Waipaoa River, Aotearoa New Zealand: Changing connectivity, catchment-scale response times and prospective river futures

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# ABSTRACT

High rates of erosion in the 2208 km2 Waipaoa River catchment have been the defining management issue since the mid-twentieth century. Erosion was dramatically enhanced by forest clearance for pastoral agriculture in the late nineteenth and early twentieth century, primed by a combination of highly erodible lithologies, steepland terrain, regular intense storm events, and slopes undercut during postglacial river incision. Catchment connectivity relationships in the Waipaoa have been profoundly altered. Simultaneous sediment inputs from deforested slopes deliver sediment directly into tributary and trunk stream channels, causing significant bed aggradation and channel infilling. Gullies initiated mid-twentieth century overwhelm receiving streams, forming alluvial fans and represent the single largest long-term sediment source to the system. In the upper catchment, widening of aggraded channels contributes more sediment, particularly through bank and valley-side erosion. The fine-grained nature of sediment supplied by lithologies in the upper catchment accentuates downstream delivery of materials, resulting in channel contraction and floodplain accretion in the lower Waipaoa. Efforts to mitigate erosion by afforestation have been successful in some headwater tributaries, with channel degradation beginning, but this process generates additional sediment that is conveyed downstream. We use a combination of LiDAR and river channel cross-sections to demonstrate contemporary longitudinal patterns of connectivity in the Waipaoa River and assess the prospective river futures of this anthropogenically altered system. We also report initial findings on the impacts of Cyclone Gabrielle in February 2023.