



Case Study

Measuring the effects of groyne reduction in a major Dutch river

CHALLENGE

High frequency, accurate and crucial surface water measurements in monitoring locations almost permanently located under water.

SOLUTION

Making use of dedicated monitoring poles, specially designed for Divers dataloggers, fixed underwater in the river bedding. Due to the high frequency measurements needed in the project, the Cera-Divers are regularly replaced by a diving team working underwater from a floating platform. Each year the individual Diver performance and accuracy were analyzed to ensure the data could be used for further analysis.

RESULTS

Meeting required accuracy expectations enabling the collected data to be used for measuring the effects of groyne reduction.



Perpendicular groynes in the Waal river (source: <https://beeldbank.rws.nl, Rijkswaterstaat, Ruimte voor de Rivier>)

Room for the River project

“The Room for the River” Programme in the Netherlands is one of the most important water management programs of the 21st century. Due to the Netherlands’ location within a delta of three major rivers, the Rhine, Meuse and Scheldt, flood protection is of high importance in water management.

The goal of the Dutch Room for the River Programme is to give the major rivers more room to be able to manage higher water levels. The plan has three objectives:

- By 2015 the branches of the Rhine will cope with a discharge capacity of 16,000 cubic meters of water per second without flooding;
- The measures implemented to increase safety will also improve the overall environmental quality of the river region;
- The extra room the rivers will need in the coming decades to cope with higher discharges due to the forecast climate changes, will remain permanently available.

At more than 30 locations measures are taken to give the rivers space to flood safely. Nine different solutions are used to give the rivers more space, these are: lowering of floodplains, deepening summer bed, water storage, dike relocation, lowering groynes, high-water channel, depoldering, removing obstacles and strengthening dikes.



Lowering of groynes (source: <https://beeldbank.rws.nl, Rijkswaterstaat, Ruimte voor de Rivier>)



How to monitor if groyne reduction is effective?

Rijkswaterstaat and Deltares have investigated if the groyne reduction in the Rhine and Waal rivers will have the desired effect on lowering the water levels in the river during periods of high water levels. Van Essen Instruments was asked to provide validated data including an uncertainty analysis of the recorded water levels with respect to Normaal Amsterdams Peil (NAP, mean sea level).

Twenty-two monitoring points were installed and equipped with Cera-Divers. The monitoring points were specifically designed for this surface water application to reduce the effects of waves and the effects of water flow within and around the dedicated Diver poles. The Divers are suspended within these poles, a hollow steel cylinder with a diameter of 15 cm. The poles are pushed approximately 5 meters in the river bed, with a height of approximately 55 cm above the river bed. The top of casing was surveyed to NAP. The 22 monitoring points were installed in clusters and each cluster has its own barometric monitoring point. A total of 8 barometric monitoring points were installed. The Cera-Divers were programmed with the averaging sample method where a measurement was taken every 1 second and the average of those measurements was stored every 10 minutes. This was done to further reduce the effects of waves caused by shipping and



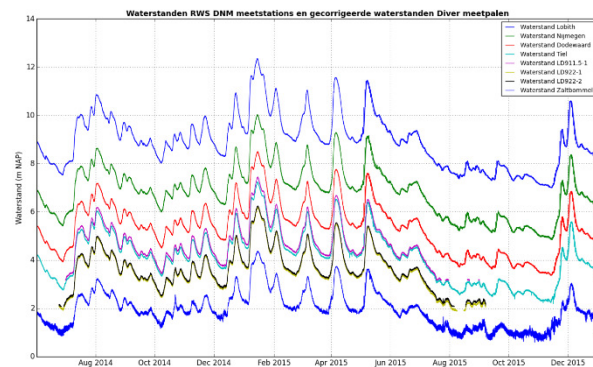
Installation of Cera-Diver in surface water monitoring point (source: Rijkswaterstaat)

rapid temperature variations and thus obtain accurate water levels.

An uncertainty analysis was performed on the entire measurement setup that included water density, acceleration of gravity, top of casing elevation, barometric pressure, Diver pressure, the elevation difference between the Diver and the barometric datalogger. Furthermore, the surface water data was analyzed and interpreted according to the requirements of Rijkswaterstaat.

Divers for surface water monitoring

Divers are well known for groundwater applications. However, since the first Diver models were produced in the 1990's, Divers have also been used effectively in surface water applications. For the Room for the River project Divers were selected by Rijkswaterstaat due to the fact that standard river gauges are costly and far less flexible when compared to the custom designed Rijkswaterstaat Diver surface water monitoring setup. The setup can be reused or replaced in a different position and the Diver can be changed depending on requirements. Divers have proven to be an accurate and reliable datalogger for measuring relatively small changes in surface water levels. Rijkswaterstaat has used the Diver in many other surface water monitoring projects.



Water levels from Diver surface water monitoring points (LD911.5-1, LD922-1 and LD922-2) compared to Rijkswaterstaat standard river gauges: Lobith, Nijmegen, Dodewaard, Tiel and Zaltbommel