Riparian Revegetation: Assessing Restoration Outcomes

Healthy Waterways Strategy 2018-2028
Port Phillip & Westernport, Victoria

Melbourne Water

THE UNIVERSITY OF MELBOURNE

Strategic alignment

Regional Performance Objectives (RPOs):

- RPO-29: Programs, standards, tools and guidelines are in place to protect wetland vegetation communities.
- RPO-30: Climate change resilient revegetation management practices are understood and implemented.

Key Research Areas:

- Streamside vegetation & instream habitat: Identifying critical constraints to revegetation success and opportunities to improve vegetation outcomes.
- Streamside vegetation & instream habitat: Understanding the potential impacts of climate change on riparian vegetation communities and opportunities to effectively build resilience or transition vegetation communities.

Summary

Melbourne Water (MW) manages approximately 24,000 km of waterways across the 12,783 km2 greater Melbourne region. Significant funding is invested in vegetation management and maintenance, including $96M Capex and $74M Opex funding (over $170M) over the next five years (not including developer funded works) for vegetation establishment through actions such as revegetation. Melbourne Water undertakes revegetation and rehabilitation activities through developer works, capital projects (major and minor), grants and maintenance programs (Melbourne Water, 2018).

In the Healthy Waterways Strategy MERI framework, there are a number of key evaluation questions (KEQs) that focus on restoring, managing and maintaining vegetation along waterways. Specifically, the Rivers Monitoring and Evaluation Plan (MEP) under the MERI framework assumes that 80% of plantings at a site will survive to two years post-establishment for Capital projects and 6 to 12 months post-establishment for Grant projects (Melbourne Water, 2021).

However, given the region's climatic, physiographic and land use variability, there is considerable uncertainty regarding the effectiveness, efficiency and/or consistency of achieving the desired intervention outcomes across the region.

While some monitoring programs have sought to track changes of interest over time as a result of management interventions, such as the Works Monitoring (WM) program, considerable uncertainty around the critical drivers of intervention effectiveness remains.

To improve our understanding of the outcomes of our riparian revegtation programs and the drivers of success, this project has:

- Updated the Healthy Waterways Strategy conceptual models for riparian vegetation interventions, and
- Developed databases to store long-term data on vegetation composition, structure, and dynamics at selected works sites and developed a fit-for-purpose riparian revegetation intervention monitoring method.

The Restoration Outcomes Monitoring Protocol (ROMP) (Jellinek et al., 2021) was developed in 2021 to allow Melbourne Water to effectively monitor management interventions such as revegetation and weed and pest animal control over short (<3 years) and mid to long (3 to 20+ years) time-frames. This monitoring protocol was initially used in two projects in 2021 to assess:

- Plant survival at 2 or more years post-planting to determine if the assumed 80% establishment target has been met at 19 Capital Works sites across all the MW catchments, and
- The development of older revegetated sites (12 years post-planting) in comparison to remnant/ target habitats (Foley-Congdon, In Review).

ROMP is now being implemented by Capital Works programs in 2022 and future projects to determine how effective management interventions (including revegetation, pest animal control and weed control) are at restoring vegetation at sites across the Melbourne Water region.

Recommendations from research

- Need for regular maintenance, weed control and monitoring to ensure and track the survival of mid-storey tree and shrub species and to allow native ground cover to establish in revegetated areas.
- Ensure works sites are managed over the short to medium term, including undertaking pest and weed management activities beyond the 3-year management period.
- Undertake long-term monitoring at management intervention sites using the ROMP method, and ensure vegetation data is stored digitally on a purpose-designed database.
- Employ and train field staff and associated project managers on conservation land management principles and ecological restoration principles.

What did we do?

Articulated linkages between MW goals and management interventions which were then captured in updated vegetation

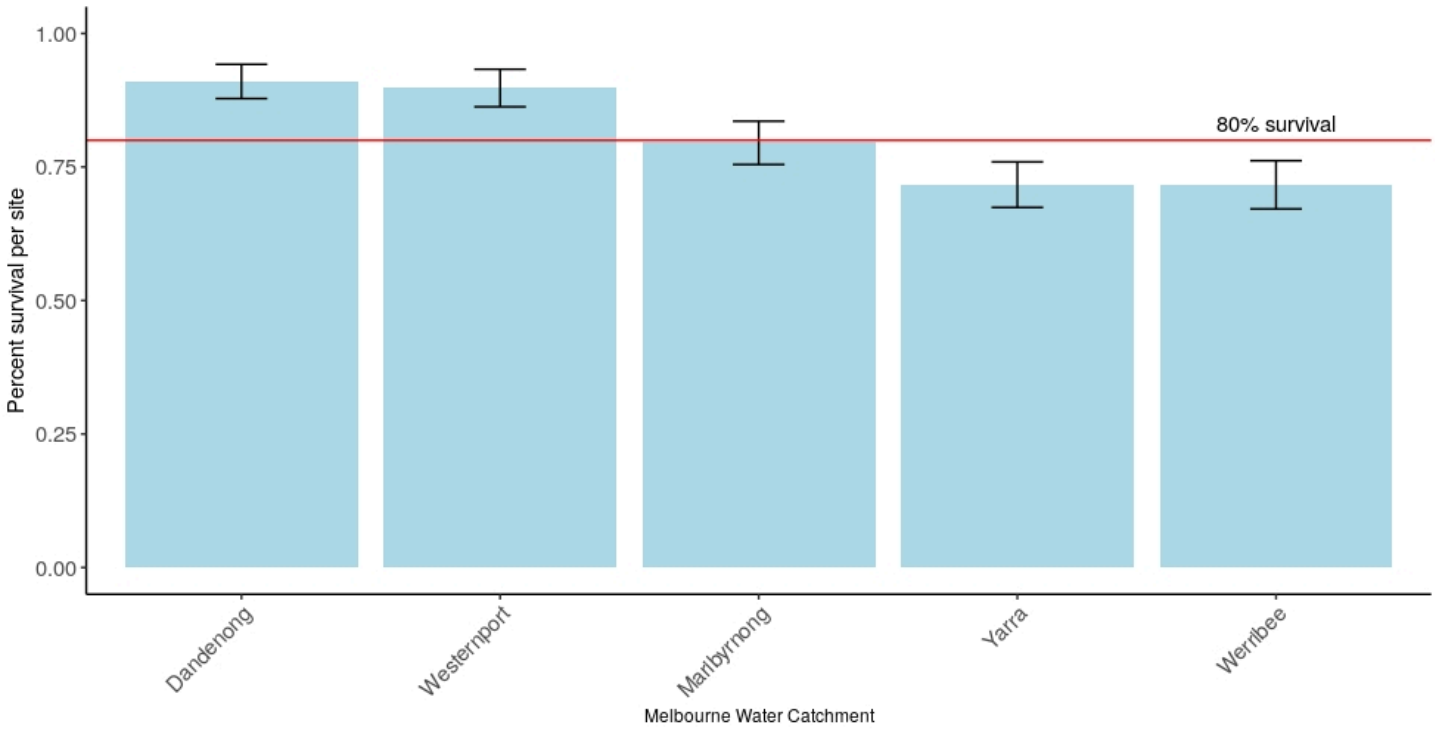


Figure 1 survival rates of plantings at 2 or more years (at a total of 19 sites) across the five major catchments of the Melbourne Water region. Bars represent standard errors

conceptual models. and developed essential methods to acquire robust data needed to effectively monitor and evaluate vegetation management intervention outcomes at Capital Works sites.

- Reviewed Melbourne Water's Works Monitoring program which used the ISC2 method to assess management interventions, and provided a summary of project outcomes and limitations (Jellinek et al. 2021).
- Reviewed Melbourne Water's existing vegetation data and started to develop a purpose-built database to store this data into the future.
- Reviewed and clarified Melbourne Water's goals relating to vegetation management and monitoring and how these related to the Healthy Waterways Strategy and other reporting requirements (e.g., Monitoring Evaluation Plans).
- Compared multiple institutional vegetation monitoring methods and conceptual models (e.g., RIMP, ISC2) to understand their relative strengths and weaknesses and developed conceptual models identifying the critical factors that influence the success and failure of vegetation management interventions including contextual and site attributes.
- Developed monitoring guidelines and associated data analysis plans for assessing vegetation management interventions (ROMP), where revegetation, weed control and pest animal control is undertaken (Jellinek et al. 2021).
- Assisted in the implementation of the ROMP method at 15 management intervention sites in 2022. These will be monitored into the future to assess management interventions effectiveness.

Critically reviewed and provided practical support for the development of improved methods and tools for vegetation management and monitoring:

- Reviewed the Vegetation Condition (VC) monitoring methods for riparian areas (Dell 2020) and wrote a proposal to align VC with ROMP methods. This included a desktop review to better align VC and Vegetation Visions (VV) sites with other proposed faunal monitoring (macroinvertebrates, birds, etc.).
- Developed a field manual for the collection of Vegetation Visions data in the field by contractors.
- Worked to develop a database structure to try to ensure Melbourne Water's major sources of historical and future vegetation data is entered and maintained in a robust way into the future. Trialled the Vegetation Visions online data collection method using the Survey123 app.
- Analysed and reported on the outcomes of the 2021 Vegetation Visions assessment undertaken by Alluvium.

Understanding climate change impacts on vegetation management to support climate-smart adaptation planning and strategies:

- Worked with Melbourne Water staff on climate adaptation strategies for revegetated areas such as the D5 project (Modelling the risk of key revegetation species to a changing climate).
- Developed a business case for a climate adjusted seed production area undertaken by Melbourne Water in the Western Treatment Plant.
- Provided advice on climate adjusted plantings in the Dandenong area by Melbourne Water, Parks Victoria, Dandenong City Council and Federation University.

What did we find?

Below are two projects that have used the ROMP method to monitor the outcomes of restoration activities, particularly

revegetation.

ROMP survival monitoring

The ROMP survival monitoring undertaken at 19 sites planted in 2018–2020 found that plant survival ranged from 72 – 91% (Fig. 1). Plant survival rates were substantially higher in the Dandenong and Westernport catchments and lower in the Maribyrnong, Yarra and Werribee catchments (Fig. 1). Aridity (the combination of annual precipitation and annual temperature) was a major factor driving plant survival ($p = 0.001$), with plantings in more arid catchments (e.g., Werribee and Maribyrnong) having substantially lower survival than those in less arid catchments (e.g. Dandenong and Westernport) (Fig. 2). The density of weeds and the presence/absence of pest animals did not have a substantial impact on the survival of revegetation in the sites studied.

Comparing revegetated and remnant sites

This study resurveyed 17 works sites (that were previously included in the Works Monitoring (WM) program) using the ROMP method to assess the 'success' of the revegetation at these sites in comparison to remnant/target sites, 12 years after planting. While woody plant species richness and canopy cover did not differ substantially between revegetated and remnant sites, the study did find that native tree and shrub abundance, recruitment of native trees and shrubs, and the cover of native shrubs and groundcover plants was substantially lower at works sites than remnant sites. Similarly, at works sites the cover of exotic ground cover plants was substantially higher than at remnant sites (Fig. 3), and remnant sites had a higher diversity of plant lifeforms compared to works sites. Higher browser frequency and lower connectivity to native vegetation in the surrounding landscape were associated with reduced revegetation outcomes, while soil chemistry and compaction had no discernible effects on revegetation outcomes.

In summary, works sites lacked the critical vegetation structure and native ground cover to emulate remnant vegetation. Lack of mid-story species may be due to low survival rates after the initial planting, possibly due to weed cover, which may also suppress native ground cover and recruitment.

Related projects

The D5 project factsheet on climate change impact on re-vegetation species provides information on how different plant species commonly used in revegetation will respond to a changing climate. Similarly, the mid-term review out- lining vegetation condition changes across the Melbourne Water

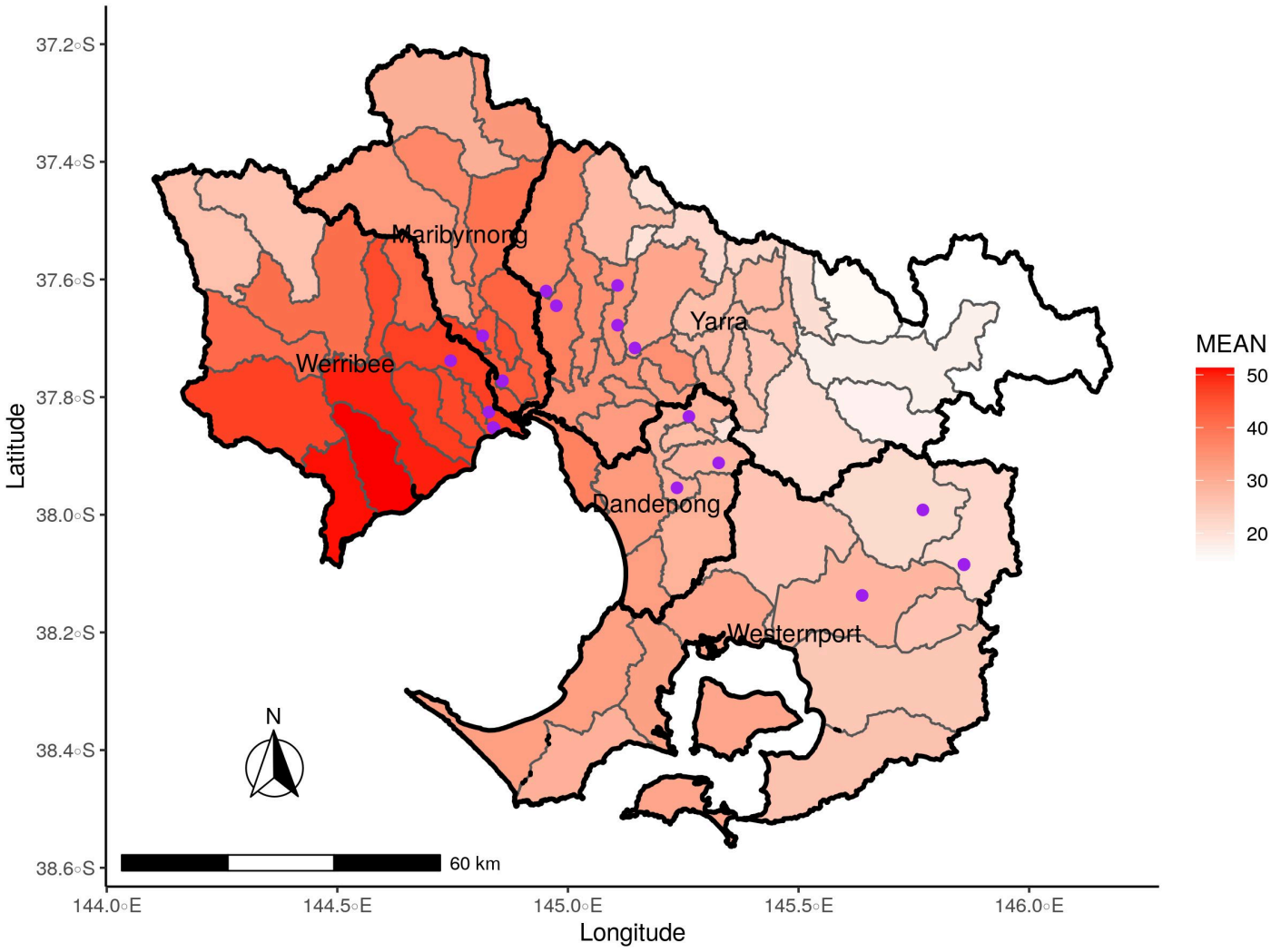


Figure 2 Mean aridity of subcatchments the Melbourne Water region, with the 19 plant survival monitoring sites indicated by purple points.

region (via the Vegetation Visions monitoring) also provides information on how vegetation is tracking.

Future direction and Knowledge gaps

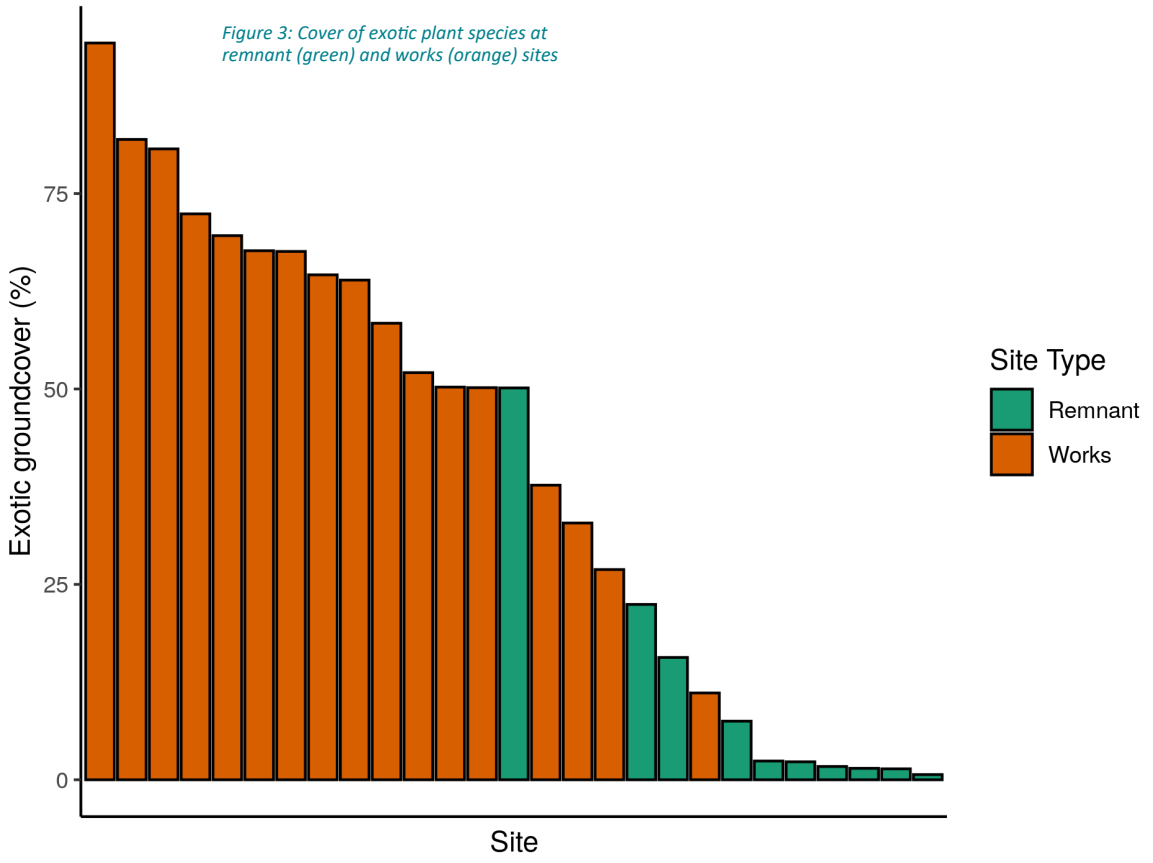
As discussed above, the ROMP method is currently being used to monitor Capital Works management interventions now and into the future. This will provide valuable information on how restored areas develop over time and the factors likely to impact restoration outcomes. Additional key knowledge gaps include:

- An understanding of how animals are using restored areas. This would require greater alignment between the various MW projects currently monitoring vegetation and fauna such as birds and invertebrates.
- Impacts of weeds, pest animals such as deer, and climate change on restored and remnant habitats.
- The ability to use new technologies (LiDAR, high resolution satellite imagery) to monitor restored habitats over time.
- How to better forecast and mitigate climate change impacts on remnant and areas of revegetation investment.

How are we sharing findings?

- ROMP monitoring protocol and works have been discussed with Capital Works staff and associated Melbourne Water staff.
- Liaison with Catchment Management Authorities interested in the ROMP method.
- Presentation of results at scientific conferences such as the Ecological Society of Australia annual conference.
- Project Report: 21.1 A Review of the Works Monitoring Method: Effectively monitoring revegetation interventions into the future.

Figure 3: Cover of exotic plant species at remnant (green) and works (orange) sites



For more details on the research outcomes of this project, or other projects of the MWRPP, please contact:

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