NON-REVENUE WATER SAVINGS, ACHIEVED THROUGH VIBRATION SENSOR INTEGRATED DIGITAL METERS

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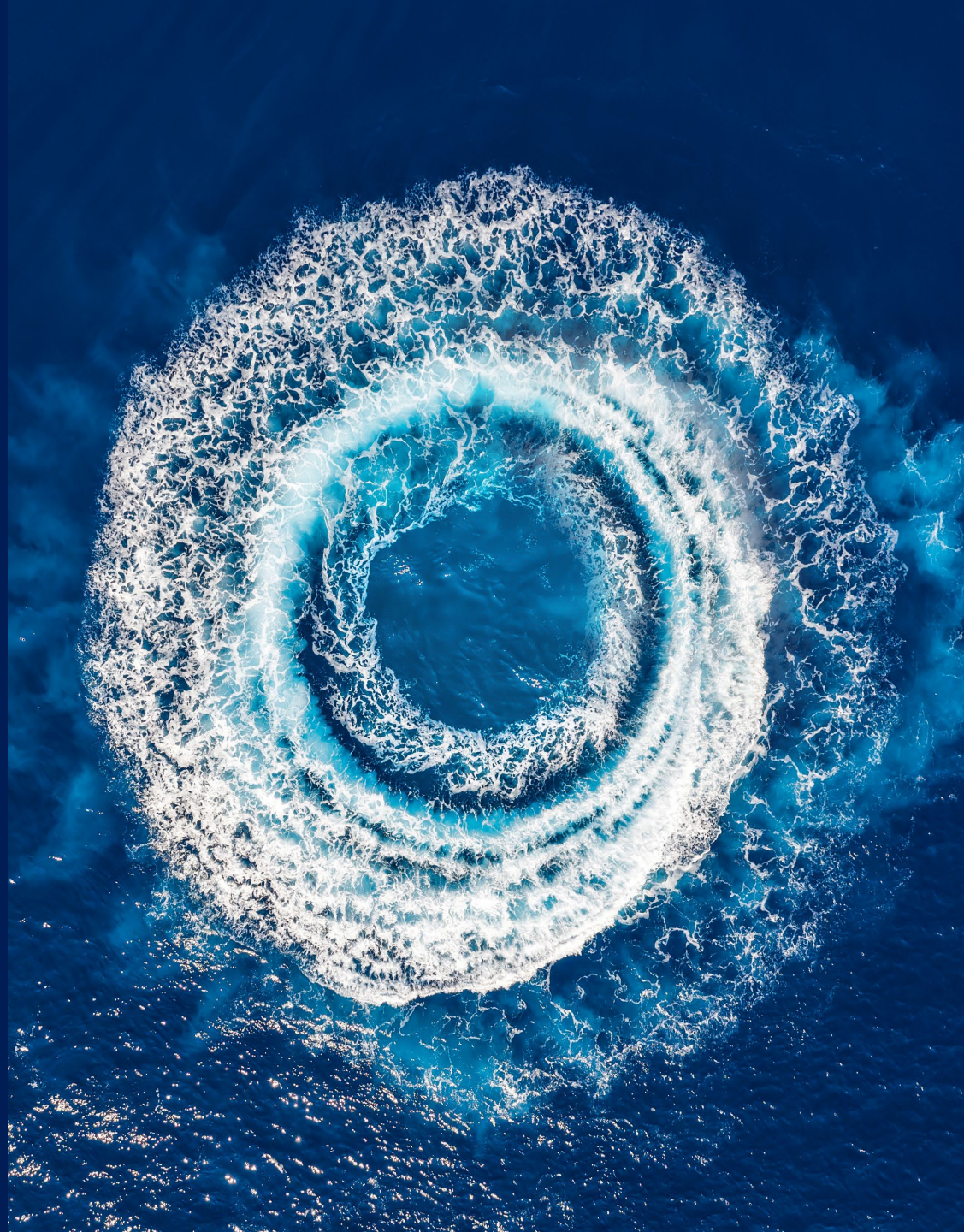


Agenda

Introduction/Background

- Non-Revenue Water
- Typical Approaches for Physical Losses
- Example: Sotto Sensors

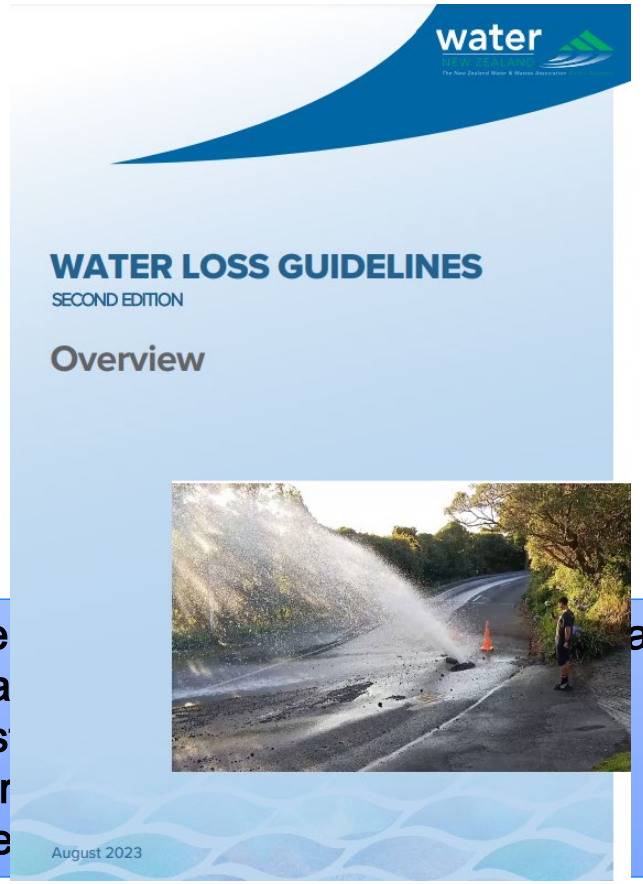
South East Water Case Study

- Understanding Data from Trials
- Estimating Volume and Leaks Counts
- Business Model

What is Non-Revenue Water?

IWA Australian Standard water balance definition (International Water Association, 2003)

System input volume	Authorised consumption	Billed authorised consumption	Billed metered consumption (including water exported)	Revenue water
			Billed unmetered consumption	
		Unbilled authorised consumption	Unbilled metered consumption	Non-revenue water
			Unbilled unmetered consumption	
	Water Losses	Apparent Losses	Unauthorised consumption Metering inaccuracies	
		Physical Losses	Leakage on transmission and/or distribution mains	
			Leakage and overflows at storage tanks	
			Leakage on service connections up to the measurement point	



How do we typically address these losses?

Typical approaches for physical losses

Several common strategies have been developed to detect and manage water losses in the network. This include one or a combination of:

- District Metering Areas (DMAs),
- Acoustic leak detection,
- Customer reporting of leaks and other sources of data

- A structured DMA or zone usually supports water balances more accurately
- Can be costly to establish and maintain.
- Can be considered as a leakage management tool allowing for other techniques in the field like step testing.
- How many leaks are present in the area? How large each of them are? Where are they within the DMA?> should be used in conjunction with other strategies

What about digital meters (DM)?

- DM supports a water balance or Minimum Nightly Flow (MNF)– see DMA
- Digital Meters are particularly accurate at low flow rates; furthermore, this accuracy is also maintained over the life of the meter.
- DM **does not assist**in identifying physical losses, hence should also be used in conjunction with other strategies

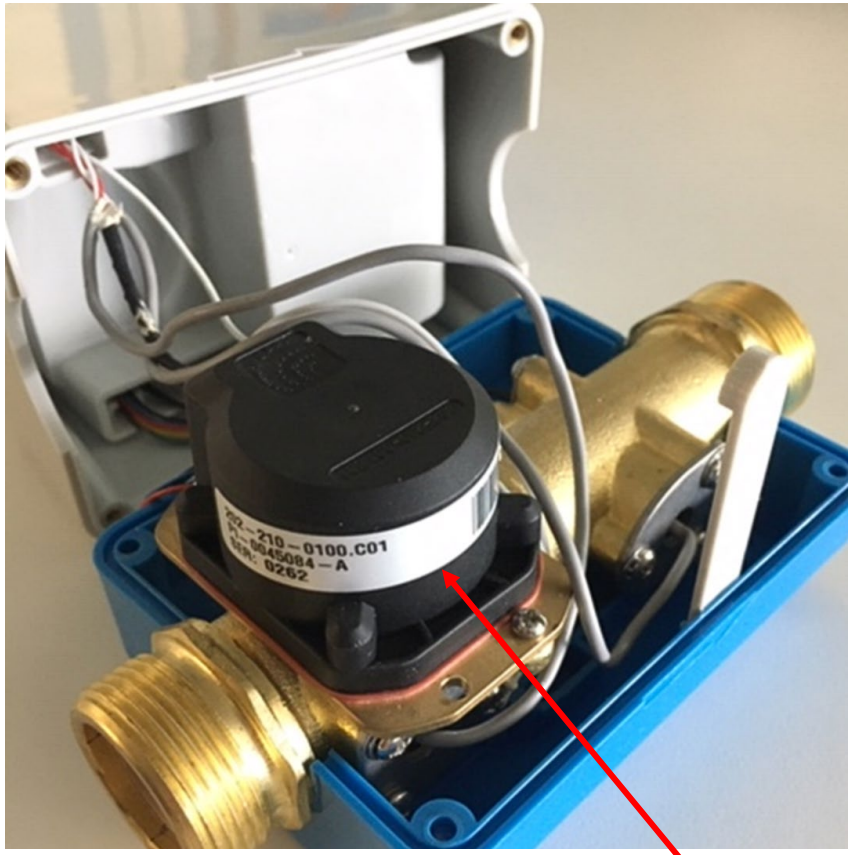
Typical approaches for physical losses

The following case study, and it's associated business analysis is unique to SEW. The case study results do not infer or imply that equivalent results may or could be experienced by any other water utility.

Approach	Leak or Burst Prediction Analysis Options	Location and Isolation
A. DM & DMA	Minimum Night Flow analysis Pressure monitoring	Field leak location detection required across the DMA.
B. DM & Integrated meter leak detection & DMA	Minimum Night Flow analysis Pressure monitoring Integrated meter leak detection	Field targeted leak detection within a property or immediate surrounding properties. Reduces operational field location time. Quantitative loss may be inferred, assisting in prioritisation.
C. DM & Integrated meter leak detection (no DMA)	Pressure monitoring Integrated meter leak detection	Field targeted leak detection within a property or immediate surrounding properties. Reduces operational field location time. Qualitative loss is inferred, with limited quantification.

Iota's Sotto Sensor used for the case study

Digital Meter



SEW has integrated the Sotto sensor into DMs

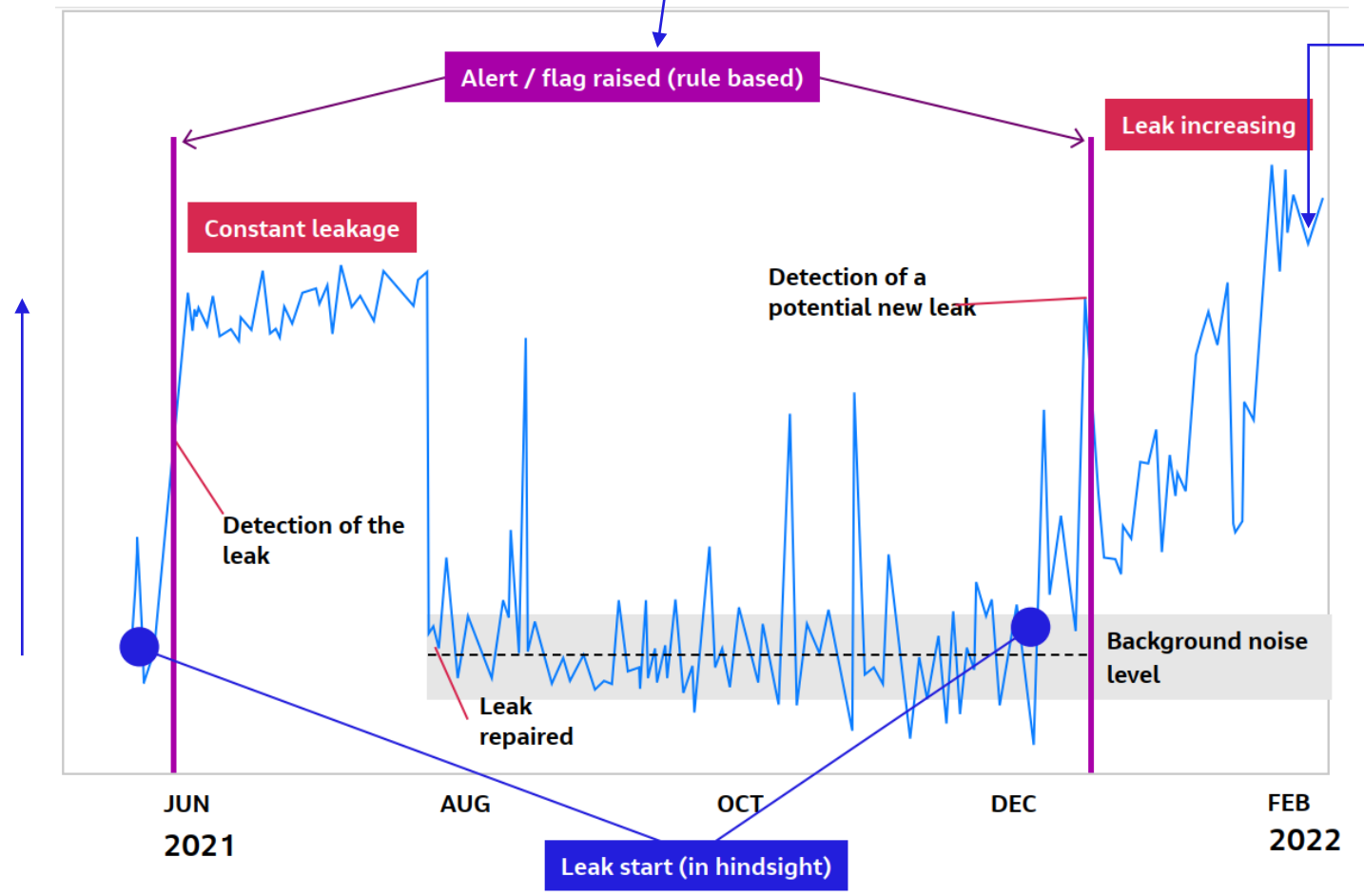
Specifications provided by Iota:

- Fully integrated into the digital meter
- Minimal DM battery usage (reducing the total battery life by approximately 6 months from 10-15 years)
- Uses the digital meter NBIoT
- **Gathers nine data samples at 15minute intervals, usually between 12am and 2am daily**
- Small incremental cost when integrated into the DM
- Detects leaks up to 80 metres (indicative. Range depends on leak size, the network configuration, pipe material and soil type)

Sotto signals

Rule based (here: 3 consecutive day above background noise)

Example of the raw signal from Sotto



An algorithm determines potential leaks based on intensity behaviour.

Vibration data analysed to determine the intensity and location of leaks.

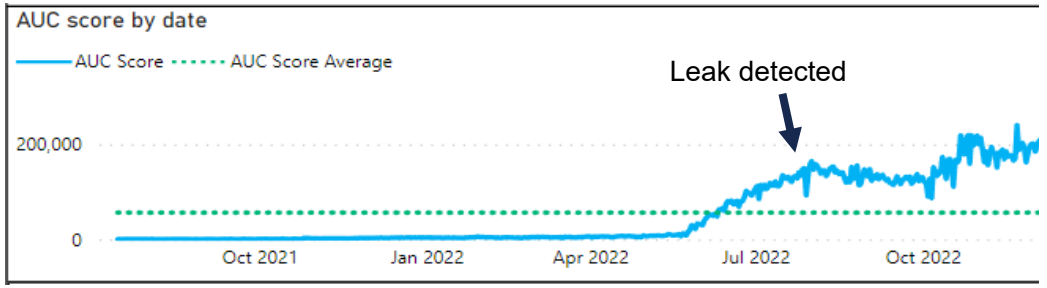
Data analytics are required to process the vibration data. Any potential leak will have a score related to its intensity recorded during the night when ambient noise is at its lowest.

Example of the collective view of a particular leak

The intensities registered by some DM with Sotto at properties in the immediate neighbourhood or surrounding street can be used to approximate leak location through **triangulation**.

Heat map – Digital meter sensor data

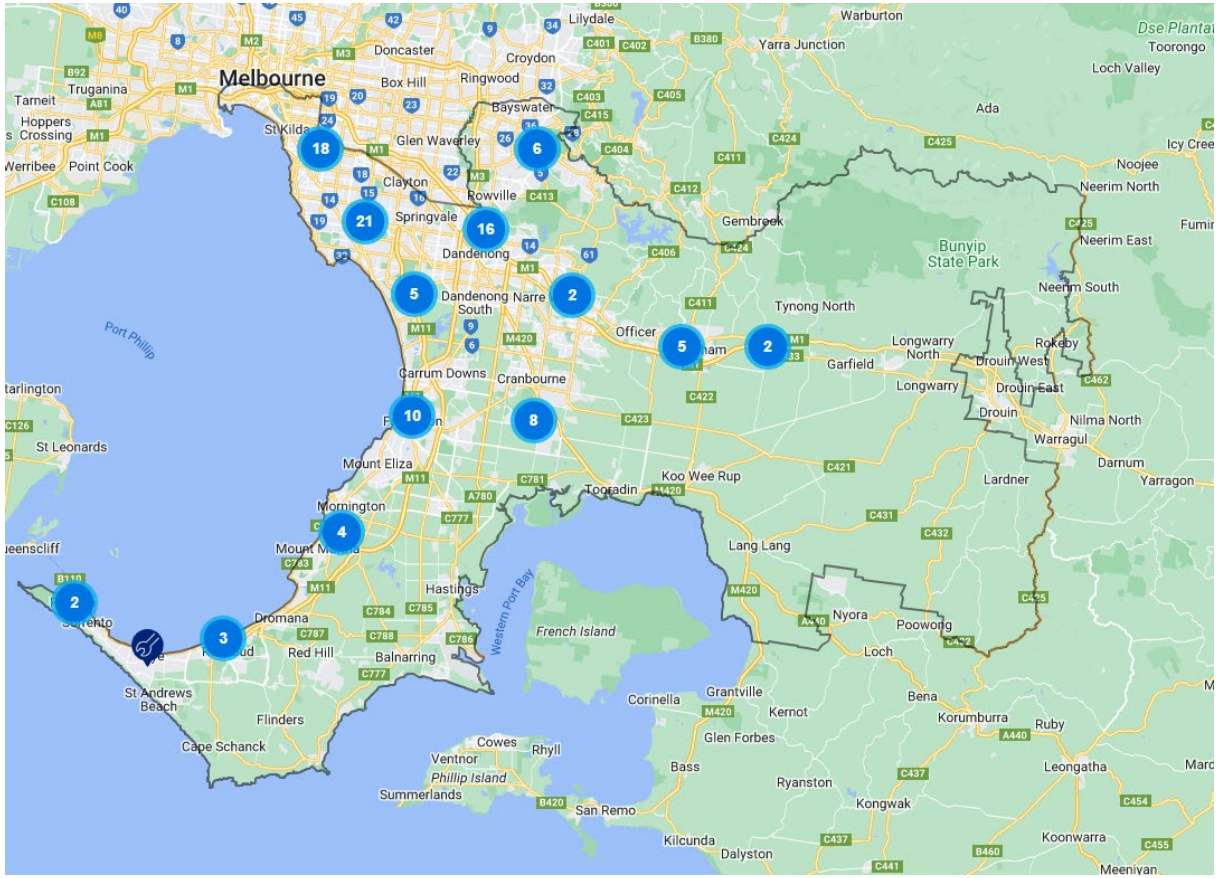
Before network leak repair



Accuracy can be further improved for leakage flow rate when the data is combined with MNF analysis from the DMA. Processing the data includes determining and removing false positives (e.g. traffic noise, sprinklers) specific to the network.

South East Water (in a few words)

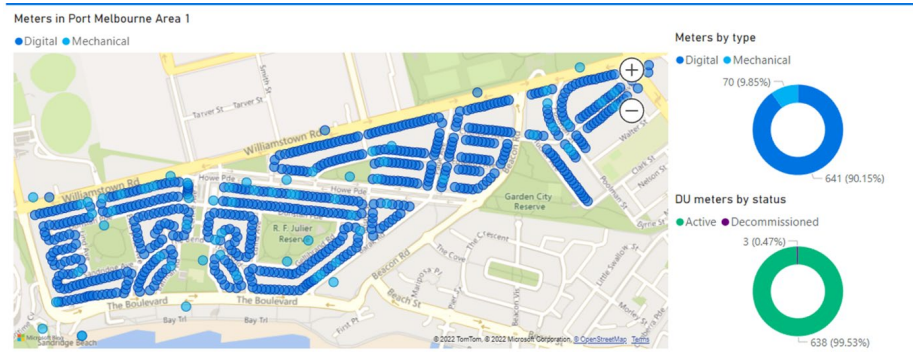
- One of three water retail in Victoria
- iota services commercialising and marketing innovations, products and services
- ~165GL bulk water purchased from Melbourne Water
- ~1.8m population
- ~$300/ML bulk price



Live network interruption (18/10/2023)

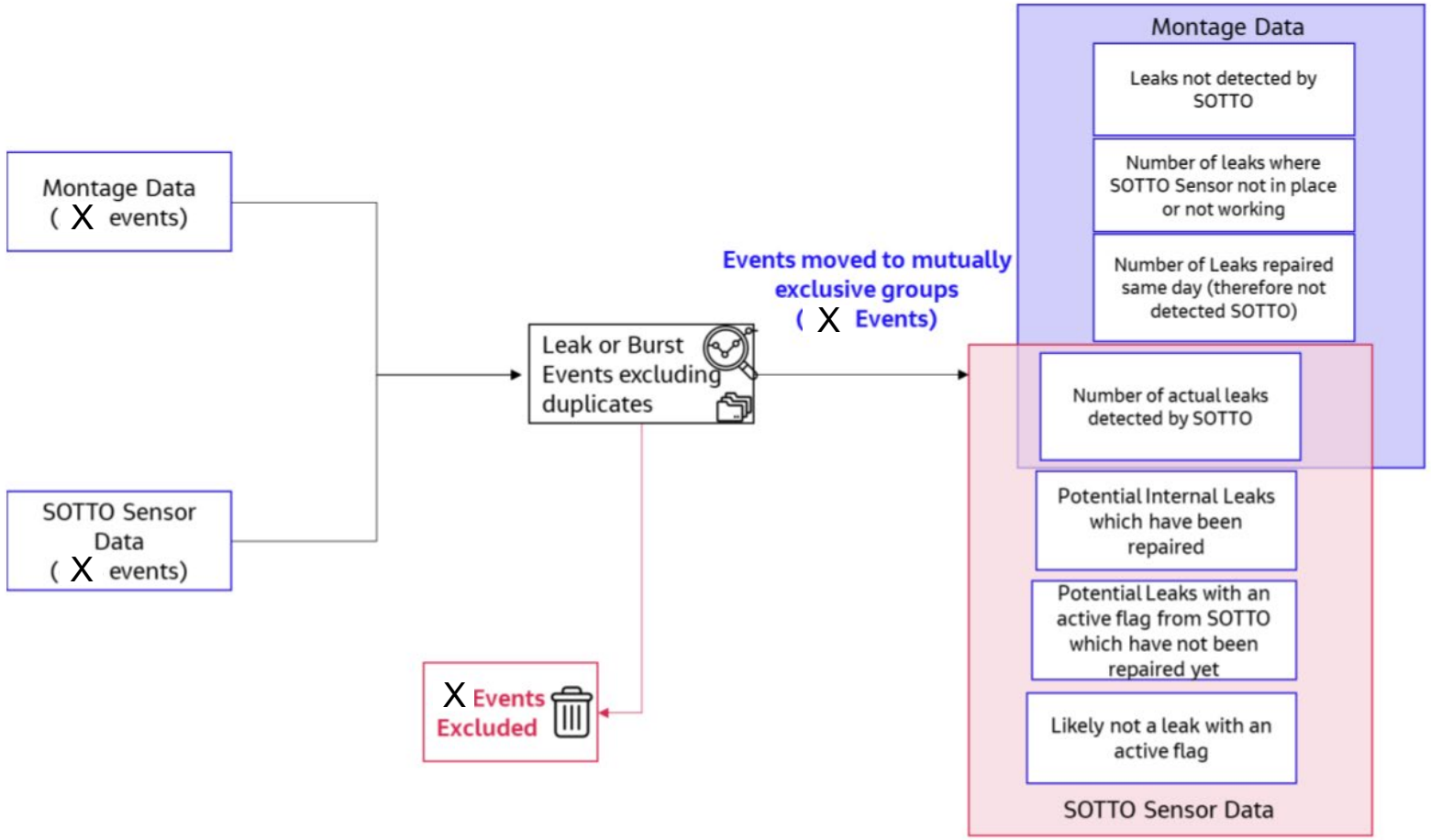
SEW CASE STUDY – LEAK DETECTION USING SOTTO

- June 2022, SEW Sotto trials (5100 sensors) within several neighbourhoods.
- Jacobs designed and implemented this analysis in conjunction with SEW. **The information presented is intended to provide a case study for reference and insight when considering trialling and scaling leak detection sensing with these technologies.**
- **SEW sought to prove the hypothesis that a 1% reduction of water purchased from Melbourne Water is achievable with a Sotto-enabled network.**
- The analysis was structured based on the following Problem Statements unique to SEW:
  - What is the **success rate of leaks being detected** in an existing neighbourhood network using vibration data from Sotto?
  - What is the financial viability of including the Sotto sensors in an integrated digital meter deployment **at every property**?
  - What is the financial viability of Sotto sensors in an integrated digital meter deployment **at every second property**?
- SEW's current methodology of leak detection, location and subsequent repair is referred to as Business as Usual (BAU).

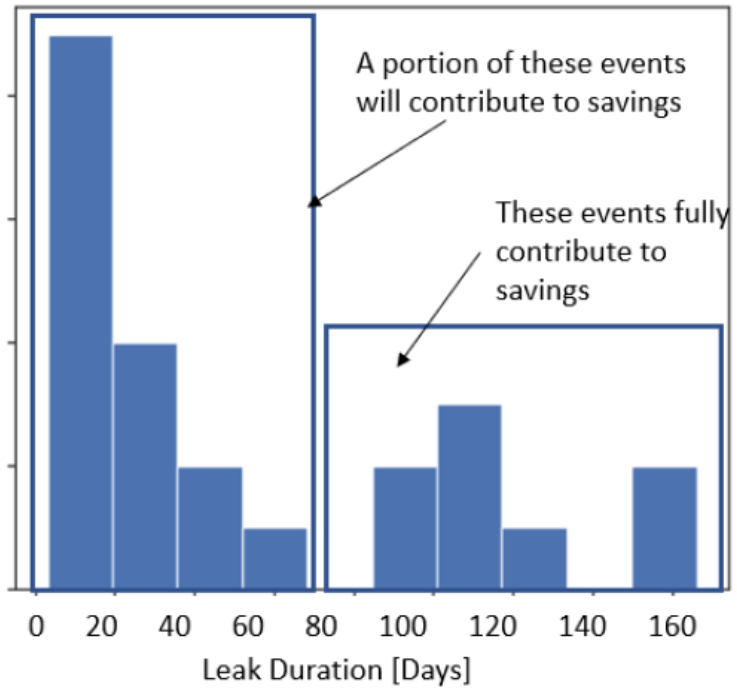


Example of 700 sensors deployed in Port Melbourne

Data cleansing and sanity check



What is a quantity saved? Is a leak detected unique to Sotto?



In general, SOTTO will detect leaks earlier than BAU, hence leading to a higher amount of water saved.

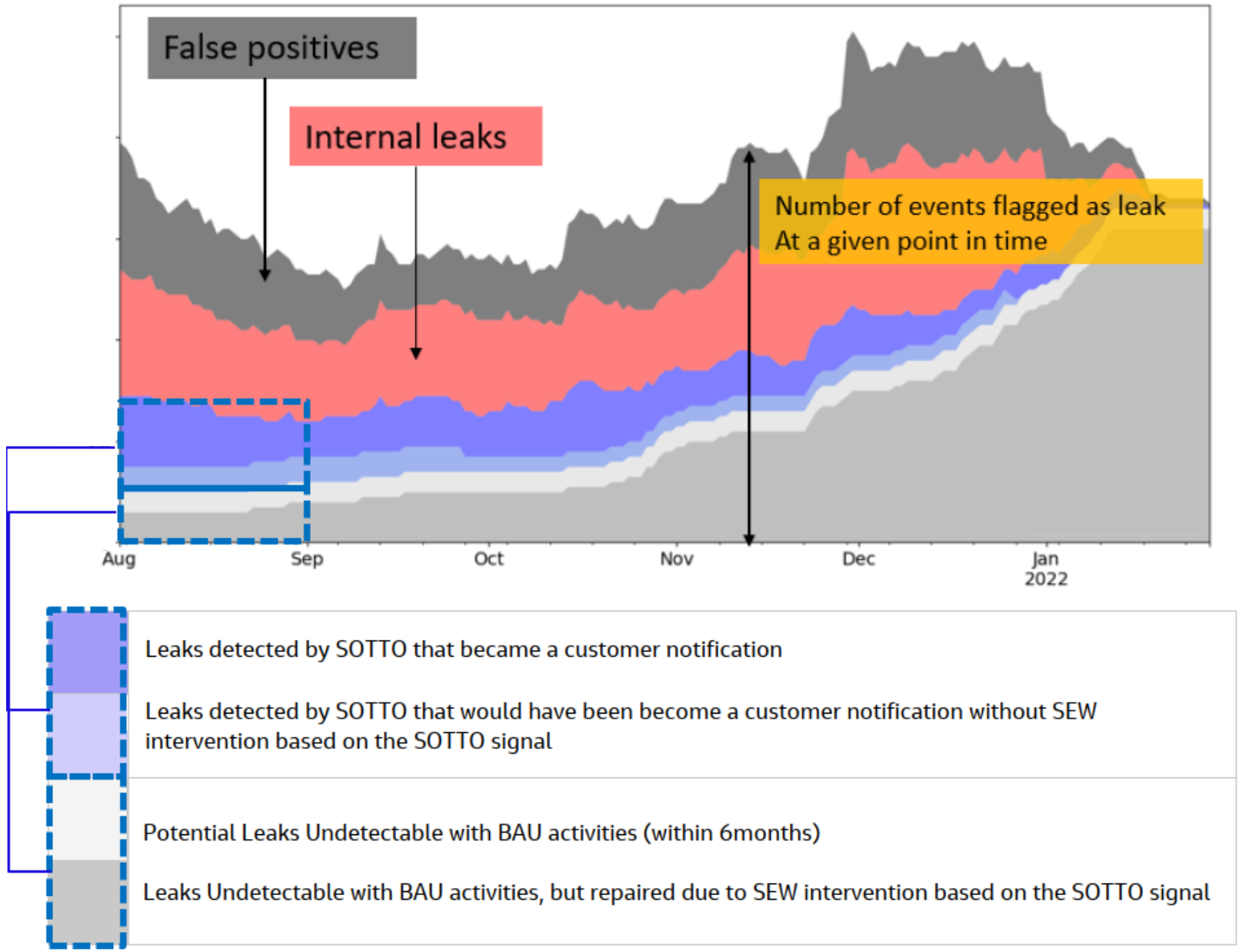
For our volumetric estimation of NRW, only a portion of the first group (repairs below 70 day) will contribute to savings (once SOTTO is deployed), whereas the second family will contribute fully to the estimated NRW volume.

Only a portion of volume of water loss can be saved after being flagged by SOTTO as a potential leak.

- Gain confidence that the sensor detects an event being a real leak and not a false positive.
- Schedule and send a repair crew onsite according to SEW operational availability.
- Execute the repair of the leak.

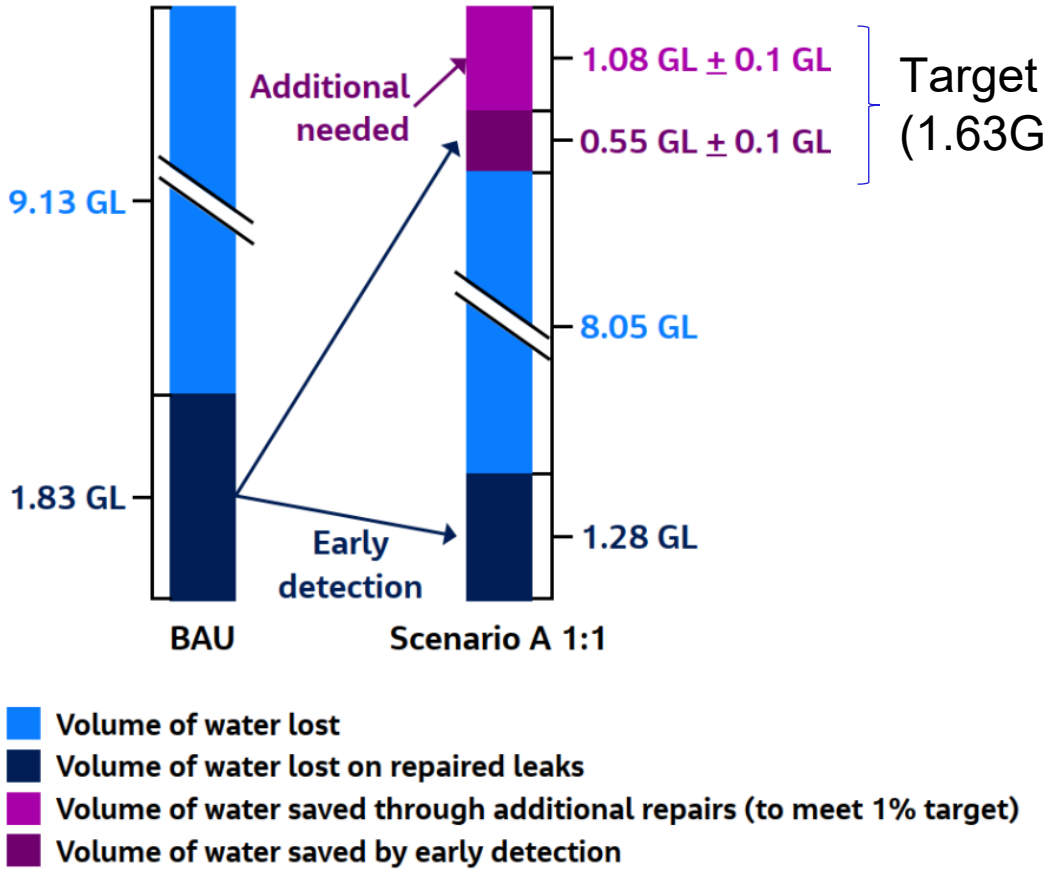
Time is of essence

Thorough analysis is needed to quantify the volume *saved* from the distinct capabilities of the sensor.



Background leaks

Potential leak savings from the Sotto deployment (SEW network)



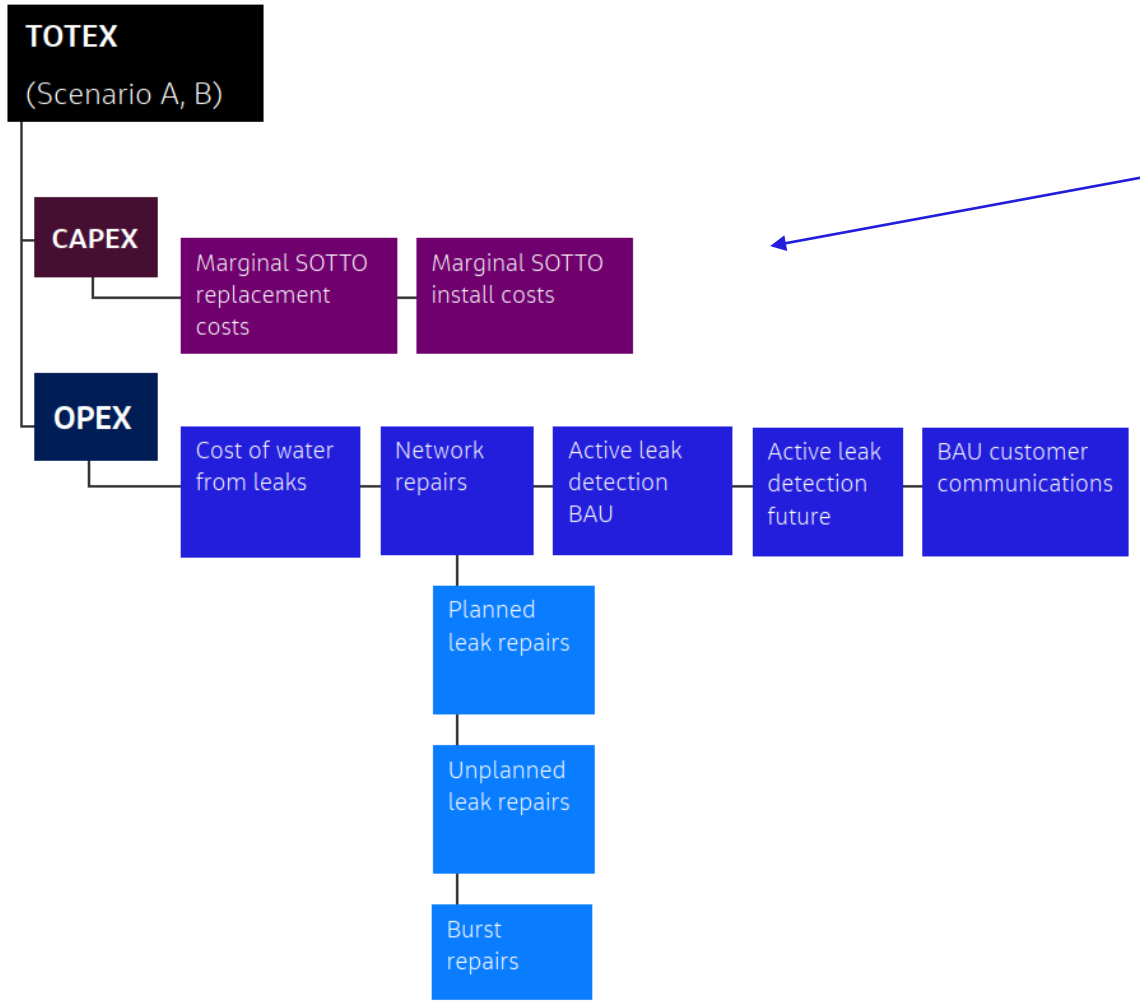
A portion of water can be saved through *early detection.*

To reach 1% reduction in water purchased from MW (1.63 GL) additional repairs are needed.

After some modelling …

	BAU	Scenario A
Additional repairs needed. Several assumptions are behind the model. One of them is to assume that largest leak flow rate are targeted first.		1330

Business model



Obvious upfront cost.

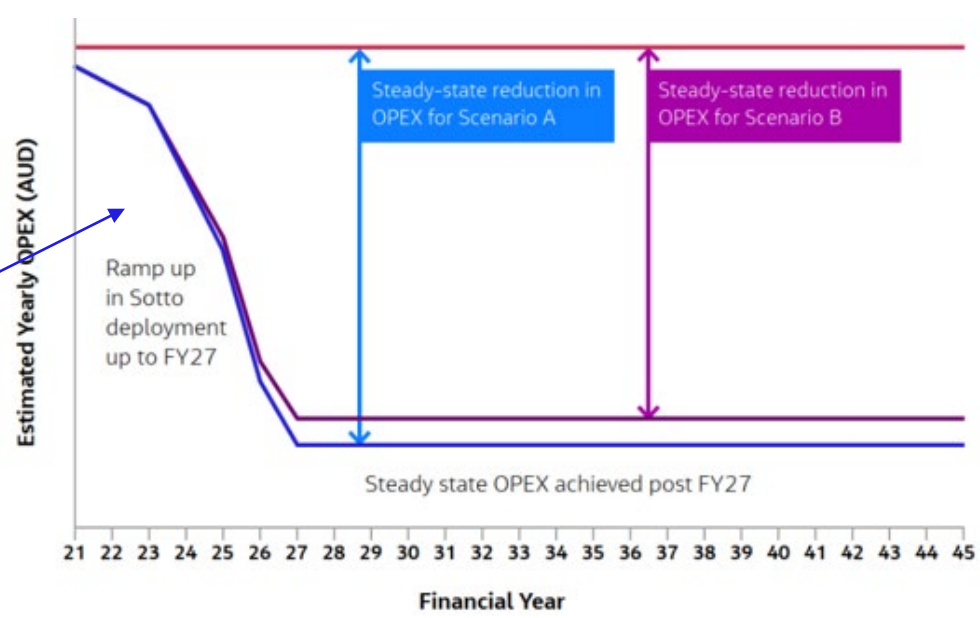
- Time needed to roll out the DMs
- NPV, CPI

Repairs (for cost purpose) are decomposed into distinct groups:

- Planned
- Unplanned
- Burst

Results

Savings starting



BAU

	BAU	Scenario A	Scenario B
TOTEX	BAU TOTEX	4.5% saving on BAU TOTEX	5.6% saving on BAU TOTEX
Steady State OPEX Cost	BAU OPEX	10.9% saving on BAU OPEX	10.2% saving on BAU OPEX
Additional repairs needed. Several assumptions are behind the model. One of them is to assume that largest leak flow rate are targeted first.		1330	2180

Financial Analysis comments/findings:

- More leaks which would have been customer notification can become planned.
  - *Benefit: Future planning efficiencies are expected to make the planned unit cost cheaper compared to unplanned BAU unit cost.*
- Volume of Water can be saved from early detection
  - *Benefit: Marginal water cost avoided.*
- Water can be saved from leaks not found by BAU (which SOTTO Detects)
  - *Benefit: Marginal water cost avoided.*
- Bursts from leaks may be prevented
  - *Benefit: Not considered as trial data is not conclusive.*

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