UTS Institute for Sustainable Futures

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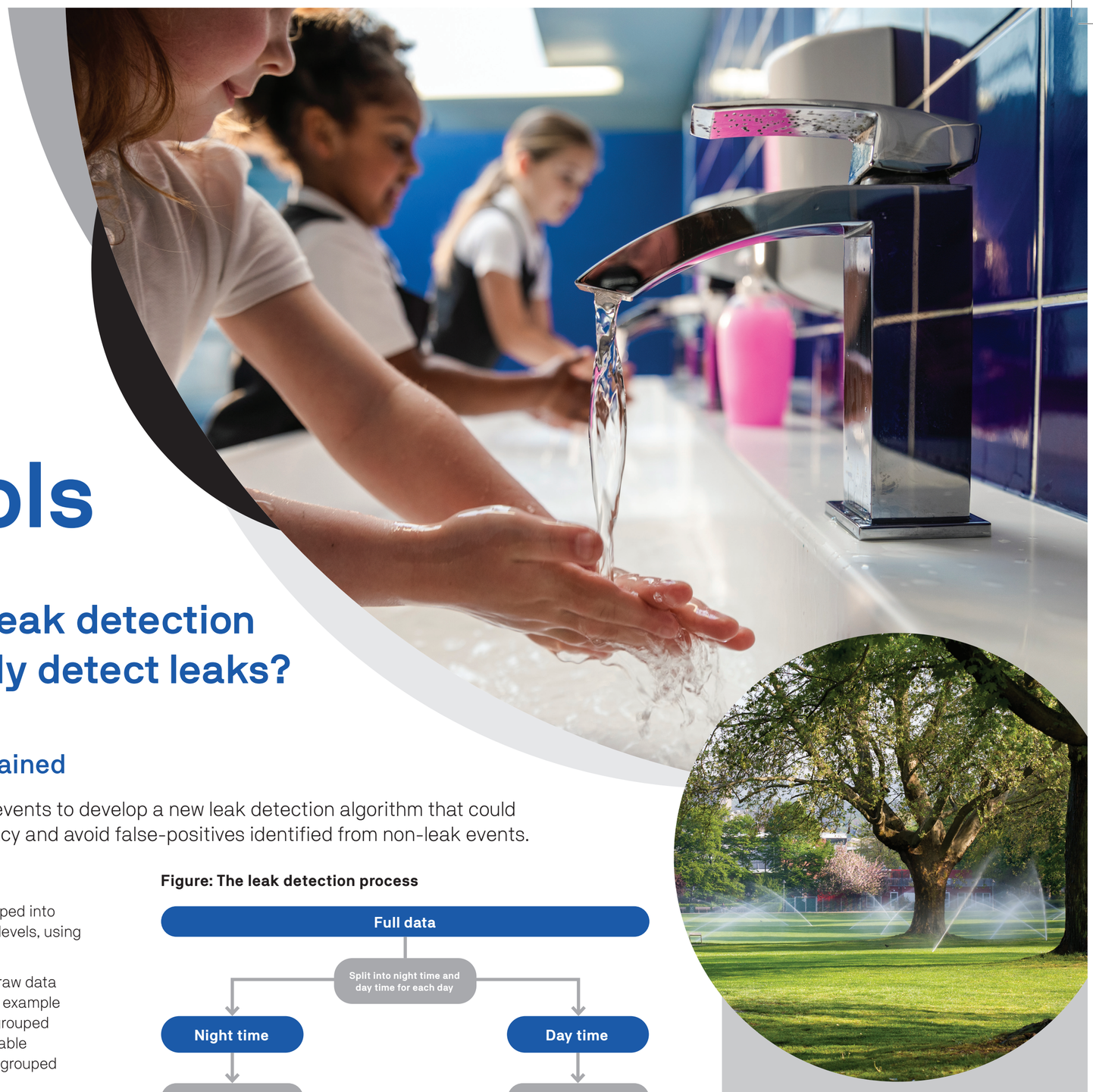
Improving leak detection in schools

How can we improve smart water meter leak detection algorithms to more reliably and accurately detect leaks?



The promise of accurate leak detection and alerts is often made by smart water meters.

The most common method of leak detection is to check for overnight flows or long periods of non-zero data. However, these simple approaches miss the varied nuances found in residential and non-residential water practices. Irregular water usage patterns, such as overnight irrigation make it much more difficult to accurately detect and quantify leaks.

The Institute for Sustainable Futures has addressed the complexities encountered during the development of a leak detection algorithm and put forward solutions that improve the reliability of leak detection.

"It is our recommendation that any leak algorithm should be nuanced and flexible enough to discern 'normal' water use behaviour for each user."

Yohan Kim 2021

Research approach explained

ISF used manually identified leak events to develop a new leak detection algorithm that could detect leaks with improved accuracy and avoid false-positives identified from non-leak events.

Segmentation of water use

Each school's water use data is initially grouped into segments, with similar volume and volatility levels, using what's called changepoint analysis.

Considering segments instead of individual raw data points simplifies the analysis process. In the example below, we can see that night time period is grouped into just one segment, since it's relatively stable throughout the night. The day time period is grouped into four segments.

The leak detection process

After data is segmented, each segment is analysed for leaks and labelled as either no leak, leak or wasted water. Any leak that is shorter than a threshold is re-classified as wasted water. Wasted water events are not used to calculate benefit from leaks avoided, unlike leak events.

Figure: Segmentation of water use

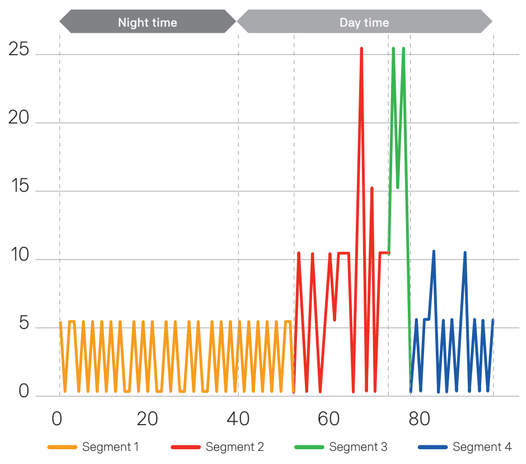
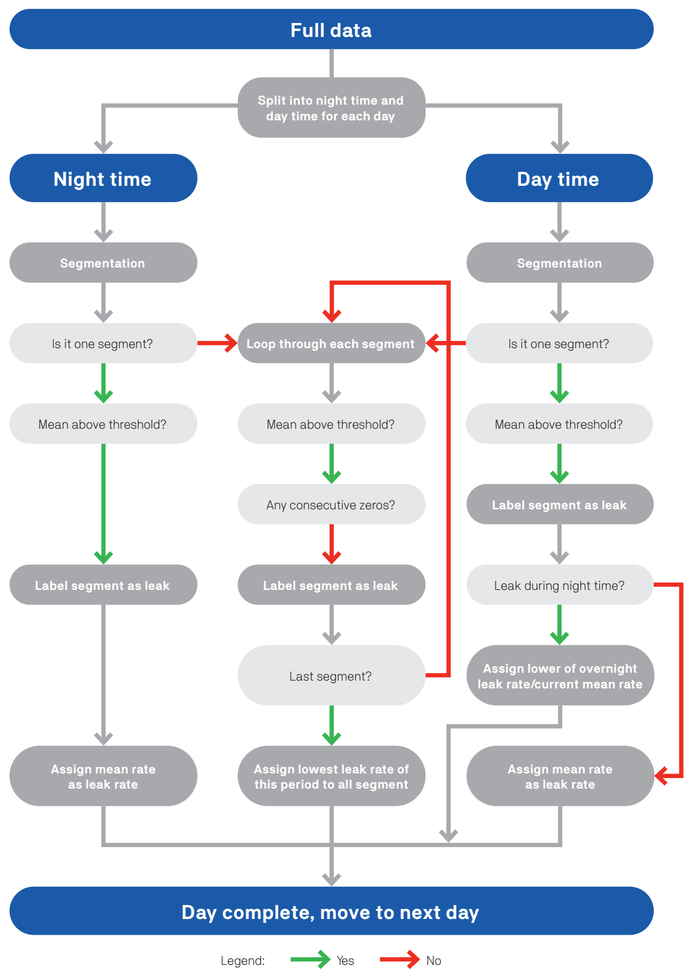


Figure: The leak detection process



The Schools Water Efficiency Program (SWEP)

SWEP was established in Victoria to save water and energy in schools, as well as educate current and future generations about the importance of the efficient use of these resources to achieve a more sustainable environment. SWEP uses ISF's new leak detection algorithm to help all participants save water and associated costs by identifying leaks as soon as they occur.

What we achieved:

Capturing the unique behavioural characteristics of users is critical in reliable leak detection. Modelling this behaviour can differentiate leaks from similar behaving events, such as wasted water and irrigation, can reduce false positives and prevent over reporting of leaks.

The new algorithm, was found to significantly increase the reliability and accuracy of identified water leaks.

Specifying bespoke analysis by time of day and day of week to capture behavioural differences. For example, a spike in water use that starts on Friday and ends on Monday is most likely a device that has been left open over the weekend and should be treated as wasted water and not as a short leak event.

Clustering time series data into dynamic segments to improve computational speed. For example, clustering a long period of zeros as one inactive period and skipping it during analysis instead of checking each zero point individually.

Setting a baseline leak rate to isolate leakage from normal use. If the leak rate doesn't drastically change throughout the day, we can isolate leakage from normal use, preventing an overestimation of leakage.

Joining neighbouring leak periods to reduce double counting of leak events. To prevent any overestimation of leaks avoided and thus water saved by the program.

Dr Yohan Kim
Senior Research Consultant

Dr Pierre Mukheibir
Professor of Water Futures

Alexandra Butler
Research Consultant

Ahlam El Halabi
SWEP Project Officer
Yarra Valley Water

Les Walker
Senior Policy Officer
DELWP

More information:

Find out more about the type of work that our team does at **www.uts.edu.au/isf/explore-research/water**