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Understanding the geomorphology of macrochannel systems for flood risk management in Queensland, Australia

Chris Thompson (1) and Jacky Croke (1,2)

(1) School of Geography, Planning and Environmental mangement, University of Queensland, Brisbane,Australia (c.thompson2@uq.edu.au), (2) DSITI, Queensland Government, Brisbane, Australia

The year 2010-2011 was the wettest on record for the state of Queensland, Australia producing catastrophic floods. A tropical low pressure system in 2013 delivered further extreme flood events across South East Queensland (SEQ) which prompted state and local governments to conduct studies into flood magnitude and frequency in the region and catchment factors contributing to flood hazards. The floods in the region are strongly influenced by El Nino-Southern Oscillation (ENSO) phenomenon, but also modulated by the Interdecadal Pacific Oscillation (IPO) which leads to flood and drought dominated regimes and high hydrological variability. One geomorphic feature in particular exerted a significant control on the transmission speed, the magnitude of flood inundation and resultant landscape resilience. This feature was referred to as a 'macrochannel', a term used to describe a 'large-channel' which has bankfull recurrence intervals generally greater than 10 years. The macrochannels display non-linear downstream hydraulic geometry which leads to zones of flood expansion (when hydraulic geometry decreases) and zones of flood contraction (when hydraulic geometry increases). The pattern of contraction and expansion zones determines flood hazard zones. The floods caused significant wet flow bank mass failures that mobilised over 1,000,000 m3 of sediment in one subcatchment. Results suggest that the wetflow bank mass failures are a stage in a cyclical evolution process which maintains the macrochannel morphology, hence channel resilience to floods. Chronological investigations further show the macrochannels are laterally stable and identify periods of heightened flood activity over the past millennium and upper limits on flood magnitude. This paper elaborates on the results of the geomorphic investigations on Lockyer Creek in SEQ and how the results have alerted managers and policy makers to the different flood responses of these systems and how flood risk management plans can be developed based on the identified hazard zones and geomorphic processes of macrochannel systems.