

Fryirs, K.A. 2001. *A geomorphic approach for assessing the condition and recovery potential of rivers: Application in Bega catchment, South Coast, New South Wales, Australia.* PhD thesis, Department of Physical Geography, Macquarie University, Sydney

Abstract

This thesis develops a framework for assessing geomorphic river condition and recovery potential. Application of the framework is demonstrated in Bega catchment, on the South Coast of New South Wales, Australia.

Systematic assessment of the geomorphic character and behaviour of different river types (termed River Styles), and the evolution of rivers throughout the catchment since European settlement (i.e. circa 1788) forms the basis of this thesis. Notions of comparing like-with-like, naturalness, irreversible geomorphic change, river sensitivity and disturbance response, the geomorphic effectiveness of floods and catchment scale linkages of geomorphic processes are appraised to assess the potential for geomorphic river recovery. Theoretical notions of river recovery are moved beyond conceptualisation towards tangible and realistic application on-the-ground.

Each River Style has an inherent capacity for adjustment and sensitivity to change. Therefore, predictable disturbance responses can be identified and a natural range of river character and behaviour defined (termed the natural range of variability). This perspective provides the basis upon which to identify irreversible geomorphic change and define natural reference conditions. A natural river system is *dynamically-adjusted and operates within a range of variability that is appropriate for the River Style, and the catchment boundary conditions under which the river presently operates.* This does not always equate to a pre-disturbance reference condition (i.e. pre-European settlement). It is recognised explicitly that the imposed character and behaviour of many rivers (resulting from human disturbance) places constraints on the ability of these systems to adjust. Many Australian river systems, including those in Bega catchment, have been irreversibly altered as a result of European disturbance and changes to the sediment regime. Imposing a pre-disturbance state for recovery efforts is unrealistic under the prevailing boundary conditions.

River condition is a measure of naturalness. The contemporary character and behaviour of a river is compared to a natural reach of the same River Style to determine its geomorphic condition. The degree to which a reach has deviated from natural dictates its geomorphic condition (i.e. good, moderate or poor).

River recovery is defined as a *direction or trajectory of change along which a chronological sequence of geomorphic adjustment occurs after disturbance.* The condition of the landscape, its sensitivity to change and the nature of future flood events all dictate the likely future trajectory of change. Multiple creation (development of a new state) or restoration (return to a pre-disturbance state) endpoints are identified for any particular reach. These creation or restoration endpoints sit within the natural range of variability of a River Style.

The catchment scale linkage of geomorphic processes dictates the potential for a reach to attain a natural endpoint (whether it be creation or restoration). To assess river recovery potential each reach is placed within its catchment context and limiting factors and off-site impacts to recovery assessed. This thesis uses an alluvial sediment budget to quantify the changing nature of the sediment regime in Bega catchment, and evaluate how sediment supply and availability limit the recovery potential of rivers in this catchment.

The river condition and recovery potential framework forms a logical, scientifically-based template for developing cost-effective, strategic and environmentally sustainable river rehabilitation outcomes that improve river condition and enhance river recovery. This thesis argues that river rehabilitation efforts will be seriously compromised if the creation of catchment-based visions, identification of target conditions for river rehabilitation, and prioritisation of river management efforts occurs in the absence of a sound understanding of the geomorphic condition and recovery potential of rivers.

The framework developed in this thesis has been successfully applied in Bega catchment. Significant variability in the catchment-wide character, behaviour and condition of rivers is noted. However, a series of downstream patterns is identified, controlled by the longitudinal connectivity of different River Styles, the availability of sediment and the off-site impacts of disturbance throughout the catchment. A combination of these attributes dictates the recovery potential of rivers in Bega catchment. A catchment-wide river rehabilitation plan based on the geomorphic condition and recovery potential of rivers is developed and applied