

ABSTRACT

Eutrophication causes serious water quality problems in some South African impoundments, and the first step taken to control it was the promulgation of a 1 mg P/l standard to be implemented in so called sensitive catchments. It was necessary to evaluate the impact of that standard and other phosphate control measures, e.g. the restriction of the phosphate content of detergents, on the trophic status of impoundments.

The OECD eutrophication modelling approach, consisting of nutrient export, nutrient budget and chlorophyll-phosphate regression models was used to predict the response of nineteen impoundments to nutrient loads. We predicted the trophic response of impoundments as the % time severe nuisance conditions can be expected as a consequence of assuming various eutrophication control strategies being implemented. Severe nuisance conditions were assumed to occur if chlorophyll concentrations exceeded 30 mg/m³. Our conclusions depended on this somewhat arbitrarily selected trophic status indicator variable and users of this report must realize that if other trophic status indicator variables or a lower chlorophyll concentrations were selected different conclusions about the response of impoundments to phosphate control measures may have been reached.

Up to the year 2000 the trophic status of the Vaal, Midmar, Albert Falls, Bronkhorst Spruit and Loskop Dams was predicted not to have reached a state that would require a phosphate standard to be introduced in their catchments. Control measures might be required in the catchments of Roodekopjes, Koppies, Bloemhof, Bridle Drift and Misverstand Dams. The phosphate standard to be implemented in August 1985, was predicted to have only a marginal impact on Roodekopjes and Bridle Drift and none on Koppies, Bloemhof and Misverstand Dams. Highly eutrophic conditions were predicted in Rietvlei, Hartbeespoort, Bon Accord, Roodeplaat, Klipvoor, Vaal Barrage, Laing, Shongweni and Inanda Dams such that control measures would have to be introduced in their catchments. Most of these impoundments were predicted to show a marked response to the phosphate standard. The exceptions are Vaal Barrage and Bon Accord Dam, which will receive such

large phosphate loads that more stringent phosphate standards would be required, and Laing Dam which receives a non-point source load so large that its response to the standard, which only controls point sources, would be marginal. Banning phosphate based detergents, as the only alternative to introducing a phosphate standard, is predicted to be unlikely to succeed in controlling eutrophication of impoundments. Nevertheless control of detergent phosphate load in the water environment may play a supporting role in a strategy to reduce phosphate at source.

Phosphate, rather than nitrogen, is predicted to limit the trophic response of impoundments after the introduction of the phosphate standard; consequently the future response of impoundments was predicted to be consistent with the OECD chlorophyll-phosphate relationship.

Runoff affects the hydraulic loads and non-point source phosphate loads on impoundments, as well as the average impoundment volumes. The large variation in annual runoff from South African catchments affects the result of phosphate control measures on the trophic response of impoundments. The OECD modelling approach assumes steady state; consequently the highly variable nature of South African hydrology is not explicitly accounted for in our predictions. We assumed annual runoff to be equal to the long term mean annual runoff for each catchment and a corresponding average impoundment volume of 80% of the full supply volume to simulate the response of impoundments. We regard the variable runoff in South Africa as the most important factor responsible for the lack of steady state in impoundment-catchments systems and recommend that procedures should be developed to take into account the effect of variable runoff in predictions of the trophic response of impoundments.

The most serious limitation on predicting the impact of eutrophication control measures on water quality is the lack of appropriate well-defined water quality variables which can be quantitatively related to eutrophication-associated water quality problems. Research to establish such relationships should receive a high priority.

The results reported and the conclusions reached in this report should be used with caution because we had to make many assumptions and had limited

data for many of the systems. Decisions on eutrophication control in individual catchment-impoundment systems should only be made after careful scrutiny of our assumptions and after an effort has been made to obtain additional data on the system involved. Models should be developed to simulate the dynamic behaviour of impoundments for future assessments of the trophic response of impoundments to eutrophication control measures.