From Hunted to Hunter: How one water company achieved a tenfold decrease in water leakage from 36% to 3.7%

About Service des eaux de la Ville de Luxembourg

Service des eaux de la Ville de Luxembourg is the public authority with responsibility for the provision of water to Luxembourg City. It supplies 105,000 residents over an area of 51Km^2. Although Luxembourg City is not particularly large, it poses a number of challenges for the water provider. The city layout is complex, as it straddles hills and drops into two gorges. The water infrastructure must cope with elevation changes of over 100 meters. Additionally, there are large changes in population with the number of people present in the city more than doubling during the day.

Much of the water is supplied from local springs which can provide up to 60% of requirements. The remainder must be purchased in from a third party, which is more expensive. This makes the cost of lost water through leakages very apparent. For this reason, VDL has a history of investing in technology to reduce leakages. However, this investment is carefully scrutinised and decisions are made using a data led approach. Results have been impressive with successive rounds of investment yielding a tenfold reduction in water lost through leakage from 36.6% to 3.7%.

Introduction of noise loggers

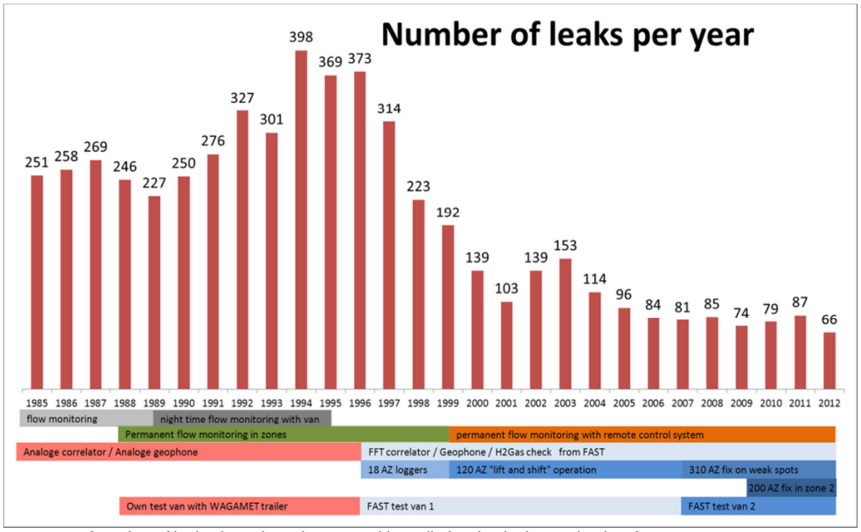
Noise logger placed on a spindel

VDL's first use of noise logging as method of leak detection was in 1996. The previous years had been difficult with leaks on the network increasing to over one a day. Of those 40% were emergency call outs for visible leaks. As Roger Schlechter, who oversees leak detection at VDL commented, "We felt like we were being hunted. Everybody knew the number for the water service". The introduction of flow monitoring and correlation technologies had not achieved the desired results. Collating and analysing the leakage data, Roger noticed that flow monitoring appeared to be making things worse. Pressure changes from opening and closing the system combined with the potential to introduce air were putting stress on the infrastructure. A new approach was clearly needed.

For the next round of investment Roger believed it was important to work alongside a partner who would get to know and understand their problems and work on solutions with them. A relationship was developed with FAST GmbH to introduce Acoustic Zone Monitoring, a noise logging technology. Noise loggers were directly installed onto pipes, valves or fittings where they recorded noise levels during low-water-usage times. The loggers were programmed to transmit this data during set times during the day. A measurement van with a receiver unit was used to collect and analyze the data as it was driven past during transmission times. By comparing over time minimum noise levels during periods of low usage, (typically taken at night), it is possible to determine the likelihood of a leak. For simplicity, this is given as one of three values: leakage, no leakage, possible leakage. Crews can then be deployed to a specific site to investigate as appropriate.

After an initial 18 noise loggers were deployed two immediate advantages became apparent. Firstly, passive monitoring ensured the infrastructure was not being put under any additional stress and so new leaks were not being introduced. Secondly, the data collected gave a more accurate indication of the leak location. Consequently, repairs were quicker and the manpower required to conduct the leak surveys was less.

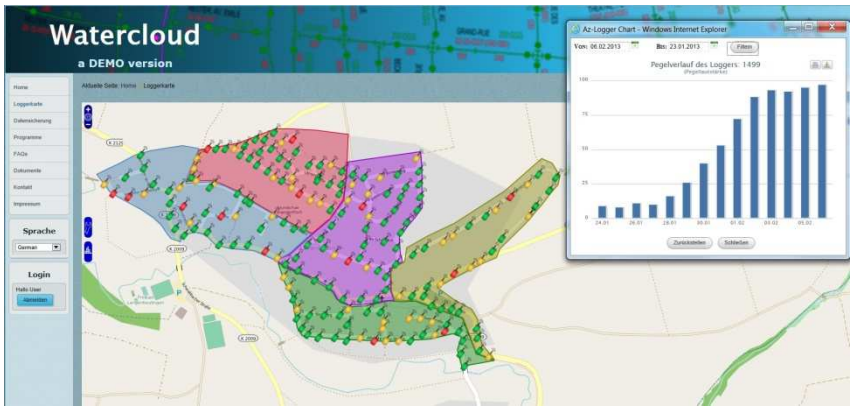
With the success of these loggers clearly evident, VDL increased their numbers to 120. These were used on a "lift and shift" basis and moved around the different zones. The loggers were split into three groups of 40 loggers which were left for three days at a time. The recorded measurements were saved which enabled comparisons over time. With the introduction of these additional loggers the time taken to find and repair a leak reduced from a month to a week. The number of leaks was also steadily decreasing. In 1994 prior to the introduction of the loggers 398 leaks had been recorded, in 2006 this had fallen to 84.



Decrease of number of leaks throughout the years with applied technologies on the time frame

Further investment followed with an additional 310 loggers permanently deployed on known weak areas of the infrastructure. The benefit of noise logging for leak detection was clear and an obvious next step was to deploy the technology across the entire infrastructure. This would ensure leaks would be found across the whole network and a program of planned repairs could be put in place. In addition to the cost savings from reduced water leakage, it would allow planned repairs with advance warnings of road closures and supply disruption. However, the challenge was to achieve this without requiring additional manpower for data collection.

Watercloud: enabling the wider deployment of noise loggers



Watercloud Map overview with installed loggers and retrieved data of one

Watercloud uses peer to peer transceiver stations and GSM master stations to automatically send monitoring data to a cloud database which can be accessed at any location by the client. The number of noise loggers which can be used on the network is no longer constrained by the manpower required to collect the data.

Each transceiver station can receive data from up to 10 loggers. The master stations can then collect the data from up to 50 transceivers or loggers and upload it by GSM into the central database. This data is overlaid onto a graphical depiction of the network giving a simple overview of the network status at any time. The data for each logger is displayed in a clear traffic light format: red indicates a leak; yellow indicates concern and green requires no action.

Currently, VDL have deployed 1400 loggers. The goal is to cover the complete infrastructure using 2000 loggers, 750 transceiver stations and 40 GSM master stations. Finally, as Roger puts it, “We are no longer the hunted but the hunter. Working with FAST GmbH we have developed a solution that puts us in control of our leak detection process. With the reduction in non-revenue water we see the system paying for itself.” Instead of reacting to calls or emergencies, the crew can check the network status either in the control room or out in the field. It is possible to plan and prioritise responses. With less time being used to collect data, the crew can focus their time on repairs. Additionally, with the correlation capabilities of the loggers, survey sites are smaller and the time to repair is shortened.

Benefits

	2010	2011	2012	2013
Total water consumption m^3	7,422,626	7,264,333	7,246,556	7,081,452
Customer consumption m^3	6,933,860	6,959,388	7,055,447	6,821,503
Non-revenue water m^3	488,766	304,945	191,109	259,949
Non-revenue water %	6.6	4.2	2.6	3.7

Table 1: Revenue and non-revenue water 2010 to 2013

Reduction in non-revenue water
Prior to the introduction of noise loggers non-revenue water was 36% of total water consumption. Since the investment in Acoustic Zone monitoring the trend has been towards a steady reduction in non-revenue water and was 3.7% in 2013. Continued savings have been made in recent years with a reduction in volume from 488,766m^3 in 2010 to 259,949m^3 in 2013. As leaks are being found and repaired quicker the volume of non-revenue water has been falling faster the number of leaks. For VDL this has represented considerable savings as less water needs to be purchased from 3rd parties.

	1994	1998	2004	2009	2013
No. of loggers installed	0	18	130	440	1,115
Total no. of leaks	398	192	114	74	52
Leak type %					
Emergency	41	33	30	12	19
Customer call	56	48	27	51	29
Planned repair	3	18	43	36	52

Table 2: Number and type of leaks since the introduction of noise loggers

Number of leaks reduced
The introduction and increased installed base of noise loggers has resulted in a reduction of leaks from 398 to 52. With the number of the repairs reduced and the locations more accurately indicated less staff is required for repair crews.

Fewer emergency calls
Prior to the introduction of noise loggers on 97% of all repairs were in response to emergency or customer call outs. In 2013 just over half of all repairs were planned allowing VDL greater control over the work. This resulted in less disruption for the residents of Luxembourg as the impact of inconvenient road closures or supply restrictions could be minimised.

Improved leak location information
As the noise loggers are capable of correlation it is possible to localise leaks. Smaller survey areas improve the time it takes to pinpoint and repair the leak.

Reduced staff requirements
With fewer leaks and better information on their location it has been possible to reduce the number of repair staff from 15 to 4.

About the technology

AZ BIDI Loggers

Bi-directional programming	Allows user to set own parameters for: Duration of measurement window Timing of measurement window Frequency of measurements Data transfer window Data transfer frequency Amplification factor for noise signal Transmission power Date and time
Data collection	Statistical minimum for previous measurement window Statistical level for previous 14 measurement windows Frequency spectrum Logger no. Logger position
Correlation	User can conduct correlation using two noise loggers
Transmitting power	10mW
Frequency	433Mhz
Amplification	200,000 fold
Port	Bi-directional radio
Protective classification	IP 68
Temperature Range	-15^{o}C to +55^{o}C

Transceiver station

Transmitting power	10mW
Frequency	433MHz
Radio distance,(Repeater to Repeater – above surface)	Max. 2500m dependent on local conditions
Port	Bi-directional radio
Protective classification	IP 67
Temperature Range	-15°C to +55°C

GSM master stations

Transmitting power	10mW
Frequency	433MHz
Transmitting Data	UMTS (SIM-Card, mobile network)
Port	Bi-directional radio
Protective classification	IP 67
Temperature Range	-15°C to +55°C

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