Floating Wetlands Pilot Project

A cleaner and greener approach to wastewater

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Abstract:

Gazetted in June 2022 by the Minister for Water was the Statement of Obligations (Emission Reduction) under the Water Industry Act. Under this Statement, water corporations must source 100 percent of their electricity from renewable sources by 2025. Water corporations must also reduce their collective greenhouse gas emissions by 42.4 percent by 1 July 2025, 93.7 percent by 1 July 2030, and 100 percent (net-zero) by 1 July 2035.

A trial has been developed at WPW's Cowes Wastewater Treatment Plant (CWWTP) using two species of wetland plants on floating platforms. The trial aims to improve wastewater quality, use less energy and lower carbon emissions by utilising nature-based solutions to overcome these challenges.

The floating wetland is made up of 1,800 native wetland plants, with plant roots growing into the water column to promote the formation of biofilms. By directing the waterflow through the root masses, the roots are able to capture and biologically process suspended solids and promote sedimentation, with the plants taking up dissolved nutrients and pollutants from the water.

Deakin University's Blue Carbon Lab and the CSIRO are collecting and analysing data on water quality, plant growth and tissue composition and greenhouse gases (carbon dioxide, methane, and nitrous oxide) emitted from the lagoon on which the trial is being conducted over an 18-month period.

This paper looks at the role of the operator in installing the floating wetland, challenges and lessons learnt from the current trial.

1.0 Introduction

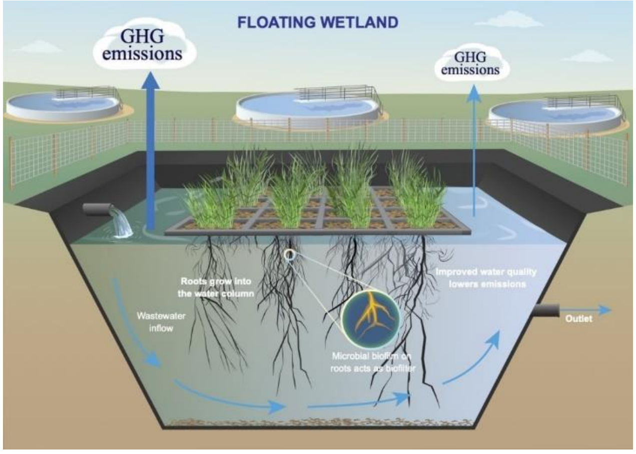
WPW must meet emission reduction targets by 2035 and meet compliance obligation under the Environmental Protection Act. The cornerstone of the Environmental Protection Act is the General Environment Duty (GED). The GED requires all Victorians to manage risks to human health and the environment that their activities create. Everyone must take steps to prevent or minimise those risks including greenhouse gas emission reduction.

Treatment of wastewater is the largest emitter of greenhouse gas in the Victorian public sector. During the last financial year (22/23), Scope 1 and Scope 2 greenhouse gas emission from wastewater treatment plants was 78% of WPW's emission profile.

WPW is into its second iteration of its Climate Change Strategy (2023-2028). This pilot study is an action within the Strategy and results from the pilot will inform the design of a permanent wetland system at the King Road Wastewater Treatment Plant (KRWWTP).

Analysis of international studies suggests that, on average, floating wetlands could reduce dissolved nitrogen by 58% and dissolved phosphorous by 49%. Since the installation of the floating wetland, Blue Carbon Lab's initial results have shown a 50% reduction in average greenhouse gas emissions since the start of the trial. However, the data show considerable variability and there has not been any reduction in nutrient levels within the wastewater lagoon yet. Therefore, the mechanisms driving this reduction in greenhouse gas emissions remain unclear while the floating wetland remains in its establishment phase.

At the CWWTP, treated wastewater makes it way to the lagoon where the floating wetlands are installed. Inflows at this point are separated half to a control zone and half to a test zone which makes up 7% of the lagoons total area.



2.0 Project inception

The concept idea of a floating wetland formed a video submission to the Intelligent Water Networks (IWN) Hydrovation challenge in 2022. The concept won the challenge, and the idea was born.

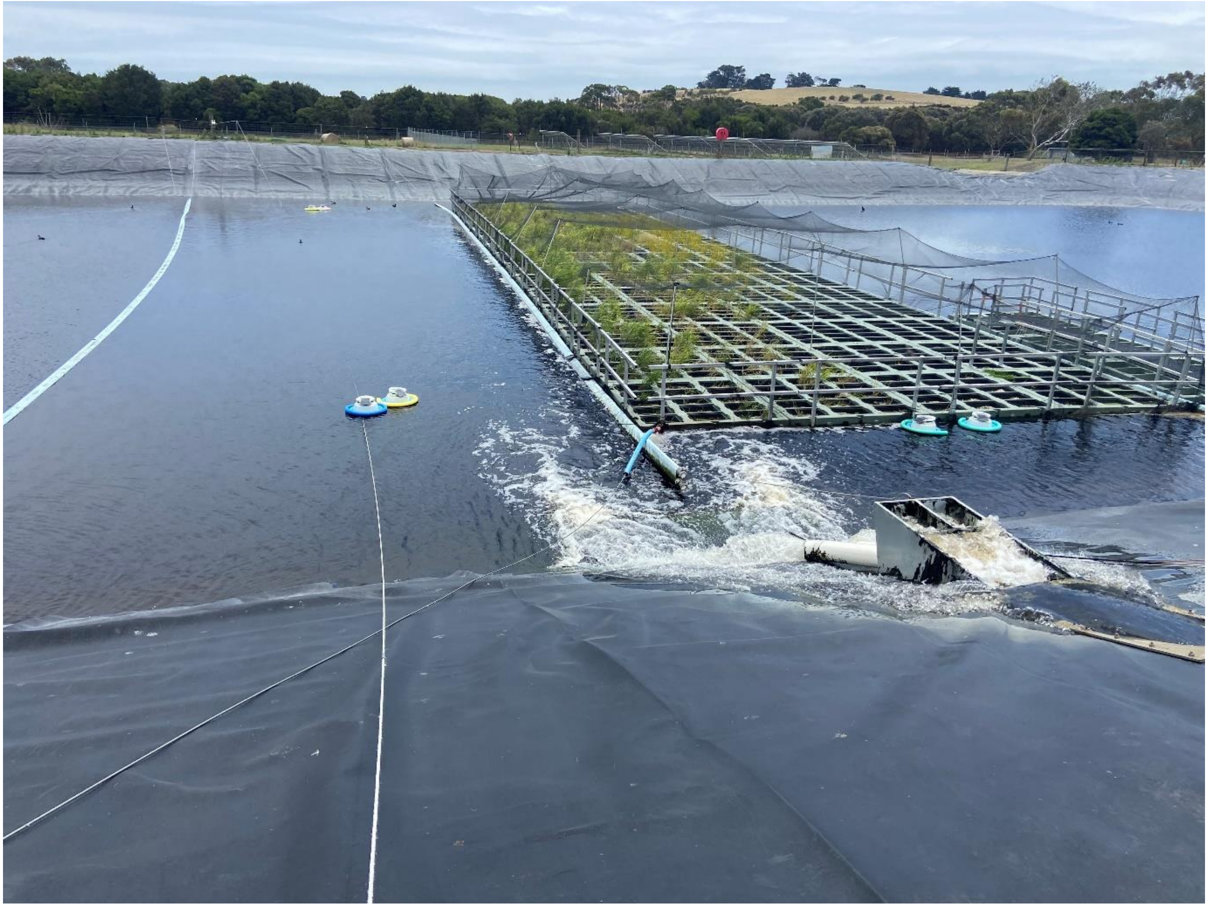
Winning the Challenge funded a feasibility assessment to be undertaken in collaboration with Deakin University's Blue Carbon Lab to 'Assess the Teal Carbon Storage Opportunities in a Restored Wetland Filled with Recycled Water' at KRWWTP. Following the feasibility study, a concept design for the wetland system was developed by partners of Blue Carbon Lab and the University of NSW. The Pilot design for CWWTP was developed as part of Water Services Association Australia (WSAA) W-Lab trials and selected for the trial due to its scale which is more suited for experimental design. Results will inform the detailed design of the wetland system at KRWWTP and potential opportunities for future wetland establishment on Phillip Island.

The pilot project received funding of $200,000 from the Department of Energy, Environment and Climate Action (DEECA) as part of the Integrated Water Management Grant Program. The funding provided by DEECA supports the research components of the project, while WPW will cover the capital costs associated with the infrastructure of the project. Total funding support for the project is $250,000 with additional support from IWN and Yarra Valley Water over the two-year project life.

3.0 Installation

The installation began in late March 2023 with the fitting of the baffle curtains (used to divide flows into test and control zones). This was done by using a 40m long vinyl with sleeves at the top and bottom. The top was filled with 90mm stormwater pipe and fitted with pool noodles to keep it afloat. The bottom was filled with heavy chains to keep the curtain open.

The wetland was tensioned at both sides of the lagoon to keep zones separate. Once completed a splitter box was installed at the inlet works to then separate flows. 64 pods weighing 250kgs each when full were then planted out. With scaffolding at the sides, coverage was approximately 7% of the total lagoon surface. The lagoon is 4500sqm, the wetland has approximately 331 sqm cover.



Installation was achieved via a ramp consisting of carpet and two lengths of timber (keeping pods off lining to prevent tearing). The pods are connected via a block system with joining pieces screwed into place at 6 points on each pod. The team faced many hurdles during installation while working over an operational treatment lagoon. Vaccinations and PPE were a must (including a life jacket) and while no incidents occurred during installation, difficulties arose in the floating of the pods that were planted out due to the weight of a loaded pod. This was overcome by tying ropes to the finished rows in the lagoon and safely exiting staff from pods over the course of the day. The labour was intense and fatigue was closely monitoring with scheduled break periods.

Craning in the platforms and walkway into place without damaging the liner presented challenges. However, once we had installed the four rows of 15 pods the process of installing the net and replacing plants that had floated loose was very easy. The whole installation process took the team of 12 (with various contractors at certain stages) about a week to complete this, including everything from assembling the scaffold, adding the rock and plants and tying off the bird netting. Now that the project is installed the bird netting will remain for about 1 year to allow plants to grow. Phillip Island has a very dense and diverse bird population.

4.0 Lessons learned

With the installation complete and operational, we found the splitter box was not big enough for the inflows causing overflow at the sides. Whilst still operable, an area of improvement would be more precise calculations during the development of the design.

The handrail/scaffolding had two types of bolts for each setup meaning having more tools on hand. We also found the predrilled holes for bolts were in the wrong place, meaning we had to drill out every handrail piece to make them fit. The pods needed a lifting mould at base as it was very difficult pushing 250kg of a pallet down a ramp (this is being addressed by manufacturer for future installations). The planting and gravel filling of 1,800 pod boxes is very labour intensive and ideally would use lighter materials, for example coco fibre (if research shows its effectiveness).

A more ergonomic loading system could reduce manual handling and strain on back.

5.0 Plants

During the project the team planted 1,800 plants that consisted of:

- 900 *Phragmites australis* (Common Reed)
- 900 *Baumea articulata* (Jointed Twig Rush)

Both species have previously shown good uptake of pollutants and are native to Australia.

***Phragmites australis* (Common Reed)**

Native to all areas in Australia, it was traditionally used by Indigenous Australians for a number of applications including rope and the roots were used as food.

First used in floating wetlands in the UK in the 1990's in treatment of stormwater, *Phragmites australis* has a high ability to accumulate various nutrients and heavy metals. Because of this, *Phragmites australis* is the most commonly used plant in constructed wetlands across the world. Mature plants produce around 2,000 seeds per year although germination rates are low.

***Baumea articulata* (Jointed Twig Rush)**

Baumea articulata is a native Australian perennial plant that has long slender stems and tall flowers. It is used heavily in landscaping for erosion control and can grow up to 2.5m tall. Its seeds are 3mm long and are dispersed via wind. It can resprout after fire and other damage by reproducing vegetatively via rhizomes.

Baumea has been traditionally used by Indigenous Australians to find water sources and to make baskets.

6.0 Operations and Maintenance

The wetlands are monitored via several floating greenhouse gas sensors. The plants are checked monthly by a team of researchers where root and plant samples are analysed for nutrient uptake. Maintenance of the wetlands is undertaken by WPW after visual inspection by Plant Operators.

6.0 Conclusion and some unexpected side benefits

Eight months into an eighteen-month trial there are some early trends emerging with Blue Carbon Lab's initial results showing a 50% reduction in greenhouse gas emissions since the start of the trial. However further analysis is required to provide conclusive results.

7.0 Acknowledgements

I would like to thank the team at WPW, Deakin University's Blue Carbon Lab, CSIRO, and Covey Associates.

With a special thanks to those at WPW that took the time to really help along the way: Ilse Hall, Melinda Glew, Zoe Geyer and Jake Weir.

8.0 References

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