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Water Sensitive Cities Australia

Baranduda Fields Stormwater Harvesting: Rapid BCA

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Introduction

The Department of Environment, Land, Water and Planning (DELWP) manages regional Integrated Water Management (IWM) forums which allow stakeholders to collaborate in planning and managing the water cycle in their areas. Fifteen IWM forums operate across Victoria, with 10 forums servicing regional Victoria. DELWP and stakeholders from the regional forums have identified a practitioner knowledge gap in identifying the benefit of IWM in regional/rural Victoria.

To address this issue, DELWP commissioned Water Sensitive Cities Australia (WSCA) to deliver the *Economic evaluation in regional Victoria* project. The project aims to foster understanding of the benefits of implementing IWM in small towns, while supporting regional stakeholders by improving capacity to undertake economic evaluation and deliver business cases. From a stakeholder perspective, the project will demonstrate 'how better business cases help you to secure project funding' – a value proposition for agencies and communities.

This document presents a worked example of conducting a rapid Benefit Cost Analysis (BCA) of an IWM project in regional Victoria. We applied the Investment Framework For Economics of Water Sensitive cities (INFFEWS) tools developed by the Cooperative Research Centre for Water Sensitive Cities (CRCWSC).

The case study is based on the Baranduda Fields Stormwater Harvesting by Wodonga Council. It describes the rapid economic assessment (BCA) of the project. It aims to show practitioners how the BCA process can be used effectively to support IWM in the regions. However, this case study was undertaken independently of DELWP's IWM grant process, and the economic evaluation results will have no bearing on grant allocations.

Case study area

This section provides a general overview of the area and the project.

General socio-economic profile of the area

Wodonga (postal code: POA 3690) is located on the NSW border in north east Victoria. (Figure 1). It lies wholly within the boundaries of the City of Wodonga LGA and is separated from its twin city in New South Wales, Albury, by the Murray River.

Figure 1. Location of Wodonga
Source: https://www.alburywodongaaustralia.com.au/info/location-and-maps/.

Wodonga has a population of 35,051 – 16,971 males and 18,083 females (ABS 2021 census). As shown in Figure 2, its population is evenly distributed over gender by age groups. Around 34% of Wodonga's residents have completed year 12 or equivalent level of education (Table 1). The median age is 39 years. Median personal income is $758 per week (in 2021), only slightly lower than Victoria's median income and up 18% from 2016. Monthly mortgage and rent payments are also lower than the state median level. The proportion of people in higher household income groups increased in 2021 when compared with 2016 (Figure 3).

Table 1. Socio-economic and demographic data for Wodonga according to the 2016 and 2021 census

	Wodonga (2016)	Wodonga (2021)	Victoria (2021)	% change (2016-2021)
Total persons	33,518	35,051	6,503,491	5
Age groups:				
0-4 years	2,359	2,087	375,900	
5-14 years	4,431	4,635	793,556	
15-19 years	2,220	2,218	363,201	
20-24 years	2,184	2,024	410,337	
25-34 years	4,591	4,620	975,493	
35-44 years	4,069	4,291	918,738	
45-54 years	4,337	4,323	826,885	
55-64 years	4,092	4,301	746,547	
65-74 years	3,048	3,872	605,557	
75-84 years	1,569	2,025	344,801	
85 years and over	610	666	142,475	
Highest year of school completed:				
Year 12 or equivalent	10,247	12,020	3,171,913	
Year 11 or equivalent	4,042	4,390	583,433	
Year 10 or equivalent	6,314	6,461	656,988	
Year 9 or equivalent	2,183	2,083	283,874	
Year 8 or below	1,480	1,394	248,202	
Did not go to school	163	203	67,416	
Median values:				
Median age of persons	37	39	38	5
Median total personal income ($/weekly)	644	758	803	18
Median total family income ($/weekly)	1,481	1,829	2,136	23
Median total household income ($/weekly)	1,206	1,400	1,759	16
Median mortgage repayment ($/monthly)	1,387	1,385	1,859	0
Median rent ($/weekly)	250	285	370	14
Average number of persons per bedroom	0.8	0.7	0.8	-13
Average household size	2.4	2.4	2.5	0

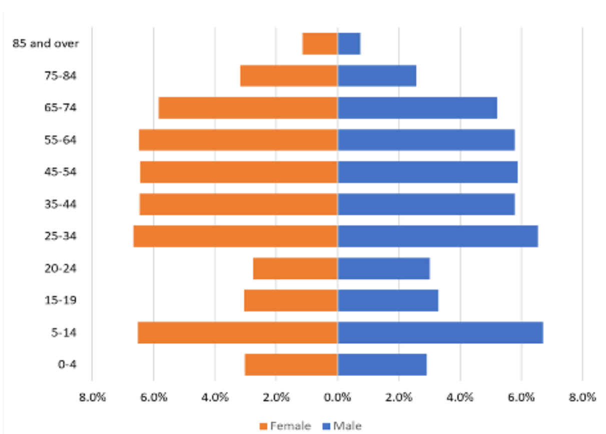

Figure 2. Wodonga population by age groups and gender

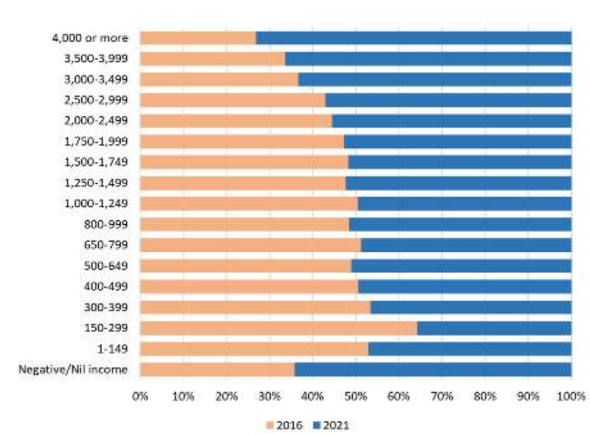

Figure 3. Total Household Income in 2016 and 2021 (AUD)

Source: ABS (2021) (https://www.abs.gov.au/census/find-census-data/quickstats/2021/POA3690).

Baranduda Fields Masterplan project

The proposed Baranduda Fields project is a major regional sporting complex planned for the Baranduda-Leneva Valley (Figure 4). It has high regional significance and could become a destination that offers unique and inclusive spaces for various social interactions and recreation activities. Using sustainable and innovative approaches could link the community to the environmental value which exists at Baranduda Fields (Spiire, 2020).

Figure 4. Baranduda-Leneva area
Source: City of Wodonga (https://www.wodonga.vic.gov.au/Our-Major-Projects/Baranduda-Fields-Sporting-Complex).

The land, owned by Wodonga Council, covers 100 hectares and is bounded by Middle Creek (north-west), Baranduda Boulevard (south-west), Kiewa Valley Highway (north-east) and Boyes Road (south-east) (Figure 5),

The project aims to provide water resource resilience and ensure public spaces are appropriately managed despite adverse climate conditions.

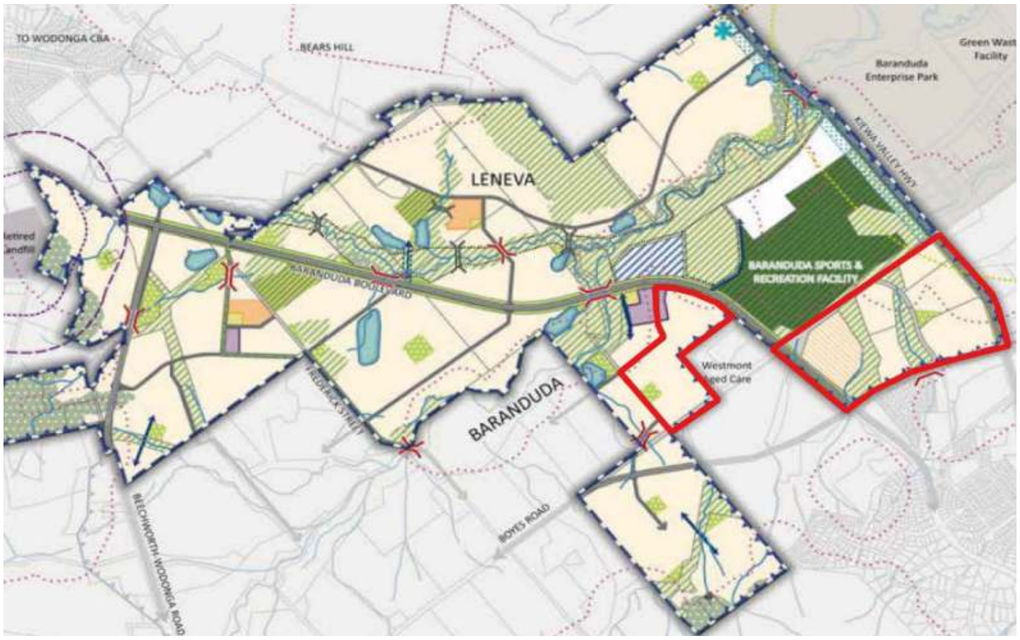

Figure 5. Baranduda project site
Source: Spiire (2020).

Previously, 4 integrated water opportunities options to reduce reliance on drinking water for irrigation of the sports fields were identified (Spiire, 2020), with:

- Option 1: Recycled water
- Option 2: Rainwater harvesting
- Option 3: Stormwater harvesting
- Option 4: Bioretention swales.

As suggested by the Council, this study examines options 3 and 4.

Option 3: Stormwater Harvesting

Stormwater harvesting provides an alternative water source, particularly for large outdoor uses (such as irrigating sports fields and parks) and other uses that do not require drinking quality water (e.g., toilet flushing).

Stormwater harvesting could be used for irrigation within the reserve, provided it received additional water treatment, including media filters with coagulation, UV treatment and restricted access during irrigation (Spiire, 2020). MUSIC modelling determined the potential water supply from stormwater reuse and size the stormwater harvesting storage required (Spiire, 2020).

As well as providing an alternative water source, effective stormwater management can reduce the detrimental impacts that urban developments can have on waterways (Figure 6).

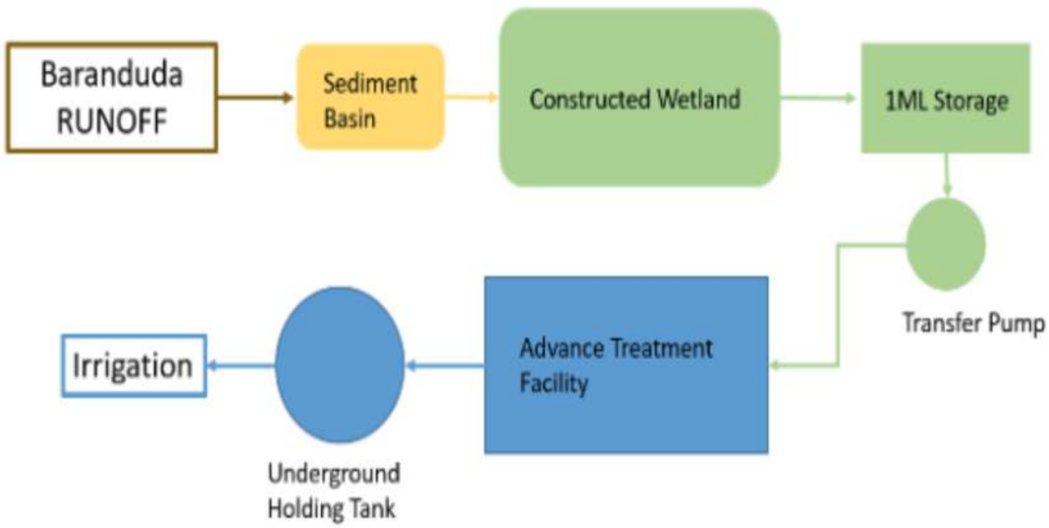

Figure 6. Stormwater harvesting process
Source: Spiire (2020).

Option 4: Bioretention swales

Bioretention swales within the site's car parks can capture and treat stormwater runoff, by removing gross pollutants such as sediment and nutrients (Table 2). These assets also passively irrigation trees and vegetation within the car park and garden beds.

MUSIC modelling estimated the treatment provided by the bioretention swales, based on the following assumptions:

- bioretention swales accounted for 0.2% of the total catchment area (120m^2)
- the total catchment area is the car park area within Baranduda Fields (6ha)
- 100% of the car park drains to the bioretention swales (Spiire, 2020).

Table 2. Water quality treatment results for bioretention swales

Pollutant	Original load	Residual load	% reduction
Total suspended solids (kg/yr)	5,730	1,320	77%
Total phosphorous (kg/yr)	11.3	5.4	52%
Total nitrogen (kg/yr)	81.3	56	31%
Gross pollutants (kg/yr)	997	0	100%

Council requested the BCA after an initial concept design for the scheme was completed, to help decide whether it was worth proceeding to detailed design investigations. The concept investigation tested the scheme's feasibility and developed preliminary cost estimates and performance metrics of creating alternative water sources and protecting the downstream waterways via stormwater harvesting scheme and bioretention swales (Figure 7).

The project could also generate significant benefits for the environment and local community:

- harnessing stormwater as an alternative resource to support long term sustainability of water resources
- reusing stormwater to offset potable water use
- removing pollutants from stormwater
- increasing vegetation via bioretention swales
- creating opportunities for water education

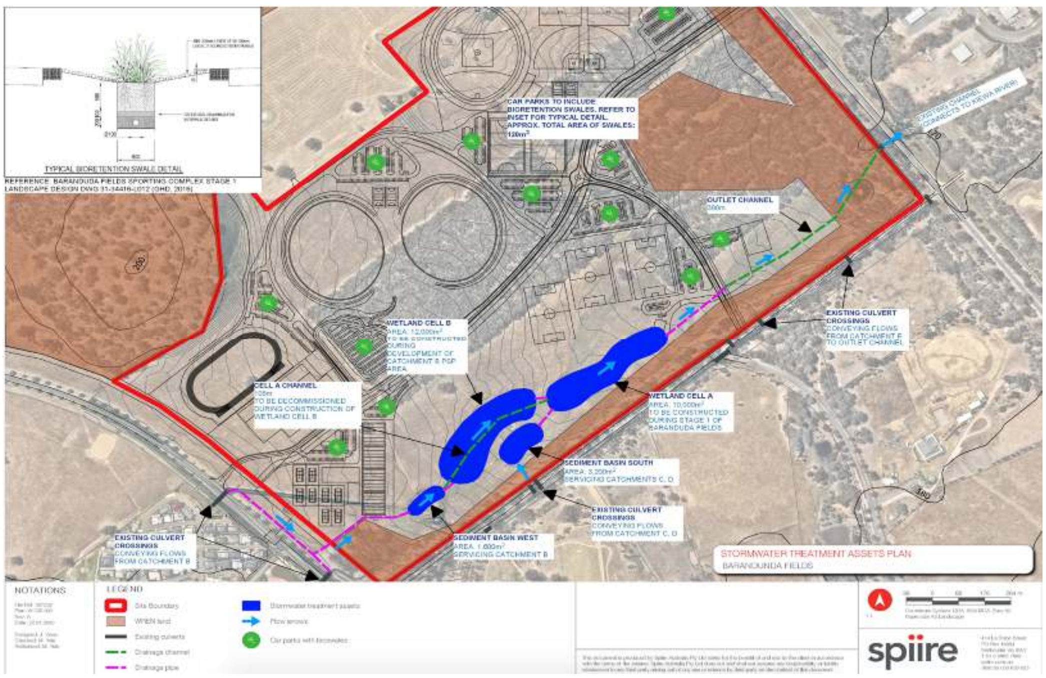

Figure 7. Stormwater treatment asset plan, Baranduda fields
Source: Spiire (2020).

The BCA was used to evaluate the business case as a whole, and to present a clear case for council to consider whether further investment is worthwhile. We used the INFFEWS tools to rapidly evaluate benefits and conduct the BCA.

Methodology

The project uses the INFFEWS framework – an economic evaluation framework that identifies and quantifies economic, environmental and community values of investments in water sensitive practices and systems.

The BCA evaluates, compares and ranks projects, by estimating the Net Present Value (NPV) and Benefit: Cost Ratio (BCR) for each project. The BCA process involves:

- clearly defining the project scenario
- identifying the activities required to deliver the project, and the impacts of these activities
- identifying and quantifying relevant benefits stemming from these activities
- attributing costs and benefits to different stakeholders e.g. council, relevant private individual and businesses, other partner organisations (Figure 8).

The calculations should also consider the risks of project failure.

Results (NPV and BCR) are calculated globally (for all identified stakeholders) and for the project organisation alone.

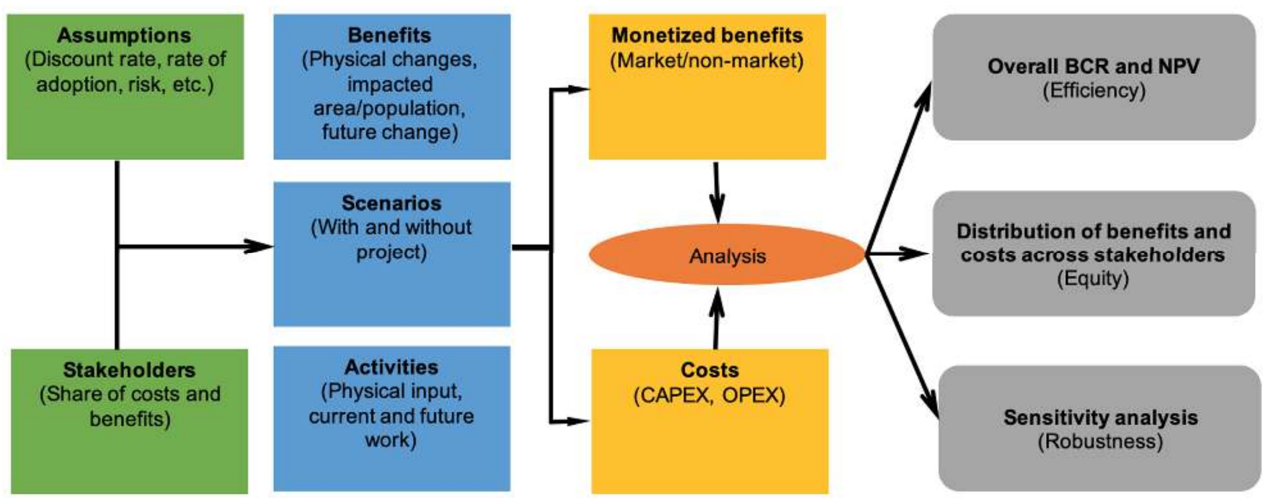

Figure 8. Key elements of the BCA framework (adapted from Iftekhar and Pannell, 2022)

We implemented the framework by following these steps:

Step 1: Conducted a benefit assessment based on the high-level project description using inputs from the council, existing literature and other stakeholders as practically feasible.

Step 2: Conducted the preliminary BCA and shared the results with key stakeholders

Step 3: Revised assumptions, if necessary, based on stakeholder feedback.

Stakeholder consultations

A number of stakeholder meetings were carried out to define the scope the analysis; such as gathering team ideas, technical details, and, research activities.

	Items discussed
Workshop 1 Date: September 28, 2022 Method: Online Participants: 3 Council 2 University 1 WSCA	• Discussing views on potential benefits from the project • Identifying potential beneficiaries • Understanding opportunities and limitations • Identifying variables in the modelling tool • Understanding the structure, source of data needed for the analysis
Workshop 2 Date: November 10, 2022 Method: Online Participants: 1 Council 2 University 1 WSCA	• Discussing views on potential benefits from the project • Understanding opportunities and limitations • Identifying variables in the modelling tool • Understanding prior literature on similar studies • Understanding the structure, source of data needed for the analysis
Workshop 3 Date: November 16, 2022 Method: Online Participants: 2 Council 2 University 1 WSCA	• Clarifying assumptions, benchmarks used in benefit identification • Discussing parameter, calculations used in quantifying the physical benefit • Discussing parameter, calculations used in monetising the benefits • Justifying the underlying assumptions used in quantification and monetisation of benefits using prior research

Data collection

We collected information via the following steps:

- Analysis of council documents: We collected and reviewed relevant documents from the council[1]:
  - 20023 MP 10 BF Master Plan Revised Road Option D – Staging REV02
  - Baranduda Fields Reclaimed Water Irrigation Functional Design Report Final – GHD
  - Baranduda Fields IWM Presentation
  - Baranduda Fields Master Plan_Dec18
  - Leneva-Baranduda WOWMP
  - Oct_2022_Baranduda Fields Stage 1 Business and Economic brochure 2019
  - Baranduda fields integrated water management strategy catchment analysis and options assessment January 2020 (Spiire, 2020),
- Validation of the assumptions: We validated the assumptions with industry experts and council representatives.

[1] For an in-house analysis this step could be omitted assuming that all relevant information is available.

Parameterisation of the analysis

We carried out the following steps to complete the analysis

- Define with and without project scenarios
- Identify costs
- Identify benefits
- Identify other parameters

These steps are described below.

Define with and without project scenarios

The ‘without-project’ scenario is the baseline for analysis. We use the difference between the two scenarios to estimate the costs and benefits of implementing the project.

In the initial project discussions, stakeholders identified various benefits of alternative water sources, including drinking water savings, increased flexibility due to council management of the facility, removal of pollutants from stormwater, increased vegetation due to bioretention swales and education opportunities. We refined this list based on consultation with the council, literature review and expert feedback. Table 3 lists the final benefits.

Table 3. Framing the ‘with project’ and ‘without project’ scenarios

Benefit identified due to alternative water source	With project	Without project
Potable water savings due to stormwater harvesting scheme (option 3)	The proposed stormwater harvesting scheme will provide stormwater for most irrigation, in place of drinking water. Beneficiary: Council	There will not be any potable water saving without the stormwater harvesting scheme.
Improved flexibility for council from having more independent operations of the system	The decisions regarding alterative water sources (e.g., duration, infrastructure) are taken freely because council manages the facility (not a corporate entity). Beneficiary: Council	Limited flexibility and control of decisions about alternative water sources.
Pollution abatement benefits due to reduced stormwater discharge to Kiewa River (option 3 and 4)	Harvesting stormwater also removes pollutants, helping to support healthy ecosystems, increase water quality and improve amenity. Beneficiary: Broader community	The untreated stormwater will continue to affect ecosystems and water quality because stormwater pollutes waterways.
Pollution abatement benefits due to bioretention swales (option 4)	Bioretention swales treats stormwater runoff from carparks to protect the Kiewa River. Beneficiary: Broader community	The untreated stormwater will continue to affect ecosystems and water quality because stormwater pollutes waterways.
Water education benefits due to adopting alternative water sources (option 3 and 4)	Raising awareness about water reuse, enhanced community awareness and education of the water cycle will impact people’s perceptions about saving, recycling, and effective management of water. Beneficiary: Broader community	Current awareness regarding alternative water sources will not change.

Increased amenity due to vegetation (option 4)	Increased vegetation within the site through passive irrigation. Beneficiary: Local community	No additional irrigation
Water security (option 3)	Increased engagement on alternative water schemes will favourably affect people's perceptions about water security especially during drought seasons. Beneficiary: Local community	The current level of engagement will not change.

Stakeholders approved the 'with project' and 'without project' scenarios to ensure the BCA assumptions were transparent. We examined all costs and benefits over a 25-year analysis timeframe to provide a long-term view.

Identify costs

We estimated the capital costs of the stormwater harvesting scheme to be $1.6 million, and the capital costs of the bioretention swales to be $18,000 (based on Spiire, 2020). We used the consumer price index to convert these estimates to 2022 values.

Council helped estimate annual operating costs, which were assumed to be 5% of capital expenditure. Given the long (25-year) time horizon of the analysis, it was important to consider possible assets that would need to be renewed. For simplicity and given the high-level nature of the estimates available, these replacement costs were annualised and lumped with the assumed operating expenditure.

In this case, both capital and operating costs will fall to council.

Identify benefits

Identifying and valuing benefits involves 4 stages:

Stage 1: Identify the Categories of benefits when defining the with and without project.

Stage 2: Quantify the physical unit or changes in benefits due to the proposed project. Take care to include and calculate only the additional benefits generated by the project.

Stage 3: Convert the quantified benefits into dollars using appropriate market or non-market values. Take care not to double count benefits.

Stage 4: Identify the key stakeholder or beneficiary groups for each benefit type.

Table 4 lists the benefit items, and the input values and assumptions used to quantify and value them.

Table 4. Input values and assumptions used to quantify and monetize benefits

Benefit identified	Benefit description	Key beneficiary	Physical benefit	Basis for physical benefit	Monetary value	Basis for value
Potable water savings 	**Due to stormwater harvesting (option 3)** The stormwater harvesting scheme will provide stormwater for the majority of irrigation, in place of drinking water	Council	59.27 ML/year	Source: Spiire (2020) Assumptions: • The volume has been calculated based on total monetized value and the water price reported in Spiire (2020) • Assuming a constant benefit over the project period Calculation: $136,323/$2.3 per kL = 59. 271 kL/year	$2.5/kL	Source: North East water market value (2022)
Improved flexibility to the council 	**Due to more independent operation of the system**	Council	Not applicable	Cost savings benefits due to more efficient operation	$2,860/ year	Source: • Council spend approx. $65K per year on an individual oval or sports field and they would save roughly 5% on those costs (including reduced water consumption) under the council management model • There are 2 footballs AFL grounds (Council estimate) Assumptions: • 44% of the anticipated cost savings is due this project (assuming the share of capital costs of options 3 and 4) Calculation: $65,000*2*0.05*0.44 = $2,860 per year

Benefit identified	Benefit description	Key beneficiary	Physical benefit	Basis for physical benefit	Monetary value	Basis for value
Pollution abatement benefits due to reduced stormwater discharge to Kiewa river	**Benefits of pollution abatement in stormwater due to stormwater harvesting (option 3)** Stormwater is a major source of pollution to urban waterways. By harvesting stormwater, pollutants are also removed helping to support healthy ecosystems, increase water quality and improve amenity	Broader community	79 kg	Source: 0.224 to 0.346 (log mg/L) TN concentration for urban surface area (City of Greater Geelong 2019) Assumptions: • Assuming 59.27ML/year of stormwater is removed • The total TN removed per year is 74 kg to 84 kg • The mid-point is taken as the expected pollutant removal benefit • Assuming a constant benefit over the project period Calculation: (74 + 84) *0.5 = 79 kg	$4,789/kg TN	Source: $6,645/kg TN Melbourne Water (2022) Assumption: • TN is the limiting pollutant (in other words, TN is the most significant pollutant) • The offset rate depends on cost of wetland installation and land price • Offset rates are adjusted for land prices • The average land prices for mixed-use lands per sq meter for outer Melbourne region (Mooreland, Brimbank, Casey, Knox, Monash and Kingston) was $855.48 / sqm (DEWLP, 2020) • The average land prices for mixed-use lands per sq meter for Wodonga Council was $616.54 / sqm (DEWLP, 2020) Notes: Reduced stormwater discharge to Kiewa River. Nitrogen is commonly used as a proxy to represent various types of pollutants that can be removed by stormwater treatment initiatives, the cost of purchasing nitrogen offset from Melbourne Water, which represents the cost of providing stormwater treatment in urban Melbourne Calculation: 6645*(616.54/855.48) = 4,789 /kg TN

Benefit identified	Benefit description	Key beneficiary	Physical benefit	Basis for physical benefit	Monetary value	Basis for value
Pollution abatement benefits due to bioretention swales 	**Benefits of pollution abatement in stormwater due to bioretention swales (option 4)** Bio retention swales are proposed to provide treatment of car park runoff to protect Kiewa River	Broader community	25.3 kg	Source: Spiire (2020) Assumptions: • Assuming a constant benefit over the project period	$4,789/kg TN	Source: $6,645/kg TN Melbourne Water (2022) Assumption: • TN is the limiting pollutant • The offset rate depends on cost of installation and land price • Offset rates are adjusted for land prices • The average land prices for mixed-use lands per sq meter for outer Melbourne region (Mooreland, Brimbank, Casey, Knox, Monash and Kingston) was $855.48 / sq m (DEWLP, 2020) • The average land prices for mixed-use lands per sq meter for Wodonga Council was $616.54 / sq m (DEWLP, 2020) Notes: Nitrogen is commonly used as a proxy to represent various types of pollutants that can be removed by stormwater treatment initiatives, the cost of purchasing nitrogen offset from Melbourne Water, which represents the cost of providing stormwater treatment in urban Melbourne Calculation: 6645*(616.54/855.48) = 4,789

Benefit identified	Benefit description	Key beneficiary	Physical benefit	Basis for physical benefit	Monetary value	Basis for value
Education benefits to school children and aged groups 	**Education benefits to school children and aged groups** Raising awareness about water reuse, enhanced community awareness and education of the water cycle		140 individuals	Source: Assumption: • Avoided cost or cost saving benefits • Assuming the schools would have to take trips to another suitable site to get same level demonstration benefits • Assuming one trip of 30 students/school/year saved (3 schools) • Assuming one trip of 50 elderlies /year saved Calculation: 30*3 + 50 = 140	$64 /visitor-day	Source: $128/visitor day (Business Victoria,2022) Assumption: • Half a day trip level expenditure Calculation: 128*0.50 = 64 /visitor-day
Increased amenity due to vegetation 	**Benefits from increased vegetation within the site through passive irrigation**	Local Community	2,083 households value the increased vegetation (grass and many trees)	Source: • Expected number of regular users of car parks is 50,000 per year, not including events (Council estimates) • Assumption: • About 10% of the new users would appreciate the amenity • Assuming 2.4 person per households • Assuming on average one car per household Calculation: (50,000/2.4) *0.10 = 2,083 households	$27.55/ household	Source: Iftekhar *et al.* (2022) Assumption: • The willingness to pay estimates for Baranduda were calculated as the difference between 'Grass and some trees' and 'Grass and many trees' option • The difference has been adjusted for median weekly household income of 2021 in Wodonga • Median weekly household income in Wodonga for 2021 is $1,400 (ABS, 2021a) • Median weekly household income in Melbourne city for 2021 is $1,677 (ABS, 2021b) Calculation: (146-179) *(1,400/1,677) = $27.55/household

Benefit identified | Benefit description | Key beneficiary | Physical benefit | Basis for physical benefit | Monetary value | Basis for value

Water security 	Regional water security benefits from more decentralized option	Local Community	14,604 households	Source: 14,604 households based on ABS 2021 census (ABS,2021a) Assumption: • It is assumed that all households are concerned about regional water security	$17.98/ household/ year	Source: Cooper *et al.* (2019) Assumptions: • Household willingness to pay (WTP) to avoid water restrictions in Wodonga after drought in 2012, - $59.93/Household/Year (2022CPI adjusted value) • The WTP estimate reflects avoidance of restrictions at household level. This needs to be adjusted to reflect the fact that the water security benefit is at regional level and for average rainfall years • It is proposed to adjust the WTP estimate to 30% of the original value reflecting the issues Calculation: $59.93*.30 = $17.98 household/Year

Identify other parameters

The values used for other parameters required to complete the BCA are presented below.

Project duration: We assumed project duration of 25 years based on council consultation.

Discount rates: We assumed a constant 5% discount rate over time. We conducted sensitivity analysis for low (3%) and high (7%) rates.

Adoption: A factor in influencing the delivery of many water sensitive projects is the behaviour of community members or businesses who would need to adopt new practices. For example, having a sports complex might not change people's attitude towards maintain an active lifestyle, thus might not contribute to an increased usage of the facility as assumed in the current analysis.

Benefits are adjusted to reflect judgements about the level of adoption that is realistic, by first estimating the benefits assuming full adoption, and then scaling down the benefits. Most of the benefits of this project are intangible and attributed to local and broader communities, so we adjusted the adoption parameters slightly downwards (Table 5).

Table 5. Adoption proportion used in the analysis

Benefit	Adoption proportion used in the analysis
Regional water security benefits from more decentralised option	0.8
Education benefits	0.8
Increased amenity due to passive irrigation	0.8
Drinking water savings	1
Savings in operating costs	1
Benefits of pollution reduction in stormwater due to stormwater harvesting	1
Benefits of pollution reduction in stormwater due to bioretention swale	1

Consideration of different types of project risks: Given the council will manage the project, we assumed the overall risk of the whole project failing is very low (0–5% risk of failure).

Ranges of parameter values for sensitivity analysis: To understand the sensitivity of the outcomes (i.e., NPV and BCR) to the parameter values, we included low and high values for each parameter. The difference between the low and high values should reflect the level of confidence in the values used (Table 6).

Table 6. Low and high level of values used for different parameters

	Low level (negative % change)	High level (positive % change)
Regional water security benefits from more decentralised option	-50%	50%
Education benefits	-50%	50%
Increased amenity due to passive irrigation	-50%	50%
Potable water savings	-50%	50%
Savings in operating costs	-50%	50%
Benefits of pollution abatement in stormwater due to stormwater harvesting (option 3)	-50%	50%
Benefits of pollution abatement in stormwater due to bioretention swale (option 4)	-50%	50%
Adoption	-30%	30%
Project risks	-10%	10%
Costs	0%	30%

Results

The main evaluation metrics the BCA Tool produces are the net present value (NPV) and benefit cost ratio (BCR), which indicates whether it is worthwhile to invest in the project. If the NPV is positive or BCR is greater than one, it is assumed that it might be worthwhile to invest in the project. The tool produces results for both overall and the project organization.

Baseline outcomes

The present value of the benefit is about $7.4 million (Table 7). Adjustment for project risk and adoption bring the present value of benefit to $7.1 million. The present value of cost is $3.3 million which includes project implementation (capital and operating) and excess burden to raise funding by the Council.

At the base values the overall project seems to be beneficial. The overall net present value is $3.8 million, and the benefit cost ratio is 2.14. The NPV is immune to the assumptions related to the constrained nature of the budget. The BCR is higher 2.15 if the constrained nature of the budget is considered.

Table 7. Baseline outcome of the project: overall project

Overall BCA results	Present values	Explanation
Potential benefits	$7,353,685	(not adjusted for adoption and project risk)
Deduction	$220,611	(adjustment for adoption and project risk)
Benefits	$7,133,074	(adjusted for adoption and project risk)
Costs (total)	$3,331,205	
- Project organisation	$3,084,449	
- Other stakeholders	$0	
- Excess burden	$246,756	
Net Present Value	$3,801,869	NPV
Equivalent Annual Value	$269,752	EAV = annuity for 5% constant discount rate
Benefit: Cost Ratio (constrained budget)	2.15	BCR = (Benefits − Unconstrained costs) / Constrained costs
Benefit: Cost Ratio (unconstrained budget)	2.14	BCR = Benefits / All costs

However, at project organization level the NPV is less than zero (Table 8) indicating that from purely project organization perspective the project may not be beneficial.

Table 8. Baseline outcome of the project: project organization

Results attributable to project organization	Present values	Explanation
Potential benefits	$2,279,714	(not adjusted for adoption and project risk)
Deduction	$68,391	(adjustment for adoption and project risk)
Benefits	$2,211,323	(adjusted for adoption and project risk)
Costs (total)	$3,084,449	
Net Present Value	-$873,126	NPV
Equivalent Annual Value	-$61,950	EAV = annuity for 5% constant discount rate
Benefit: Cost Ratio (constrained budget)	0.64	BCR = (Benefits − Unconstrained costs) / Constrained costs
Benefit: Cost Ratio (unconstrained budget)	0.72	BCR = Benefits / All costs

In Figure 9 the annual and the cumulative net benefit over the analysis period has been presented which shows the initial cost of implementing the project and gradually increasing net benefits.

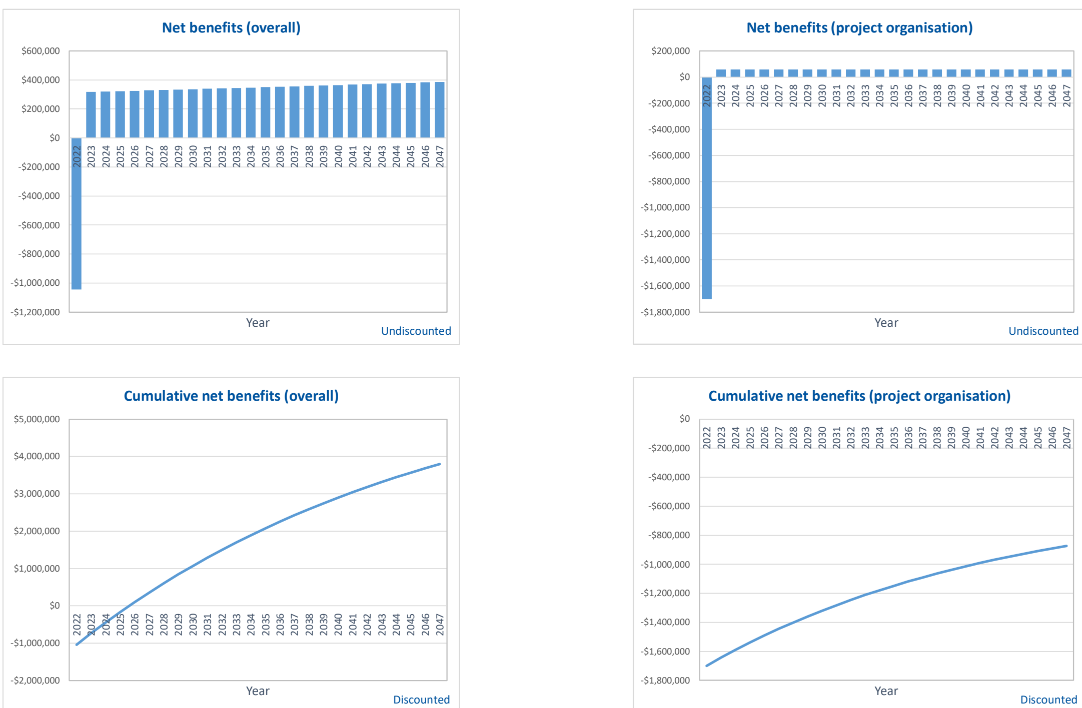

Figure 9. Evolution of net benefits

Distribution of costs and benefits

It seems the largest share of benefits is due to the regional water security benefit from decentralized management options (Table 9) covering around 60% of the total benefits of the project. This is followed by the potable water savings benefits (30%).

Table 9. Share of benefits

Benefit	Overall		Project organisation	
	NPV ($)	%	NPV ($)	%
Regional water security benefits from more decentralized option	4,250,394	60	0	0
Education benefit	131,184	2	0	0
Increased amenity due to passive irrigation	55,665	1	0	0
Potable water savings	2,169,449	30	2,169,449	98
Savings in operating costs	41,874	1	41,874	2
Benefits of pollution abatement in stormwater due to stormwater harvesting (option 3)	366,981	5	0	0
Benefits of pollution abatement in stormwater due to bioretention swale (option 4)	117,527	2	0	0
Sum	7,133,074	100	2,211,323	100

Sensitivity analysis

Given the high uncertainty with input parameters it is reasonable to examine the distribution of net present value and benefit cost ratio. Based on the sensitivity analysis it could be suggested that 94% of the time the overall net present value of the project would be positive or the BCR is greater than 1. On the other hand, 54% of the times the project will be beneficial to the project organization (Figure 10).

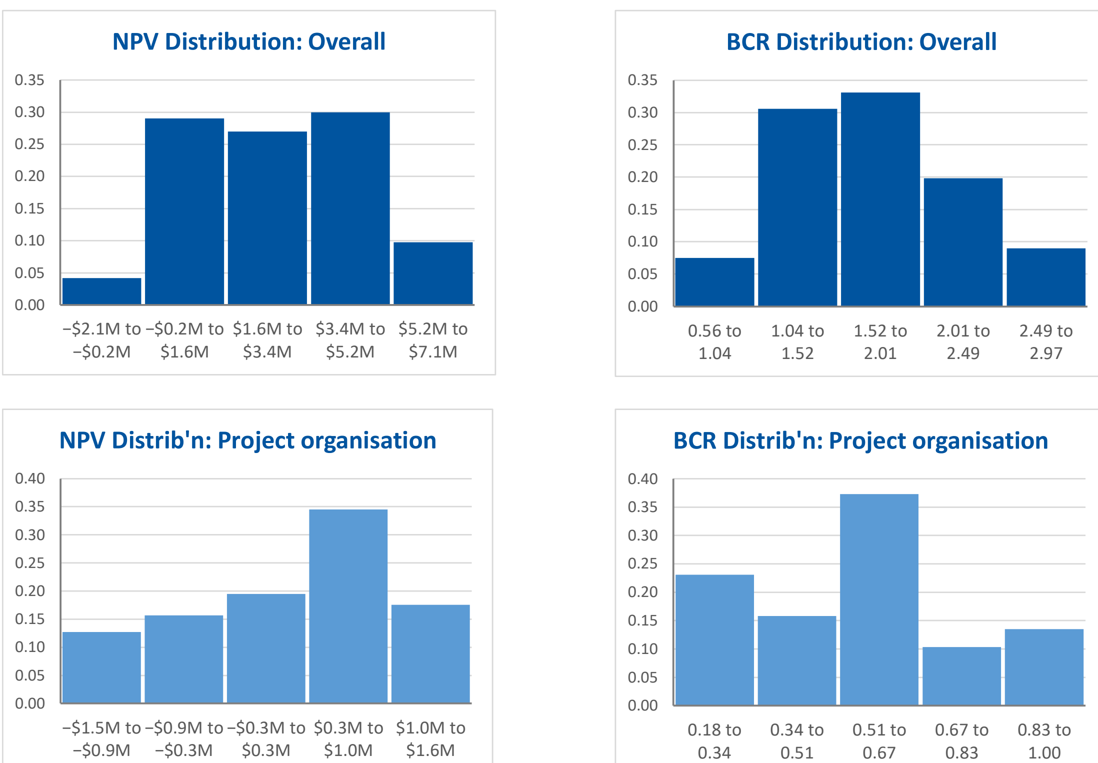

Figure 10. Distribution of overall net present value and benefit cost ratio

Another important parameter to check is the impact of discount rate. It can be seen that even with high discount rate the net present value of the project is positive (Table 10).

Table 10. NPVs and BCRs for different discount rates: overall

	Low discount rate 3%	Default discount rate 5%	High discount rate 7%
Benefits (present value)	$8,636,760	$7,133,074	$6,033,064
Costs (present value)			
- Project organisation	$3,376,177	$3,084,449	$2,869,963
- Other stakeholders	$0	$0	$0
- Excess burden	$270,094	$246,756	$229,597
Net Present Value (NPV)	$4,990,488	$3,801,869	$2,933,504
Benefit: Cost Ratio (constrained budget)	3.69	3.02	2.54
Benefit: Cost Ratio (unconstrained budget)	2.37	2.14	1.95

Conclusion

The rapid economic (cost benefit analysis) assessment process adopted for Baranduda Fields reveals several important issues that could be useful for assessing IWM projects in regional Victoria –

- The overall benefit cost ratio is above 2 indicating that the project is likely to generate positive social benefits. In other words, the project is likely to be beneficial or worthy of investment.

- The net benefit of the project would depend on incorporation of many different types of benefits including regional water security benefits, education and social awareness benefits and increased amenity benefits. If only selected benefits (such as potable water savings or removal of pollutants) were included the net benefit of the project may not have been large.

- The rapid assessment process demonstrated in this case study could be used to conduct a rapid appraisal of projects at a design level that is easily scalable. Such rapid but rigorous process could provide valuable information guidance before going into more detailed designing and proper cost-benefit analysis.

- Many of the projects are not beneficial to the project proponent in purely financial sense, even though the overall net benefit of the project could be positive. In such cases, project proponents might seek co-contribution/support from other agencies (such as DEWLP) and form partnerships with other agencies.

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