

Fibre optic leakage detection system – Peak District National Park, United Kingdom

Early detection and exact localisation of leakages are fundamental requirements to protect embankments. Temperature measurements using fiber optic cables can detect erosion in time and prevent serious damage.



Embankments at Riding Wood Reservoir (left) and at Digley Reservoir (right), United Kingdom

The **Riding Wood Reservoir** was originally constructed in 1878 and has a storage volume of 235.000 m³. An approximately 21 m high earth fill dam with a clay core impounds the reservoir. Riding Wood is one of the four reservoirs that supply Holmbridge Water Treatment Works. Temperature sensors were installed in 2012 on the downstream side of the clay core. They were set up for the usage as long-term leakage monitoring system. The aim of the monitoring system is to detect possible seepage water passing through the clay core. For this purpose, 1090 m fibre optic hybrid cable was installed. For the Heat-Pulse-Method two components in the cable are important: the optical fibre as temperature sensor and the copper wires for the heating.

Nine soundings were rammed vertical into the ground along a 117.5 m section of the embankment. In the process, depths of up to 19.5 m were reached. A reference measurement was carried out in June 2015, which can be used as comparison to following measurements.



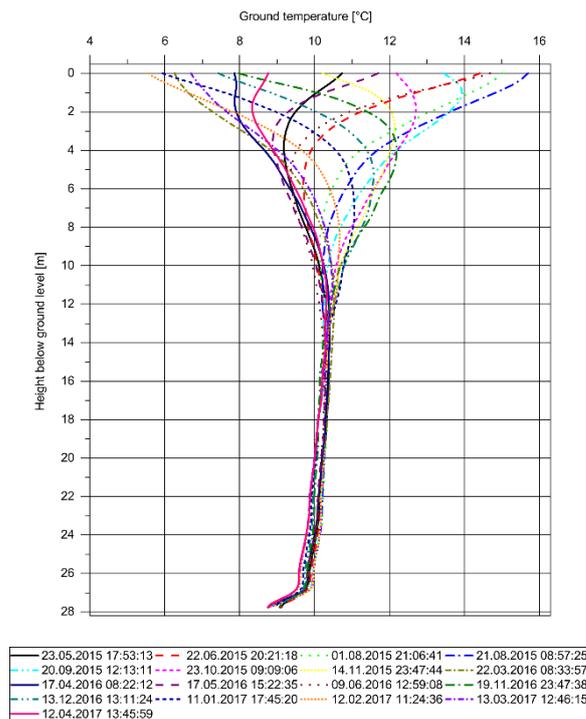
Installation of the temperature sounding at the embankment of the Riding Wood Reservoir



Installation of the fibre optic cable at the Digley Reservoir Embankment

Near the Riding Wood Reservoir is the **Digley Reservoir**. Since its construction in 1953 the 50 m high earth fill dam with the clay core subsided significantly. In October 2014, 13 temperature probes were installed permanently downstream along 192.8 m of the slope in order to start long-term measurements. The monitoring system was installed in order to detect possible seepage water passing through the embankment. Therefore, 505 m of fibre optic cable was used for the Gradient-Method and the Heat-Pulse-Method. The temperature soundings are approximately 5 m from the downstream edge of the crest and were rammed into the downstream slope of the dam to a depth of up to 29 metres. The installed monitoring system has an accuracy of ± 0.5 m and ± 0.1 K.

A reference measurement was carried out in April 2015, where no leakage was detected. In the future, changes in the leakage behaviour can be detected during subsequent control measurements. The following diagram shows the temperature depth profiles of the sounding T3 for selected dates for a period of 2 years. The sounding T3 shows the temperature profile of a non-percolated dam. In the upper 10 m of the sounding you can see the seasonal temperature fluctuations, which decrease in amplitude with the depth.



Selected temperature-depth profile for a period of 2 years for the soundings T3 at the Digley Reservoir