

Sai Wan Estate



Project nature: Wireless Automated Groundwater Monitoring System
Project: Contract GE/2005/03 (Ground Investigation - Urban)
Client: HKSAR Government (CEDD – GEO)
Fugro company: Fugro Geotechnical Services Ltd (Hong Kong)
Period: 2006 - 2007
Project value: n/a

Instrumentation has a valuable role to play in geotechnical engineering. However, there has been a reluctance to install extensive automated instrumentation systems in the past.

One of the reasons has been the requirement to install cabling between each instrument and the associated data logging system. Cable installation is costly in terms of time and manpower, and once installed the cables are vulnerable to mechanical and lightning damage. Installation of dedicated datalogging equipment for each instrument increases hardware and communications costs significantly and creates a data management nightmare, as data from multiple sources needs to be consolidated and checked.

There is now a much better alternative – advances in the fields of data acquisition, low power wireless networking, data management

and internet technologies allow the implementation of low-cost, low power wireless networking between instruments and a central data acquisition system, meaning that instruments can be deployed without concerns about cabling, and the data acquisition system can be sited conveniently to communicate both with the sensors and with an off-site data management system that can be used to post data to the internet as soon as it has been received from site.

Fugro developed such a system in house, and one of the first projects in which it was deployed was an automated groundwater monitoring system on two steep man-made slopes above the Sai Wan housing estate in Hong Kong (Figure 1).

The site location was a difficult environment in which to install a cabled system, in that access



Figure 1 – Site location

is extremely difficult, and the resulting long runs of cables would be vulnerable to lightning damage.

The system comprised a total of nine piezometers installed at different depths in five boreholes located at various locations on the two slopes.

The system used a self-organising network of low-power wireless dataloggers capable of capturing and transmitting sensor readings between themselves to a central base station, without the need for line-of-sight connections and cables.

Five wireless local dataloggers were installed, one at each instrumented borehole location. Each local datalogger was housed in a lockable enclosure located at the top of the borehole (Figure 2).

The wireless local dataloggers communicated automatically with each other and a base station located on the roof of an adjacent building to form a self-organising wireless network such that any sensor could be reached from any location within the network. In the event of failure of any wireless local datalogger, the data transmissions from the remaining units were designed to automatically re-organise the routes themselves to maintain connectivity to the base station.

The wireless local dataloggers read the sensors every five minutes, and sent the readings to the base station. The base station collected the readings from all the wireless local dataloggers within the self-organising network at regular intervals. Every fifteen minutes, the base station sent the accumulated readings to the



Figure 2 – Wireless local datalogger and antenna, at top of borehole

off-site data management system over a wireless GPRS link without disturbing the data acquisition.

The data management system was a geotechnical instrumentation database that received the incoming data from site, checked it against pre-defined threshold values, issued automatic alerts via email and SMS message if required, and made the data available to a website (Figure 3). This allowed users could check the data over the internet, as soon as it was received from site, wherever they were physically located, and without the need for special software.

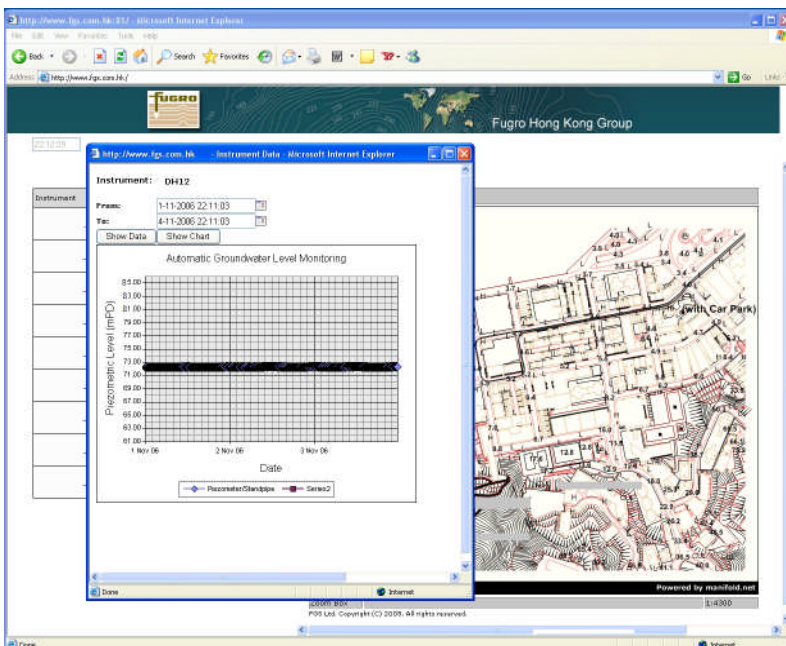


Figure 3 – website with real time graphical display of sensor readings

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