

River management futures: The next 30 years of stream management in Australia

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Key points

- Trends of the past 30 years of river¹ management provide some guidance for the next 30 years.
- Australian river management is moving into a more complex future shaped by climate change, more intense floods, longer dry periods, changing rural land ownership, and urban growth.
- The short-term grants model that underpins modern stream management will not be enough, and future management will need steadier funding, stronger governance and more capacity for integrated management, adaptive management and compliance.
- Managers will need to work at much larger scales and in new places, especially tropical, arid and pastoral landscapes, with partners such as Traditional Owners, pastoral companies and private conservation groups.
- Traditional Owners will become routine partners in river management, including as cultural-flow and burning managers, environmental-water partners and knowledge authorities.
- Future management will need to give rivers more room to flood, erode and recover, especially as climate change increases pressure on channels and floodplains.
- New technologies will support better management, but only if they are coupled with strong coordination, governance and a capable workforce (who spend time in the field).

Abstract

Australian river management has changed substantially over the past 30 years, moving from a focus on rivers as economic infrastructure toward river health, ecological restoration, socio-ecological systems, climate adaptation and stronger Traditional Owner partnerships. This paper reflects on those trends and asks how they may shape the next 30 years of waterway management in Australia. It argues that future river management will be influenced by climate change, changing rural land ownership, expanding protected and Indigenous-managed lands, greater Aboriginal involvement in water governance, urban growth, and increasing pressure on channels and floodplains. While scientific prediction, spatial data and modelling have improved dramatically, long-term policy and sustained resourcing (both financial and human capital) have failed to keep pace. The paper suggests that stream managers will increasingly work beyond the familiar rivers of south-eastern Australia, including in tropical, arid and pastoral landscapes, and with a wider range of partners such as Traditional Owners, large pastoral companies, private conservation organisations, lifestyle landholders and urban communities. Climate change will create the dual challenge of too little water in many systems and too much water during floods, requiring stronger floodplain planning, erosion corridors and “room for rivers” approaches. The paper also argues that the current model of short-term grants to landholders for local or reach-scale projects will not be sufficient for the next phase of river management. Future progress will require steadier funding, stronger governance, and a focus on true catchment-scale programs, better integration of environmental water with catchment and riparian management, and a greater willingness to protect rivers from future damage as well as repair past impacts. New

¹ Please note that I use river, stream and waterway interchangeably in the paper

technologies could be a huge boon to future management, but only if we have the governance and staff to capitalize on the flood of new information we could receive.

Keywords

River management, climate change, environmental flows, floodplains, Traditional Owners, rural land use, urban streams, adaptive management

Introduction

Another paper in the conference reflects on the past 30 years and presents an action plan for the industry based on work done at the last few ASM conferences (Fryirs et al., this volume; Russell et al. 2023, 2026). Here I speculate on the next 30 years by asking whether the trends of the last three decades will continue.

Every paper and report on river management quite rightly exhorts governments (it is usually governments) to do more of this and less of that. For example, a recent paper (Capon et.al. 2025) identified nine priority actions to repair non-estuarine river and groundwater systems in Australia (e.g. riparian, connectivity, bore management) estimating that this would cost A\$3.1 Billion per year over 30 years, and should be implemented by regional communities. Identifying and costing such priorities is critical, but how do we think about planning for the next 30 years?

We can think about the future as a set of forces or trends that we must respond to. But we (you) are not helpless pawns in the face of external forces. You are making the future. As I scanned over the many papers in the past proceedings of the Australian Stream Management Conferences it was the names that struck me. The many hundreds of authors and colleagues who have worked and shaped the industry over the last 30 years, edging forward usually without grand predictions to guide them. It is easy to be pessimistic but there has been spectacular progress over the last 30 years.

How did those authors make progress? The trajectory of Australian stream management involves long periods of incremental adjustment interrupted by disruptions: major droughts, floods, demographic shifts, and governance reforms. There have been a few paradigm changing decisions, to name a few: the creation of the Landcare movement, national funding from the Natural Heritage Trust and the decision to allocate it through regional natural resource management bodies; capping water allocation in the Murray-Darling Basin (MDB), introducing a water market as part of the National Water Initiative, major responses to the Millennium Drought, and tackling the catchment impacts on the Great Barrier Reef. So we operate within a series of out-of-phase cycles including:

- floods and droughts (the recent slew of droughts and floods in eastern Australia is an example)
- political cycles (swinging from conservative to progressive governments, particularly at State level)
- fads and fashions (stream management has had many ‘fads’ and they may well be good: e.g. natural channel design, willow removal, design of habitat structures, use of natural materials such as wood and vegetation rather than rock and concrete, (more recently) rehydration, natural flood management).
- governance and policy restructures (each state has its own model, but everywhere there has been a shift to grant based management delivered by regional catchment bodies through voluntary community-based projects).
- growing capacity for scientific prediction (there has been a spectacular increase in our capacity to measure and model that can be used to verify field observation, interpretation and measurement).

We are often poor at predicting the big events (I discuss scientific prediction more below). For example, the 50 or so papers published from the first Australian Stream Management Conference did not mention climate change, but they did signal a few developments that have emerged. The editorial of the second conference stated “*How then do we integrate several scientific disciplines with the passion*

and knowledge of community groups? In addition, how do we meet the challenge of extending our stream rehabilitation efforts to long reaches of stream, and entire catchments?”. I think that we have made some progress on these fronts, but there is a lot more work to do to harness and use the knowledge generated and enact large-scale programs that will help address the future challenges that rivers face.

Usually, it is only with hindsight that we can see the arc of fundamental change. So, what can we think about now, or plan for now, that will help to push the arc toward our goals? The first way to think about this is to ask if the major trends that we have seen over the last 30 years will continue, and if so, will the trends be linear, exponential, or what? Will these trends be disrupted by major events? The hypothesis is that the past can be used as a guide to the future, but it is inevitable that new trajectories will emerge, underscoring the need for foresight and adaptability rather than maintenance of the status quo.

Past trends in stream management in Australia

When 1ASM was held in 1996 managers were already moving away from managing waterways as economic and engineered infrastructure. Under that paradigm the focus was on managing the perceived harm that waterways can do to people and livelihoods in terms of floods, erosion and pollution. Since then, we have focused on undoing the harm that humans have done to streams. In crude terms, over the past three decades, Australian stream management goals have roughly evolved through five phases (Table 1). This has seen our goals move from “managing rivers for human use” toward an emphasis on inter-generational equity, and perhaps inter-species equity: *The goal of stream management is to maintain or improve the ecological integrity and adaptive capacity of waterways so that future generations inherit functioning and resilient river systems*. Thirty years is about one generation.

Table 1 Crude phases of waterway management

Period	Perception of Streams	Management Focus/Approach
1970-80s	Rivers as economic infrastructure	Efficient utilisation, managing threats from floods, erosion and poor water quality
1990s	Rivers as environmental assets requiring protection and rehabilitation	Integrated natural resource management
Early 2000s	River health and ecological restoration	
2020s	Rivers as socio-ecological systems	Adaptive management supporting environmental, social and economic values
Emerging	Rivers as intergenerational and interspecies commons	Resilience, climate adaptation and Traditional Owner partnership

How to think about planning over the next 30 years

There is some ‘futurist’ literature that has had a go at longer-term planning. A useful example is the work of the Australian Academy of Technological Sciences and Engineering (ATSE). In 1989 they held a symposium on the future of the southern Murray Basin. Interestingly, salinity was seen as possibly the greatest threat to the Basin as this time. Climate change, combined with impressive management means that “*salinity appears to be under control within a strict management regime*” (Hart et.al. 2020). A development we do not celebrate enough. The ATSE have recently published another impressive series of essays speculating on the next 50 years in the southern Murray-Darling Basin (Radcliffe and Flapper, 2024). The breadth and complexity of this 230 page collection hints at the futility of trying to address this for all Australian streams in this short paper.

Arup with the Australian Water Association (2022) surveyed 750 practitioners to produce the ‘Future of Australian Water’ report. What strikes me about the word cloud from that report (Figure 1) is how diffuse it is – all of the words are the same size, except for Water! No specific priorities seem to emerge.



Figure 1 Summary of priorities in the Future of Water report (Arup 2022) highlighting that ‘water’ seems to be the only clear priority

My approach here is to identify some topics, briefly address what has happened in the last 30 years in waterway management (based on my experience), and then speculate about how these trends might develop for Australian streams over the next 30 years.

Predictions

First let me comment on predictions and policy. Over the last 30 years there has been a spectacular improvement in our capacity to predict in natural resource management, including physical processes and biological systems. Key to this is the convergence of spatial science, tools such as LiDAR, better field measurements, combined with powerful modelling capabilities. The scale of prediction has gone from sub-catchment scale to property scale. There is a growing literature on the complex role of scientific predictions in policy (e.g. Sarewitz et.al. 2000). This is very real for many river managers where long term predictions prompt action, but time lags, variability and large catchment areas mean that measured end-of-system improvements are hard to demonstrate. This has played out for Great Barrier Reef catchment managers (Waterhouse et.al. 2022) and for environmental water managers in the Murray-Darling. Scientific predictions are essential for planning and adaptive management for the next 30 years, and they should tell us the direction of many changes, but good policy is always a bet on the future, and we must accept that it is made in a fog of uncertainty. Given how poor most predictions prove to be (especially those based on the past) we need to ensure that our industry is mature and sophisticated enough to respond to whatever evolves in the future. Having said that, here are some foggy predictions based on extrapolating past changes.

Rural land use

Australian rural landscapes have been consolidating into larger corporate and broadacre enterprises in inland production regions (WA wheatbelt, Riverina, Mallee and northern Queensland grazing lands), with larger enterprises being more productive and profitable (Figure 2). At the same time farms are fragmenting into smaller lifestyle and hobby-farm properties in peri-urban and high-amenity landscapes (Tonts, 2002). These trends will continue (Kingwell, 2023) and ABARE describes a rapidly declining farming population as an ‘entrenched’ trend. These changes will have major impacts on stream management. The major delivery model for stream management over the last 30 years has been devolved-grants to landholders via regional bodies. Whilst this model will remain important, I believe that more sophisticated models will develop (see the Policy section below). For example, there are major opportunities to work at-scale with large, highly professional farms, backed by increasingly globalized industry bodies. At the other end will be environmentally motivated, but fragmented communities of less-skilled hobby farmers.

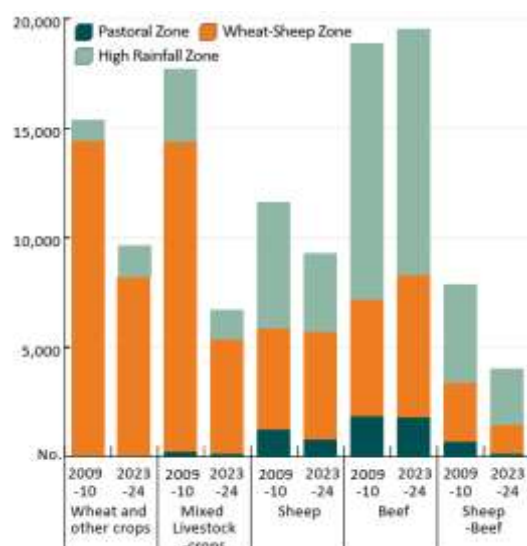


Figure 2 Number of broadacre farms, industry by zone, 2009–10 to 2023–24 (Source, ABARES, 2026)

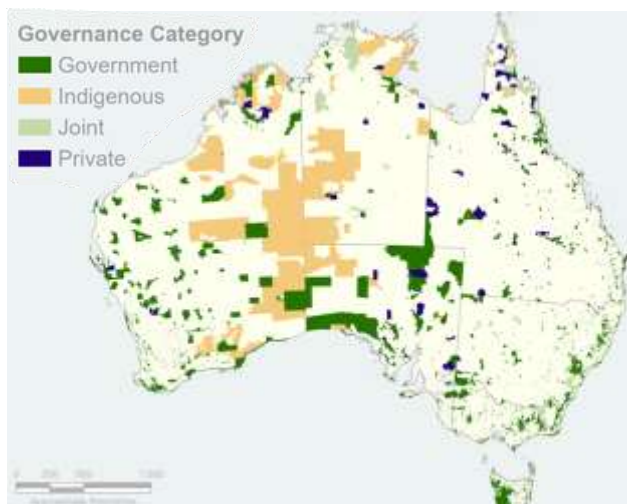


Figure 3: National reserve system 2024 (DCCEEW, 2024)

The majority of streams in Australia are not being managed

Stream management has been concentrated in the SE corner of Australia. Recent years have seen some expansion to the Great Barrier Reef catchments, major research in the tropics via the Tropical Rivers and Coastal Knowledge (TRaCK) program, and growing interest in arid zone streams, including the Lake Eyre Basin. Over the next 30 years it is critical that managers turn their attention to the globally distinctive stream systems of the semi-arid majority of the country. Streams in these areas have been substantially degraded, mostly by broad acre cattle and sheep grazing (Fuller & Rutherford, 2021). Any attempt to manage streams in these areas has to consider protected areas and mega-farms owned by diverse corporate entities.

One quarter of the area of Australia is protected reserves (188 m km²). Over the last three decades, Australia has seen a marked expansion of both indigenous-managed and private protected lands. Over half of that protected area is Indigenous Protected Areas, and a further 25% of Australia is under some form of direct Aboriginal control. About 10 million km² is now managed as private conservation reserves across 6,000 properties (The Nature Conservancy, 2023). Beyond the protected areas, 44% of Australia's land is pastoral leases, and a large proportion of these are leased by huge pastoral companies, sometimes international, and often by families (The Guardian, 2020). Any interest or involvement of stream managers in these areas will involve a very different approach to management than is presently practiced in the heavily populated regions of Australia. It will involve collaborations with traditional owners, pastoralists, and private conservation groups. It would involve a very different suite of management approaches than we are accustomed to.

As one example, I see a much greater involvement of stream managers with large corporations who manage land, mines, and water at large scale. Big companies respond to a different set of imperatives than small land-holders. Reputations and social licence (ESG) can be important to them potentially providing opportunities for large scale stream management projects. In short, in 30 years time, the next generation of stream managers will be working across Australia not just on its muddy edge and working with different groups in new and novel ways. A key group will be traditional owners.

Traditional Owner management

Over the next 30 years traditional owner (TO) involvement in stream management will become routine. Above I noted that 20% of Australian land is TO managed (Figure 3), but they have some influence over more than 70%. Despite this, TO groups control less than 0.2% of water (Hartwig et.al. 2021). Clearly,

they have powerful cultural, native-title, land-management and legal interests in water, but these have only weakly translated into tradeable or consumptive water ownership. In 30 years time, Aboriginal people will almost certainly be recognised not only as stakeholders in river management, but as water owners, cultural-flow managers, environmental-water partners and knowledge authorities.

Too little water, too much water

Climate change is already profoundly affecting stream management in Australia, and these effects are superimposed on a system that has already over-allocated water (mostly for irrigation) and over allocated land close to rivers for agriculture and housing. Climate change effects on temperature and rainfall are amplified in runoff. This is clear from the dramatic declines in stream discharges already being experienced in SW Western Australia (Petrone et.al. 2010). In SE Australia we are already seeing longer dry periods, reduced baseflows, less reliable environmental water, and more frequent floods. We have already seen the future in the Millenium Drought and in myriad floods.

Decades of water management mean that there are few easy wins left in environmental water management. The public has paid dearly for over-allocation of water, not just in the Murray-Darling. The problem of constraints on delivering environmental flows represents, in my mind, the quintessential challenge of the next decades: how to scale environmental restoration in the face of myriad private interests. Governments are incrementally solving the constraints problem. So, after decades of environmental flow management, and billions of dollars, what are the priorities for the next decades? Certainly, one priority is integration of water delivery, riparian and catchment management at full catchment scale. We have the capacity to do this now, but we are let down by poor governance and compliance systems, more in some states than others.

Over the next 30 years more floods on floodplains will clash with more demand for housing on flat land. Flooding is Australia's most expensive natural disaster, with \$7.4 billion in insurance claims in four major east coast floods in 2022 alone (Parliament of Australia, 2023), and we need a million new homes built by 2030. As always, the start of the solution is strong planning controls that prevent more houses on floodplains, and much better options for managed retreat. Across the world there is a push to allow more room for rivers by setting aside erosion and flood corridors (Nardini, 2022). Will the next 30 years finally see inappropriate development moving off dangerous floodplains and vulnerable communities provided with sustainable resilience, mitigation and managed retreat options?

New technologies

Just as they have in the last 30 years, new technologies will transform stream management in Australia. Remote sensing, drones, environmental DNA, autonomous sensors and satellite monitoring will provide faster, cheaper and more continuous information on every aspect of streams: including flow, water quality, erosion and ecosystem health. Artificial intelligence will help integrate large datasets, detect emerging problems and predict future conditions. Digital twins and improved hydraulic and ecological models will allow managers to test interventions before investing in them. Especially exciting are the opportunities for much improved transparency and community participation. However, better data will not automatically produce better rivers without organisations that can act on this new knowledge, including consistent funding, adaptive management and real regulation. Also critical is a well-trained professional workforce who actually spend time in the field.

Policy, governance and compliance

Over the last 30 years Australian states have been carrying out a huge, uncontrolled experiment in stream and catchment management structures. Each state has a different management model but driven in part by targeted buckets of Commonwealth funding. Which state model is best? Are we learning much from the experiment, or is each state locked in 'path dependency'? There are some commonalities in the models:

- All states have catchment-based management (which was not the case before the 1990s).
- Water allocation/supply has been split off from environmental management.

- There has been a move away from direct government management by statutory authorities to quasi-management by regional NRM bodies whose main powers are to advise and allocate grants to communities.
- Strategic catchment planning and prioritisation of resources (both financial and human capital) is difficult with short term grants.

There have been remarkable successes in the grant-based model, not least being empowered communities. But there are limitations. Consistent funding would underpin a measured and strategic approach to management and provide career development for practitioners. However, funding in NRM is at the mercy of fickle Commonwealth enthusiasms and state government cost-shifting in times of fiscal constraint, or reactive splurges of funding after major disasters, much of which is not invested in strategic or cost-effective ways. How do we secure consistent funding for stream management to underpin the long-term, integrated management we need? One solution that we should think about for the next decades is to think of funding as an ‘externality price’ on the degradation of streams as a result of food and fibre production. That price could accrue on the sale of products produced by water and land. In Victoria they have a quasi-externality price called the “environmental contribution” which is a small charge on all water bills. This provides four-year blocks of dedicated funding. Another related idea is to recombine water authorities (that are responsible for sale and management of water and can raise revenue) with catchment management agencies in order to provide a consistent funding source, again tied to water sales. Ideally this type of model would create an organisation that could return to actually managing streams as well as supporting local action by communities with grants. Another perhaps less likely development would be the introduction of a ‘universal living wage’ (based on Australia’s mineral wealth) that could reduce the pressure for primary producers to degrade waterways, and free them to rehabilitate them.

Associated with the above funding options is the capacity (and political will) for stream managers to expand their focus from repairing the damage of the past, to better protect streams from further damage. Stream managers are engaged with land-use planning (statutory planning) for flood management in cities and sometimes in rural areas. They also have a role in environmental water allocation planning, and sometimes in water quality regulation through environmental protection agencies. Where they should have a stronger role is in regulating landuse activities that would affect streams under planning schemes. The other area that is almost entirely absent is any *compliance* and *inspection* role around waterways. These are examples of the shift that has taken place from active management to indirect management through community grants. Effective management needs plenty of carrots, but at least a few sticks. We are virtually stickless across Australia.

Urban streams and amenity

The last 30 years has seen an explosion of research and management in urban streams in large cities, focusing on flooding and stormwater (Hart et.al. 2021). There has always been great interest in urban streams as environmental corridors (e.g. Merri Ck in Melbourne, Bush et.al. 2003), but recent years have seen urban waterways emerging as critical social assets. The Covid period in particular saw waterway corridors becoming life-lines for locked-down people in these cities. Recent stream ‘day-lighting and ‘de-channelisation’ projects are the beginning of what I predict will be a surge of amenity projects across large Australian cities. An important study by Polyakov et.al. (2017) demonstrates the economic benefits of such projects.

Another area that will emerge over the next 30 years is management of streams in smaller urban cities and towns. The literature and research on urban waterways is almost entirely concentrated on streams within large cities (mostly Sydney, Melbourne, Brisbane). The much more common urban-stream situation is where a stream runs through a town or regional city. The stream affects the town, and the town affects the stream, but these interactions have been largely ignored.

Conclusions

The successes, failures, and trends of the last 30 years of stream management help us to plan the next 30 years. Managers will be working in a much more complex world shaped by climate change, more intense floods, longer dry periods, changing rural land ownership, urban growth, and a much stronger role for Traditional Owners. The work is also likely to expand beyond the familiar rivers of south-eastern Australia into tropical, arid and pastoral landscapes, where the partners, pressures and management tools are quite different.

A key message is that the old model of short-term grants for local projects will not be enough. Future river management will need to work at larger scales, linking environmental water, catchment repair, riparian management, land-use planning and floodplain protection. There will be opportunities to work with large pastoral companies, private conservation groups, Aboriginal organisations, urban communities and smaller lifestyle landholders, but each will require a different approach.

Stream managers have achieved a lot over the past 30 years, often through steady, practical progress rather than grand predictions. But the next phase will need stronger governance, steadier funding, better planning controls, and a willingness to give rivers more room to flood, erode and recover.

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