Catchment carbon offsets to build climate resilience in catchments and help the water sector achieve net zero emissions

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Key Points

- Victoria's Water Corporations have ambitious targets for greenhouse gas emissions reductions, some of which may be achieved through self-generated or collaborative projects with Catchment Management Authorities.
- The catchment carbon offset trial was undertaken to identify opportunities for Victoria's water sector to undertake multi-benefit offset projects which complement Government climate change, water and natural resource management policies.
- A case study undertaken as part of the catchment carbon offset trail demonstrated an effective framework for designing and evaluating carbon offset projects that would also build landscape climate resilience and provide complementary environmental and socio-economic benefits.

Abstract

The Catchment Carbon Offsets Trial (CCOT) sought to complement Victorian government policies and strategies relating to climate change, water, catchment management and biodiversity by demonstrating how projects may deliver emissions reductions, climate resilience and improve catchment management outcomes. It was intended to enhance understanding of carbon offset opportunities and help align water sector emissions abatement activities with regional natural resource management (NRM) plans and strategies. A case study in the Gellibrand River catchment of south-western Victoria demonstrated that catchment carbon offsets may be an appropriate and cost-effective means of generating carbon offsets while simultaneously providing multiple environmental and social benefits. It provided a replicable process for designing and evaluating catchment carbon offset projects.

Keywords

Carbon offsets, climate resilience, river health, water quality, net zero emissions.

Introduction

Water for Victoria, Victoria's Water Plan (DELWP, 2017) highlighted that the water sector contributed around 25% of the greenhouse gas emissions for which the Victorian state government is responsible. To help achieve the State's target of net zero emissions (NZE) by 2050, all sectors of government activity with significant emissions are required to commit to actions that will reduce net emissions to zero within an agreed timeframe.

This is a challenge to which Victoria's Water Corporations have responded enthusiastically. They are developing a range of measures to access or generate renewable energy, as well as reduce energy usage and associated emissions. However, Water Corporations operating waste water treatment plants face significant challenges in eliminating fugitive emissions from those plants and are considering the use of offsets to help achieve their emissions reduction targets.

Water for Victoria identified opportunities to progress the State's NZE target through local, collaborative projects between Water Corporations and Catchment Management Authorities (CMAs). These "catchment carbon offsets" projects would provide emissions abatement, complementary environmental and climate resilience benefits and help to implement the CMAs' Climate change and natural resource management plans. Water Corporations' Statement of Obligations for Emissions Reduction (Neville, 2018) restrict the use of offsets to those which are self-generated or created with a CMA and satisfy the National Carbon Offset Standard (NCOS).

The Catchment Carbon Offsets Trial (CCOT) sought to complement Victorian government policies and strategies relating to climate change, water, catchment management and biodiversity by demonstrating how projects may deliver emissions reductions, climate resilience and improve catchment management outcomes. The project was intended to enhance understanding of carbon offset opportunities and help align water sector emissions abatement activities with regional natural resource management (NRM) plans and strategies, particularly those seeking to build climate resilience in landscapes. The project was strongly collaborative among the Victorian water sector, which comprises CMAs, Water Corporations and the Department of Environment, Land, Water and Planning (DELWP).

Catchment carbon offset concepts

The catchment carbon offset (CCO) concept was framed around the idea of projects being designed to retain and increase carbon stocks in the landscape while simultaneously providing environmental and social benefits which are consistent regional NRM planning frameworks, programs and targets.

A CCOT workshop with water sector stakeholders (Jacobs, 2018) developed the CCO concept to include these additional key features or principles:

- Offset projects result in permanent, real and additional reductions in atmospheric CO_2 which are credibly quantified and independently verified;
- The sequestered carbon is resilient with climate change and "protected" from ownership and policy changes;
- Non-carbon benefits are visible, certain and clearly defined;
- Offset projects build or result from stable, long-term relationships within the water sector and with local communities;
- Offset projects are typically local to CMAs and Water Corporations.

Two alternative "models" of CCO were defined: certified and flexible. *Certified* offsets satisfy the key features of CCOs (as above) and would be formally certified (or at least be eligible for certification) under the Australian NCOS (as required by Water Corporations' Statement of Obligations for Emissions Reduction). *Flexible* offsets share the same essential features of CCOs, are credibly measured, but they are not independently verified and credited. They result in emissions reductions which are evident in state and national greenhouse gas accounts, but are not formally credited and may not contribute to progress towards Water Corporations' emissions reduction committments.

It was anticipated that CCO projects would generally aim to provide certified offsets, as these would be the most attractive to Water Corporations seeking progress towards their NZE targets. However, the Catchment CCOT consistently considered the role, if any, of flexible offsets in CCO projects.

CCO "options" are the various methods by which carbon offsets – with the key features of CCOs (as above) - may be generated. These options could potentially generate one or more of three main forms of carbon offset:

- *Green carbon:* carbon sequestered by and/or retained in woody perennial vegetation and soils in forests, woodlands or plantations;
- *Blue carbon:* carbon retained in aquatic or marine soils, vegetation or other structures (e.g. coral reefs);
- *Brown carbon:* carbon sequestered by plants and stored in agricultural soils.

While brown carbon projects may provide some environmental benefits which are consistent with the CCO concept (e.g. improved soil health, climate resilience), their alignment with the full suite of features was not considered to be sufficient for them to qualify as CCOs. Blue carbon projects potentially align strongly with the CCO concept and are of considerable interest to some CMAs and Water Corporations. However, methods for formal offset crediting are mostly lacking, as are frameworks for property rights. For this reason, only green carbon options are currently under consideration as catchment carbon offsets.

Catchment carbon offset case study

Overview

A key feature of the CCOT was a "virtual" case study to explore how:

- CCO projects might be designed to deliver emissions reductions, climate resilience in landscapes, improved catchment health and better alignment between regional NRM plans and water sector emissions abatement; and

- These co-benefits could be evaluated.

The case study was selected following a call for expressions of interest from Victorian CMAs and Water Corporations. Six expressions of interest were received, with the one from Wannon Water - in conjunction with Corangamite CMA, Glenelg Hopkins CMA and Federation University's Centre for eResearch and Digital Innovation (CeRDI) – being selected.

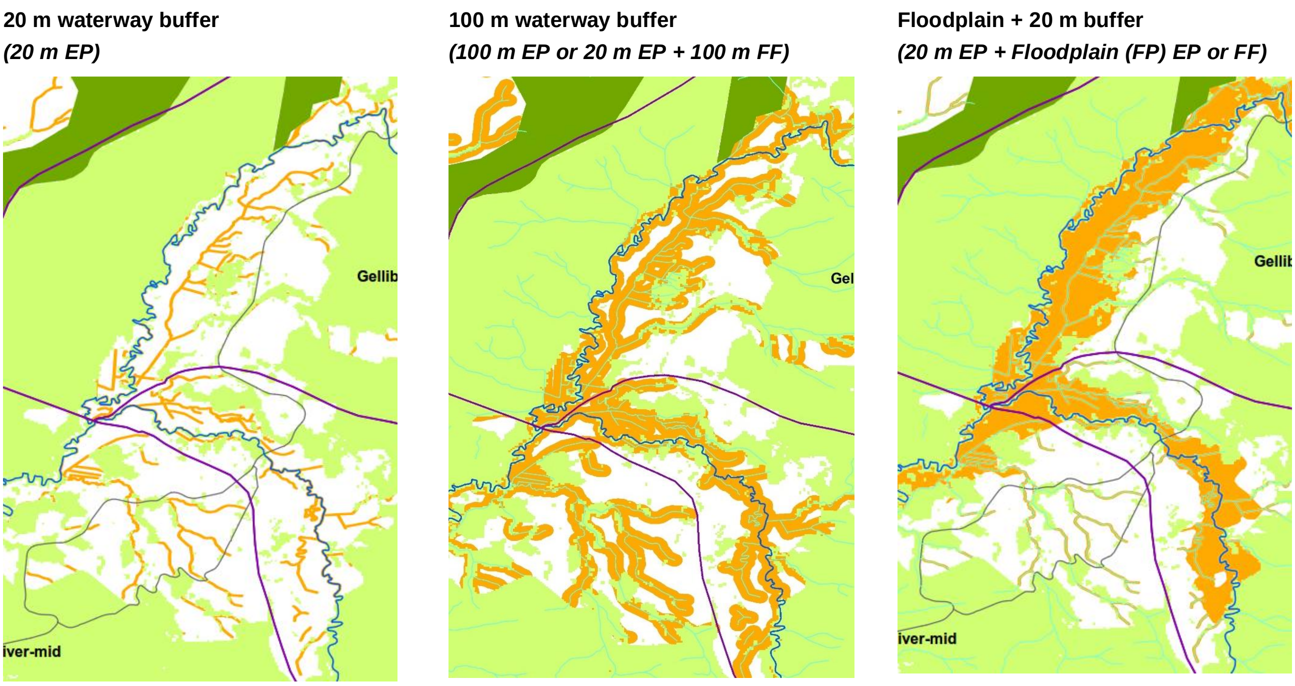
Case study design

The case study was designed to generate certified carbon offsets to at least satisfy Wannon Water's expected annual requirements (~7,000 t CO_2-e/y), while improving water quality and river health in the catchment above Wannon Water's Otway South water offtake on the Gellibrand River, in south-west Victoria. Wannon Water's two water offtakes in the Gellibrand catchment are the main sources of drinking water for Warrnambool and several other nearby towns.

The main causes and drivers of poor water quality in the Gellibrand catchment were considered to be: uncontrolled access of livestock to waterways; in-stream erosion; and unmanaged entry of overland flows carrying excess nutrients from fertilisers, urine, manure and dairy effluent systems. Five main vegetation configurations (illustrated in Figure 1) were developed to address these factors, generate carbon offsets and provide other environmental and socio-economic co-benefits:

- *20 m waterway buffer:* 20 m riparian buffers along both sides of all defined waterways. These would be established using locally indigenous native species (or environmental plantings; EP). This configuration is considered to provide the minimum width of revegetated buffer to materially improve water quality in catchment and provide the complementary environmental and socio-economic benefits being sought.
- *100 m waterway buffer:* 100 m revegetated buffer along both sides of all defined waterways. The first 20 m of the buffer zone would be planted to locally indigenous native species, with the remainder of the area established using similar EPs or farm forestry (FF) plantings. The 100 m revegetated buffer was considered to represent the plausible upper limit of revegetation in the catchment.
- *Floodplain + 20 m buffer:* which would comprise a 20 m EP revegetated buffer along sides of all defined waterways, with further areas of EP or FF planting occupying all remaining areas of floodplain for a 1% annual exceedance probability (AEP) flood event.

Farm forestry plantings were assumed to be of Blue Gums (*Eucalyptus globulus*) for carbon accounting purposes and would be harvested at 15 year intervals and then replanted. According to the design, environmental plantings would remain unharvested and in place “permanently" (i.e. for at least 100 years).



Note: Brown lines and areas mark the extent of revegetation under each of the configurations. The location of the waterway is shown for the 100 m waterway buffer and floodplain+20 m buffer configurations. The illustration shows the Gellibrand River floodplain at the junction between the Gellibrand and Carlisle Rivers and does not differentiate between environmental and farm forestry plantings in the 100 m and floodplain + 20 buffer configurations.

Figure 1. Catchment carbon offset case study design options

In evaluating potential outcomes, the case study considered these CCO designs and two alternatives:

- *Base case:* a “do nothing” option in which no new action would be taken to manage source water quality upstream of the Otway South offtake or to improve river health. Under this option, existing water treatment infrastructure would be used to satisfy health-based water quality targets. While this is a “base case” for evaluation purposes, because of the water quality risks, it is unlikely to be a realistic option for Wannon Water.

- *Engineered water quality treatment:* in this option, rather than treat the catchment source of water, ultra-violet (UV) treatment would be introduced at each of the five plants treating water from the Gellibrand River. This will allow Wannon Water's drinking water supplies to meet evolving health-based water quality targets and to treat growing levels of *Cryptosporidium* and *Giardia* in the source water – without treating the catchment.

Significant areas of native vegetation have been retained in the case study area (50,000 ha of native vegetation within the 66,400 ha case study catchment). This limits the area available (or required) for new plantings to address water quality and river health issues. The total area of new plantings (EP and/or FF) under the main revegetation configurations ranged between 720 ha for the 20 m waterway buffer option and 3,400 ha for the 100 m waterway buffer option. These represent 9% and 42% of agricultural land in the study area, respectively.

Evaluation of potential case study legacies

One intent of the case study was to test approaches to evaluating the various potential legacies of CCO projects. A scorecard (Table 1) was developed to represent the results of evaluations of each form of potential project legacy. The scorecard included the five CCO options, "do nothing" base case and engineered water quality treatment option. Descriptions of some of the key legacies and learnings from the evaluation are given below.

Emissions reduction legacies

New plantings, even those with harvested farm forestry plantings, have potential to sequester carbon and generate certifiable offsets for some of Wannon Water's greenhouse gas emissions. Certifiable carbon offsets were estimated for each of the CCO configurations using FullCAM, the Australian Government's carbon accounting model. The average annual carbon sequestration ranged between 7,800 t CO_2-e for the 20 m waterway buffer to 40,000 t CO_2-e for the unharvested 100 m waterway buffer (Table 1). While carbon sequestration rates for the farm forestry plantings were high, the overall level of sequestration was significantly reduced by harvesting at 15 year intervals. The modelling suggested that all of the CCO options could generate sufficient certifiable carbon offsets to meet Wannon Water's needs.

Emissions associated with new UV water treatment plants were also estimated from projected energy use. Non-certifiable or flexible offsets resulting from reduced agricultural emissions were estimated using data from Agriculture Victoria (2017) to be as much as 20,000 t CO_2-e/y for 100 m waterway buffer EP and FF options.

Financial legacies

The case study's potential financial legacy was assessed by considering all the costs and benefits that could be denominated in dollars. Costs included those from establishing and running the different CCO project options and the engineered water treatment plant alternative. They also included the value of foregone dairy production where the CCO option displaced agriculture[1]. Revenue or benefit sources included the value of carbon credits generated (based on a price of $11/ t CO_2-e), as well the sale of timber produced by farm forestry plantings. Any savings in water treatment costs resulting from improvement in source water quality as a result of the CCO options were also estimated (Table 1).

[1] Local anecdotal evidence suggests waterway buffers wider than about 20 m lead to reduced net dairy production value.

Costs and revenues over a 50 year project were all discounted (using 7% discount rate) and the net present value (NPV) calculated. A "break-even" carbon price was also calculated (the carbon price required for zero NPV for each option). The overall costs and benefits were also divided into normal project costs (i.e. the costs associated with establishment and running of any environmental planting or farm forestry project of this type) and the costs and benefits specifically associated with running the project as a carbon offset (Table 2).

Table 1. Catchment carbon offset case study score card

Effect	Base case	Waterway buffers				Floodplain + 20 m	
		Eng WQ treatment	20 m EP	100 m EP	20 m EP + 80 m FF	All EP	20 m EP + FF
Certifiable carbon offsets							
Average sequestration (t CO_2-e/y)	0	0	7,800	40,000	35,000	17,000	16,000
Financial appraisal							
Net present value ($)	0	-$8.3M	-$4.4M	-$72M	-$43M	-$32M	-$25M
Environmental legacies							
Non-certifiable emissions reductions (t CO_2-e/y)	0	-460	0	20,000	21,000	8,900	9,100
% Treatment of causes of water quality impairment	Negative	Negative	56%	90%	85%	80%	80%
Change in % length of waterway with connected vegetation	Negative	Negative	13%	13%	13%	13%	13%
Additional area of connected terrestrial vegetation (ha)	0	0	356	391	391	356	356
Change in river flow regime (% mean annual flow)	0	0	-0.4%	-1.7%	-2.7%	-0.8%	-1.1%
Other socio-economic legacies[1]							
Waterway cultural values[2]	-1	-1	1	1	1	1	1
Waterway social values	-1	-1	3	2	1	2	1
Bushfire risk	0	0	0	0	-1	0	-1
Community partnerships	0	0	3	3	2	3	2
Confidence in level of implementation	0	4	3	1	2	1	2

Notes:

1. Socio-economic criteria were assessed on a scale ranging from -4 (very much worse than current base case) – 0 (current base case conditions) -+4 (very much better than current base case).
2. The cultural values assessment is preliminary only and based on the kinds of features which characteristically have higher cultural value. A full assessment should be undertaken with Traditional Owner representatives to determine any changes in cultural values with a CCO project.

Apart from the untenable "do nothing" option, all options had a negative net present value. The most favourable option financially was the 20 m waterway buffer option. The strongly negative values of the farm forestry options reflect the relatively low value of the pulpwood they were assumed to produce compared with dairying. The break-even carbon price (per t CO_2-e; Table 2) varied between $51 (20 m waterway buffer) and $146 (floodplain + 20 m, all EP).

Operating the projects as carbon offset projects rather than conventional environmental planting or farm forestry projects (without carbon revenue) generated additional value (in NPV terms) of between $1.0M and $5.7M (20 m and 100 m EP waterway buffer configurations; Table 2). This reflects the difference between the value of certified carbon offsets (at $11 t CO_2e) that could be generated and the estimated cost of participation in carbon markets over the 50 year life of project.

Table 2. Catchment carbon offset case study – other financial legacies

Effect	Base case	Waterway buffers Eng WQ treatment	20 m EP	100 m EP	20 m EP + 80 m FF	Floodplain + 20 m All EP	20 m EP + FF
Break-even carbon price ($/t CO_2e)	n/a	n/a	$51	$140	$97	$146	$122
NPV generated by operation as a carbon offset project ($)	0	0	$1.0 M	$5.7M	$5.0M	$2.2M	$2.1M

Water and river health

The CCO plantings were designed to address the main causes of water quality issues in the catchment. Livestock would be excluded from waterways and riparian revegetation would help to reduce in-stream erosion and filter overland flows before entry into waterways. Floodplain and 100 m riparian plantings would also displace livestock and dairy effluent systems and reduce the entry of nutrients from these and other agricultural sources. If fully implemented, the planting designs were estimated to be capable of treating between about 50 and 90% of the overall causes of water quality impairment within the case study catchment (Table 1).

All planting configurations would also increase the length of connected native vegetation along waterways within the (largely forested) catchment by 13% (Table 1). Improvements in river health resulting from higher water quality and greater riparian vegetation connectivity may be somewhat offset by reduced catchment water flows due to interception by vegetation (e.g. Clifton *et al.*, 2006). These were estimated to range between 0.4% (20 m waterway buffer) and 2.7% (100 mm waterway buffer with FF) of mean annual flow (~8000 ML/y for the latter).

Cultural and social values were assessed qualitatively and were thought to improve with each of the CCO options, particularly those without farm forestry (Table 1).

Biodiversity

The CCO plantings would enhance vegetation connectivity along waterways and improve aquatic, riparian and terrestrial habitat. The area of reconnected remnant native vegetation with the CCO project was estimated to range between 356 ha and 391 ha (Table 1). Improved habitat connectivity, may help to protect populations of threatened aquatic and terrestrial species (e.g. River Blackfish *Gadopsis mamoratus*, Yellow-bellied Glider *Petaurus australis*) and improve environmental conditions within the estuary of the Gellibrand River.

Climate resilience

The CCO options would help to build climate resilience in the case study landscape through improvements in water quality and vegetation connectivity along waterways and across cleared agricultural landscapes. This was not formally reflected in the scorecard (Table 1) to avoid double counting of benefits.

Other socio-economic values

The CCO plantings would likely have both positive and negative socio-economic legacies. The 100 m waterway buffer configuration would, if fully implemented, occupy about 40% of the remaining agricultural land in the Gellibrand catchment (upstream of the Otway South offtake). As this option would displace agricultural land use, it may also lead to the loss of farming families and a decline in social values associated with the local community. This social cost may be at least partly offset by the benefits from community partnerships between Corangamite CMA, Wannon Water and local landholders to implement the project.

Riparian revegetation should also improve social and recreational values associated with the Gellibrand River, its tributaries and estuary. It should also help to protect or enhance Indigenous cultural values (Table 1). Increasing vegetation cover in the catchment may increase bushfire risk to residents, land uses, water quality and natural environments. However, given that the case study area currently has a high level of native vegetation cover, the change in bushfire risk was assessed to be negligible for most options (Table 1).

Conclusions

The Catchment Carbon Offset Trial developed and piloted (in the case study) an effective framework by which Water Corporations and CMAs can collaborate in generating carbon offsets that also build landscape climate resilience and provide complementary environmental and socio-economic benefits. The case study found that a project which could be practicably implemented was capable of satisfying a Water Corporation's offset requirements and provide catchment-scale environmental benefits. Running the project as a catchment carbon offset project rather than a conventional catchment management project (i.e. without generating certifiable carbon) would reduce the present cost of establishment and operation by at least $1.0 million over 50 years.

The Catchment Carbon Offsets trial and case study has created a valuable legacy, which is considered to include:

- Establishing that CCO projects can be an appropriate means of generating carbon offsets, while simultaneously providing various complementary environmental and social benefits and implementing State government policies for climate change, water and natural resource management;
- Creating a vocabulary and conceptual framework for considering multi-benefit carbon offsets;
- Development of a replicable process for designing and evaluating CCO projects, as well as supporting information and tools.

Acknowledgments

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