Eco-Hydraulic Modeling to Support Levee Setback and Floodplain Design

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EXTENDED ABSTRACT

The San Joaquin River Restoration Project (SJRRP) is located below Friant Dam near Fresno, California. The project is a direct result of a Settlement reached in September 2006 on an 18-year lawsuit to provide sufficient Chinook salmon habitat by the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council (NRDC), and the Friant Water Users Authority (FWUA). The Settlement received Federal court approval in October 2006. Federal legislation was passed in March 2009 authorizing Federal agencies to implement the Settlement.

The Settlement is based on two goals: (1) Restoration : To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish; (2) Water Management: To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

One of the major requirements of sustaining fish populations will be the creation of a sufficient amount of floodplain habitat for juvenile salmon rearing. The river is constrained by levees in many reaches and it is necessary to setback the levees to contain the restoration flows and to create floodplain habitat. Because the setback requires the purchase of valuable agricultural land in the Central Valley of California, the floodplain design should be carefully designed in order to maximize the benefit of this expensive resource.

The existing floodplain habitat for the SJRRP was first quantified using a two-dimensional hydraulic model (SRH-2D, Lai, 2008). The depth and velocity over approximately 100 miles of the San Joaquin River was computed. The reach was divided into several separate models to decrease computational time and make the terrain datasets more manageable. Habitat Suitability Indices (HSI) were applied to depth and velocity output from the model and then cover suitability was estimated using vegetation mapping of the river corridor. The required floodplain area was based upon estimation of the assumed territory size required to meet a sustainable population.

Once the required suitable floodplain was estimated a levee setback was proposed and the designs for the floodplain grading and revegetation were developed to meet the required habitat objective. The hydraulic and sediment transport conditions were simulated using one- and two-dimensional hydraulic and sediment transport models (Huang and Greimann, 2010; Lai, 2008). The floodplain design incorporated the expected channel evolution into the design. The revegetation strategy is based upon results from the one and two-dimensional hydraulic and sediment transport models that were linked to vegetation modules that simulate the interactions

between riparian vegetation, flow and sediment. The models simulate the effect of vegetation on hydraulic roughness, as well as the effect of hydraulics on the establishment and mortality due to desiccation, scour, and inundation.

REFERENCES

Huang, V.H., Greimann, B. (2012). Sedimentation and River Hydraulics – One Dimension, Version 3.0, Technical Service Center, Bureau of Reclamation, Denver, CO.

Lai, Y.G. (2008). SRH-2D version 2: Theory and User's Manual. Sedimentation and River Hydraulics – Two-Dimensional River Flow Modeling, Technical Service Center, Bureau of Reclamation, , Denver, CO.