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Satellite-Based Leak Detection in the GCC: A Case Study

Water Vision Technology (WVT) was retained in October 2021 by a large utility in the GCC to apply its Satellite Leak Detection Technology (SLDT. The objective of the pilot project was to assess the technical efficacy and value proposition of the WVT method in identifying leaks in comparison to the traditional leak detection methods.

For this purpose, the utility assigned 13 District Metered Areas (DMAs) to WVT to demonstrate the effectiveness of the technology. The utility reported that the thirteen assigned DMAs all had non-revenue water (NRW) higher than 40% prior to the pilot project. It was further reported that the utility had struggled to achieve NRW reductions in these DMAs.

To confirm a successful deployment of the SLDT benchmark metrics were agreed to before the work began. By defining success criteria, the client can determine at what level of performance they would be willing to continue with the service, and the service provider is able to proactively predict the result of the program.

The Key Performance Indicators (KPIs) agreed to by the parties for the pilot project are shown in Table 1. These criteria were selected as they are the performance achieved by the utility internal leak detection staff when searching for leaks in the traditional manner within the identified DMAs. Success is defined as the WVT program exceeding the performance of the traditional utility teams.

Pilot Success KPI	Utility Target
Number of Leaks found per KM	**> 0.2**
Number of Leaks found per Crew Day	**> 2**
Leak Distance from Pinpointed Location	1.5 meters
% Dry Holes	1

Table 1

A GIS database of the pipe system within the selected DMA's was provided to WVT and a satellite image of the areas was collected on 5 October 2021. Physical boots-on-the-ground (BOTG) leak pinpointing work began on 27 October and was completed on 22 November 2021. The results of the program are listed in Table 2.

WVT- Utility Pilot Project Results	
Kilometer of Pipe Surveyed by Satellite	1719.2
Kilometer of Pipe Physically Inspected by BOTG	60.5
Leaks Found	152
BOTG Crew Days	22.5
Leaks per Crew Day	**6.8**
Leaks per Kilometer Investigated	**2.5**

Table 2

As can be seen from the tables WVT exceeded the KPIs set as success criteria by a significant margin. 6.8 leaks per day versus a benchmark of 2: a 3.4-fold improvement. 2.5 leaks per kilometer found versus a benchmark of 0.2: a 12.5-fold improvement. What this shows is that the satellite survey can identify areas in the system where there are clusters of leaks. Leaks are not evenly distributed in a system. Some areas have a higher density of leaks. The SLDT can pre-locate those areas with higher leak densities

thus allowing for the BOTG leak crews to be more successful in finding leaks. Of the 152 leaks found pursuant to this effort, 137 were on the utility side of the meter and fifteen were on the customer side. Seventy-eight percent of the utility side leaks were found on service lines. The 137 utility side leaks result in NRW and thus a net loss to the utility. The value proposition is achieved when these leaks are repaired.

For the third KPI, all actual leaks should be found within 1.5 meters from the pinpointed locations, most leaks were indeed within this target. In some cases, the excavations were extended rather than filling and re-excavating. The fourth KPI, 99% of pinpointed leaks are found on sites pinpointed by the BOTG crews, was achieved as the WVT performance against this was 99.52%.

To evaluate the value proposition, the leak size and duration must be considered. The value proposition can be articulated in terms of water saved or recovered, or, in terms of avoided cost or money saved. In this case the BOTG leak detection teams calculated the size of the leaks by analyzing the system pressure at the leak location and the size of the hole in the pipe. When the leak was pinpointed the utility crews evacuated the pipeline and exposed the leak. This allowed for a direct evaluation of the leak size. The WVT team executed a leak measurement analysis from 75 defective pipe segments that were recovered after repair. They were connected to a remote supply and pressurized to 2 BAR leak flow rate was observed. This allowed for a valid estimation of leak flow rate. See Figure 1.

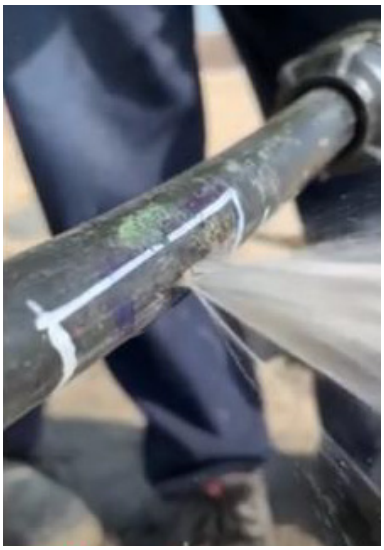
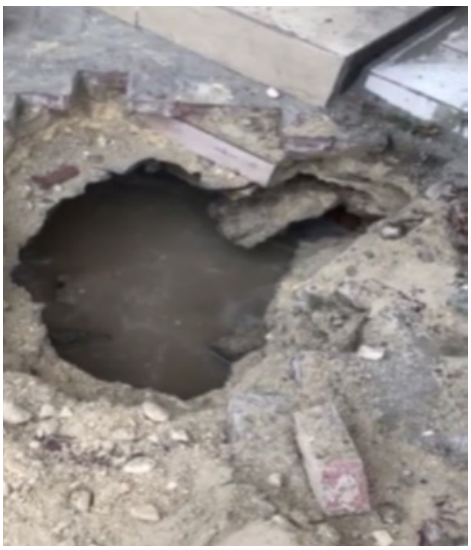


Figure 1



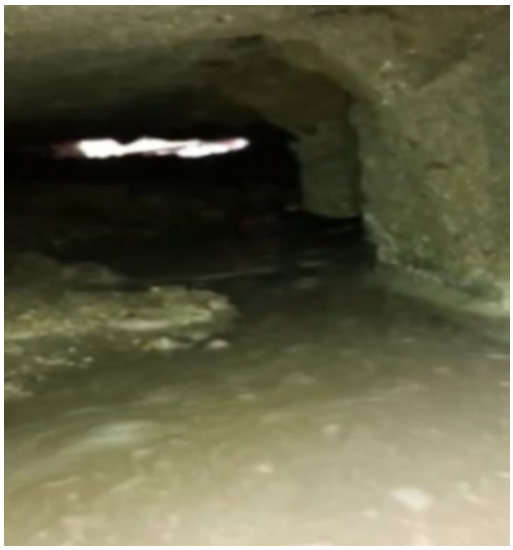


Figure 2

A total of 177.34 cubic meters per hour of water loss was stopped by fixing the leaks found in this program. This equates to a total of 4256.16 cubic meters per day or 1,532,217.60 cubic meters of water per year. The leak duration can be estimated based on whether the leak was surfacing or not. In this pilot study fully 93% of the leaks identified were non-surfacing leaks. Leaks that customers or citizens would never have noticed and could have lasted months or years before catastrophic failure of the pipeline. Because most of the leaks found were unreportable it can be assumed that the leaks would go unnoticed for a prolonged period of time. It was estimated that, based on the cost of water production, the utility is saving 2,762,580.03 Euro per year.

One example that supports the contention of long-term non-surfacing leakage is shown in Figure 2. Pursuant to excavating a pinpointed location extensive underground damage was uncovered associated with the leak. A large, 6–7-meter length, cave was found. The leak had clearly been active for several years to cause this much settlement and erosion. During excavation it was noticed that the building's foundation had been eroded causing structural damage. This underscores the value in quickly finding non-surfacing service leaks well beyond the water and money savings. Liability, damage and potential negative health impacts can be avoided.

The pilot study achieved all the success criteria developed prior to the progression of the work. The technical efficacy of the SLDT approach was clearly demonstrated.