RESPONSE TO FEBRUARY 16, 2018 REQUEST FOR ADDITIONAL INFORMATION, RESOURCE AGENCY LATE FILING, AND OTHER RELATED INFORMATION

ATTACHMENT O

ESTIMATED COSTS FOR USFWS LARGE WOODY MATERIAL MEASURE

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MEMORANDUM

DATE: Friday, April 27, 2018

TO: Turlock Irrigation District and Modesto Irrigation District

FROM: Noah Hume PE (C45808) and Chris Lyle, Stillwater Sciences

SUBJECT: Estimated costs for USFWS Large Woody Material measure

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In their comment letter of January 29, 2018 to the Commission, the U.S. Dept. of Interior Fish and Wildlife Service (USFWS) provided several recommendations under Section 10 (j) of the Federal Power Act based upon juvenile rearing habitat for Chinook salmon in the Lower Tuolumne River. Stillwater Sciences has developed a conceptual cost estimate to fulfill the USFWS large wood material (LWM) measure outlined in FPA § 10(j) USFWS Condition 3: Restore and Enhance Juvenile Salmonid Rearing Habitat in the Lower Tuolumne River. Below are the conditions of the measure.

"3. Enhancement of Large Woody Material Resources

i. Licensees shall place a total of 1,600 pieces of LWM from La Grange Dam down to the confluence with the San Joaquin River.
ii. LWM will be placed at an appropriate distribution, density, and configuration as recommended by the restoration ecologist and in consultation with the Agencies.
iii. LWM pieces shall be placed within or adjacent to floodplain lowering and planting sites where feasible.
iv. A minimum of 10% of LWM pieces (160 pieces) shall be secured or embedded in the bank to provide at least partial inundation at 300 cfs upstream of the Licensees' existing Infiltration Gallery and 200 cfs in areas downstream of the Infiltration Gallery.
v. All pieces of LWM shall be a minimum of 24 inches in diameter and 18 feet in length. A minimum of 50% of LWM pieces shall have a crown or rootwad attached.
vi. The total number of pieces of LWM may be supplemented by existing pieces of LWM meeting the size criteria. "

Given the available background information and conceptual nature of this projects feasibility actual placement locations have not been selected. Because of the large distances between known river access points for heavy equipment, we have assumed that LWM would be pre-assembled and transported to placement locations by heavy-lift helicopter. Stillwater has implemented several projects using this technique and believe this method would be the most cost-effective means of achieving wide distribution of LWM in the lower Tuolumne River. There are several assumptions required, principally that the proximity of staging area to placement location which has been assumed to be equal to or less than thirty minutes round trip via helicopter to accomplish the placement of the 1,600 LWM assemblies in the allotted 800 hours. If landowner access agreements can be attained at key increments along the project reach flight times may be able to be reduced. Several preliminary calculations were needed to provide requisite ballast weights, anchorage quantities and typical structure composition.

For this cost estimate it has been assumed that all features will be pre-assembled in one or more staging areas. The typical feature configuration will be composed of either a LWM piece with crown or rootwad attached or a LWM piece with two 3-ton boulders attached at the same or either end dependent of the desired functionality. For example, placement of both boulders on the same end of the LWM piece would allow the non-ballasted side to act dynamically during all flow conditions and water depths providing habitat complexity, shading of the water column and cover from predation. If the ballast boulder were to be placed on opposite ends the feature would be more or less static. This configuration would be beneficial for recruitment of bedload material, tailwater scouring, velocity refuge and racking of smaller debris.

We have provided conceptual level cost estimates for LWM implementation in the amount of $14.9 M below. This is exclusive of state and local permits and any post project monitoring that may be required, which could add an additional $200k and total $15.1M

Element	Cost
LWM Delivered	$1,800,000
Ballast Boulders	$1,440,000
Assembly and Anchorage:	$825,000
High lift Helicopter (800 hrs)	$10,480,000
Revegetation of staging areas	$100,000
Construction Management:	$100,000
Total:	$14,920,000