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System-focused environmental flow regime prescription, monitoring and adaptive management

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The definition of appropriate environmental flow regimes through hydropower schemes and water storage reservoirs is key part of mitigation. Insufficient (magnitude and variability) environmental flows can result in much environmental harm with negative impacts being encountered by morphological, ecological and societal systems. Conventionally, environmental flow regimes have been determined by using generic protocols and guidance such as the Tennant method of environmental flow estimation. It is generally accepted that such approaches to minimum environmental flow definition, although being a useful starting point, are not universally applicable across catchment typologies and climatic regions. Such approaches will not always produce conditions that would be associated with 'Good Ecological Status' under the Water framework Directive (or equivalent). Other similar approaches to minimum environmental flow estimation are used that are specific to geographies, yet still the associated guidance rarely thoroughly covers appropriate definition for healthy holistic systems across the flow regime.

This paper draws on experience of system-focused environmental flow regime determination in the UK and the Georgian Caucasus Mountains, which allowed for a critical analysis of more conventional methods to be undertaken. The paper describes a recommended approach for determining appropriate environmental flow regimes based on analysis of the impacted geomorphological, ecological and societal systems in a way which is sensitive to the local holistic environment and associated complexities and interactions. The paper suggests that a strong understanding of the local geomorphology in key in predicting how flows will manifest habitat differently across the flow regime, and be spatially dynamic. Additionally, an understanding of the geomorphological system allows the flow of course and fine sediment to be factored into the initial suggested environmental flow regime. It is suggested that more peripheral influencing factors should be given serious consideration when developing environmental flow regimes. These factors could include the development of ice, non-fluvial geomorphic processes such as landslides, connectivity with groundwater and provision for local cottage industries. Even with a thorough appreciation of the holistic system, the value of detailed environmental monitoring and adaptive management plans cannot be underestimated as a means of further managing risk and uncertainty in complex systems.

It is suggested that by taking a more holistic and system-focused approach to environmental flow definition, that environmental flow regimes can be tailored to the specificity and complexity of any given location. By improving the way that environmental flow regimes and associated physical mitigation are prescribed, monitored and managed it should be possible to develop more sustainable forms of energy production whilst minimising environmental harm as far as possible.