CRCWSC INFFEWS benefit: cost analysis tool: Application to Mandurah MAR project

Land use / development type	Scale
Public open space – recreation and sport	Precinct
Water source/supply	Scale
MAR at Caddadup WWTP	Precinct
Efficient irrigation system	POS
Site conditions	
Soils	Sandy
Groundwater level	High
Groundwater availability	Fully allocated
Local government	Location
City of Mandurah	Dawesville

Benefit: Cost Analysis (BCA) is widely used to support decision making about investments in projects or policies, and to underpin business cases for investment. The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) has developed a BCA Tool as part of the Investment Framework For the Economics of Water Sensitive Cities (INFFEWS) that's tailored to assessing investments for water sensitive cities. It provides evidence for use in business cases to support balanced and systematic decision making.

The BCA Tool incorporates project benefits, costs and associated risks to a range of stakeholders to determine a net present value (NPV) and benefit cost ratio (BCR) for the project and allows for sensitivity analysis. It provides a systematic and user-friendly approach to project evaluation.

Finding a water source for the Ocean Road Recreation Area expansion, City of Mandurah

The City of Mandurah identified a section of unused land adjacent to the Ocean Rd Primary School to be converted to an active open space reserve. The goal of the project was to provide residents south of the Dawesville Channel with dedicated public open space for sporting and recreation opportunities.

Funding was acquired from a number of stakeholders, including a significant contribution from the Department of Primary Industries and Regional Development under the Royalties for Regions investment scheme.

The major obstacle for the project was identifying a sustainable and affordable water source for irrigation of the area. The unique conditions of the site, located on a narrow strip of land between the Indian Ocean and the Peel-Harvey Estuarine System, meant that securing water for irrigation of the reserve was the limiting factor for the project. The use of scheme water from the Water Corporation was not considered viable given the pressure on our drinking water source and the cost of scheme water.

The first supply option considered was the use of groundwater. However, this was not possible because the groundwater management area was fully allocated and the Department of Water and Environmental Regulation advised that no further groundwater allocations would be available. Additionally, testing indicated that abstraction of the quantities required for the project could result in saltwater intrusion into the groundwater.

The City then identified three alternatives: a small desalination plant; synthetic turf; or use of treated wastewater from the Caddadup Wastewater Treatment Plant (WWTP) via a Managed Aquifer Recharge scheme.

Applying the BCA tool

While the BCA Tool was not used during the project, it does provide an opportunity to retrospectively apply the tool and demonstrate how it can assist in the decision-making process in water-sensitive projects.

To use the tool, the user must first define the **without-project** scenario and the **with-project** scenario. Benefits must be measured relative to what would have happened without the project. Without that, you are not actually measuring benefits of the project. In this case there were multiple **with-project** scenarios to compare using the CRCWSCs BCA Comparison Tool.

Without-project scenario

The **without-project** scenario was irrigation of the oval with scheme water at $2.20 /kL (estimated for the purpose of the comparison).

With-project scenario #1 – Desalination plant

The first scenario involved constructing a small dedicated desalination plant and supporting infrastructure to collect, treat and transport sea water to the oval for irrigation. The capital costs associated with the scenario included the costs of constructing the plant, an investment from Western Power to provide the infrastructure to supply power to the plant, and the construction of pipe system to deliver the water to the oval. The operational costs included removal of waste products, power usage, maintenance, and costs associated with the disposal of the saline brine waste product. The benefits included a sustainable source of water and avoidance of the use of scheme water as shown in Table 1.

Table 1: Scenario 1 - Dedicated desalination plant

Costs	Benefits
Capital costs (CoM) - $750,000 - $900,000 for acquisition of land and construction of the plant Capital costs (Western Power) - $100,000	Sustainable source of water (non-market value) Avoidance of scheme water during establishment - 42,000 kL for establishing year = $92,400
Operating costs - $102,000 per annum: Removal of waste products, power costs, maintenance of plant and disposal of saline brine waste product	Recharge of groundwater from added irrigation Avoidance of scheme water costs for 37,000 kL per annum = $81,400/annum

With-project scenario #2 – Synthetic turf

The second "with-project" project scenario involves installing synthetic turf as a substitute for real turf at the site. The appeal of synthetic turf is that it requires less water to maintain. The initial cost of synthetic turf was estimated at $1,500,000 and would have to be replaced every 6-8 years and there is a small water requirement to cool the synthetic turf before use in sports and recreation. The costs and benefits of this scenario are summarised in Table 2.

Table 2: Scenario 2 - Synthetic turf

Costs	Benefits
Capital costs (CoM) - $1,500,000	Significantly lower water usage
Operating costs (CoM) - $220,000 per annum. Full replacement every 6-8 years = ~$210,000 per annum plus scheme water to cool before use = ~$10,000/annum	Avoid scheme water cost of approx. 34,000 kL per annum = $71,400/annum

With-project scenario #3 – Caddadup WWTP Managed Aquifer Recharge

The final project scenario involves installing five production bores to retrieve treated wastewater that has been infiltrated into the superficial aquifer at the Caddadup WWTP, as well as construction of the supporting infrastructure to transport the water to the oval.

This scenario also included the connection of St. Damians Primary School's holding tank for irrigation of their school grounds. This aspect of the project was only possible in this scenario due to the lower cost of supply, as the school would only be charged by the City of Mandurah for water usage equal to the operational costs required to provide the water (electricity for pumping, maintenance, and water quality testing). The costs and benefits of this scenario are summarised in Table 3.

Table 3: Scenario 3 - Caddadup MAR

Costs	Benefits
Feasibility study (CoM) - $28,000 for monitoring, lab fees, modelling Capital cost (CoM) - $655,000 for bore installation, storage tank installation and pipe system to oval	Sustainable source of water (non-market value) Avoidance of scheme water during establishment estimated at 42,000 kL for establishing year = $92,400
Operating cost (CoM) - $25,500 for power for pumping, land lease fee and water quality monitoring	Recharge of groundwater from added irrigation Avoidance of scheme water - 37,000 kL per annum = $81,400/annum

INFFEWS BCA tool outputs

The approach for applying a BCA to the Ocean Road Recreation Area project is to conduct a BCA for each of the project scenarios and then compare the outputs using the BCA comparison tool. The BCA comparison tool allows for a simple comparison of the calculated NPV and BCR for both the overall project and the project organisation between each of the scenarios.

The costs and benefits for each scenario are entered into the systematic and user-friendly spreadsheet. For each project, the adoption circumstances and any associated risks are entered. The tool also allows the user to attribute costs and benefits to different stakeholders, which assists with the presentation of individual agency business cases.

To simplify the project for the purpose of this example, a number of assumptions have been made:

- The initial capital costs are covered by the funds from the Royalties for Regions scheme;
- All ongoing operational costs are covered by the City of Mandurah;
- Water requirement for the establishing year of the project is 42,000 kL;
- Annual water requirement for irrigation are 37,000 kL; and,
- St Damians Primary School would not contribute under scenarios 1 & 2, as the cost would be prohibitive for the school.

Results

When comparing these BCAs, which are mutually exclusive, the rule of thumb for selecting the best projects is to choose the one with the largest NPV that can be afforded within the available budget. In this case the largest NPV for both the overall project and the project organisation is scenario 3 – the MAR option (Table 4). The results of the BCA comparison provide strong supporting evidence that pursuing the MAR option for irrigation of the recreation area is the most beneficial option for the City of Mandurah and the project as a whole.

Table 4: BCA comparison results

	BCR	NPV
Scenario 1 – Desalination		
Overall	-0.54	- $2,428,215
Project organisation	0.24	- $1,197,934
Scenario 2 – Synthetic turf		
Overall	-0.54	-$3,816,670
Project organisation	0.13	-$2,158,466
Scenario 3 - MAR		
Overall	-0.02	-$311,157
Project organisation	1.81	$247,575

Outcome

Whilst the Ocean Road Recreation Area project was undertaken by the City of Mandurah in 2015, this retrospective BCA assessment demonstrates the process and outcomes of the Tool. It is a robust tool that allows organisations to accurately weigh up the costs, benefits and risks of a project in a systematic and very user friendly way.

Using the BCA tool

The most critical element is to correctly define the 'with-project' and 'without-project' scenarios before you start. As this project required the comparison of more than one option, multiple BCAs were required. The use of the tool for comparison of the 'with' and 'without' scenarios only requires one BCA and is simpler.

A significant benefit of the BCA tool is that it is not limited to market valued costs and benefits. It is highly recommended that the BCA Tool is used in conjunction with the CRCWSC's Value tool to determine monetary estimates for non-market costs and benefits across a range of project outcomes over the life of the project. Where an independent business case is required for a single stakeholder, the benefits should be stakeholder specific so that the costs and benefits to project stakeholders can be independently represented.

Although the tool is easy to use and supported by substantial background and user-guide information, it is important that some guidance is obtained from an economist during the assessment to cross-check assumptions and inputs to ensure correct economic theory and practice is applied. The CRCWSC currently provides industry support for use of the tool and it is recommended that the spreadsheets are reviewed by the CRCWSC team prior to finalisation.

Commonly used terms

Benefit: Cost Analysis (BCA) compares the overall benefits of a project with the overall costs of the project.

Benefit cost ratio (BCR) is a monetary measure of the overall benefit divided by the overall project costs. It is usually calculated as the present value of all benefits divided by the present value of all costs.

Business case – presents a qualitative and quantitative argument in support of a project or proposal. A BCA will usually form part of the Business Case.

Net present value (NPV) measures the present value of net benefits. It is calculated as the present value of all benefits minus the present value of all costs.

References and resources

Blanchard, T. *Ocean Road Recreation Area: Managed Aquifer Recharge Wastewater Reuse*. City of Mandurah.

CRCWSC: INFFEWS Benefit: Cost Analysis Tool https://watersensitivecities.org.au/content/inffews-benefit-cost-analysis-tool/

CRCWSC Non-market values and Benefit Transfer tool https://watersensitivecities.org.au/research/our-research-focus-2016-2021/integrated-research/irp2-wp2/

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