

# **Springs Flows Restoring Surface Water Features post Disturbance – Shinumo Creek, Grand Canyon**

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The influence of groundwater on stream and riparian features is relatively unexplored. This presentation provides a case study of the restorative effects of several large perennial springs on a debris flow impacted Colorado River tributary stream. Shinumo Creek is a relatively high gradient perennial stream (92 m/km) that historically supported native fisheries and a robust riparian habitat. Overland flow occurs during brief intense monsoonal storms during summer months, otherwise almost all flow, including snowmelt, is derived from karstic springs emanating from the Muav Limestone. The Galahad Fire began May 23, 2014, and burned 2484 hectares of ponderosa pine forest in the headwaters of the creek (~10% of the watershed), with a portion burned below the rim on extremely steep slopes. Subsequent monsoonal storms caused two large floods later in the summer: the first was observed to carry substantial charcoal and ash into the Colorado River; the second included a debris flow with a stage approximately 5 m above base. Site visits following the floods found no fish in the mainstem of the creek, a denuded woody riparian zone, and channels severely altered with sequenced scour and fill reaches. Large sections of the channel had in-filled with fine sediments (coarse sand/pebbles) creating braided shallow reaches insufficient for native fisheries. Channel change surveys were conducted in 2015, 2016, and 2017 consisting of streamgauge analysis, bedload hydrophones, repeat cross-sections, pebble counts, and repeat photography. Within three years the stream has largely recovered to a pre-disturbance cobble-boulder bed single-thread channel. The majority of channel change occurred during spring snowmelts: a two to three week period of high, sediment poor, flow from springs that effectively flushed the channel re-creating fisheries habitat for the endangered Humpback Chub. Climate change predictions for the region indicate more severe summer monsoon storms and less snowpack in the contributing area. If these predictions come true there will be more frequent disturbance events and less springs contributions to restore perennial channels after debris flows. Effective adaptive management of Grand Canyon perennial surface water resources will require an understanding of springs and regional groundwater processes and their vulnerabilities.