

PHOSPHATE MONITOR PROTECTS CUMBRIAN LAKE DURING RESTORATION

Novel phosphate monitoring technology from OTT Hydrometry is helping the South Cumbria Rivers Trust (SCRT) to improve water quality during a project to restore a lake in the north of England. Funded by United Utilities, the Elterwater Remediation Project has been created to improve water quality by increasing water flow through the lake and dramatically lowering residency time.

Background

Situated 2 km North West of Lake Windermere, Elterwater is a high amenity value lake comprised of three basins measuring 930m long with variable widths up to 320m. The Lake is also a Site of Special Scientific Interest (SSSI). Between 1974 and 1999 United Utilities operated a wastewater treatment works serving the Elterwater village within the consents of the day. However this and other sources, left a legacy of phosphorus enriched sediments in the inner and middle basins of the lake. These in turn caused eutrophic and hyper-eutrophic conditions leading to algal blooms, anoxia and poor water quality.

In the United Utilities asset management plan for April 2010 to March 2015 (AMP5) a study was commissioned that identified the key issues and options for resolution. These included improving the lake's water quality by dredging to remove the phosphorus rich sediments or diverting two local becks to improve water turnover and prevent the conditions necessary for phosphorus release and the creation of algal blooms.

Dredging would permanently remove the phosphorus rich sediments but could cause significant environmental damage particularly in the disposal of the enriched sediments. Consequently, the preferred solution is to divert the becks. Dr Mike Sturt SCRT's Technical Officer explains: "Soluble Reactive Phosphate (SRP) released from the sediment accumulates over time and becomes bioavailable resulting in a proliferation of algae and bacteria, which causes a lowering of dissolved oxygen and pH, which in turn causes an increase in SRP desorption from the sediment. So there is a complex cycle in play which causes thermal stratification and anoxic/high turbidity conditions in the summer months. As a result, Elterwater is incapable of supporting natural, healthy populations of fauna and flora beyond benthic invertebrates."

Phosphate Monitoring

Phosphate in the lake sediment is clearly the cause of the lake's ongoing water quality problems, so the aim of the



restoration project is to implement a sustainable solution that does not result in an increase in SRP within the water body. Background phosphate monitoring therefore commenced in August 2014 and samples have been taken at 2 week intervals for laboratory analysis. However, continuous monitoring is always preferable, when possible, because spot sampling risks missing pollution incidents.

Traditional continuous phosphate monitors employ colorimetry and generally require mains power, which is often not available at remote sites. However, the 'Cycle-P' from OTT Hydrometry is battery powered and able to operate unattended in the field, running over 1,000 tests before a field service is necessary to change the reagents. When combined with telemetry, the instrument delivers almost real-time data at user-selectable intervals (typically 1 to 4 hours). "The Cycle-P is ideal for Elterwater," Mike says. "The lake is an hour's drive each way from our office, so the facility to leave it running, but with remote access, saves a great deal of time and money."

"Initially, two Cycle-P units were installed at Elterwater; either side of the middle basin, but after 1 year of operation, it became clear that one unit was sufficient – at the outlet of the inner basin."

"The performance of the Cycle-P has been excellent; it has proved to be accurate and reliable, producing good quality data that is consistent with laboratory analysis."

The Cycle-P is an in-water total reactive phosphate analyser that has been designed for operation by both chemists and non-chemists. The instrument has an onboard logger, and the quality of the data is underpinned by QA/QC processing in conjunction with an on-board NIST standard. The Cycle-P methodology is based on US EPA standard methods, employing pre-mixed onboard colour coded cartridges for simple reagent replacement in the field. With a detection limit equal to or less than 0.0023 mg/L PO₄-P, and a range of 0-0.3 mg/L PO₄-P the Cycle-P is able to measure down to extremely low levels, which makes it ideal for the Elterwater application. However, a higher range can be specified at the time of order (0 to 1.2 mg/L).

Progress to-date

The background monitoring undertaken by the Cycle-P (and lab samples) has not shown significant SRP in the water body because the release of phosphate from the sediment is quickly taken up by algae. However, the piped diversion of the Great Langdale Beck delivers around 122 litres/sec of very clean water, and the Cycle-P constantly checks that this is not causing a rise in SRP from the sediment. If alarm conditions arise, the system automatically sends a text message to Dr Sturt's mobile phone. The Environment Agency has also installed a water quality monitor (DO, pH, EC, turbidity) at the same location and this also has a text alarm system.

Mike says: "The clean water from Great Langdale Beck started to arrive in the inner basin during early February 2016 and at the time of writing no alarms have occurred, so we are cautiously optimistic!"



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