Do our interventions really work? Lessons from a stocktake of intervention effectiveness

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Key Points

- A review or stocktake of 81 intervention techniques was undertaken as part of Melbourne Water's Healthy Waterways Strategy (HWS) mid-term review process.
- The stocktake documented the range of interventions applied in HWS implementation and identified which ones to continue, improve, do more of, or stop implementing.
- While many interventions were commonly reported as partially effective or having mixed results, over half of the intervention techniques reviewed were found to be sufficiently effective and appropriate to continue their application.
- The Stormwater infiltrate and harvest intervention group had the most interventions with the potential to improve the application or increase the application extent of new techniques.
- Future research is needed to understand how climate change could potentially impact the effectiveness of different intervention techniques.

Abstract

Interventions are on-ground actions undertaken to protect or improve the condition of a waterway or address a threat to waterway values. A review of intervention techniques was undertaken as part of Melbourne Water's Healthy Waterways Strategy (HWS) mid-term review process to document the range of interventions applied in Strategy implementation and investigate which ones to continue, improve, do more of, or stop implementing.

In total, 81 intervention techniques were reviewed using over 120 technical reports and published papers to inform the stocktake, drawing on 20 years of research and monitoring undertaken through the Melbourne Water Research Practice Partnerships and other relevant research programs undertaken in the region. Standards were developed to guide the synthesis of information and evaluation of intervention techniques regarding the extent of intervention use in the region, level of effectiveness in meeting the objectives for HWS and level of appropriateness for application in waterways in the region.

While many interventions were commonly reported as partially effective or having mixed results, over half of the intervention techniques reviewed were found to be sufficiently effective and appropriate to continue their application. The remaining interventions were categorised with the potential for improvements (n=11), interventions that have been trialled but could be more widely adopted (n=14) and interventions with evidence of limited effectiveness or appropriateness (n=2).

Waterway managers can apply broad lessons from the intervention stocktake to ensure the benefits of existing interventions are maximised and consider the application of new and emerging intervention techniques.

Keywords

Interventions, MERI, evaluation, effectiveness, appropriateness

Introduction

The Healthy Waterways Strategy 2018-2028 establishes a region-wide plan to protect and improve the health of rivers, wetlands and estuaries across the Port Phillip and Westernport catchment (Melbourne Water, 2018). The Strategy considers the health of waterways using a framework of *waterway values* and *waterway conditions*. Ten-year sub-catchment and regional *Performance Objectives* were established to guide on-ground actions, initiatives and collaborations that progress towards the 50-year long-term targets.

Monitoring, evaluation, reporting, and improvement (MERI) processes were established for the HWS, providing a framework for tracking Strategy progress and ensuring continuous improvement and learning (Melbourne Water, 2019). The mid-term review commenced in 2022, assessing the strategy's progress and identifying areas for improvement.

As part of the Science Inquiry element of the mid-term review process, intervention techniques were assessed to document the range of interventions applied in HWS implementation and investigate which ones to continue, improve, do more of, or stop implementing (Melbourne Water, 2024, Rossrakesh et al., 2024). The assessment focused on on-ground interventions undertaken to protect or improve the condition of a waterway or address a threat to waterway values.

In this paper, we present an overview of the HWS interventions and their groupings, key findings on the application and maturity of interventions and identify interventions that require further consideration based on the lessons learned through Melbourne Water's research and investigations into the effectiveness of works. The Interventions technical report to inform the Healthy Waterway Strategy mid-term review (White et al., 2023) provides more detail on the level of application of interventions and their effectiveness and appropriateness.

Method

The intervention stocktake focused on providing foundational information in response to a key evaluation question: *To what extent are interventions appropriate and effective for achieving outcomes?*

A list of interventions currently in use was compiled through consultation with Melbourne Water staff and then mapped to the HWS conceptual model 'management levers' for each key environmental and social value (see Melbourne Water, 2020) to provide a consolidated understanding of the techniques used for HWS implementation.

Information was collated for each intervention in the form of a stocktake to provide foundational information about:

- What is being applied and why?
- How common is the use of the intervention, and what different techniques are used?
- Learnings from any related research or monitoring programs in the region
- Information on the effectiveness and appropriateness of the intervention for achieving HWS outcomes.

Over 120 technical reports and published papers were reviewed to inform the stocktake, drawing on 20 years of research and monitoring undertaken through the Melbourne Water Research Practice Partnerships and other relevant research programs undertaken in the region. This was supplemented with published papers from different parts of Australia or overseas for specific interventions where research and monitoring in the region was limited.

Evaluation standards

Standards were developed to guide the synthesis of information and evaluation of intervention techniques (Table 1). The standards include the performance categories of low, medium, high, and unable to assess for the following criteria:

- Maturity of intervention (length of time the intervention has been used in HWS catchments)
- Level of effectiveness (effectiveness in meeting the objectives for HWS) and
- Level of appropriateness (appropriateness for application in waterways in the region).

Table 1. Standards used to guide the synthesis and evaluation of information for the intervention stocktake.

Low	Moderate	High	Unable to Assess
Maturity of intervention			
Intervention has had limited use in the region by only being used as part of pilot or research studies over the past 10 years.	Intervention use has been focused in particular area but is gaining momentum in surrounding areas over past 10 years.	Intervention has been used regularly and broadly over a minimum of a 10 year period in the region.	Uncertain about how the long intervention has been used for.
Level of effectiveness			
No or limited evidence available that intervention is achieving intended objectives. AND/OR Studies shown intervention generally not providing successful outcomes.	Intervention is showing some signs of achieving the intended objectives but results are not consistent. AND/OR Studies have shown a mixture of success from using intervention in other locations.	Intervention has a significant impact on achieving the intended objectives and provides benefits to other values. AND/OR Studies have shown successful outcomes from using intervention in other locations.	Timing of intervention is too short to assess against achieving objectives. AND/OR Limited studies available of intervention used elsewhere.
Level of appropriateness			
Evidence indicates that intervention has negative impacts for other key values when applied. AND/OR Application of intervention poses significant risks to the practioner that needs special permits and tailored H&S practices. AND/OR Can only be used in very limited circumstances or conditions.	Evidence indicates intervention can have some negative impacts for another key values under some circumstances. AND/OR Application of intervention poses moderate risks to the practioner that can be managed through standard H&S practices. AND/OR Can be used under a specific range of circumstances or conditions.	Evidence indicates intervention can have some negligible known negative impacts for another key values. AND/OR Application of intervention poses minor risks to the practioner that can be managed through standard H&S practices. AND/OR Can be used across a broad range of locations and conditions.	No potential information available about impacts to other values. AND/OR Unclear about any limits to the application of the intervention.

The following definitions clarify how specific terms were applied in the evaluation.

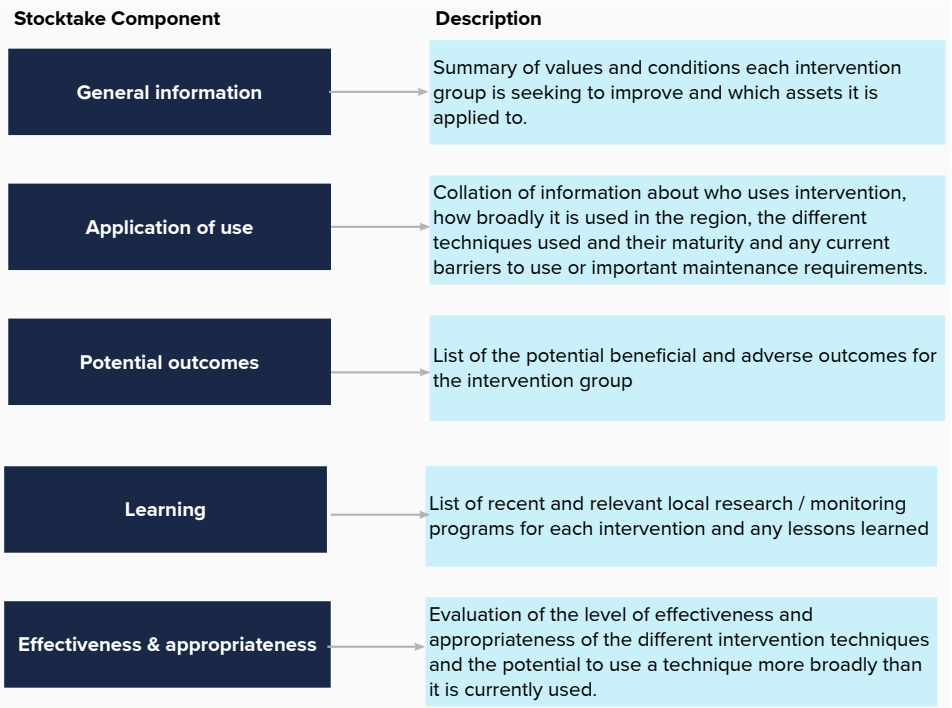
Intervention maturity - the length of time and extent to which an intervention has been applied in the HWS region to allow learnings for improvements to be made (e.g. interventions that have been extensively used across the region for more than ten years are considered as having high maturity).

Appropriateness - The degree to which the design and implementation of interventions meet the needs of HWS partners and the broader community they serve (e.g. how appropriate is it to use deer control methods in peri-urban areas?).

Effectiveness – Achievement of interventions in supporting condition and value objectives (e.g. how effective is the weed control method in reducing or removing weeds?).

Information for each intervention group was also collected as outlined in Figure 1 and presented in a practical, high-level summary for practitioners to refer to as a resource.

Figure 1. Components of the intervention stocktake



Limitations

There have been several limitations to the review of interventions, including:

- The stocktake represents a high-level assessment and evaluation of the effectiveness and appropriateness of different intervention techniques used in the HWS region. It does not represent an in-depth literature review for each intervention.
- The assessment was limited by the information and research provided or could be accessed at the time of the evaluation. In some cases, information was sourced from grey literature, which is not subjected to the same level as peer review as published literature.
- Due to time constraints, there was limited opportunity to seek further input from on-ground practitioners. The intention is to continue updating the intervention stocktake over time with input from other agencies.

Results

List of interventions

The list of interventions currently in use for the HWS is listed in Table 2. Interventions are categorised into 18 groups linked to the environmental and social values conceptual models developed for the HWS. In total, 81 intervention techniques from 16 of the intervention groups were reviewed regarding their level (maturity) of application, effectiveness and appropriateness in the context of the HWS.

Administrative and 'other' interventions were excluded from the science inquiry review of interventions. Not all interventions are used regularly or broadly across the region; some are in the early adoption phase as part of a research program.

Table 2. List of interventions currently used to implement the HWS.

Conceptual model management lever	Intervention group	Intervention technique
Vegetation management	Vegetation establishment and maintenance	Tube stock, Direct seeding, Reprofiling, Thinning, Burning, Fencing
	Weed control	Physical, Chemical, Alternative chemical, Thermal, Biological
Pest animal and abundant wildlife management	Pest animal control	Baiting, Lethal, Exclusion fencing, Biological, Ripping, Noise
Urban stormwater and pollution management	Stormwater infiltrate	Streetscape WSUD (raingardens, passively watered street trees, swales) Lot scale (raingardens, leaky rainwater tanks, green roofs) Regional (smart tanks / technology of flow release, constructed wetlands)
	Stormwater harvest	Similar as above but with different objectives
	Industrial pollution management	Lot and streetscape swales and raingardens, Property containment measures, Precinct toxicant traps, Stormwater treatment wetlands Diversion to sewer
	Litter management	Floating litter traps, Street sweeping, Gross pollution traps, Litter vacuum General litter management
	Sediment control	Site controls, Sediment ponds/traps, Desilting
	Wastewater management	Wastewater treatment plants, Septics, Sewerage network management
Waterway management structures and operation	Instream barrier management	Barrier removal, Fishways, Barrier operation change
	Channel modification	Bank protection, Grade control, Large Woody Debris reintroduction / fish hotels, Daylighting / naturalisation,
Water license and entitlement management	Instream flow management	Environmental flow release, Metering
	Floodplain / wetland flow management	Pumping, Levee modification, Structure (weirs and pipes)
Agriculture and runoff management	Rural land management	Headwater stream protection, Riparian buffer /swales, Fencing (multi-purpose), Off-stream stock water, Track management, Erosion control, Farm dam management, Fertilizer management, Effluent management, Constructed WQ systems, Shade and shelter belts
	Forestry runoff management	Road silt management, Buffer strips, Drainage crossing points
Community facilities	Access management	Paths, Canoe platforms, Improving existing access, Visitor facilities, Signage
Foundational	Administrative	Policy, Strategy, Guidelines, Compliance & enforcement, Licencing, Education
	Other	Translocation of species

Application and maturity of intervention techniques

Intervention techniques were reviewed to ascertain the level of application across the region and maturity (extent and period) of their application. Just under half (44%) of the 81 intervention techniques reviewed were assessed as high for application and maturity, meaning they have been used across the region for ten years or longer and represent interventions that are 'tried and tested'. Many interventions in the Sediment control, Pest animal control, Wastewater management, Rural land management, Forestry management intervention groups fell into this category.

One quarter (25%) of interventions were assessed as moderate application and maturity, with their use gaining momentum over the past ten years. Interventions in this category included those in the Stormwater infiltrate, Stormwater harvest and Industrial pollution management groups. The maturity of these interventions likely

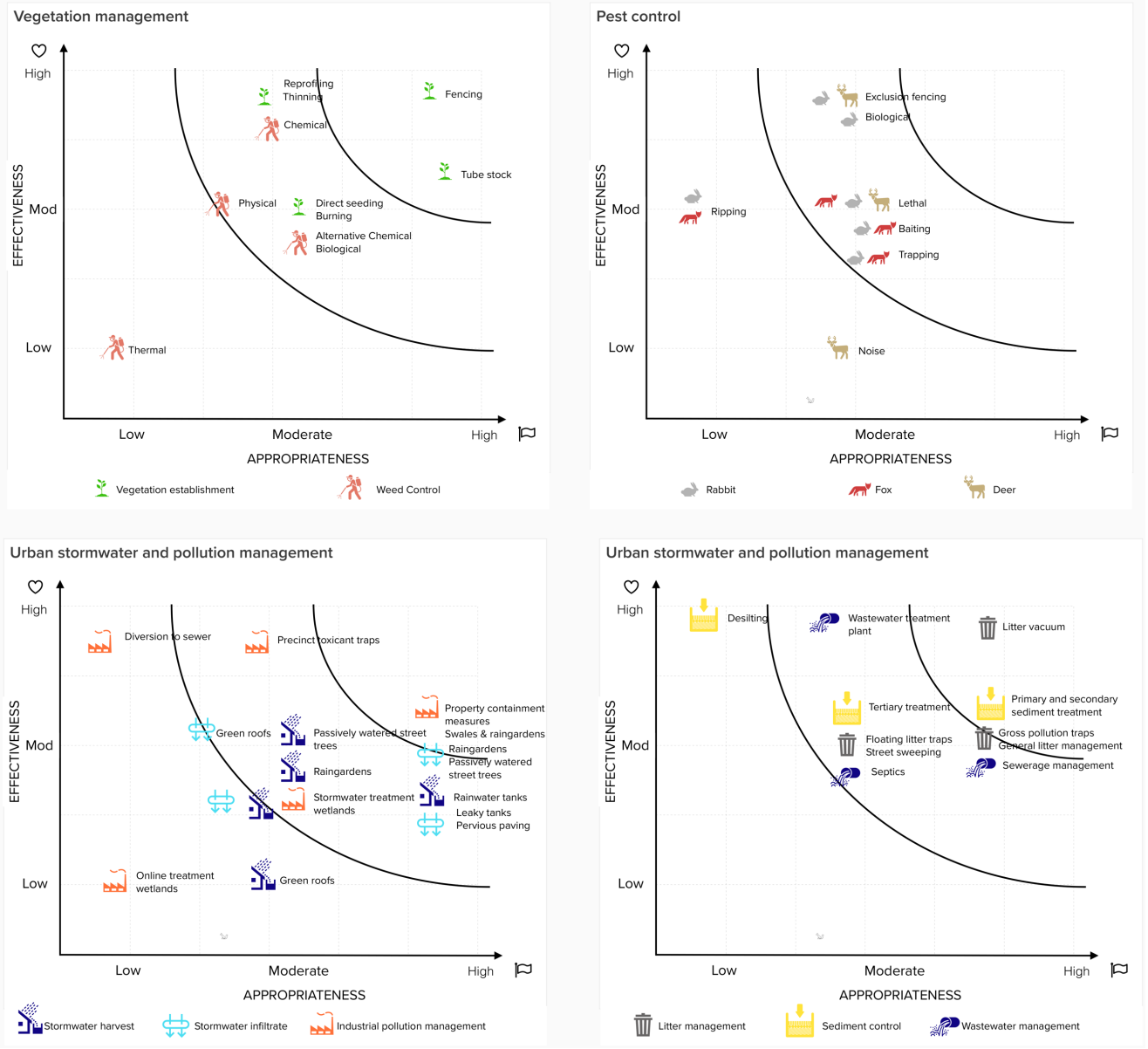
reflects an increased emphasis in the current HWS on addressing stormwater flows and urban and industrial water quality.

Interventions were assessed as low maturity if they had limited application within the region or were still in the research and development phase (i.e., trialled through research or a pilot program). Twelve of the 16 intervention groups had at least one intervention technique assessed as 'low maturity', and 30% of intervention techniques were evaluated as low maturity. Interventions still in the research and development phase included litter vacuums, precinct toxicant traps in industrial areas, smart tanks, structural flow interventions, noise (pest animal control) and thermal weed treatment.

Effectiveness and appropriateness of intervention techniques

The investigation into interventions originally intended to provide a high-level evaluation of the effectiveness and appropriateness of HWS interventions in response to the key evaluation question. However, preliminary analysis and literature review revealed that interventions were more commonly reported as partially effective (e.g. moderate level of effectiveness) or having mixed results (i.e. effectiveness varied between studies or results being inconclusive or dependent on the site context or intervention design) (Figure 2).

Figure 2. Summary of evaluation results for some interventions in the HWS region.



This mirrors a similar finding to Doerr et al., (2018) (who developed a knowledge bank of management effectiveness for NRM in Australia), who found that interventions were more commonly reported as partially effective. They reported that it was unclear whether full effectiveness is achievable as it is often context-specific, meaning it can be difficult to come up with general findings for effectiveness. Richards & Vollebergh (2018) reported similar variability in the outcomes of riparian works and highlighted the importance of understanding the confidence of reported outcomes and the factors that influence the outcomes.

To provide more context for future decision-making, the available evidence from studies conducted in the Melbourne region was summarised, and where there was sufficient evidence (i.e. confidence), a preliminary list of interventions that required further consideration in their application was identified.

Based on the results from the investigation, three categories of intervention were identified with the following characteristics (see Table 3):

1. *Interventions that could benefit from improvements to design/implementation and/or maintenance.* Melbourne Water and HWS partners may want to consider how to adjust or refine techniques in response to the research findings. Eleven interventions were included in this category with several in the Stormwater infiltrate and harvest and Rural land management groups.

2. *Interventions that have been tested through research and pilot programs and found to be effective, but have not been widely adopted.* Melbourne Water and HWS partners could consider if there are opportunities to apply these interventions more broadly. Fourteen interventions were included in this category and cover many of the different intervention groups.

3. *Interventions with evidence indicating they have limited or low effectiveness or may not be appropriate for application.* Melbourne Water and HWS partners may want to consider stopping or changing the way these interventions are applied. Only two interventions were included in this category, however the Interventions technical report (White et al, 2023) highlights a further seven interventions that may require careful consideration, subject to further review of the evidence.

Table 3. Interventions for further consideration of their application

Intervention group	Intervention	Maturity of intervention in region	1.Potential to improve intervention	2. Tested through research/pilot programs but not widely adopted	3.Reconsider due to limited effectiveness/ appropriateness
Vegetation establishment and maintenance	Tubestock planting	High	✓		
	Direct seeding	Low		✓	
	Reprofiling (saltmarsh)	Low		✓	
Weed control	Chemical weed control	High	✓		
	Alternative chemical control	Low		✓	
Pest animal control	Ripping near waterways	High			✓
	Lethal control (deer)	Moderate		✓	
	Exclusion fencing (deer/rabbits)	Low		✓	
Instream barrier management	Fishways	High	✓		
	Barrier operation change	Low		✓	

Intervention group	Intervention	Maturity of intervention in region	1.Potential to improve intervention	2. Tested through research/pilot programs but not widely adopted	3.Reconsider due to limited effectiveness/ appropriateness
Channel modification	Daylighting / naturalisation	Moderate	✓		
	LWD introduction / fish hotels	Low		✓	
Floodplain wetland flow management	Structural flow intervention, Partial levee removal and Pumping	Low / Moderate		✓	
Stormwater infiltrate and harvest	Smart tanks	Low		✓	
	Stormwater wetlands	Moderate	✓		
	Raingardens	Moderate	✓		
	Green roofs	Low		✓	
	Leaky tanks	Low		✓	
	Passively watered street trees	Moderate	✓		
Industrial pollution management	Property containment measures	Moderate	✓		
	Precinct toxicant traps	Low		✓	
	Swales and raingardens	Low		✓	
Litter management	Litter vacuum	Low		✓	
Sediment control	Online treatment wetland (tertiary system)	High			✓
Rural land management	Riparian buffers/swales	High	✓		
	Gully erosion control	Moderate	✓		
Access management	Signage	High	✓		

The detailed findings and learnings for each intervention within the three categories are set out in the Interventions Technical Report (White et al, 2023) and range from modifying the application of the intervention (e.g. reducing the density of tube stock planting of overstorey species) to increasing the application to other areas (e.g. broader application of smart tanks). The Stormwater infiltrate and harvest intervention group had the most interventions with the potential to improve the application or increase the application extent of new techniques. The remaining interventions were assessed as suitable to keep applying as needed.

In addition, the following high-level lessons learned emerged from the research and literature regarding the effectiveness of interventions.

- Interventions are likely to be more effective when combined with other interventions (e.g., revegetation and weeding).

- Maintenance in the form of follow-up activity is crucial to ensuring the effectiveness of an intervention is maintained over time (e.g. fishways providing access for different fish species over a range of conditions ten years after construction).
- Trials and pilot programs are an important aspect of developing new intervention techniques and can be used to understand the benefits, costs and risks in different settings prior to committing to broad scale application (e.g. barrier operation change).

Future considerations

As noted in Doerr et al 2018, the effectiveness of natural resource management programs can be improved by comparing multiple interventions that are designed to achieve the same outcome, rather than examining one intervention at a time. This approach has been used in the region (e.g. stormwater control measures, revegetation techniques) and allows for more rapid learning and can increase the cost-effectiveness of investment. This approach should continue and expand to consider other intervention groups in the region.

Doerr et al 2018 also reflected that incorporating a few sites with novel interventions into a broader program can both minimise the risk and maximise learning. This is currently underway in the region with research testing the use of smart tanks and leaky wetlands.

It should be noted that not all intervention types lend themselves to being monitored with formal comparisons and controls (e.g. environmental watering), and in such cases, clear articulation of the anticipated system change that will occur through interventions over time is essential using conceptual systems models, and monitoring and learning about effectiveness should focus on testing those conceptual models.

Future research is needed to understand how the effectiveness of different intervention techniques could potentially be impacted by climate change. A good example of this is fishways which are designed based on local condition hydrology and hydraulics. A change in flow conditions due to climate change impacts could reduce the effectiveness of the fishway, a phenomenon that is already happening in the Melbourne region. There are likely to be several intervention techniques that have been previously installed that may need to be adjusted to maintain effectiveness. Conversely, intervention techniques need to be applied to help maintain climate resilience. Local empirical studies on climate implications for interventions are needed to ensure current and future intervention investment is good value for money.

Conclusions

The review of interventions has provided a consolidated set of information on the types of interventions applied through Healthy Waterways Strategy implementation in the Port Phillip and Westernport region. A review of the effectiveness and appropriateness of interventions and the lessons learned from monitoring and research has helped to identify a sub-set of interventions for further consideration by Melbourne Water and Strategy partners.

This includes 11 interventions with the potential for improvements, 14 interventions that have been trialled or tested through research but have not yet been widely adopted and two interventions with evidence of limited effectiveness or appropriateness.

Future research is needed to understand how the effectiveness of different intervention techniques could potentially be impacted by climate change. Local empirical studies on climate implications for interventions are needed to ensure current and future intervention investment is good value for money.

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