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Water use – drivers and savings

Research into water use in Auckland and Wellington offices has been used to develop a water efficiency rating tool.

TO UNDERSTAND WATER demand and how water use efficiency can best be targeted, a PhD research project spent 3 years investigating water use in 93 office buildings in Auckland and Wellington.

A large proportion of commercial buildings in New Zealand are office buildings, especially in city centres. Water metering in these buildings provides drivers for water efficiency and conservation activities, but a good understanding of water end-uses and what constitutes good or bad performance is missing.

Basic water audits were undertaken on the 93 buildings studied, including site visits, talking with building owners, managers and occupants and analysing water meter readings from the supply utilities. During each visit, an inventory was taken of all water-using appliances on site.

Not enough WELS-certified appliances

The level of Water Efficiency Labelling Scheme (WELS)-certified appliances was lower than expected. However, common area retrofits generally only take place every 10-15 years, which is longer than the current WELS standard has been in place in New Zealand.

About 15% of the buildings studied employed some or all WELS certified appliances. It was also found that 91% of the buildings in the sample used mechanical ventilation of which 56% were water cooled.

Limited cost-recovery in buildings

In commercial buildings, building managers are responsible for the water bill, which may then be included in the individual lease agreements for building tenants. Few buildings had cost-recovery methods in place, so water user's were unaware of how much they were consuming.

Where submeters were found during site visits, the majority of building managers were unaware of their installation or were only using them for accuracy in their consumption monitoring practices, rather than cost-recovery of the water bill.

Three buildings had full water audits

Full water audits were undertaken in three Wellington office buildings. This involved attaching a temporary pulse sensor and data logger onto the main water meters - a more complex process than expected.

The existing water meters in the studied buildings differed widely, and the compatible pulse sensors that could be attached to each meter even more so. The monitoring equipment was in place for 310 days, 477 days and 637 days.

The individual end-uses showed enormous variance in flows on each floor in the building - primarily due to the different reticulation networks for each floor creating different pressures through both gravity and the end-use fittings. For example, hand basin faucets ranged from 4.2 L/minute to 56.9 L/minute in one 16-storey building.

An extensive breakdown of the water end-uses could not be performed due to the complexity of the water reticulation systems

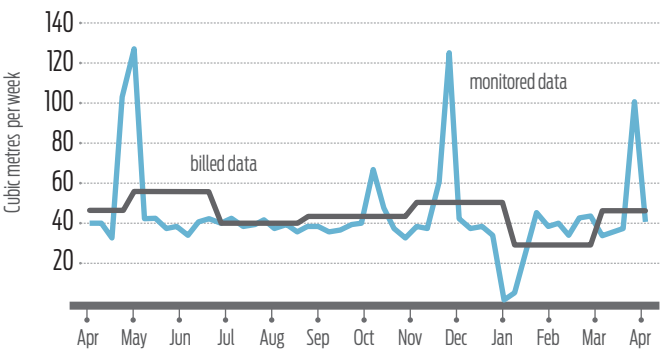

Figure 1: Building annual billed versus monitored water use.

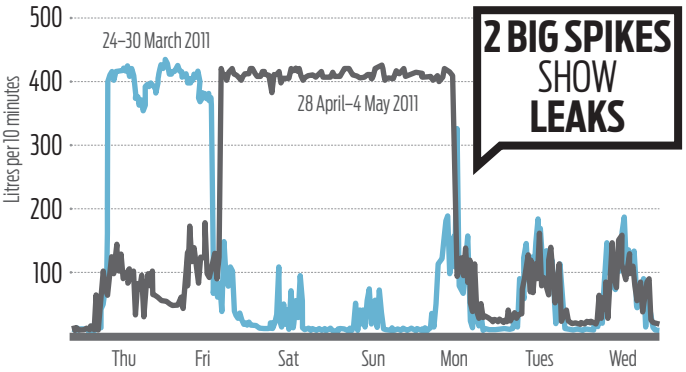

Figure 2: Building leak occurrences during two monitoring periods.

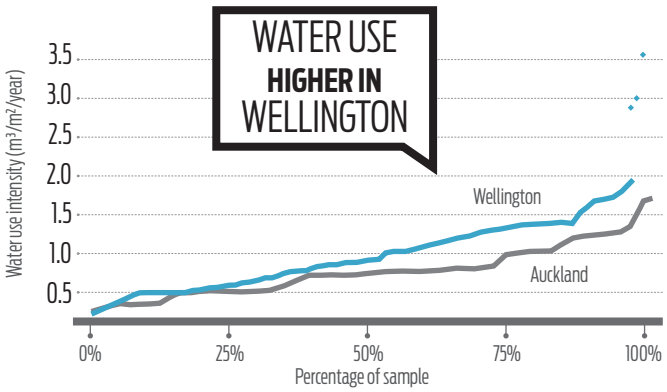

Figure 3: Cumulative distribution of two datasets.

in each building, and the cost and disruption of implementing more permanent monitoring equipment.

Because the revenue meter readings were bimonthly (see Figure 1), the monitored data shows significantly higher variability. However, it also showed minimal correlation with ambient temperatures, which was not expected. With water-cooled air-conditioning systems and irrigation, water evaporation and therefore use would be expected to increase as the ambient temperatures rise.

Tariffs vary between cities

During monitoring, several toilet valve malfunctions were picked up in the monitoring data (see Figure 2). If alarm levels were preset, these malfunctions could have been detected much earlier. As this was in Wellington, approximately $300 was lost (174,000 L) over the 3-day period - in Auckland, it would have been more than $750.

The commercial water tariff in Wellington has three components: an annual service fee, ingoing water charge and outgoing wastewater charge. The ingoing water charges are based on the amount of water going into the building through the water meter. The outgoing wastewater charge is calculated as a percentage of the capital value of the building and is included within the annual council rates.

In Auckland, commercial water tariffs also have these three components. However, outgoing wastewater is charged as a percentage of the amount of ingoing water and can be reduced with water efficiency measures to reduce ingoing water.

The example of a urinal upgrade in Table 1 shows that it will take more than twice as long to pay back in Wellington than in Auckland. The difference in tariff structures is the hypothesis behind the water-use intensity differences in Auckland and Wellington (see Figure 3).

Rating tool will benchmark

A primary aim of this research was to develop a method of rating and comparing a building's water performance in New Zealand. Analysis of water use intensity was calculated as cubic metres of water per square metre of net lettable floor area per year, or m^3/m^2/year.

Wellington water use is consistently higher than in Auckland (see Figure 3). The median water use for:

- Auckland office buildings was 0.76 m^3/m^2/year
- Wellington office buildings was 1.03 m^3/m^2/year.

Three extreme outliers were also identified, which are shown as the three blue points on Figure 3.

Using the information from this research, a water efficiency rating tool has been developed. This rates a building's performance against the regional benchmarks, estimates an end-use breakdown of water uses within the building and then provides the optimum water efficiency package based on budget and priority areas identified through the previous calculation step.

Table 1

WATER EFFICIENCY IMPLEMENTATION COST-BENEFIT ANALYSIS

LOCATION	COST TO INSTALL SENSOR-ACTIVATED URINAL FLUSHING	WATER SAVINGS	COST SAVINGS	PAYBACK PERIOD
Auckland	NZ$4,407	2,195 m^3/year	$9,532/year	0.46 years
Wellington			$3,765/year	1.17 years