Science of The Total Environment, Volume 657, 20 March 2019, Pages 1000-1013

Assessing and planning future estuarine resource use: A scenario-based regional-scale freshwater allocation approach

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ABSTRACT

Rapid urbanisation and industrial growth in South Africa increases the need for proactive allocation of freshwater resources on a regional scale. A nine-step method is described that sets long-term targets for water resource condition and future use with a focus on estuary water quantity and quality requirements. The approach specifically focuses on the environmental flow allocation to estuaries, nested within a broader, regional (multi-catchment and multi-estuary) water resource landscape. The method differs to most other approaches in that the responses of multiple estuaries to escalating future development in a region are coherently quantified (versus only considering a single estuary in a single catchment). A case study that assessed the health, biodiversity importance and resilience to current and future pressures of 64 estuaries is used to illustrate the method. Projected growth in the study area was integrated into a range of future dam development and wastewater discharge scenarios. The results showed that estuaries around the urban centres were in poor condition, but those in the more rural areas in a more natural state. As a result of their small size, most of the estuaries in the region had little resilience to changes in freshwater quantity and nutrient loading. In contrast, the larger systems, targeted for dam development, only showed sensitivity to water abstraction during low-flow periods when base-flow reduction caused mouth closure and changes in nutrient processes. Broadly, the approach aimed to find a balance between ecological requirements and socio-economic development, which meant that maintaining larger systems in relatively good condition would be at the expense of smaller systems that are already in a poor condition. The approach developed was successful in quantifying the responses of multiple estuaries to escalating future pressures on a regional scale, and could be replicated to assist in managing water resources elsewhere in data-limited environments.