What are the best options to restore degraded urban waterways? Developing and applying an urban waterway assessment and prioritisation framework in the Parramatta River catchment

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Key points

- In urban catchments, options for waterway restoration are diverse, and prioritising projects presents a challenge to catchment and waterway managers. Prioritising restoration opportunities requires a catchment-specific approach, with locally specific weightings applied to different restoration criteria, reflecting local stakeholder views, priorities, economic considerations, and practical constraints.
- Established frameworks increasingly support assessment of social and economic benefits alongside ecological criteria. This broadening of scope introduces additional complexity in balancing competing objectives during prioritisation.
- A staged prioritisation approach, combining rapid feasibility screening, multi-criteria assessment, and stakeholder input, provides a transparent and practical method for shortlisting priority sites.

Abstract

Across Australia and globally, academics, waterway managers, and decision makers have developed and applied many different frameworks to prioritise waterway bank naturalisation, restoration, and improvement works. These take varying approaches to incorporate ecological and socio-economic values into a decision support framework. However, a key challenge in applying any of these frameworks in an urban context is how to address the scale and diversity of potential waterway improvement opportunities. This challenge is being addressed in the Parramatta River Catchment Group's (PRCG) 'Bank Naturalisation and Priority Corridors' project. The 266 km^2 Parramatta River catchment includes approximately 212 km of waterways, ranging from concrete channels to almost completely natural streams. In this context, the project needed to consider equally both socio-economic and ecological values. The project also required a tool which could synthesize and filter information about hundreds of options into a shortlist of priorities.

This paper will review established frameworks and their features. It will outline the framework developed for the PRCG and describe how it was applied to 287 waterway sections to identify a shortlist of 35 priority sections. The paper will also evaluate how the framework supported the subsequent decision-making process, where the shortlist was further refined in collaboration with stakeholders, and six sections selected for design development. The six concept designs display geographical and typological distribution and diversity, highlighting decision-making challenges and opportunities. Many of the lessons learned from the process can be applied in other catchments and by waterway managers and stakeholders, including local communities.

Keywords

Urban waterways, assessment, prioritisation, decision-making, frameworks, restoration, naturalisation

Introduction

The Parramatta River catchment covers an area of 266 km^2, extending from Blacktown in Sydney's west to the Harbourside suburbs of Birchgrove and Woolwich in the east. The catchment spans 12 Local Government Areas (LGAs), 11 of which (along with other land managers) are members of the Parramatta River Catchment Group (PRCG).

Since 2023, the PRCG has been working on the 'Parramatta River Bank Naturalisation and Priority Corridors project', funded by a $1,000,000 grant from the NSW Government. This project aims to:

1. Develop strategic policies to protect and enhance existing riparian vegetation.
2. Identify priority sites within the PRCG catchment for riverbank revegetation.
3. Deliver initial implementation (on-ground works).

The focus of the project is not the Parramatta River itself, but its tributaries, including the approximately 143 km of waterways shown in Figure 1. These waterways range from channelised and concrete-lined drains to others retained in near-natural form, with riparian zones preserved. Examples are shown in Figure 2.

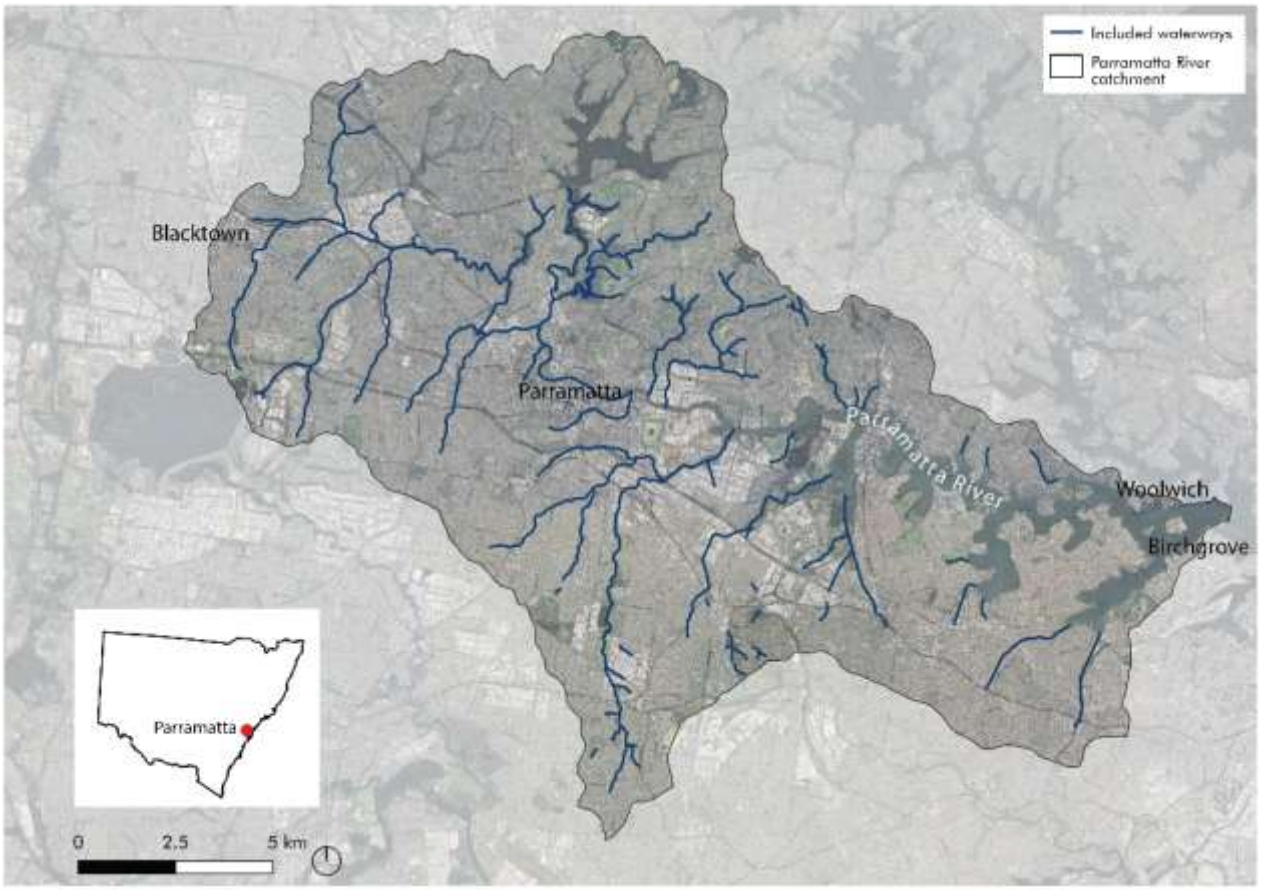

Figure 1 The waterways included in the project

During 2024-2026, PRCG engaged Civille, a strategic design consultancy, to help deliver three key components of the project:

1. A prioritisation framework for selecting sites for bank naturalisation/restoration.
2. A set of shortlisted sites.
3. Concept and detailed designs for selected sites.

This paper explains how the prioritisation framework was developed and applied in the Parramatta River catchment, addressing the following challenges:

- Diverse waterways and options for improvement within the catchment (see Figure 2), from naturalisation of concrete channels to stabilisation and revegetation of streams in more natural form.
- A wide range of methods and findings found in past studies and plans.

This diversity made it challenging to compare waterway values and the benefits of naturalisation/restoration at different sites. Furthermore, stakeholders responsible for managing waterways across the catchment also brought different perspectives on waterway values and the potential benefits of different options.

Figure 2 Examples of waterway conditions in the catchment (a) Girraween Creek; (b) Toongabbie Creek; (c) Darling Mills Creek

Literature review

The review process involved searching for examples of urban waterway prioritisation frameworks published in Australia, including examples in the grey literature (see Table 1). Rather than a comprehensive review of local examples, the focus was on frameworks published in national and state-level guidance, which informed local practice, and examples where the authors had deliberately set out to establish a new method for prioritisation.

Table 1 Urban waterway prioritisation frameworks for planning stream restoration activities

Example	Main inputs to the framework	Main prioritisation criteria
Logan City Council (LCC) Waterway Knowledge & Prioritisation Tool (LCC, ND)	• "Level of naturalness" (15 criteria) • "Risk profile" (14 criteria) • Socio-economic indices (6 criteria)	• High levels of naturalness and at a high risk of degradation • Higher for socio-economic indicators
Framework for prioritising waterways for management in WA (Macgregor et al., 2011)	• Assessment based on values and threats across a range of ecological, social and economic parameters	• High value, high threat sites
Sydney Water's method for prioritising channel naturalisation projects (Cunningham et al, 2018)	• Constraints (e.g. available space, land zoning, heritage, services) • Opportunities (e.g. ecological and social)	• Long listing based on zoning, local population, mapped ecosystems • Shortlisting based on constraints and opportunities
'Restoring Sydney's Creeks' draft channel naturalisation guideline (NSW DPIE, 2018)	• Assessment of site constraints (E.g. ownership, space, flooding) • Assessment of benefits, costs and risks of naturalisation	• Long listing based on constraints • Shortlisting with a cost-benefit analysis against social, economic, and environmental criteria

Example	Main inputs to the framework	Main prioritisation criteria
Rehabilitation manual for Australian streams (Rutherford, Jerie, & Marsh, 2000)	• Stream condition (ecological) • High ecological conservation value assets	• Better existing condition • 'Trajectory' - deteriorating to improving • Proximity to sections in good condition • Ease of rehabilitation/restoration
Healthy Land and Water Qld Strategic Waterways Tool (Water by Design 2019)	• Assessment of waterway condition and social, environmental and economic values • Diagnosis of causes of poor waterway health (hazards) • ID of treatment options (needs)	• High values + high hazards = risks that need to be managed • High values + high needs = opportunities to create value • High hazards + high needs = opportunities for crucial projects

The review examined two main ways in which these examples differed (see Figure 3):

- **They varied in terms of the extent to which they incorporated socio-economic values and objectives** into the prioritisation process. Figure 3 illustrates how the examples can be placed along a spectrum. While the *Rehabilitation manual for Australian streams* (Rutherford, Jerie, & Marsh, 2000) had an almost complete focus on ecological values and objectives, more recent frameworks have included socio-economic values and objectives to a greater extent. *The Healthy Land and Water Qld Strategic Waterways Tool* (Water by Design, 2019) stands out for its balanced focus on environmental, social, and economic criteria.
- **They varied in terms of the assessment approach, from more aspirational to more pragmatic**. While most of the examples relied on thorough assessment of waterway reaches against a large number of criteria, Sydney Water's and DPIE's (McManus, Blackham, & Kirby, 2018 and NSW DPIE, 2018) rely on a rapid first-pass or 'broad filter' assessment to come down to a long list, before undertaking more detailed multi-criteria assessment on long listed sites. The former approach is more aspirational and outcome-focused, while the latter is more pragmatic, encouraging assessment of constraints first, before considering opportunities.

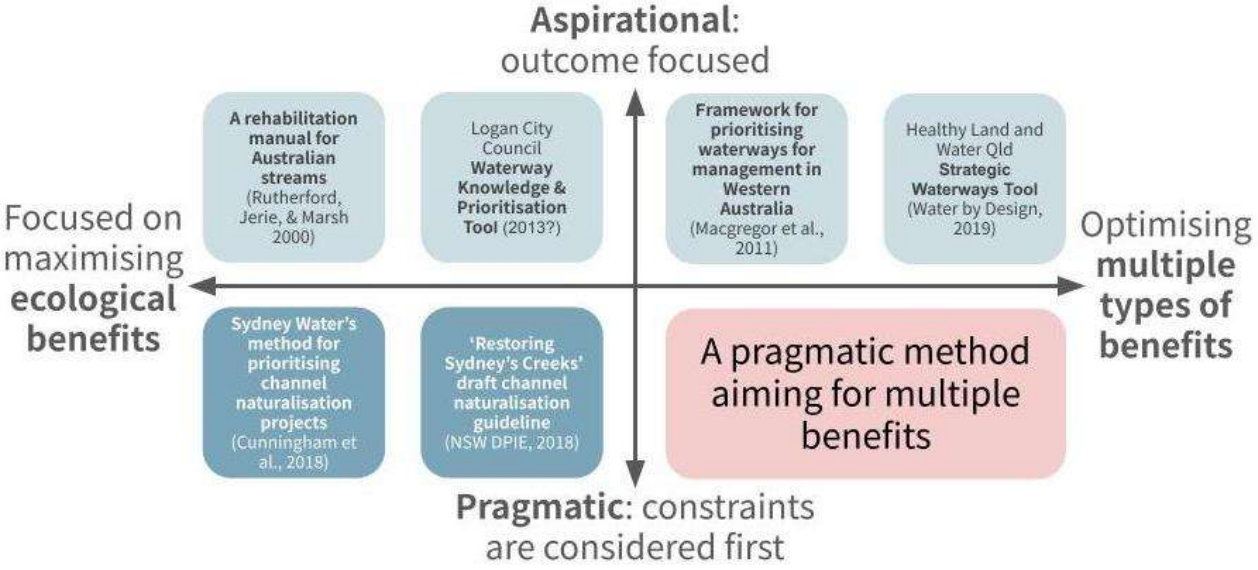

Figure 3 Selected waterway prioritisation frameworks. PRCG's framework is characterised as 'pragmatic' and optimising for multiple types of benefits

Method

Framework development and application

For the PRCG, it was clear that a method was needed that was both:

- **Pragmatic,** to navigate the challenges described above: diverse waterways, diverse options, and a wide range of past studies and plans all conducted differently.
- **Multi-dimensional**, including environmental, social, and economic criteria, reflecting the range of values and objectives relevant to PRCG and its members.

Figure 3 shows how the framework needed to perform differently to all the others examined but also suggests how it was able to draw on both the pragmatic approach of Sydney Water and DPIE and the balanced multi-dimensional approach of Healthy Land and Water Qld.

Like Sydney Water and DPIE, the method used a long listing process to make a rapid first-pass assessment. Like Healthy Land and Water Qld, the shortlist assessment applied a range of environmental, social, and economic criteria, including both a scoring method across all these criteria, as well as a method to identify different types of opportunities, which were difficult to compare to each other but all worth prioritising for different reasons. The long list and shortlist criteria were developed in consultation with a working group of PRCG member representatives.

Developing and refining the long list

With limited time available for this stage of the project, and 143 km of waterways to assess, including 287 reaches (or 'sites'), it became apparent that the long listing criteria would need to be able to be applied:

- Rapidly, using available GIS data.
- Consistently by multiple operators working in parallel.
- Objectively, with little need for expert judgement or detailed review by stakeholders.

Most long listing criteria were applied as a negative screen, due to the spatial constraints imposed by a highly urbanised environment. This rules out sites with no opportunity to progress due to land ownership, lack of setback for naturalisation, and other significant constraints (e.g. access, contamination, etc.) A positive screen was also applied, including sites already identified as a priority by councils (e.g. where naturalisation has been proposed in an existing plan). After this process, the long list had 187 sites.

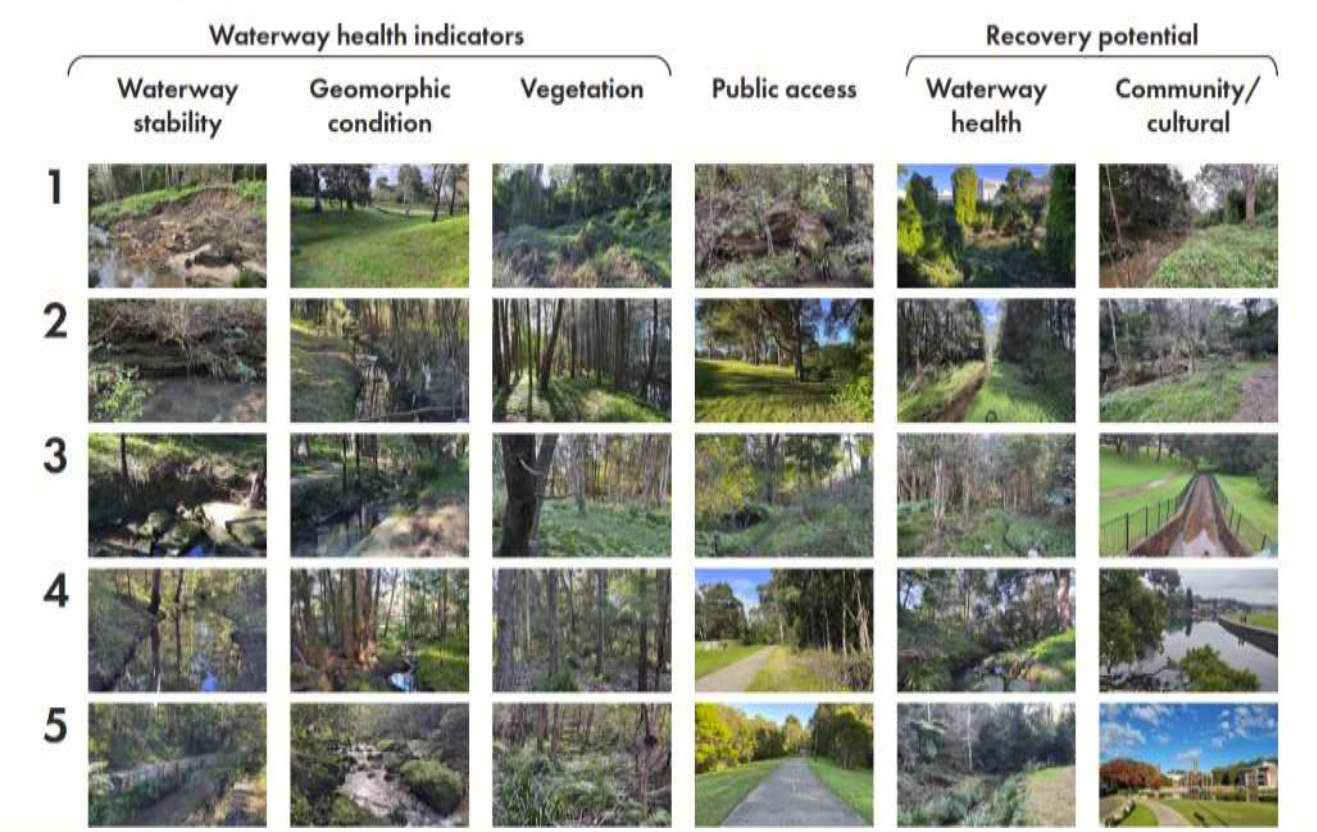

Figure 4 Pictorial 'Scoring System' rubric used for shortlist assessment

Developing and refining the shortlist

While there was access to information from previous studies, it was challenging to base the assessment on these because they varied so widely in their currency, methods, and outputs. Stakeholders were looking for an approach that could be applied consistently across the catchment, giving them confidence in the process and its outcomes. Therefore, a method was devised that could be applied in the field, based on a walkover of each site. As with the long listing, the method needed to be able to be applied rapidly and consistently by multiple practitioners working in parallel, but at this stage it was necessary for assessors to apply their judgement based on experience, and for stakeholders to scrutinise the results, applying some adjustments based on their local knowledge. At this stage, the assessment criteria included:

- Three indicators of waterway health that could be visually assessed rapidly in the field:
  - Waterway stability (extent of active erosion).
  - Geomorphic condition (extent of 'naturalness'/modification).
  - Vegetation (structure and 'weediness').
- One indicator of socio-economic value:
  - Public accessibility.
- Two indicators of 'recovery potential':
  - An assessment of the overall potential for waterway health recovery
  - An assessment of the overall potential for improvement of community/cultural values.

Each of these criteria was accompanied by a 1-5 scoring system. To support consistent assessment, field assessors were provided with a scoring rubric, including both a set of written descriptions and photos for each score for each indicator. The pictorial rubric is shown in Figure 6.

Following field assessment, scores were compiled and reviewed as a whole. Some were adjusted to correct for inconsistencies between assessors. This process was followed by a workshop, where

stakeholders had the opportunity to review the scoring and suggest adjustments based on their local knowledge. At the end of this process, the shortlist had 35 sites, including four different types (examples shown in Table 2):

- High value waterways, which scored highly on all the waterway health indicators.
- Stream stability priorities, which scored low for stream stability but had good recovery potential.
- Waterways with high potential for waterway health recovery.
- Waterways with high potential to enhance community/cultural value.

Table 2 Examples of shortlisted sites

	
Darling Mills Creek - 'section 1' was assessed as having high waterway health and was identified as a strong candidate for protection. The site is already actively protected and managed by the local council. The assessment validates the ongoing protection and management of this site.	**Toongabbie Creek - 'section 2'** was assessed as having high potential for both ecological and community/cultural recovery. Assessors noted the potential for planting to enhance ecological value, naturalisation of a piped section to improve connectivity, and significant potential to improve access and community use.
	
Archer Creek - 'section 4' was assessed as having high potential for ecological recovery and improvement, with infrastructure constraints, e.g. high-pressure gas line running in between the path and creek.	**Subiaco Creek - 'section 4'** was assessed as having very low waterway stability, but good potential for recovery. Property boundary at top of bank prevents naturalisation.

Refinement to 6 sites

The framework supported the subsequent decision-making process, where the shortlist was further refined in collaboration with stakeholders, and six sections selected for design development. During

this stage, stakeholders revisited the assessment and interrogated its results before arriving at six preferred sites.

Results

The six sites selected by stakeholders to progress to the concept design stage are listed in Table 3, including information about why each site was shortlisted.

Table 3 Sites selected by stakeholders to progress to concept design

Waterway site	Type of priority	Assessor comments
Archer Creek, 'section 4'	High potential for ecological recovery	Identified as a priority by the local council. Good potential for naturalisation with very high community usage and visibility.
Duck River, 'section 11'	Moderate potential for ecological and/or cultural recovery	Poor current waterway health. A large amount of work would be required to have any noticeable improvement in waterway heath. Constrained by sports fields, there is no real scope for social or cultural enhancements.
Grantham Creek, 'section 2'	High potential for ecological recovery	Good potential to restore before erosion and channelisation becomes any worse. Part of a large parkland area with existing access. Signs that people are using the bushland with some restoration visible.
Hawthorne Canal, 'section 3'	High potential for community/cultural recovery	Intermittent green space mixed between tennis courts and sports fields along both banks – potential for good increase in engagement and interaction with waterway and already adequate access and visibility.
Tarban Creek, 'section 3'	High potential for ecological recovery	Good community access and use. Creek could benefit from stability near the pond outlet as well as from native planting along the southern walk, but limited scope for works given close proximity of assets.
Vineyard Creek, 'section 4'	Stream stability priority	Active major erosion, with major bank collapse and incision occurring as well as large sediment deposits into the creek.

These sites are diverse in terms of:

- Waterway types and current condition.
- Restoration opportunities and potential to enhance ecological and community benefits.
- Management - they are located in six different council areas.

Concept designs have now been prepared for these six sites, and at three sites (Tarban Creek, Duck River, and Hawthorne Canal), these concepts are currently progressing through the detailed design process. At a fourth site (Grantham Creek) there are plans to progress with revegetation, which will be undertaken by the local council in collaboration with bush care groups.

Discussion

The methodology applied in this project was successful or mostly successful as:

- A pragmatic process that could be applied rapidly, based on available information, in the short timeframe available for the assessment process.
- A repeatable process that could be applied consistently by different assessors.
- A transparent process for assessment that stakeholders could revisit and interrogate its results.

- A process which can incorporate multiple objectives and consider both ecological and community/ cultural priorities, as well as the shortlisting of a range of site types with different values/opportunities.

However, there was also some iteration required. It is notable that the six sites selected by stakeholders include two sites that were long listed but not initially assessed as high priorities (Duck 11, Tarban 3). When stakeholders applied their local expertise to the assessment of the shortlist, they were able to identify considerations absent in the initial shortlisting assessment rubric. This included specific organisational and community priorities, opportunities (e.g. adjacency to other projects), and feasibility relative to organisational capacity. Changes over time also prompted revaluation of priority, particularly regarding stability-related risk.

This suggests a potential challenge in transposing the prioritisation method to other contexts. While the methodology and high-level prioritisation criteria (e.g. stability, geomorphic condition, etc.) are applicable elsewhere, it is advisable to adjust the scoring criteria and weightings to reflect local conditions, stakeholder preferences, and priorities driven by the socio-economic context. This is recommended as a worthwhile process, preferable to trying to apply standardised scoring criteria to vastly different situations.

The six sites ultimately selected for concept design development were well supported by stakeholders. Two of the sites that did not progress to detailed design (Archer Creek and Vineyard Creek) were put on hold after the concept design stage due to their complexity and associated high construction costs. However, the concept designs can support future funding opportunities. The other site that did not progress to detailed design (Grantham Creek) became a bush care-led revegetation project, in response to community feedback at the concept design stage. This outcome would have been difficult to predict at the shortlisting stage and suggests it is a good idea to keep options open at each stage of design development.

Conclusion

In the primarily urban Parramatta River catchment, there are many waterways of widely varying condition. Restoration opportunities are plentiful and diverse, and could deliver a wide range of environmental, social, and economic benefits, depending upon the amount of funding available for implementation. Therefore, the problem is not so much one of optimisation, i.e. to maximise benefits, but one of pragmatism, i.e. which of the many often incomparable potential options and benefits should be selected? Therefore, the PRCG needed to apply pragmatic criteria in addition to benefits criteria to assess feasibility in creating the long list, and to gain stakeholder acceptance to refine the shortlist. A similar method, including first pass feasibility screening followed by multi-criteria analysis (MCA) and stakeholder review, could be applied anywhere that waterway managers are faced with a large number of potential opportunities and need to narrow them down quickly.

Specific details such as first pass screening criteria, MCA assessment criteria, and stakeholder preferences necessarily need to reflect local issues, values, priorities and preferences. These observations may aid the development of these criteria in other contexts:

- Keep first-pass screening criteria simple and objective, to aid quick assessment at this stage. Avoid criteria that require interpretation or expert judgement.
- Criteria requiring interpretation and judgement can be built into an MCA, after which the outcomes of the assessment will need to be reviewed and may need to be adjusted.
- It is hard to capture everything in the assessment process, so it is helpful to have a process that is somewhat flexible, enabling each step to be reviewed as needed. This could include adding, removing or refining criteria during the assessment process.
- Take note of whether stakeholder knowledge and preferences can be considered earlier in the process, and of the potential value of incorporating stakeholder knowledge when performing and/or refining the assessment.

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