element in their Study Plan 1.1 Channel Morphology Above Englebright in part with analyses proposed in section 5.3.3.3 *Estimate Changes in Bedload Transport under Regulated and Unimpaired Conditions*. This section relies on using return intervals and flow exceedances of the largest daily annual flow per year (*e.g.*, the annual instantaneous or 1-day peak flow) for existing and unimpaired hydrology. As NMFS pointed out in their PSP comments (filed on July 18, 2011), and in other comments on study plan drafts provided to the Applicant, all bedload transport analyses should be calculated using annual flow duration curves. This includes an assessment of the total frequency of the number of days per year where bedload transport capacity is occurring under existing and regulated conditions. Merely using the one largest flow per year to assess sediment transport, as the Applicant is proposing, can mask changes in the frequency and duration of sediment transport as well as the total annual transport capacity. In order to address NMFS Request Element #4, the Applicant must calculate bedload transport rates and statistics using the annual flow duration curves for existing and unimpaired conditions, and not just rely on evaluation of the annual maximum discharge.

Request Element #6: Synthesize Study Results to Evaluate Ecological and Geomorphic Impacts requests that an analysis be completed comparing coarse sediment supply and sediment transport capacity under regulated and unimpaired conditions. The Applicant did not adopt this request for information in their Channel Morphology Above Englebright Dam Study Plan (Study 1.1): *YCWA has not adopted NMFS's request because NMFS has not shown that YCWA's* *proposed study does not meet the stated information needs or justified the level of effort and cost to collect the requested information given the existing information and lack of salmon in the study area (Study Criterion 7). Sediment supply prior to dam construction ("unimpaired") is not relevant as the purpose of the study is to assess the baseline (i.e., current) conditions. Sediment supply and coarse sediment storage is being assessed and these estimates will be used in the analysis when the discussion is about changes in sediment transport capacity due to regulation* (Revised PSP p. 3-6). The Applicant's responses regarding the extra cost and effort of collecting the requested information are not warranted; the Applicant is already proposing to calculate sediment supply under both regulated and unimpaired conditions (section 5.4.2.9 *Sediment Supply*; Study Plan 1.1) and sediment transport capacity under regulated and unimpaired conditions (section 5.3.3.3 *Estimate Changes in Bedload Transport under Regulated and Unimpaired Conditions*; Study Plan 1.1). Thus, it is unclear to NMFS how the requested information represents anything but a minor compilation of data elements already proposed to be collected by the Applicant with minimal additional cost and effort. In summary, the data elements necessary to construct an existing and unimpaired sediment budget are already being proposed to be collected by the Applicant in their Study Plan; however, the Applicant is not proposing to aggregate the data elements in a manner that would assess Project effects (necessary under 18 CFR §5.11(d)(4)), or to provide the most useful information for determining PM&E measures related to channel morphology.

The Applicant also stipulates that an unimpaired sediment budget is not relevant to assess the baseline (as quoted above) and further states on pg. 3-47 of the Revised PSP: *A sediment budget and channel sediment dynamics under reference conditions will not be done as the objective of* *the study is to evaluate the continued operation of the project and referring to a hypothetical reference reach or a sediment budget prior to the establishment of the project is unwarranted and would not inform the development of license requirements (Criteria 5).* The two primary assumptions of an unimpaired sediment budget are as follows: 1) the sediment supply trapped behind Project dams is assumed delivered to downstream reaches; 2) the natural high flow regime (both magnitude and duration) or unimpaired hydrology continues downstream of Project facilities where flow alteration occurs, which is used to calculate an unimpaired sediment transport capacity. Sediment entrapment at Project dams and flow regulation at Project facilities are ongoing effects, and are quantifiable metrics (as illustrated and proposed in the Applicant's Study Plan 1.1) that are not hypothetical situations with abstract relevance to the Project and its ongoing effects. Again, the Applicant is already proposing to calculate unimpaired sediment supply and transport capacity, the latter of which is driven by unimpaired hydrology that is a common metric used in this and other FERC licensing proceedings to assess Project effects (*e.g.*, the Applicant's Study Plan 2.1 Hydrologic Alteration).

A sediment budget framework used to assess Project effects to geomorphic processes by analyzing the mass balance between sediment supply and transport is consistent with the goals, objectives, and methods outlined for other recent FERC hydroelectric relicensing studies (*e.g.*, McCloud-Pit Project FERC No. 2106 in CA and the Carmen-Smith Project FERC No 2242 in OR). NMFS continues to request that the mass balance between sediment supply and transport be compared under regulated and unimpaired conditions, as this mass balance and how it has changed due to Project operations (*i.e.*, sediment entrapment at dams and high flow regulation) is a critical piece of information necessary to understand the Project's effects to channel morphology and associated aquatic habitat. This information is directly relevant to informing potential PM&E measures, such as gravel augmentation and/or instream flow regimes that maintain geomorphic function. NMFS provides a detailed methodology of how to construct / calculate the requested comparison of sediment supply and transport capacity in section 1.2.6, Element #6 (pg. 10-11) of Study Request #4 submitted to the Commission on March 7, 2011. The Revised PSP as proposed is not adequate to satisfy this element.

<u>Downstream of Englebright Dam</u>

Request Element #4: Calculation of Bed Mobility and Sediment Transport Capacity

The Applicant proposes to satisfy this request element in their Study Plan 1.2 Channel Morphology Below Englebright using the available 2D model combined with a critical Shields stress approach. Within the details of their approach the Applicant describes a method to estimate a non-dimensional Shields stress for a hypothetical spawning gravel size distribution (pg. 6 Study Plan 1.2): *Define a representative spawning bed-material size for a heterogeneous gravel/small cobble mixture and calculate the non-dimensional Shields stress (τ^*).* While NMFS believes running the bed mobility / sediment transport analysis for a hypothetical spawning gravel size is a useful exercise, it is unclear within Study Plan 1.2 whether the Applicant intends to conduct the same analyses for the actual grain size distribution of the existing bed surface. NMFS cannot find explicit mention of calculating the non-dimensional Shields stress (τ^*) for the existing bed surface, which NMFS understands would be possible using existing substrate maps of the entire lower Yuba River collected by the RMT. In order to adequately address Request Element #4 within NMFS Study Request#4, all sediment transport and bed mobility analyses need to be calculated for the existing bed surface condition as well as the hypothetical spawning gravel distribution. In particular, calculating the Geomorphic Process flows described on pg. 7 of the Study Plan 1.2 must be done using the existing bed surface grain size distribution.

An analysis of geomorphic process flows that mobilize morphologic units and entire geomorphic reaches is described on pg. 7 of Study Plan 1.2. Included in the geomorphic process flow analysis is a return interval and duration analysis of the mobilizing flows. However, the Study Plan does not specify whether return interval and duration analyses will be conducted for existing conditions and/or unimpaired conditions. In order to fulfill NMFS Request Element #4, these analyses need to be conducted for the existing and unimpaired flow regimes.

Request Element #6: Synthesize Study Results to Evaluate Ecological and Geomorphic Impacts. Page 7 of Study Plan 1.2 describes methods to calculate sediment export and channel morphology adjustments based on differencing DEMs from 1999 and 2009. Because these sediment export amounts and channel adjustments occur over a period of 10 years it is likely not possible to attribute these morphologic changes to specific flow events or specific annual hydrographs. However, the sediment export amounts and channel adjustments can be reduced to average rates of export/change per year (by dividing the calculated adjustments by 10 in order to quantify a rate). By calculating an annual rate of change, the Applicant could extrapolate these rates to estimate the expected amount of sediment export and morphologic change (both by reach and at morphologic unit types) over the duration of potential new license periods (*e.g.*, over 30 or 50 years). Sediment export amounts and morphologic unit adjustments should be compared with estimates of sediment volumes stored in the Lower Yuba River and each geomorphic reach in order to understand the trajectory of the Lower Yuba River channel morphology over potential new license periods. This information can be used to assess potential Project effects to channel morphology and develop potential PM&E measures related to channel and/or habitat improvement projects. This information should be provided as partial fulfillment of NMFS Request Element #6.

In section 5.3.4 of Study Plan 1.2, a list of attachments to be included with the report is detailed, which includes *"hydraulic/sediment transport input and output files"*. The file format of these files is not specified. While the included files should include the necessary files for participants to run and verify sediment transport calculations, the output files should also be provided in GIS and tabular (*i.e.*, Excel) format so that Relicensing Participants can analyze and summarize the data even if they do not have the capability of running and processing the hydraulic and/or sediment transport models.

NMFS Request #5:

"Effects of the Project and Related Activities on Large Wood and Riparian Habitat for Anadromous Fish"

In the Revised Study Plan, the Applicant asserts that NMFS has not shown a project nexus to LWD loading in the Lower Yuba River in NMFS study plan request:

> *NMFS requests that the study plan address "quantify LWD (Large Woody Debris) frequency and how LWD functions as a geomorphic control and forcing mechanism in the LYR (Lower Yuba River)". As described in the PAD and elsewhere, Englebright Dam is not a Project facility, nor does Englebright Dam preclude the transport of LWD from the upper reaches of the Yuba Watershed to the lower Yuba River since Englebright Dam is an overflow bypass structure and USACE does not remove LWD from Englebright Reservoir. YCWA's New Bullards Bar Reservoir does act as a barrier to LWD; however LWD impacts of New Bullards Bar Reservoir are addressed in other study plans (e.g., Study 1.1, Channel Morphology Upstream of Englebright Reservoir). NMFS in the study*

> *plan request does not show how LWD frequency would, therefore, be a Project effect, or have a Project nexus, or why proposed studies would not be adequate, and, therefore, this study element of the study request does not meet Criteria 5 or 7.*
> (Revised PSP pg. 3-8).

NMFS believes this quote from the Revised PSP actually demonstrates **why there is** a Project effect to LWD resources in the Lower Yuba River. Because Englebright Dam does not preclude LWD transport up and over to the dam and the USACE does not remove LWD from Englebright Reservoir, the LWD trapped and lost at Project Reservoirs such as New Bullards Bar would have been able to pass Englebright Dam and reach the Lower Yuba River where it would have provided habitat for anadromous fish. Thus, LWD trapped at Project facilities upstream of Englebright Dam represents a direct loss to the Lower Yuba River of a key geomorphic and habitat input; therefore, LWD resources both upstream and downstream of Englebright Dam must be assessed as part of evaluating the ongoing Project operations. LWD serves a vital role in stream ecosystems by shaping channel morphology, storing sediment and organic matter, and providing habitat for aquatic organisms including anadromous fish. Information requested by NMFS in Study Request #5 will directly assess Project effects to LWD and will also help inform potential PM&E measures that could include LWD habitat structures and/or LWD augmentation programs.

Request Element #1: LWD Removal from Project Works specifies an annual volumetric flux of large wood be developed for LWD entering and removed from Project reservoirs and Englebright Reservoir. This element was adopted with modification by the Applicant. However, NMFS does not consider this Element to be satisfied. The Applicant states:

> *Quantitative and anecdotal information will be gathered and summarized as described in Section 5.3.3 in Study 6.1 Riparian Habitat Upstream of Englebright. This information*

> *will be compiled from YCWA records regarding quantity and fate of woody material removed from New Bullards Bar Reservoir, from Our House Dam, and from Log Cabin Dam.* (Revised PSP, pg. 3-48).

However, Study Plan 6.1 as submitted with the Revised PSP does not mention assessing LWD removal at any Project Reservoirs in either a quantitative or anecdotal manner (a failure to meet criteria 18 CFR §5.11(d)(5)). NMFS notes that methodology similar to what is described above was previously included in Study Plan 1.1 Channel Morphology Above Englebright when it was submitted with the PAD and PSP; however, that language has been stricken from the current Study Plan 1.1 in the Revised PSP (this can be seen in the red-lined version of Study Plan 1.1 included in Appendix 2 to the Revised PSP on approximately pdf pg. 1,015 of 1,718 in the Appendices 1 and 2 pdf). Thus, the current study plans submitted with the Revised PSP do not contain any provisions to quantify LWD removal from Project reservoirs (a failure to meet criteria 18 CFR §5.11(d)(5)), despite the Applicant's assertion that it is their intention to do so, based upon their comments within the Revised PSP.

Within the Applicant's Revised PSP comments (note the Applicant's current Study Plans don't mention any approach) they do not commit to providing an annual or quantitative estimate of LWD trapped in reservoirs:

> *Because antidotal information will be used, no specific metrics are predetermined in Study 6.1. Annual estimates of the volume of LWM trapped in reservoirs may be included in reporting efforts if available information is adequate to do so.* (Revised PSP pg. 3-48).

The uncertainty of available information stems from the Applicant's lack of reporting and summarizing all relevant and available information pertaining to their Project facilities in the PAD. NMFS is requesting that information be provided that quantifies the volume of LWD trapped in Project reservoirs. If existing records are sufficient to assess the volume of LWD trapped by the Project reservoirs, then the Applicant should provide that information. If existing records are insufficient to assess volume of LWD trapped at the Project reservoirs, then the Applicant should develop and deploy other methodologies to meet the data request. For example, a combination of these methods could be used to estimate the influx of LWD to Project reservoirs: the Applicant could deploy video cameras monitoring LWD transporting into the reservoirs, the Applicant could survey and quantify the volume of LWD removed from reservoir booms over the next two years, and the Applicant could use LWD influx estimates to other reservoirs (within the Sierra Nevada region) and scale those results by contributing drainage area. It is NMFS' belief there is ample information and/or available methods to develop quantitative estimates of LWD trapped at Project reservoirs. This information is vital to assess how much LWD is being depleted from reaches and aquatic ecosystems downstream of Project reservoirs, the information will be useful to develop PM&E measures pertaining to potential habitat and LWD enhancements, and the information will be used to calculate a LWD budget (Request Element #3 discussed below).

Element # 2: LWD Surveys

Upstream of Englebright Dam

NMFS requested that LWD surveys be collected at all of the geomorphic intensive study sites upstream of Englebright Dam (currently proposed by the Applicant at 7 sites: Table 5.3.1 in the Applicant's Proposed Study Plan 1.1, which includes one on Oregon Creek, three on the Middle Yuba, one on the North Fork Yuba, and two on the Yuba River upstream and downstream of Colgate Powerhouse). Upstream of Englebright Dam, NMFS requested additional LWD surveys in other response reaches not selected for geomorphic surveys, so that sufficient information would be available to characterize LWD loading throughout the Project affected reaches. The Applicant says they have "adopted with modification" NMFS study request element for LWD surveys upstream of Englebright Dam, by proposing to inventory LWD at two sites total: one on Oregon Creek and one randomly selected from the remaining six sites (pg. 3-48 Revised PSP and pg. 6 of Study Plan 6.1 Riparian Habitat Above Englebright). Thus, only one LWD survey would be conducted out of all sites on the Middle Yuba, North Yuba, and Yuba rivers upstream of Englebright Dam. Given that these three segments of the Yuba basin exhibit different channel morphologies (*e.g.*, channel widths and gradients) as well as varying degrees of Project effects (*e.g.*, New Bullards and Our House impoundments affect peak flow regimes and LWD delivery to different degrees), one LWD survey over a small sub-reach is completely inadequate to quantify instream LWD loading throughout the Project affected areas in the North, Middle, and Yuba rivers upstream of Englebright Dam, and the Applicant has provided no rational for how such a small sample would adequately quantify LWD resources. Therefore, the Revised PSP does not adequately address Element #2.

NMFS considers the seven detailed geomorphic sites proposed in Study Plan 1.1 the bare minimum necessary to evaluate the different channel types and river segments with varying degrees of Project influence to sediment and LWD supply and flow alteration within the Project affected area upstream of Englebright Dam. NMFS maintains that LWD surveys need to be collected along the entire length of all seven of the geomorphic intensive study sites and not just the two sites currently proposed by the Applicant. Because LWD loading within a stream channel can have high spatial variability, additional LWD surveys should be collected in reaches where Project affects to channel morphology are most likely to develop (*i.e.*, typically called response reaches which are defined on pg. 4-6 of NMFS Study Request #4). Based on the Applicant's Habitat Mapping Report (Attachment 3.10A), response reaches are most likely to occur in Oregon Creek and the Middle Yuba. The Applicant is currently proposing in Study Plan 1.1 to evaluate coarse sediment storage at 20 sites (7 intensive geomorphic sites and 13 additional sites on Oregon Creek and the Middle Yuba); a logical extension of that field work is to collect LWD surveys at the additional 13 coarse sediment storage sites, which should provide a reasonable characterization of instream LWD loading upstream of Englebright Dam.

As part of Element #2, NMFS requested LWD surveys upstream of Project facilities or in reaches outside of the Yuba basin with similar climate, hydrology and geomorphology of the study reaches. The Applicant has agreed and proposed to collect a LWD survey on Oregon Creek upstream of Log Cabin Dam, which NMFS supports and believes will serve as a reasonable comparison for Oregon Creek downstream of Log Cabin Diversion Dam. However, due to the small drainage area and channel width, the control site on Oregon Creek will not serve as a good control reach for the North Yuba, Middle Yuba, and Yuba rivers in the Project-affected reaches. NMFS maintains that establishing suitable control reaches directly upstream of Our House Dam on the Middle Yuba River should be feasible. Other dams on the Middle Yuba River are more than 27 miles upstream of Project facilities, which implies that the vast majority of LWD trapped at these dams would break, abraid, and/or be lost to floodplain or jam deposition before it would enter Our House Reservoir or any potential control reach. To adequately meet Request Element #2, NMFS maintains that LWD control reaches should be established for the Project affected reaches of the North Yuba, Middle Yuba, and Yuba rivers.

Downstream of Englebright Dam

In the Revised PSP, the Applicant is proposing to conduct LWD surveys at two randomly selected sites downstream of Englebright Dam (section 5.3.1.3.5 pg. 10 of Study Plan 6.2 Riparian Habitat Below Englebright). No detail is provided as to where the geographical extent ranges for the two randomly chosen samples sites will be selected nor is there specification for how long (channel distance) the two samples will extend. Standard protocol for LWD surveys that are meant to serve as sub-samples for larger reaches are to extend the sub-samples for distances about 20 times the bankfull width; NMFS maintains that each LWD sub-sample should extend approximately 20 times the bankfull width. In section 5.3.1.1 and Table 5.3.1.1-1 of Study Plan 6.2 the Applicant describes a qualitative division of the Yuba River downstream of Englebright Dam into eight reaches on the basis of key geomorphic or topologic features, including changes in slope in the longitudinal profile and associated geomorphic variables. After excluding two bedrock dominated reaches near Englebright Dam and one reach near the confluence of the Feather River, the Applicant proposes in Study Plan 6.2 to establish *at minimum of one vegetation study site* in each of the remaining five geomorphic reaches in the Lower Yuba. Just as one vegetation study site is necessary per reach type in order to capture changes in channel geometry, slope, and riparian vegetation, at least one LWD survey is necessary for each geomorphic reach of the Lower Yuba as delineated by the Applicant in Study Plan 6.2. Instream LWD loading is strongly influenced by channel width, potential depositional surfaces such as alluvial bars and floodplains, LWD supply from local riparian and hillslope sources and upstream fluvial inputs, and LWD transport that is a function of flow regimes and channel hydraulics tied to water surface slope and depth. Thus, it is reasonable to expect LWD loading to vary within each geomorphic reach in the Lower Yuba River, and the Applicant's currently proposed two randomly selected LWD sample sites (which in theory could both be placed in the same geomorphic reach) are insufficient to characterize the resource and fulfill NMFS Request Element #2.

Element # 3: Evaluation of Project effects on LWD and LWD Budget. The Applicant stated this element was adopted with modification in the Revised PSP. However, NMFS does not consider this Element to be satisfied. The Applicant's proposed Studies 6.1 and 6.2 do not propose a LWD budget, or the specific elements of a LWD budget (such as influx to Project reservoirs) necessary to accurately determine Project effects. The Applicant contends that they have adopted with modification Element #3 by proposing to collect the data detailed above under Request Elements #1 and #2 (*i.e.*, LWD estimates into Project Reservoirs and the proposed LWD surveys). NMFS notes again the Revised PSP no longer contains any language or methods for a plan to conduct the required measurements of LWD NMFS has requested. Aside from omission of methods for LWD influx into Project reservoirs, as detailed above the Applicant is only proposing to quantify this Project effect if available records are sufficient to do so, and is not proposing to undertake other readily available methods to estimate the LWD trapped in Project reservoirs if the records are insufficient. As also detailed above in Request Element #2, the number of proposed LWD survey sites is vastly insufficient to adequately characterize LWD loading in all the Project affected river reaches (*e.g.*, Oregon Creek, North Yuba, Middle Yuba, and Yuba [upstream and downstream of Englebright Dam] rivers), which within each river reach contain different geomorphic reach types and varying degrees of Project alterations to LWD and sediment supply and flow regulation. While these two elements (LWD influx to Project reservoirs and LWD stream surveys) are parts of a LWD budget, each element is insufficiently quantified in and of itself and, even if they were properly quantified, they do not cumulatively provide enough information to quantify Project effects to LWD resources or to develop a LWD budget.

The Applicant's response for not constructing a LWD budget is as follows (pg. 3-49 Revised PSP):

> *The Project nexus (Criterion 5) is the volume of wood trapped in Project-facilities that is no longer available to downstream reaches, and the estimate of LWM in Project-affected reaches compared to regional estimates of LWM loading in similar sized Sierra streams. Existing conditions will be assessed and Project influences on LWM loading will be discussed. LWM loading prior to the dams being in place are not relevant as those conditions cannot be quantified and the effects of continued operations given the existing LWM availability and fate [emphasis added] are the object of the study….. YCWA does not intend to incorporate into the study proposal methods for evaluating Project effects on LWM since Relicensing Participants have expressly stated that they view the relicensing studies as data gathering, not an impacts evaluation, and prefer that the study report provide the study data only.*

NMFS agrees that an LWD budget is a tool/analysis to assess Project effects, which is precisely why NMFS has requested this information be developed by the Applicant (18 CFR §5.11(d)(4)). As the Applicants states, there is a Project nexus for LWD resources – "*The Project nexus is the volume of wood trapped in Project-facilities that is no longer available to downstream reaches*", and the effects of the Project nexus must be evaluated as stated in 18 CFR §5.11(d)(4). Furthermore this Project nexus, as detailed by the Applicant, is why NMFS' proposed in its Element #3 the development of a LWD budget that includes evaluation of an existing conditions scenario and an unimpaired condition scenario. The difference between these two scenarios is the volume of LWD trapped in the Project reservoirs (an ongoing condition and Project effect), where the unimpaired scenario assumes this volume is delivered downstream of the dams. This is improperly cast by the Applicant as an evaluation of conditions prior to dams being in place, but is rather a quantification of the current, and ongoing effects of LWD trapped by Project reservoirs. NMFS Study Request #5 is a detailed study which, if adopted without modification, would provide the necessary information to assess the Project's effects on LWD resources and anadromous fishes and their habitat through the development of a quantitative LWD budget. This information would be used to assess whether potential PM&E measures are necessary to mitigate for LWD lost at Project reservoirs and quantify what these measures might require as far as LWD additions and/or habitat enhancement structures.

Element #4 Riparian Habitat and Vegetation is not adequately addressed by the Applicant's Revised PSP for Project-affected reaches upstream of Englebright Dam – reaches proposed to be evaluated in the Applicant's Study Plan 6.1 Riparian Habitat Upstream of Englebright Dam. In NMFS' response to the PSP filed on July 18, 2011, NMFS requested the following information/analyses be added to Study Plan 6.1 in order to satisfy Element #4 Riparian Habitat and Vegetation of NMFS Study Request #5:

1) the frequency of overbank flows that can facilitate riparian seedling establishment under current and unimpaired conditions;
2) assessment of altered hydrology due to Project operations and its relation to riparian stand condition, structure, and composition;
3) assess whether the quantity (both frequency and areal extent) of surfaces available for riparian vegetation establishment has been affected by Project operations that impact the coarse sediment supply;
4) describe how riparian vegetation has changed through time; and

5) evaluate regeneration and germination processes and how they relate to altered Project hydrology.

The Revised PSP (pg. 3-19) states the Applicant has adopted data request #4, and adopted with modification requests #1-3 and 5. NMFS does not agree that items #1, 2 and 5 have been incorporated within Study Plan 6.1 in a meaningful or sufficient way, and NMFS continues to request that these remaining items be included in an evaluation of the Project's effects on riparian resources upstream of Englebright Dam (note, all of these items are being evaluated downstream of Englebright Dam in Study Plan 6.2).

In response to data request #1) assess frequency of overbank flows that can facilitate riparian seedling establishment under current and unimpaired conditions, the Applicant states the following on pg. 3-19: *YCWA's study proposal addresses NMFS' request to quantify the frequency of overbank flows. Riparian study sites will be co-located to the extent possible with YCWA's Channel Morphology Upstream of Englebright Reservoir (Study 6.1). Data collected for Study 1.1 will be used in conjunction with data collected for Study 6.1 to quantify the inundation duration and frequency established at transects (Study 6.1, p. 7).* While it does appear that the sites will be co-located between the two studies, there is no description or methods put forth that specify hydraulic calculations or models will be used to determine at what stage and discharge overbank flows will occur, nor is there a mention of a statistical analyses of these flows under current or unimpaired conditions (note, both are necessary to evaluate Project effects). The only methodology description that pertains to hydrology or flow in the riparian study plan 6-1 is on pg. 7 of Study Plan 6.1 under the header *"General Riparian Information to* *be collected includes: Hydrologic connectivity (or lack of)"*. If one searches Study Plan 6.1 for the words, *inundation, duration, or frequency* no matches are found. No methods are provided as to how the hydrologic connectivity will be assessed, nor are there any methods for calculating the flow and stage necessary for overbank flow. In contrast, Study Plan 6.2 Riparian Habitat Below Englebright Dam, specifically states that the hydrodynamic model will be used to assess inundation duration and frequency of riparian vegetation. If the Applicant intends to evaluate the "*inundation duration and frequency established at transects"* as stated on pg 3-19 of the Revised PSP, then additional information is needed in Study Plan 6.1 in order to meet the criteria in 18 CFR §5.11(d)(5).

In response to data request #2) assessment of altered hydrology due to Project operations and its relation to riparian stand condition, structure, and composition, the Applicant states the following on pg. 3-19: "*YCWA's study proposal, in part, addresses NMFS' request. Riparian study sites will be co-located to the extent possible with YCWA's Channel Morphology Upstream of Englebright Reservoir (Study 6.1). Data collected for Study 1.1 will be used in conjunction with data collected for Study 6.1 to record hydrology and its relation to riparian stand condition, structure, and composition."* Once again, minimal methods, description, or mention is provided in Study Plan 6.1 to relate hydrology or flow frequency with riparian stand condition, structure, or composition. On page 7 of Study Plan 6-1, NMFS notes the Applicant will "*add that the presence of riparian vegetation to cross-sectional profiles to indicate where the vegetation occurs relative to bankfull and flood prone widths*," but there is no description of how this information will be related to hydrology, which does not meet the criteria in 18 CFR §5.11(d)(5).

In regards to NMFS's riparian habitat requests outlined above, in the Revised Study Plan on pg. 3-20 the Applicant states: "*In requests 1 – 3 and 5, NMFS requests assessment of Project effects. YCWA does not intend to incorporate into the study proposal methods for evaluating Project effects since Relicensing Participants have expressly stated that they view the relicensing studies as data gathering, not an impacts evaluation, and prefer the study reports provide the study data only*." The Applicant is correct that NMFS is requesting assessments of Project effects to riparian resources– as the request was submitted according to the ILP regulations that require NMFS to explain any nexus between project operations and effects on the resource to be studied. In many of the riparian requests above, NMFS is requesting evaluation of the riparian resources relative to the Project's effects on hydrology, which is commonly done by comparing and contrasting results using existing and unimpaired hydrology. For example, if the stage-discharge of inundation of various riparian communities and/or overbank flows is calculated as requested by NMFS, then the frequency of these discharges occurring should be evaluated with both existing and unimpaired hydrology in order to quantify the Project's effects on these inundation flows. Unimpaired hydrology will be available as part of other ongoing studies, and comparing inundation frequencies is the simplest and most direct way to evaluate Project effects.

The Applicant's Study Plan 6.1 states (pg. 4) that they will co-locate where possible riparian study sites at 5 of the 6 channel geomorphology study sites proposed in Study Plan 1.1, and add one transect on the Middle Yuba River above Our House Dam. However, there are actually seven detailed geomorphology sites currently proposed in Study Plan 1.1 (Table 5.3-1, pg. 6-7 Study Plan 1.1) not including the three sites upstream of Project Reservoirs. By comparing the potential study site tables in Study Plan 1.1 (Tale 5.3-1) and Study Plan 6.1 (Table 5.3-1), it appears that the Applicant is intending not to collect riparian vegetation information at the following two channel morphology sites: 1) Middle Yuba Below Our House Dam and 2) Yuba River Above Colgate Powerhouse (note, these two sites are in Study Plan 1.1 but not Study Plan 6,1). At the geomorphology site Middle Yuba Below Our House Dam, there is altered hydrology from Project diversions and almost no coarse sediment supply to the reach due to sediment entrapment at Our House Dam; this could affect the quantity and quality of surfaces available for the establishment of riparian vegetation. At the geomorphology site on the Yuba River Above Colgate Powerhouse, the hydrology is significantly altered relative to unimpaired conditions from flow bypasses through Colgate Powerhouse Tunnel, which could potentially alter riparian vegetation structure. NMFS requests that riparian habitat be evaluated at both of these geomorphology sites in order to understand Project effects to riparian conditions and habitat throughout the Project affected reaches.

NMFS' Request #6:
"Request for Information or Study Effects of the Project and Related Activities on the Loss of Marine-Derived Nutrients in the Yuba River"

The Applicant's Revised PSP comments regarding NMFS' Request #6 are discussed in Section 3.2.2 "Replies to Comment Letters That Requested New Studies", sub-section 3.2.2.6.

Applicant comment:

> *NMFS requested a new study named Effects of the Project and Related Activities on Loss of Marine-Derived Nutrients in the Yuba River (NMFS, Enclosure A, pp. 20 through 22).* (p. 3-49).

NMFS' reply:

It is incorrect that NMFS requested a new study in Enclosure A, pp. 20 through 22 of its July 18, 2011, filing. Enclosure A is not a new Request #6, but rather contains NMFS' comments on the Applicants PSP (per 18 CFR §5.12, "Comments on proposed study plan"). NMFS' Request #6 was submitted along with other requests for information or study earlier in the ILP (per 18 CFR §5.9, "Comments and information or study requests"). As all other requests filed in this ILP, NMFS' Requests were "new" when filed on March 7, 2011. Whether termed "new" or otherwise by the Applicant, all submitted requests for information or study should be given adequate consideration for incorporation into the Revised PSP.

Applicant comment:

NMFS did not include a detailed study proposal in its comment letter, but referred to the study proposal with the same name that NMFS included in its March 7, 2011 comments on YCWA's PAD. (p. 3-49).

NMFS' response:

Detailed study plans are the responsibility of the Applicant to develop, not NMFS or another resource agency. Under the ILP, the Applicant assembles and submits them, first as a PSP and then a Revised PSP. Prior to the development of the PSP, resource agencies and other parties submit requests for information or study (see 18 CFR §5.9), with the intent of having the Applicant incorporate the requests into its PSP and Revised PSP. This approach provides applicants with the flexibility to design an approach most efficient given its own resources and knowledge of its project, while still providing the information needed by the resource agency.

NMFS requested information regarding loss of marine derived nutrients that it anticipated would require development of a plan of study by the Applicant.

The Applicant does not adopt any of NMFS' Request #6. NMFS notes the lower Yuba River is ESA-designated critical habitat for spring-run Chinook salmon and Central Valley steelhead, and the area downstream of Daguerre Dam is critical habitat for green sturgeon. Both the lower and upper Yuba River are MSA-identified "essential fish habitat" for Chinook salmon. NMFS Request #6 was intended to assess the degree of loss of marine-derived nutrients delivered (or formerly delivered) to these areas. The Applicant again appears to assert there is no nexus between the Project and the returns of Chinook salmon to the upper or lower Yuba River.

NMFS' Request #8:

"Request for Information or Study Anadromous Fish Ecosystem Effects Analysis: Synthesis of the Direct, Indirect, and Cumulative Effects of the Project and Related Facilities on Anadromous Fish"

The Applicant provides that this study was adopted with modification in the Revised PSP. However, NMFS does not consider any of the elements of Request 8 to be satisfied. Instead, the Applicant has proposed the study "ESA/CESA-Listed Salmonids Downstream of Englebright Dam" (Study 7.8) as sufficient to provide a comprehensive synthesis of potential Project effects on anadromous salmonids. The Applicant states:

> *NMFS does not describe available existing information, nor does NMFS describe the proposed synthesis of all available information presently incorporated in YCWA's proposed ESA and CESA Listed Salmonids Below Englebright Dam Study (Study 7.8) that pertains to anadromous salmonids in the lower Yuba River. Therefore, NMFS has not explained or justified the need for additional information consistent with FERC Criterion 4."* (p. 3-55).

While the Applicant's proposed study 7.8 states it will synthesize available information, the Revised PSP does not present a <u>plan</u> for evaluating the <u>Project's effects</u> on the anadromous resources (species and habitats) identified by NMFS. NMFS' comments on the PSP (July 18, 2011) detailed a few of the many ways in which the Applicant's Study 7.8 fails to assess Project effects, as is the essential purpose of ILP studies. As discussed in the "General Comment" section above, NMFS views the core purpose of an Applicant's Study Plan to lay out how it intends to evaluate the effects of the Project on the resources to be studied. Early in this ILP, NMFS expressed its concerns to the Applicant that studies by the Lower Yuba River Accord River Management Team (RMT), if incorporated into the Applicant's Study Plan, must explain Project nexus -- identify how the RMT study to be used as an ILP study lays out a plan for evaluating the Project's effects on the resources to be studied.

This task is not accomplished in the Revised PSP. Its section 5.3 (Study Methods) states:

> *This study will consist of the following four steps: 1) compile data from previously conducted studies; 2) compile ongoing data collection and information; 3) conduct the analyses necessary to accomplish the previously stated goals and objectives; and 4) prepare report.* (p. 6).

Rather than providing explanations of the analyses to be applied (to assess the Project's effects) the Revised PSP merely states that the necessary analyses will be conducted. Additional text lacks description of the analyses to be conducted, instead referring the reader to the web site for the RMT:

> *This study plan will present data compilations and analyses conducted by the RMT, CDFG, and YCWA described above pertaining to relevant components associated with the previously stated goals of this study plan. M&E Program data compilations and analytic methods…will follow the specific analytic methods described in the Yuba Accord M&E Program (refer to www.yubaaccordrmt.com).* (p. 8)

The content of a Revised PSP is to contain explanation of methods to assess Project effects on the resources to be studied, not to refer to other documents for this explanation.

In its requests for information or study (March 7, 2011), NMFS submitted its Request #8 to (again) call the Applicant's (and FERC's) attention to its concerns that if RMT investigations are to be used as ILP studies, the Applicant's PSP must explain how they will determine Project effects on anadromous fishes and habitats. In this Revised PSP, the Applicant has referenced RMT studies, which is not sufficient for a Study Plan. Second, the Applicant's stated intention to not incorporate methods for evaluating Project effects is concerning (see discussion above, and pages 3-7, 3-20, 3-24, and 3-49). ILP regulations, not agreements between Relicensing Participants, govern the content requirements of an Applicants Study Plan (see NMFS' comments above on this point). Third, the following text is provided as explanation of the relationship between RMT investigations and its Revised PSP:

Where this study proposal states that information for the study is being developed by the Lower Yuba River Accord River Management Team (RMT), if the RMT does not develop the information as described in this study proposal, YCWA will develop the information. Also, all information developed as part of the relicensing, whether it is developed in the relicensing process or developed in the RMT process and brought into the relicensing, will be made public when YCWA files its final study report. Further, if this study relies on information from RMT data, report or analytics, YCWA will attach the relevant RMT work product to the relicensing report for this study. (p.1, footnote 1).

Thus, the Applicant states it will develop the information if the RMT does not, but does not include a plan for study in its Revised PSP (one is directed to follow references and review the RMT plans and other information). Regardless of how information is developed, the Applicant will make the information available later, in its final study report. The relevant RMT report will be attached. The Commission should review this "plan" of study, and approve in its Study Plan Determination only a Plan that meets the ILP content requirements.

At this point, NMFS questions how the synthesis of ILP and RMT study will occur without development of life cycle models for Chinook salmon and steelhead, which are not discussed in the Revised PSP. With regard to spring-run Chinook salmon, there appears to be no plan to assess the potential effects of the Project in the context of other factors influencing the population, through a salmon life cycle model (Hendrix 2008; Scheuerell *et al.* 2006). At this point, neither the Applicant nor the RMT have outlined a plan for such model development, which could satisfy NMFS' Request #8 (by synthesizing the information about the Project's effects on this resource, and expressing them as population effects). Life-cycle models have been successfully used to demonstrate the effects of hydropower projects on population dynamics (see Carmen-Smith Hydroelectric Project FERC no. 2242, Population Dynamics of Bull Trout and Spring Chinook Salmon Technical Report (Stillwater 2006), for example).

For *O. mykiss*, the Revised PSP contains no plan for using collected information (*e.g.*, scale samples, temperature data and modeling, seasonal and annual abundances of emigrating juveniles, etc.) to inform a modeling framework such as that developed by Satterthwaite *et al.* (2009), and applied in the Central Valley to evaluate the life history displayed by *O. mykiss*. The modeling framework could be used to predict evolutionary endpoints for steelhead life history in response to management actions that change stage-specific survival or growth rates. For example, model runs that vary lower Yuba River temperatures would yield the life history (anadromy versus residency) responses to such management actions (that change stage-specific growth rates). Other investigations could monitor the relative abundances of anadromous versus resident forms of *O. mykiss* over time. Currently, the proportion of anadromous versus resident forms of *O. mykiss* in the sympatric lower Yuba River population is unclear, but it is assumed both are present. The Revised PSP states:

> *Regarding O. mykiss, the physical appearance of adults and the presence of seasonal runs and year-round residents indicate that both sea-run (steelhead) and resident rainbow trout exist in the Yuba River downstream of Englebright Dam. Thus, it is*

> *recognized that both anadromous and resident life history strategies of O. mykiss have been and continue to be present in the river...* (p. 1).

Donohoe *et al.* (2008) provide models that go beyond using physical appearance and seasonal runs (that may or may reflect ocean migrations), and determine maternal origin of *O. mykiss* juveniles from the analysis of Sr:Ca ratios in the core region of the otolith, provided that the Sr:Ca ratio of the stream and the difficulty of the migratory path from the ocean are known. Such study could indicate the existing proportion of *O. mykiss* in the lower Yuba that are the progeny of resident versus anadromous females. Further study could provide estimates of rates of exchange between the two life history forms, determine if reproductive isolation is occurring in the Yuba River, and could inform Project license conditions where they overlap with potential management actions.

NMFS provides the discussion above only to illustrate how information from "one of the more thoroughly studied rivers in the Central Valley of California" might be used to assess the Project's effects on the anadromous populations. It is the responsibility of the action agency (FERC) to assess the effects of the Project on Central Valley steelhead and spring-run Chinook salmon in the Yuba River, for inclusion in a later biological assessment. The ILP regulations governing study require the Applicant's Revised PSP to contain methods for assessing the Project's effects on the resources to be studied.

NMFS' Request #8 provides that the anadromous species in the lower Yuba River are the resources to be studied. NMFS study elements #1-#7 were specifically crafted to evaluate the Project's effects on anadromous fish habitats, population structure and dynamics. NMFS did not find any language in proposed study 7.8 that will explain how the Project affects anadromous fish. The Applicant proposes to summarize the following information sources:

"…21 available field studies and data collection reports, 20 other relevant documents (e.g., plans ,policies, historical accounts and regulatory compliance), 14 ongoing data collection, monitoring and evaluation activities for the Yuba River Accord Monitoring and Evaluation Program (M&E Program), and 4 other data collection and monitoring programs." (Appendix 1, Study 7.8, p. 3).

However, none of the studies mentioned above were designed expressly for evaluating the effects of the Project on anadromous fish, and these studies are insufficient for development of protection mitigation and enhancement measures related to Project effects on anadromous fish. The primary purpose of the RMT Monitoring and Evaluation (M&E) program is to:

"…provide the monitoring data necessary to evaluate whether implementation of the Yuba Accord will maintain fish resources (i.e., the fish community including native fish and non-native fish) of the lower Yuba River in good condition, and will maintain viable anadromous salmonid populations." (Attachment 7.8A, p. 39).

The Yuba Accord flow schedule is but one aspect related to Project facilities and operations. RMT studies that were designed to only evaluate Yuba Accord implementation may be insufficient for evaluating the entirety of the Project's effects on anadromous fish and the ecosystems which support them.

Because study 7.8 does not mention how synthesis of RMT studies will evaluate Project effects as a whole, study 7.8 as constructed, is insufficient to gather the information requested in NMFS Request #8. In addition, if RMT studies are to be used in a synthesis study, then the detailed study plans of the 14 RMT monitoring and evaluation studies listed on p. 41 of attachment 7.8A should be included in any Revised PSP approved by the Commission, along with a written description of how the studies comply with the ILP content requirements of 18 CFR §5.11(d) including, "Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied" (18 CFR §5.11(d)(4)).

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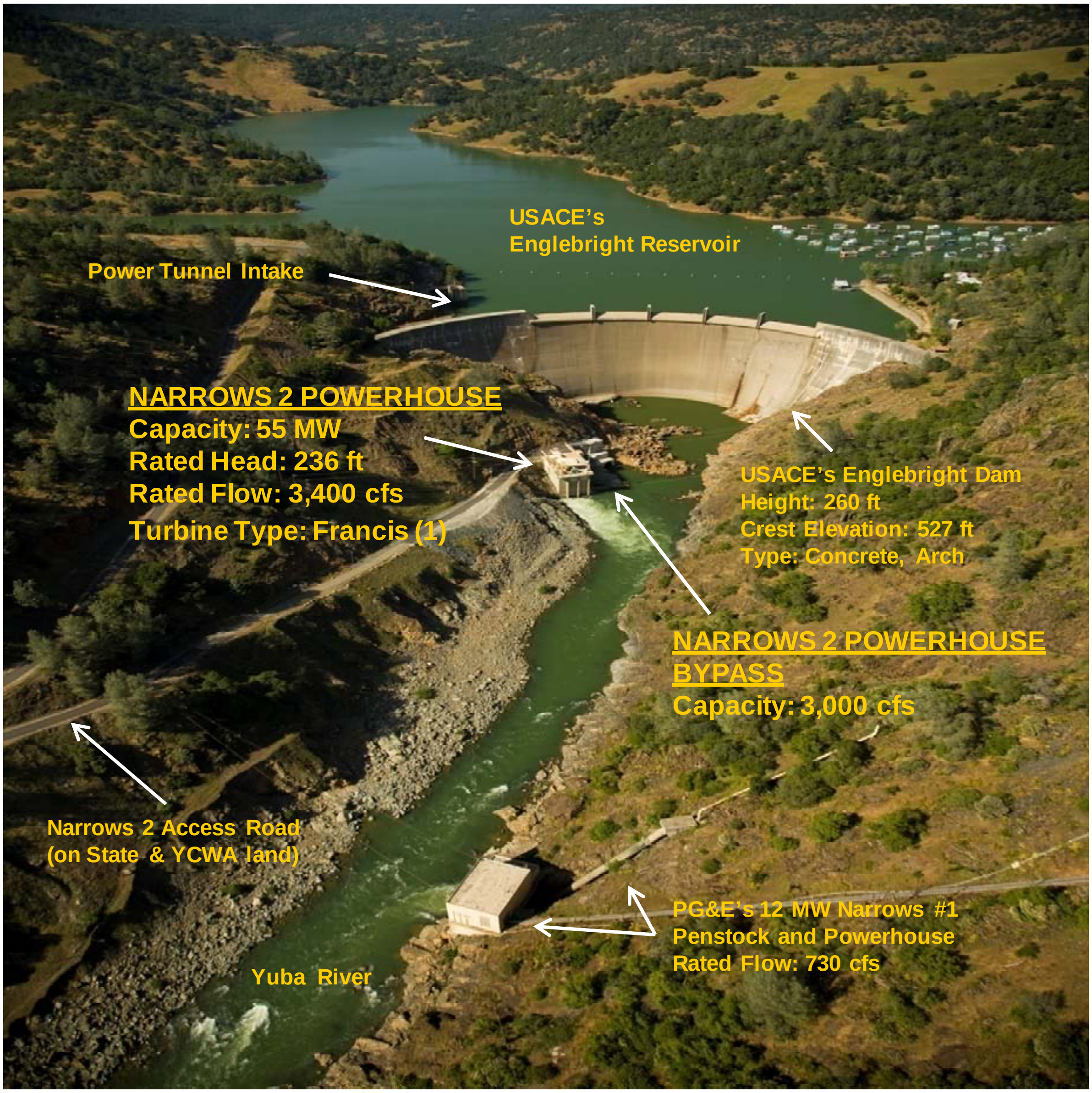

Photo 5. Narrows 2 Powerhouse.

Ecology and Management of the Spring Snowmelt Recession

SARAH M. YARNELL, JOSHUA H. VIERS, AND JEFFREY F. MOUNT

We present a conceptual model for the ecology of the spring snowmelt recession based on the natural flow regime that relates the quantifiable components of magnitude, timing, and rate of change to abiotic and biotic factors that govern riverine processes. We find that shifts in the magnitude of the recession largely affect abiotic channel conditions, whereas shifts in the timing of the snowmelt primarily affect biotic conditions. Shifts in the rate of change affect both abiotic and biotic conditions, creating the largest observed changes to the stream ecosystem. We discuss these components with regard to the success of riverine species in California's Mediterranean-montane environment. We then present two scenarios of change to the spring snowmelt recession—effects of flow regulation and climate warming—and discuss their potential implications for riverine ecology. Our conceptual model can help guide watershed stakeholders toward a better understanding of the impacts of changing spring recession conditions on stream ecosystems.

Keywords: stream ecology, Mediterranean-montane, climate change, regulated rivers, natural flow regime

Over the past decade, the natural flow regime paradigm (Poff et al. 1997) has garnered widespread study, discussion, and general acceptance in the scientific community as a guide for the conservation, restoration, and management of rivers (Marchetti and Moyle 2001, Arthington et al. 2006, Richter et al. 2006). However, one fundamental aspect of the natural flow regime is the spring snowmelt recession and its effect on both geomorphic and ecological stream processes, the importance of which has received little attention in both scientific study and resource management. In mountain regions, the spring snowmelt constitutes the bulk of the total annual discharge, often delivering more than 70% of annual streamflow (Hauer et al. 1997). In Mediterranean-montane environments, where summer low flows dominate for up to six months of the year, and where at least 65% of annual precipitation falls in the three months of winter, the physical, chemical, and biological impact of this large springtime pulse of water is profound (Gasith and Resh 1999). Yet little research has addressed the direct and indirect effects of the spring snowmelt recession on the biotic and abiotic processes necessary to sustain aquatic and riparian ecosystems.

Here, we present a conceptual model for the ecology of the spring snowmelt recession, with an emphasis on Mediterranean-montane systems. We delineate those components of the natural flow regime most relevant to the recession hydrograph and their relation to physical and biological stream processes. Specifically, we relate the quantifiable components of magnitude, timing, and rate of change to abiotic and biotic stream factors. We discuss these components with regard to the success of riparian and riverine species such as cottonwood (*Populus* spp.) that are native to streams throughout the western United States, and to the foothill yellow-legged frog (*Rana boylii*), an indicator species for in-stream biota of California's Mediterranean-montane aquatic ecosystems. We then present two scenarios of change to the spring snowmelt recession and discuss their potential implications for general stream ecology. Changes resulting from flow regulation that produce a recession with a very high rate of change between two extremes of flow—flood and base flow—contribute to homogeneous channel conditions and a lack of diversity in aquatic and riparian species. Similarly, changes resulting from climate warming, which shift the timing and decrease the magnitude of the snowmelt recession, ultimately alter in-stream and riparian species compositions and increase the abundance of nonnative species. We believe our conceptual model can help guide water resource managers and watershed stakeholders toward a better understanding of the impacts of changing spring recession flow conditions on stream ecosystems.

The spring snowmelt recession

Stream ecology is multifaceted, with the diversity and abundance of species dependent upon conditions and processes occurring at multiple spatial and temporal scales (Imhof et al. 1996). Governed by regional and basin-scale characteristics, the flow regime plays a key role in determining abiotic and biotic conditions at subbasin scales (Poff et al. 1997, Lytle and Poff 2004). A primary feature of the natural flow regime in snowmelt-dominated mountain basins is the

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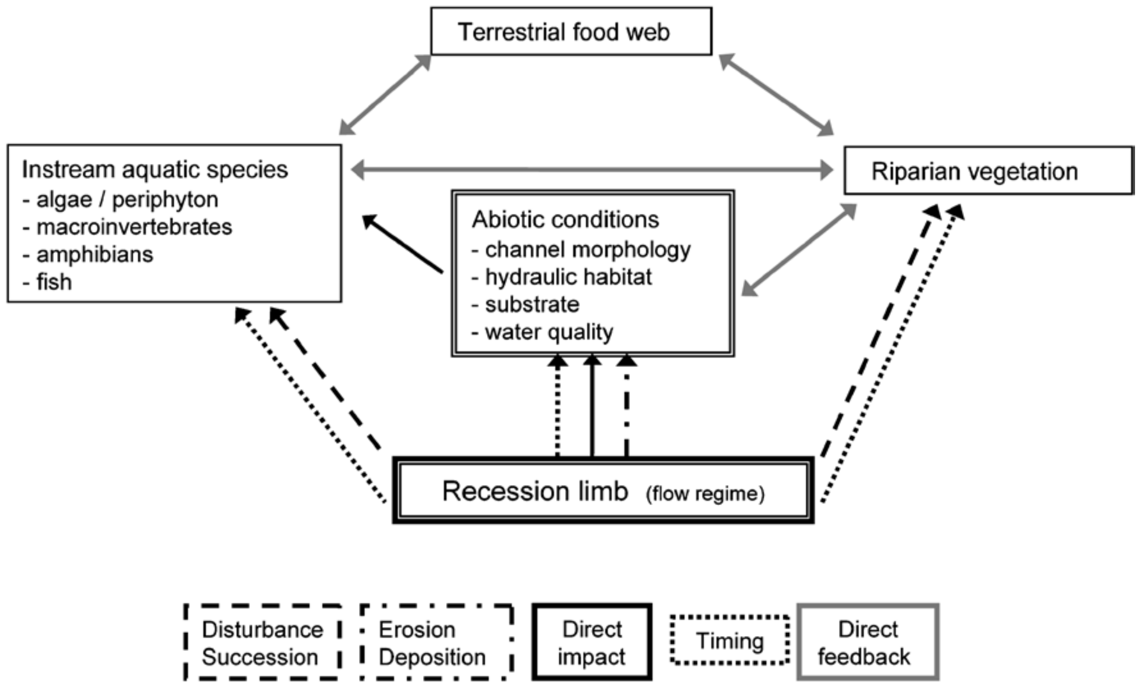

Figure 1. Conceptual model for spring snowmelt recession dynamics. Arrows indicate direction of impacts from physical and ecological processes and feedback relationships.

spring snowmelt recession: It shapes abiotic and biotic processes, such as erosion, deposition, and riparian succession; and dictates reproductive timing cues for in-stream biota (figure 1). Resulting changes in abiotic conditions directly affect the habitat of in-stream aquatic species, whereas changes in biotic conditions create feedbacks between riparian vegetation, in-stream habitat, and terrestrial food webs (Nakano et al. 1999).

The shape of the spring snowmelt recession hydrograph affects not only the availability and quality of water throughout the spring but also how sediment is transported, sorted, and ultimately deposited, thereby determining the abiotic and biotic conditions within the channel. Changes to the shape of the spring snowmelt recession hydrograph can be quantified using three primary components of the natural flow regime (Poff et al. 1997): magnitude, timing, and rate of change (figure 2). The magnitude is the level of discharge (often denoted Q) at the start of the recession, most simply defined as the last significant flow peak of the runoff season. The timing is the date at which the recession starts (t_s), and the rate of change is how quickly the flow changes from one discharge to the next (dQ/dt). Each of these components is easily quantified, and each can have independent effects on stream condition. Changes to the magnitude, for example, can create a different response within the stream system from changes to the timing.

The remaining two components of the natural flow regime, duration and frequency, can also be related to the spring snowmelt recession, and in some cases deserve specific consideration. The duration, or the length of time for the recession to reach summer base flow ($t_s - t_b$), is a

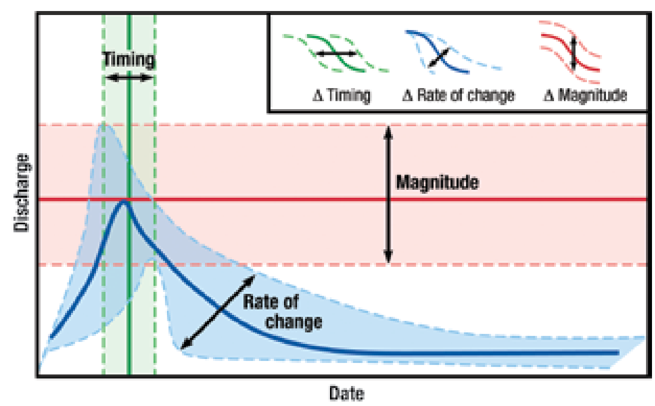

Figure 2. Primary quantifiable components of the spring snowmelt recession. Arrows indicate the direction in which increases or decreases in a component will shift the hydrograph.

function of the magnitude and rate of change. Generally, a slower rate of change will result in a longer-duration recession and vice versa. However, similar rates of change might occur in low-magnitude, short-duration recessions, and high-magnitude, long-duration recessions, though the abiotic and biotic effects of one can be very different from the other. Therefore, it is important to consider the duration of the recession in tandem with the rate of change when evaluating the impacts to stream conditions. By definition, the frequency of the snowmelt recession is annual; however, the frequency of a particular value of each hydrograph component varies on an interannual basis, producing different hydrograph recession shapes each year, depending on climate conditions. For example, in dry years, magnitudes may be lower, timing may be earlier, and the rate of change may be lower than in wet years. In this article, we focus specifically on quantifying and evaluating a single annual spring snowmelt recession; however, it is important to recognize the range of interannual variability in spring runoff conditions, and how that variability contributes to ecological diversity (Naiman et al. 2008).

Role of the spring snowmelt recession in creating and maintaining stream diversity

The spring snowmelt pulse and recession dominates the annual discharge of rivers emerging from winter snowpack headwaters (figure 3). These flows can provide the majority of the annual total flow volume in high-elevation basins and a substantial contribution of flow in mid-elevation basins subject to both rain and snowmelt runoff (Jarrett 1990, Hauer et al. 1997). In most snow-dominated mountain basins, the peak magnitude of the snowmelt pulse typically corresponds to the annual peak flow, even in systems subject to periodic rain events (Jarrett 1990). As a result, the snowmelt pulse is the primary disturbance that mobilizes channel sediments and drives riparian and aquatic successional processes. As the timing of snowmelt is largely a function of increasing day length, the corresponding receding hydrograph provides predictable flows for the reestablishment and population expansion of aquatic and riparian species prior to the low-flow season.

In Mediterranean-montane climates—characterized by dry, hot summers and wet, cool winters—winter floods provide an extreme contrast to summer drought; thus, the spring recession provides the singular annual event during which favorable habitat conditions occur and in-stream biota can recover (Gasith and Resh 1999). With gradually declining flows and a low frequency of pulses, the spring recession provides a stable transition from high abiotic pressures (e.g., scour, turbidity) during winter high flows to high biotic pressures (e.g., competition, predation) during late-summer and fall low flows (figure 4). During the recession, predictable flow conditions coincide with high resource availability, resulting in high reproductive success, growth rates, and survivorship for species adapted to this seasonal flow regime (Gasith and Resh 1999).

Whether in snowmelt-dominated systems or mixed rain-snow systems, the processes of disturbance, erosion, and deposition associated with the spring recession directly and indirectly affect certain biotic and abiotic conditions. Typified by a gradually decreasing discharge regime that extends for several months into summer, the spring snowmelt recession modifies channel morphology and substrate, provides diversity in hydraulic habitat, alters water quality, promotes recruitment for riparian vegetation, sets reproduction cues for fish and amphibians, and increases diversity in benthic producers (figure 5).

Effects of the spring snowmelt recession on abiotic conditions result primarily from the flow dynamics of gradually receding discharge. The peak discharge of the snowmelt

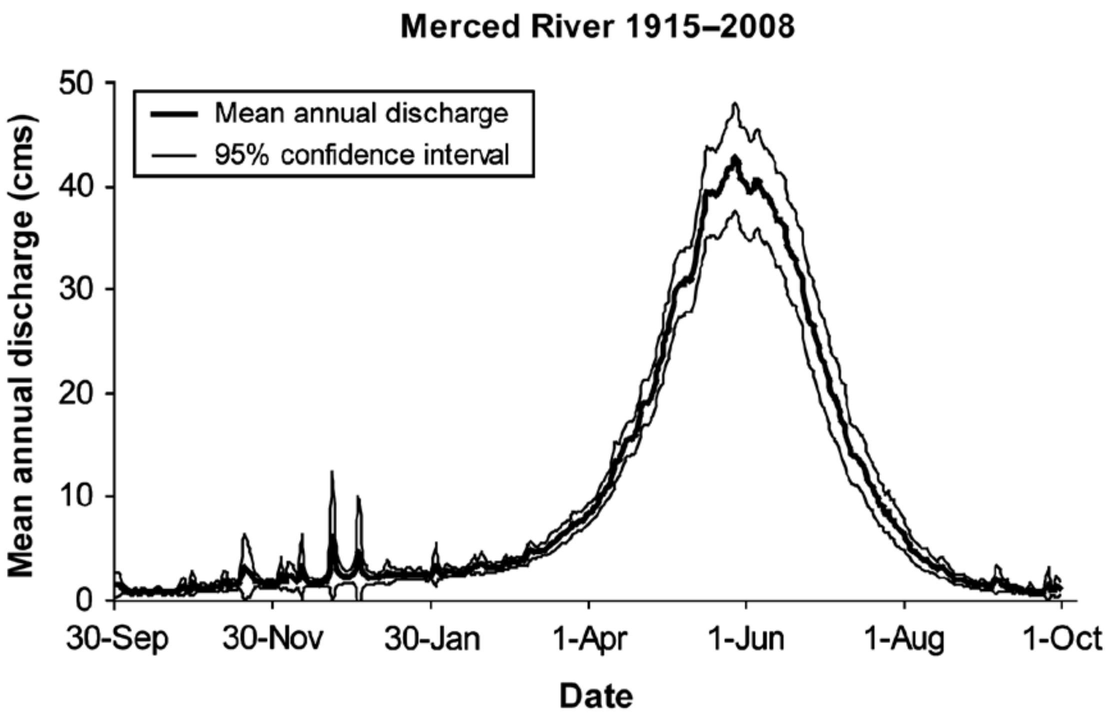

Figure 3. Annual hydrograph of a snowmelt-dominated Mediterranean-montane basin. Discharge is expressed in cubic meters per second (cms). Source: Data are from the Merced River, Yosemite National Park, California, US Geological Survey gage 11264500, elevation 1224 meters. In the Northern Hemisphere, spring typically occurs between March and June.

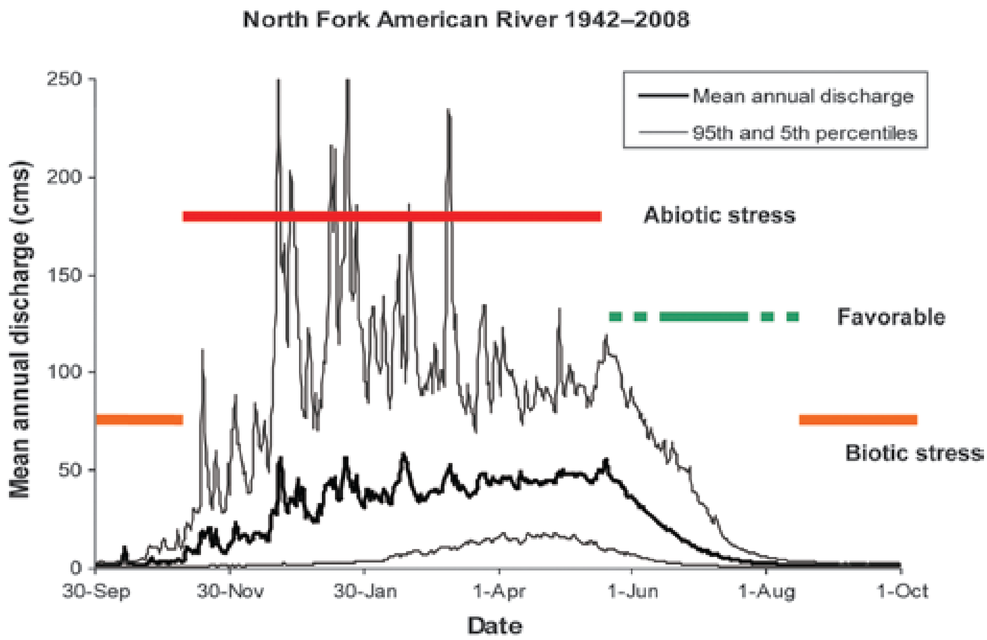

Figure 4. Annual hydrograph of a mixed rain-snow-dominated Mediterranean-montane basin. Discharge is expressed in cms, cubic meters per second. Source: Data from the North Fork American River, California, US Geological Survey gage 11427000, elevation 218 meters. In the Northern Hemisphere, spring typically occurs between March and June.

pulse is a primary driver for the extent and magnitude of sediment mobilization and transport (Madej 1999); however, as discharge decreases and sediment deposits, channel bars form and bedload is sorted into a variety of substrate patches. The geometry, size, and composition of these features are dependent upon local morphology and sediment supply (Ashworth 1996). Longitudinally, high flows redistribute sediment from tributaries and other supply locations, but as flows decrease, continued movement of smaller sediments increases the variability in channel elevation (Madej 1999). As flow gradually recedes, inundation of the floodplain slowly declines, creating a "moving littoral" that provides a high diversity of habitat patches with varying hydraulic conditions (Ward and Stanford 1995). This connectivity with the floodplain also results in greater export of nutrients and producers to the channel (Bowen et al. 2003, Ahearn et al. 2006), while the gradual decrease in volume of low-temperature, snowmelt-derived water results in colder water temperatures later into summer (Leland 2003).

Effects of the spring snowmelt recession on biota can be indirect, through changes in abiotic habitat conditions, or direct, through physical disturbance (e.g., scour) or changes in the timing of reproductive cues. As spring flows mobilize and deposit sediment, both aquatic and riparian habitats are modified through changes in channel morphology and substrate composition, creating shifts in availability and configuration. For example, newly reworked bars provide open, bare surfaces for colonization of riparian plants (Scott et al. 1996), while sorted and flushed substrates provide fresh surfaces for algal growth, niches for macroinvertebrate colonization, and clean spawning gravels for fish (Peterson 1996, Milhous 1998, Osmundson et al. 2002). High flows that cover floodplains increase both the availability and diversity of hydraulic habitat, and as flows recede, changing hydraulic conditions further increase habitat variability over time (Ward and Stanford 1995). Greater variability in hydraulic habitat has been associated with higher species diversity in fish and macroinvertebrate assemblages, which contributes to ecosystem biodiversity (Pastuchova et al. 2008).

For species adapted to the strong seasonality typical of temperate mountain rivers, the spring snowmelt pulse and recession create a predictable disturbance that not only resets riparian succession through scour but also provides timing cues for reproduction and growth (Naiman et al. 2008). Riparian communities are strongly influenced by spring flow regimes, where moderate disturbance enhances species diversity through succession (Merritt and Cooper 2000) and gradually receding flows provide the required conditions for seedling recruitment (Shafroth et al. 1998). As a result, the timing of seed dispersal for many species, such as cottonwoods, is tightly linked with this brief, but opportune, time (Rood et al. 2005, Stella et al. 2006). For primary producers, disturbance from high-snowmelt discharges that reduce algal and grazer densities is followed by a predictable flow recession with elevated nutrients, which promotes rapid growth, greater grazer densities, and higher diversity (Peterson et al. 2001). These riparian and aquatic successional processes, coupled with elevated food resources, create conditions conducive to higher-level trophism and greater niche space for species, such as spring spawning fishes and river-breeding amphibians. As a result, aquatic and semi-aquatic vertebrates often synchronize their reproductive

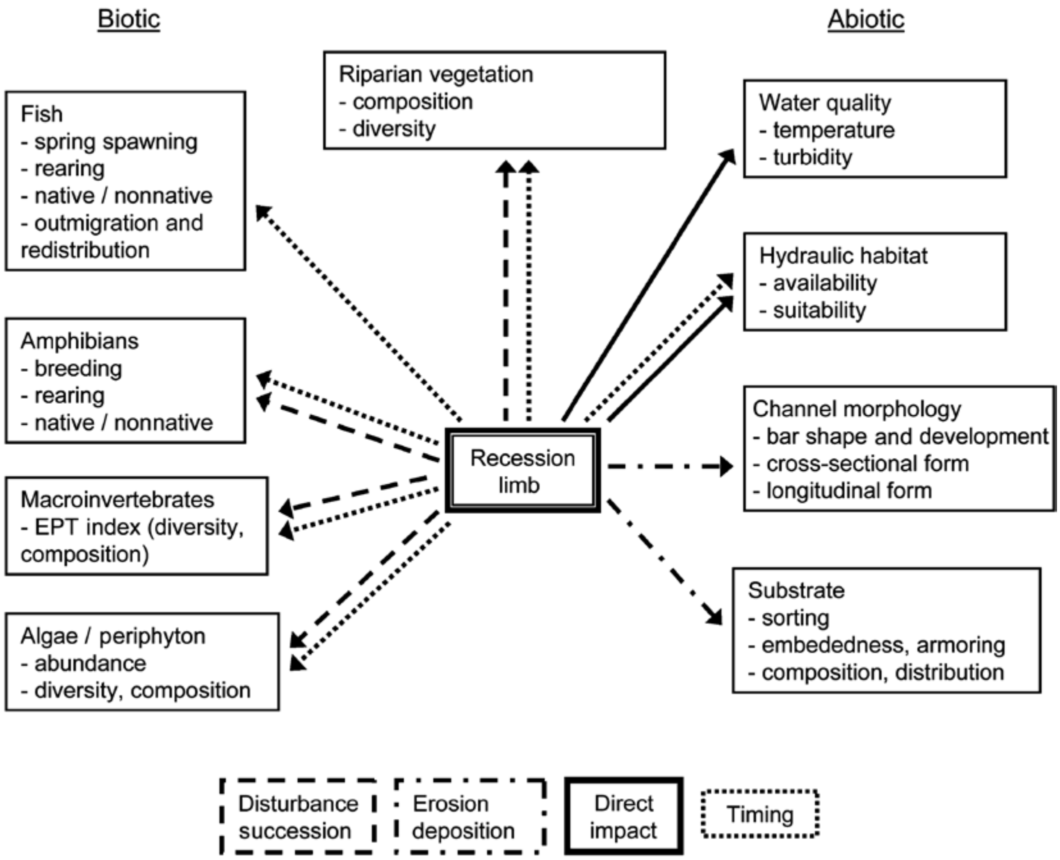

Figure 5. Detailed environmental relationships for spring snowmelt recession dynamics. Arrows indicate ecological and physical processes (described in the legend) acting upon each stream condition.

activities with the spring recession, such that suitable habitat conditions, temperature regimes, and abundant resources allow for optimal reproduction and growth (Kupferberg 1996, Freeman et al. 2001). These cues are primary drivers in population dynamics such that shifts in the timing of the spring recession can alter aquatic community composition and diversity (Jager et al. 1999, Marchetti and Moyle 2001, Jowett et al. 2005).

Over time, natural variability alters the shape and position of the spring snowmelt recession hydrograph. Wet years can produce large-magnitude recessions with a low rate of change and long duration, whereas dry years may result in earlier, smaller-magnitude recessions with a higher rate of change and shorter duration. In some snowmelt-dominated systems, the range in flow variability might be quite small and linked primarily to fluctuations in annual snowfall and temperature (figure 3). In contrast, the rain-dominated stream systems or combination rain-snow systems most typical of Mediterranean-montane climates can exhibit a much larger range in natural flow variability driven by confounding variations in precipitation, snowfall, and air temperature (figure 4). In each of these cases, however, the range of natural variability in unimpaired systems is governed by the natural fluctuations in climate patterns. As a result, species adapt in synchrony to the general predictable cycle of seasons, with these variable year-to-year conditions benefiting different species and promoting biodiversity (Naiman et al. 2008).

Species adaptations to the spring snowmelt recession

In a highly dynamic stream environment, many aquatic species have evolved their life-history strategies to take advantage of high flood predictability and associated seasonal processes (Lytle and Poff 2004, Naiman et al. 2008). The timing of the spring snowmelt recession and the shape of the recession hydrograph contribute to reproductive cues for many riparian and aquatic species, such as cottonwoods, willows, mayflies, amphibians, and salmonids (figure 6a). As flows gradually decrease through spring, the hydrograph passes through these windows of reproduction or biotic thresholds at magnitudes that support habitat (i.e., availability) in sufficient condition (i.e., suitability) for species persistence. Shifts in the timing of the recession or changes to the shape of the recession hydrograph that preclude suitable habitat during a particular species' window of reproduction can lead to a lack of success (Rood et al. 2005, Stella et al. 2006).

For many species, certain abiotic conditions are also required for successful reproduction, such as clean, scoured

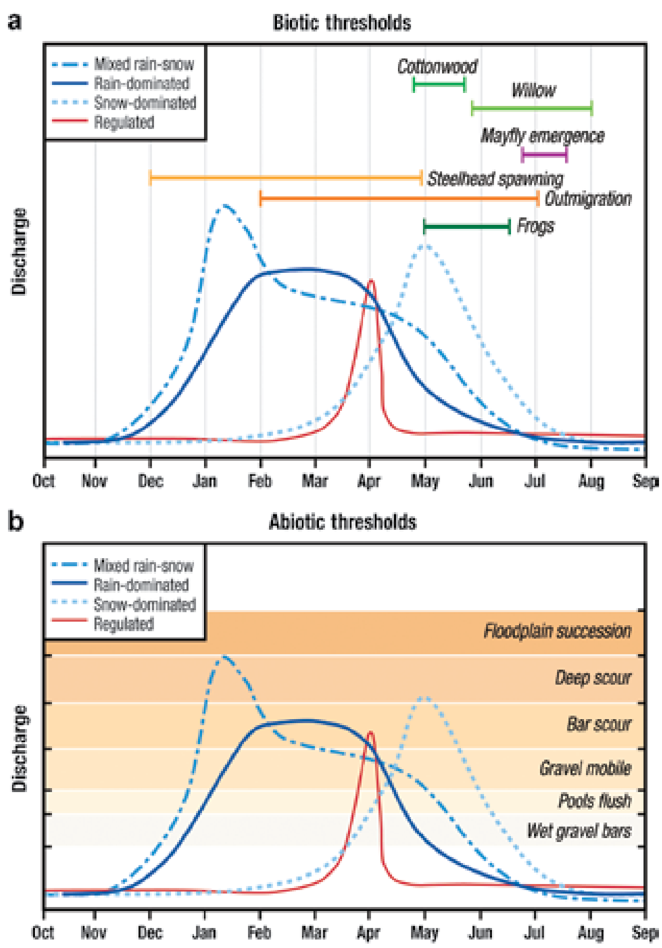

Figure 6. Examples of (a) biotic thresholds and (b) abiotic thresholds for rivers with varying hydrologic conditions. Exact threshold values will vary by species and river location.

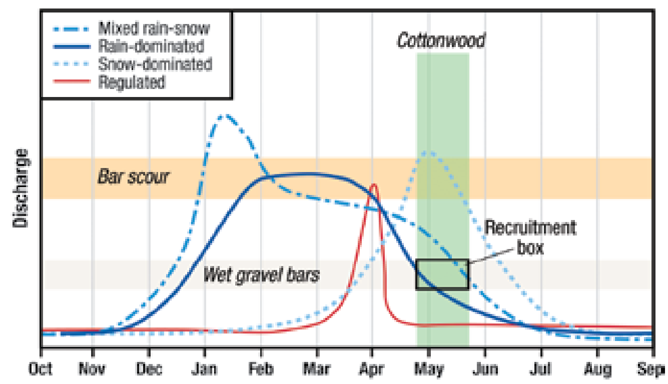

*Figure 7. Abiotic and biotic thresholds for cottonwood (***Populus** *spp.). Before but not during the reproduction window (green band), flows must be high enough to initiate bar scour (orange band). During the reproduction window, flows must be high enough to wet gravel bars (pink band) and recede slowly enough to allow for germination of seeds. Where these abiotic and biotic thresholds cross under the hydrograph is the "recruitment box" (Rood et al. 2005).*

channel bars for riparian species and amphibians, emergent cobbles and boulders for macroinvertebrates, or newly flushed gravel substrates for salmonid redds (Harper and Peckarsky 2006, Stella et al. 2006). These conditions are largely governed by the magnitude of flow (figure 6b). In some cases, abiotic thresholds must be crossed before or at the start of the spring recession to create suitable habitat conditions within a given species' reproductive window. In other cases, certain abiotic conditions must be met during a species' reproductive window. The combined abiotic and biotic thresholds for a particular species of interest in relation to the components of the hydrograph can inform a better understanding of potential reproductive success and potential limiting factors.

Where abiotic and biotic thresholds for individual species intersect under the spring recession hydrograph, in-stream physical habitat conditions can be suitable for reproductive success, creating a window of opportunity. Recruitment needs for woody riparian species, such as cottonwood (*Populus* spp.), require certain abiotic conditions to be met at certain times (figure 7; Rood et al. 2005, Stella et al. 2006). High-magnitude flows during winter or early spring are required to scour substrates and create open, bare channel bars free from vegetation. In late spring, seeds disperse for approximately three to four weeks, and those that land on open, inundated, or wet gravel bars are likely to germinate. Thus, the timing of wet gravel bars must coincide with the timing of seed dispersal for successful germination. The rate of change in the discharge following germination must be slow enough to allow for roots to establish and grow in tandem with the receding water level. If the dimensions of the hydrograph are such that (a) this "recruitment box" is missed (Rood et al. 2005), (b) the magnitude of winter flows is too low to create scour on bars, or (c) the rate of recession is too steep to allow for root growth, then cottonwood recruitment will be reduced or unsuccessful (Rood et al. 1995).

Abiotic and biotic effects of changes in magnitude, timing, and rate of change

To date, research has rarely focused on the integrative effects of the spring snowmelt recession on stream ecology; however, ample research exists regarding the effects of flow on particular aspects of stream systems. We have compiled results from these studies to describe expected responses in stream ecosystems to shifts in each of the primary recession components (magnitude, timing, and rate of change) that result from natural or managed changes within a stream system (tables 1, 2, 3). While some responses are well studied, such as the effect of shifts in timing on cottonwood recruitment, others, such as changes to the cross-sectional shape of channel bars as flow duration changes, can only be surmised at this time.

Shifts in the rate of the spring snowmelt recession create the largest impacts on the stream system (table 1).

Table 1. Expected responses to shifts in the rate of change of discharge during the spring snowmelt recession.

Shift	Expected response	Reference
Decreased rate of change	Increased channel surface and subsurface sorting and armoring	Hassan et al. 2006
	Increased spatial patterns in channel substrate sorting	Ashworth 1996
	Development of shallow-sloped graded channel bars	Surmised
	Increased diversity of bed load as flood duration increases	Powell et al. 2001
	Decreased water temperatures, increased turbidity	Leland 2003
	Increased connectivity with floodplain resulting in greater diversity of habitat patches and greater export of nutrients and producers to channel	Ward and Stanford 1995, Bowen et al. 2003
	Increased habitat availability for early fish life stages resulting in increased year-class strength and survival	Freeman et al. 2001
	Increased variability in hydraulic habitat resulting in increased diversity in fish assemblage, macroinvertebrate assemblage and general biodiversity	Lambeets et al. 2008, Pastuchova et al. 2008
	Increased habitat stability and resource availability resulting in increased biota	Gasith and Resh 1999
	Increased diversity of riparian vegetation due to increased habitat diversity	Scott et al. 1996, Merritt and Cooper 2000
	Increased riparian species seedling recruitment	Shafroth et al. 1998
	Increased macroinvertebrate diversity following increased algal productivity	Peterson et al. 2001
	Increased riparian arthropod diversity	van Looy et al. 2007
Increased rate of change	Little to no armor layer on deposited material; no vertical grain sorting	Hassan et al. 2006
	Increased armoring in main channel	Ligon et al. 1995
	Increased transport of fines, increased substrate embeddedness	Wood and Armitage 1997
	Development of steeply sloped ungraded channel bars	Surmised
	Decreased habitat availability and variability due to rapid return to base flow	Bowen et al. 2003
	Increased water temperatures due to rapid return to base flow	Inferred
	Decreased salmonid spawning activity during high rates of change in flow	Moir et al. 2006
	Increased stranding of early life stage fish and amphibians	Kupferberg et al. 2008
	Increased temperature stress for fish resulting in decreased success	Jager et al. 1997
	Increased riparian vegetation encroachment	Lind et al. 1996
	Decreased riparian species seedling establishment	Rood et al. 1995
	Decelerated riparian leaf breakdown rates	Langhans and Tockner 2006
	Decreased arthropod abundance and diversity due to increased substrate embeddedness	Paetzold et al. 2008
	Decreased primary productivity due to high variability in flow	Acs and Kiss 1993

Decreasing the rate of change of flow alters the movement and deposition of sediment in the channel such that particles become well sorted and substrate patches become more spatially diverse (Hassan et al. 2006). As discharge gradually declines, subsequently smaller and smaller particles are deposited in different areas of the channel as a result of decreasing flow competence, creating a wide variety of well-sorted habitat patches of differing grain size. Furthermore, we surmise that this gradual deposition of sediment as flows diminish over a channel bar will produce a shallow, graded, cross-sectional shape that provides proportionally larger regions of shallow, in-stream habitat at a variety of flows. Larger duration flows resulting from a slower recession also increase connectivity with the floodplain, which has been shown to have numerous ecosystem benefits (Ward and Stanford 1995, Tockner et al. 2000), including a greater export of nutrients to the channel (Bowen et al. 2003) and greater fish growth and survival (Freeman et al. 2001). As flows slowly drop down into the channel, the variability of hydraulic conditions as water passes over diverse topography and substrate creates a gradually shifting mosaic of habitats that allows (a) a variety of riparian species to establish (Merritt and Cooper 2000, Shafroth et al. 2002), (b) terrestrial arthropods to disperse (Lambeets et al. 2008), and (c) primary producers to flourish (Peterson et al. 2001). The overall result is a highly heterogeneous environment that promotes the biodiversity of fishes, macroinvertebrates, and riparian vegetation assemblages.

Table 2. Expected responses to shifts in the magnitude of discharge at the start of the spring snowmelt recession.

Shift	Expected response	Reference
Increased magnitude	Increased sediment transport capacity and redistribution of sediment	Madej 1999
	Increased scour of sediments in depositional sites; flushing of fines	Osmundson et al. 2002
	Increased habitat availability for early fish life stages resulting in increased year-class strength and survival	Freeman et al. 2001
	Decreased water temperature due to larger volume snowmelt	Inferred
	Increased variability in hydraulic habitat depending on channel morphology	Moir et al. 2006
	Increased fish diversity and abundance due to increased habitat diversity and availability	Propst and Gido 2004
	Increased scour/drift of macroinvertebrates and prey availability for fish	Suren and Jowett 2006, Franssen et al. 2007
	Initial decrease in algal productivity due to scour, but subsequent increase in productivity due to release of grazing invertebrate pressure	Peterson 1996, Power et al. 2008
Decreased magnitude	Channel narrowing, loss of backwaters and side channels; channel simplification	Ligon et al. 1995, Van Steeter and Pitlick 1998
	Decreased erosion and deposition, reduced lateral migration rates; decreased channel elevation variability	Shields et al. 2000, Parker et al. 2003
	Increased transport and deposition of fines	Wood and Armitage 1997, Parker et al. 2003
	Increased water temperature due to smaller volume snowmelt	Inferred
	Increased vegetation encroachment, denser vegetation	Lind et al. 1996, Shafroth et al. 2002
	Increased growth in early life stages of amphibians	Kupferberg 1996
	Decreased diversity of macroinvertebrates and abundance of fish due to loss of habitat	Jowett et al. 2005, Dewson et al. 2007
	Shift toward less-specialized riparian arthropod assemblages	Lambeets et al. 2008
	Decreased algal production and increased senescence due to reduced scour and increased deposition of fines	Peterson 1996

Table 3. Expected responses to shifts in the timing of the start of the spring snowmelt recession.

Shift	Expected response	Reference
Later	Decreased water temperatures	Inferred
	Decreased growth of amphibians	Kupferberg 1996
	Increased growth of cold-water fish due to decreased temperatures	Jager et al. 1999
Earlier	Increased water temperature resulting in changes in timing of macroinvertebrate emergence, maturation age for trout, and fish and macroinvertebrate composition	Jager et al. 1999, Marchetti and Moyle 2001, Harper and Peckarsky 2006
	Increased growth for warm water fish and amphibians	Kupferberg 1996, Jager et al. 1999
	Decreased growth for cold water fish	Jager et al. 1999
	Decreased riparian seedling recruitment	Rood et al. 2005, Stella et al. 2006
	Increased low flow duration resulting in decreased arthropod abundance and changes to fish and macroinvertebrate composition	Marchetti and Moyle 2001, Jowett et al. 2005, Suren and Jowett 2006, Paetzold et al. 2008

Conversely, increases in the rate of change of discharge that produce a “flashy” recession lower the availability and diversity of in-stream habitats, as the duration of the recession is shorter. As flows rapidly decrease, mobile sediment abruptly deposits as unconsolidated substrate with minimal sorting or armoring (Hassan et al. 2006). Fewer substrate patches of varying sizes are created and finer sediments are not flushed from coarser particles, leaving deposits that lack biologically important interstitial space. A quick return to base flow within the main channel most likely creates a steep-sloped, ungraded channel bar that is further steepened by continued erosion along the edge of the main channel at the toe of the bar. The high rate of change in flow can limit the reproductive success of many species, such as salmonids attempting to spawn (Moir et al. 2006), or riparian plants attempting to establish (Rood et al. 1995), and can also reduce the diversity of algal and ground beetle communities (Acs and Kiss 1993, van Looy et al. 2007). A quick return to the base flow limits access to adjacent floodplains, decreasing shallow habitat availability and variability (Bowen et al. 2003), and as a result, reducing overall aquatic primary productivity (Ahearn et al. 2006). Subsequent increases in the duration of sustained low flows within the main channel result in greater transport of fines and substrate embeddedness (Wood and Armitage 1997), increased riparian vegetation encroachment (Lind et al. 1996), higher temperature stress for fish (Jager et al. 1997), and decreased rates of ecosystem processes such as leaf-litter decomposition (Langhans and Tockner 2006). The result is a stream system where the abiotic and biotic conditions reflect only the two extremes of flood and base flow, rather than the full spectrum and diversity of flows occurring in between.

Shifts in the magnitude of flow at the start of the spring snowmelt recession primarily affect the abiotic conditions within the stream (table 2). Greater discharges result in higher sediment transport and redistribution within channels as larger portions of the channel substrate are mobilized, ultimately increasing disturbance and habitat variability. The larger volume of cold snowmelt water in the channel creates greater hydraulic habitat availability and decreases water temperatures, conditions that are both particularly beneficial to fishes (Freeman et al. 2001). Although an increase in magnitude may be detrimental to macroinvertebrate and algal communities in the main channel as a result of scour, additional habitat availability in overbank areas and subsequent rapid recolonization in the channel can lead to greater benthic community species abundance and diversity (Franssen et al. 2007, Power et al. 2008). For communities adapted to a seasonal flood regime, high-magnitude scouring flows can provide the opportunity for producers to flourish during the predictable recession before grazer densities rise and subsequently provide energy to higher trophic levels (Power et al. 2008). For amphibians or riparian species, impacts from an increase in magnitude will depend on local channel conditions. For example, higher flow volume might result in reduced tadpole growth as a result of lower water temperatures and decreased breeding habitat availability if high flows flood suitable habitat, or it might increase breeding habitat availability if high flows provide access to warm, open, overbank areas (Kupferberg et al. 2008).

A lower magnitude of the spring snowmelt recession limits stream channel heterogeneity and aquatic species' productivity in several ways. Decreased erosion and deposition of coarse sediment over time reduces lateral channel migration (Shields et al. 2000), homogenizes channel elevations (Parker et al. 2003), and results in overall channel narrowing and simplification (Ligon et al. 1995, Van Steeter and Pitlick 1998). The subsequent loss of backwaters and side channels depletes habitat variability, and the overall lower-flow volume reduces in-stream habitat availability and macroinvertebrate diversity (Dewson et al. 2007). In addition, lower discharges generally result in higher water temperatures, which can negatively affect fishes by intensifying stress (Jowett et al. 2005), or positively affect the growth of amphibians (Kupferberg 1996). Lower discharges can also lead to increased vegetation encroachment and growth rates if flows are not adequate to scour established seedlings (Shafroth et al. 2002) and decreased algal productivity due to greater deposition of fine sediments (Peterson 1996). Most of these habitat conditions are likely to be amplified over time if low-magnitude discharges persist.

Shifts in the timing of the start of the spring snowmelt recession alone will have little impact on the abiotic conditions in the channel, with the exception of water temperature (table 3). If the timing of snowmelt occurs earlier in the season, there will be a longer duration of the warm-water conditions associated with the low-flow season. This might be beneficial to tadpole growth rates, for example, but detrimental to cold-water fish species (Jager et al. 1999). Conversely, shifts to timing that provide cold snowmelt runoff later into the summer will aid in sustaining lower water temperatures and shortening the duration of the low-flow season.

Biologically, shifts in timing can have profound impacts on population dynamics, particularly for species that have adapted to reproduce during the relative stability of the snowmelt recession (table 3). For example, cottonwood establishment is notable for its dependence on numerous factors (figure 7). If the timing of the recession shifts such that conditions do not coincide with the seed dispersal window, seedlings will not establish (Rood et al. 2005). Similarly, river-breeding amphibians time egg laying to optimize a balance between the risk of scour from early spring high flows and the benefits of increased growth prior to winter floods (Kupferberg 1996). Mayfly (Order: Ephemeroptera) emergence has been shown to occur during the tail end of the spring snowmelt recession when both water temperatures are higher and cobbles are first emerging, providing ideal conditions for egg-laying and hatch success (Harper and Peckarsky 2006). An earlier recession in the spring will lengthen the duration of warm summer and fall low flows. Although this might benefit warm-water species, it also intensifies stress to cold-water species, leading to changes in fish composition over time as warm-water and cold-water species vie for available habitat (Marchetti and Moyle 2001). Longer durations of low flows and related temperature changes may also affect macroinvertebrate and arthropod diversity, as habitat conditions clash with life-history strategies (Suren and Jowett 2006, Paetzold et al. 2008).

Although specific impacts from shifts in each of the three primary hydrograph components of the spring snowmelt recession can be described through thoughtful analysis of

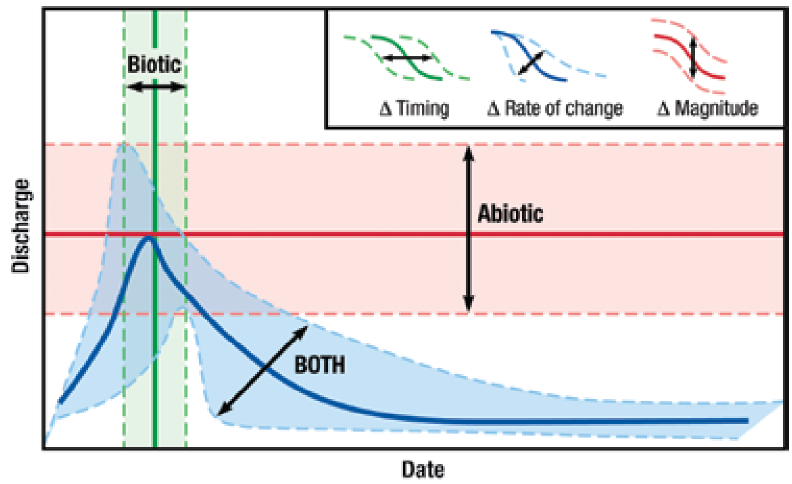

Figure 8. Dominant type of ecological impact resulting from shifts in the primary quantifiable components of the spring snowmelt recession.

a particular stream system, several general conclusions also emerge. Shifts in the magnitude of flow at the start of the recession that reflect a change in the volume of water in the channel will have the largest impacts on the abiotic conditions in the channel. Conversely, shifts in the timing of the recession will primarily affect biotic conditions. Shifts in the rate of change during the recession will profoundly affect both abiotic and biotic conditions, creating the largest observed changes to the stream ecosystem (figure 8). Which of these components requires the most focus in an analysis of the flow regime will depend on the stream system and the nature of the problem to be addressed.

River regulation and the spring snowmelt recession

It is well established that the damming of rivers for hydropower generation and water diversion alters in-stream habitat conditions and habitat connectivity by modifying discharge and sediment movement (Ligon et al. 1995). While most riverine species are adapted to natural variations in stream conditions, changes to the flow regime in managed systems often fall outside the range of natural variation, and thus have detrimental effects on native species. Efforts to minimize negative impacts on a species resulting from regulation have included prescribed "environmental" flows that mimic certain aspects of a natural flow regime and that provide discrete geomorphic or ecological functions such as substrate-flushing flows or minimum in-stream flows (Milhous 1998). More recent environmental flow efforts have moved beyond such discrete functions to a more holistic approach that incorporates greater flow variability by assessing the frequency and duration of low flows, high flows, and natural pulsed flows (Richter et al. 2006); however, quantifying the degree to which a managed hydrograph meets ecological requirements, and determining expected responses from shifts in managed hydrographs, remains elusive (Arthington et al. 2006). An assessment of the spring snowmelt recession in a managed hydrograph can not only show potential ecosystem responses from observed shifts in the hydrograph as described above but can also, if reference data are available, provide additional quantifiable recommendations for environmentally beneficial flows.

One example of a species that is directly affected by changes to the spring snowmelt recession is the foothill yellow-legged frog (*R. boylii*), a river-breeding amphibian native to mid-elevation streams in California and southern Oregon that was designated a California Species of Special Concern (Jennings and Hayes 1994). Individuals breed annually in early spring following the start of the spring snowmelt recession, timing their reproduction so as to minimize the risk of egg scour caused by unpredictable late-spring storms, and also to maximize growth during summer low flows (Kupferberg 1996). Frogs lay egg masses on open, newly scoured cobble bars, where the eggs must remain submerged for up to two weeks until tadpoles hatch. After hatching, tadpoles graze in shallow, warm, near-shore environments throughout the summer until metamorphosis occurs in fall. Although they are well adapted to the natural seasonal cycle of flow in Mediterranean climates, egg masses are still vulnerable to scour from late-season storms and to desiccation from rapid decreases in spring flow, whereas tadpoles are vulnerable to scour from rapid changes in flow during the summer (Kupferberg et al. 2008). As a result, frogs have been found to associate with river reaches of high habitat heterogeneity where a variety of suitable habitats exist for all life stages across varying flows (Yarnell 2008).

Regulated rivers in California (i.e., rivers with discharge largely controlled by dams, weirs, and diversions) often exhibit a spring flow regime that is markedly different from a natural spring snowmelt recession. As winter rain and snowmelt flows are captured behind dams and fill reservoirs, streams receive constant base flows that are periodically interrupted by high-magnitude, high rate-of-change events (i.e., spills). This bimodality of flow extremes results in a

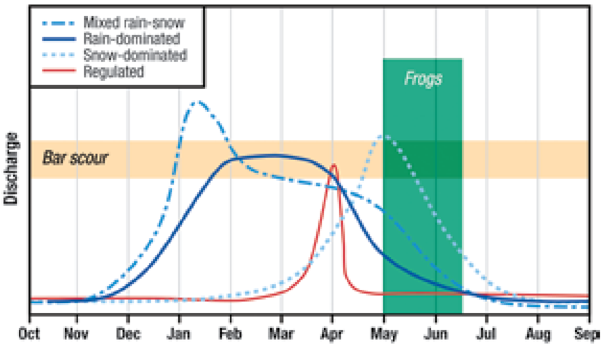

Figure 9. Abiotic and biotic thresholds for foothill yellow-legged frog (*Rana boylii*). Before but not during the reproduction window (green band), flows must be high enough to initiate bar scour (orange band). During the reproduction window, flows must recede slowly enough to avoid desiccation of eggs.

more homogeneous channel with limited habitat availability (see references in table 2). In addition, the timing of these spill events is highly variable, coinciding only occasionally with natural peaks in spring runoff. For species such as the foothill yellow-legged frog, the timing of these spill events and the high rate of recession directly determines its annual reproductive success (figure 9). High-magnitude winter storms and early spring storms provide the required benefit of newly scoured cobble bars for egg deposition, but spill events that occur in late spring either during or after breeding can cause widespread scour and mortality (Kupferberg et al. 2008). Conversely, flows that are abruptly diminished during or after the breeding season, such as might occur when a spill event has concluded, will desiccate eggs and newly hatched tadpoles. Prescribing a spring flow regime that gradually ramps down from a spring spill event or that mimics the timing and rate of change of a natural spring snowmelt recession will reduce the potential for egg or tadpole mortality while also providing high habitat availability for multiple native species.

Climate warming and the spring snowmelt recession

The effects of climate warming on water resources in temperate latitudes will be profound: Many studies in western North America show contemporary shifts in the seasonality of snowmelt runoff (Maurer et al. 2007, Stewart 2009). The Mediterranean-montane climate of California is expected to warm by between 2 degrees Celsius (°C) and 6°C over the next 50 to 100 years (Young et al. 2010). Higher air temperatures will reduce the proportion of precipitation that falls as snow and increase the amount of winter rain, subsequently resulting in greater variability in the shape and position of the spring snowmelt hydrograph (Maurer et al. 2007). While shifts in the timing, magnitude, and rate of the spring snowmelt recession may not be as extreme as observed in some regulated systems, the shifts are likely to move beyond the historic range of natural variability (Maurer et al. 2007). As a result, the spring recession hydrograph in a typical, mixed rain-snow-dominated Sierran mountain basin will exhibit shifts in timing, magnitude, rate of change, and duration (figure 10). Depending on the basin, the timing of the spring snowmelt recession is predicted to occur two to four weeks earlier, the magnitude to be reduced as more precipitation falls in the form of rain, and, as a result of only slight decreases in the rate of change, the duration of the snowmelt recession may be shorter (Stewart 2009). Determining how each component of the spring hydrograph will shift in response to climate warming is basin-dependent and complex, but even knowledge of general trends in how the spring hydrograph might change can provide some information on potential ecosystem impacts. The specific impacts of these shifts on a stream's ecology will vary by elevation, latitude, and the degree of overall temperature increase (Young et al. 2010), but several general conclusions can be reached on the basis of current available data (tables 1–3).

As climate warming shifts the timing of the spring snowmelt recession to earlier in the season, and decreases the magnitude of flow at the start of the recession, we expect to see a longer duration of the warm, low-flow season as less snowmelt is delivered downstream. Although the rate of the recession may decrease slightly, significant reductions in magnitude negate this effect, resulting in an overall shorter duration of cold water within the system. An earlier start to the recession will provide longer time for growth of some species, such as amphibians and native warm-water fishes; however, the resulting increase in low-flow duration will also expand the abundance of nonnative species (Marchetti and Moyle 2001). Consequently, an elevational shift in the distribution of cold- and warm-water fish species will occur as cold-water species are limited to higher elevations (Jager et al. 1999). An earlier and shorter spring recession will also limit the extent of suitable habitat and recruitment success for woody riparian plant species, as adequate flow conditions occur less often during times of seed dispersal (Rood et al. 2005, Stella et al. 2006). The resulting lower diversity and abundance in the riparian vegetative community and the associated changes in channel habitat, compounded by an increase in sustained low flows, will diminish riparian arthropod diversity and change the aquatic macroinvertebrate community (see references in tables 1–3). These changes in the riparian and aquatic communities will have cascading impacts to the adjacent terrestrial ecosystem (Nakano et al. 1999).

A decline in the magnitude of flow at the start of the spring snowmelt recession will also cause less redistribution of sediment, creating large abiotic changes in stream systems. The abiotic impacts will be more complex in Mediterranean-montane basins, where a decreased snowmelt pulse is confounded by higher magnitude and frequency of winter rain events. High-magnitude winter rain events will mobilize extensive amounts of sediment and create high levels of disturbance; however, the rapid recession rate of these flashy winter storms in contrast to the slower recession rate of the snowmelt pulse will create changes in how the sediment is sorted and deposited. Channel substrates will be more homogenous, as

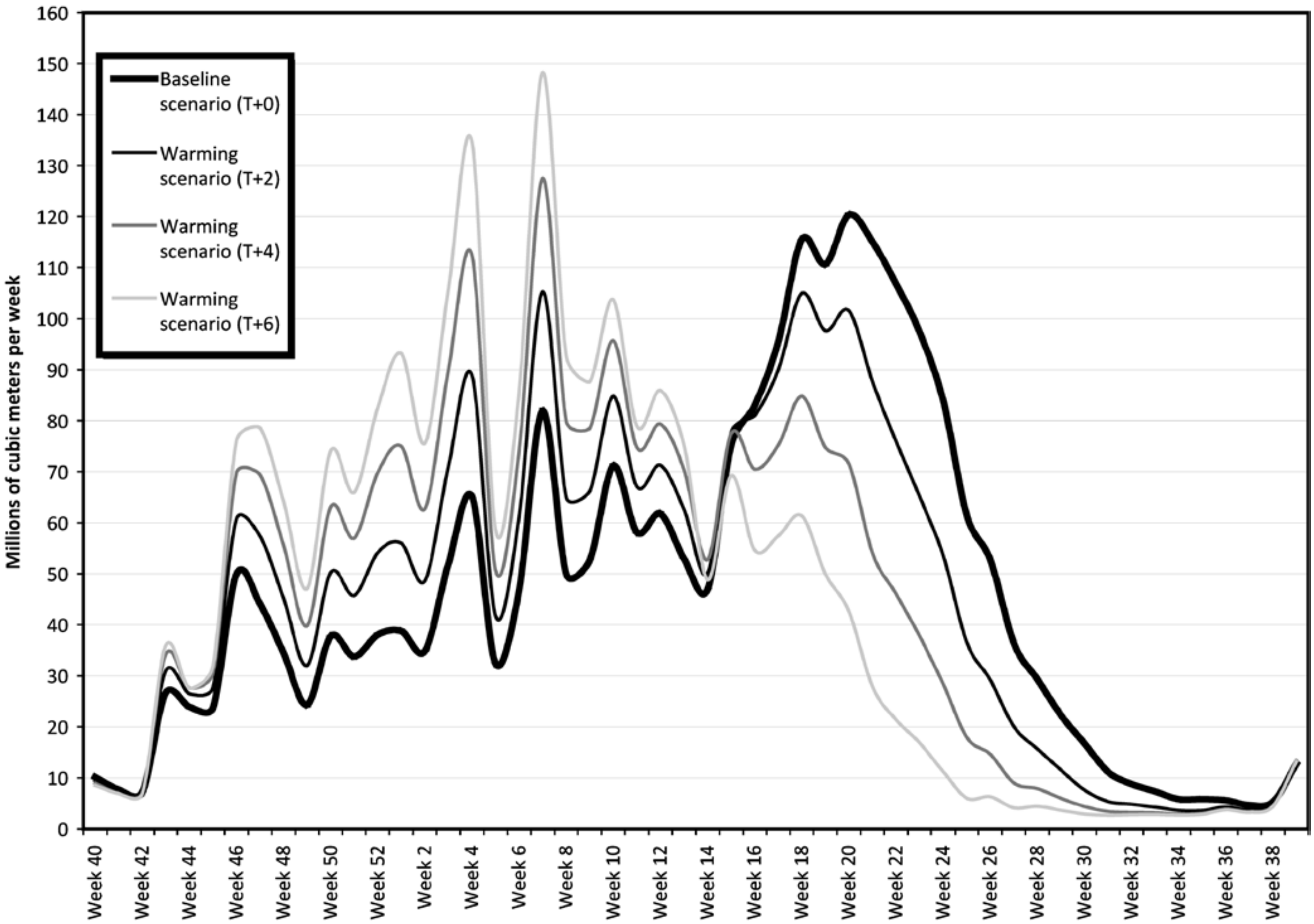

Figure 10. Simulated weekly hydrograph of Tuolumne River under warming scenarios. Snowmelt recession progressively decreases in magnitude and rate of change as air temperature increases. Weeks refer to California water year, beginning October 1 (week 40). Source: Data from Young and colleagues (2010).

rapidly deposited sediment is not redistributed and sorted over time; channel bars may be more steeply sloped, creating less habitat availability as flows fluctuate (see references in table 1). Similar to conditions observed in regulated systems, a flashier spring hydrograph as a result of climate warming may create channel habitat conditions reflective of two dominant flow stages, flood and low-flow, rather than of multiple flow stages ranging between the two extremes. The overall result is a stream system with greater homogeneity in habitat conditions, and thus less overall biodiversity.

Although the extent of stream and riparian ecosystem alteration as a result of climate warming is not yet fully understood, we do know that the western United States (Stewart 2009), and California's Sierra Nevada in particular (Young et al. 2010), is undergoing a shift in its hydrologic regime, unprecedented in recent human history. The ability of aquatic and riparian organisms to adapt to changing habitat conditions will be limited by the rapid pace of change. Further, most aquatic and riparian ecosystems are heavily degraded, and sentinel species are already at risk (Marchetti and Moyle 2001). Thus, there is a pressing need to better understand the complexities of stream ecology, as changing hydrologic conditions will alter the composition, behavior, and function of aquatic and riparian ecosystems that currently depend on spring snowmelt.

Conclusions

From the basis of the natural flow regime paradigm and general conclusions regarding the effects of flow on geomorphic and ecological stream processes, we were able to develop a conceptual model of the ecology of the spring snowmelt recession that specifically relates the quantifiable hydrograph components of magnitude, timing, and rate of change to abiotic and biotic stream factors. This conceptual model is particularly suited to the Mediterranean-montane environments, but is also applicable to other regions with similar hydroclimatic conditions.

Our conceptual model indicates that changes in the shape of the spring snowmelt recession hydrograph can have both direct and indirect effects on aquatic and riparian species. For example, shifts in the timing of the start of the recession coupled with higher rates of change can directly affect cottonwood recruitment or foothill yellow-legged frog egg survival, whereas decreases in flow magnitude could adversely affect the availability of suitable habitat for both species. In general, we found that shifts in the magnitude of flow at the start of the recession have the largest impacts on abiotic conditions in the channel, whereas shifts in the timing of the recession primarily affect biotic conditions, pushing many species' periods of reproduction out of phase with the availability of suitable habitat. Shifts in the rate of the recession affect both abiotic and biotic conditions, creating the largest observed changes to the stream ecosystem (figure 8).

We also investigated two scenarios of change to the spring snowmelt recession and discussed their potential implications for general stream ecology. The effects of climate warming on aquatic ecosystems in Mediterranean-montane climates will be profound, with shifts in each of the three primary components of the recession (magnitude, timing, and rate of change). Shifts in the timing at the start of the recession and decreases in the magnitude of the flow, coupled with a shorter duration resulting from a relatively small increase in the rate of change, will alter in-stream and riparian species compositions, forcing cold-water aquatic species to inhabit higher elevations, and leading to a higher abundance of nonnative species. Shifts in the spring recession as a result of flow regulation can create similar patterns. On the basis of our conceptual model, we found that managed hydrographs with a flashy, short-duration spring snowmelt recession overlying a steady base flow can create channel conditions reflective of the two observed extremes in discharge, flood and base flow. Aquatic and riparian species will be reflective of the homogeneous channel conditions and lack diversity.

We believe that there is an opportunity to mitigate the better-documented negative impacts of flow regulation through dam operations (e.g., manipulation of ramping rates), such that the bounds of the spring snowmelt recession do not exceed those of unimpaired systems. Restoration of the spring recession, with the diversity of flows and predictable resources it provides, will help to create a wide variety of channel habitats that contribute to increased species diversity and abundance. We believe our conceptual model can help guide water resource managers to more effectively maintain key ecosystem services in regulated rivers, and help watershed stakeholders form adaptation strategies for anticipated changes in the nature of flow regimes in lotic environments as a result of climate warming.

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Enclosure D

CERTIFICATE OF SERVICE

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Yuba County Water Agency	)	**Project No. P-2246**
Yuba River Hydroelectric Project	)	
	)	

I hereby certify that I have this day served, by first class mail or electronic mail, a letter to Secretary Bose, Federal Energy Regulatory Commission, containing the National Marine Fisheries Service's comments on the Applicant's Revised Proposed Study Plan pertaining to the Yuba River Hydroelectric Project. This Certificate of Service is served upon each person designated on the official P-2246 Service List compiled by the Commission in the above-captioned proceeding.

Dated this 1st day of September, 2011

Larry Thompson
National Marine Fisheries Service