IAHS2017-354
IAHS Scientific Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

How sustainable is reactive gravel management following floods? New data from the UK Cumbria Floods of 2015 suggests not.

George Heritage (1), Neil Entwistle (2), and David Milan (3)

(1) AECOM. Exchange Court, 1 Dale Street, Liverpool, L2 2ET,UK, (2) School of Environment and Life Sciences, University of Salford, Peel Building, University of Salford, Salford M5 4WT, UK, (3) School of Environmental Sciences, University of Hull, Cottingham Road, Hull, HU6 7RX, UK

Heavy rainfall from 4-6 Dec 2015 led to widespread flooding in Cumbria and across other parts of northern Britain. The flooding resulted from some exceptionally high rainfall totals across the Cumbrian fells, exceeding 300mm and breaking existing UK rainfall records. Several thousand homes and businesses were inundated with floodwater across Cumbria, with parts of Lancashire, Northumberland and southern Scotland. Damage across Cumbria has been estimated at £ 500 m. The flooding activated a large number of sediment sources in the many catchments, most notably around Thirlmere and sediment was also mobilised in the rivers. Reactive management of the watercourses following the flooding has concentrated on removal of gravel and clearing of vegetation as these are perceived as having been significant causes of local flooding.

The flood presented a rare glimpse into the geomorphic response of upland river systems to extreme events. We employed combined aerial LIDAR data and ortho-photography to critically assess the location, type and magnitude of sediment mobilisation, supplemented with sUAV-derived imagery to generate DEMs. Coarse sediment flux during the flood was assessed through DEM subtraction of key fluvial sites feeding Thirlmere, and sediment delivery was assessed through DEM differencing of alluvial fans. Three key findings throw some insight into the geomorphic response to this event: 1) volumes of sediment mobilisation were not as high as anticipated, with minor changes of lake alluvial fans indicative of limited sediment delivery; 2) areas of exposed gravel on floodplain surfaces appear to have resulted from stripping of surface vegetation and soil rather than gravel being delivered to the floodplain; 3) reactivated wandering channel zones appear to have acted as buffers to large scale sediment movement rather than acting as large supply zones.

System-wide response was difficult to quantify, particularly around settlements due to the rapid clean-up operation, involving removal of large gravel deposits. However we can conclude that sediment mobilisation was not as large as had been assumed, and suggest that channel management activities such as dredging exacerbated the impacts experienced at key locations. Furthermore, the mechanical disruption armoured bedforms (bars, berms and fans) within these otherwise stable upland systems, undertaken as part of the clear-up operation, may leave rivers more susceptible to geomorphic response to flood events in the future.