

## Are environmental flow targets 'climate ready'?

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### Key Points

- Environmental flow targets are based on the assumption of a stationary climate and that ecosystems will remain the same in the future
- As climate and hydrological regimes change, environmental water managers will need to plan for a different ecological future
- After examining current environmental water plans, we found that climate change and/or adaptation is rarely considered when setting long-term ecological objectives
- Water managers will need to consider a range of forward looking strategies when setting future ecological objectives rather than looking to the past

### Abstract

Implementing environmental flows is an important step in helping to restore riverine ecosystems impacted by flow regulation. The rapidly changing climate now presents a new challenge for environmental flow determinations as ecosystems undergo potentially fast and permanent change.

To assess whether ecological objectives from current environmental flow assessments consider climate change or climate adaptations we assessed environmental flow objectives in water management plans from south east Australia. Our survey showed most flow targets are set with reference to historical flow regimes, and most do not consider or include future climate or hydrology modelling. It is reasonable to conclude that any climate adaptations included in existing objectives are untested with no evidence to support their 'achievability'.

This research provides evidence the environmental water industry in south east Australia is currently underprepared for a future climate and ensuing hydrologic and ecological change. This lack of forward planning creates a significant risk that the use of environmental water will be ineffective in achieving desired goals, and at worst maladaptive in a changing climate.

### Keywords

Environmental flows, Objectives, Climate Change, Adaptation

As global populations continue to grow and demand for freshwater increases, there will be continued pressure on providing water for consumptive uses and river regulation. In an effort, to restore ecological values and river health, water has been recovered in some regulated rivers for environmental benefit. The determination of how to best use this water is considered in environment flow assessments. Globally there are over 200 different methods of flow assessments (Tharme, 2003).

The rapidly changing climate now presents an additional challenge for environmental flow assessments as ecosystems undergo potentially rapid and irreversible change. Expected impacts of climate change on the hydrology of river systems includes changing rainfall run off relationships and altered seasonality of flows. Ecological responses to the altered hydrology are likely to include reduced overbank flooding affecting carbon inputs and food webs (Morrongiello et al., 2011). Species vulnerability modelling suggests large modifications of geographic ranges due to thermal tolerance exceedances with higher water temperatures (Comte and Olden, 2017, Dudgeon, 2019). Although this is not an exhaustive list of expected changes to riverine hydrology and ecology, they are issues that should be considered in future environmental flow management.

Based on a review of climate change adaptation literature, we assembled a list of adaptations that could be included in ecological objectives for environmental water management. Using this list, we examined existing riverine environmental flow management plans to determine if current ecological objectives consider climate change impacts and/or adaptation. We assessed 44 plans from Victoria, southern New South Wales and the

Murray River in South Australia. Our evaluation showed most environmental flow objectives are set with reference to historical flow regimes, and most do not consider future climate or hydrological scenarios in determining whether past ecological states can be maintained under future conditions of water availability, temperature and thermal regime changes. None of the documents included hydrologic modelling of future flow, and very few objectives include proactive management strategies to sustain ecosystems under altered climatic conditions. It can therefore be concluded that any climate adaptations included in existing objectives are untested as to their 'achievability'.

To move forward, the environmental water industry needs to develop 'climate ready' flow targets i.e. an aspirational goal of establishing restoration targets today that are considered feasible under future climate and flow regimes. There are many uncertainties when developing future targets, such as climate change itself and future greenhouse gas emissions, rainfall run off relationship changes and associated river flows, complex ecosystem responses to biotic and abiotic influences. The inclusion of hydrological and ecological response modelling should be considered when setting future targets. Targets also need to consider increased frequency of extreme events (e.g. drought and floods), species vulnerability assessments and non flow related constraints. To be truly 'climate ready' future targets need to include, or recognise these issues. Thompson et al. (2021) rightly suggest future management practices need to change from those of the past and should be based around a decision of whether to "resist, accept, or direct" ecosystem responses to climate change.

- Resist; managers aim to retain historical ecosystem functions
- Accept; ecosystem transformations are accepted as is e.g. changes cannot be stopped or there is a lack of willingness to change
- Direct; where new ecosystem configurations are planned and managed for

The development of 'climate ready' flow targets can help inform transparent trade off decisions and assist with decision making such as to 'resist, accept or direct'.

## **Conclusions**

A lack of forward planning in environmental water management is likely to result in the inability to achieve ecological targets. There is an urgent need to establish 'climate ready' flow targets that are considered feasible today and under the future climate regime to ensure water recovered for environmental benefit is used effectively.

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