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Emu Lake, Western Australia

Application date: 16th /17th April 2007, 3-7th December 2007 and 9th/10th June 2011

Summary

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

***Description**: Stormwater basin / Ornamental lake*

Size (ha): 10.5
Max. depth (m): 2.2
Average depth (m): 1.5
Conductivity (µS/cm): 450

Dosage: 7 tons (16-17/4/07), 26 tons (3-7/12/07) and 22.2 tons (9-10/6/11)

The Lake

Figure 1: Aerial view of Emu Lake

Emu Lake was constructed from a natural swamp located in Ballajura in the City of Swan, Western Australia (Figure 1). It covers an area of approximately 10.5 ha (105,000 m^2) and is fed by stormwater runoff and groundwater from the Gnangara mound. Since its construction in 1980, the water quality in the lake has deteriorated with blue green algal blooms (particularly the toxic form of cyanobacteria) becoming more dominant in recent years.

Emu Lake the lake was primarily designed to receive stormwater but has a dual purpose as an aesthetic water feature. This particular lake frequently suffers from thick algal blooms and has been periodically closed to recreational activity since its construction in 1980 (Figure 2).
The manmade lake contains an organic rich peat layer about 1m below the overlying sand sediment. Sediment testing has shown that the phosphorus source into the lake is most likely from dissolution of P in the peat layer moving through the sand layer and into the water column during periods of sediment-water interface disequilibrium. Other sources of phosphorus contributing to the overall P budget are from direct inflow through drains and from groundwater interaction from the surrounding residential areas.

Figure 2: Emu Lake on 19th January 2011

The Treatment

A trial application of 7 tons of Phoslock were applied to 1/3rd of the lake on 16th/17th April 2007 to reduce the phosphorus load. Phoslock was sprayed from the shore into the lake via a hopper that mixed the Phoslock and site water into a slurry. After the success of the trial 26 tons was applied to the whole of the lake between 3-7th December 2007. On 9th/10th June 2011, a top-up application of 22.2 tons of Phoslock was applied to Emu Lake. The application consisted of a 3 stage strategy where the lake was segmented into 3 application zones. This allowed for accurate placement of the slurry using a combination of shore based and water based application. Due to access restrictions and prevailing winds, parts of the lake were accessible only by boat. For the boat application, 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.

Figure 3: Phoslock applied to Emu Lake from the shore in the 2007 application.

Figure 4: Phoslock delivered to hopper and then sprayed from boat in the June 2011 application.

The 3 application zones were:

1. North zone application
With a calculated area of approximately 5.25 hectares, 10.5 tons of Phoslock was applied to this zone. The areas to the east were applied with slurry from the shoreline while the western reaches were accessed with the use of the boat.

2. East zone application
With a calculated area of approximately 2 hectares, 4.5 tons of Phoslock was applied to this zone. Most of the slurry was applied from the shoreline from several locations with the central section to the west of the island accessed by the boat mounted slurry gun.

3. South zone application
With a calculated area of approximately 2.84 hectares, 5.65 tons of Phoslock was applied to this zone.
The Phoslock slurry was applied from the shoreline from several locations with all of the western section accessed by the boat mounted slurry gun.

Restoration of a shallow stormwater basin

Results

Figure 5 shows that the FRP concentration decreased by half after the 2007 Phoslock trial and full applications. Water sampled in Dec 07 directly after the 2nd application showed that the FRP concentration decreased from about 9.5mg/L to 4mg/L (Figure 5). There was a slight increase in FRP 4-6 weeks after the application, however this was likely due to the decomposition of algal cells in the water body after being slowly starved of phosphate. Monitoring showed a marked improvement in water quality over the period of the trial before the bund was breached due to stormwater input that winter. It is possible that the increase in FRP at the end of 2008 was due to the Phoslock active sites being saturated (i.e. the concentration of FRP coming into the lake exceeded the amount of available binding sites on the Phoslock) and a top-up application was needed at this time to reduce the FRP load. Unfortunately this was not undertaken and the algae returned to the lake. Concentrations of FRP reached a peak in March 2011, hence the need for a top-up application in June 2011. Due to this application in June, the FRP remained low during the following summer. Figure 6 shows that the Total Phosphorus concentration significantly decreased after each of the Phoslock applications and did not reach pre-application concentrations again over the approx 4 year monitoring period.

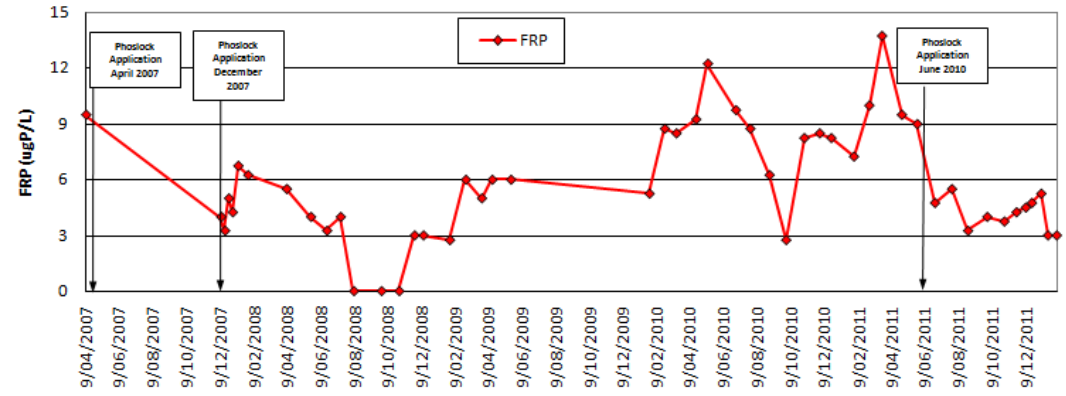

Figure 5: Concentrations of Filterable Reactive Phosphorus (FRP) in Emu Lake from April 2007 to February 2012.

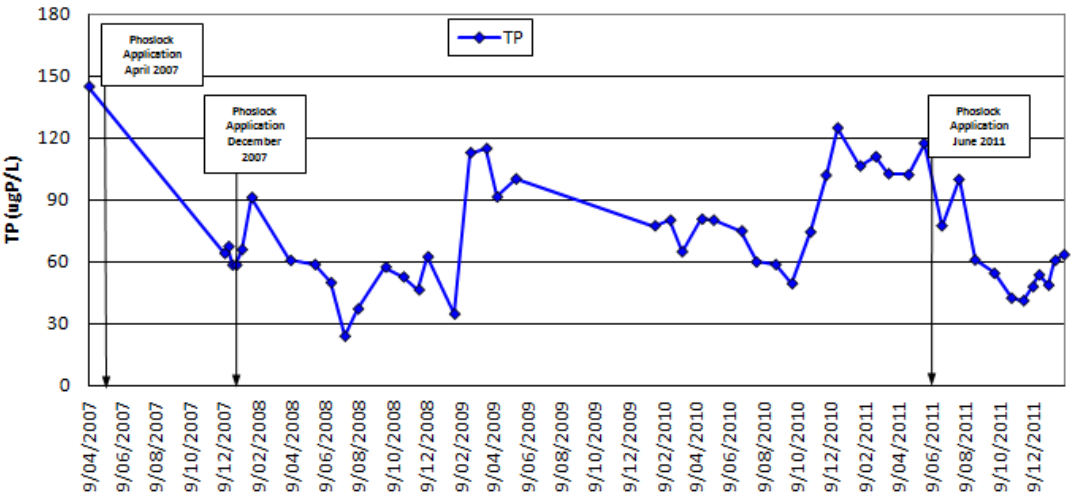

Figure 6: Concentration of Total Phosphorus (TP) in Emu Lake from April 2007 to February 2012.

Conclusion

A trial application of Phoslock to Emu Lake in April 2007 was deemed to be successful so a second, larger application was applied to the whole of the Lake in Dec 2007 to remove the immediately bio-available and potentially bio-available phosphorus from both the water column and sediments. In June 2011, a top-up application was undertaken to reduce the concentration of phosphate that had slowly increased over time (since the exhaustion of the Phoslock from the doses in 2007).

Based on the available data, we believe that the 2007 applications were effective in significantly reducing the concentration of bio-available phosphorus in the lake as well as the concentration of algae. However, as this lake regularly receives nutrient laden stormwater there was a need for a top-up dose in 2011. It is also likely that future regular (yearly) doses will be needed to ensure that the P concentrations are kept low, as to not promote algal blooms.

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