

Using riparian protection to offset discharged treated wastewater

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Key Points

- As populations grow in urban centres increased inflow pressure on wastewater management systems increase.
- Using riparian offsets as a measure to reduce nutrient load from discharged recycled water.
- Net environmental benefits to whole catchment.

Abstract

As populations rapidly grow on the urban fringe towns of Melbourne, water authorities are faced with increased inflows into their wastewater management facilities (WMF). Goulburn Valley Water (GVW) encountered this in Kilmore, Victoria and needed to assess the future capacity of their WMF and options for the reuse of the increased volumes of treated wastewater.

An options investigation was completed for alternative use of the treated wastewater with discharge to the creek deemed most viable with a riparian offsets project. A proposal to remove nutrient input (Phosphorus) from other sources within the catchment was approved by the EPA in collaboration with the Goulburn Broken CMA. This included working with landholders along the Kilmore Creek catchment to undertake activities such as streamside fencing and revegetation.

Through the partnership with GVW and GB CMA, a strong community engagement process and an ongoing payment plan offered to landholders, we were able to achieve the 2025 offset target within the first 12 months of a 3-year plan.

Population growth in these once small rural towns provides opportunities for innovative projects, with strong environmental benefit, to be considered. Collaboration and co-design of projects between agencies and communities that benefit both the environment and accommodate the need for growth in these towns are at the forefront of river and land management.

Keywords

Wastewater, offsets, riparian, urban, population, waterway, nutrient load

Introduction

Goulburn Valley Water (GVW) provides water supply and sewerage services to the township of Kilmore, Victoria. Prior to the completion of this project, sewage was treated at a lagoon-based wastewater management facility (WMF), with recycled water irrigated to land. Kilmore is located on the urban fringe of Melbourne and predicted to undergo significant population growth over the next 50 years. This will increase the sewage volumes requiring management and render the previous recycled water management method insufficient.

Traditional upgrade solutions, based around mechanical treatment, winter storage, and discharge to land posed several issues for this site. Upgrades to winter storage and irrigation was not viable, as land suitable, and of the scale required, is not available to manage the anticipated long-term increase in recycled water volumes, making the traditional solution unsustainable. GVW investigated, and have implemented, a Riparian Offsets Scheme with a whole of catchment approach that sees the additional recycled water returned to stream. This creates positive outcomes in terms of sustainable recycled water management and improved ecological values of the Kilmore and Kurkurac Creeks, currently in poor condition.

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Extensive Ecological Risk Assessments (ERA) undertaken by ecologists were used to advise the offsets project. DELWP's Index of Stream Condition records Kurkurac Creek as in 'Poor' condition, and the ERAs identified Kilmore Creek to be in even poorer condition. The need to manage the nutrient concentrations in the recycled water was highlighted, particularly phosphorus and ammonia, and the importance of timing releases to the waterways to mimic natural flows and maximise environmental benefit.

The offsets project consisted of two components, being augmentation of the existing WMF to reduce nutrient concentrations and disinfect the recycled water, utilising winter storages to allow for recycled water releases at specified times of the year to support ecological values, as well as catchment works (offsets) to minimise sediment and nutrient transportation from farmland into the waterways. The catchment works included stock exclusion, provision of off-stream watering points, riparian revegetation, and weed control.

Based on the predicted discharge water quality and quantity, a phosphorus reduction target of 945 kg per annum was required to be offset through the implementation of catchment offsets. This target includes a safety factor of 1.5 in accordance with the Water Quality Offsets Framework (Alluvium and Marsden Jacobs Associates, 2015). Through a partnership between GVW and the Goulburn Broken Catchment Management Authority (GB CMA) the 2025 offset target was achieved within the first 12 months of a three-year plan.

This project was the first of its kind to be implemented in Victoria, with no precedence to provide assurance that the concept would be successful. With technical expertise, and knowledge in the processes proposed for the WMF upgrades, the understanding that the receiving waterways were in poor health, and initial engagement with landholders suggesting support to participate, GVW moved forward with confidence in the project.

EPA Approval Process

The Environment Protection Authority (EPA) is authorised to issue works approvals and licences for activities with potential to have a significant impact. The State Environment Protection Policy (Waters) lets EPA use water quality offsets as a regulatory tool when licensing wastewater discharges, allowing less stringent discharge limits than would typically be the case (EPA 2018).

This project was the first EPA works approval and licence amendment application in Victoria to include water quality offsets. As a result, it became a highly consultative process. GVW needed to provide confidence to the EPA that the proposed approach would be as effective as traditional point source controls and provide reassurance that no other more traditional option was suitable.

Prior to this project, GVW's EPA Licence for the Kilmore WMF only allowed for discharge to land. Discharge to water licence limits, informed by the ERAs, were agreed on with EPA prior to commencement of upgrade works. Once the EPA were satisfied that augmentation works at the WMF were completed and offsets implemented according to the Works Approval, a Licence amendment for the site was granted, allowing for ongoing discharge to creek under an offset's regime.

Wastewater Management Facility Augmentation

Wastewater Management Facility (WMF) augmentation works were implemented to reduce nutrient levels in the final recycled water, prior to any discharge to waterway. Upgrades included improved and additional aeration in treatment lagoons to assist ammonia reduction, and chemical dosing to reduce phosphorus load. In addition, eight vertical flow wetland cells were constructed post the winter storage, to further polish the recycled water, with UV disinfection prior to discharge to waterway.

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Landholder and Community Engagement

The success of this project relied widely on community and, more specifically, adjoining frontage landholders to engage and participate in the offsets project.

A total of 42 landholders in the offset zone along both Kilmore Creek and Kurkurac Creek were individually consulted, accounting for 70% of the total possible landholders. Meetings were held on site with landholders and a representative from both the GB CMA and GVW. The purpose of these meetings was to explain the project to the landholder and address any questions or concerns, as well as gauging interest levels in participating in the project, and assessing the works that may need to occur on each property. This allowed for more effective costings to be estimated for the project. This process was vital in understanding how the implementation of the project would need to be structured going forward.

Project Objective

1. The purpose of the Kilmore offset project was to both improve the condition of Kilmore and Kurkurac Creeks through riparian protection works.
2. To satisfy the offset requirements under the EPA works approval for GVW to provide a method for the management of Kilmore's recycled water.

Options Analysis

When considering our approach to the implementation of this project, three key areas were considered and investigated.

1. Would landholders participate in the project to a level that ensured reaching the required offset?
2. What would be the best process to ensure landholder participation in the project and how would this be delivered?
3. How could we secure the required catchment offset into the future?

Based on Landholder feedback during the consultation period, the likelihood of participation was subjectively assessed by GB CMA staff using a scoring system of 1-3 (1 = unlikely to participate, 2 = possibly will participate, 3 = likely to participate). Of those who were likely to participate, based on a 20m setback, an estimated 66.98 ha was estimated to be protected, reaching the 2025 target.

Several delivery options were proposed including:

1. Riparian cost share incentives program – this option would involve landholders to financially contribute to the riparian works program as well as commit to ongoing maintenance of the works.
2. Fully funded incentives program – all costs covered for required riparian works.
3. Market based instrument/Tender - landholders able to choose the activities and price that best suits them and enables the delivering agency to identify the best value for investment.
4. Fixed rate payment – along with fully funded works, an additional payment would be made to frontage managers for riparian area protected.

On the recommendation from GB CMA, GVW proceeded with the fully funded incentives program with a yearly allowance paid to landholders based on the hectares protected. This additional payment provides landholders with funds to do basic maintenance on the fence and site if needed and also provides a 'loss of opportunity' payment as this was flagged as a concern for many of the frontage managers.

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Catchment Modelling

Properties in the area are predominately used for mixed farming and grazing. Of particular interest were the properties greater than 5ha which accounted for 40 of the 61 properties in the target area, or 99% of the stream frontage.

The Water Quality Model used in this assessment was developed for Melbourne Water by Central Queensland University (RMCG 2015). This model was selected for Kilmore Creek because of its ability to test a series of specific actions at a property level.

In this application the model was used to estimate the amount of phosphorus that specific riparian works will intercept and therefore prevent from entering the waterway. After a review of the waterway and catchment condition using both aerial imagery and site visits, the actions identified included gully stabilization and rehabilitation, stock exclusion fencing (Ha) and riparian revegetation (Ha).

Variables for the modelling included rain, land use and soil properties as well as dimensions, slope, groundcover, and stocking rates.

For each defined set of work the amount of phosphorus intercepted by a set unit of that action was modelled using Melbourne Water's Water Quality Model (Table 1). The model estimated the average annual kilograms of phosphorus reduction intercepted by these works.

Table 1. Description of works and the modelled phosphorus reduction (RMCG 2015)

Type of Work	Description	Model Output: Phosphorus reduction (kg per annum)	Units of Work
Gully Rehabilitation	1 gully is 5m wide x 300 m long, and 2 m deep	30	Per gully (300 x 5 x 2 m)
Riparian Fencing for stock exclusion	Fencing riparian area excluding 2 head of cattle (or equiv.) per hectare	12.7	Per hectare
Riparian buffer revegetation	Change from pasture grasses to trees and medium density understorey	1.2	Per hectare

Like all models, there is a degree of uncertainty that what the model predicts will translate in practice. To deal with this potential uncertainty, a safety factor of 1.5 was allowed for, as proposed in the Water Quality Offsets Framework (GVW, 2016).

The amount of phosphorus required to be offset was a combination of predicted discharge quantity and quality as well as the allowance for the safety factor. Table 2 below, shows the 2025 target for the average amount of phosphorus to be offset.

Table 2. Average recycled water discharge volume

Year	Average Discharge Volume (ML/ann.)	Average recycled water Phosphorus Concentration (mg/L)	Safety Factor	Average Phosphorus load to be Offset
2025	315	2	1.5	945

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Implementation

Project Implementation

Incentives were available to private landholders with frontage within the project scope of the Kilmore Creek, Kurkurac Creek and their tributaries. Funding was available for targeted actions that would lead to the protection and management of riparian frontage and gully stabilisation.

The minimum standards for the approved activity were developed using the Goulburn Broken CMA River Health Implementation Guidelines (GB CMA, 2013), the DELWP Output Delivery Standards (DELWP, 2015) and internal workshops with a subgroup of the project steering committee.

Activities included:

1. Fencing
2. Revegetation
3. Weed Control
4. Alternative Water Points

Riparian fencing was required to be a minimum set back of an average 20m from top of bank and not narrower than 10m in any one place. This is based on the Victorian Waterway Management Strategy Policy 9.7 (DEPI 2013).

GVW provided financial support to landholders, fully funding the project fencing, revegetation and weed control required within the protected area. Landholders who required alternative water were provided with a capped monetary value dependent on the size of their protected area.

Project Outputs

A total of 9 landholders signed up for the project. Table 3 outlines the completed outputs achieved and their phosphorus load offset.

Table 3. Project outputs per activity achieved.

Activity	Output	Phosphorus load offset by activity (Kg/ann.)
Landholder Agreement	9	n/a
Fencing (km)	17.07	n/a
Area Protected (ha)	77.7	986.79
Revegetation (ha)	46.2	55.44
Alternative Water Points	9	n/a
Total Offset (Target = 945)		1,042.23

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Ongoing monitoring

Various forms of monitoring have been implemented to assess the overall effectiveness of the offsets. A summary of these is outlined in Table 4.

Table 4. Summary of the monitoring program to assess the effects of offsets.

ASSESSMENT CATEGORY	INDICATOR	LOCATION/AREA	FREQUENCY
Management Actions	Length of frontage fenced (km)	Measured at all offsets works sites	At the end of each reporting period
	Area of revegetation (ha)		
Stream and riparian conditions	Nutrients and turbidity	Physio-chemical water quality sites	2 Monthly
	Macroinvertebrate fauna	Biological monitoring sites	Annually
	Riparian Intervention Monitoring (RIM) indicators	At nominated intervention and control sites	Pre intervention works and again in 3 years

Management Actions

Implementation of the on-ground works component of the offsets project was scheduled over a three-year period. Year one was so successful that all targets were met in the first 12 months. Measures of all works, including length of frontage fenced, and area of revegetation have been recorded, and compared with the modelling, to inform that targets have been met or exceeded.

Riparian Intervention Monitoring

As a broad indicator of the effect of the offsets implemented on the various landholder sites across the catchment, GVW funded a Riparian Intervention Monitoring (RIM) Assessment of one of the nine sites participating in the project, combined with a control site. This assessment was conducted prior to completion of implementation works, following the documented set of methods (Morris et al. 2015) for assessing streamside zone condition and instream physical form. It is anticipated that future assessments will show a significant and positive change at the implementation site due to the establishment of the riparian offsets. Although not assessed, it can be assumed that similar results will be achieved at the other eight offsets sites.

Legal agreements and Annual site inspections

GB CMA assisted GVW to establish Riparian Offsets Management and Work Agreements with all nine participating landholders to ensure the ongoing integrity of the riparian offsets. Conditions include exclusion of stock, maintenance of stock proof fencing, and allowing access to GVW or their representatives to inspect the offsets works.

Site inspections are carried out annually, to assess condition of fencing, inspect for evidence of access by stock, necessity for weed control, and success of revegetation. These inspections enable GVW to assess the ongoing integrity of the offsets, while also maintaining the relationships with landholders that were so well established by the GB CMA.

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Water quality

Fifteen physio-chemical and biological monitoring sites have been identified (Figure 1) to assess for impact on the receiving waterways. These sites were originally established and monitored as part of the ERA process.

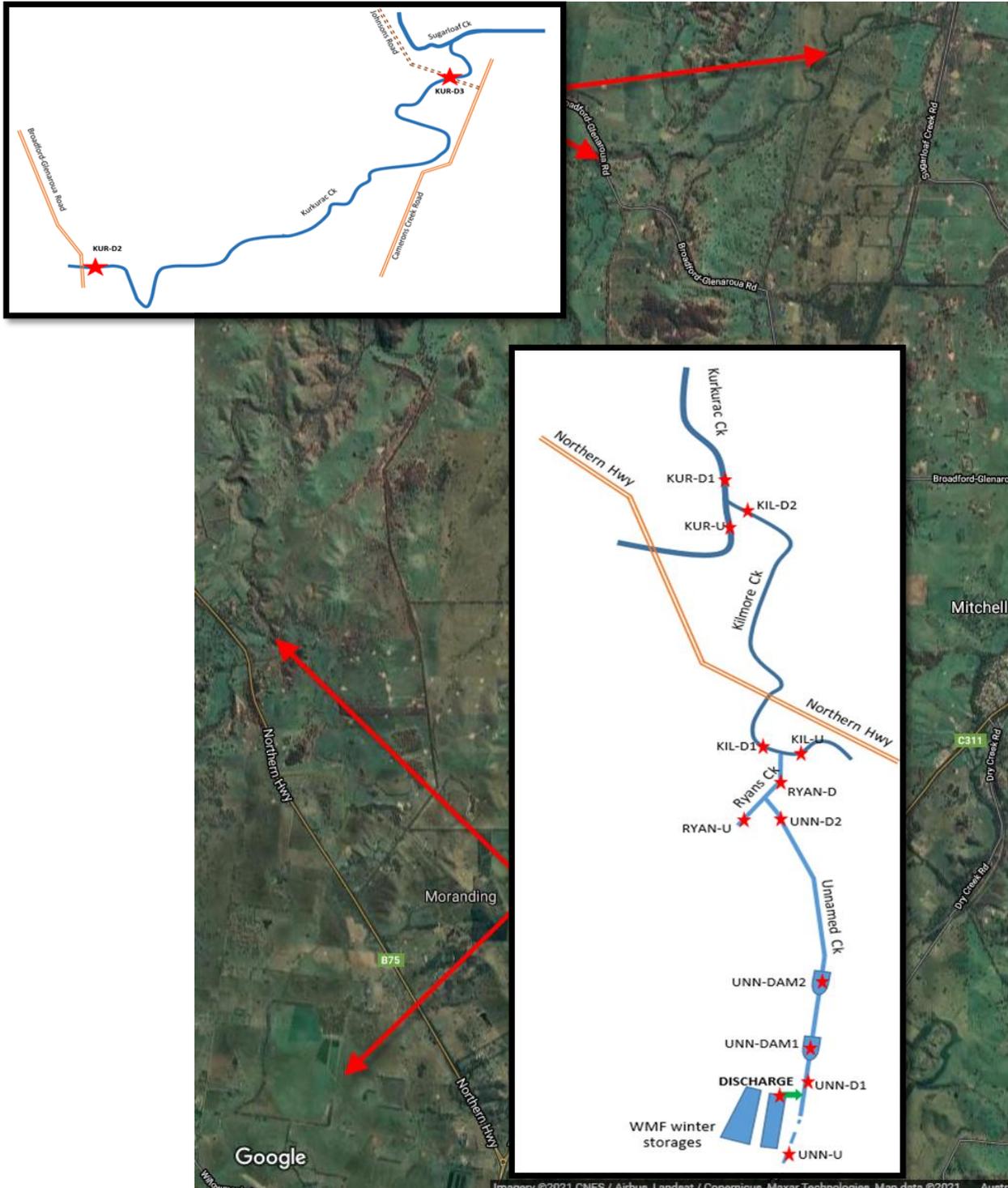


Figure 1:
Recommended sampling sites for the discharge from the Kilmore WMF

The water quality monitoring program includes both control and impact sites, and KIL-D2 marks the end of the EPA's defined mixing zone in the Kilmore Creek, immediately upstream from the confluence with the Kurkurac Creek. This site will assist to assess mixing zone compliance, as well as the impact of the offset sites

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located upstream. It will also inform potential to reduce the mixing zone over time. There has only been one short discharge under this amended EPA Licence to date. Once a sufficient data set is established, a review of water quality results is proposed, to assess performance of the mixing zone, and ensure minimal risk further downstream.

Drone footage

The opportunity for GVW to collect drone footage inhouse on an annual basis has allowed for collection of a visual record of change over time of the participating offsets properties. Three consecutive years of footage have been captured to record the establishment of the offsets, due to the staggered nature of the implementation. Footage will continue to be collected as required. The most recent footage can be seen at <https://youtu.be/Pqe1O1Tz70o>.

Conclusions

The success of this project was attributed to several reasons, the most prominent being that of the poor condition of the Kilmore Creek and its tributaries. These waterways were, for the most part, unfenced with minimal to no riparian vegetation. This allowed for a large scope of potential offset sites. On top of this, landholders were positive about the project and took the opportunity to undertake riparian protection works through the project. Should the area have consisted largely of already protected frontages, or of waterways with higher pre-existing water quality, an offset project such as this may not have been the most viable option.

Where feasible, these types of projects are hugely impactful. The innovation of managing the impact of rapidly growing townships by returning recycled water to stream in a controlled way whilst creating positive outcomes for the community and improved ecological values to a system in generally poor condition is to be commended.

A strong partnership and collaborative approach between GVW, GB CMA as well as support provided from the EPA, contributed to the success of this project. As regional specialists in establishing and implementing waterway health programs, GB CMA involvement provided the EPA with confidence in the effectiveness of the project (EPA 2018).

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