

## Finding water leaks in pipes of different types:

This document presents ideas for finding leaks in water pipes. Including:

Cement Pipes

Metal Pipes

Plastic and non-conductive Pipes

We introduce three methods for finding leaks. Each method works for different cases.

Method one: Monitoring the inside and outside of the pipes (Figure 1).

Method two: Monitoring the earth or areas alongside the pipes (Figure 2).

Method three: Monitoring temperature variation around the pipes using infra-red camera

Two methods rely on forming a basic electrical circuit sending electric pulses over time frequencies to measure variations in earth resistance surrounding the pipes.

Earth types have different conductive properties. Moist increases electrical conductivity.

The idea is to design an electric circuit works using an electric current and the earth resistance. If the conductivity in normal condition is set to read zero, any increase in moisture will increase conductivity increasing current flow and triggering higher readings and alert signals passed to control.

Rain and snow sensors will be needed in cold and rainy areas to adjust alerts triggers.

### Method 1

Suitable mainly for metal pipes. An electrode is planted inside the pipe, fitted with small turbine work by the water flow generating a small electric current enough to drive a small electric circuit.

The circuit has two poles. One in the water and one in the earth at the pipe level or under it, the distance to the pipe depends on the type of earth and its water absorption.

The circuit sends electric pulses over a set time frequency e.g. per hour. Signal will be set to zero for normal operation during normal conductivity. If there is a leak and increase in conductivity, the signal reading increases triggering light or sound alerts to control indicating the location of the leak. Humidity sensor would be installed to help ignore alerts triggered by weather changes like rain and snow that increase the surface air humidity.

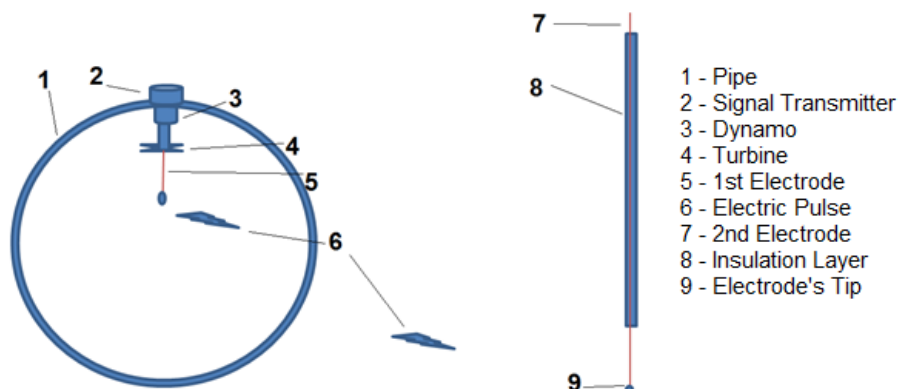


Figure 1

## Method 2

This method depends on the variation of earth resistance using sensors alongside the pipe. Each location will have a device consists of a circuit with an electrode measuring earth resistance, a small solar cell to power the circuit and a transmitter to send signals to control.

The device and electrode are planted in the earth at a distance from the pipe defined by the type of the earth and conductivity properties. Then other electrodes are planted alongside the pipe at suitable equal distances between the electrodes. Electrodes are insulated completely apart from their tips immersed at a suitable depth.

The solar cell powers the circuit continuously using a rechargeable solar battery for day and night operation. Sending pulses out checking earth conductivity that would increase in case of a water leak and the variation in resistance. Sensors for weather variation will be installed to ignore weather moisture increase.

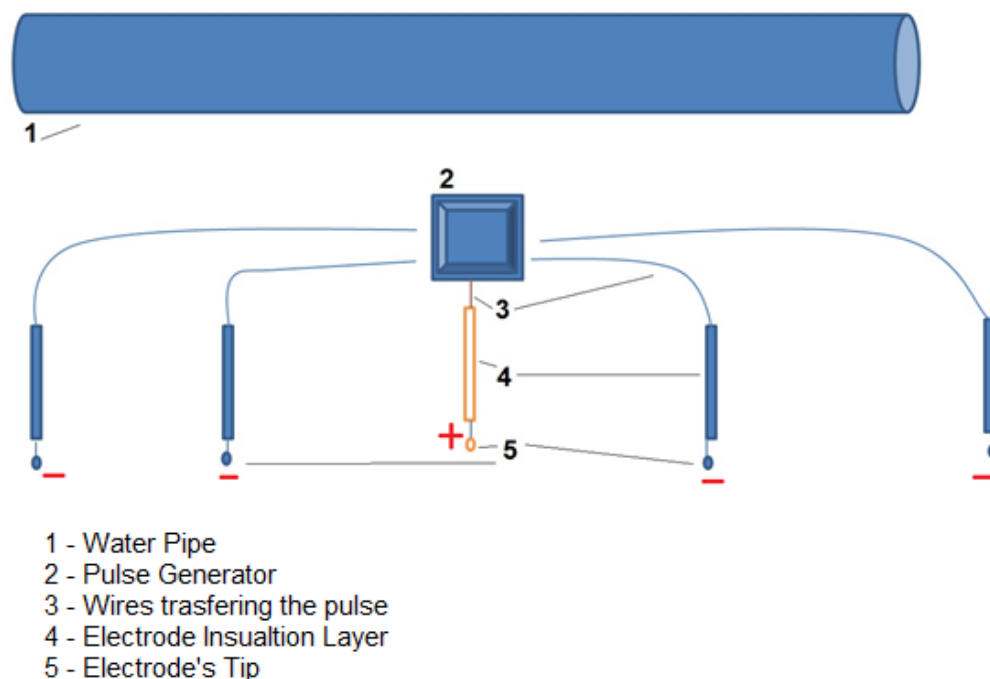


Figure 2

## Operation

This is a device to alert control/engineers about leaks in water pipes. It sends an electric pulse through a circuit using earth around the pipe as resistor.

The variation in earth moisture changes the resistance in the circuit triggering different alerts transmitted using basic mobile transmitter to control. Alerts can be green and red indication normal and moisture increase respectively.

## The device

Electrical circuit of two electrodes using earth conductivity as resistor.

Power pack in form of dynamo if inside the pipe or solar battery cell for the eternal operation.

A signal transmitter using mobile text sims or wires laid on the pipes depending on costs and lengths.

We assume using one transmitter per kilometre with several sensors between them to reduce costs.

### Method 3

Temperature variation of the pipe surface where there is a leak.

Using drones or poles fitted with infra-red cameras to take photos periodically over certain distances e.g. between 1-3 Kms and compare colour changes that would indicate temperature variation due to water leaks around the pipes.

The cameras would send the information to control to analyse the variation.