July 1, 2015

NMFS INSTREAM FLOW RECOMMENDATIONS FOR MARBLE MOUNTAIN RANCH DIVERSION

Coho use of Stanshaw Creek flows:

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

The flow volume in Stanshaw Creek is important during the late spring and summer to provide access and also to provide the attraction flow to help the juvenile coho locate the 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 growth, typically starting in mid-May and continuing through October (Bartholow 2005, Belchik 1997). Lethal water temperature occur in the mainstem Klamath in July and August, reaching exceedence levels of over 50 percent (Asarian 2013). It is important that coho have a chance to get out of the mainstem before it reaches these levels, so it is critical that the tributaries remain connected before the mainstem reaches the lethal levels.

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

In the period of record analyzed, the estimated 7-day low flow dropped below 1.9 cubic feet per second (cfs) sometime within the August-October period in each of the four years analyzed. The period analyzed represents an average hydrologic period for Stanshaw Creek. The data indicate that even without a surface water diversion, the flows in Stanshaw Creek may naturally decrease to the point of disconnection with the mainstem. However, during the times of disconnection, Stanshaw Creek flows continue to flow subsurface to the pond and to the Klamath River, providing critical cold water refugia and a source of good water quality vital to the survival of juvenile coho in the warm low flow period. During the summer of 2012, Witmore documented water temperatures averaging 16ºC in Stanshaw Creek pond, and a population estimate of 140 juvenile coho salmon, with high rates of growth at 0.004 g/g/day (Witmore 2014).

Instream flow recommendation:

There is no single flow identified as a "tributary connection flow" since the connection depends on groundwater flow, water level in both the Klamath and Stanshaw Creek, and the size of the sediment berm at the confluence. Though connection to the pond would be beneficial at all time, it is most important at flows that occur in May and June. Based on the flow analysis using the Ti Creek station, the estimated minimum unimpaired 7-day average low flow in Stanshaw Creek for both May and June is 3.1 cfs. Observations by Taylor estimated a Stanshaw Creek flow of 1.3 cfs when the pond was not connected to the mainstem on November 17, 2014 (Taylor 2015). A lowest flow in Stanshaw that ensures connectivity is probably between 2.0- 3.0 cfs considering the annual variation in the groundwater and berm configuration. There is a large range of the annual 7-day low flow minimum and maximum flow in May and October; the beginning and end of the warm season (Table 1).

Table 1 Stanshaw Creek 7-day low flow range for the 1961-1964 period analyzed (estimated as an average hydrologic period).

	Range of 7-day low	
	minimum (cfs)	maximum (cfs)
May	3.1	16.8
June	3.1	9.3
July	2.2	6.0
August	1.9	3.8
September	1.7	2.9
October	1.0	15.1

The variability of streamflow from year to year is large but each component of the receding hydrograph has an important biological role whether to provide good water quality to the Klamath, to provide an attractive flow for juvenile coho before temperatures rise in the mainstem, or to provide connectivity to Stanshaw Creek. 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 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 from May 15 through October 31 regardless of the water year type and that no diversion be allowed below 1.5 cfs to ensure water quality and food supply is maintained for the over-summering coho in the pond. Based on stream flow estimates shown in Table 1, an unimpaired stream flow below 1.5 cfs likely occurs only in very dry years in the late part of the low flow season.

A diversion of 10% would allow a variable diversion throughout the summer season (Table 2). A variable diversion can be difficult to manage and is dependent on constant stream flow measurement. Stanshaw Creek has no other known diversions above the Marble Mountain ranch diversion, so the stream flow above the diversion is assumed to be unimpaired flow. Because Stanshaw Creek has several steep areas limiting fish access and steepens to over a 6% slope in the vicinity of the diversion, the upper part of the stream is not expected to provide much if any spawning or rearing habitat for salmonids. Because of the limited habitat above the diversion, NMFS recommends that a flume type diversion structure be designed to control the diversion rate to 10% of the existing flow. The structure would be designed to allow 10% of the flow to be diverted so that the following diversion rates would occur between May 15 and October 31

Table 2 Table of diversion rates using 10% rule and 1.5 cfs minimum bypass

Flow rate above diversion (cfs)	Diversion(cfs)
10	1
5	0.5
3	0.3
2	0.2
1.5	0

Diversions that occur from November 1 through May 14 could utilize the same weir structure with an upper limit based on the maximum water right. The lower reach of Stanshaw Creek provides rearing habitat for adults and juvenile coho in the November through mid-May period as well as important macro-invertebrate production. Hydraulic analysis based on five cross sections surveyed in 2002 above the Highway 96 culvert, show an inflection in the water surface width as the flows drop below about 1.5 to 2.0 cfs (Figure 1, Figure 2, and Figure 3). The inflection on the curve represents the low flow channel and the point where the wetted channel width drops off quickly with flow. It is important to maintain this base flow to protect macro-invertebrate production and to provide a minimum level of edge water rearing area. Two cubic feet per second bypass flow should protect the edge water during the November – mid-May period when flows drop to these low levels. Table 3 shows the estimated range of flows that occur in the November through May period. The minimum flows in this period generally occur between storms and do not represent the spring recession flows typical in May.

The habitat identified for this recommendation is based on food supply but change to the recession part of the hydrograph in this period is abrupt and may adversely affect species that are not currently listed under the Endangered Species Act. NMFS recommends that diversions occurring using this recommendation return any hydroelectric portion to the stream after use to avoid unnecessary impacts.

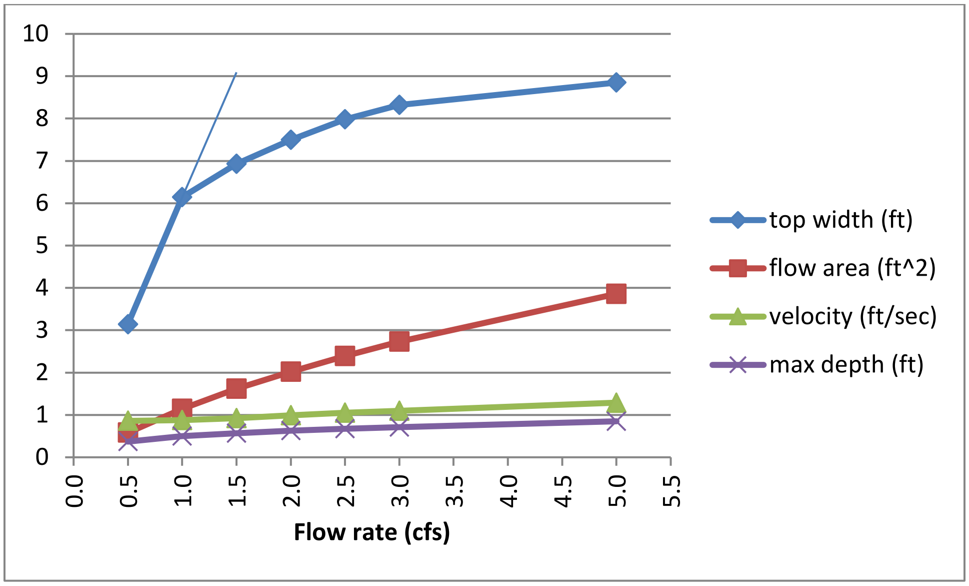

Figure 1 Cross Section 2 (sta 89.83)

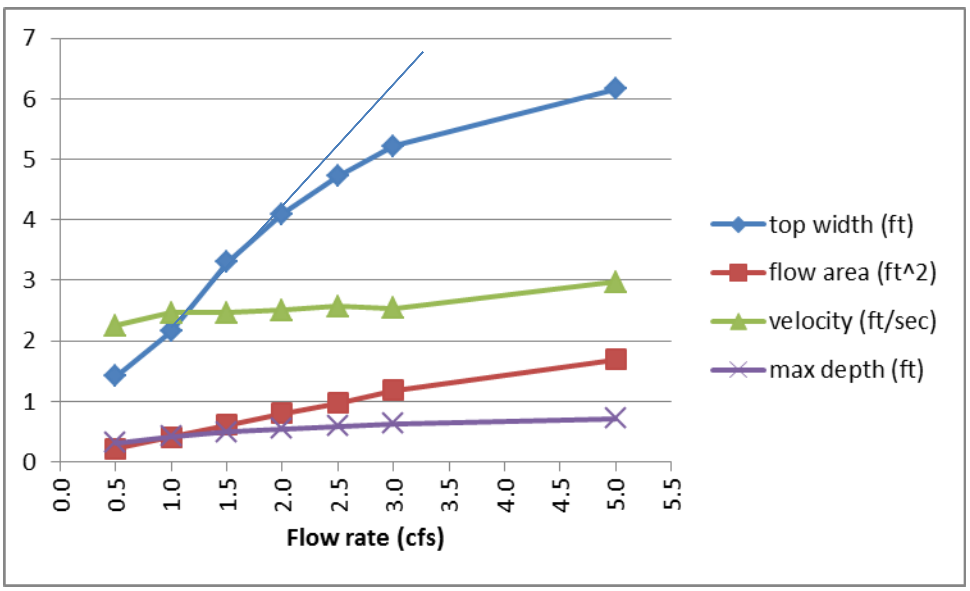

Figure 2 Cross Section 3 (sta 75.33)

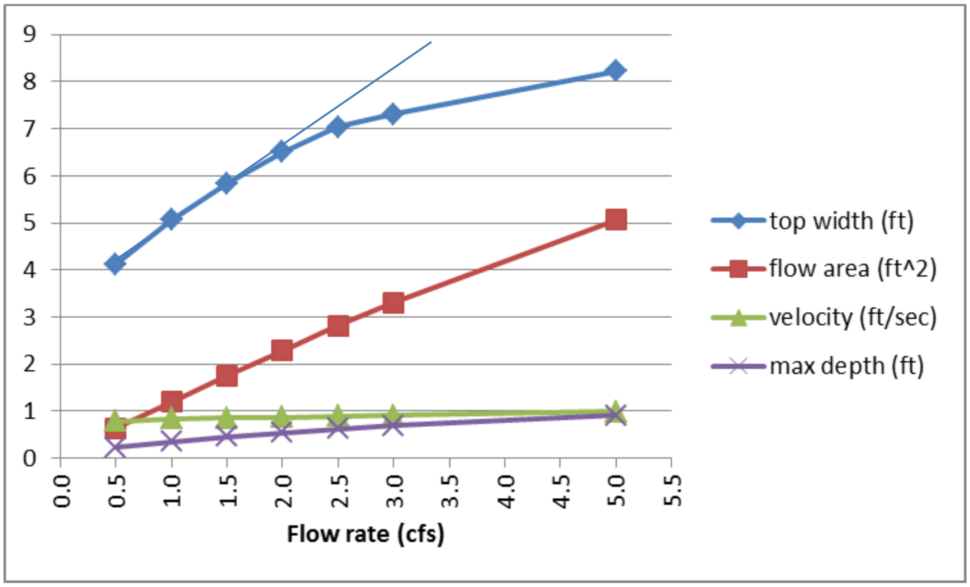

Figure 3 Cross Section 4 (sta 54.13)

Table 3 Estimated range of flow from November to May

	November - May		
Month	average(cfs)	minimum(cfs)	maximum(cfs)
January	7.5	2.3	84.2
February	13.5	4.6	47.9
November	6.1	0.9	42.5
December	7.7	2.9	62.5
March	11.3	5.4	31.7
April	11.9	5.7	34.2
May	8.1	2.3	17.4

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