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August 26, 2016

VIA *US Mail and Email (kenneth.petruzzelli@waterboard.ca.gov)*

Kenneth Petruzzelli
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Re: Cleanup and Abatement Order R1-2016-0031

Dear Mr. Petruzzelli:

Following our telephone conversation on August 5, 2016 and receipt of Cleanup and Abatement Order R1-2016-0331 ("CAO"), regarding Douglas and Heidi Cole's (the "Coles") diversion at Marble Mountain Ranch, I am providing additional information on behalf of the Coles to propose amended deadlines for the deliverables contained in the CAO. The resource improvement team for Marble Mountain Ranch, including Will Harling at the Mid Klamath Watershed Council, Joey Howard of Cascade Stream Solutions, and Rocco Fiori of Fiori Geosciences have reviewed and discussed the CAO and its deadlines at length to determine how best to comply with its requirements. Each Required Action in the CAO is discussed below, detailing the reasons the Coles may not be able to comply with the CAO's requirements or providing reasons the Coles need additional time to provide the information required under the CAO.

Before receiving the CAO, the Coles and their resource improvement team have continued to diligently pursue resource improvements at Marble Mountain Ranch. Their most recent efforts have been focused on installing a six inch pipe in the diversion ditch to comply with the National Marine Fisheries Service ("NMFS") recommended bypass flow during low flow periods. That effort remains one the Coles are committed to implementing and continue to believe is the best alternative to improve ditch stability, reduce seepage and provide adequate consumptive use supply during low flow periods.

NMFS Bypass Flow Letter Dated August 3, 2016 Complication

A complication for the Coles in complying with the CAO is the August 3, 2016 NMFS bypass flow recommendation letter that indicates the Coles are unable to divert water for non-consumptive use unless that water is returned to Stanshaw Creek, including during high flow periods. (National Marines Fisheries Service, technical assistance letter (Aug. 3, 2016) pp. 8-11 (a true and correct copy of this letter is attached).) That recommendation limits the amount of water that the Coles can allow in their diversion which in turn complicates several of the analyses required under the CAO. While further explored below, briefly, the ditch and slope evaluation required under the CAO will demand water in the diversion system in excess of the amounts that would be allowed under the NMFS bypass flow recommendation. Therefore, the Coles cannot comply with the directives from both NMFS and the North Coast Regional Water Quality Control Board unless there is a phased approach to the NMFS non-consumptive bypass flow recommendation.

Beyond the difficulty of complying with both NMFS recommended bypass flow and the North Coast Regional Water Quality Control Board's directives in the CAO, the NMFS bypass flow recommendation's requirement that the Coles return flow to Stanshaw Creek in order to divert non-consumptive water prohibits the Coles from exercising their full pre-1914 water right to divert 3 cfs for consumptive and non-consumptive use. In recent months, the Coles have foregone diverting the full extent of their 3 cfs water right during low flow periods, limiting their diversion to consumptive use only, to benefit the fisheries in Stanshaw Creek. That effort has proven successful. Continuing to reduce the Coles diversion during upcoming high flow periods imposes heavy costs on the Coles for electricity generation. These costs are in excess of $50,000 and the environmental benefit of the 10% bypass flow recommendation is unclear.[1] The Coles request further clarification from both NMFS and the North Coast Regional Water Quality Control Board to successfully approach implementing both directives and exercising their pre-1914 water right.

CAO Compliance

The Required Actions section of the CAO contains four main action items with various subtasks outlined within each of the four main tasks and then provides for quarterly progress reports and final implementation deadlines. Before discussing the CAO's requirements individually, the Coles and their resource improvement team have some general concerns about the requirements in the CAO.

First, the level of detail and the assurances of no failure required under the CAO may be impractical on several fronts. The Coles are committed to the diversion's sustainable management, but best and prudent effort in many cases is all anyone can guarantee when factors beyond the Coles control such as large herds of elk or other large animals migrating through the area are involved.

Secondly, the Coles are small business owners with limited funds to address all of the demands under the CAO. Implementation of several of the items contained in the CAO may require new consultants and additional funding. The process of finding consultants

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[1] The Coles and their resource improvement team are reviewing the studies cited in the NMFS technical assistance letter to justify the return flow requirement.

and securing funding can be unpredictable and slow. This may delay compliance with the CAO even with the Coles best efforts.

Finally, the CAO goes beyond the scope of the stakeholder group's discussion to date. For example, the CAO requires water quality monitoring if flow is returned to waters of the state from the Coles diversion. This further limits the Coles' ability to develop, implement, and fund improvements that would reroute any return flow to Stanshaw Creek. Funds and efforts that could be used to return flow to Stanshaw Creek must be realigned to address the water quality monitoring required under the CAO. Thus, compliance with all of the deadlines in the CAO will be difficult if not impossible.

Required Action No. 1 – Water Efficiency Study and Water Delivery System Design

The current deadline under the CAO requires submitting all information outlined under this action item on or before October 15, 2016 at 5:00 pm. A water efficiency study is a study the Coles have been engaged in and pursuing for quite some time, but the requirements under the CAO are more expansive than what has been previously discussed by all stakeholders. The CAO's addition of water quality review to the water efficiency study will complicate the focus of the study, and requires additional time and funding to include in the scope of work. A water quality analysis will require additional consultants and testing that was not previously contemplated at this juncture. Funding for such a study is not part of currently existing grants and it is not practical to seek grant funding opportunities for this type of evaluation at this time. The Coles will have to determine how to address these costs and find a consultant to do the testing required for such a study. Therefore, the Coles propose a revised deadline of **October 29, 2016** for this item.

Required Action No. 2 – Restoration and Monitoring Plan

Several subtasks contained within Required Action Item number 2 regarding a restoration and monitoring plan for the Irving Creek outlet go beyond the scope of the discussions with stakeholders to date and the level of scrutiny and detail required under the CAO may make compliance prohibitively expensive. The CAO requires an 85% success rate for replanting, but does not allow for the time required to properly evaluate the outfall point to ensure that success rate. The 85% success rate would require extensive inspections, soil testing, and it is likely that a physical process that could impact the success of revegetation could be missed even with extensive testing if conditions are not ideal for study.

Rocco Fiori previously provided a sedimentation study for the Coles diversion. (See the attached Fiori GeoSciences Technical Memorandum dated May 14, 2016.) To further evaluate sedimentation and erosion along the Coles diversion and at the Irving Creek outlet, the ditch and the Irving Creek outfall point must have more water in the system and leaf off conditions. The success of the restoration and monitoring plan depends on proper inspections and identification of any difficulties associated with slope stabilization and revegetation at Irving Creek. Specifically, the current headcut at the Irving Creek outfall point may have additional seepage points below the outfall not readily observed in dry conditions. Making the evaluations of Irving Creek during leaf off, wet conditions will ensure that the proper solution for addressing any impacts to the waters of the state at the outfall point are identified.

Additionally if fill of areas of erosion at the outfall point is identified as the correct solution following study, properly identifying all points of seepage will be integral for successful resource improvement. Fill placed without identifying all points of seepage will not remain in place under wet conditions with additional seepage points. This will result in sediment being discharged to Irving Creek. To further complicate the matter, as previously discussed above, the NMFS bypass flow recommendation make it impossible for the Coles to provide fully wet conditions for study unless the NMFS bypass flow is phased in over time. Thus, creation of the restoration and monitoring plan requires conditions that are not available before Required Action Item number 2's current September 10, 2016 deadline and those conditions may never be available under the Coles current regulatory circumstances.

Beyond the physical limitations associated with the conditions required for successfully drafting and implementing a restoration and monitoring plan, the Coles face a secondary difficulty in complying with this Required Action Item. Rocco Fiori, who authored the original sedimentation study, is not available to begin the study of the Coles diversion until November of this year, which coincides with the onset of the physical conditions needed to conduct inspections of the outfall. Once Mr. Fiori can begin his inspection and study of the outfall, he will require three to four months to run tests and take soil samples on the diversion and outfall point and then draft the technical reports to comply with the CAO. Delaying the inspections is necessary to ensure high quality reports and save existing funds for resource improvement efforts. Mr. Fiori has already engaged in a preliminary evaluation of the system and is familiar with the difficulties and opportunities for resource improvement at Marble Mountain Ranch. His services will be more informed and less costly than if the Coles have to start over and find a new hydrogeologist to evaluate their diversion. His familiarity with the system means that he will provide a more thorough and expansive evaluation of the system as a whole.

Finally, the costs of such an expanded inspection and testing regime is unlikely to be funded through grant money. This leave the Coles without an avenue to comply with the CAO if they must provide testing that ensures there will be no failures of the restoration implemented at the Irving Creek outfall point. The Coles request further clarification regarding the scope of the required monitoring plan. Tentatively, based on the intent of the monitoring plan, the Coles believe a revised compliance date of **March 31, 2017** for submission of the restoration and monitoring plan will provide the Coles with the time to allow Rocco Fiori to evaluate the Irving Creek outfall point and to establish a successful restoration and monitoring plan.

Required Action No. 3 – Ditch Evaluation and Operations and Monitoring Plan

Required Action Item number 3 requires a ditch evaluation and an operations and monitoring plan if the Coles intend on continuing to operate the diversion ditch to convey water to Marble Mountain Ranch. This requirement carries with it many of the same issues previously discussed for the Irving Creek outfall point. The continued operation of the diversion ditch and the related reports require: (1) the clarification of the requirements under the NMFS bypass flow; (2) leaf off, wet conditions to properly evaluate seepage, fill saturation, and stability; (3) additional time to allow for Mr. Fiori's proper conditions and time to do the required study and to draft the reports from the studies; and (4) additional funding as the requirements go beyond the scope of any previously discussed requirements for the study of the ditch system.

Beyond these issues, the level of evaluation for ditch stability in the CAO requires the identification and analysis of *ANY* physical process and mechanism that may be influencing sedimentation discharge or erosion along the ditch. That level of evaluation will be nearly impossible to achieve without a huge investment in just studies of the diversion. Those are resources that could be better used in addressing issues along the diversion to avoid erosion. Therefore, the Coles request clarification of the level of study required under Required Action Item number 3 before proceeding with the study. Based on a reading of the CAO's requirements that make them achievable, the Coles can provide a ditch evaluation by **March 31, 2017**.

While the Coles require additional time for the ditch evaluation, they will provide a ditch monitoring and operation plan for this coming wet season within the deadline contained in the CAO. The Coles will provide formalized protocols for ditch inspection and management to the North Coast Regional Water Quality Control Board for review in compliance with the CAO's deadline on **October 15, 2016**.

Required Action No. 4 – Slope Assessment and Water Quality Sampling

Once again, the extent of the slope assessment and water quality sampling required under Required Action Item number 4 has not been previously discussed among the stakeholders. It also carries with it a number of issues discussed previously, including: (1) requiring leaf off, wet conditions to properly evaluate sediment deposits and erosional sources; (2) additional time to allow for Mr. Fiori to do the required study and then the additional time to draft the required reports; and (3) additional funding as the requirements go beyond the scope of any previously discussed requirements for the study of the ditch system. To allow for the required time to provide the slope assessment, the Coles propose a revised deadline of **March 31, 2017** for that portion of Required Action Item number 4.

Moreover, according to Mr. Fiori, based on his previous evaluation of the Coles diversion, a slope stability study will not provide any additional information for implementing resource improvements at Marble Mountain Ranch. Mr. Fiori's technical memorandum dated May 14, 2016 indicates laying a six inch pipe in the diversion ditch is the optimal approach to avoiding any release of sediment to the waters of the state from the Coles diversion during low flow periods.[2] Any additional slope stability study will find that the optimal solution for addressing the diversion of greater rates of flow will be to lay pipe in the ditch to carry that flow. Thus, a sedimentation study will not provide additional information to address any impacts to waters of the state and will delay implementation of the solution to the issue.

The water quality sampling element of Required Action Item number 4 we interpret to be required only if the Coles are discharging water from the diversion after use at Marble Mountain Ranch. Therefore, this requirement is dependent on the clarification regarding the NMFS bypass flow recommendation letter. Provided the Coles are able to divert and discharge water over the next few wet seasons, water quality sampling will require that the Coles hire additional consultants to test the water and implement systems for the chain of custody of the samples. Further, finding funding for the water quality monitoring is unlikely. Therefore, the Coles will have to divert resources to this monitoring effort as well. Please confirm that the water quality sampling is only required during high flow periods when there is return flow to waters of the state. Based on this interpretation, the Coles request until **December 1, 2016** to develop the monitoring plan once it is clear that they will be allowed to discharge return flow in the high flow season.

Required Action Item No. 5 – Quarterly Progress Reports

The Coles will provide quarterly progress reports beginning on **October 1, 2016**. These progress reports will comply with the requirements under the CAO to provide an "update on project development and permitting, a description of steps taken to develop and implement the required plans, and any unforeseen circumstances that may affect the progress on meeting the deadlines and requirements of [the CAO]." Please confirm that the CAO does not require that these reports be submitted by "an appropriately qualified and experienced California-licensed professional." In order to focus the funds available on the resource improvement efforts, the current plan is to have Doug Cole with some assistance from his resource team submit these reports.

Required Action Items No. 6 and 7 – Complete all Restoration and Mitigation Measures and Submit Completion Report

The Coles will endeavor to meet the October 15, 2018 and December 15, 2018 deadlines for the completion of the restoration and mitigation measure implementation and related completion report. However, based on the currently needed additional time for the initial

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[2] Mr. Fiori's technical memorandum has been submitted to North Coast Regional Water Quality Board staff and all stakeholders in the Marble Mountain Ranch discussion along with a number of other documents regarding the proposed six inch pipe project. The Coles and their resource improvement team have not received any feedback regarding Mr. Fiori's study or its findings.

reports, the Coles may have difficulty meeting these targets. Once Rocco Fiori has completed all the required studies and reports, the Coles will be able to provide a revised deadline for these final two items.

Summary of Deadlines and Funding

To streamline the discussion of proposed deadlines among all stakeholders, the table below summarizes the items required under the CAO, the current deadlines for those items, the deadlines proposed in this letter for those items, and the funding status of each of those items.

CAO Required Action Item Number	Deliverable	CAO Deadline	Proposed Deadline	Funding Status
1.	Water Efficiency Study	October 15, 2016	October 29, 2016	Currently grant funded without the water quality study. Water quality study will require the Coles personally fund the effort.
2.	Restoration and Monitoring Plan	September 10, 2016	March 31, 2017	Funded on a much smaller scope. The 85% revegetation success rate and required study will require additional grant funding.
2.	Final Restoration and Monitoring Report	January 1, 2021	Pending Rocco Fiori studies	CAO requirements are beyond the scope of current funding.
3.	Ditch Monitoring and Operations Plan	October 15, 2016	October 15, 2016	Scope of monitoring plan is currently beyond funding.

3.	Ditch Evaluation	October 15, 2016	March 31, 2017	Funded on a much smaller scale. Level of assurance of ditch operation beyond the scope of current funding.
4.	Slope Assessment	September 10, 2016	March 31, 2017	Funded on a much smaller scale. Level of assurance of ditch operation beyond the scope of current funding.
4.	Water Quality Assessment Plan	September 10, 2016	December 1, 2016	Not funded.
5.	Progress Reports	October 1, 2016 and ongoing quarterly	October 1, 2016 and ongoing quarterly	Not funded.
6.	Restoration and Monitoring Measures Completed	October 15, 2018	Pending study completion	Not funded at level of CAO's requirements.
7.	Restoration and Monitoring Measures Completion Report	December 15, 2018	Pending study completion	Not funded at level of CAO's requirements.

Please contact me at your earliest convenience to discuss the deadlines and other matters contained herein. Submittal of this request for additional time does not waive the Coles right to appeal the CAO within "30 days after the date of [the CAO]".

Regards,

Churchwell White LLP

for Barbara A. Brenner
BAB/kaf

cc: Douglas and Heidi Cole
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TECHNICAL MEMORANDUM

Sediment Delivery Potential from Failures on the Stanshaw Creek Diversion Ditch
Prepared for: Will Harling, Mid-Klamath Watershed Council and Douglas and Heidi Cole, Marble Mountain Ranch.
Prepared by: Rocco Fiori, Engineering Geologist, PG8066.
May 14, 2016

1.0 Introduction

This memorandum provides my preliminary findings of a survey to assess the sediment delivery potential from failures on the Stanshaw Creek diversion ditch. The Marble Mountain Ranch has a patented water right to divert water from Stanshaw Creek for consumptive and non-consumptive uses. The North Coast Regional Water Quality Control Board (NCRWQCB) and National Marine Fisheries Service (NMFS) are concerned operation of the diversion ditch constitutes a threat to downstream beneficial uses including water quality, and fish and wildlife habitat. This assessment was conducted at the request of Douglas and Heidi Cole, owners of the Marbled Mountain Ranch, and Will Harling, Director of the Mid-Klamath Watershed Council (MKWC).

2.0 Approach

The purpose of the survey was to assess the relative potential for ditch failures to deliver sediment to Stanshaw Creek and other waters of the State of California. The assessment was comprised of the following activities:

1. Review of a recent ditch inspection report prepared by NCRWCB staff (Feiler 2015).
2. Rapid field reconnaissance of the site on April 20, 2016, with Douglas Cole, Will Harling, and Joey Howard (Cascade Stream Solutions).
3. Desktop analysis, including qualitative assessment of site conditions using a 1-meter resolution LiDAR DEM, Digital Ortho-Photographs, and the Regional Geologic Map (Wagner and Saucedo 1987) with ArcGIS.

3.0 Findings

3.1 Ditch Failure Modes

I observed many of the erosion points described in the NCRWCB ditch inspection report and concur with the general characterization of the types of failure modes operating along at the ditch line by Feiler (2015). Based on my observations it appears the failure modes and frequency of occurrence can the ranked in the following order, (with type 1 modes having the greatest likelihood of occurring):

1. Water seepage through the outboard embankment fill material. This failure mode has two likely outcomes: a) slow slump failure of the fill with the potential for ditch flow to overtop the embankment and discharge downslope; or b) rapid slump failure of the fill, leading to the near instantaneous discharge of ditch flow downslope. Type 1b failures are most likely to lead to onsite erosion and possibly contribute to offsite sedimentation.
2. Cutbank failure. The outcome of this failure mode depends on the volume of the failed material. For a) small cutbank failures, the failed material will likely displace some of the ditch flow onto the outboard edge of the embankment and not lead to any onsite erosion; or for b)

larger cutbank failures, the failed material can cause the ditch flow to overtop the embankment. Type 2b failures are the most likely to lead to onsite erosion and possibly contribute to offsite sedimentation.

3. Tree Windthrow. Windthrow from the cutbank or embankment fillslope can lead to either a) slow, or b) rapid failure of the embankment fill, or c) slow and d) rapid displacement of ditch flow on to or over the embankment fill. The magnitude of onsite erosion and possibility of offsite sedimentation is dependant on the size of the tree and duration of uncontrolled ditch flow through the failure.

3.2 Sediment Delivery Potential

Based on my preliminary field observations and desktop analysis it appears the first 1100 feet (starting at the Point of Diversion) of the ditch has the greatest potential to deliver sediment to Stanshaw Creek in the event of a ditch failure. This is primarily because the ditch is located directly above the stream channel, and secondarily because the ditch is partially within the fluvial corridor of Stanshaw Creek (Figure 1). The remaining sections of the ditch have a low to moderate sediment delivery potential (Figure 1 and Table 1). The lower delivery ratings are due to the capacity of large topographic benches and dense vegetation to intercept and store a majority of sediment before it can be delivered to the receiving waters of the State (Figure 1).

Table 1. Relative sediment delivery potential of the Stanshaw Creek Diversion Ditch.

Distance from POD (feet)	Relative Sediment Delivery Potential	Percent of Ditch Length	Receiving Waters	Rationale
0 to 1100	High	24	Stanshaw Creek	Ditch is directly above stream
1100 to 2100	Low	22	Stanshaw Creek	Topographic bench likely to store most sediment and attenuate turbid runoff
2100 to 2800	Moderate	15	Stanshaw Creek	Reduced effect of the topographic bench to store most sediment and attenuate turbid runoff.
2800 to 4600	Low to Moderate	39	Klamath River	Topographic bench likely to store most sediment and attenuate turbid runoff

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3.3 Other Sediment Sources

There is approximately 6,400 feet of streambank (2 X 3,200 ft.) on Stanshaw Creek between the Point of Diversion and the Highway 96 Culvert (Figure 1). A preliminary slope stability analysis indicates these slopes are marginally to highly un-stable. Wagner and Saucedo (1987) mapped the landform in this area as Qls (Quaternary Landslide), which also indicates a higher potential for slope instability. Slope failures along the lower reach of Stanshaw Creek are likely a greater source of sediment delivery compared to the features along the ditch described by Feiler (2015), and could create background sedimentation and turbidity levels that would likely overprint inputs emanating from a ditch related failure.

3.4 Recommendations

1. During the field review, Mr. Cole described that his inspection and maintenance efforts target repairs to seepage and other minor failure problems before they evolve into larger or catastrophic failures. Similar inspection and maintenance efforts are recommended moving forward.
2. The use of a pipeline would avoid or minimize the likelihood of sediment delivery related to conveyance of the Cole's water right from the Point of Diversion to the points of consumptive and non-consumptive use.
3. If a pipeline is the selected alternative, consider retaining the existing ditch alignment as an inspection and maintenance travel way. Mild outsloping and appropriately spaced rolling dips along the travel way could be used to effectively improve the stability and drainage of the travel way, and to provide a route for rapid response in the event of a pipeline failure.
4. Slope stability analysis could be used to identify potential areas of concern and develop mitigation strategies.
5. A sediment budget could be used to obtain an accurate assessment of sediment contributions from past ditch failures and other sources.

References

Wagner, D.L., and G.J. Saucedo. 1987. Geologic Map of the Weed Quadragle, California, 1:250,000. State of California, Department of Conservation. Regional Geologic Map Series. Weed Quadrangle – Map No, 4A (Geology), Sheet 1 of 4.

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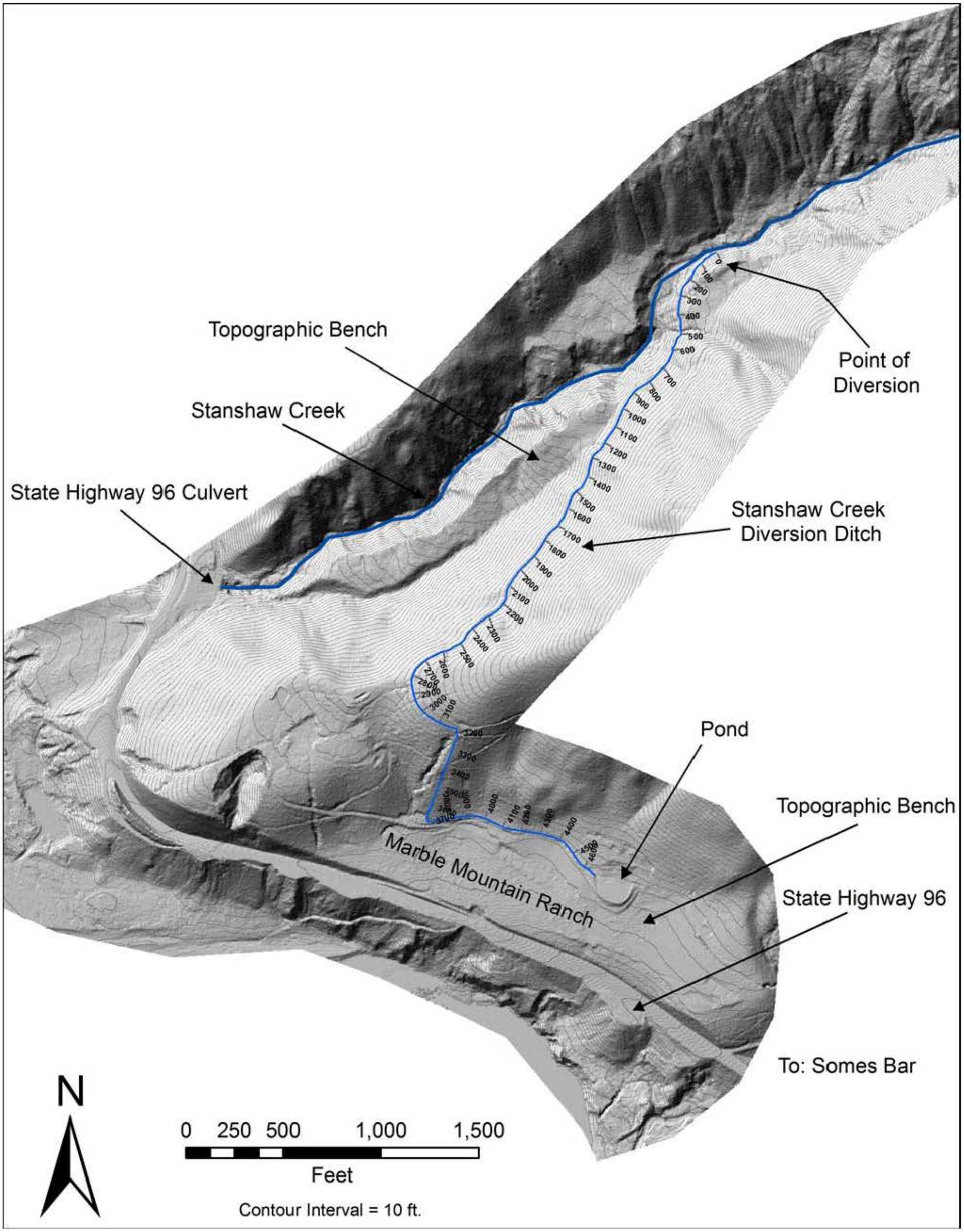

Figure 1. Project Location Map. Marble Mountain Ranch and the Stanshaw Creek Diversion Ditch. Base image is a 2010 1-meter LiDAR DEM Hillshade, provided by the Mid-Klamath Watershed Council.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404

August 3, 2016

Refer to NMFS No: 150307WCR2016AR00269

Barbara Evoy, Deputy Director
Enforcement Unit 5, Division of Water Rights
State Water Resources Control Board
1001 I Street, 14th Floor
Sacramento, California 95814

Dear Ms. Evoy:

Thank you for requesting technical assistance from NOAA's National Marine Fisheries Service (NMFS) to develop a flow recommendation for Stanshaw Creek that will protect listed coho salmon and their habitat and other important aquatic ecosystem functions. Stanshaw Creek, a tributary to the Lower Klamath River, supports Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*) evolutionarily significant unit (ESU) (70 FR 37160, June 28, 2005) and SONCC coho salmon ESU critical habitat (64 FR 24049, May 5, 1999) designated under the Endangered Species Act (ESA) (Figure 1). Stanshaw Creek is a critical cold water tributary to the Klamath River. Protecting low flow has been identified in the SONCC coho salmon recovery plan as a priority in the Klamath River for coho salmon recovery (NMFS 2014). In addition to listed coho salmon, Stanshaw Creek also supports amphibians and other aquatic life.

In 2001, NMFS submitted a water right protest to the California State Water Resources Control Board, Division of Water Rights (Division of Water Rights) in response to the Marble Mountain Ranch application for an appropriative water right from Stanshaw Creek. The NMFS protest letter identified a minimum bypass flow protective of coho salmon and their critical habitat. Since the original application and NMFS protest, the Division of Water Rights completed the *Division of Water Right Report of Inspection, Registration: D030945*. The inspections occurred on December 17, 2014 and February 12, 2015. The Division of Water Rights investigated the water right and found that the Marble Mountain Ranch has a pre-1914 right to divert up to 3.0 cubic feet per second (cfs). In addition to this finding, the Division of Water Rights also described the Marble Ranch diversion as "a potential waste and unreasonable use of water, an unreasonable method of withdrawal, and a harm to public resources." The Division of Water Rights requested assistance from the California Department of Fish and Wildlife and NMFS to establish a bypass flow on Stanshaw Creek that is protective of listed coho salmon and riparian ecology, both of which are considered Public Trust Resources.

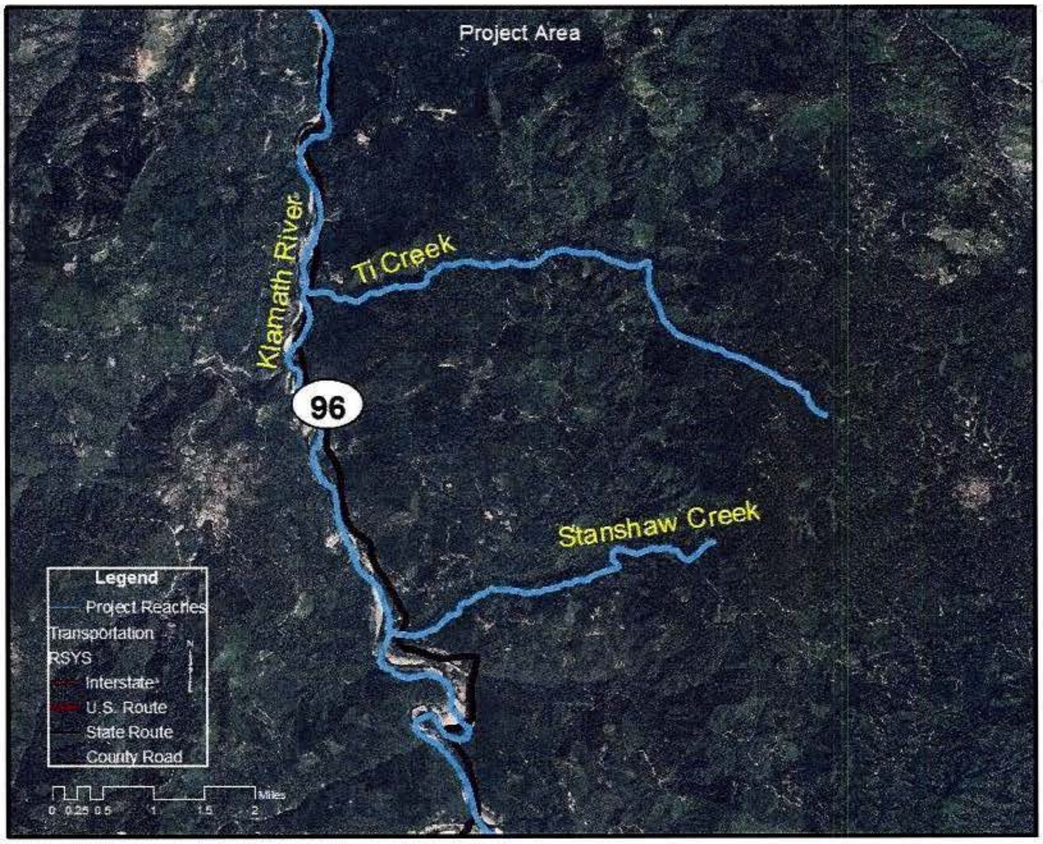

Figure 1 Stanshaw Creek Diversion Project Area.

Importance of Stanshaw Creek Flows to Coho Salmon and Stream Ecology

Juvenile coho salmon and other salmonids in the Klamath River rely on the cold water refugia provided by off channel habitat and tributaries such as Stanshaw Creek (NMFS 2014). When the mainstem Klamath River temperatures rise and flows recede, juvenile coho salmon seek cooler off-channel habitat where they may remain throughout the warm season (May through October). The off-channel pond at the Stanshaw Creek confluence with the Klamath River provides important rearing habitat for juvenile coho salmon, as well as for Chinook salmon and steelhead. In the Klamath River, mainstem temperatures can range from 21 – 27 °C in July and August with daily extremes as high as 29.5 °C (Belchick 1997, Bartholow 2005). Preferred temperature ranges for juvenile coho salmon rearing have been reported from 11.4 - 14.6 °C (Brett 1952, Coutant 1977, Beschta *et al.* 1987) with lethal temperatures occurring at 25.8 °C (Beschta *et al.* 1987) and cessation of growth at a temperature of 20.3 °C (Brett 1952, Reiser and Bjornn 1979). Besides directly causing physiological stress, elevated water temperatures in the Klamath River are correlated with an increased prevalence of diseases, including *Ceratonova shasta,* that cause mortality in Klamath River coho salmon (Hallett *et al.* 2012, Ray *et al.* 2012)

The flow volume in Stanshaw Creek is important during the late spring and summer to provide attraction flow and access for juvenile coho salmon and other salmonids to cold water refugia. Access to tributaries becomes increasingly important as water temperatures in the Klamath River begin to reach levels that cause stress and limit juvenile coho salmon growth, typically starting in mid-May and continuing through October (Bartholow 2005, Belchik 1997). Water temperatures lethal to coho salmon and other salmonids occur in the mainstem Klamath River in July and August, reaching exceedence levels of over 50 percent (Asarian 2013). As such, coho salmon and other salmonids need access to cold water tributaries before the mainstem water temperature reaches stressful or lethal levels if they are to survive in the Klamath River.

The connectivity between the Klamath River and the off-channel pond and stream is most important to coho salmon in this warm transition period, but coho salmon may continue to use the mainstem Klamath River for feeding opportunities even as the mainstem reaches lethal levels during some portions of the day. Witmore (2014) documented a daily migration pattern of juvenile coho salmon from Tom Martin Creek (a coldwater tributary) into the mainstem Klamath River, presumably to access food resources. This migration pattern continued throughout the summer as flows from Tom Martin Creek created a cold water plume in the mainstem Klamath River.

In addition to access to Stanshaw Creek, streamflow from Stanshaw Creek is important for coho salmon after flows recede below the point of connectivity to the Klamath River. The low flow in Stanshaw Creek maintains the off-channel pool water quality and provides a source of food supply to the pool.

Stanshaw Creek Stream Flow Estimate

The Stanshaw Creek watershed is almost 100% forested and flows in a westerly direction to its confluence with the Klamath River. The watershed area is 4.3 square miles above the confluence with the Klamath River and approximately 4.0 square miles above the point of diversion (POD). A diversion ditch runs from the POD on Six Rivers National Forest land to the Marble Mountain Ranch. Stanshaw Creek is ungagged, therefore, the low flow hydrograph was estimated by correlation with USGS hydrographic data for Ti Creek, located in a 9.46 square mile watershed to the east of Stanshaw Creek. The streams are expected to have a similar hydrologic response because of their similar size, elevations, vegetation, geology, soil type, and both flow in a westerly direction into to the Klamath River.

Daily average stream flow for Stanshaw Creek was estimated by prorating the Ti Creek flow data with the proportional watershed area (*i.e.*, $Q_{Stanshaw} = Q_{Ti} \times \frac{Area\ Stanshaw}{Area\ Ti}$). Table 1 lists the estimated minimum 7-day average flow for each low flow month and year. Based on this calculation, Stanshaw Creek has an estimated average annual flow of 10.1 cfs and an average 7-day minimum low flow of 2.6 cfs at the point of the Marble Mountain Ranch diversion. The lowest flow typically occurs in October though the estimates show that streamflow begins to recede toward low flow as early as May and the lowest flow may occur as late as November.

Table 1 Stanshaw Creek annual minimum 7-day average streamflow estimates based on prorating the Ti Creek flow data by proportional watershed area.

Minimum of 7-day average per year						
month	1960	1961	1962	1963	1964	Min. for month
May		11.3	4.7	14.1	7.6	4.7
June		6.3	4.6	8.9	5.2	4.6
July		4.2	3.2	5.7	3.9	3.2
August		3.5	2.8	4.3	3.3	2.8
September		3.2	2.5	3.9	2.7	2.5
October	2.4	3.2	1.5	3.5		1.5
November	2.7	3.7	1.3	4.9		1.3
December	5.1	4.7	9.1	8.0		4.7
Min. for year	2.4	3.2	1.3	3.5	2.7	1960-1964 Overall min. = 1.3 cfs Average annual min. =2.6 cfs

The Ti Creek daily streamflow record used for these estimates spans only four years (WY 1961-1964). Therefore, the Ti Creek data was further assessed to ensure that the period of record for Ti Creek did not represent an abnormal period of record for stream flow.

The water year type during the 1960 through 1964 period was evaluated by comparing to the full record of nearby longer term gages that included the many years before and after the 1960-1964 period. The gages used for comparison and their period of record are listed in Table 2.

Table 2 Period of record of long term gages near Stanshaw and Ti Creek.

USGS Stream gage	Period of record evaluated
# USGS 11521500 INDIAN C NR HAPPY CAMP CA	1957-2014
# USGS 11523000 KLAMATH R A ORLEANS	1927-2015
# USGS 11522500 SALMON R A SOMES BAR CA	1929-2015

Figure 2 shows the annual minimum 7-day average flow per square mile for the available stations. The figure includes the Stanshaw Creek estimates for 1960-1964. The data indicate that watershed area is negatively correlated with low-flow per square mile where there is a higher minimum flow per square mile in the smaller watersheds. The watershed area of Ti Creek is two orders of magnitude smaller than Indian Creek, which is reflected in the much higher minimum flows per square mile. Despite the differences in minimum low flow based on watershed size, the low flow for the all gages follow a similar pattern from year to year which helps verify that the streams have a similar hydrologic response based on the water year type. Redwood Creek, which is located on the coast of Northern California near Orick, is included on the figure to show that inland Klamath River streams have a higher and more constant low flow per square mile than the coastal streams.

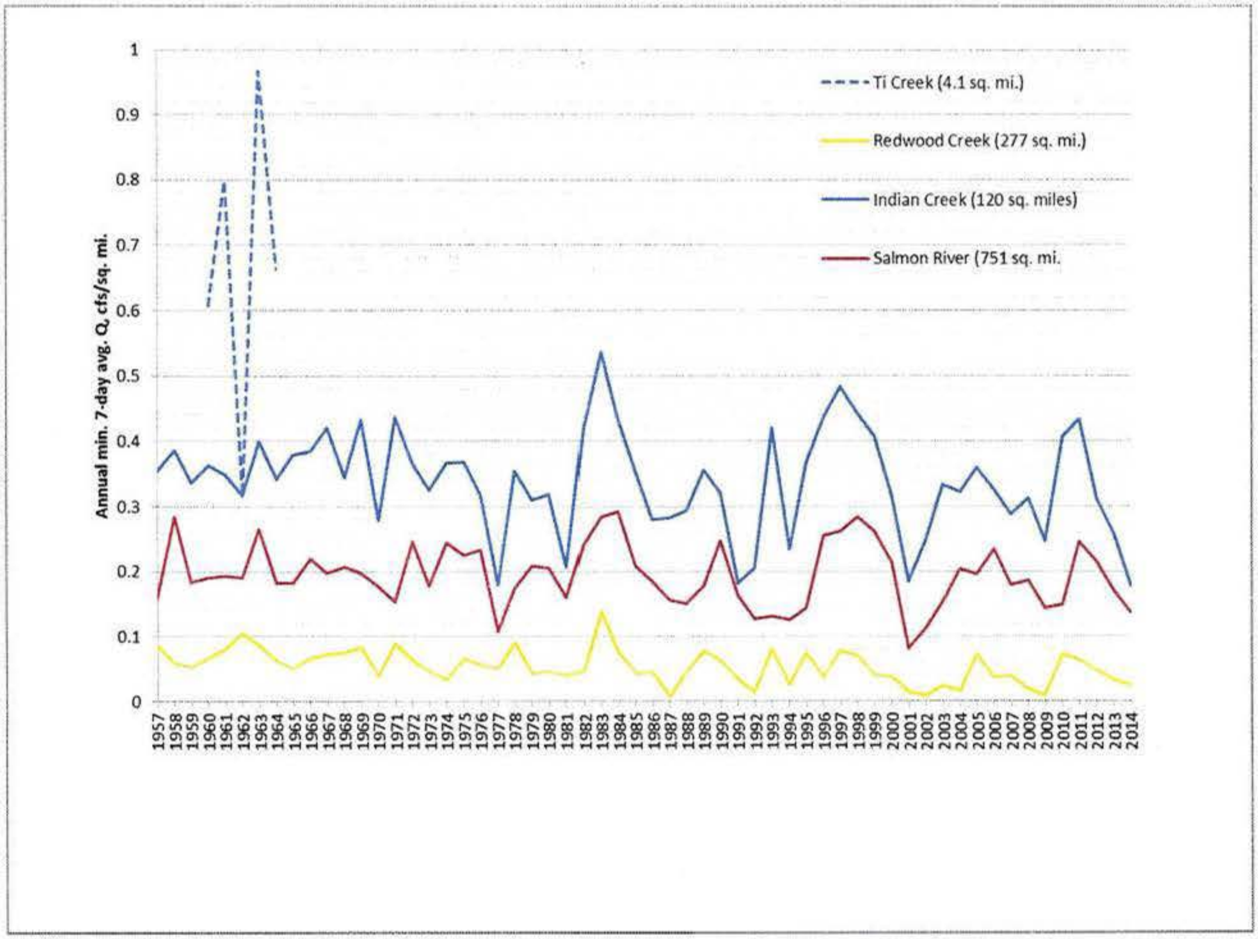

Figure 2 Comparison of annual minimum of 7-day average flow per square mile.

Flow duration curves were developed for the annual minimum 7-day average flow for each of the gages (Figure 3). The annual minimum 7-day average stream flows for 1960 through 1964 period are highlighted on each duration curve, and show the 1960 through 1964 period represents a range of moderate years in the low flow season. A flow duration curve for Redwood Creek is included on

Figure 3. Redwood Creek is located in the coastal range where snow has a much smaller effect on the hydrology and the geology is different. The figure helps verify that the hydrologic response of the inland streams is relatively similar, while the coastal Redwood Creek is different. The inland gages tend to have less variation at low flow from year to year. Figure 2 and Figure 3 work together to demonstrate that Stanshaw Creek has a similar hydrologic response as the other Klamath River watershed gages and that the 1960-1964 period represent moderate flow years and not an abnormal period of record.

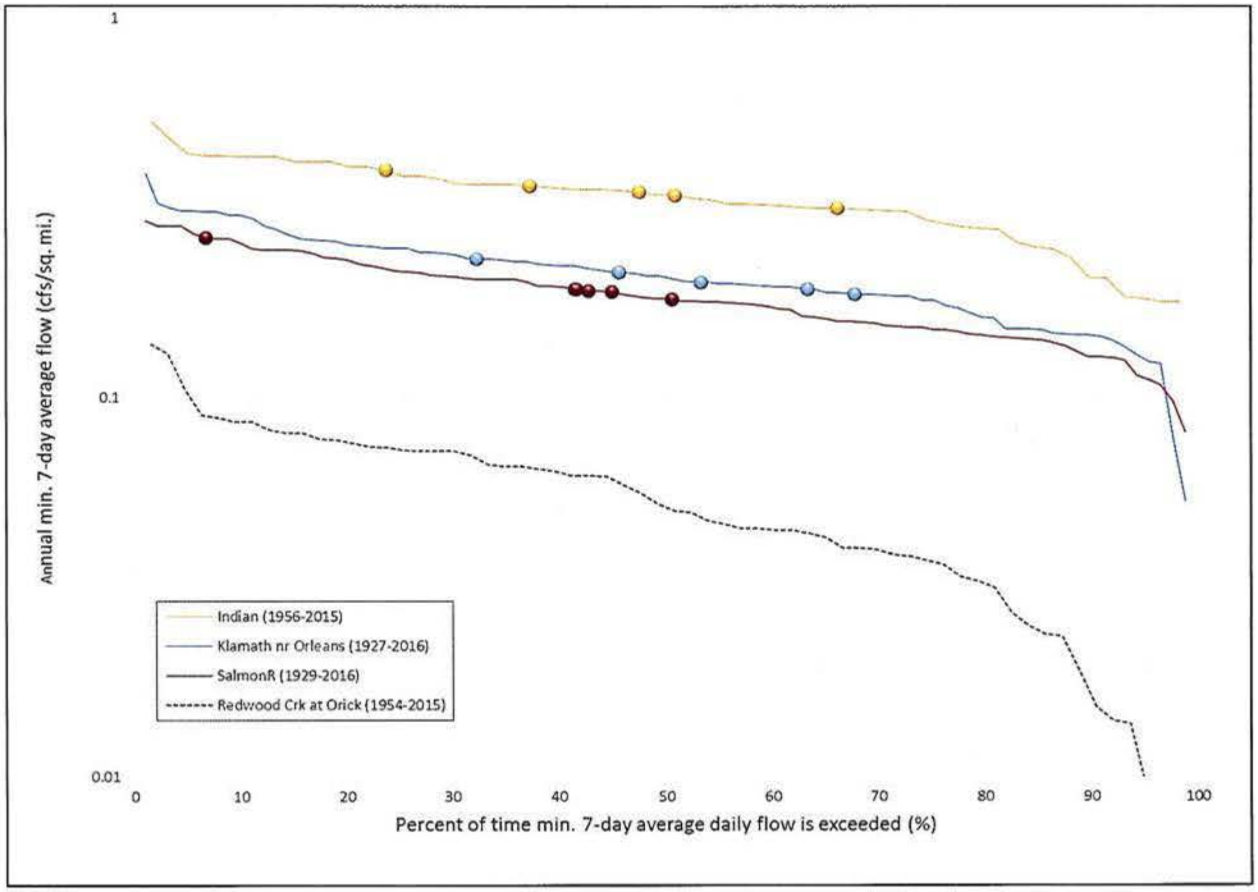

Figure 3 Annual Minimum 7-day average exceedence curves for long-term stream flow gages near Stanshaw and Ti Creek with years 1960-1964 marked.

Streamflow was measured in Stanshaw Creek several times from 2001-2014 above the POD (Table 3). Flow measurements were taken during low flow, but not necessarily at the lowest flow of the year. Two measurements were taken in 2012 showing a 0.5 cfs recession from September to October. Assuming recession at this rate from September to October, the lowest annual minimum flow for Stanshaw Creek in 2003 would have receded to 1.9 cfs, and the average of the years measured would have been 2.2 cfs. The average and minimum of the measured values are similar to the calculated average of 2.6 cfs and minimum of 1.3 cfs for Stanshaw Creek shown in Table 1 when using Ti Creek as a reference stream. The minimum flows of Salmon River and Indian Creek for each year from 2001 through 2014 are shown in Figure 4. From the Indian Creek and Salmon River comparison in Figure 4, the measured flows from 2001-2014 likely span a full range of water year types. Therefore, NMFS is confident that using Ti Creek hydrologic data prorated by proportional watershed area provides a viable surrogate to estimate low flows for Stanshaw Creek for wet through dry years.

Table 3 Stanshaw Creek flow measurements at the POD

Date	Stanshaw Creek flow above POD (cfs)	Measured by
9/4/2003	2.4	Orleans RD
9/13/2011	3.2	Karuk
9/20/2012	2.5	NMFS
10/4/2012	2.0	Orleans RD

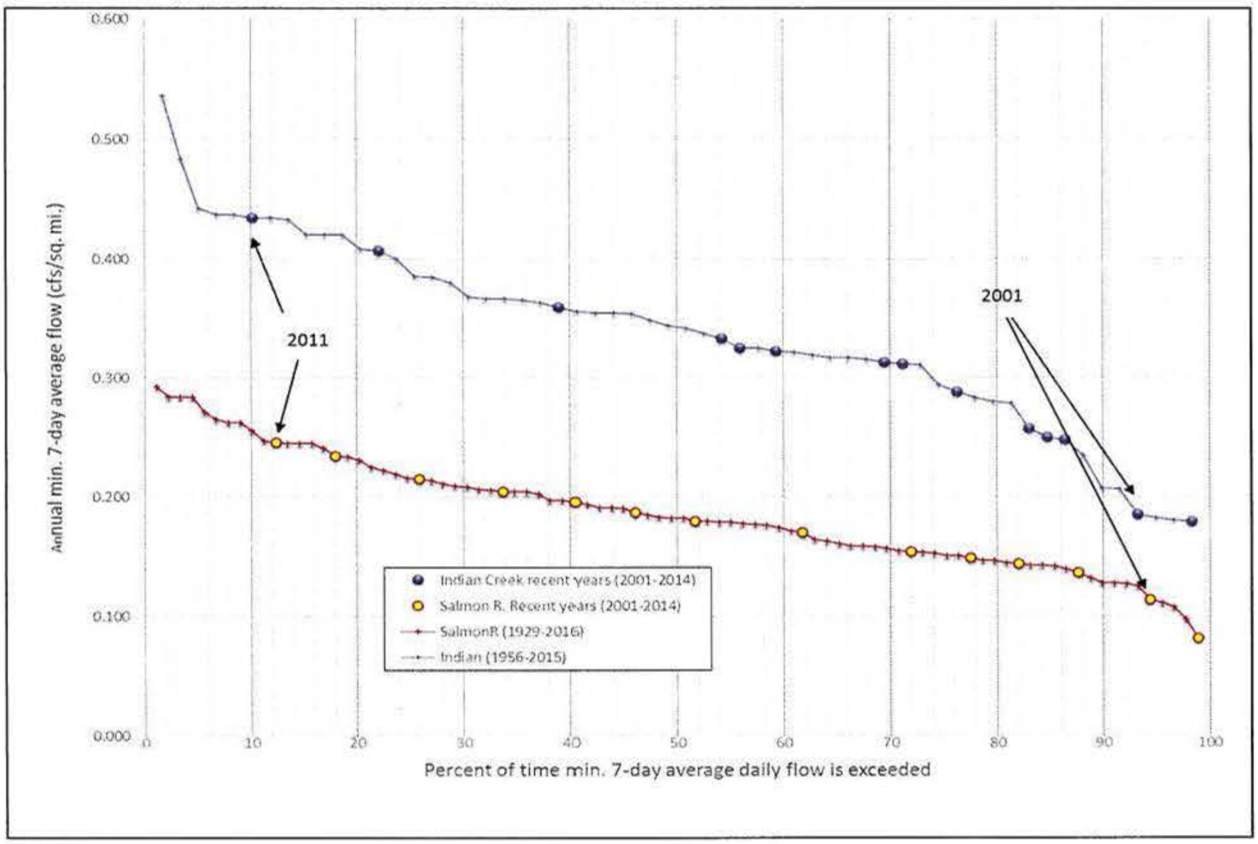

Figure 4 Data points for recent years are highlighted on the Salmon River and Indian Creek annual minimum 7-day average flow duration curve. The data show that 2001-2015 contained a full range of summer low flow from above average in 2011 to very dry in 2001.

Instream flow recommendation

The Marble Mountain Ranch diversion from Stanshaw Creek consists of both consumptive and non-consumptive use. The consumptive diversion is used to provide domestic and irrigation water for the Marble Mountain Ranch owners and business. The non-consumptive diversion is used to generate hydroelectric power. Currently, the diversion for hydroelectric generation is routed out of Stanshaw Creek watershed and discharged into Irving Creek, a tributary to the Klamath River to the west of Stanshaw Creek.

NMFS recommended bypass stream flow for the Marble Mountain Ranch diversion on Stanshaw Creek is based on an unimpaired hydrograph and includes rerouting the non-consumptive use back to Stanshaw Creek. Stanshaw Creek watershed is almost 100% forested with two small upstream diversions that State Water Board determined to be insignificant for this analysis. Based on this assumption, Stanshaw Creek streamflow just above the point of diversion is considered unimpaired for this bypass flow recommendation.

"Unimpaired hydrograph" is the term used to represent the hydrograph that should exist without diversions. The distinction between the term "unimpaired hydrograph" and the "natural hydrograph" (with no human caused alterations) is made to acknowledge that there may be human caused watershed-wide changes (*e.g.*, roads, vegetation changes, human caused climate change) that have also altered the natural hydrograph, but are not in direct control by the water users.

Reductions in the various components of the unimpaired hydrograph are assumed to correspond to reductions in stream habitat (Richter *et al.* 1996, Poff 1997). While any diversion may have an impact, a diversion of only a small percentage of unimpaired flow will maintain the natural variability of the hydrograph. A variable diversion rate that maintains the natural shape of the hydrograph is preferred over a minimum bypass flow recommendation that would flatten the receding part of the annual hydrograph. Diversions that "flatline" the receding part of the hydrograph, as is the case with a single bypass flow recommendation, will negatively affect juvenile fish outmigration as well as the quality of juvenile rearing habitat when their growth rate is high. Fish size is a critical factor in coho salmon smolt survival when migrating into the ocean (*Holtby et al.* 1990).

By analyzing case studies where ecologic goals were used to set the magnitude of water diversions, Richter *et al.* (2011) found that diversions limited to 6-20% of the unimpaired flow provided protection to the riverine ecology. For a high level of protection, the study suggested a presumptive standard of no more than a 10% diversion. A high level of protection is defined as minimal change to the natural structure and function of the riverine ecosystem. Klamath River SONCC coho salmon have a critical need for the cold water refugia provided by Klamath River tributaries such as Stanshaw Creek throughout the low flow season. Any loss of cold water during this time would decrease the quality and function of habitat. Because of the critically high summer Klamath River water temperatures, NMFS recommends a bypass flow that maintains at least 90% of the unimpaired flow. In addition to the critical need for cold water refugia in the Klamath, other considerations in setting this high standard for a bypass flow is that the actual flows at the point of diversion may already be somewhat impaired by existing and past land use, unaccounted diversions, and changing climate. Also, streamflow measurements used to direct the diversion could have measurement errors which may result in unintentionally diverting a higher percentage of flow.

Since the POD is above the anadromous reach, an additional non-consumptive diversion for hydropower generation may occur in the reach between the POD and upper limit of anadromy provided that a minimum bypass flow is maintained in this reach to protect the low flow channel and edgewater important for macro-invertebrate production. An additional requirement is that the non-consumptive portion of the diversion is returned to Stanshaw Creek at the upper limit of anadromy and that the stream water temperature remains consistent with the stream temperature above the diversion to maintain the low temperature benefit of the cold water refugia.

There is no single flow identified as the flow that maintains connectivity of Stanshaw Creek and the Klamath River since the connection depends on site features that vary with each water year (*e.g.*, groundwater flow, water level in both the Klamath and Stanshaw Creek, and the size of the sediment berm at the confluence). Taylor (2015) estimated a Stanshaw Creek flow of 1.3 cfs when the pond was not connected to the mainstem on November 17, 2014. The lowest flow in Stanshaw Creek that ensures connectivity is probably between 2.0 and 3.0 cfs considering the annual variation in the groundwater and berm configuration. Depending on the water year type and associated timing of the spring recession period, there is a large range of the annual 7-day low flow minimum and maximum from May through October which is the beginning and end of the warm season. For the moderate water year types analyzed, the pond may become disconnected by late July or the flow may stay connected to the Klamath throughout the low flow season during a wet year. Although connection to the pond would be beneficial at all times, it is most important at flows that occur in May and June as the Klamath River temperatures begin to rise when juvenile coho salmon are seeking refuge in the cooler water. Based on the flow analysis, an unimpaired Stanshaw Creek should stay connected to the Klamath River throughout May and June in all but the driest years.

Each component of the receding hydrograph has an important biological role to provide good water quality to the Klamath River, to provide an attractive flow and access for juvenile coho salmon to Stanshaw Creek and the off channel pond before temperatures rise in the mainstem, and to maintain good water quality and food supply to the pond and Stanshaw Creek throughout the low flow period. Flows need to be conserved on wet years to provide the tributary connection, improved water quality, and cold water attractive flow into the Klamath. Flows need to be conserved on dry years to maximize the water quality and food supply to the off-channel pond and cold water seep to the Klamath. Because of the thermal sensitivity and connectivity needed throughout the summer, the Marble Mountain Ranch diversion should be limited to zero or a small fraction of the flow as the flows recede and water temperatures rise. NMFS recommends that no more than 10% of the estimated unimpaired flow be diverted from Stanshaw Creek up to the limits of anadromy, throughout the low flow season, regardless of the water year to ensure water quality and food supply is maintained for the over-summering coho salmon in the pond. By design, a 10% diversion will decrease in size as the flow decreases. For example, as the flow drops from 3 cfs to 2 cfs the allowable diversion would decrease from 0.3 cfs to 0.2 cfs. As discussed previously, diversions of 10% or less of the unimpaired flow are considered to be protective of stream ecology (Richter *et al.* 2011).

The upper reaches of Stanshaw Creek provide important macro-invertebrate production and a food source to the Klamath River, the off-channel pond, and the anadromous reach of Stanshaw Creek. The topography of five cross sections were surveyed in 2002 in the reach above the Highway 96 culvert, above the assumed upper limit of anadromy. Hydraulic analyses of the five cross sections demonstrate the changing channel width as the flows recede. Figure 5, Figure 6, and Figure 7 show an inflection in the water surface width as the flows drop between about 1.5 to 2.0 cfs for three representative cross sections (the other two cross sections are more affected by assumed boundary conditions in the hydraulic analysis). The inflection on the curve represents the point where the wetted channel width drops off relatively quickly with flow. Maintaining a flow above the inflection point is important to protect macro-invertebrate production and to provide a minimum level of edge water rearing area. Based on this analysis, a two cubic feet per second bypass flow should protect the edge water in the reach between the POD and the upper limit of anadromy. The minimum bypass of 2.0 cfs at the POD assumes a that the non-consumptive diversion of up to 3.0 cfs will be returned to Stanshaw Creek above the upper limit of anadromy. Even with 2.0 cfs minimum bypass flow, NMFS anticipates natural variation in the bypass flow at the POD as demonstrated on the example diversion shown in Figure 8.

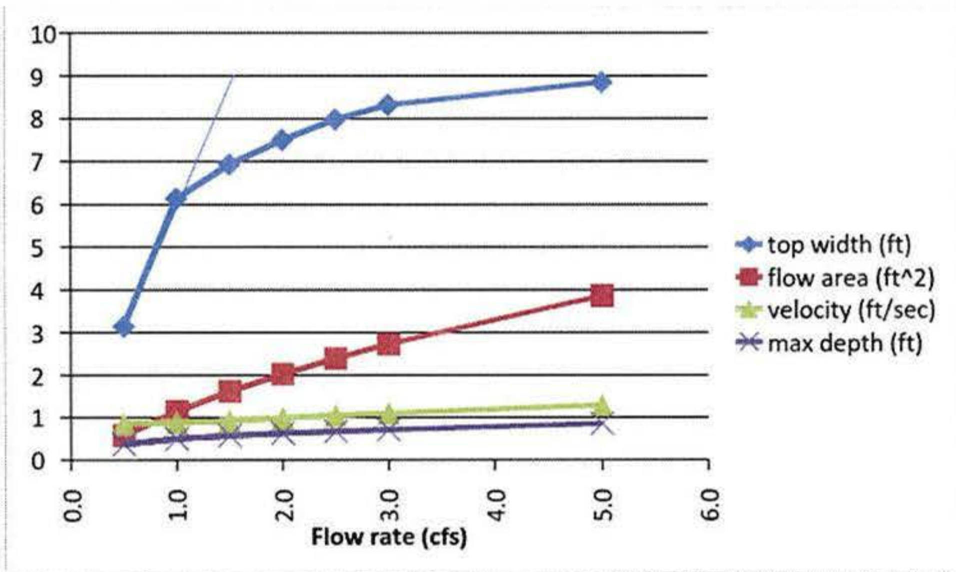

Figure 5 Cross Section 2 of Stanshaw Creek.

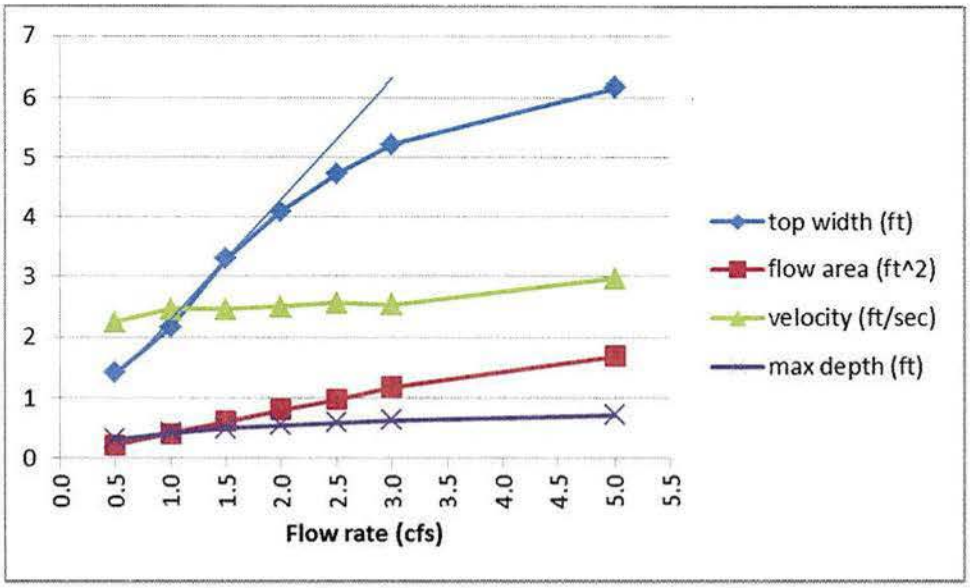

Figure 6 Cross Section 3 of Stanshaw Creek.

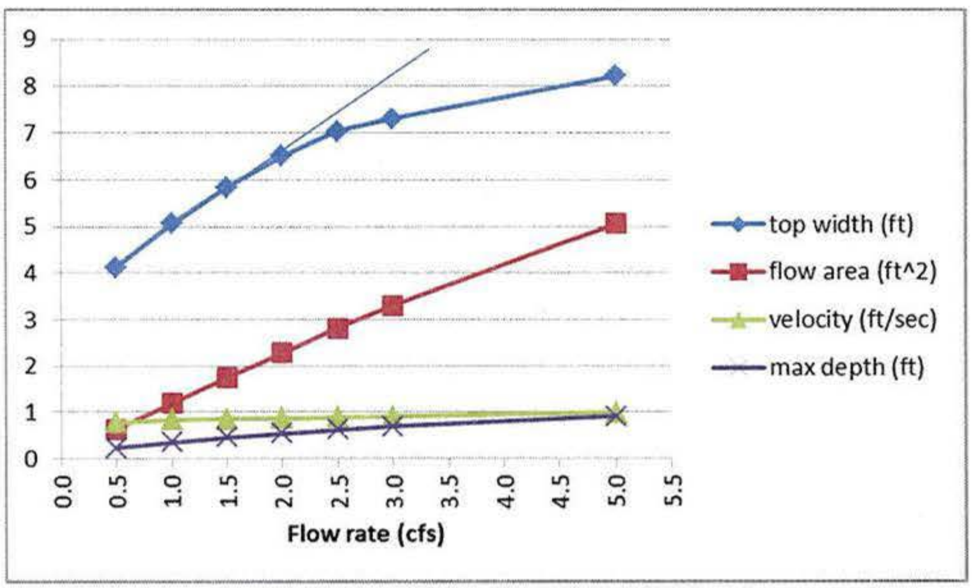

Figure 7 Cross Section 4 of Stanshaw Creek.

In summary, Stanshaw Creek low flows provide critical cold water to the Klamath River and access to cold water, off-channel refugia and food supply during low flow months. A maximum 3.3 cfs diversion that bypasses at least 90% of the unimpaired streamflow into the anadromous reach throughout the year will provide habitat to help conserve and protect listed coho salmon. In reaches above anadromy, a 2 cfs minimum bypass flow will be protective of listed salmonid habitat provided the non-consumptive diversion is returned to Stanshaw Creek with a negligible increase in water temperature. The non-consumptive (*i.e.*, hydropower) diversion is expected to only occur when streamflow is relatively high prior to the low flow season. The non-consumptive diversion is dependent on the ability to use the water and return it to Stanshaw Creek above the anadromous reach while maintaining a minimum of 2 cfs in the stream to maintain important ecosystem functions. The non-consumptive diversion used for hydropower would be limited to the minimum operating threshold of the turbine. After the threshold is reached, the non-consumptive diversion would cease, so the diversion would be limited to consumptive use and a 90% bypass would occur at the POD.

Figure 8 shows an example of the bypass flow recommendation using the Stanshaw Creek daily average stream flow estimates. The figure shows the estimated unimpaired hydrograph for the 1962 recession period and throughout the low flow season, along with the 90% bypass flow after the non-consumptive diversion is returned and the bypass at the POD with a minimum of 2 cfs. Also, shown are the diversions for consumptive and non-consumptive use. Under this bypass flow recommendation, at least 90% of the unimpaired hydrograph is preserved in the anadromous reach. This bypass flow recommendation has a daily variation as the flows naturally recede. If methods to control diversion on a real-time basis cannot be developed, further analysis could be done to establish seasonal diversions that would cover all water year type on a weekly or biweekly or monthly basis to allow manual control of the diversion.

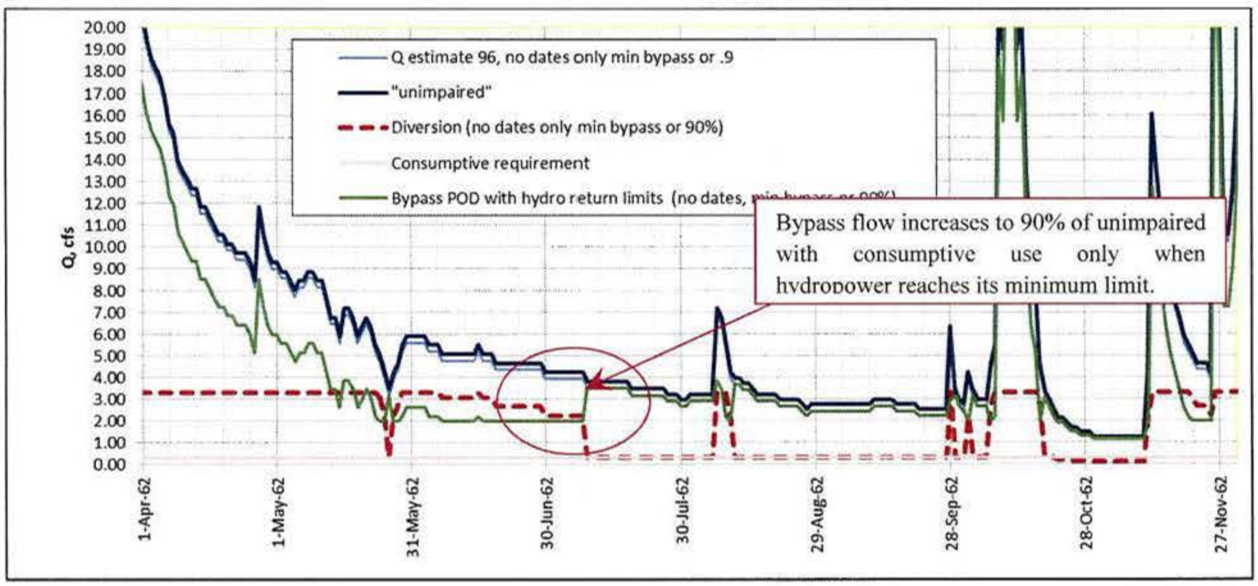

Figure 8 Example of bypass flow recommendation with assumed 0.3 cfs consumptive use and maximum 3.0 cfs non-consumptive use.

Please contact Margaret Tauzer, NMFS hydrologist/hydraulic engineer in Arcata, California at (707) 825-5174 for any additional questions concerning this flow recommendation.

Sincerely,

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Assistant Regional Administrator
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cc: Jennifer Bull, CDFW, Yreka, CA
Neil Manji, CDFW, Redding, CA

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