Australia

Large Scale Rainwater Harvesting Down Under

Guenter Hauber-Davidson

It may seem strange to think of rainwater harvesting and Australia, supposedly the driest continent on earth. Yet, the country can look back on a long tradition of rainwater utilisation. Strangely this is more so inland with less than 500mm of annual rainfall, where it was often the only source of water. In contrast, in some of the heavily inhabited coastal regions where most Australians live, until a few years ago rainwater harvesting was even forbidden! This is despite that coastal strip enjoying plenty of rain with 900 to 1,200mm per annum. So much for the "driest continent".

In recent years, like many other countries, Australia has been facing a water crisis. Increasing population, cheap water encouraging liberal use and little emphasis on efficiency, and a failure of adding new supplies exacerbated by the effects of climate change have brought home a stark reality: Some cities were running out of water!

Fuelled by severe water restrictions placing harsh limitations on watering lawns and gardens and no longer allowing to wash cars with a hose, along with a strong personal sense of wanting to do something about the water crisis, domestic rainwater tanks have seen a huge revival. Spurred along by generous rebate schemes of up to A$1,500 (€900) Australians just love them. Rainwater tanks have become the latest "must have" item.

"Rainwater tanks have seen a complete revival in Australia."

This has now spilled over into commercial rainwater harvesting. Despite the cheap cost of water (A$ 1.00 – 1.35/m^3 = € 0.65 – 0.80/m^3) a growing number of schemes are being developed. For new buildings, thanks to the Green Star rating scheme, it is almost a given. For existing facilities employees demand that their company do "their bit" to save water. It is increasingly important to be seen to customers as being green (or blue?), and it makes commercial sense, especially with financial assistance from one of the many available funds.

The scope is large. Some 30 % of Australia's urban water consumption is non-residential. A quarter of that could be reduced through water efficiency measures. Of this demand, some 8 % could readily be supplied by commercially viable rainwater harvesting schemes.

Example of a basement intercept "without overflow"

"In a water efficient environment, 8% of Australia's current non-residential demand could be supplied by rainwater."

Such projects can capture rainwater from 1,000 to 10,000 m^2 and more. If schemes collecting storm water (i.e. rainwater including ground surface run off) were included, collection areas of 50,000 m^2 and beyond can be found.

The key to make these projects viable is to work the tanks hard. An empty tank is a good tank. That way sensible demand has created enough storage volume to capture the next rain event. Some schemes can achieve annual savings of up to 15 times their tank volume. Simplistically speaking, the tank has emptied and filled 15 times per year. The trick is to connect large and ideally continuous demands to the tank. Cooling towers are a perfect example of this. They even match demand with seasonal rainfall patterns (higher in summer). Process, wash water, irrigation or swimming pool top-up are other good supply points. Toilet and urinal flushing (unless waterless urinal can be installed) are also suitable. However, they can quickly become cost prohibitive when too many connections need to be made. Single point supplies demanding large volumes of water are more economical.

Alternatively, in buildings like warehouses where few truly potable demands exist, it is possible to connect rainwater directly to the mains supply. A new pipeline is then run to supply water authority water to areas such as the kitchenettes.

Large rainwater harvesting schemes are of interest to hospitals, works depots, shopping centres, tertiary institutions, military bases, prisons, sports facilities and parks and gardens.

Basic Design Philosophy

Where rainwater is the only form of water supply, it makes sense to try and capture every drop possible. However, commercial rainwater harvesting systems in the urban context should be designed to run empty from time to time. Their function is to supplement the reticulated water supply, not to replace it. People opting for excessively large storage volumes often do not fully appreciate this.

The goal is to build an integrated water supply network where the large dam supplied systems work hand in hand with thousands of mini dam supplies found in the form of both residential and commercial rainwater tanks installed throughout the municipal area. In Australia, it would also match the area where the greatest water demand occurs with the regions enjoying the greatest rainfall.

Key Design Parameters

Rainwater harvesting schemes should be designed such that an empty tank is filled by 40 to 60mm of rain, i.e. 40 to 60L of tank volume

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Design and Performance Parameters for Some Commercial Rainwater Harvesting Schemes in Sydney

Scheme	Water Use	Collection Area m²	Annual Rainfall mm	Tankage kL	mm of rain to fill emty tank	Projected Potable Water Savings kL			
						per annum	per kL Tankage	per m2 collection area	as % of rainfall
Football Stadium	Irrigation	2,450	920	150	61	1,700	11.3	0.69	75 %
Car Park	Irrigation	10,000	1,150	660	66	7,160	10.8	0.72	62 %
Depot	wash water	1,500	720	80	53	620	7.8	0.41	57 %
Call Center (with shift work)	Amenities	8,500	1,120	400	47	6,300	15.8	0.74	66 %
Hospital	Cooling tower	3,400	675	120	35	1,980	16.5	0.58	86 %
Depot	Amenities, irrig., wash	1,200	1,190	100	83	995	10.0	0.83	70 %
Depot	Vehicle wash	1,600	1,120	150	94	810	5.4	0.51	45 %
Depot	Vehicle wash	400	1,190	20	50	210	10.5	0.53	44 %

Projected water savings based on results from RainHarD design model

Location	Annual Rainfall* mm	Cost of Water and Sewerage per kL	Value/1,000m² roof area	Comment
Sydney - Coastal	1,200	$3.00	$2,500	
Sydney - West	900	$3.00	$1,900	
Melbourne - City	650	$2.35	$1,100	
Melbourne - South East	750	$2.35	$1,300	
Adelaide	500	$1.16	$400	no variable wastewater charges
Perth	800	$2.82	$1,600	lower yield because of seasonal rainfall (none to little in winter)
Darwin	1,700	$0.90	$1,100	
Brisbane	1,100	$1.45	$1,100	no variable wastewater charges
*rounded numbers are used to avoid a perceived false accuracy due to the high local variability of rainfall				

per m² connected roof area. Depending on the connected demand, this allows to utilise 50 to 80 % of the total available rainwater. The less of the total water demand can be met by rainwater, the greater the proportion of available rainwater used. The table below summarises key parameters for a few schemes.

Using these design guidelines the indicative value of rainwater in Australia can be determined. In areas close to the coast in Sydney 1,000 m² of roof area can replace over $ 2,500 worth of water a year, while in Adelaide a combination of low rainfall, low water supply and fixed sewerage charges creates a yield of $ 400 only.

Key Success Factors

The key to identify a commercially viable large rainwater harvesting scheme is to find the best combination of sizeable easy to capture roof areas, a suitable tank location, a solution to deal with residual overflows and large suitable single rainwater supply points.

One unique challenge often encountered in commercial systems, where 10 or 20 downpipes may be channelled into one, is how to deal with residual system overflows and how to avoid large rainwater collection pipes. Downpipes for most regions in Australia have to be sized for a peak hydraulic capacity to cope with a rain intensity of 200 mm/hr lasting for five minutes. This is expected to occur once every 20 years.

“The peak flow diversion design allows to build systems that would otherwise not be feasible.”

Sizing collection pipes on this basis makes them uneconomically big. It requires catering for very large system overflows from the rainwater tank. A connection system designed to divert peak flows at the downpipe interception negates the need to size collection mains in accordance with the 200 mm/hr guideline. Instead, pipes can be dimensioned based on as little as a 5 to 10 mm/hr intensity.

The setup also permits to install a cut-off valve at the tank. It pushes all overflows back through the existing downpipes via the flow diversion at the interception point. It enables placing tanks in locations that would otherwise not be feasible because they cannot handle residual overflows.

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Example of a peak flow diversion

Applying a similar principle allows to have "tanks without overflows". The top of the tank is above the highest connection point. With sufficient allowance for freeboard and if the connection does not become surcharged, then once the tank is full, water can simply no longer flow into the tank.

Summary

Large commercial rainwater harvesting schemes can make a significant contribution to help solve the water crisis. Embedded into an integrated urban water supply scheme, appropriately sized, and when combined with innovative design solutions such as peak flow diversion they can present a viable cost effective alternative to energy intensive desalination plants or large recycling and pumping schemes.

About the Author

Guenter Hauber-Davidson is one of Australia's leading experts on commercial rainwater harvesting. Based in Sydney he has developed some of Australia's largest and most innovative rain and stormwater harvesting schemes including the peak flow diversion solution. To size these schemes he developed RainHarD, a rainwater harvesting design model.

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