

REGULATED RIVER RESTORATION MONITORING: THE ELWHA RIVER DAM REMOVAL AND RESTORATION PROJECT

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Introduction: National Park Sediment Monitoring Issues Related to Regulated River Operation and Restoration

Fluvial system response to the operation and restoration of regulated rivers, including understanding interactions between sediment transport, sediment storage and channel morphology, is the subject of several important monitoring projects in the National Park Service. Sediment transport and/or channel morphology monitoring currently is ongoing or planned at a variety of parks including Grand Canyon NP, Dinosaur NM, Black Canyon of the Gunnison NP, Sleeping Bear Dunes NS, Rocky Mountain NP, Point Reyes NS, Yosemite NP, Olympic NP, and Missouri National Recreational River. In all cases, the monitoring objective is to interface monitoring with modeling to help predict or define long term channel and water quality conditions under alternative dam operations or dam removal scenarios. Monitoring efficiencies are poor because of: 1) an absence of accepted bedload transport monitoring technologies; 2) difficulties monitoring suspended sediment and characterizing sediment size fraction in real time; and 3) difficulty in characterizing changes in sediment storage, channel morphology, and channel aggradation/degradation on the reach and system scales.

Elwha River Sediment Monitoring Plan

Second to the sediment monitoring program of the Grand Canyon Monitoring and Research Center, the largest physical process monitoring program in NPS currently is being planned to support the removal of two large hydroelectric dams near Port Angeles, Washington, on the Elwha River in Olympic NP. Roughly 18 million cubic yards of sediment are stored in the reservoirs behind the two dams. Large episodic releases of bedload and suspended sediment will be associated with drawdown of the reservoirs and demolition of the dams. It is anticipated that roughly one-quarter to one-third of the stored sediment will be released downstream during and following dam removal.

Available sediment transport models were not deemed reliable enough to accurately predict sediment redistribution in the former reservoirs, downstream suspended sediment concentrations at the intakes to industrial and municipal water supplies, downstream channel aggradation and/or channel realignments, or littoral transport and deposition in the Strain Juan de Fuca. As a result, real time monitoring of sediment storage, transport and channel aggradation/adjustment will be required as feedback to both the dam removal and water treatment activities. Modification of the dam demolition schedule and other remedial management actions will be dependent upon rapid determination of sediment concentrations, and channel processes and conditions. Recognizing the importance of sediment monitoring to the dam removal and river restoration project, the Bureau of

Reclamation and National Park Service convened a workshop of sediment experts to assist in the development of a Sediment Monitoring and Management Plan for the project (Randle, et.al. 2003). The project, which is scheduled to begin in 2007, would benefit enormously by technologies that enable real time monitoring of suspended sediment transport, instream sediment storage, and changes in channel elevation and morphology – especially on the reach scale.

As designed, the sediment monitoring program will consist of adaptive management component and restoration monitoring components (Table 1). Adaptive management monitoring will be in direct support of dam demolition. Information from adaptive management monitoring will be used to modify demolition schedules or to trigger contingency actions to protect downstream water quality, infrastructure or property. Restoration monitoring will be used to expand the body of scientific knowledge about dam removal and the restoration of affected ecosystems.

Table 1. Subjects of Sediment Resources Monitoring: Elwha River Dam Removal and Ecosystem Restoration Project (from Randle, et.al, 2003)

Monitoring Category	Adaptive Management	Long-Term Restoration
Reservoir Sediment Erosion and Redistribution	X	X
➤ Delta erosion and downstream progression	X	X
➤ Release of coarse sediments from the reservoirs	X	X
Hillslope Stability	X	X
Water Quality (Suspended Sediment Transport)	X	X
Riverbed Aggradation and Flood Stage	X	X
➤ Bed material size measurements	X	X
➤ River water surface elevations	X	X
➤ Channel geometry	X	X
Aquifer Characteristics	X	
➤ Water table elevations	X	
➤ Well water yields, quality	X	
River Channel Planform and Channel Geometry	X	X
Large Woody Debris Processes	X	X
Coastal Processes		X
➤ Turbidity plume		X
➤ Beach bathymetry and shoreline position		X
➤ Beach profile surveys		X
➤ Beach berm survey		X
➤ Beach sediment size measurements		X
➤ River mouth cross section surveys		X
➤ Ediz hook geometry		X
Sediment Budgets		X

Reference

Randle, T.J., J. Bountry, B. Jackson, and G. Smillie. 2003. Elwha River Restoration Draft Sediment Monitoring and Management Plan: Recommendations of the Elwha River Physical Processes Monitoring Workshop. U.S. Bureau of Reclamation, Aug. 13-17, 2001. Port Angeles, WA 56p.