Embedding fluvial geomorphology in the updated Technical Guidelines for Waterway Management

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Key Points

- The existing Technical Guidelines for Waterway Management (2007) have served as a resource to guide the selection, design and implementation of options for intervening in the on-ground condition of Victorian waterways for over fifteen years.
- Core users include waterway managers and consultants.
- Core users require an up-to-date and easy-to-use resource to guide physical interventions on Victorian waterways.
- The updated Guidelines embed fluvial geomorphology into the Victorian waterway management framework.

Abstract

Victoria's existing Technical Guidelines for Waterway Management (2007) (the existing Guidelines) have served as a resource to guide physical interventions on waterways by waterway managers and consultants for over fifteen years. Advancement in the scientific understanding of waterways, management approaches and the advent of new technical tools available to design interventions means that an updated and modernised set of technical guidelines was needed.

This paper describes a project undertaken to update the existing Guidelines, with an updated set of Technical Guidelines for Waterway Management (the Guidelines) based on principals of fluvial geomorphology as a foundation for effective waterway management and the establishment of a clear, explicit and succinct link between problems and proposed solutions through a decision framework. The Guidelines were developed in partnership with Victoria's nine Catchment management Authorities, Melbourne Water, the Victorian Department of Energy, Environment and Climate Action (DEECA) and a number of specialist waterway consultants. The structure, content, and usability of the Guidelines were refined through a combination of a project partner steering committee, industry workshops and peer-review.

Using a four-step process, the Guidelines help waterway managers decide if, where and how to intervene with onground waterway management works to manage one or more of four fluvial geomorphic processes: incision, aggradation, meander migration and avulsion. A comprehensive set of analysis methods and design aids support this process and the design of site and reach scale interventions in both urban and rural environments.

By capturing the latest science, management practices and the substantial experience in waterway management embedded within Victoria's CMAs and Melbourne Water, the Guidelines provide an invaluable resource for the wider industry. The Guidelines add to the growing body of other guidelines and standards that support waterway management and the drive for better outcomes for waterways and the values they support.

Keywords

Fluvial geomorphology, technical guidelines, waterway management, stakeholder engagement

Introduction

Waterway managers, engineers, project officers and statutory planners across Victoria's waterway management industry require an up-to-date and easy-to-use resource to guide physical interventions in Victoria's waterways. The current version of the Technical Guidelines for Waterway Management (the existing Guidelines) has served this function for thirteen years by providing a single resource that documents best-practice techniques

for interventions aimed at improving the condition of Victoria's waterways. Advances in the scientific understanding of waterways, management approaches and the advent of new technical tools means that an updated and modernised set of technical guidelines was needed.

This project updated the existing Guidelines without attempting to force the much larger and ever-growing body of waterway management literature, guidelines and fact sheets into what are technical guidelines for on-ground works. Recent reviews of the existing Guidelines identified the need for a greater emphasis on practical guidance for on ground works, and a clear, succinct link between problems and solutions.

This paper summarises the approach adopted by the project team to review the existing Guidelines and develop an updated version of the Technical Guidelines for Waterway Management (the Guidelines). The project sought to determine what technical material would remain, be removed, or added to the existing Guidelines and the adoption of a four-step decision making process to the Guidelines. We briefly summarise the four-step process and the principal parts of the documents- the management option summaries, supporting analyses and design aids, worked example and standard drawings. The updated Guidelines are expected to be published mid-2024 and will serve as an important resource for Vicotria's waterway management industry.

Approach to updating the guidelines

The intended purpose of waterway interventions, and of the Guidelines, is the protection and enhancement of the environmental, cultural, social and economic values of waterways. With that purpose in mind, The Guidelines have been developed to assist the selection, design and implementation of interventions in the on-ground physical processes and form of waterways. Fundamentally, the Guidelines aim to help practitioners decide which, if any, on-ground interventions to use at the reach or site scale, and how to implement those works. The Guidelines complement related waterway management strategies including the Victorian Waterway Management Strategy and regional waterway strategies.

Our approach to updating The Guidelines was built on a foundation of stakeholder engagement, in which we defined, adjusted and simplified the document scope, content and layout in response to feedback from intended users i.e. waterway managers seeking clear, readable, best practice guidelines on physical interventions in waterways.

Stakeholder engagement

The Guidelines were developed in partnership with Victoria's nine catchment management authorities (CMAs), Melbourne Water, Department of Energy, Environment and Climate Action (DEECA) and the consulting industry. A combination of steering committee workshops, industry workshops and peer-review of the content, structure and usability of the Guidelines were used to refine the Guidelines.

Narrowing the targeted audience

The Guidelines have primarily been developed to assist the implementation of on-ground programs of management by Victoria's CMAs, Melbourne Water and consultants working in Victoria's waterway and catchment management industry. The Guidelines will also be of relevance to community groups, landholders, and other organisations with an interest in the implementation of effective waterway management programs.

It is also intended that the Guidelines could be used by Victoria's CMAs and Melbourne Water to assist in the regulation of works proposed by other organizations and stakeholders and as a means of capturing and documenting the considerable practical experience in effective interventions embedded within CMAs.

Focusing in on the issues addressed

The Guidelines focus on the on-ground management of physical processes occurring in waterways. More particularly, the Guidelines have been developed to assist with the management of Victoria's waterways that are subject to unacceptable rates of channel change, including waterway incision (degradation), meander migration, waterway aggradation (sedimentation), and channel avulsions.

The Guidelines consider how the waterway manager can directly influence these physical geomorphic processes, consider ecology and habitat design, and enhance waterway condition by managing instream and riparian elements such as the:

- Extent and condition of riparian vegetation; and
- Physical form of the waterway channel and floodplain.

As a consequence, the Guidelines explicitly deal only with a subset of the suite of challenges that face waterway managers and a subset of management options available to influence waterway condition and processes. The Guidelines do not address other important elements of waterway management programs, but they do provide links to other relevant guidelines or policies where available. Similarly, the Guidelines do not address adjoining landscapes such as wetlands and estuaries, although some of the techniques included in the document may be applicable in these landscapes.

Integration with regional strategies

The Guidelines have not been developed for the purpose of regional, catchment or sub-catchment scale planning and prioritisation. The Guidelines help give effect to regional waterway strategies by guiding on-ground implementation of regional work programs at the reach and site scale. The Guidelines can also be used to assist with decisions about intervening on waterways that are not a priority in regional waterway strategies. The Guidelines align with the approaches and principles of the Victorian Waterway Management Strategy and should sit within the context of a comprehensive planning process.

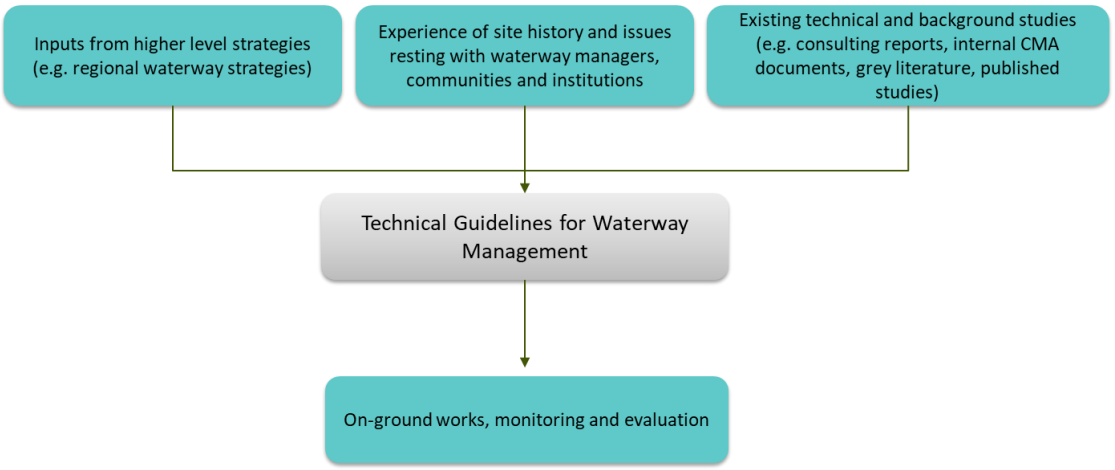

Figure 1. Link between, inputs to the Guidelines, the Guidelines and on-ground works

Embedding fluvial geomorphology

Recognising and understanding the four main geomorphic processes shaping the form of Victoria's waterways is a critical step in managing waterways (Step 1 of the Four Step Process). It helps with understanding the changes occurring in the reach and waterway, to distinguish between cause and effect (or causes and symptoms) and to identify the appropriate actions. The four main geomorphic processes shaping the form of Victoria's waterways include:

- Incision
- Aggradation
- Meander migration
- Avulsion

Understanding the erosion and deposition linkages between these processes underpins a great deal of waterway management. This is why many higher-level strategies (such as regional waterway strategies) will have identified these processes as being important, either explicitly or by way of the threats each process generates and identified management actions to address those threats. When background information on geomorphic

processes is unavailable for a reach or site, waterway managers can use the descriptions provided in The Guidelines to identify the processes and understand the activities that may accelerate rates of channel change.

Making the Guidelines user friendly

The Guidelines have been developed in a format that enables users to enter the document at any point. In this respect users may seek options for addressing a particular issue or problem or may seek more specific information on a particular design approach. Users new to waterway management may also choose to read the document from cover to cover.

The Guidelines have been structured around a four-step process to guide decision making by waterway managers. This four-step process provides waterway managers with an 'entry point' for common waterway management decisions.

By stepping through the four-step process, waterway managers make decisions about the need for, and aims of, any on-ground works in waterways.

The four-steps are:

- Understand your waterway: Identify values and define objectives for your waterway reach.
- Decide whether to intervene.
- Develop a management approach: Identify opportunities and constraints and apply supporting analyses.
- Design and implement on-ground works.

The four-step process is shown in Figure 2.

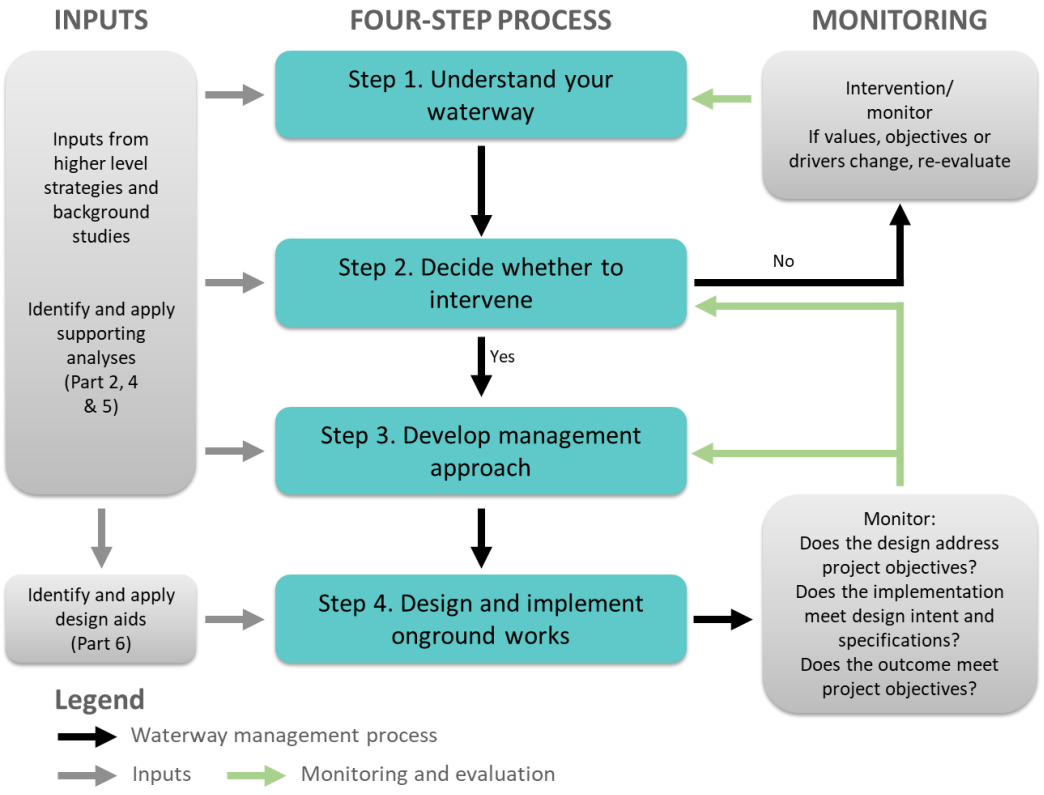

Figure 2. The four-step decision process included in the Guidelines and how the four-steps relate to the document structure.

The four-step process

Reach and site scale interventions are best undertaken within a clearly articulated and communicated framework, drawn from, or informed by, higher-level and larger-scale strategies and work plans. The foundation of this framework is identifying the values that are to be protected, identifying and defining agreed objectives for these values, identifying the threats to those values and their objectives, what happens if you do not intervene, and to predict what will happens if you do intervene.

The aim of the four-step process is to ensure:

- That on-ground interventions are aligned with the relevant regional waterway strategy where applicable, and/ or to ensure that an appropriate process is adopted for sites and circumstances where regional waterway strategies do not cover the site (or those strategies do not provide sufficient detail to guide management).
- That the default action of not intervening (the base case) is explicitly considered at the outset of any potential project.
- That a clear link has been established between the proposed management option and the activities, drivers and impacts to values and agreed objectives.

The four-step process includes several decision points where waterway managers may choose to either not intervene at a site, or to pause and then re-evaluate the project objective as the system and the scale of intervention required is better understood. The four-step process is shown schematically in Figure 2.

Step 1: Understand your waterway

The first step in the four-step process is to identify the waterway values at the reach or site, derive agreed objectives for these values, understand the geomorphic processes operating within the waterway reach and the threats these pose to the agreed objectives. When considering a process that threatens achievement of objectives, the ultimate aim is to understand the underlying cause of that process, to predict how a waterway would change in the future without any intervention (the waterway's trajectory), and the impacts the predicted change will have on waterways and related values. This graphically shown below in Figure 3.

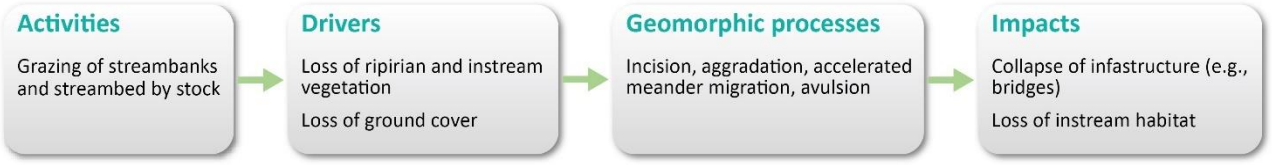

Figure 3. Example impact logic - with activities, drivers, geomorphic processes and impacts.

Step 2: Decide whether to intervene

The second step in the four-step process is to consider the identified impacts and geomorphic processes and decide whether to intervene (Figure 2). Although the waterway manager may face pressure to quickly intervene in a waterway to resolve an immediate and obvious issue, the first step is always to understand what will happen without intervention, i.e. what happens if the waterway manager does not intervene? What happens if the geomorphic processes don't actually impact on the values that are important at the site, or if the intervention causes more harm elsewhere in the system than good at the project site? It is at this step that the waterway manager must also reflect on the broader social, legal, environmental and cost-benefit considerations.

Step 3: Develop reach scale management approach

After completing Step 2 and deciding that intervention is warranted, the next step is to develop a reach scale management approach. The reach scale management approach provides guidance on the fundamental drivers and processes being addressed by the intervention and aids selection of the most appropriate interventions. Regional waterway strategies may include management approaches for waterways identified as a high priority for management, but The Guidelines have a suite of tools that can be used to develop such strategies if this is not the case.

When developing a reach scale management approach, regardless of whether on-ground physical works are required or not, the waterway management priority should be to halt or modify the driving activity. Only after the driving activity has been addressed, or if the driving activity cannot be halted or modified, should on-ground physical interventions be considered.

The Guidelines include a management option selection guide that helps waterway identify and select management options that address the geomorphic processes of concern (see Figure 4).

Process and drivers		Approach to management				
Geomorphic process	Driving activity	Intervention option	Option ranking to address process		Comment	Relevant supporting design method, supporting analyses and external references
Stream incision	Incision stages 2 to 5	Do not intervene	Cost: Success: Adverse impact:	NA NA NA	Choosing not to intervene may be based on allowing the incision cycle to complete over time and that any impacts associated with the incision stages (deepening, widening, infilling etc.) are considered in line with project objectives and targets.	Option summary: *Section 3.3.1*
	Incision stages 2 to 3	Grade stabilisation: Rock chutes and native vegetation establishment and management	Cost: Success: Adverse impact:	$$$ ✓✓✓ ☺	Rock chute and vegetation-based grade control programs are one of the most effective means of controlling and managing channel bed incision.	Option summary: *Section 4.2.17* Supporting design aids: *Section 6.2* - page 122, *Section 6.4*, *Section 6.5*
		Grade stabilisation: Reduce stream slope through reinstatement of meanders	Cost: Success: Adverse impact:	$$$ ✓✓✓ ☺	The reinstatement of meanders within a defined reach can be used to effectively lengthen the stream, reducing the effective stream slope/energy slope and potential for incision to occur.	Option summary: *Section 4.2.8* Supporting design aids: *Section 5.3*
		Grade stabilisation: Grass chutes and native vegetation establishment and management	Cost: Success: Adverse impact:	$$ ✓✓ ☺	Grass chutes can be used to manage incision in ephemeral systems with infrequent, low energy (in line with erosion thresholds of grass) and short duration flow events. They are generally not effective in permanently flowing waterways as they rely on grass coverage for stability.	Option summary: *Section 4.2.10* Supporting design aids: *Section 6.2*, *Section 6.4* 168 - page 122, Section 6.7.2 – page 168

Figure 4. Extract of management option selection guide for Incision.

Step 4: Design and implement on-ground works

The final step in the four-step process is to design and then implement on-ground works if and as required. Supporting analyses and design aids to guide the design of on-ground works are provided in Part 5 and 6 of the Guidelines. The design and implementation of on-ground works should reflect both the relevant reach scale management approach and the stated project objectives. Key tasks include:

- Identify the required level of service for analysis, design and implementation.
- Design works to appropriate and applicable standards.
- Implement activities and works.
- Monitor and evaluate.
- Document and report.

Management option summaries

To further help guide waterway managers, the Guidelines provide waterway managers with summarised information about options for the management of waterway geomorphic processes. These management options may be applied to influence the inflow of water and sediment, the extent and condition of riparian (and in-stream) vegetation and the physical characteristics of the channel.

An example of this is shown in Figure 5.

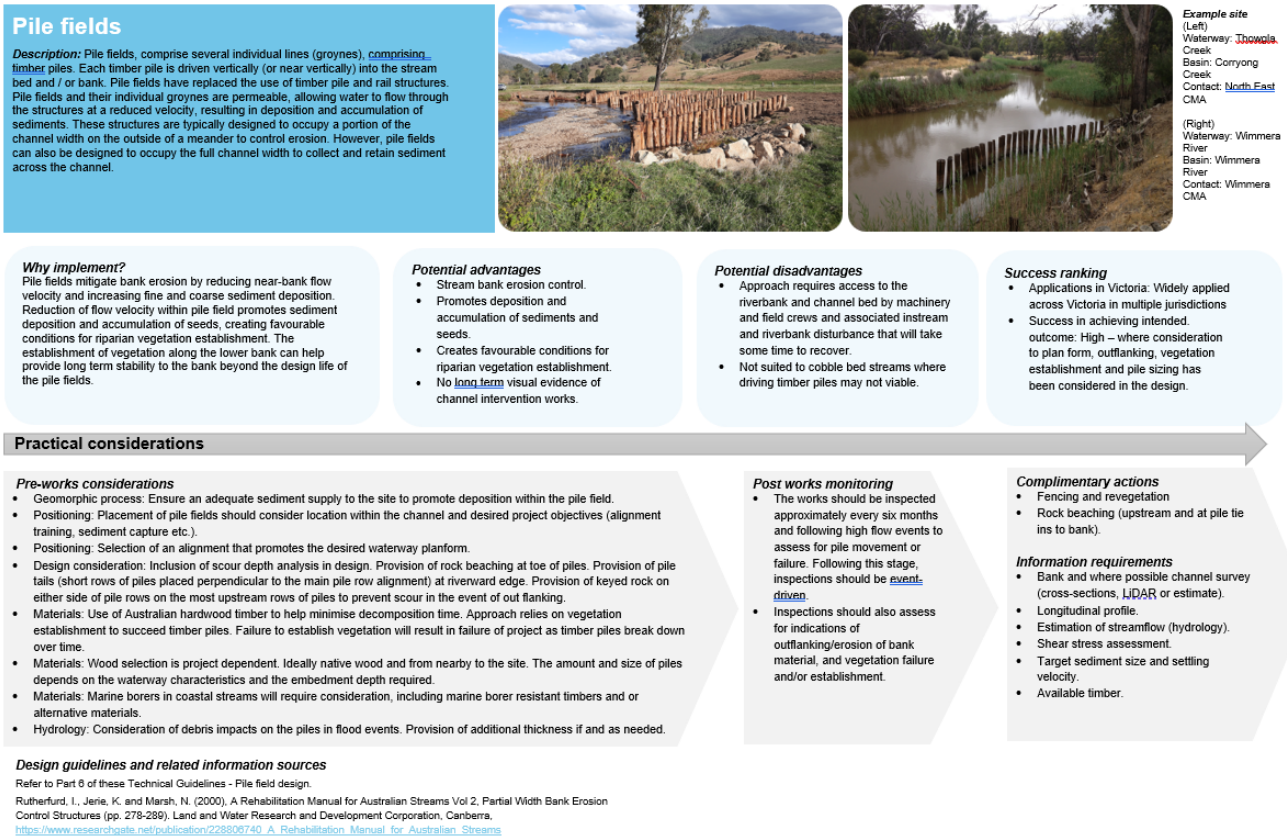

Figure 5. Example management option summary for Pile Fields.

Design aids

This section of the Guidelines provides access to design aids that may assist with the design of a selection of waterway management techniques. Included in this section are design approaches for reach scale programs and more discrete individual projects.

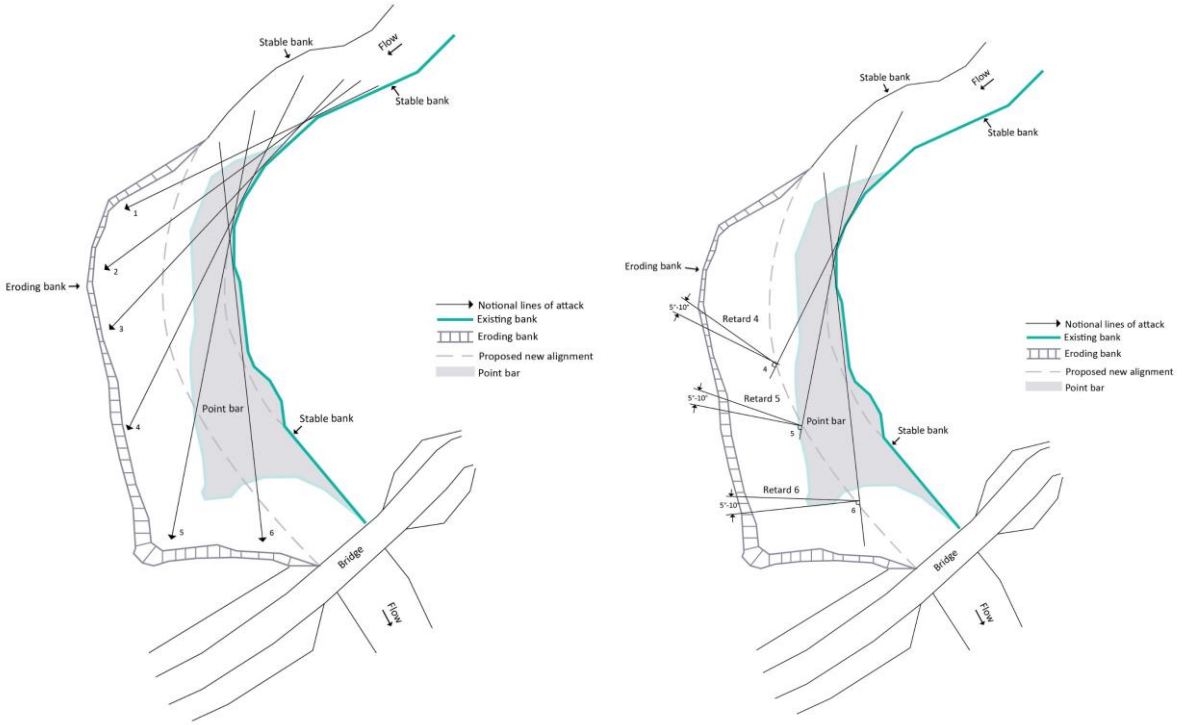

Figure 6. Example - pile field design for streambank stabilisation design aid.

Worked examples and standard drawings

This section of the Guidelines illustrates the application of the four-step process thorough a worked example.

The worked example does not illustrate all necessary components in the development and delivery of a waterway management project. Components, such as the methods for the communication of the project, have not been detailed. Similarly, the example does not include details of relevant legislation and policy that may impact on the development and delivery of the project.

The standard drawings listed below have been prepared to help waterway practitioners with often used techniques. The purpose of these drawings is to provide typical standard details for range of commonly applied intervention options. These drawings should be used as guide only and changes made where required to suit identified geomorphic processes and conditions unique to the site.

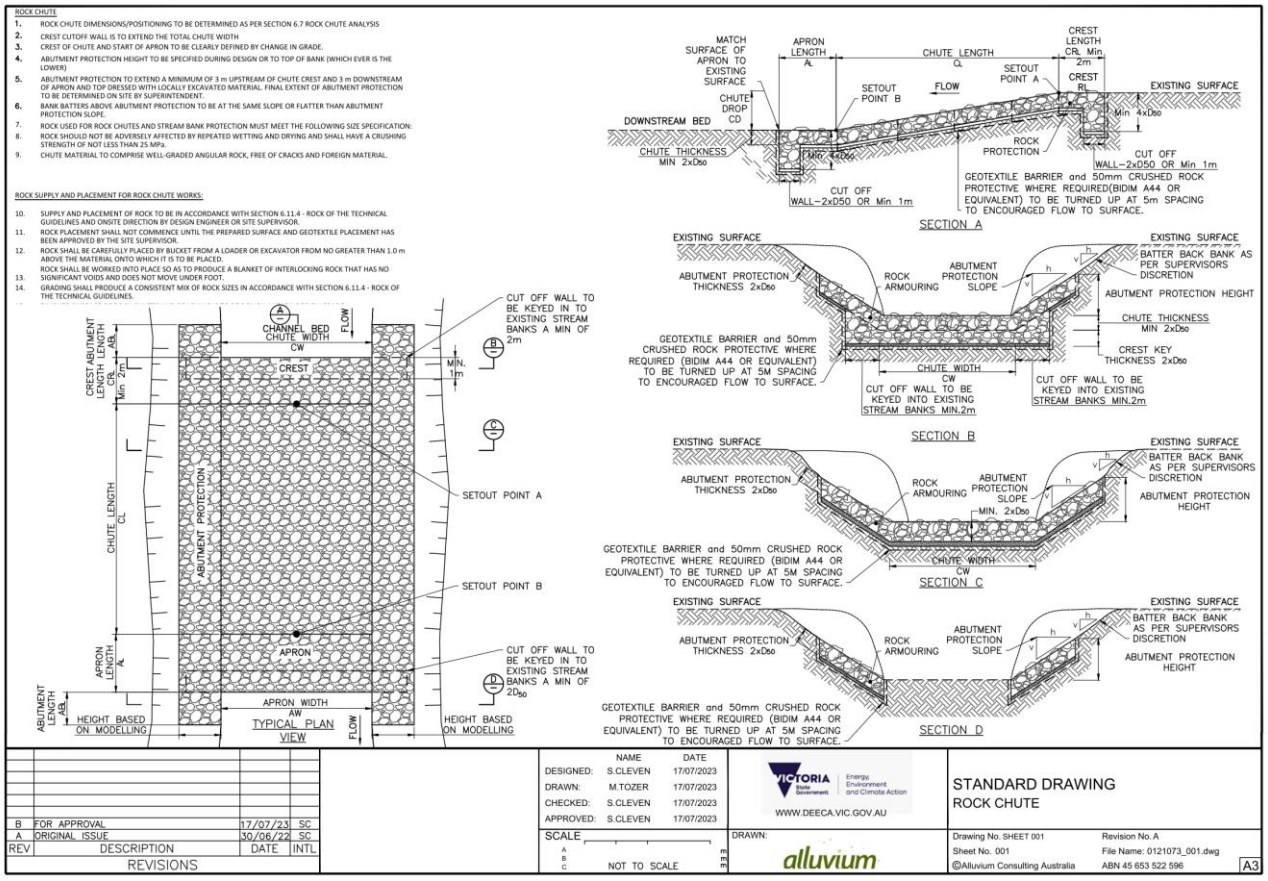

Figure 7. Example – Rock Chute standard drawing.

Conclusions

The Guidelines have been structed so that users can work through the document sequentially, building an understanding of geomorphic processes, deciding on whether to intervene in a waterway with onground works and then making decision about how and where to intervene. This mirrors the 4-step decision making process embedded in these Guidelines. Users can also enter the Guidelines at specific sections, quickly drawing on relevant material without the need to move through material irrelevant to the task at hand.

By capturing the latest science, management practices and the substantial experience in waterway management embedded within Victoria's CMAs and Melbourne Water, the Guidelines provide an invaluable resource for the wider industry. The Guidelines add to the growing body of technical documents, related guidelines and

standards that support waterway management and the drive for better outcomes for waterways and the values they support.

Acknowledgments

The Technical Guidelines for Waterway Management have been developed for the Department of Energy, Environment and Climate Action (DEECA) through a collective effort with many organisations and individuals. In particular the department thanks:

Project consultants: Alluvium Consulting Australia Pty Ltd (Stuart Cleven, Ross Hardie, Dr Alex Sims, Marnina Tozer, Prof Ian Rutherfurd).

- Steering Committee: Chris Saunders (DEECA, Project Manager), Peter Vollebergh (DEECA), Kelly Snell (Corangamite CMA), Andrew Briggs (North East CMA), Sean Phillipson (East Gippsland CMA) and Dylan McWhinney (Goulburn Broken CMA).
- Peer reviewers: Dr Dean Judd (Water Technology), Greg Peters (Streamology), Dr Rob Hale, Dr Zeb Tonkin and Dr Ashley Sparrow (DEECA, Arthur Rylah Institute); and Anne Buchan and Angela Muscatello (DEECA, Biodiversity).
- Representatives from all CMAs who provided feedback on the scope, structure and final draft of the Guidelines and many of the photos included in the Guidelines.

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