Chapter 9

Method I: Acoustic correlation using hydrophones on large diameter pipes and on non-metallic pipes

The water-borne wave is detected directly by hydrophones placed into the water at convenient fittings such as fire hydrants. Trunk mains are also more difficult to monitor permanently because of their large diameters, the longer distances between access points, and the multitude of acoustic interference (low-frequency

Figure 9.1 Correlation result with hydrophones on a 500 mm PVC pipe over a distance of 876 m, filter range 20–48 Hz. (Source: Primayer)

Leak Detection: Technology and Implementation
Editor(s): Stuart Hamilton and Bambos Charalambous
doi: 10.2166/9781789060850_0049

rumbling). In order to be able to successfully correlate in this situation, the functions listed in Section 9.1 are ulitised together with optimised low-frequency signal processing. The distance between two sensors can range from 300 metres up to typically 2000 metres.

9.1 PERMANENT CORRELATION MONITORING USING HYDROPHONE SENSORS

The system typically consists of the following components per measurement point, whereby two measurement points will be typically approximately 800 metres apart:

- high-sensitivity hydrophone sensor that listens directly inside the water column and transmits sound data via cellular communications to a data gateway
- data gateway to relay the sound recording to a central server or cloud solution
- automatic bleeding valve option to evacuate air bubbles trapped inside the pipe or hydrants just before the measurement
- power sources for the sensor and the gateway (either mains power, independent battery packs or solar panels for self-sufficiency). Smaller, internal battery powered models available (Figure 9.3).

Advantages

- Low labour intensity compared to frequent manual leak surveys
- Low running cost
- High pinpointing accuracy
- No need to close off valves or empty pipes
- Remote leak detection and network management
- Near-real-time (daily) leak alarm.

Disadvantages

- Relatively high initial system purchase cost
- Secondary on-field confirmation and localisation
- Some systems require need for permanently installed equipment above ground. (Below ground cellular communications systems are available.)
- Higher power requirements than other noise monitoring systems.

Figure 9.2 Solar-powered 3G data gateway on a nearby pole (right) and hydrophone sensor with external antenna and battery pack, plus automatic bleeding valve (left). (Source: Gutermann)

Recently, lower cost alternatives have become available for trunk main monitoring without the need for street furniture or permanent power supplies. This is a remote correlating noise logger which does not use GPS signals for time synchronisation and can therefore dispense with above-ground aerials. Instead it uses a combination of radio and cellular communications to provide accurate time synchronisation using only underground antennae. This allows daily monitoring of hydrophone data with the same pinpoint accuracy, though shorter duration audio recordings are made so external power supply is not required. The lower system and installation costs facilitate deployment of the system across larger areas (Figure 9.3).

Figure 9.3 Remote correlating loggers with hydrophone sensors showing leak location (the red dot) over a distance of 4618 m. (Source: Anglian Water/Primayer)