Final Report: Suspended Sediment Budget for the Elwha River Floodplain

CENTER FOR ENVIRONMENTAL JUSTICE AND SUSTAINABILITY (CEJS)

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1. Project Summary

The removal of two large dams from the Elwha River, near Port Angeles, Washington, represents one of the largest river restoration projects in history. The second and larger of the two dams was finally removed on in August of 2014, liberating large amounts of sediment that had been stored in the reservoir upstream from the dam. Because of the many monitoring datasets being collected as part of the project, there are several interesting scientific opportunities. My project focuses on identifing what controls the storage of sediment on the river's floodplain. Floodplain sediment plays an important role in building soil and in changing the hydraulic characteristics of the river. The project relies on both field observations and computer modeling. The field component uses simple, low-tech repeat cross-section surveys to provide high-resolution measurements of elevation change within forested areas of the Elwha river floodplain. The sections were originally installed in 2013 between large reference trees that were flagged in the field and marked with nails so that the sites can be re-occupied. The computer modeling part uses the CAESAR landscape evolution model to simulate floodplain flow conditions over the post-dam period. These simulations are used to scale up the sediment deposition measurements to the entire system.

2. Main Accomplishments

Summer 2014

Field work: Cross sections were re-occupied during August, 2014. A total of 25 of the 43 sites had experienced significant sediment deposition.

Computer modeling: A preliminary CASEAR model of the system was developed based on topography/bathymetry provided by the U.S. Bureau of Reclamation and U.S. Geological Survey.

Fall 2014

Computer Modeling: The CAESAR model was optimized and calibrated using river stage data collected by the U.S. Geological Survey.

Code Development and Analysis: Source code for the CAESAR model is modified so that the model would store cumulative flow across each 10m x 10m grid cell. This variable was regressed against observed sediment deposition to develop a model of floodplain sediment storage that could be applied to the entire system. The results indicate that through August 2014, roughly 250,000 cubic meters of sediment had been stored on the floodplain. This is probably less than 10% of the total release through that date. However, no large post-dam floods occurred prior to December 2014.

Dissemination: Results were presented at the Fall 2014 meeting of the American Geophysical Union in San Francisco, CA. The citation for this presentation is as follows.

Lauer, J.W., Polka, J., (2014). Floodplain sedimentation in vegetated areas of the Elwha River floodplain, 2012-2014. Abstract EP33A-3599 presented at 2014 Fall meeting, AGU, San Francisco, Calif., 15-19 Dec.

Winter 2015

Field work: I attempted to visit my field sites during early February 2015 to collect sedimentation rates after a large flood that occurred in December 2014. However, an even larger flood occurred on the morning I arrived at the site. Instead of collecting sediment deposition data, I instead collected suspended sediment samples from inundated portions of the floodplain. These will be useful for model calibration.

Spring 2015

New Collaborations: I visited the Elwha River with a group of researchers from University of British Columbia (UBC) with whom I have been collaborating, and began to collaborate with UBC Ph.D. student Katie DeRego on numerical modeling of the Elwha. Together, Katie and I applied a computer model I have written, Morphodynamics and Sediment Tracers in 1-D (MAST-1D) to the Elwha River system downstream from the lower of the two dams, representing the time prior to dam removal. The simulations show that river bank erosion downstream from the dam may have provided a moderate sediment supply during the entire period the dams were in place. I also began advising a student, Jane Walden (Physics, Seattle University) on undergraduate research on the Elwha. We spent much of the Spring planning a major field campaign for Summer 2015 during which Jane and Katie collected sediment size date from banks and bars along much of the Middle and Lower Elwha Rivers.

Dissemination: Results were presented at the CEJS Fellows presentation on April 1st at Seattle University. I also summarized the work at an invited talk in Delft, Netherlands. A citation is given below.

Lauer, J.W. (2015). "Sediment sorting in channel-floodplain complexes: Modeling approach for coarse bed systems" (Invited), Presented at Workshop on Modeling Mixed-Sediment River Morphodynamics, Delft, Netherlands, 27-29 May.

Summer 2015

Field work: During summer of 2015, I helped Katie DeRego and Jane Walden prepare for and execute a five-week long summer field campaign on the Elwha. Work included collection of surface and subsurface sediment grain size distributions along the Middle and Lower Elwha as well as within both reservoirs. We collected physical samples and photographs from bar surfaces and eroding cut banks, and showed that the photographic-based results match the surface-based measurements relatively well. We also revisited all of my floodplain sedimentation sites and measured overbank sediment thickness at all sites that had not been eroded by the river.

Dissemination: Results of 2015 work were presented at a University of Washington Marine Geology and Geophysics seminar on February 8, 2016. The work was also presented at American Geophysical Union Fall 2015 meeting. Jane Walden and Katie DeRego also presented their work at the Elwha Research Symposium in Port Angeles, November 19, 2015. The citations are given below.

Walden, J., J.W. Lauer, K. DeRego, and M. Hassan. (2015). "Influence of dams on size-specific sediment transport and storage on the Elwha River, Washington." Abstract EP33A-1028 presented at 2015 Fall Meeting, AGU, San Francisco, Calif., 14-18 Dec.

DeRego, K., J. Walden, J.W. Lauer, B. Eaton, and M. Hassan. (2015). "A characterization of eroding cutbank material to the Elwha River." Presented at Elwha River Science Symposium, Port Angeles, Washington, 18-20 Nov.