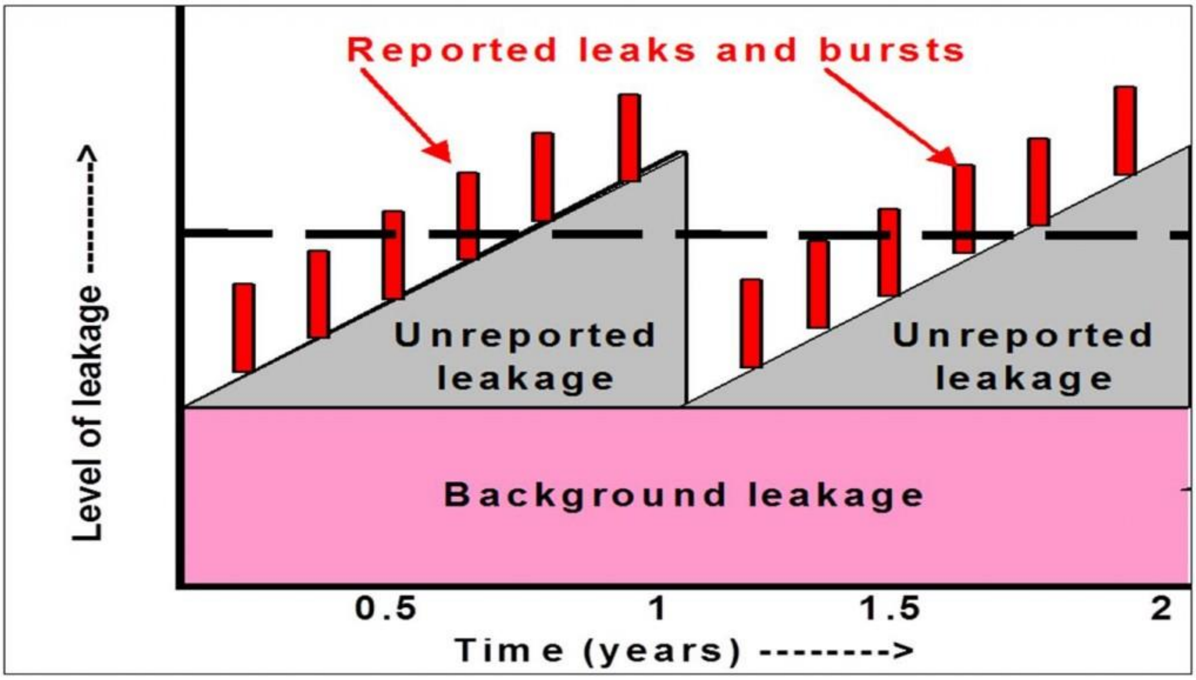
Economic ALC Intervention

Rate of Rise of Unreported Leakage

Calculating Active Leakage Control economic frequency and budgets

Calculation of economic intervention frequencies for active leakage control (ALC), based on continuous night flow measurements in small District Metered Areas (DMAs), commenced in the UK in the early 1990s. However, outside the UK, a simpler less data-intensive practical method, based on regular survey, was needed to promote the wider use of active leakage control and quickly estimate ALC budget requirements.

The approach adopted by IWA Task Force members (Lambert & Fantozzi, 2005; Lambert & Lalonde, 2005) is based on Rate of Rise of Unreported Leakage, which can be quickly estimated in several different ways. The concept was initially proposed in a 1998 Financial Times *Energy* publication authored by Lambert, Myers and Trow .



The figure above is a simplified view of the three components of leakage in a system – background leakage (pink), unreported leakage (grey) and reported leaks (red). Following an active leakage control intervention, unreported leakage starts to rise, and at some time (T) another intervention will be needed; the process then repeats itself. How can economic intervention time (Te) and annual ALC budget be calculated?

If the Rate of Rise of unreported leakage can be estimated, even approximately, then it can be shown that the economic intervention time Te occurs when the monetary value of the unreported leakage volume (represented by the volume of the grey triangle times CV, the Variable Cost of leakage) equals the cost of an intervention (CI). Note that Intervention Cost excludes repair costs.

Te is then simply calculated as: $Te = \sqrt{(CI/(0.5 \times CV \times RR))}$

Once Te has been calculated, the Economic Intervention Frequency (EIF), the Annual Budget for Intervention (ABI) and the Economic Annual Unreported Real Losses (EAURL) can also be quickly and easily calculated.

If Intervention Cost CI is in \$, Variable Cost CV is in \$/m^3, and Rate of Rise of unreported leakage is in m^3/day, per year, then:

Economic Intervention Frequency EIF (months) = $\sqrt{(0.789 \times CI/(CV \times RR))}$ (1)

Economic % of system to be surveyed annually EP (%) = 100 x 12/EIF …(2)

Annual Budget for Intervention (excluding repair costs) ABI (\$) = EP% x CI (3)

Economic Annual Unreported Real Losses EAURL (m3) = ABI/CV .... (4)

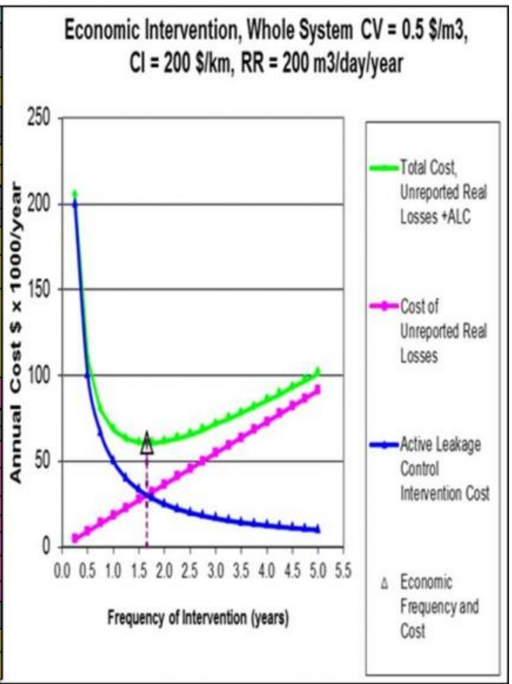
This practical approach can be applied to a whole Utility distribution system, or to any individual Zone within the system.

Three methods are given for assessing Rate of Rise of unreported leakage, but because the Economic Intervention time Te varies with the square root of the Rate of Rise, an approximate value of RR is sufficient to enable calculations to proceed. They can be refined later, as each time an intervention is made, Rate of Rise can be recalculated (based on the unreported leaks found, and the time since the last intervention); so the approach can become self-calibrating for each Zone within a distribution system.

Because Rate of Rise has unusual units, Lambert and Fantozzi developed a 5 stage international grading system (Very Low/ Low/ Moderate/ High/ Very High) for Rate of Rise, and Confidence levels for the calculations. The results below, from the 2009 Australian version of ALCCalcs software provided to Australian WSAA Utilities, show that this simplified approach produces ‘mimimum cost’ solutions of the same form as more complex UK Economic Leakage Level calculations based on continuous minimum night flows.

Provisional Categories for Rate of Rise (Lambert & Fantozzi)		
RR CATEGORY	Rate of Rise in litres/service conn./day/year	
	Range	Mid-range value
VERY LOW	Less than 20	15
LOW	20 to 40	30
MODERATE	40 to 80	60
HIGH	80 to 160	120
VERY HIGH	More than 160	

Data entry		Calculated values	Data from another Worksheet		
Step 1: Enter Country, Currency, Volume Units, Utility and System					
Country	Australia	Currency =	AUD	Volume units =	m^3
Utility	Master			System	Whole System
Step 2: Enter mains length & number of service connections					Conf. limits+/
Length of mains		250.0	km		1.0%
Number of service connections		10000			2.0%
Step 3: Enter key parameters for calculations (CV, CI, RR)					Conf. limits+/
Variable cost of water CV =		0.500	AUD/ m^3		10.0%
Full system intervention cost CI (excluding repair costs) AUD/km =		200	50000	AUD	10.0%
Natural Rate of Rise of unreported leakage RR		200.0	m^3/day in a year		25.0%
		20.0	litres/conn/day per year		
		1.00	m^3/km mains/day/year		
and is categorised as being		Low			
Step 4: Review calculated figures for Economic Intervention					Conf. limits+/
Economic Intervention every		19.9	months		4.0
Economic Percentage checked		60%	of system per year		12%
Annual Budget for Intervention		30.2	Thousand AUD		6.1
		3.0	AUD/conn/year		0.6
Economic Unreported Real Losses		60.4	Thousand m^3/year		12.3
		16.6	litres/service conn./day		3.4
		0.66	m^3/km of mains/day		0.13
Step 5: Complete the Audit trail for the calculation					
Name	A.N.Other		Date	2nd Dec 2009	
e-mail	Anyone@anywhere.com				



Source: ALCCalcs software, ILMSS Ltd

This approach to Economic Intervention also greatly simplifies the assessment of Short-Term Economic Leakage Levels

Two keynote papers presented at International Conferences in 2005 can be accessed for supplementary information:

Lambert, A.O., and M. Fantozzi, July 2005. Recent advances in calculating economic intervention frequency for active leakage control, and implications for calculation of

economic leakage levels. IWA Conference on Economics, Statistics and Finance, Rethymno, Crete, Greece, July 2005.

Lambert, A.O., and Lalonde A, September 2005. Recent advances in calculating economic intervention frequency for active leakage control, and implications for calculation of economic leakage levels.

 26th November 2020