

About Schlumberger Water Services

We deliver innovative solutions to our clients through leading technologies and professional expertise to meet the increasingly complex technical and regulatory challenges in today's groundwater industry.

Schlumberger's Water Services division specializes in assessing, developing, and managing groundwater resources using some of the finest, advanced and cost effective technologies available today.

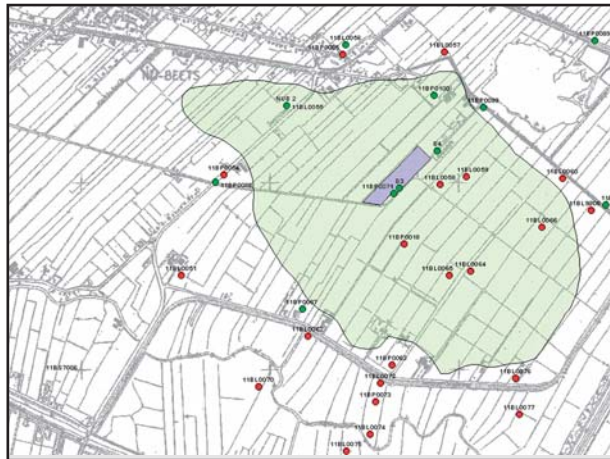
Whether you're looking for field-scale data collection, data management, modeling, or resource decision-making solutions, our teams of specialists are here to help you address all your groundwater projects safely and efficiently.

Applied Technologies:

- Diver* Dataloggers
- MOSDAX
- Geophysics
- Data Management
- Aqueous geochemical analysis and modeling
- Cross-hole geophysics

Monitoring for Groundwater Characterization

Vitens, The Netherlands



A monitoring network including monitoring wells

Highlights:

- Diver dataloggers provided Vitens with accurate bi-weekly water level measurements to comply with local water extraction permits
- Vitens required automated water level measurements obtained more frequently, requiring less time and staff resources
- Vitens was able to identify drawdown levels saving time and money

Background

The Netherlands is considered a low-lying country with very small changes in elevations throughout. Groundwater levels in the majority of the country are less than 5 meters below the surface. Heavily industrialized and with land used predominantly for agricultural activities, the Netherlands has an extensive network of monitoring wells in place to monitor the effects of water extraction and to manage groundwater resources. The country has 11 water supply companies. Each company is responsible for measuring the water levels of their designated monitoring wells on a bi-weekly basis, as part of the licensing agreement issued by the province. These measurements were registered manually at each monitoring well by company staff or volunteers. The data is then submitted digitally or in writing to NITG-TNO, the national groundwater database, where groundwater levels and subsequent effects are stored nation-wide.

Vitens, the largest water supply company in the Netherlands, started an investigation to identify alternatives for this labor intensive and costly way of collecting data. Vitens has had past experience using Schlumberger Water Services' (SWS) Diver dataloggers on the island of Vlieland, a project developed to optimize the collection of groundwater data.

Challenges

For the country, one of the main reasons for collecting water level measurements is to ensure that water extraction activities are not directly impacting the environment and agricultural activities in a negative way. Without these measurements, predicting the long-term effects from water extraction and issuing permits for new water extraction activities would be challenging.

Case Study: Monitoring for Groundwater Characterization

For Vitens, the data was hardly, if ever, used for the purpose of improving the efficiency of a pumping station - more data would be needed. However, the concern for Vitens was to ensure the bi-weekly water level measurements were taken on-time to comply with permits and without increasing staff resources. With the extensive network of monitoring wells, it became clear to Vitens that a better method for obtaining the water level measurements was required.

Solution

Vitens performed extensive feasibility studies on the Diver groundwater dataloggers in an attempt to improve the water level measurement process and increase their efficiency.

In 2001, Vitens deployed TD-Divers* into observation and pumping wells to see if they could automate their network and improve the process of data collection.

Compact and durable, the Divers were suspended by online cables inside the monitoring wells where they automatically registered water levels on a continuous basis and stored the data in their memory. This eliminated the need for company staff to visit the wells every two weeks to gather the necessary water levels. The data instead was

uploaded by field computers every three



Vitens monitoring network

months at the surface, without having to retrieve the Diver.

Over the course of 4 years, Vitens deployed over 4500 Diver dataloggers to the monitoring network. In that time, Schlumberger Water Services has developed software to further improve the download of data from the Divers. The new software allowed downloads to occur with standard pocket PCs (PDAs) instead of the more expensive field computers.

By utilizing the Diver, the frequency of measurements significantly increased. In a three month period, 14 measurements were captured instead of the required bi-weekly measurements with only one site visit by a single staff member.

The data gathered was reliable and accurate. Compared to the original manual method of monitoring, the Diver significantly reduced the opportunity for errors from occurring.

With the additional data submitted to NITG-TNO, hydrological models could be further developed and used to predict the effects of water extraction on groundwater levels and the environment, and to identify if permits for new water extraction activities should be granted.

Although not being



Diver dataloggers for accurate groundwater monitoring

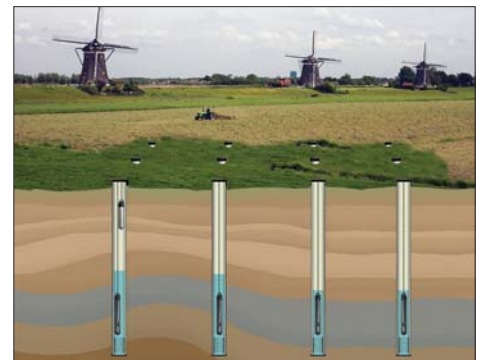
used within the Vitens project, Diver data can also be conveniently imported into HydroGeo Analyst* (HGA). This software program offers the first all-in-one solution by integrating a complete range of easy-to-use analysis and reporting tools with a powerful and extremely flexible database technology.

Results

Through their investigation, Vitens concluded that Schlumberger Water Services' Diver dataloggers were a cost-effective alternative compared to manual measurement methods. The use of Diver dataloggers improved efficiency, and reduced the time and resources needed to gather water level data.

The investigation also led Vitens to recognize there were other applications for the Diver from which they could benefit. Through the use of the Diver to continuously monitoring water levels, Vitens was able to optimally manage their pumping wells.

Since the data collected clearly showed decreasing drawdown levels, Vitens was able to identify when a pump's filter was drawing in air opposed to water and allocate resources to regenerate it as required, saving them time and money.



Cross-section of monitoring network