

Clatto Reservoir, Scotland

Application dates: 4th/5th March 2009

Summary

Aim: To bind phosphorus in the water column to reduce eutrophication and address reoccurring problems with blue-green algal blooms

Description: Recreational Reservoir

Size (ha): 9

Max. depth (m): 7

Average depth (m): 4

Conductivity ($\mu\text{S/cm}$): 87

Dosage: 24 tons Phoslock[®] (4-5/3/09)

The Reservoir



Aerial view of Clatto Reservoir

Clatto Reservoir (CR) is located on the north west outskirts of Dundee (56°30' N 3°01'4 W). It is a popular recreational reservoir, used for various educational activities by Ancrum Outdoor Educational Centre (AOEC), and was formerly used to supply water to the city of Dundee. In recent years the reservoir has not been used for water supply, but it can still be used for this purpose in case of an emergency. The reservoir has a total water volume of about 350,000 m³.

Recently the lake has experienced large cyanobacterial blooms and has been frequently closed to recreational users. Testing undertaken by the Scottish Environment Protection Agency (SEPA) in August 2008 showed high concentrations of various species of blue green algae (including *Gloeotrichia*, *Coelosphaerium*, *Microcystis* and *Anabaena*) with concentrations ranging between 50,000 to 129,000 cells/mL (well above the World Health Organization (WHO) guidelines of 20,000 cells/mL). Due to the potential for the reoccurrence of such blooms, which can pose a serious hazard to animal and human health, the Managers of CR were eager to identify and implement measures that would reduce concentrations of blue green algae.

It is unclear as to the origin of the high phosphorus loads in CR as the reservoir is located near the top of a hill and there are no major streams flowing into it. There are however a number of possible sources of phosphorus:

- 1) Overflow water from adjacent water treatment works
- 2) Underground inflow from upstream reservoirs that has been used in the past to flush or top up CR
- 3) Large bird population on the lake (between 30 and 150 water birds - gulls, ducks and several pairs of swans reside on the reservoir)
- 4) Addition of barley straw (algal control measure) - most of the barley straw bales were removed prior to the Phoslock[®] application.

The Treatment

A total of 24 tonnes of Phoslock[®] were applied to the reservoir between 4-5 March 2009 to reduce the phosphorus load in the reservoir.

Bags of Phoslock[®] were loaded onto the pontoon at the beach area. Pallets were lifted by the telescopic loader and placed on the pontoon, that was held in place manually. Two tonnes were loaded per run.

On the first run, the product was sprayed near the shores of the reservoir - at a distance of approximately 3 m from the edge and from the islands. As the area near the beach was rather shallow, a distance of at least 6 m was kept.

On the next four passes a systematic pattern was followed to insure an even application. The pontoon was navigated parallel to the northern shoreline starting near the northern shoreline and each



Phoslock[®] being loaded onto a pontoon in Clatto Reservoir.



Phoslock[®] applied from pontoon.

run covering a greater area towards the south. To administer more in the deeper eastern part of the lake, a short pass (returning to the beach) was included on every run. The same systematic pattern as the previous day was followed for the next 5 runs, covering the middle and southern part of the reservoir. On the 6th run two tonnes were sprayed only near the eastern shore in parallel lines with this shoreline (perpendicular to the previous runs). The 7th and final run went along parts that might have been under dosed in the western half of the reservoir, around and in between the islands.

Water sampling was taken from two sites, 1m and 4m below the water surface.

Restoration of Scottish Recreational Reservoir

Results

Data collected prior to the application of Phoslock® showed that the sediment in Clatto Reservoir contained a significantly larger pool of phosphorus (P) than the water column, with a concentration of 730 mg P per kg dry weight. The total P concentration in the water column was relatively high with 0.079 mg P/L of which most was present as (algal) biomass at the time of sampling (shown by the low ortho-

phosphate concentration). Data collected prior to and after the application of Phoslock® at a depth of 1m and 4m above the sediment surface in the reservoir are presented in Figure 1. These graphs clearly show maintenance of low TP concentrations after the application of Phoslock®. Soluble Reactive Phosphorus (SRP) and TP concentrations at 1m did not exceed 10 µg l⁻¹ (detection limit) and 35 µg l⁻¹

respectively following the application. Although TP and SRP concentrations were relatively low at the time of the application (indicating that most of the phosphorus pool in the reservoir was already in the sediment), it is important to note that high concentrations of TP (comparable to those measured in September and October 2008) were not observed after the application of Phoslock® during summer 2009.

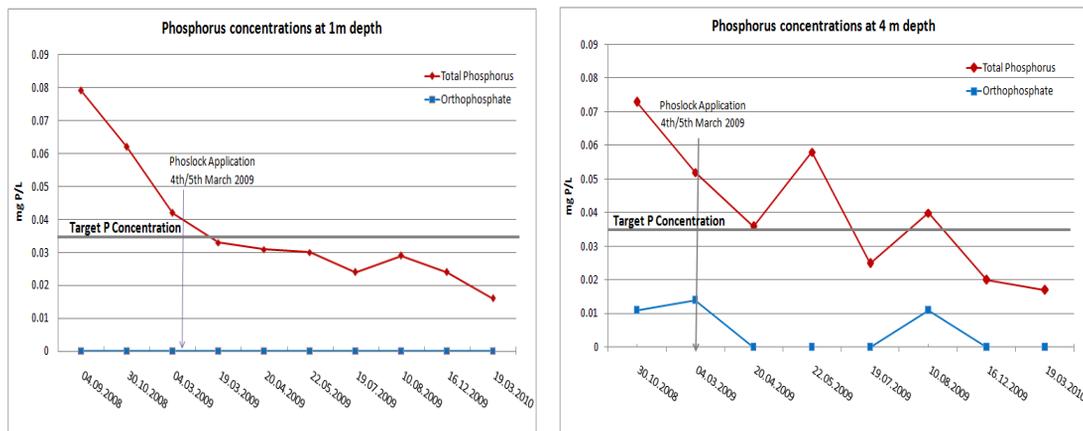


Figure 1. Concentrations of TP at varying depths prior to and after the Phoslock application at Clatto Reservoir

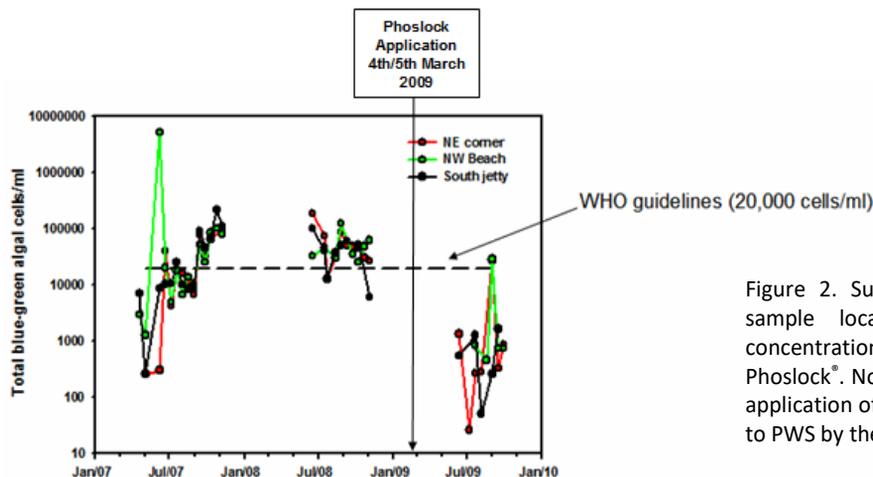


Figure 2. Summary of all SEPA data from all sample locations showing the Total BGA concentration before and after the application of Phoslock®. Note the significant decrease after the application of Phoslock® (modified figure supplied to PWS by the CEH).

Conclusion

The aim of the Phoslock® application to Clatto Reservoir was to remove the immediately bio-available and potentially bio-available phosphorus from both the water column and sediments. Data from the water column indicates that phosphorus concentrations were reduced for a year following the application. Algal data provided by SEPA before and after the application also suggests that there has

been a significant reduction in the concentration of cyanobacteria in the reservoir. . Based on the available data, we believe that the application of Phoslock® to Clatto Reservoir has been an effective nutrient management strategy that has significantly reduced the concentration of bio-available phosphorus in the lake as well as the concentration of cyanobacteria.

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Additional information can be found on our website or can be provided on request.