UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
WEST COAST REGION
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4706

June 21, 2016

In response refer to:
WF:WCR:FERC P-12496-002

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

Re: United States Department of Commerce's, National Oceanic and Atmospheric Administration's Fisheries Service, West Coast Region, Federal Power Act COMMENTS, Preliminary §18 PRESCRIPTIONS, §10(j) CONDITIONS, and §10(a) RECOMMENDATIONS for the Lassen Lodge Hydroelectric Project, Federal Energy Regulatory Commission Project No. 12496-002, located on South Fork Battle Creek, California.

Dear Secretary Bose:

The United States Department of Commerce, National Oceanic and Atmospheric Administration's Fisheries Service, West Coast Region (NMFS), provides our Federal Power Act Comments; preliminary §18 Prescriptions, §10(j) Conditions, and §10(a) Recommendations in Enclosure A; and supporting data in Enclosure B for the above referenced Project. We also provide our Resource Management Goals and Objectives for the above referenced Project in Enclosure C.

Thank you for the opportunity to participate in this proceeding. If you have questions regarding this document, please contact Mr. William Foster at (916) 930-3617.

Sincerely,

Steve Edmondson
Chief, FERC Branch
NMFS, West Coast Region

Enclosures

cc: FERC Service List P-12496-002

Enclosure A

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Lassen Lodge, LLC	**)**	**Project No. P-12496-002**
Lassen Lodge Hydroelectric Project	**)**	
South Fork Battle Creek	**)**	

U.S. DEPARTMENT OF COMMERCE, NOAA FISHERIES SERVICE, WEST COAST REGION, FEDERAL POWER ACT COMMENTS, PRELIMINARY §18 PRESCRIPTIONS, §10(j) CONDITIONS, AND §10(a) RECOMMENDATIONS.

1.0 Introduction

Rugraw, LLC (Applicant), filed a Final License Application (FLA) on April 21, 2014, with the Federal Energy Regulatory Commission (FERC) for the Lassen Lodge Hydroelectric Project, FERC No. P-12496-002 (Project), located on South Fork Battle Creek, California. The Applicant updated its FLA to FERC in December 2015. Subsequently, on April 25, 2016, FERC issued its "*Notice of Application Ready for Environmental Analysis and Soliciting Comments, Recommendations, Terms and Conditions, and Prescriptions*" in the proceeding, setting a June 24, 2016, deadline for filing a response. Thus, the U.S. Department of Commerce, NOAA Fisheries Service, West Coast Region (NMFS), provides our Federal Power Act (FPA) Comments; preliminary §18 Prescriptions, §10(j) Conditions, and §10(a) Recommendations (collectively, FPA Terms) for the Project in this Enclosure A, Sections 4-7; as well as supporting data in Enclosure B. We also discuss how our FPA Terms, if adopted into the new license, would achieve NMFS' Resource Management Goals and Objectives for the Project (provided in Enclosure C); serve to enhance anadromous fish resources and aid in the recovery of ESA-listed anadromous fish; and protect the designated critical habitats of those species (NMFS 2014).

2.0 Status of Anadromous Fish Resources

NMFS is a federal agency with jurisdiction over anadromous fish resources affected by the licensing, operation, and maintenance of hydroelectric projects. See Reorganization Plan No. 4 of 1970 (84 Stat. 2090), as amended; the FPA (16 U.S.C. § 803(j) and 811); the Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. § 661 and 662); the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. §1801 *et seq.*); and the Endangered Species Act (ESA) (16 U.S.C. §1531 *et seq.*). NMFS notes that the anadromous and resident salmonids listed below will either be present in (for residents) or be able to access the Project's 2.4-river mile (RM) bypassed reach (RM 20.6-23.0). Anadromous fish would be able to reach the ESA-designated limit of anadromy at Angel Falls (RM 22.3), once the South Diversion Dam at RM 14.35, of the Battle Creek Hydroelectric Project, FERC Project No. 1121, is removed from the South Fork Battle Creek. The *Battle Creek Salmon and Steelhead Restoration Project*

(BCSSRP) plans to remove this last barrier to anadromy by approximately 2020 and this action is reasonably certain to occur (USBR *et. al*., 2004; USBR 2014). We also note that any resident *O. mykiss* already present upstream of anadromous limits (current or future) and upstream of the Project's bypassed reach could migrate downstream through the bypassed reach and be affected by the Project. These resident *O.mykiss* could seed future anadromous *O. mykiss* populations.

Thus, NMFS is concerned with the following anadromous and resident salmonid resources:

- Sacramento River (SR) winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*), (Endangered) (59 FR 440, January 4, 1994);

- Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) (Threatened/Critical Habitat to RM 22.3) (64 FR 50394, September 16, 1999 / 70 FR 52488, September 2, 2005);

- California CV (CCV) steelhead (*O. mykiss*) (Threatened/Critical Habitat to RM 22.3) (71 FR 834, January 5, 2006 / 70 FR 52488, September 2, 2005);

- CV fall-/late fall- (fall-run) Chinook salmon (*O. tshawytscha*) (Species of Concern and access to RM 22.3) (73 FR 60987, October 15, 2008);

- Pacific Chinook salmon, all ESUs (*O. tshawytscha*) (Essential Fish Habitat to RM 22.3) (PFMC 1999; 71 FR 61022, October 17, 2006); and

- Resident *O. mykiss* within the 2.4 RM bypassed reach, upstream and downstream of Angel Falls (RM 22.3).

NMFS notes above that there is no critical habitat designated within the South Fork Battle Creek for SR winter-run Chinook salmon, as current designation only occurs in the Sacramento River itself, upstream of the Delta (NMFS 2014). However, all of the above ESA-listed salmonids can still access the South Fork Battle Creek and could migrate up to Angel Falls (RM 22.3) once implementation of the BCSSRP in the South Fork Battle Creek is completed. The Project's bypassed reach has two sub-reaches: (A) from the Powerhouse tailrace (RM 20.6) upstream to Angel Falls (RM 22.3) and (B) from Angel Falls (RM 22.3) upstream to the Diversion Dam (RM 23.0). NMFS is concerned with the Project's effects on salmonids and habitats within the entire bypassed reach: For resident *O. mykiss* within the 2.4 RM bypassed reach (either side of Angel Falls) and for anadromous fish within the 1.7 RM sub-reach downstream of Angel Falls. The 1.7 RM downstream of Angel Falls is also designated critical habitat for ESA-listed salmonids and contains EFH for Pacific salmon.

NMFS believes that the *O. mykiss* located upstream of Angel Falls need adequate instream flows over the entire bypassed reach so that there is adequate connectivity for these fish to exhibit anadromous behavior if they so choose. In addition, studies have shown that isolated populations of non-anadromous *O. mykiss* can revert to the anadromous form if given an opportunity - even after over 70 years of isolation (Docker and Heath 2003; Thrower *et al*. 2004). Thus, such isolated *O. mykiss* populations serve as sources for the eventual recovery of CCV steelhead, contribute to the diversity of life-history strategies of *O. mykiss*, and support the over-all viability and recovery of the *O. mykiss* complex within the Battle Creek watershed (NMFS 2014).

3.0 Description of the Proposed Project

The Applicant updated the FLA and the Project's description on December 4, 2015. The proposed Project would consist of the following features: (1) an 8-foot-high by 63-foot-long diversion dam; (2) an impoundment of approximately 0.5 acre; (3) a 17 by 25-foot enclosed concrete intake structure with two 5 by 12-foot trashracks; (4) a 20 by 59-foot control/fish screen structure located contiguous with the concrete intake structure (5) a 7,565-foot-long, 48-inch diameter, low-pressure pipeline connected to a 5,230-foot-long high-pressure penstock (total pipe length is 12,795 feet/2.4 miles and total net head is 791 feet); (6) a 50 by 50-foot powerhouse containing one generating unit with a 5,000-kilowatt capacity; (7) a 50 by 50-foot substation area; (8) a 40 by 35-foot switchyard; (9) a 100 by 100-foot multipurpose area; and (10) a new 12-mile-long, 60-kilovolt transmission line.

4.0 NMFS' FPA Comments

Below, NMFS provides comments regarding ongoing issues with data the Applicant used to support its FLA and to justify their proposed terms and conditions.

4.1 Comments on Hydraulic Geometry (HG) Method:

The Applicant's use of the HG Method is completely insufficient and will not provide the necessary information to assess the proposed Project's impacts on salmonid resources.

Throughout the early and current FLA process, the Applicant utilized the HG method to attempt to understand how wetted width, flow depth, flow velocity, and aquatic habitat change with varying instream flow levels. The HG method within the FLA is, by in large, substituted for more traditional and accepted approaches (e.g., PHABSIM) often used in FERC licensing proceedings to analyze and quantify how aquatic habitat changes with different discharges. A major limitation of the HG method compared to more traditional approaches is that it only predicts cross-sectionally averaged depths and velocities (i.e., one average depth and velocity across an entire station or cross-section) and assumptions are further made that this one averaged depth and velocity is somehow reflective of available habitat. In a steeper, coarse-bedded stream such as South Fork Battle Creek, parameters such as flow, depth, and velocity are very dynamic and highly variable at any given location (as evidenced in many of the field photos submitted with the FLA Appendices). NMFS finds the use of cross-sectionally averaged depths and velocities at the habitat-unit and micro-habitat unit scale to be a fundamental flaw in the use of the HG method within the FLA to quantify available habitat at varying flow levels.

In addition to the inherent limitations of trying to use the HG method to quantify habitat vs flow relationships, the Applicant's approach to constructing their HG relationships is too coarse to have any reliability in the parameterization of their HG relationships. Standard practice for developing "at-a-station" HG relationships (what is utilized in the FLA) is to collect data at several different flow stages and discharges (see Hogan and Church (1989), where each "at-a-station" relationship is derived from six different measurements). The Applicant collected habitat data at one discharge per survey: 13 cubic-feet-per-second (cfs) in the first survey and at

34 cfs in the second survey. Then, for both surveys, the Applicant attempted to quantify habitat parameters at a second flow level (the bankfull discharge) through various indirect methods. The Applicant estimates that the bankfull discharge is in the range of 510 to 700 cfs. These bankfull discharge levels are roughly 40-50 times the 13 cfs measurement (first survey) and 15-20 times the 34 cfs measurement (second survey). Even if the Applicant's estimated bankfull parameters were reliable (discussed in greater detail below), having only one data point (within the range of possible Project induced instream flows being evaluated, including the range of flows most impacted by the Project) severely limits the HG method and resulting habitat analysis in ascertaining small differences in baseflow or in minimum instream flow as presented in the FLA. Thus, the HG methods developed in the FLA cannot reliably speak to how habitat parameters, such as rearing area, vary from 8 to 13 to 20 cfs (as presented in Figure 23 of Appendix C). Typically, HG relationships are developed through fitting a power function through several points (e.g., Hogan and Church 1989). Because the Applicant is attempting to parameterize the HG power functions with only two data points, they follow an approach presented in Jowett (1998) that utilizes ratios of two different depths, widths, and discharges to develop the parameters for HG relationships. First, Jowett (1998) actually *measured* widths, depths, and discharges at two calibration flows. Second, Jowett (1998) represents their rapid two point calibration and development of HG relationships as a *broad, regional tool* to aid in initial assessment of proposed environmental flow changes (pg 465 Jowett 1998). They do not represent it as a method to develop site specific instream flows (such as determining rearing habitat changes from 8 to 13 to 20 cfs), but rather as a screening tool to understand when mean or modal depths or velocities were approaching a threshold that would trigger more detailed habitat survey and analysis. The Applicant's use of the Jowett (1998) method to determine that 13 cfs is an appropriate instream flow in the bypassed reach appears to be a misapplication of the Jowett's proposed method of a rapid, regional assessment tool.

As previously discussed, the Applicant measured initial habitat data in both surveys at one low discharge (13 and 34 cfs). Although the Applicant measured from 1-3 transects per habitat unit (survey 1 and 2, respectively), they then extrapolated such data at a second estimated bankfull discharge. Thus their HG relationships are entirely dependent on the second extrapolated bankfull discharge point. NMFS believes that several assumptions made in the extrapolation of the bankfull discharge data point are too coarse an estimate and far too unreliable to be the primary building block of an assessment that attempts to set a minimum instream flow. This data problem persisted even after the Applicant's second survey, where they re-measured additional transects (at 34 cfs and three per unit) at a select number of habitat units. While the additional transects did tend to narrow the variability, the underlying estimate of bankfull and the HG process was still too crude. First, the Applicant assumed they could consistently identify a bankfull indicator (or stage) in the field in a coarse, step stream. Identifying bankfull indicators in the field is a notoriously subjective process that varies greatly between field crews, and this uncertainty exponentially increases in steep, confined streams with bank materials composed of large boulders (like South Fork Battle Creek). Identifying field bankfull indicators is a more reliable process in lower gradient meandering streams with consistent riparian vegetation (e.g., willow) lines. Second, the Applicant has assumed that identified field bankfull indicators are equivalent to a 2-year return interval flow. NMFS finds this to be a questionable assumption, with no additional evidence to determine if this is applicable to South Fork Battle Creek. Typical bankfull stage commonly varies from a 1.5 to 2.33-year return interval flow, and is known to vary as low as 1.2-year return interval flow and as high as 5-year return interval flow. Thus the confidence that the 2-year return interval correlates to the bankfull discharge is very low. The third set of assumptions that is problematic with the bankfull discharge data point is the method for calculating what the 2-year return flow actually equates to. The first method used a peak flow analysis of a 9-year flow record, which is too short of a record to reliably determine peak flow return intervals (typically a 20-year period is viewed as the minimum record length for calculating a peak flow analysis). Presumably, because the flow record was so short, a second method using a U.S. Geological Survey (USGS) regional regression equation was deployed to calculate a 2-year return interval flow. USGS regional regression equations are coarse, generalized tools designed to inform projects where only rough peak flow estimates are needed – such a generalized tool does not provide precise control for hydraulic relationships. The two approaches estimated 510 and 700 cfs, respectively, and they were averaged together to get a 600 cfs 2-year return interval flow, which was then assumed to have produced the stage identified as bankfull. NMFS believes the confidence in the correlation of 600 cfs to bankfull stage (notwithstanding issues in identifying bankfull stage) is very low, which in turn renders the HG relationships entirely dependent on this point (because there are only two points deriving the relationship) to be unreliable. This problem is then compounded as the estimated bankfull is nearly 15-50 times greater than the 13-34 cfs observations and there are no additional observations within the flows of interest (e.g., 10-150 cfs).

In summary, the Applicant's attempt to understand how habitat parameters such as flow, depth, and velocity change with different discharges by only measuring data at two relatively low flows (13-34 cfs) is completely insufficient and will not provide the necessary information to assess the proposed Project's impacts from diverting water, which could be as high as 88 percent (%) of the natural inflow when the inflow to the reach is 108 cfs. NMFS believes that the HG method (itself based on limited hydrological information) would tend to underestimate the volume/depth-stage at particular flows and does not account for variations in hydrology due to either wetter/cooler or drier/hotter water years. Furthermore, the Applicant's claim that such data result in a remarkable "fit" is simplistic at best, as data is only collected at two points with no accounting for variance. Finally, the Applicant's claim that the HG method utilizes the "linear relationships" observed when such habitat parameters are plotted on a log-log scale is misstated. More correctly, the claimed "straight line fit to data plotted on a log-log scale" is not a linear relationship, it is a power function (which hints at the potential for the coarse type of relationship being investigated). Much of the Applicant's conclusions are not adequately supported due to the use of the HG Method for providing flawed basic physical data.

4.2 Comments on Proposed Minimum Instream Flow (MIF)

The Applicant's proposed MIF of 13 cfs is not adequately supported and would not provide sufficient protection for salmonid resources.

NMFS believes that the Applicant's proposed MIF (13 cfs) and the theoretical amount of fish habitat available based on the Applicant's methods, are likely far too low because they are based on the results from the faulty HG method. The HG method supplies the theoretical depth and width of water in the channel at particular flows. The extent of that volume of water determines how much theoretical holding, spawning, and rearing habitat is available. The amount of sufficiently wetted habitat determines the relative amount of theoretical fish production. However, the Applicant determined that rearing habitat would limit ultimate production within the reach, based in part on the HG method. While limited rearing may occur within this small reach (with any method), NMFS believes that rearing habitat in general should not be considered as "limited" because fish will displace downstream (out of the bypassed reach) and will find additional suitable habitat. Thus, basing the proposed MIF on 13 cfs because it "would over-seed the available rearing habitat" is not a valid means to determine a MIF in this case. In addition, there may be times during the year that the resulting restricted flow in the bypass reach, limited by the concurrent diversion rate, is not adequate to transport spawning gravels, maintain riparian habitats, maintain hydraulic connection to floodplains, provide connectivity between sub-reaches, or maintain proper channel geomorphology within the bypassed reach.

Finally, in our §10(j) Condition #1, *Minimum Instream Flow*, we provide support for our proposed MIF of 35 cfs year-round in an Excel document (filed concurrently with this REA Letter in Enclosure B). The Excel document contains flow vs habitat (PHABSIM) modeling that was developed by the U.S. Fish and Wildlife Service (USFWS) with data provided by Cramer Fish Sciences (USFWS and CFS, personal communication, 2016). The maximum average habitat for Chinook and steelhead fry and juvenile life stages occurs at 35 cfs within the bypassed reach (assuming suitable water temperatures). In our §10(j) Condition #2, *Water Temperature Monitoring*, we propose that suitable water temperatures should be based on the U.S. Environmental Protection Agency's (USEPA) (2003) 7-Day Average of the Daily Maximum (7DADM) criteria.

4.3 Comments Regarding Periods of Diversion

The Applicant's proposed periods of operation, including "July to October" are not adequately supported and may adversely impact salmonid resources.

As mentioned above, the Applicant proposes a MIF of 13 cfs in the bypass reach, and since the turbines require at least 5 cfs to operate, the proposed Project would cease diverting water for generation at inflows of 17 cfs or less. The Applicant asserts that this would typically occur in "early July" and diversions would start up again in November. However, the hydrology data provided in the *Technical Report, Lassen Lodge Flow Duration Analyses* (Hydmet 2012 - *Flow Duration Report*, filed as an Appendix with the License Exemption Application in 2012) does not appear to support this generalization of the Project not affecting stream flows from July through October. Based on Figures 21-24 in the *Flow Duration Report* (Hydmet 2012), the following theoretical flows occurred: (1) July flows exceeded 17 cfs and 30 cfs 70% and 40% of the time, respectively; (2) August flows exceeded 17 cfs and 30 cfs 40% and 10% of the time, respectively; and (3) September and October flows exceeded 17 cfs and 30 cfs about 25% and 20% of the time, respectively. Thus, this generalized view that the Project will be offline in July and August does not appear supported by data previously filed by the Applicant. Furthermore, it appears that the Project will, at times, significantly reduce the natural flow (e.g., reducing the natural flow by more than half from 30 cfs to 13 cfs) during peak water temperature periods in late July and August. Finally, based on Hydmet's (2012) *Flow Duration Report*, analysis of the Project's effects on stream flows, water temperatures, aquatic habitat, and designated critical habitat should be extended through the July and August periods.

Water temperatures would also be affected by Project operations and unsuitable water temperatures would adversely impact salmonid resources and adversely modify critical habitat. As described above, it appears the Project would typically divert water during most of July and into August. The Project is proposing to significantly reduce the monthly median flow (Table 1 Appendix A to Exhibit E) in multiple months that can potentially reach warm water temperatures, including April (an 88% reduction from 107 cfs to 13 cfs), May (a 74% reduction from 129 cfs to 34 cfs), and June (an 81% reduction from 69 cfs to 13 cfs). Thus, the Applicant's simplistic mitigation of not operating during low flow periods less than 18 cfs (which appears to reliably occur only in September and October, based on Hydmet's (2012) *Flow Duration Report*) does not address potential water temperature changes during other possible important anadromous fish life stage seasons (migration, holding, spawning, and rearing). At any time during the year, the relatively warmer water in the bypass reach could cause the net downstream water temperatures to be outside the recommended water temperature tolerance of an anadromous fish's life stage at that particular time of year. NMFS believes that the water temperature in the Project's bypassed reach should not exceed the USEPA (2003) 7DADM water temperature criteria for migration/over-summering, 18 degrees Celsius (°C), spawning (13°C), and rearing (16°C) at specific times (to the extent controllable by the Project). Finally, we recommend that post-license water temperature monitoring shall determine, using an adaptive management approach, if more stringent criteria are needed by month, water year, or salmonid life stages (see our §10(j) Condition #2, *Water Temperature Monitoring*).

5.0 NMFS' Preliminary §18 Prescription Article

NMFS respectfully requests, pursuant to its authority under §18 of the FPA, that FERC incorporate into the Project license, in its entirety and without modification, the following article:

> *Authority is reserved for the National Marine Fisheries Service to prescribe the construction, operation, and maintenance of fishways at the Project, including measures to determine, ensure, or improve the effectiveness of such prescribed fishways, pursuant to §18 of the Federal Power Act, as amended, during the term of the Project license.*

Rationale for FPA §18 Prescription Article

Pursuant to §18 of the FPA, the Commission shall require the construction, maintenance, and operation by an Applicant at its own expense of such fishways as may be prescribed by the Secretary of the Interior or the Secretary of Commerce, as appropriate, 16 U.S.C. § 811. The Secretary of Commerce is exercising its §18 authority through the inclusion in the license of a separate license article that reserves the authority to prescribe fishways, over the term of the license, pursuant to §18 of the FPA. This is a mandatory term that FERC must include.

6.0 NMFS' §10(j) Conditions

NMFS provides our §10(j) Conditions below that would go into the new license for Rugraw, LLC's (as Licensee) Project. Many of these conditions call for various plans to be developed and implemented by the Licensee. However, for every plan, the Licensee shall develop said plan in consultation with the following Resource Agencies: NMFS, USFWS, California Department of Fish and Wildlife, and the State Water Resources Control Board. Said plans shall then be submitted to FERC for approval and the Licensee shall implement said plans upon FERC's approval.

6.1 NMFS' §10(j) Condition #1: Minimum Instream Flow (MIF) in the Bypassed Reach

(A) Once the Project begins power generation, the Licensee shall provide a year-round minimum instream flow (MIF) in the bypassed reach of 35 cfs during Project operations, or the natural flow (if the natural flow is less than 35 cfs), in order to provide for habitat connectivity and fish passage within the bypassed reach's sub-reaches, located upstream and downstream of Angel Falls.

(B) The Licensee shall monitor the MIF at select gages (see §10(j) Condition #2, *Flow Monitoring Plan*):

1) At a gage located at the Diversion Dam and
2) At gages located both upstream and downstream of Angel Falls.

(C) Ramping Rate: Flow changes shall be ramped at a rate no greater than one-inch stage per hour, based on a gage located between Angel Falls and Powerhouse Spring No. 4.

Rational for NMFS' §10(j) Condition #1:

(A) Licensee's Final License Application (FLA):
FLA, Appendix C: Stream Flows and Potential Production of Spring-Run Chinook Salmon and Steelhead in the Upper South Fork of Battle Creek.

Page 47 states,

- *"Sellheim and Cramer (2013) identified several locations within the project reach where passage was not possible when flow was only 13 cfs..."*
- *"It appeared, based on professional judgment of the passage impediment at each location, that modest flows of 30-50 cfs (and possibly less) would be sufficient to enable passage between all channel units within the project reach."*
- *"... that flows of 10 cfs will provide spawning capacity capable of producing far more age-1 parr than the rearing capacity can support."*
- *"...that bypass flows in the range of 10-13 cfs would be sufficient to support a vibrant population of rainbow trout."*

Page 48 states,

- *"Occasional higher flows reaching 30-50 cfs would be desirable, based on professional judgment, to ensure that resident trout can move between channel units within the reach."*
- *"...bypass flows in the range of 30-60 cfs should be sufficient to provide adequate passage opportunities for trout to move about within the reach to position themselves for spawning."*

(B) NMFS: The Licensee has proposed a MIF of 13 cfs for the Project's bypassed reach based on how that flow would, "*...provide spawning capacity capable of producing far more age-1 parr than the* [local] *rearing capacity can support*." However, the FLA indicates that 13 cfs is not sufficient for fish passage within the proposed bypassed reach. The FLA also states that higher flows (according to professional opinion) may be needed for fish passage between channel units within the bypassed reach.

Thus, NMFS believes that the MIF in the bypassed reach should be 35 cfs and not be based solely on the capacity of the local rearing habitat. Salmonid juveniles would naturally tend to move downstream, out of the Project's bypassed reach, to find suitable rearing habitat. The MIF should include the flows necessary for salmonid passage/migration, spawning, rearing, and holding, which as referenced above, appears to be 3-5 times higher than the Licensee's proposed MIF of 13 cfs.

Furthermore, NMFS provides support for our proposed 35 cfs MIF in an Excel document (filed concurrently with this REA Letter in Enclosure B). The Excel document contains flow vs habitat (PHABSIM) modeling that was developed by the USFWS with data provided by Cramer Fish Sciences (USFWS and CFS, personal communication, 2016). The maximum average habitat for Chinook and steelhead fry and juvenile life stages occurs at 35 cfs within the bypassed reach (assuming suitable water temperatures). In addition, our §10(j) Condition #2, *Water Temperature Monitoring*, proposes that suitable water temperatures should be based on the USEPA's (2003) 7DADM criteria.

Therefore, ensuring that prescribed flows are maintained and adjusted as needed serves to achieve NMFS' Resource Management Goals and Objectives for the Project. The following two Resource Management Goals (Enclosure C, Sections 2.1-2.2) each relate to ten Resource Management Objectives, which are detailed below in Enclosure C, Sections 3.1 to 3.10.

Resource Goal: 2.1 and Corresponding Resource Objectives (3.1-3.10):

Protect, conserve, enhance, and recover native anadromous fishes and their habitats by providing access to suitable habitats and by restoring fully functioning habitat conditions for related rearing and feeding (see 3.1, *Flows*; 3.2, *Flow Ramping*; 3.3, *Water Quality*; and 3.4, *Water Availability*); migration (see 3.5, *Fish Passage*); spawning (See 3.6, *Channel Maintenance*); and adjoining riparian and benthic macroinvertebrate (BMI) habitats (see 3.7, *Riparian and Large Woody Debris/Materials [LWD] Habitat*). In addition, minimize risk to anadromous fishes from predation (see 3.8, *Predation*) and hatchery influences (see 3.9, *Fish Hatchery Operations*) and ensure coordination within the watershed (see 3.10, *Coordination*).

Resource Goal: 2.2 and Corresponding Resource Objectives (3.1-3.10):

Identify and implement measures to enhance and protect, mitigate, or minimize direct, indirect, and cumulative impacts to, native anadromous fish resources, including related rearing and feeding (see 3.1, *Flows*; 3.2, *Flow Ramping*; 3.3, *Water Quality*; and 3.4, *Water Availability*); migration (see 3.5, *Fish Passage*); spawning (See 3.6, *Channel Maintenance*); adjoining riparian and BMI habitats (see 3.7, *Riparian and LWD Habitat*); predation (see 3.8, *Predation*); hatchery influences (see 3.9, *Fish Hatchery Operations*); and ensure watershed-wide coordination (see 3.10, *Coordination*) to minimize risk to anadromous fishes.

Achieving of these Resource Management Goals and Objectives serves to enhance and protect anadromous fish resources, including those species that are ESA-listed and have designated critical habitats, and aid in the recovery of listed species and conservation of their habitats.

6.3 NMFS' §10(j) Condition #2: Water Temperature Monitoring and Criteria

(A) Within 90-days of License issuance, the Licensee shall develop and implement, in consultation with the Resource Agencies, a Water Temperature Monitoring Plan (WTMP). The WTMP shall include the USEPA (2003) 7DADM water temperature criteria (see Part D below) and designate existing water temperature gages (or new gages if needed) that would be used to monitor instream water temperatures between just upstream of the Diversion Dam and just downstream of Panther Grade.

(B) A draft of the WTMP shall be provided to the Resource Agencies for a 60-day review. The Licensee shall incorporate the Resource Agencies comments into a Final WTMP within a 45-day period and file the WTMP, along with documentation of Resource Agency consultations, with FERC. The Licensee shall include a discussion of any comments and recommendations, including a discussion of any measures not included in the WTMP. The Licensee shall implement the WTMP upon approval by FERC.

(C) The locations of water temperature gages are as follows:

1) Just upstream of the Diversion Dam.
2) At the intake's header box, recording what is being diverted into pipeline.
3) Just upstream of Angel Falls.
4) Upstream of Powerhouse Spring Number 4, just downstream of Angel Falls. (between Angel Falls and Powerhouse Spring No. 4).
5) At the Powerhouse discharge (what the powerhouse is discharging)
6) Just downstream of the Powerhouse (or just upstream of Panther Grade).
7) Just downstream of Panther Grade.

(D) Water Temperature Criteria: The water within the bypassed reach shall not exceed the following USEPA (2003) 7DADM water temperature criteria by period given, to the extent controllable by the Project:

1) The water temperature in the Project's bypassed reach shall not exceed the USEPA (2003) 18°C 7DADM water temperature criteria at any time.

2) The water temperature in the Project's bypassed reach shall not exceed the USEPA (2003) 13°C 7DADM water temperature criteria for salmonid spawning from November 1 to March 1.

3) The water temperature in the Project's bypassed reach shall not exceed the USEPA (2003) 16°C 7DADM water temperature criteria for salmonid rearing from March 2 to May 31.

(E) Post-license water temperature monitoring shall determine, using an adaptive management approach, if the water temperature criteria and time periods noted above in D1-D3 are obtainable, if the time periods need to be adjusted, or if more stringent USEPA (2003) 7DADM criteria are needed by month, water year, or salmonid life stages.

(F) To maintain water temperatures in the bypassed reach within the above temperature criteria, the Project's operations shall put more water into the bypassed reach by reducing the diversion rate or by reducing or shutting down power generation as needed.

(G) The compliance point for the 7DADM water temperature criteria shall be measured using gages both upstream and downstream of Angel Falls.

Rationale for NMFS' §10(j) Condition #2

Water temperature compliance should be based on the USEPA's (2003) recommended temperature thresholds to protect salmonids. The EPA (2003) criteria use the 7DADM (average of daily maximums) instead of the daily average. In addition, the USEPA's (2003) criteria include the following additional water temperatures: 13ºC for salmonid spawning and egg incubation; 16ºC for salmonid rearing; and 18ºC for salmonid migration or over-summering. These specific criteria are applicable in this proceeding because the Project it is located in the upper reaches of the South Fork Battel Creek watershed.

NMFS has specified the above USEPA (2003) criteria because migration, over-summering, spawning, and rearing periods are important stages for salmonids. While we have specified water temperature criteria for salmonid migration/over-summering (18ºC), spawning (13ºC), and rearing (16ºC) as well as time periods, this will need confirmation with post-license water temperature monitoring. This is because NMFS does not have confidence in the validity of the Applicant's water temperature model (NMFS 2016). Therefore, we propose that real-time data be collected post-license so that the Project can adaptively manage water temperatures for all periods of salmonid life stages if necessary. Part of that adaptive management process would involve petitioning FERC to confirm or impose additional USEPA (2003) water temperature criteria noted above by salmonid life stage or period if the Resourced Agencies decide that additional criteria are needed.

NMFS's (2016) comments on the water temperature model's development were not very favorable. We noted that the four theoretical test flows were relatively close together and there were no runs using significantly higher flows (such as 75, 150, and 500 cfs) that would occur in winter to spring. The model runs were also done over a 3-month period (May to July) that would be relatively warmer and dryer (using dry and critically dry water year data). Model runs using above normal to wet water year data over late summer, fall, winter, and spring periods are also needed to assess how the Project operations affect CCV steelhead and CV Chinook over the whole year. Thus, we propose the post-license monitoring and an adaptive management approach to better protect salmonids and adjust water temperatures in the bypassed reach via Project operations (to the extent possible). The situation may turn out that more stringent USEPA (2003) 7DADM criteria may be needed by month, water year, or salmonid life stages.

Water temperature monitoring, via a set of gages, is necessary to adaptively manage the Project's operations so as to enhance and protect salmonid resources, including ESA-listed species and designated critical habitats. In addition, ensuring that suitable water temperatures are maintained and adjusted as needed (via increased flows) serves to achieve the following NMFS' Resource Management Goals and Objectives for the Project (detailed in Enclosure C): Resource Management Goals 2.1 and 2.2 and corresponding Objectives (3.1-3.10).

6.3 NMFS' §10(j) Condition #3: Flow Gage Monitoring Plan

(A) Within 90-days of License issuance, the Licensee shall develop and implement, in consultation with the Resource Agencies, a Flow Gage Monitoring Plan (FGMP). The FGMP shall designate existing flow gages (or new gages if needed) that would be used to monitor MIFs between upstream of the Diversion Dam and downstream of Panther Grade.

(B) A draft of the FGMP shall be provided to the Resource Agencies for a 60-day review. The Licensee shall incorporate the Resource Agencies' comments into a FGMP within a 45-day period and file the FGMP, along with documentation of Resource Agency consultations, with FERC. The Licensee shall include a discussion of any comments and recommendations, including a discussion of any measures not included in the FGMP. The Licensee shall implement the FGMP upon approval by FERC.

(C) The locations of flow gages are as follows:

1) Just upstream of the Diversion Dam.
2) At the intake's header box, recording what is being diverted into pipeline.
3) Just upstream of Angel Falls.
4) Upstream of Powerhouse Spring Number 4, just downstream of Angel Falls. (between Angel Falls and Powerhouse Spring No. 4).
5) At the Powerhouse discharge (what the powerhouse is discharging)
6) Just downstream of the Powerhouse (or just upstream of Panther Grade).
7) Just downstream of Panther Grade.

Rationale for NMFS' §10(j) Condition #3

Flow gaging is necessary to monitor compliance with license conditions. Ensuring that prescribed flows are maintained and adjusted as needed serves to achieve the following NMFS' Resource Management Goals and Objectives for the Project (detailed in Enclosure C): Resource Management Goals 2.1 and 2.2 and corresponding Objectives (3.1-3.10).

6.4 NMFS' §10(j) Condition #4: Salmonid Monitoring Plan

(A) Within 90 days of License issuance, the Licensee shall develop and implement, in consultation with the Resource Agencies, a Salmonid Monitoring Plan (SMP) to quarterly monitor the presence of all life stages of both anadromous and resident salmonids within the bypassed reach. Standard fisheries sampling techniques shall be used in the implementation of the SMP (Kohler and Hubert 1999).

(B) A draft of the SMP shall be provided to the Resource Agencies for a 60-day review. The Licensee shall incorporate the Resource Agencies comments into a SMP within a

45-day period and file the SMP, along with documentation of Resource Agency consultations, with FERC. The Licensee shall include a discussion of any comments and recommendations, including a discussion of any measures not included in the SMP. The Licensee shall implement the SMP upon approval by FERC.

(C) The SMP consists of the following actions to monitor for both anadromous and resident salmonids:

1) Snorkel Surveys: The Licensee shall design and implement snorkel surveys once per quarter (seasonally) within the entire bypassed reach to enumerate any salmonids present. The design and implementation of the SMP shall be done, in consultation with the Resource Agencies, using standard techniques, and the results shall include types, numbers, and size-classes of fish observed (Kohler and Hubert 1999).

2) Inform Resource Agencies: The Licensee shall inform FERC and the Resource Agencies when they anticipate implementing the snorkel surveys.

3) Frequency: The Licensee shall do quarterly snorkeling surveys, annually, through the term of the new license.

(D) Reporting: The Licensee shall inform the Resource Agencies if either steelhead/rainbow trout (*O. mykiss*) and/or Chinook salmon (*O. tshawytscha*) are present within the bypassed reach as soon as possible, via email or telephone. Annually, upon completion of quarterly snorkel surveys, the Licensee shall produce an annual draft report containing the methods and results of the quarterly snorkel surveys to the Resource Agencies for review. Results shall include types, numbers, and size-classes of fish observed (Kohler and Hubert 1999). The Licensee shall incorporate the Resource Agencies' comments and provide a final annual report to them and to FERC.

(E) Adaptive Management to Protect Salmonid Resources: The snorkeling information shall be used in an adaptive manner by the Resource Agencies to assess the Project's impacts on salmonids present within the bypassed reach. If the Resource Agencies believe that it is necessary to adjust the Project's operations, to protect salmonid resources and habitats, then the Resource Agencies shall inform FERC as soon as possible and request concurrence for any proposed changes to the Project's operations.

Rationale for NMFS' §10(j) Condition #4

Monitoring for resident *O. mykiss*, steelhead, and any Chinook salmon within the bypass reach via snorkeling actions is necessary to adaptively manage the Project's operations so as to enhance and protect salmonid resources, including ESA-listed species and designated critical habitats. Surveys should be done quarterly to capture any seasonal variations. The quarterly salmonid monitoring upstream of Angel Falls is necessary because any *O. mykiss* residents can exhibit anadromous behavior and emigrate downstream, adding to the potential wild gene pool of both steelhead and resident *O. mykiss*. In addition, NMFS believes that quarterly salmonid monitoring downstream of Angel Falls serves to assess the Project's impacts on not only any resident *O. mykiss*, but more importantly, asses the Project's effects on ESA-listed salmonids and their designated critical habitats. If ESA-listed salmonids are detected downstream of Angel Falls, then the Project's operations may need to be adaptively managed to protect these

ESA-listed species and their designated critical habitats. Finally, ensuring that habitat and flow conditions influenced by the Project within the bypassed reach are suitable for all salmonid resources and habitats serves to achieve the following NMFS' Resource Management Goals and Objectives for the Project (detailed in Enclosure C): Resource Management Goals 2.1 and 2.2 and corresponding Objectives (3.1-3.10).

6.5 NMFS' §10(j) Condition #5: Benthic Macroinvertebrate Monitoring Plan

(A) Within 90-days of license issuance, and after consultation with the Resource Agencies, the Licensee shall file with FERC a Benthic Macroinvertebrate Monitoring Plan (BMMP). The BMMP shall describe the following:

1) The initial BMI baseline and regular BMI sampling, in the Project's bypassed reach.

2) BMI sampling shall be conducted in accordance with the California Stream Bioassessment Procedure (Harrington 2003).

3) Within 60 days of license issuance and prior to the start of Project construction, the Licensee shall conduct baseline BMI surveys of the bypassed reach.

4) Regular BMI surveys shall be conducted in years 2 through 4 and every 4 years thereafter through the term of the license (unless an alternative monitoring schedule is approved in consultation with the Resource Agencies).

(B) A draft of the BMMP shall be provided to the Resource Agencies for a 60-day review. The Licensee shall incorporate the Resource Agencies comments into a BMMP within a 45-day period and file the BMMP, along with documentation of Resource Agency consultations, with FERC. The Licensee shall include a discussion of any comments and recommendations, including a discussion of any measures not included in the BMMP. The Licensee shall implement the BMMP upon approval by FERC.

(C) The BMMP will be used to assess the effects to the benthic macroinvertebrate (BMI) community in the Project's bypassed reach under new flow regimes and other changes stipulated by the new license. Specifically, the plan shall describe the methods the Licensee will use to monitor BMI species composition and relative abundance. Data will be used to determine trends in the BMI community structure, as represented by metrics (*e.g.*, taxa richness, EPT index, tolerance value), in the California Stream Bioassessment Procedure (Harrington 2003) and determine the trends in metrics within reaches, between reaches, and in comparison with previous results.

(D) When scheduling sampling site selection or field data collections, the Licensee shall notify the Resource Agencies at least 30-days in advance to provide the opportunity to participate or observe. If field conditions or operational situations preclude a 30-day notification, the Licensee will provide notice as far in advance as feasible.

(E) The Licensee shall provide results of BMI monitoring to the Resource Agencies in a technical report following completion of each sampling effort. In addition to describing the results, the report shall compare the results with those of previous surveys. Finally, if the

Resource Agencies determine, based upon the results of BMI monitoring, that the project is having unmitigated impacts to BMI, the license shall include in the technical report, its recommendations for mitigating impacts to BMI.

Rationale for NMFS' § 10(j) Condition #5

The Licensee did not provide any past or current information regarding aquatic BMI assemblages within the bypassed reach in its FLA. Aquatic BMI assemblages are communities of aquatic macroinvertebrates that serve as "sensitive species assemblages." BMI are an integral part of a stream's ecosystem, are important food sources for resident stream fish, and the quality of the BMI community and its structure reflects the degree of impairment that exists within a stream's ecosystem.

The Project's operations and proposed MIF in the bypassed reach could affect the BMI composition and diversity. The BMMP will be used to assess the effects to the BMI community in the Project's bypassed reach under new flow regimes and other changes stipulated by the new license. BMI data will be used to determine trends in the BMI community structure, as represented by metrics (*e.g.*, taxa richness, EPT index, tolerance value), in the California Stream Bioassessment Procedure (Harrington 2003) and determine the trends in metrics within reaches, between reaches, and in comparison with previous results. Project impacts can be assessed by (1) describing differences in BMI assemblages at study sites upstream and downstream of Project facilities and (2) identifying the Project's effects on the BMI community by comparing BMI assemblages across study sites and to reference sites. In addition, changes in flow, organic matter/debris, substrate, etc. may be necessary to mitigate Project impacts on BMI. Finally, ensuring that habitat and flow conditions influenced by the Project within the bypassed reach are suitable for all BMI resources and habitats serves to achieve the following NMFS' Resource Management Goals and Objectives for the Project (detailed in Enclosure C): Resource Management Goals 2.1 and 2.2 and corresponding Objectives (3.1-3.10).

6.6 NMFS' §10(j) Condition #6: Debris and Sediment Management

(A) Within 90 days of License issuance, in consultation with the Resource Agencies, the Licensee shall develop and implement a Debris and Sediment Management Plan (DSMP). The DSMP shall describe the operations and actions that would ensure the periodic downstream transport of substrates would occur past the Project's dam. Such substrates include small and large woody debris (S/LWD) and sediment that becomes trapped behind the Project's dam. The DSMP shall also detail the monitoring of such substrate transport and assess the riparian habitat's response to the Project's operations.

(B) A draft of the DSMP shall be provided to the Resource Agencies for a 60-day review. The Licensee shall incorporate the Resource Agencies comments into a DSMP within a 45-day period and file the DSMP, along with documentation of Resource Agency consultations, with FERC. The Licensee shall include a discussion of any comments and recommendations, including a discussion of any measures not included in the DSMP. The Licensee shall implement the DSMP upon approval by FERC.

(C) The main actions in the DSMP include the following:

1) Sediment: The License shall operate the sluice gate in the dam periodically during high flows such that accumulated sediment can continue downstream. The DSMP shall provide details of this operation and when it would be implemented.

2) Small/Large Woody Debris: Periodically, after high flows have receded, the Licensee shall remove S/LWD, impinged on or blocked by the dam, and place it downstream of the dam and back into the active channel. The DSMP shall provide details of this operation and when it would be implemented.

3) Monitoring: The plan shall include a monitoring component to measure the sediment retention upstream of the sluice gate, the debris and sediment distribution downstream of the dam, and the riparian habitat's response to the new conditions resulting from the Project. At a minimum, the downstream monitoring shall include:

(a) Reach-wide parameters (e.g., total length and gradient, average width and depth);
(b) wetted width of each riffle;
(c) water velocity;
(d) relative substrate composition (i.e., fines, gravel, cobble, boulder, and bedrock);
(e) a pebble count;
(f) substrate consolidation and percent embeddedness; and
(g) canopy cover, height, and breast-height diameter of canopy trees shading the stream.

Rationale for NMFS' §10(j) Condition #6

(A) Sediment Management:
The Licensee proposes to have a sediment/gravel sluice gate as part of its dam. Thus, while salmonid spawning gravel transport would be interrupted by the Project's dam, such sediment would be allowed seasonally to move downstream during high flow events. This term ensures that the Licensee operates the sediment sluice gate at appropriate, seasonal, high-flow periods.

The availability of suitable spawning gravel below dams is necessary to mitigate and minimize direct, indirect, and cumulative impacts of a Project's facilities and operations on sediment movement and deposition, river geometry, channel characteristics, and BMI communities. This includes impacts on stream competence, capacity, flood plain conductivity, bank stability and extent, duration, and repetition of high flow events. In addition, this includes impacts to habitat diversity and complexity such as pool/riffle sequencing, availability of suitable salmonid spawning gravels, and instream cover as well as the quality of BMI/forage communities. Suitable spawning habitat typically consists of gravels of a size that are movable by females during redd construction, low levels of fine sediment accumulation, and gravel permeability sufficient to allow minimum intra-gravel dissolved oxygen and water velocity requirements of salmonid eggs (Kondolf 2000a; 2000b; Merz and Setka 2004).

(B) S/LWD Management:
Stream flow in the vicinity of LWD develops complex structures that promote gravel deposition, substrate rejuvenation, and hyporheic flows (Abbe *et al.* 2003; Bryant *et al.* 2005). Anchored or lodged LWD can create complex in-channel hydraulics that promote zones of scour and

deposition, creating accumulations of spawning gravels for Pacific salmon, providing hydraulic refugia (Bisson *et al.* 1987), and creating pools by forcing flows to scour channel beds and banks. Such processes also create cover and refugia zones for juvenile fish rearing and adult fish holding (Roni and Quinn 2001). Channel complexity and habitat heterogeneity associated with individual LWD pieces and aggregations offers all salmonid life stages hydraulic and thermal refugia, structural partitioning that provides protection from predation, and visual isolation that lowers interspecies competition (Dolloff 1983). The wood itself supplies nutrients and substrate for aquatic organisms (Anderson *et al.* 1978). Moreover, structural properties of LWD are a factor in the retention of salmonid carcasses, which provide important marine-derived nitrogen (N) to N-limited terrestrial ecosystems and organic nutrients to salmon juveniles, macroinvertebrates, terrestrial animals, and birds (Naiman *et al.* 2002; Merz and Moyle 2006).

(C) Monitoring Sediment and Riparian Response:
Downstream monitoring is needed to quantify Project effects on the dewatered reach. The nature of sediment pass-through devices is that they become impacted over time by the various shapes and sizes of sediment moving through. Over time, these devices can fail, causing sediment and rough material to be caught behind the dam. In order to assure that the sediment pass-through device continues to be effective and operational, monitoring is needed.

Additionally, the data collected in the riparian monitoring component will allow for tracking to determine changes over time in lateral distribution of riparian species and the relative contribution of the riparian overstory to salmonid habitat. Of particular interest will be the changes in substrate composition and distribution, changes in canopy biomass and cover, and the presence or absence of mature canopy trees in areas with substrates capable of supporting them.

At a minimum, the downstream monitoring of sediment and riparian response shall include:

1) Reach-wide parameters (e.g., total length and gradient, average width and depth;
2) Wetted width of each riffle.
3) Water velocity.
4) Relative substrate composition (i.e., fines, gravel, cobble, boulder, and bedrock).
5) A pebble count.
6) Substrate consolidation and percent embeddedness.
7) Canopy cover, height, and breast-height diameter of canopy trees shading the stream.

(D) Riparian Habitat's Value to Salmonids:
Riparian habitat is critically important for juvenile salmonids, because it provides food, cover, refugia from high flows, and thermal diversity to enhance growth. Terrestrial in-fall from riparian invertebrates contributes to the energetics of the river and to the salmonid food web (Allan *et al*. 2003). Insect biomass from in-water decomposition significantly enhances juvenile salmonid recruitment (Cederholm *et al*. 2000). Access to a productive floodplain and riparian area results in positive, population-level effects to steelhead trout (Hayes *et al*. 2008), and the benefit of off-channel and floodplain access to Chinook salmon survivorship has been well established (Jeffres *et al*. 2008, Limm and Marchetti 2009, Sommer *et al*. 2005).
The primary energetic drivers of riparian ecosystem function are organic matter from riparian vegetation and riparian insects and marine-derived nutrients from anadromous fish (Allan *et al*. 2003, Cederholm *et al*. 2000, Cummins *et al*. 1989, Pozo *et al*. 1997, Ward and Stanford 1995). Without invertebrate contribution from the riparian edge, food availability for juvenile salmonids

is severely limited, and it is the ecological processes of the riparian habitat that function to enhance food quantity and availability. For example, Cummins *et al*. (1989) describe a suite of invertebrate taxa grouped in a category called "shredders" that collectively contribute to the invertebrate biomass in rivers. Shredders feed on "conditioned" plant litter that has been leached in the aquatic environment and colonized by microorganisms, with the conditioning taking from weeks to months depending upon plant species and stream temperature" (page 24 of Cummins *et al*. 1989). Common prey species, for both adult and juvenile salmonids, fall into the category of shredders (*i.e.*, amphipods, isopods, stoneflies, caddisflies, and some mayflies). Shredders convert organic matter (*e.g.*, leaves, twigs, and woody debris) into fine particulate organic matter. Short and Maslin (1977) found that the fine particulate organic matter contribution made by shredders contributed significantly to the food resource base for the invertebrate "collectors" that are also important prey for juvenile and adult salmonids. Consequently, the ecological chain of shredders, conditioners, and collectors allows the riparian ecosystem to provide prey biomass to both the main channel and to off-channel areas.

(E) Goals and Objectives:
Finally, ensuring that sediment and S/LWD can periodically be transported downstream of the Project's dam, the monitoring of such substrate movement, and the monitoring of the riparian habitat's response will benefit all salmonid resources and habitats. In addition, such substrate transport also serves to achieve the following NMFS' Resource Management Goals and Objectives for the Project (detailed in Enclosure C): Resource Management Goals 2.1 and 2.2, their corresponding Objectives 3.1-3.5, 3.6 (*Channel Maintenance*), 3.7 (*Riparian/LWD Management*), and the remaining Objectives 3.8 to 3.10.

7.0 NMFS' §10(a) Recommendations

NMFS is not providing any separate §10(a) Recommendations at this time. Accordingly, we are requesting that our §10(j) Conditions be incorporated into any license issued for this Project under §10(a). We realize that our jurisdiction extends up to Angel Falls; however, we have nevertheless provided §10(j) Conditions for the entire Project's bypassed reach for brevity. Therefore, some portions of our §10(j) Conditions could also be considered under §10(a), particularly those portions that have plans or actions located upstream of Angel Falls. Finally, we believe that our FPA Terms are appropriate for this Project and should be incorporated as terms in the new license to protect both anadromous and resident salmonids and their respective habitats, including any ESA-designated critical habitats and essential fish habitat for Pacific salmon.

8.0 References

Abbe, T.B., Brooks, A.P., Montgomery, D.R. 2003. Wood in river Rehabilitation and Management. In: Gregory, S.V., Boyer, K.L., Gurnell, A.M. (Eds.), American Fisheries Society, Bethesda, MD, pp. 367-389.

Allen, J. D., M. S. Wipfli, J. P. Caouette, A. Prussian, and J. Rodgers. 2003. Influence of streamside vegetation on inputs of terrestrial invertebrates to salmonid food webs. Canadian Journal of Fisheries and Aquatic Sciences 60:309-320.

Anderson, N. H., Swell, J. R., Roberts, L. M., and Tema, F. 1978. The role of aquatic invertebrates in processing of wood debris in coniferous forest streams. Amer. Midi. Nat. 100:64-82.

Bryant, M.D.; Edwards, R.T.; Woodsmith, R.D. 2005. An approach to effectiveness monitoring of floodplain channel aquatic habitat: salmonid relationships. Landscape and Urban Planning. 72: 157–176.

Bisson, P. A., R. E. Bilby, M. D. Bryant, C. A. Dolloff, G. B. Grette, R. A. House, M. L. Murphy, K. V. Koski, and J. R. Sedell. 1987. Large woody debris in forested streams in the Pacific Northwest: past, present and future. Pages 143-190 in E.O. Salo and T.W. Cundy, editors. Streamside Management Forestry and Fishery Interactions. Univ. of Wash., Institute for Forest Resources, Contribution 57, Seattle, WA.

Cederholm, C. J., D. H. Johnson, R. E. Bilby, L.G. Dominguez, A. M. Garrett, W. H. Graeber, E. L. Greda, M. D. Kunze, B.G. Marcot, J. F. Palmisano, R. W. Plotnikoff, W. G. Pearcy, C. A. Simenstad, and P. C. Trotter. 2000. Pacific Salmon and Wildlife - Ecological Contexts, Relationships, and Implications for Management. Special Edition Technical Report, Prepared for D. H. Johnson and T. A. O’Neil (Managing directors), Wildlife-Habitat Relationships in Oregon and Washington. Washington Department of Fish and Wildlife, Olympia, Washington.

Cummins, K. W., M. A. Wilzbach, D. M. Gates, J. B. Perry, and W. B. Taliaferro. 1989. Shredders and riparian vegetation. BioScience 39(1):24-30.

Docker, M.F. and D.D. Heath. 2003. Genetic Comparison between Sympatric Anadromous Steelhead and Freshwater Resident Rainbow Trout in British Columbia, Canada. *Conservation Genetics* 4: 227–231, 2003. *Kluwer Academic Publishers.*

Dolloff, C.A. 1983. The relationships of wood debris to juvenile salmonid production and microhabitat selection in small southeast Alaska streams. Bozeman, MT: Montana State University. 100 p. Ph.D dissertation.

Harrington, J. M. 2003. *California Stream Bioassessment Procedures*. CDFG, Water Pollution Control Laboratory, Rancho Cordova, California.

Hayes, S. A., M. H. Bond, C. V. Hanson, E. V. Freund, J. J. Smith, E. C. Anderson, A. J. Ammann, and R. B. MacFarlane. 2008. Steelhead growth in a small central California watershed: upstream and estuarine rearing patterns. Transactions of the American Fisheries Society 137:114-128.

Hogan, D.L. and M. Church. 1989. Hydraulic geometry in small, coastal streams; progress toward quantification of salmonid habitat. Can. J. Fish. Aquat. Sci. 46: 844-852.

Jeffres, C. A., J. J. Opperman and P. B. Moyle. 2008. Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river. Environmental Biology of Fishes 83:449-458.

Jowett, I.G. 1998. Hydraulic geometry of New Zealand rivers and its use as a preliminary method of habitat assessment. Regl. Rivers: Res. Mgmt. 14: 451 – 466.

Kohler, C. C. and W. A. Hubert, Editors. 1999. Inland Fisheries management in North America, 2nd Edition. American Fisheries Society, Bethesda Maryland.

Kondolf, G.M. 2000a. Some suggested guidelines for geomorphic aspects of anadromous salmonid habitat restoration proposals. Restoration Ecology 8: 48–56.

Kondolf, M. G. 2000b. Assessing salmonid spawning gravel quality. Transactions of the American Fisheries Society. 129: 262-281.

Limm, M. P., and M. P. Marchetti. 2009. Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) grown in off-channel and main-channel habitats on the Scremento River Ca using ototlith increment widths. Environmental Biology of Fishes 85:141-151.

Merz, J.E. and P.B. Moyle. 2005. *Salmon, Wildlife, and Wine: Marine-Derived Nutrients in Human-Dominated Ecosystems of Central California*. Report provided to the East Bay Municipal Utility District, Lodi, California, and U.C. Davis, Davis, California.

Merz, J. E. and J. D. Setka. 2004. Evaluation of a spawning habitat enhancement site for Chinook salmon in a regulated California river. North American Journal of Fisheries Management. 24:397-407.

Naiman, R. J., R. E. Bilby, D. E. Schindler, and J. M. Helfield. 2002. Pacific salmon, nutrients, and the dynamics of freshwater and riparian ecosystems. Ecosystems 5: 399–417.

National Marine Fisheries Service (NMFS). 2014a. *Final Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead*. NMFS, West Coast Region, Sacramento, CA. July 22, 2014.

NMFS. 2016. Letter from Steve Edmondson (NMFS) to Secretary Bose (FERC), Re: "*NOAA Fisheries Service's Comments on Final Reports for the Lassen Lodge Hydroelectric Project, Federal Energy Regulatory Commission Project No. 12496-002, South Fork Battle Creek, California*. NMFS, West Coast Region, Sacramento, CA. January 15, 2016.

Pacific Fisheries Management Council (PFMC). 1999. Pacific Fishery Management Council. Description and identification of essential fish habitat, adverse impacts and recommended conservation measures for salmon. *Amendment 14 to the Pacific Coast Salmon Plan, Appendix A*. Pacific Fisheries Management Council, Portland, Oregon.

Pozo, J., E. González, J. R. Díez, J. Molinero, and A. Elósegui. 1997. Inputs of particulate organic matter to streams with different riparian vegetation. Journal of the American Benthological Society 16(3):602-611.

Roni, P. and T.P. Quinn. 2001. Density and size of juvenile salmonids in response to placement of large woody debris in western Oregon and Washington streams. Canadian Journal of Fisheries and Aquatic Sciences 58*:* 282–292.

Sommer, T. R., W. C. Harrel, A. M. Solger, B. Tom, and W. J. Kimmerer. 2004(a). Effects of flow variation on channel and floodplain biota and habitats of the Sacramento River, California, USA. Aquatic Conservation Marine and Freshwater Ecosystems 14:246-261.

Thrower, F.P., *et al*. 2004. Genetic Architecture of Growth and Early Life-History Transitions in Anadromous and Derived Freshwater Populations of Steelhead. *Journal of Fish Biology (2004) 65 (Supplement A), 286–307*. Available online at http://www.blackwell-synergy.com.

U.S. Bureau of Reclamation (USBR), NMFS, USFWS, CDFG, and Pacific Gas and Electric Company, Inc. 2004. Battle Creek Salmon and Steelhead Restoration Project (BCSSRP) Draft Adaptive Management Plan (AMP). Prepared by Terraqua, Inc. April 2004.

USBR. 2014. USBR's website: The Battle Creek Salmon and Steelhead Restoration Project (BCSSRP). http://www.usbr.gov/mp/battlecreek/index.html.

U.S. Fish and Wildlife Service (USFWS) and Cramer Fish Sciences (CFS). 2016. Personal communication: Excel file with flow-habitat PHABSIM modeling based on CFS' pressure-transducer and flow data.

Ward, J. V., and J. A. Stanford. 1995. Ecological connectivity in alluvial river ecosystems and its disruption by flow regulation. Regulate Rivers: Research & Management 11(1):105-119.

Federal Register Notices (FR)

FR. 1993. 58 FR 33212, June 16, 1993. Designated Critical Habitat for Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit. Final Rule.

FR. 1994. 59 FR 440, January 4, 1994. Endangered and Threatened Species; Status of Sacramento River winter-run Chinook salmon (as Endangered). Final Rule.

FR. 1999. 64 FR 50394, September 16, 1999. Endangered and Threatened Species: Threatened Status for Two Chinook Salmon Evolutionarily Significant Units in California. Final Rule.

FR. 2005. 70 FR 52488, September 2, 2005. Endangered and Threatened Species: Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California. Final Rule.

FR. 2006a. 71 FR 834, January 5, 2006. Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead. Final Rule.

FR. 2006b. 71 FR 61022, October 17, 2006. Endangered and Threatened Species: Revision of Species of Concern List, Candidate Species Definition, and Candidate Species List.

FR. 2008. 73 FR 60987, October 15, 2008. Fisheries off West Coast States; West Coast Salmon Fisheries; Amendment 14; Essential Fish Habitat Descriptions for Pacific Salmon. Final Rule.

Enclosure B

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Lassen Lodge, LLC	**)**	**Project No. P-12496-002**
Lassen Lodge Hydroelectric Project	**)**	
South Fork Battle Creek	**)**	

FLOW-HABITAT MODELING (EXCEL) FOR DETERMINING MINIMUM INSTREAM FLOW IN THE PROJECT'S BYPASSED REACH

An Excel file, provided by the U.S. Fish and Wildlife Service (USFWS), is concurrently filed with NMFS' Letter. The Excel file contains Flow-Habitat Modeling (PHABSIM) that supports NMFS' proposed minimum instream flow of 35 cfs in the Project's bypassed reach (USFWS and Cramer Fish Sciences [CFS], personal communication, 2016). USFWS's analysis used data provided by CFS. The maximum average habitat for Chinook and steelhead fry and juvenile life stages occurs at 35 cfs.

Reach Area Weighted Suitability (ft^2/ft)

Proportion of reach : 100.00 %

1:- Chinook juvenile [CH-J] (Payne and Associates (1995))

2:- Chinook fry [CH-F] (Payne and Associates (1995))

3:- Steelhead juvenile [SH-J] (Payne and Associates (1995))

4:- Steelhead fry [SH-F] (Payne and Associates (1995))

Flow (cfs)	CH-J	CH-F	SH-J	SH-F	CH-J	CH-F	SH-J	SH-F	Mean	Flow (cfs)
5	1.426	5.019	3.285	4.962	9.9%	37.7%	18.6%	40.0%	26.5%	**5**
10	3.115	7.853	6.817	9.154	21.6%	59.0%	38.6%	73.9%	48.2%	**10**
13	4.6492	9.155	8.8978	10.2646	32.2%	68.8%	50.4%	82.8%	58.5%	**13**
15	5.672	10.023	10.285	11.005	39.2%	75.3%	58.2%	88.8%	65.4%	**15**
20	8.496	11.939	12.955	11.424	58.8%	89.7%	73.3%	92.2%	78.5%	**20**
25	10.84	13.316	14.919	12.392	75.0%	100.0%	84.4%	100.0%	89.9%	**25**
30	12.93	13.2	16.958	12.211	89.5%	99.1%	96.0%	98.5%	95.8%	**30**
35	14.067	13.168	17.669	11.146	97.3%	98.9%	100.0%	89.9%	96.5%	**35**
40	14.452	12.938	17.577	9.838	100.0%	97.2%	99.5%	79.4%	94.0%	**40**
45	14.248	12.486	17.169	9.068	98.6%	93.8%	97.2%	73.2%	90.7%	**45**
50	13.814	11.923	16.625	8.37	95.6%	89.5%	94.1%	67.5%	86.7%	**50**
55	13.366	11.348	15.988	7.479	92.5%	85.2%	90.5%	60.4%	82.1%	**55**
60	12.9	10.564	15.212	6.658	89.3%	79.3%	86.1%	53.7%	77.1%	**60**
65	12.358	9.837	14.343	5.951	85.5%	73.9%	81.2%	48.0%	72.1%	**65**

Enclosure C

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Lassen Lodge, LLC	**)**	**Project No. P-12496-002**
Lassen Lodge Hydroelectric Project	**)**	
South Fork Battle Creek	**)**	

U.S. DEPARTMENT OF COMMERCE, NOAA FISHERIES SERVICE, WEST COAST REGION, RESOURCE MANAGEMENT GOALS AND OBJECTIVES FOR THE PROJECT

1.0 Introduction

Rugraw, LLC (Applicant), filed a Final License Application on April 21, 2014, with the Federal Energy Regulatory Commission (FERC) for the Lassen Lodge Hydroelectric Project, FERC No. P-12496-002 (Project), located on the South Fork Battle Creek, California, between river miles (RM) 23.0 to 20.30. On April 25, 2016, FERC issued its "Notice of Application Ready for Environmental Analysis" (REA Notice). Therefore, the U.S. Department of Commerce, NOAA Fisheries Service, West Coast Region (NMFS), files with FERC our Federal Power Act (FPA) Comments; preliminary §18 Prescriptions, §10(j) Conditions, and §10(a) Recommendations (FPA Terms) in Enclosures A and above; and our Resource Management Goals and Objectives that support our FPA Terms in this Enclosure C.

Subject to certain exceptions, the FPA §10(j) states that,

> "...i*n order to adequately and equitably protect, mitigate damages to, and enhance, fish and wildlife (including related spawning grounds and habitat) affected by the development, operation, and management of the project, each license issued under this subchapter shall include conditions for such protection, mitigation, and enhancement… based on recommendations received pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) from the National Marine Fisheries Service, the United States Fish and Wildlife Service, and State fish and wildlife agencies*." [16 U.S.C. § 803(j)]

The FERC's licensing regulations likewise request that Resource Agencies list their resource management goals and objectives to serve as the basis for study recommendations and subsequent prescriptions and recommendations for a project's protection, mitigation, and enhancement measures to be incorporated into a new license. See, *e.g.*, 18 CFR §5.9(b) (2) and 18 CFR §5.26(b). NMFS articulates its Resource Management Goals and Objectives broadly in connection with these responsibilities, and consistently with the guidelines for determining the scope of a licensing action.

The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq*.), together with its implementing regulations, require FERC to analyze the direct and indirect environmental effects and cumulative impacts of a project's alternatives and connected actions. The Council on Environmental Quality regulations under 40 CFR 1508.8 (b) defines indirect effects as:

> "[*effects*]...*which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include human population growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems."*

Cumulative impacts, in turn, are those combined effects on quality of the human environment that result from:

> *"[… the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what Federal or non-Federal agency or person undertakes such other actions…"] (40 CFR 1508.7, 1508.25(a), and 1508.25(c)).*

Therefore, NMFS' Resource Management Goals and Objectives for the Project, as well as our FPA Terms (discussed in Enclosure A), seek, in part, information relating not simply to the direct and immediate effects of the Project, but also the indirect and cumulative effects. In the context of the foregoing authorities, NMFS' Resource Management Goals and Objectives apply with respect to species listed under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. §1801 *et seq*.) and the Endangered Species Act (ESA) (16 U.S.C. §1531 *et seq*.). This also includes anadromous fish and resident salmonids that are not currently listed but are affected by continuing operations of the Project or may require listing in the future. Thus, our Resource Management Goals and Objectives, listed in Sections 2.0 and 3.0 below, augment the information that we have filed on the FERC record for this proceeding. Such information (applicable to the South Fork Battle Creek) collectively supports our FPA Terms, enhances anadromous and resident salmonid resources, supports the recovery of ESA-listed species, and protects ESA-designated critical habitats as noted below (NMFS 2014):

- Sacramento River (SR) winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*), (Endangered) (59 FR 440, January 4, 1994);
- Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) (Threatened/Critical Habitat to RM 22.3) (64 FR 50394, September 16, 1999 / 70 FR 52488, September 2, 2005);
- California CV (CCV) steelhead (*O. mykiss*) (Threatened/Critical Habitat to RM 22.3) (71 FR 834, January 5, 2006 / 70 FR 52488, September 2, 2005);
- CV fall-/late fall- (fall-run) Chinook salmon (*O. tshawytscha*) (Species of Concern and access to RM 22.3) (73 FR 60987, October 15, 2008);
- Pacific Chinook salmon, all ESUs (*O. tshawytscha*) (Essential Fish Habitat to RM 22.3) (PFMC 1999; 71 FR 61022, October 17, 2006) and
- Resident *O. mykiss* within the 2.4 RM bypassed reach, upstream and downstream of Angel Falls (RM 22.3).

Thus, as discussed in Enclosure A, NMFS is concerned with the Project's effects on fish and habitats within the Project's bypassed reach: upstream of the ESA-designated limit of anadromy (Angel Falls at RM 22.3) for resident *O. mykiss* and for anadromous fish resources downstream of Angel Falls (1.7 RM of ESA-designated critical habitats noted above are within the Project's bypassed reach). Thus, NMFS finds that consultation will be necessary under the ESA and the MSA for the effects of the Project on the various salmonids and habitats noted above.

2.0 NMFS' Resource Management Goals for the South Fork Battle Creek

The following two Resource Management Goals (2.1-2.2) each relate to ten Resource Management Objectives, which are detailed below in Sections 3.1 to 3.10. The achievement of these Resource Management Goals and Objectives serves to enhance and protect anadromous fish resources, including those species that are ESA-listed and have designated critical habitats, and aid in the recovery of listed species and conservation of their habitats.

Goal: 2.1 - Protect, conserve, enhance, and recover native anadromous fishes and their habitats by providing access to suitable habitats and by restoring fully functioning habitat conditions for related rearing and feeding (see 3.1, *Flows*; 3.2, *Flow Ramping*; 3.3, *Water Quality*; and 3.4, *Water Availability*); migration (see 3.5, *Fish Passage*); spawning (see 3.6, *Channel Maintenance*); and adjoining riparian and benthic macroinvertebrate (BMI) habitats (see 3.7, *Riparian and Large Woody Debris/Materials [LWD] Habitat*). In addition, minimize risk to anadromous fishes from predation (see 3.8, *Predation*) and hatchery influences (see 3.9, *Fish Hatchery Operations*) and ensure coordination within the watershed (see 3.10, *Coordination*).

Goal: 2.2 - Identify and implement measures to enhance and protect, mitigate, or minimize direct, indirect, and cumulative impacts to, native anadromous fish resources, including related rearing and feeding (see 3.1, *Flows*; 3.2, *Flow Ramping*; 3.3, *Water Quality*; and 3.4, *Water Availability*), migration (see 3.5, *Fish Passage*), spawning (See 3.6, *Channel Maintenance*), adjoining riparian and BMI habitats (see 3.7, *Riparian and LWD Habitat*); predation (see 3.8, *Predation*); hatchery influences (see 3.9, *Fish Hatchery Operations*); and ensure watershed-wide coordination (see 3.10, *Coordination*) to minimize risk to anadromous fishes.

3.0 NMFS' Resource Objectives for the South Fork Battle Creek

Objective 3.1: Flows - Implement scheduled flows in the South Fork Battle Creek watershed to the benefit of native anadromous fishes and their habitats. A range or schedule of flows is necessary to:

a) optimize suitable habitat, including the distribution of holding, spawning, rearing, and forage community, including BMI habitats;
b) stabilize flows during spawning and incubation of in-gravel forms;
c) maintain flows necessary to facilitate the efficient migration of spawning adults, the safe and timely emigration of smolts and kelts, and movement of rearing juveniles between feeding and sheltering areas;
d) maintain flows necessary to ensure redd placement in viable areas; and
e) maintain flows necessary for channel forming processes, riparian habitat protection and maintenance, and movement of BMI and forage communities.

In addition, scheduled flows should mitigate for impacts of flood control, irrigation, or other Project structures or operations that act to displace individuals or their forage or destabilizes, scours, or degrades physical, chemical, or biological quality of habitat.

Objective 3.2: Flow Ramping - Modify Project structures or operations necessary to minimize impacts of flow fluctuations associated with increases or decreases in Project discharges on anadromous salmonids and BMI as well as their habitats.

Objective 3.3: Water Quality - Modify Project structures or operations necessary to mitigate direct, indirect, or cumulative water temperature and quality impacts associated with Project' structures and operations or enhance water temperature and quality conditions in salmonid habitat. This includes water temperature management necessary to ensure the optimal survival and distribution of all life stages of anadromous fishes and forage/BMI communities within and downstream of the FERC-delineated physical project boundaries**.** In this Project, water temperatures in the bypassed reach should not exceed the U.S. Environmental Protection Agency's (2003) 7-Day Average of the Daily Maximum (7DADM) criteria for salmonids.

Objective 3.4: Water Availability - Coordinate operations with other projects, programs, or initiatives and use water transfers, water exchanges, water purchases, or other forms of agreements to maximize potential benefits to anadromous fishes and aquatic habitat from limited water supplies.

Objective 3.5: Fish Passage – The information that we have filed to date on the FERC record for this proceeding seeks to describe and understand the anadromous species we are concerned about as well as the many factors that affect the anadromous species' aquatic environment including affects attributed to the Project. For each anadromous species we are concerned about, our decision to exercise our FPA §18 authority, by either reserving our fish passage prescriptive authority or stipulating a fish passage prescription, depends on an understanding of many factors affecting the aquatic environment. Understanding how the factors below relate to our species informs how we may achieve our fish passage objectives. These factors include:

a) Man-made, in-stream facilities, their interrelated operations, and their direct, indirect, and cumulative effects on fish and other aquatic organisms;
b) Life history adaptations and biological requirements of affected anadromous fish species;
c) Natural and project-impaired river hydrology and geomorphology;
d) Assessing the relative loss of salmon-derived nutrients within areas of the watershed that are currently blocked to anadromous fish passage (Merz and Moyle 2005); and
e) Seasonal habitat conditions and ecologically sustainable river characteristics.

Ultimately, our main fish passage objectives include the following:

a) Provide and ensure the safe, timely, and effective passage of anadromous fishes to suitable spawning, rearing, holding, and migration habitats within and beyond the physical Project boundaries.
b) Provide such passage as necessary for anadromous fish to complete their life cycles and utilize seasonal habitats necessary to contribute to the recovery of SR winter-run Chinook salmon, CV spring-run Chinook salmon, CV fall-run Chinook salmon, and CV steelhead.

Objective 3.6: Channel Maintenance - Implement flow regimes and non-flow related measures, such as spawning gravel enhancements, necessary to mitigate and minimize direct, indirect, and cumulative impacts of Project's facilities and operations on sediment movement and deposition, river geometry, channel characteristics, and BMI communities. This includes impacts on stream competence, capacity, flood plain conductivity, bank stability and extent, duration, and repetition of high flow events. In addition, this includes impacts to habitat diversity and complexity such as pool/riffle sequencing, availability of suitable salmonid spawning gravels, and instream cover as well as the quality of BMI/forage communities.

Objective 3.7: Riparian and Large Woody Debris/Materials Habitat - Protect, mitigate or minimize direct, indirect, and cumulative impacts to, and enhance riparian and instream large woody debris/materials (LWD) habitat and associated forage/BMI communities, as well as habitat functions necessary to mitigate and minimize direct, indirect, and cumulative impacts of Project's facilities and operations.

Objective 3.8: Predation - Minimize and mitigate the impact of Project's structures or operations that either have in the past or continue to introduce predators, create suitable habitat for predators, harbor predators, or are conducive to the predation of native anadromous salmonids.

Objective 3.9: Fish Hatchery Operations - Minimize and mitigate the impacts of fish hatchery facilities and operations on native, wild, anadromous salmonids and their habitats. These include the direct, indirect, and cumulative impacts of hatchery product, facilities, and operations on anadromous salmonid resources.

Objective 3.10: Coordination - In developing alternatives for relicensing, include a full range of alternatives for modifying Project's and non-project structures and operations to the benefit of anadromous fishes, including anadromous salmonids and their habitats, while minimizing conflicts with operational requirements and other beneficial uses. This includes developing alternatives for greater coordination with other stakeholders and water development projects within the watershed to ensure that, at a minimum, the Project's structures and operations are consistent with and can potentially enhance on-going and future restoration efforts.

4.0 REFERENCES

Merz, J.E. and P.B. Moyle. 2005. *Salmon, Wildlife, and Wine: Marine-Derived Nutrients in Human-Dominated Ecosystems of Central California*. Report provided to the East Bay Municipal Utility District, Lodi, California, and U.C. Davis, Davis, California.

National Marine Fisheries Service (NMFS). 2014a. *Final Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead*. NMFS, West Coast Region, Sacramento, CA. July 22, 2014.

Pacific Fisheries Management Council (PFMC). 1999. Pacific Fishery Management Council. Description and identification of essential fish habitat, adverse impacts and recommended conservation measures for salmon. *Amendment 14 to the Pacific Coast Salmon Plan, Appendix A*. Pacific Fisheries Management Council, Portland, Oregon.

U.S. Environmental Protection Agency (EPA). 2003. *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards.* EPA 910-B-03-002. Region 10 Office of Water, Seattle, Washington.

<u>Federal Register Notices (FR)</u>

FR. 1993. 58 FR 33212, June 16, 1993. Designated Critical Habitat for Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit. Final Rule.

FR. 1994. 59 FR 440, January 4, 1994. Endangered and Threatened Species; Status of Sacramento River winter-run Chinook salmon (as Endangered). Final Rule.

FR. 1999. 64 FR 50394, September 16, 1999. Endangered and Threatened Species: Threatened Status for Two Chinook Salmon Evolutionarily Significant Units in California. Final Rule.

FR. 2005. 70 FR 52488, September 2, 2005. Endangered and Threatened Species: Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California. Final Rule.

FR. 2006a. 71 FR 834, January 5, 2006. Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead. Final Rule.

FR. 2006b. 71 FR 61022, October 17, 2006. Notice, Endangered and Threatened Species: Revision of Species of Concern List, Candidate Species Definition, and Candidate Species List.

FR. 2008. 73 FR 60987, October 15, 2008. Fisheries off West Coast States; West Coast Salmon Fisheries; Amendment 14; Essential Fish Habitat Descriptions for Pacific Salmon. Final Rule

Enclosure D

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Lassen Lodge, LLC	**)**	**Project No. P-12496-002**
Lassen Lodge Hydroelectric Project	**)**	
South Fork Battle Creek	**)**	

CERTIFICATE OF SERVICE

I hereby certify that I have this day served, by first class mail or electronic mail, a letter to Secretary Bose of the Federal Energy Regulatory Commission, the U.S. Department of Commerce NOAA Fisheries Service, West Coast Region, Federal Power Act Comments, preliminary §18 Prescriptions, §10(j) recommended Conditions, and §10(a) Recommendations (REA Terms) for the Project, and this Certificate of Service upon each person designated on the official service list compiled by the Commission in the above-captioned proceeding.

Dated this 21st day of June 2016

William E. Foster
National Marine Fisheries Service

	SZF	WSEL	WSEL	WSEL	WSEL	WSEL
XS1	97.9	98.94	99.49	99.87	100.09	100.28
XS2	98.6	99.12	99.55	99.87	100.07	100.25
XS3	96.6	98.85	99.59	100.04		
XS4	96.8	98.64	99.49	100.06	100.37	
XS5	98.4	98.86	99.45	100.07	100.52	
XS6	98.2	98.78	99.47	99.87	100.09	100.28
Flow		6	16	26	33	40

Max sim Q = 65

Flow (cfs)	Channel Depth at Flow (ft)						WSEL	WSEL
	Logger 1	Logger 2	Logger 3	Logger 4	Logger 5	BPH	XS1	XS2
6	1.01	0.53	2.33	1.81	0.31	2.44	98.94	99.12
7	1.08	0.59	2.43	1.93	0.37	2.54	99.01	99.17
8	1.15	0.64	2.52	2.03	0.42	2.63	99.08	99.22
9	1.21	0.68	2.61	2.13	0.48	2.71	99.14	99.27
10	1.27	0.73	2.69	2.22	0.54	2.78	99.20	99.31
11	1.33	0.77	2.76	2.30	0.60	2.85	99.25	99.35
12	1.38	0.81	2.83	2.38	0.66	2.91	99.30	99.39
13	1.43	0.85	2.89	2.46	0.72	2.97	99.35	99.43
14	1.48	0.89	2.95	2.53	0.78	3.03	99.40	99.47
15	1.52	0.92	3.01	2.60	0.84	3.08	99.45	99.51
16	1.57	0.96	3.07	2.67	0.90	3.13	99.49	99.55
17	1.61	1.00	3.12	2.73	0.96	3.18	99.54	99.58
18	1.65	1.03	3.17	2.79	1.02	3.22	99.58	99.62
19	1.69	1.06	3.22	2.85	1.09	3.27	99.62	99.65
20	1.73	1.10	3.27	2.91	1.15	3.31	99.66	99.68
21	1.77	1.13	3.31	2.97	1.21	3.35	99.70	99.71
22	1.81	1.16	3.36	3.02	1.27	3.39	99.73	99.75
23	1.84	1.19	3.40	3.08	1.33	3.43	99.77	99.78
24	1.88	1.22	3.44	3.13	1.40	3.47	99.80	99.81
24.9			3.48	3.17	1.45	3.50		
25	1.91	1.25	3.48	3.18	1.46	3.50	99.84	99.84
26	1.95	1.28	3.52	3.23	1.52	3.54	99.87	99.87
27	1.98	1.31		3.28	1.59	3.57	99.90	99.90
28	2.01	1.34		3.32	1.65	3.60	99.94	99.93
29	2.04	1.37		3.37	1.72	3.64	99.97	99.96
29.9	2.07					3.66	100.00	
30	2.07	1.40		3.42	1.78	3.67	100.00	99.98
30.6		1.41				3.68		100.00
31	2.10	1.43		3.46	1.85	3.70	100.03	100.01
32	2.13	1.45		3.50	1.91	3.73	100.06	100.04
33	2.16	1.48		3.55	1.97	3.76	100.09	100.07
34	2.19	1.51		3.59	2.04	3.78	100.12	100.09
35	2.22	1.53		3.63	2.10	3.81	100.15	100.12

36	2.25	1.56	3.67	2.17	3.84	100.18	100.14
37	2.28	1.58	3.71	2.24	3.87	100.20	100.17
38	2.30	1.61	3.75	2.30	3.89	100.23	100.20
39	2.33	1.64			3.92	100.26	100.22
40	2.36	1.66			3.94	100.28	100.25

pool	0.115973	58	0.081041
riffle	0.599544	150	0.209479
	0.715517		

WSEL XS3	WSEL XS4	WSEL XS5	WSEL XS6
98.85	98.64	98.86	98.78
98.95	98.75	98.91	98.88
99.05	98.86	98.97	98.96
99.13	98.95	99.03	99.04
99.21	99.04	99.09	99.12
99.28	99.13	99.14	99.18
99.35	99.21	99.20	99.25
99.42	99.29	99.26	99.31
99.48	99.36	99.32	99.36
99.54	99.43	99.38	99.42
99.59	99.49	99.45	99.47
99.65	99.56	99.51	99.51
99.70	99.62	99.57	99.56
99.74	99.68	99.63	99.60
99.79	99.74	99.69	99.65
99.84	99.80	99.75	99.69
99.88	99.85	99.82	99.73
99.92	99.90	99.88	99.77
99.96	99.96	99.94	99.80
100.00	100.00	100.00	
100.00	100.01	100.01	99.84
100.04	100.06	100.07	99.87
	100.10	100.13	99.91
	100.15	100.20	99.94
	100.20	100.26	99.97
			100.00
	100.24	100.33	100.00
	100.29	100.39	100.03
	100.33	100.45	100.06
	100.37	100.52	100.09
	100.41	100.58	100.12
	100.46	100.65	100.15

100.50	100.72	100.18
100.54	100.78	100.20
100.57	100.85	100.23
		100.25
		100.28

max	38.4	44.3
Date	ABS Q	PH Q
3/16/2015	25.4	31.2
3/17/2015	25.8	31.9
3/18/2015	24.9	30.6
3/19/2015	25.8	29.9
3/20/2015	25.4	29.9
3/21/2015	25.8	30.9
3/22/2015	23.4	28.3
3/23/2015	34.6	44.3
3/24/2015	33.1	36.2
3/25/2015	38.4	43.0
3/26/2015	36.2	38.9
3/27/2015	30.2	34.0
3/28/2015	30.7	34.0
3/29/2015	27.5	30.2
3/30/2015	24.1	27.1
3/31/2015	20.8	25.0
4/1/2015	23.0	26.8
4/2/2015	24.1	28.3
4/3/2015	25.4	28.6
4/4/2015	17.7	22.6
4/5/2015	10.6	16.1
4/6/2015	13.9	21.0
4/7/2015	10.6	16.9
4/8/2015	23.4	30.9
4/9/2015	21.1	27.4
4/10/2015	20.4	26.5
4/11/2015	20.4	25.3
4/12/2015	20.8	24.5
4/13/2015	17.7	21.3
4/14/2015	20.4	22.8
4/15/2015	20.4	22.1
4/16/2015	18.0	19.8
4/17/2015	18.7	18.9
4/18/2015	18.0	18.7
4/19/2015	15.9	16.3
4/20/2015	12.2	13.4
4/21/2015	9.9	11.9
4/22/2015	11.2	12.9
4/23/2015	11.2	11.9
4/24/2015	9.5	12.1
4/25/2015	19.7	25.8
4/26/2015	21.5	25.3
4/27/2015	21.1	19.6
4/28/2015	16.8	16.7
4/29/2015	15.0	15.7

4/30/2015	13.7	13.9
5/1/2015	12.4	11.7
5/2/2015	10.8	10.6
5/3/2015	9.7	10.2
5/4/2015	10.6	10.5
5/5/2015	11.2	11.1
5/6/2015	9.3	8.9
5/7/2015	7.2	7.8
5/8/2015	8.4	9.6
5/9/2015	14.2	11.7
5/10/2015	13.2	11.1
5/11/2015	8.6	8.5
5/12/2015	6.8	8.8
5/13/2015	9.9	12.5
5/14/2015	7.7	9.1
5/15/2015	8.4	10.9
5/16/2015	11.0	12.9
5/17/2015	11.0	12.0
5/18/2015	12.2	13.4
5/19/2015	12.4	12.5
5/20/2015	9.9	10.8
5/21/2015	12.4	14.1
5/22/2015	11.7	12.9
5/23/2015	23.7	30.6
5/24/2015	16.2	16.7
5/25/2015	14.8	16.3
5/26/2015	12.7	13.8
5/27/2015	12.9	12.9
5/28/2015	13.2	12.4
5/29/2015	11.9	11.5
5/30/2015	10.8	10.8
5/31/2015	8.7	8.9
6/1/2015	8.4	9.2
6/2/2015	10.6	9.6
6/3/2015	8.2	7.7
6/4/2015	6.7	7.0
6/5/2015	8.0	7.2
6/6/2015	8.2	8.2
6/7/2015	9.5	8.7
6/8/2015	9.5	8.4
6/9/2015	7.7	6.9
6/10/2015	8.0	7.5
6/11/2015	8.0	7.5
6/12/2015	7.0	6.9
6/13/2015	5.1	6.0
6/14/2015	4.8	5.9
6/15/2015	5.4	6.5

6/16/2015	6.4	7.5
6/17/2015	6.7	7.5
6/18/2015	5.5	7.5
6/19/2015	5.8	7.7
6/20/2015	5.5	6.8
6/21/2015	4.9	7.1
6/22/2015	6.4	7.9
6/23/2015	6.5	7.3
6/24/2015	5.8	6.9
6/25/2015	6.4	7.0
6/26/2015	6.8	7.1
6/27/2015	6.5	7.5
6/28/2015	6.8	7.2
6/29/2015	7.3	7.2
6/30/2015	6.2	6.5
7/1/2015	5.1	6.6
7/2/2015		6.4
7/3/2015		6.3
7/4/2015		5.4
7/5/2015		5.8
7/6/2015		6.7
7/7/2015		5.6
7/8/2015		4.3
7/9/2015		4.9
7/10/2015		5.7

Riffle 3/20/2015 Q = 29.9

FS	Depth	Station	BE	Vel
3.0		0	103.0	
2.5		25.9	102.5	
2.0		26	102.0	
1.5		29.2	101.5	
1.0		29.5	101.0	
0.5		29.9	100.5	
	0	30.8	100.0	
	1.1	33.8	98.9	0.36
	0.4	36.8	99.6	0.98
	0.5	39.8	99.5	0.01
	1.0	42.8	99.0	0.01
	2.0	45.8	98.0	0.13
	2.0	48.8	98.0	0.77
	2.1	51.8	97.9	2.20
	1.7	54.8	98.3	0.72
	1.6	57.8	98.4	1.38
	1.1	60.8	98.9	0.92
	0.7	63.8	99.3	0.56
	0.0	66.8	100.0	
0.5		69.5	100.5	
1.0		74.1	101.0	
1.5		86.5	101.5	
2.0		88.2	102.0	
2.5		92.4	102.5	
3.0		102.3	103.0	

Riffle 3/18/2015 Q = 30.6

FS	Depth	Station	BE	Vel
3		0	103.0	
2.5		0.3	102.5	
1		0.7	101.0	
0.5		3.6	100.5	
	0	4.6	100.0	
	1.4	7.6	98.6	0.56
	0.7	10.6	99.3	2.17
	1.2	13.6	98.8	1.28
	1	16.6	99.0	0.23
	1	19.6	99.0	0.16
	1.3	22.6	98.7	2.59
	0.8	25.6	99.2	2
	1	28.6	99.0	0.49
	1.2	31.6	98.8	0.36
	0	33.6	100.0	
0.5		38.1	100.5	
1		38.2	101.0	
1.5		40.7	101.5	
2		40.8	102.0	
2.5		40.9	102.5	
3		41.1	103.0	

Pool 3/18/2015 Q = 24.9

FS	Depth	Station	BE	Vel
3		0	103.0	
2.5		0.3	102.5	
1.5		1	101.5	
1		2.3	101.0	
0.5		4.3	100.5	
	0	5.2	100.0	
	0.5	8.2	99.5	0.01
	0.7	11.2	99.3	0.01
	0.8	14.2	99.2	0.01
	3.4	17.2	96.6	1.57
	2.6	20.2	97.4	1.77
	2	23.2	98.0	0.01
	0.6	26.2	99.4	0.01
	0.3	29.2	99.7	0.01
	1.4	32.2	98.6	0.56
	1.8	35.2	98.2	1.35
	1.8	38.2	98.2	0.52
	1.2	41.2	98.8	0.01
	0	42.2	100.0	
0.5		44.2	100.5	
1		45.2	101.0	
1.5		45.3	101.5	
2		54.1	102.0	
2.5		54.7	102.5	
3		59	103.0	

Pool 3/18/2015 Q = 24.9

FS	Depth	Station	BE	Vel
3		0	103.0	
2		0.1	102.0	
1		0.2	101.0	
	0	0.6	100.0	
	0.7	0.7	99.3	0.01
	1.5	3.7	98.5	0.01
	1.7	6.7	98.3	0.01
	2.0	9.7	98.0	0.23
	2.0	12.7	98.0	0.85
	2.4	15.7	97.6	0.95
	3.2	18.7	96.8	0.67
	3.2	21.7	96.8	0.23
	2.2	24.7	97.8	0.49
	0.0	27.7	100.0	
0.5		29.7	100.5	
1		30	101.0	
1.5		31.3	101.5	
2		32	102.0	
3		32.1	103.0	

Riffle 3/18/2015 Q = 24.9

FS	Depth	Station	BE	Vel
3		0	103.0	
2.5		0.7	102.5	
2		1	102.0	
1.5		1.6	101.5	
1		2	101.0	
0.5		4.6	100.5	
	0	5.2	100.0	
	0.1	7.2	99.9	0.01
	0.5	10.2	99.5	0.66
	0	13.2	100.0	
	1.4	16.2	98.6	0.69
	1.6	19.2	98.4	1.38
	1.1	22.2	98.9	0.01
	1.4	25.2	98.6	0.52
	1.4	28.2	98.6	1.44
	1	31.2	99.0	2.1
	0.9	34.2	99.1	1.71
	1	37.2	99.0	1.67
	0	40.2	100.0	
0.5		41.9	100.5	
1		45.2	101.0	
1.5		47.1	101.5	
2		48	102.0	
2.5		48.1	102.5	
3		49.1	103.0	

Riffle 3/19/2015 Q = 29.9

FS	Depth	Station	BE	Vel
3		0	103.0	
2		0.2	102.0	
1.5		5.5	101.5	
1		12.5	101.0	
0.5		13	100.5	
	0	14.1	100.0	
	1	17.1	99.0	0.49
	0.5	20.1	99.5	1.25
	0.3	23.1	99.7	0.69
	1.2	26.1	98.8	0.49
	1.1	29.1	98.9	0.01
	1.1	32.1	98.9	0.01
	1.1	35.1	98.9	1.71
	1.7	38.1	98.3	2.46
	1.8	41.1	98.2	0.13
	1.3	44.1	98.7	0.01
	0	45.1	100.0	
1.5		45.2	101.5	
2		49.4	102.0	
2.5		50.9	102.5	
3		55.3	103.0	

Lassen Lodge

This and the following text are notes about the survey

Survey carried out 3/20/2015

No substrate recorded

bed	RL	'Index'	feet		
//first comment					
0	'Transect_1'			100.00	// this is the first section
GAUGING		98.94	6		
GAUGING		99.49	16		
GAUGING		99.87	26		
SZF		97.9			
surveyflow	29.9				// this is the flow at which the survey was carı
0	103.0	0	0.1		
25.9	102.5	0	0.1		
26	102.0	0	0.1		
29.2	101.5	0	0.1		
29.5	101.0	0	0.1		
29.9	100.5	0	0.1		
30.8	100.0	0	0.1		
33.8	98.9	0.36	0.1		
36.8	99.6	0.98	0.1		
39.8	99.5	0.01	0.1		
42.8	99.0	0.01	0.1		
45.8	98.0	0.13	0.1		
48.8	98.0	0.77	0.1		
51.8	97.9	2.20	0.1		
54.8	98.3	0.72	0.1		
57.8	98.4	1.38	0.1		
60.8	98.9	0.92	0.1		
63.8	99.3	0.56	0.1		
66.8	100.0	0	0.1		
69.5	100.5	0	0.1		
74.1	101.0	0	0.1		
86.5	101.5	0	0.1		
88.2	102.0	0	0.1		
92.4	102.5	0	0.1		
102.3	103.0	0	0.1		
END					
150	'Transect_2'		100.00		
GAUGING	99.12	6			
GAUGING	99.55	16			
GAUGING	99.87	26			
SZF	98.6				
surveyflow	30.6				
0	103.0	0	0.1		
0.3	102.5	0	0.1		
0.7	101.0	0	0.1		

3.6	100.5	0	0.1
4.6	100.0	0	0.1
7.6	98.6	0.56	0.1
10.6	99.3	2.17	0.1
13.6	98.8	1.28	0.1
16.6	99.0	0.23	0.1
19.6	99.0	0.16	0.1
22.6	98.7	2.59	0.1
25.6	99.2	2	0.1
28.6	99.0	0.49	0.1
31.6	98.8	0.36	0.1
33.6	100.0	0	0.1
38.1	100.5	0	0.1
38.2	101.0	0	0.1
40.7	101.5	0	0.1
40.8	102.0	0	0.1
40.9	102.5	0	0.1
41.1	103.0	0	0.1
END			
300	'Transect_3'		100.00
GAUGING	98.85	6	
GAUGING	99.59	16	
GAUGING	100.04	26	
SZF	96.6		
surveyflow	24.9		
0	103.0	0	0.1
0.3	102.5	0	0.1
1	101.5	0	0.1
2.3	101.0	0	0.1
4.3	100.5	0	0.1
5.2	100.0	0	0.1
8.2	99.5	0.01	0.1
11.2	99.3	0.01	0.1
14.2	99.2	0.01	0.1
17.2	96.6	1.57	0.1
20.2	97.4	1.77	0.1
23.2	98.0	0.01	0.1
26.2	99.4	0.01	0.1
29.2	99.7	0.01	0.1
32.2	98.6	0.56	0.1
35.2	98.2	1.35	0.1
38.2	98.2	0.52	0.1
41.2	98.8	0.01	0.1
42.2	100.0	0	0.1
44.2	100.5	0	0.1
45.2	101.0	0	0.1
45.3	101.5	0	0.1

	54.1	102.0	0	0.1
	54.7	102.5	0	0.1
	59	103.0	0	0.1
END				
	358	'Transect_4'		100.00
GAUGING		98.64	6	
GAUGING		99.49	16	
GAUGING		100.06	26	
SZF		96.8		
surveyflow		24.9		
	0	103.0	0	0.1
	0.1	102.0	0	0.1
	0.2	101.0	0	0.1
	0.6	100.0	0	0.1
	0.7	99.3	0.01	0.1
	3.7	98.5	0.01	0.1
	6.7	98.3	0.01	0.1
	9.7	98.0	0.23	0.1
	12.7	98.0	0.85	0.1
	15.7	97.6	0.95	0.1
	18.7	96.8	0.67	0.1
	21.7	96.8	0.23	0.1
	24.7	97.8	0.49	0.1
	27.7	100.0	0	0.1
	29.7	100.5	0	0.1
	30	101.0	0	0.1
	31.3	101.5	0	0.1
	32	102.0	0	0.1
	32.1	103.0	0	0.1
END				
	416	'Transect_5'		100.00
GAUGING		98.86	6	
GAUGING		99.45	16	
GAUGING		100.07	26	
SZF		98.4		
surveyflow		24.9		
	0	103.0	0	0.1
	0.7	102.5	0	0.1
	1	102.0	0	0.1
	1.6	101.5	0	0.1
	2	101.0	0	0.1
	4.6	100.5	0	0.1
	5.2	100.0	0	0.1
	7.2	99.9	0.01	0.1
	10.2	99.5	0.66	0.1
	13.2	100.0	0	0.1

	16.2	98.6	0.69	0.1
	19.2	98.4	1.38	0.1
	22.2	98.9	0.01	0.1
	25.2	98.6	0.52	0.1
	28.2	98.6	1.44	0.1
	31.2	99.0	2.1	0.1
	34.2	99.1	1.71	0.1
	37.2	99.0	1.67	0.1
	40.2	100.0	0	0.1
	41.9	100.5	0	0.1
	45.2	101.0	0	0.1
	47.1	101.5	0	0.1
	48	102.0	0	0.1
	48.1	102.5	0	0.1
	49.1	103.0	0	0.1
END				
	516	'Transect_6'		100.00
GAUGING		98.78	6	
GAUGING		99.47	16	
GAUGING		99.87	26	
SZF		98.2		
surveyflow		29.9		
	0	103.0	0	0.1
	0.2	102.0	0	0.1
	5.5	101.5	0	0.1
	12.5	101.0	0	0.1
	13	100.5	0	0.1
	14.1	100.0	0	0.1
	17.1	99.0	0.49	0.1
	20.1	99.5	1.25	0.1
	23.1	99.7	0.69	0.1
	26.1	98.8	0.49	0.1
	29.1	98.9	0.01	0.1
	32.1	98.9	0.01	0.1
	35.1	98.9	1.71	0.1
	38.1	98.3	2.46	0.1
	41.1	98.2	0.13	0.1
	44.1	98.7	0.01	0.1
	45.1	100.0	0	0.1
	45.2	101.5	0	0.1
	49.4	102.0	0	0.1
	50.9	102.5	0	0.1
	55.3	103.0	0	0.1
END				
END				

ried out

Lassen Lodge

This and the following text are notes about the survey

Survey carried out 3/20/2015

No substrate recorded

bed	RL	'Index'	feet		
//first comment					
0	'Transect_1'			100.00	// this is the first section
GAUGING		99.87	26		
GAUGING		100.09	33		
GAUGING		100.28	40		
SZF		97.9			
surveyflow	29.9				// this is the flow at which the survey was carı
0	103.0	0	0.1		
25.9	102.5	0	0.1		
26	102.0	0	0.1		
29.2	101.5	0	0.1		
29.5	101.0	0	0.1		
29.9	100.5	0	0.1		
30.8	100.0	0	0.1		
33.8	98.9	0.36	0.1		
36.8	99.6	0.98	0.1		
39.8	99.5	0.01	0.1		
42.8	99.0	0.01	0.1		
45.8	98.0	0.13	0.1		
48.8	98.0	0.77	0.1		
51.8	97.9	2.20	0.1		
54.8	98.3	0.72	0.1		
57.8	98.4	1.38	0.1		
60.8	98.9	0.92	0.1		
63.8	99.3	0.56	0.1		
66.8	100.0	0	0.1		
69.5	100.5	0	0.1		
74.1	101.0	0	0.1		
86.5	101.5	0	0.1		
88.2	102.0	0	0.1		
92.4	102.5	0	0.1		
102.3	103.0	0	0.1		
END					
150	'Transect_2'		100.00		
GAUGING	99.87	26			
GAUGING	100.07	33			
GAUGING	100.25	40			
SZF	98.6				
surveyflow	30.6				
0	103.0	0	0.1		
0.3	102.5	0	0.1		
0.7	101.0	0	0.1		

3.6	100.5	0	0.1
4.6	100.0	0	0.1
7.6	98.6	0.56	0.1
10.6	99.3	2.17	0.1
13.6	98.8	1.28	0.1
16.6	99.0	0.23	0.1
19.6	99.0	0.16	0.1
22.6	98.7	2.59	0.1
25.6	99.2	2	0.1
28.6	99.0	0.49	0.1
31.6	98.8	0.36	0.1
33.6	100.0	0	0.1
38.1	100.5	0	0.1
38.2	101.0	0	0.1
40.7	101.5	0	0.1
40.8	102.0	0	0.1
40.9	102.5	0	0.1
41.1	103.0	0	0.1
END			
300	'Transect_3'		100.00
GAUGING	98.85	6	
GAUGING	99.59	16	
GAUGING	100.04	26	
SZF	96.6		
surveyflow	24.9		
0	103.0	0	0.1
0.3	102.5	0	0.1
1	101.5	0	0.1
2.3	101.0	0	0.1
4.3	100.5	0	0.1
5.2	100.0	0	0.1
8.2	99.5	0.01	0.1
11.2	99.3	0.01	0.1
14.2	99.2	0.01	0.1
17.2	96.6	1.57	0.1
20.2	97.4	1.77	0.1
23.2	98.0	0.01	0.1
26.2	99.4	0.01	0.1
29.2	99.7	0.01	0.1
32.2	98.6	0.56	0.1
35.2	98.2	1.35	0.1
38.2	98.2	0.52	0.1
41.2	98.8	0.01	0.1
42.2	100.0	0	0.1
44.2	100.5	0	0.1
45.2	101.0	0	0.1
45.3	101.5	0	0.1

54.1	102.0	0	0.1
54.7	102.5	0	0.1
59	103.0	0	0.1
END			
358	'Transect_4'		100.00
GAUGING	100.06	26	
GAUGING	100.37	33	
GAUGING	100.57	38	
SZF	96.8		
surveyflow	24.9		
0	103.0	0	0.1
0.1	102.0	0	0.1
0.2	101.0	0	0.1
0.6	100.0	0	0.1
0.7	99.3	0.01	0.1
3.7	98.5	0.01	0.1
6.7	98.3	0.01	0.1
9.7	98.0	0.23	0.1
12.7	98.0	0.85	0.1
15.7	97.6	0.95	0.1
18.7	96.8	0.67	0.1
21.7	96.8	0.23	0.1
24.7	97.8	0.49	0.1
27.7	100.0	0	0.1
29.7	100.5	0	0.1
30	101.0	0	0.1
31.3	101.5	0	0.1
32	102.0	0	0.1
32.1	103.0	0	0.1
END			
416	'Transect_5'		100.00
GAUGING	100.07	26	
GAUGING	100.52	33	
GAUGING	100.85	38	
SZF	98.4		
surveyflow	24.9		
0	103.0	0	0.1
0.7	102.5	0	0.1
1	102.0	0	0.1
1.6	101.5	0	0.1
2	101.0	0	0.1
4.6	100.5	0	0.1
5.2	100.0	0	0.1
7.2	99.9	0.01	0.1
10.2	99.5	0.66	0.1
13.2	100.0	0	0.1
16.2	98.6	0.69	0.1

	19.2	98.4	1.38	0.1
	22.2	98.9	0.01	0.1
	25.2	98.6	0.52	0.1
	28.2	98.6	1.44	0.1
	31.2	99.0	2.1	0.1
	34.2	99.1	1.71	0.1
	37.2	99.0	1.67	0.1
	40.2	100.0	0	0.1
	41.9	100.5	0	0.1
	45.2	101.0	0	0.1
	47.1	101.5	0	0.1
	48	102.0	0	0.1
	48.1	102.5	0	0.1
	49.1	103.0	0	0.1
END				
	516	'Transect_6'		100.00
GAUGING		99.87	26	
GAUGING		100.09	33	
GAUGING		100.28	40	
SZF		98.2		
surveyflow		29.9		
	0	103.0	0	0.1
	0.2	102.0	0	0.1
	5.5	101.5	0	0.1
	12.5	101.0	0	0.1
	13	100.5	0	0.1
	14.1	100.0	0	0.1
	17.1	99.0	0.49	0.1
	20.1	99.5	1.25	0.1
	23.1	99.7	0.69	0.1
	26.1	98.8	0.49	0.1
	29.1	98.9	0.01	0.1
	32.1	98.9	0.01	0.1
	35.1	98.9	1.71	0.1
	38.1	98.3	2.46	0.1
	41.1	98.2	0.13	0.1
	44.1	98.7	0.01	0.1
	45.1	100.0	0	0.1
	45.2	101.5	0	0.1
	49.4	102.0	0	0.1
	50.9	102.5	0	0.1
	55.3	103.0	0	0.1
END				
END				

ried out

Steelhead fry	//Payne and Associates (1995)							
Depth(ft)	0	0.1	0.2	0.3	0.4	0.6	0.7	1
Weight	0	0.1	0.8	0.96	0.98	1	1	0.96
Velocity(ft⁄s)	0	0.1	0.2	0.3	0.5	0.6	0.7	0.8
Weight	0.05	0.12	0.3	0.9	1	1	0.96	0.82
end								
Steelhead juvenile	//Payne and Associates (1995)							
Depth(ft)	0	0.1	0.3	0.6	1	1.25	1.5	2
Weight	0	0.06	0.2	0.66	0.96	1	0.88	0.64
Velocity(ft⁄s)	0	0.1	0.2	0.3	0.5	0.7	1.1	1.4
Weight	0	0	0.2	0.9	0.98	1	1	0.98
end								
Chinook fry	//Payne and Associates (1995)							
Depth(ft)	0	0.05	0.15	0.25	0.35	0.45	0.55	0.65
Weight	0	0.1	0.29	0.45	0.59	0.71	0.8	0.88
Velocity(ft⁄s)	0	0.02	0.07	0.12	0.17	0.22	0.27	0.32
Weight	0.61	0.68	0.81	0.9	0.96	0.99	1	0.98
end								
Chinook juvenile	//Payne and Associates (1995)							
Depth(ft)	0	0.51	0.55	0.65	0.75	0.85	0.95	1.05
Weight	0	0	0.1	0.32	0.51	0.66	0.78	0.87
Velocity(ft⁄s)	0	0.14	0.15	0.25	0.35	0.45	0.55	0.65
Weight	0	0	0.03	0.25	0.44	0.9	0.73	0.83
end								

1.1	1.2	1.3	1.4	1.5	1.7	1.9	2	2.2
0.8	0.64	0.56	0.46	0.52	0.3	0.2	0.16	0.1
0.9	1	1.2	1.75	1.9	2.1	2.2	2.5	2.7
0.76	0.72	0.64	0.42	0.34	0.2	0.14	0.04	0

2.2	2.5	3	3.5	4	4.5	5	100	
0.58	0.48	0.34	0.24	0.14	0.08	0	0	
1.5	1.7	2	2.3	2.5	3	3.5	4.3	100
0.96	0.84	0.64	0.42	0.16	0.04	0.02	0	0

0.75	0.85	0.95	1.05	1.15	1.25	1.35	1.45	1.55
0.93	0.97	0.99	1	0.99	0.98	0.95	0.91	0.88
0.37	0.42	0.47	0.52	0.57	0.62	0.67	0.72	0.77
0.95	0.91	0.85	0.78	0.71	0.64	0.56	0.49	0.42

1.15	1.25	1.35	1.45	1.55	1.65	1.75	1.85	1.95
0.93	0.98	1	1	0.99	0.96	0.93	0.88	0.82
0.75	0.85	0.95	1.05	1.15	1.25	1.35	1.45	1.55
0.9	0.95	0.99	1	1	0.98	0.94	0.89	0.84

2.4	2.7	6	100
0.06	0.02	0.02	0

100
0

1.65	1.75	1.85	1.95	2.05	2.15	2.25	2.35	2.45
0.81	0.75	0.68	0.61	0.54	0.47	0.4	0.33	0.27
0.82	0.87	0.92	0.97	1.02	1.07	1.12	1.17	1.22
0.35	0.29	0.23	0.18	0.14	0.11	0.08	0.06	0.05

2.05	2.15	2.25	2.35	2.45	2.55	2.65	2.75	2.85
0.76	0.7	0.63	0.57	0.5	0.43	0.37	0.31	0.25
1.65	1.75	1.85	1.95	2.05	2.15	2.25	2.35	2.45
0.77	0.7	0.63	0.55	0.47	0.39	0.32	0.25	0.19

2.55	2.65	2.75	2.85	3.45	3.55	100
0.2	0.15	0.1	0.06	0.06	0	0
1.27	1.82	1.87	100			
0.05	0.05	0	0			

3.05	3.25	4.95	5.05	5.15	5.25	5.35	5.45	5.55
0.19	0.17	0.17	0.17	0.16	0.14	0.11	0.06	0
2.55	2.65	2.75	2.85	2.95	3.05	3.15	100	
0.13	0.09	0.05	0.03	0.03	0.03	0	0	

100
0

Reach Area Weighted Suitability (ft^2/ft)

Proportion of reach : 100.00 %

1:- Chinook juvenile [CH-J] (Payne and Associates (1995))

2:- Chinook fry [CH-F] (Payne and Associates (1995))

3:- Steelhead juvenile [SH-J] (Payne and Associates (1995))

4:- Steelhead fry [SH-F] (Payne and Associates (1995))

Flow (cfs)	CH-J	CH-F	SH-J	SH-F	CH-J	CH-F	SH-J	SH-F	Mean	Flow (cfs)
5	1.426	5.019	3.285	4.962	9.9%	37.7%	18.6%	40.0%	26.5%	**5**
10	3.115	7.853	6.817	9.154	21.6%	59.0%	38.6%	73.9%	48.2%	**10**
13	4.6492	9.155	8.8978	10.2646	32.2%	68.8%	50.4%	82.8%	58.5%	**13**
15	5.672	10.023	10.285	11.005	39.2%	75.3%	58.2%	88.8%	65.4%	**15**
20	8.496	11.939	12.955	11.424	58.8%	89.7%	73.3%	92.2%	78.5%	**20**
25	10.84	13.316	14.919	12.392	75.0%	100.0%	84.4%	100.0%	89.9%	**25**
30	12.93	13.2	16.958	12.211	89.5%	99.1%	96.0%	98.5%	95.8%	**30**
35	14.067	13.168	17.669	11.146	97.3%	98.9%	100.0%	89.9%	96.5%	**35**
40	14.452	12.938	17.577	9.838	100.0%	97.2%	99.5%	79.4%	94.0%	**40**
45	14.248	12.486	17.169	9.068	98.6%	93.8%	97.2%	73.2%	90.7%	**45**
50	13.814	11.923	16.625	8.37	95.6%	89.5%	94.1%	67.5%	86.7%	**50**
55	13.366	11.348	15.988	7.479	92.5%	85.2%	90.5%	60.4%	82.1%	**55**
60	12.9	10.564	15.212	6.658	89.3%	79.3%	86.1%	53.7%	77.1%	**60**
65	12.358	9.837	14.343	5.951	85.5%	73.9%	81.2%	48.0%	72.1%	**65**

65%

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