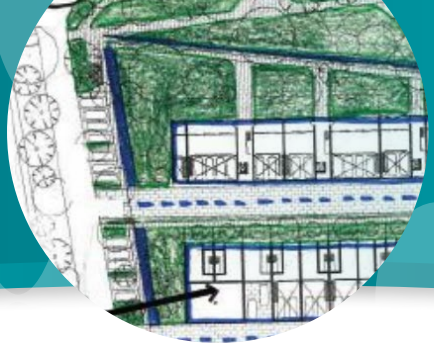
CRC for
Water Sensitive Cities



Measuring the benefit–cost of water sensitive infill development at Knutsford

Land use / development type	Scale
Residential – medium density infill	Precinct
Water source/supply	**Scale**
Rainwater tanks	POS irrigation/non-potable
Sewer mining	POS irrigation/non-potable
Site conditions	
Soils	Shallow soil on a limestone ridge
Groundwater level	High
Groundwater availability	Contaminated/unavailable
Local government	**Location**
City of Fremantle	Knutsford development

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 is tailored to assessing investments for water sensitive cities. It provides evidence for use in business cases to support balanced 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.

A business case for water-sensitive infill development: Knutsford case study

The CRCWSC's Water sensitive outcomes for infill development: Knutsford case study final report (2020) applied the Infill Performance Evaluation Framework (Renouf et al., 2020) to a site within the Knutsford Master Plan area. The report provided evidence about how water sensitive designs can increase the dwelling yield on a development site while mitigating and even reversing the potential adverse impacts of densification.

This case study applies the CRCWSC's INFFEWS BCA Tool to the Knutsford case study to assess the benefits and costs associated with water sensitive infill development, considering design, construction and use.

Knutsford background

The 4 ha development site is located 1.5 km from the Fremantle city centre and is one of eight brownfield sites near Knutsford St, Fremantle.

The CRCWSC's Knutsford case study created dwelling and public space typologies for four development scenarios; existing (EX), business-as-usual (BAU), water sensitive conservative (WS-Con) and water sensitive maximized (WS-Max).

The INFFEWS BCA tool was applied to explore the financial implications to the developer, residents and surrounding community of taking a water sensitive approach to the development. For simplicity in this case study, the 'with project' and 'without project' scenarios were the BAU and WS-Con scenarios, respectively.

'Without project' (BAU) scenario

To focus specifically on the costs and benefits associated with the style of development, the 'without project' scenario in this case study is the business-as-usual (BAU) development scenario.

This scenario includes single-storey, affordable dwellings that are considered to reflect the default infill development occurring nationally, with a built cover of 58% roof and 34% pavement. BAU assumes 107 dwellings on site with two new internal roads, resulting in a net dwelling density of 45 dwellings/ha.

The total landscaped area (including public open space and verges) is estimated at 0.65 ha with a total tree cover of 8%. Water for the development will be supplied entirely from mains (Water Corporation Scheme) and has been estimated at 13.23 ML/year (CRCWSC, 2020).

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'With project' (WS-Con) scenario

The conservative water sensitive scenario (WS-Con) involves constructing 154 dwellings on the site. These include three distinct typologies: apartments, townhouses, and warehouse apartments. The resulting dwelling density is 81 dwellings/ha (not including communal spaces). The average occupancy per dwelling was assumed to be 2.1, giving a site population of 323 people.

The WS-Con scenario includes measures to reduce the demand on mains water supply through underground rainwater tanks that will be plumbed into dwellings for non-potable use, and a sewer mining station that will treat wastewater and supply fit-for-purpose water, mainly for public open space irrigation. The resulting mains water supply demand is 10.39 ML/year.

The total landscaped area (including public open space and verges) is estimated at 1.05 ha with a total tree coverage of 22%.

The WS-Con scenario aims to be a net zero energy development. The development will use solar energy and battery systems to supply 100% of the power requirements. Gas connections will not be installed since self-sufficient gas supply is not considered feasible.

Applying the INFFEWS BCA Tool

Applying the BCA Tool requires estimating the building costs associated with each scenario and determining the differences. The differences are therefore the costs and savings for the WS-Con and BAU scenarios.

A majority of the development cost estimates were provided by DevelopmentWA from its nearby East Village development and adjusted to account for the larger Knutsford development area.

A summary of the construction costs for each scenario is included in the table at the top of the next column.

The benefit for the developer is entirely captured in the increased number of dwellings sold, as well as a slight premium in house prices for net zero energy dwellings and lifestyle.

BAU	WS-Con	Difference
Dwelling construction		
$27,820,000	$34,515,000	$6,695,000
Water-related infrastructure (infiltration galleries, underground rainwater tanks, stormwater pits, pipework for raingardens and verge plantings, soakwells, raingardens)		
$272,998	$1,139,309	$866,311
Landscaping		
$925,000	$1,508,631	$803,869
Sewer mining (installation)		
$0	$1,000,000	$1,000,000
Solar energy		
$535,000	$1,750,000	$1,215,000

A number of the benefits to the residents and wider community were drawn from a report prepared for the Department of Planning, Lands and Heritage (DPLH) by SGS Economics and Planning: *Wider Costs of Medium Density Development.* The report indicated that every new dwelling imposes an additional $1,460 per year of costs to the wider community for medium density infill developments with sub-optimal outcomes. The most substantial costs include the urban heat island effect and the reduction in amenity from the loss of trees and private open space.

The other main benefits for the WS-Con scenario are decreased demand for mains water supply and decreased power costs to residents from the net zero energy development.

Results

The results from the BCA for the overall project and for the project organisation are shown in the table below.

Stakeholder	NPV	BCR
Overall	$11,260,461	2.06
Project organisation	$5,229,820	1.49

There is a greater NPV and BCR for the overall project, which is unsurprising given a number of the benefits of the WS-Con scenario are captured by the residents, surrounding community, and the City of Fremantle.

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Outcome

The results from the BCA indicate there are tangible benefits for the residents, community, and local government when infill development applies water sensitive building typologies and water sources. However, while positive, the business case is not as strong for the developer.

For the hypothetical Knutsford infill development, choosing to develop using the WS-Con scenario over the BAU scenario represents a NPV of $5,228,820 and a BCR of 1.49 for the developer. These numbers alone are not likely to convince independent developers to 'break the norm' and create water sensitive developments, but they do show that sustainability does not need to cost extra.

A potential solution could be found in incentives for communal batteries, rainwater tanks and sewer mining facilities from local or state governments.

Commonly used terms

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.

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

London, G., Bertram, N., Renouf, M.A., Kenway, S.J., Sainsbury, O., Todorovic, T., Byrne J., Pype, M.L., Sochacka, B., Surendran, S. and Moravej, M. (2020a). *Knutsford case study final report: water sensitive outcomes for infill development*. Melbourne, Cooperative Research Centre for Water Sensitive Cities.

SGS Economics and Planning (SGS), 2020. *Wider Costs of Medium Density Development.* Prepared for Department of Planning, Lands and Heritage. Perth, WA.

New WAter Ways

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