Simulation of Rainwater Tanks under the Requirements of QDC MP 4.2
Townsville Region – August 2004 to May 2012

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Executive Summary

The author has maintained a simulation of the rainwater tank installation requirements that would apply to the Townsville region under QDC (Queensland Development Code) Mandatory Part 4.2, from August 2004 to date.

Exemption from QDC 4.2 was granted in 2007 on the basis of this and other evidence.

A re-run of the simulation with rainfall data up to May 2012 confirms that the compulsory installation of rainwater tanks in the region would continue to be an enormous waste of money.

The simulation can be applied to other areas if local daily rainfall figures can be obtained.

QDC Requirements

QDC 4.2 includes, but is not limited, to the following requirements, for each new detached dwelling:

- A rainwater tank with a minimum capacity of 5,000 litres.
- A minimum roof catchment area that is at least one half of the total roof area or 100m2, whichever is the lesser.
- The tank is connected to feed to toilet cisterns and washing machine cold water taps.
- A minimum of 20 litres of the first flush of roof catchment rainwater is diverted/discarded before entering the rainwater tank where connected to showers, wash basins, kitchen or hot water services.
- Systems must have automatic switching to reticulated supply when the tank is empty.
- The “water savings target” per dwelling for the Townsville City Council area is 44 kL per year.

The Simulation

The performance simulator is set up on an Excel spreadsheet, and calculates the volume of water collected in a tank from a given area of roof. The volume collected is calculated from daily rainfall figures recorded at the Bureau of Meteorology Station at Townsville Airport since August 2004 (see references).

The parameters used

The values in the calculations can be changed, but the results of the simulation presented below are based on the following:

- A tank size of 6,000 litres ($6m^3$). This is larger than the minimum, and considered to be suitable for installation on most residential properties. A rectangular tank of this capacity could therefore be around 3m long, 1m deep and 2m high. With

careful design it could be installed low enough to collect rainwater from both sides of a typical house and possibly outhouses.

- It is assumed that 20% of water reaching the roof will be lost before entering the tank. This allows for losses due to rain bouncing off the roof verges, over-topping the gutters in more intense rainstorms, evaporation, and losses due to the difficulty of maintaining gutters and downpipes clear of constricting debris. No losses are included for periodic maintenance, cleaning and faults.
- No 'first flush' discard mechanism is included.
- The supply is to cold-water feed to toilets and washing machine, based on 40 litres per day for toilet flushing and 80 litres per wash, 3.5 days per week = 40 litres per day for washing machine use, total 115 litres per day.
- The volume of water yield is calculated on a daily basis. The calculation contains logic for detecting 'tank full' conditions and the surplus is discarded.
- The simulation does not include the QDC 4.2 requirement to top up the tank water to minimum level from the reticulated supply.

The Results

(1 August 2004 to 31 May 2012)

Days elapsed	2820
Years	7.7
Annual saving kL	33.2
Days of rain	788
Annual saving @ $1.55/kL (2007)	$51.48
Capital cost per dwelling	5000.00
Cost recovery period years	97.1
Tank overtopped days	346
Tank empty days	56
Annual average rainfall (BoM) mm	1121.5
Annual average rainfall 1/8/04 to 31/05/12 mm	1437.2

The figure of $1.55/kL was the "penalty" rate for water in 2007, eg the charge levied for exceeding the standard annual domestic allocation of 760 kL. The domestic allocation is now 772kL, and the penalty rate is now $2.49. "Annual saving" is now $82.67.

Capital cost, at $5,000, was the cost estimated for a QDC 4.2 installation in 2007. The current figure is certainly higher – at least $7,000, so the cost recovery period on current rates is 84.6 years.

The volume of water saved is now 75% of the amount required under the QDC target.

Average annual rainfall measured for the catchment over the period has increased and is higher than the long-term BoM average calculated over the period since records were kept.

The Implications: Cost / Benefit – Townsville Region

Given that in recent years 2,000 houses have been built annually in the City, the cost of providing QDC 4.2 systems would amount to 2,000 x 7,000 = $14,000,000 p.a. at 2009 prices, or $42,000,000 over three years. The value of water saved would be $now be $165,200 p.a. or $495,600 over three years.

Given rising costs for installations, and the fact that the exemption from QDC 4.2 also provides exemption from QDC 4.3 (Alternative Water Sources – Commercial Buildings), total savings in not providing water tanks could amount to $20,000,000 p.a. or more.

The Townsville region currently enjoys a recently enhanced, secure water supply from two containments, plus the capacity to pump water from the Burdekin system should the need arise. It also has a highly seasonal rainfall pattern, and major rain days frequently occur consecutively. If the region continues to grow, it will eventually be necessary to consider supplementing the containments or developing an alternative large-scale supply, but it is clear that domestic-level containment is useless as a supplementary source of water.

Application for other areas

So far, no attempt has been made to apply the simulation in other regions. Anyone wishing to do so should contact the author.

Daily weather data for each month, for a range of weather stations, can be obtained from the BoM website in PDF and CSV (comma separated value format). It will usually be found that the last 14 months of data are available. Earlier records can be obtained, but there may be a charge. The minimum charge (quoted at time of writing) is $110.

For more limited data, eg date and rain gauge value, BoM's free Online Climate Data can now produce tables for any weather station:

http://www.bom.gov.au/climate/data/

Values can be limited in range, eg exclude zero values, values below 2mm etc. It is also possible to obtain a table containing data for all years for which records exist: in the case of Townsville Aero these go back to the 1950s.

Credits, References and Provenance

I acknowledge the valuable assistance of engineer Angel Ho in the development of the tank full/empty algorithms.

The simulation package is the property of the author, Martin Clark. Copies of this document and contact details can be obtained from the author's personal website:

http://people.aapt.net.au/jclark19/

The simulation package was developed from original research carried out by the author at the Papua New Guinea University of Technology and James Cook University of North Queensland.

The logic of the simulation has been verified by RPEQ (Registered Professional Engineer Queensland)

The rainfall figures were sourced from the Bureau of Meteorology on the following (public) link:

http://www.bom.gov.au/climate/dwo/IDCJDW4128.latest.shtml

Othe data can be obtained from:

http://www.bom.gov.au/climate/data/