TERMS OF REFERENCE FOR A DIRECTED PROJECT

THEME **Water Quality and Health**

TITLE: **Integrated and risk-based approach to better management of eutrophication in lotic and lentic systems taking into account the role of citizen scientists early warning systems.**

TOR NUMBER **1010023**

Rationale:

Eutrophication undermines governments priority outcomes, particularly job creation. Way back, the Department of Water and Sanitation invested (and continues to do so, including in the transboundary) in the construction of large dams for water security noting limitation on water availability due the country being broadly dry. However, these dams and rivers are being seriously challenged by increasing rates of pollution (nutrient enrichment) resulting in hypertrophic levels of eutrophication. Hypertrophic dams cost the economy of the country since the water they hold is not fit for any purpose in the broad five uses (domestic, recreational, industrial, agriculture and ecosystem). Currently studies suggest that up to 87% of major water dams and approximately 70% of major river systems are eutrophic to hypertrophic and experience extended periods of cyanobacterial blooms, particularly in the summer months. Close to 70% of the population will be urbanized by 2050, possible dominated by non-sewered informal settlements perpetuating eutrophication. Recently published green drop report estimated that about 92% of the country's WWTW are at medium to critical risk levels or not functioning properly. While non-point sources including agricultural runoff, untreated sewage from leaking and overflowing sewer systems, as well as runoff from informal settlements make substantial contributions, wastewater treatment plants remain the major contributors of nutrient loads to most waterbodies. The drivers of eutrophication are anthropogenic, therefore can be reversed by citizens in close partnership with policy.

The question that arises is how do we alleviate this challenge in an environmentally sustainable way, through generation of credible knowledge, legally binding application and monitoring. An integrative approach is required to manage macrophytes effectively, involving both preventative and/or early warning interventions, as well as removal and control mechanisms such as mechanical removal, chemical control, biological control, and community-based monitoring to prevent re-infestation. Implementing preventative measures is a more sustainable and environmentally friendly strategy for managing macrophytes as in the nature based solutions framework approach. Early detection and nutrient load reduction serve as proactive steps in preserving the ecological integrity of water bodies and sustaining their biodiversity. Mass development of aquatic macrophytes in rivers

and lakes is a global problem, and attempts to remove and control these annually consume substantial sums of money. Aquatic plant removal, however, does not address the causes of the mass development and is not sustainable. A solution to the sources of pollutants within the catchment is required. Before implementing any removal or control measure, it's essential to consider the specific characteristics of the water body, the extent of the infestation, and any potential environmental impacts. Therefore, there is a need for more comprehensive studies to assess effectiveness of control measures in dams, especially in rivers where chemicals such as glyphosate have not been authorised. Research is needed to evaluate the effectiveness of alternative control methods that minimize the use of glyphosate and its potential environmental risks.

It is correct to argue that eutrophication is not a new challenge, hence several methods have been attempted with little or no success hence the need to review and enhance these methods using latest innovations. In this multidisciplinary/multisectoral project, the following methods will not be repeated, but enhanced:

1. Manual removal through hand pulling and netting.
2. Mechanical removal using harvesters and cutting, and raking.
3. Biological control by introducing natural enemies (i.e. weevils) and some fish species.
4. Biomanipulation, deliberate alteration of ecosystem, such as in control of algal blooms
5. Phytoremediation, such as use of floating wetlands to absorb excess nutrients and provide habitat for beneficial organisms.
6. Chemical control through the application of selective herbicides and algaecides designed for aquatic use.
7. Barrier systems through the installation of physical barriers (i.e. booms or floating barriers).
8. Aeration through introducing aeration systems, such as diffused air or surface aerators, to increase oxygen levels in the water.
9. Buffer Zones along water bodies to filter runoff and reduce the transport of nutrients and pollutants into the water.

Literature support the Integrating approach of control methods, applied and monitored timeously following established procedures in order to achieve the desired results with minimal or no risks on human and aquatic ecosystems health. This is why toxicological tests will be required to determine safety levels of chemicals before they are registered by the Department of Agriculture, applied by the Department of Forestry Fisheries and Environment as authorised by the Department of Water and Sanitation. These key stakeholders must be engaged before submission of the proposal, throughout project execution to the finalization in order to facilitate uptake/use of the products from this study. Other key stakeholders central in the uptake of the products are Water Boards, the NGOs, communities and businesses, particularly Agriculture where fertilizers that enrich waterbodies diffuse from. Of

utmost importance are the local municipalities that own and operate waste water treatment plants.

Main Objective:

To produce a piloted and tailor-made, integrated and adaptable management guide that target point source, non-point source, and internal nutrient loads reduction methods applicable in all water resource types (wetlands, rivers, dams and even estuaries) bearing in mind the challenges of climate change. Lastly to foster collaboration between scientists, policymakers, citizen scientists, and to ensure that outcomes enhance current practices used in addressing the eutrophication management in South Africa.

Specific objectives:

1 Based on extensive publications on eutrophication, consolidate and provide critical analysis on barriers and enablers, including knowledge gaps on sustainable management of eutrophication covering all water resource types (wetlands, rivers, dams and estuaries).
2 Map sources of pollution and determine the drivers of eutrophication in a case study catchment, inclusive of all land uses
3 Identify and test the new innovations, including the nutrient binding agents in eutrophication management focusing on practicality, operation costs and maintenance
4 Investigate alternatives to drivers of eutrophication within the circular economy (green economy) context as well as onsite waste treatment as opposed to WWTP
5 Develop modelling methods for predicting and managing the occurrence of algae blooms taking into consideration the impacts of temperature changes
6 Review and update the sequency and timing for a successful implementation of integrated eutrophication management controls noting the impact of changing climate
7 Test the risks (toxicity) posed by chemical control measures on human and aquatic biota health in lentic and lotic ecosystems to support or decline chemical registration
8 Suggest appropriate citizen science monitoring tools and provide the necessary training, noting the quality control on data collection, including use of technology in real time data collection, applying artificial intelligence for interpretation and reporting
9 Through key stakeholder engagement (Policy, business and citizens) develop a tested nature-based integrated eutrophication management framework for use across the country as well as transboundary water resources management
10 Raise public awareness about the causes (anthropogenic) and consequences of eutrophication through education campaigns and community involvement
11 Recommend future research to enhance eutrophication management

Expected Deliverables:

The is no one institution or an expert that can have all the expertise required to execute this project, hence the need to set a consortium inclusive of resource economics, social and

natural scientists. The DWS in response to expanding eutrophication in the Vaal system has established an anti-pollution team to ensure the Vaal system is rehabilitated, minimize or eliminate eutrophication. As one of the key clients, a close work relationship will be required, also noting that DWS will be responsible for rolling out the nature based eutrophication management framework to the rest of the country once proven through case studies that it serves the purpose. The DWS has also produced eutrophication management strategy, which must be used as the benchmark in this study. Rand Water and uMngeni-Thukela Water Boards have keen interest in the management of eutrophication, hence their involvement is encouraged. Therefore, the following are some of the core deliverables flowing from addressing all the objectives:

1. The state of science and research on eutrophication management nationally and internationally in all aquatic ecosystems, and the gaps that need further investigation
2. The effectiveness of different eutrophication management methods, minimizing risks on ecosystems and people's health.
3. Innovations in monitoring, modelling, predicting and managing eutrophication dynamics, including algal blooms.
4. Evaluation of emerging trends and technologies in eutrophication research, proven innovations and identification of gaps and areas needing further investigation
5. Methods and guidelines on the use of toxic free chemicals not only in lentic but in lotic ecosystems as well.
6. Monitoring tools and early warning indicators for use by the empowered citizen scientists
7. An integrative eutrophication management framework tested on selected case studies following nature based solution principles

Total Budget: R 5 000 000.00 (Including VAT)
Year 1 : R 400 000.00 (Including VAT)
Duration: 5 years