

## **RIVER RESPONSE TO DAM REMOVAL: THE SOUHEGAN RIVER AND THE MERRIMACK VILLAGE DAM, MERRIMACK, NEW HAMPSHIRE**

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**Abstract** The Souhegan River is a tributary of the Merrimack River that drains a 443 km<sup>2</sup> watershed in southern New Hampshire. The lowermost barrier on the Souhegan River was the ~4-m high Merrimack Village Dam (MVD, ~500 m upstream of the confluence with the Merrimack River), which was breached and removed starting on August 6, 2008. The MVD was built in 1906 at a location where various dams have existed since the 18<sup>th</sup> century. Based on a pre-removal sediment-thickness survey, the MVD impounded at least 62,000 m<sup>3</sup> of sediment, mostly sand. We use a May 2008 ground penetrating radar survey of the impoundment to better constrain this sediment volume and stratigraphy. We also use historical maps and aerial photographs to estimate the possible extent of dam-influenced deposition at the site. We use 12 monumented cross sections, longitudinal profiles, repeat photography, and sediment samples to document the response of the Souhegan River to the removal of the MVD. Our study is part of the first full application of a recently published guide for stream barrier removal monitoring. Prior to dam removal, in August 2007 and June 2008, we surveyed the cross sections and longitudinal profile. We conducted re-surveys after removal in August and October 2008, and again in July and August 2009. Comparison between pre- and post-removal surveys shows that, in a 495-m reach upstream of the former location of the MVD, the Souhegan River eroded a net 38,100 m<sup>3</sup> (48,000 metric tons) of sediment. This response began with rapid (hours to days) incision of a narrow channel, exhuming in some places bedrock and boulders that likely formed the pre-dam riverbed. Over the year since dam removal, the channel has widened by bank erosion but this process is limited by root strength and recruitment of large woody debris in the riparian zone of the former impoundment. Downstream of the former dam location, during the first days after removal, a sand deposit up to 1.0 to 3.5 m thick, or approximately 18,500 m<sup>3</sup> (23,500 metric tons), prograded almost to the confluence with the Merrimack River. From August 2008 to August 2009, the Souhegan River removed a net 8,400 m<sup>3</sup> (10,700 metric tons) of this sediment leaving 11,100 m<sup>3</sup> (14,100 metric tons) from the initial post-removal pulse. Over this interval, the unaccounted 27,000 m<sup>3</sup> (33,800 metric tons) of sediment eroded from the former impoundment left the study reach and discharged into the Merrimack River. The Souhegan River experienced massive change during our two year study and continues to evolve as a new channel forms and stabilizes upstream and downstream of the former dam site.