Abstract

An investigation was carried out on the limnological status and the nutrient loadings of Rufaro Dam, in Marondera. The limnological parameters of the water in the dam and the inflows that were measured were conductivity, Ph, temperature, turbidity, DO, TDS, ORP, chloride, nitrate, calcium, reactive phosphorus, total nitrogen and total phosphorus. The dam sediments were analysed for total phosphorus and nitrogen and the Planning and Management of Lakes and Reservoirs focusing on Eutrophication (PAMOLARE) software package was used to model the dam variables for purposes of managing eutrophication.

The dam water was found to be eutrophic based on EPA and South African standards, with an average total nitrogen concentration of 2.12mg/L and total phosphorus concentration of 2.25mg/L.At the intake tower where domestic water was abstracted from the Ph, DO, temperature, chloride and nitrate levels were within EPA standards for reservoirs, but the turbidity, total nitrogen and phosphorus were above EPA recommendations for reservoirs. At the dam wall the DO was below EPA recommendations for reservoirs, whilst turbidity, Cl, total nitrogen and phosphorus were above EPA recommendations for reservoirs. The average conductivity was 246.78µS/cm and the Ph at the intake tower site was 8.15, which could indicate the occurrence of periodic algal blooms. Both the conductivity and the Ph were less than the Lake Chivero values. The limiting nutrient at the time of sampling was found to be nitrogen with the ratio of total nitrogen to total phosphorus in water being 1N: 2P. The concentrations of nutrients in the outflow showed that a considerable amount of nutrients were being lost through abstracting irrigation water from the bottom.

The sewage and the storm drains exported the highest loads of nutrients with the sewage stream exporting $22.67 \text{g/m}^2 \text{ P}$, $25.5 \text{g/m}^2 \text{ NO3-N}$, $37.8 \text{ g/m}^2 \text{ PO}_4\text{-P}$ and 50.7g/m^2 total N.

Modeling with PAMOLARE predicted total nitrogen levels would increase to 19.9mg/L in six years time and total phosphorus levels would decrease to 0.72mg/L, with phosphorus becoming a limiting nutrient in 2years time. These adjustments would result in reduced productivity within the dam.

Further modeling at 6.2% reduced precipitation predicted higher maximum levels of total nitrogen (20.98mg/L) and higher levels of total phosphorus (0.75mg/L) coupled with higher productivity and reduced light penetration.

The use of the Biological Nutrient Reduction (BNR) plant was expected to reduce total nitrogen by 20% and total phosphorus by 28%, whilst the diversion of storm drains to the BNR would further reduce the total nitrogen by 40 % and total phosphorus by 42%. The reduction in nutrients would not meet EPA (Appendix E) reference criteria and so additional methods of reducing effluent from the Biological Nutrient Reduction (BNR) plant would have to be sought.