

# ISLAND LIFE







Solving South Africa's devastating water issues, compounded by droughts and the destruction of wetlands, is being taken up by a new generation of engineers who work ecologically with nature, in many cases mimicking natural phenomena like floating islands.

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**W**etlands supply us with much more than water. Besides supporting populations of fish and other edible resources, they also help to control flooding, recharge natural underground water sources, and can be used effectively to clean waste. Simply, aquatic plant life acts as a 'decomposer', filtering and trapping harmful substances, sediments and nutrients in their roots, and through a kidney-like process allows microbes to absorb them for their own growth. So effective is this process that wetlands have historically become a convenient system for the disposal of waste, be that sewage or industrial, as a result polluting not just the wetlands but rivers, and soaking down into groundwater bodies and the soil needed for agriculture.

The impacts are horrendous, which is why civil engineers have spent huge amounts of money finding (largely concrete) solutions. However, one of the simplest answers lies in nature itself, with the phenomenon of floating islands. Naturally occurring floating islands are masses of vegetation that have broken away from a shoreline because their roots can no longer reach the soil. The mass of roots is buoyant and can grow to many hectares, supporting all manner of life.

The emergence of eco-engineers, who work ecologically with nature, has prompted thorough studies into how to salvage and recreate wetlands, and innovators have begun to create artificial floating islands.

Yolandi Schoeman from Baoberry, an ecological engineering services company, is one of those innovators advocating for more sustainable solutions to water quality problems.



## WETLAND WARRIOR

Schoeman is a finalist in the eco-innovation category of the Eco-Logic Awards (for which the winner will be announced this month), and a third prize recipient of the City of Johannesburg's Green Challenge Fund, for her work on the Baoberry floating island treatment called AqueouSphere, which creates a micro-habitat for the surrounding species in which it is placed.

One of the reasons the prototype caught the judges' attention is its adaptability and wide application: not only can Baoberry's islands be used for waste and stormwater treatments but also for shoreline remediation, fish spawning, conservation practices, living walkways, erosion control, aesthetic water-scaping, carbon sequestration, and community projects. "The beauty of the AqueouSphere is that

it can create sustainable businesses, particularly for local agricultural communities, and by default inspire other downstream businesses, and comes in either wet or dry formats," says Schoeman.

The plants used are varied, depending on their ultimate purpose. "We use plants with phytotechnological properties such as *Juncus sp*, *Phragmites sp*, *Typha sp*, *Cyperus sp*, to name but a few, for filtration environments such as sewage, waste and acid mine drainage. Results from the AqueouSphere prototypes we have placed around Johannesburg are proving that *Cyperus sp* and *Typha sp* are showing levels of manganese, iron, aluminium and other contaminants being absorbed into the roots and foliage, while promoting a reduction in algae and improved overall ecosystem function and health," says Schoeman.

"We also conducted separate phytotechnological trials in a greenhouse with three plant species with known phytoremediation characteristics. Four different water sources were used as growth media, with the three water plants suspended in 10-litre pots." The plants were stabilised in a nutrient solution, which was replaced two weeks later with different water sources. Each treatment was replicated four times. The trials concluded in November last year, confirming that by using appropriate plants, metal and non-metallic contaminants can be removed from an aquatic environment by means of floating islands, while at the same time creating a micro-habitat.

Costs for one square metre of an AqueouSphere start at R1500 (including the plants). AqueouSpheres are made from a combination of Polyethylene and natural materials, and are non-toxic. The plants are selected based on the environment and ecosystem characteristics they will be introduced into, and the type of contaminants needing to be removed from the ecosystem. They have an indeterminate lifespan and once positioned, begin working immediately. The ultimate result is that not only is water made cleaner (but not necessarily drinkable), the environment begins to recover and a natural balance is restored, ensuring that compromised wetlands do not die. AqueouSpheres can also be integrated into constructed wetlands to improve efficiency.

## BROADER APPLICATIONS

Mines could find AqueouSpheres enormously helpful, particularly those with acid mine drainage issues because they will survive long after mining operations cease and therefore continue to remove



Baoberry's Yolandi Schoeman, whose prototype floating wetland secured her a finalist's position in the Eco-Logic Awards eco-innovation category.



Baoberry conducts phytotechnological research to assess the uptake of contaminants by plants.

contaminants so that a functional ecosystem remains in place.

Water activist Anthony Turton is particularly concerned with how mining impacts wetlands, given that they are the natural source of many national rivers. The Upper Vaal water management area is a case in point, being the source for the Vaal River.

“There are a myriad of wetlands that are relatively functional in this area, yet underlying them all is a massive coal deposit. When that is mined, it will destroy the headwaters of one of our major national water resources,” he explains.

“This example speaks to a national discourse about sustainability that we must have. We accept that we need to develop coal to sustain our current carbon-based economy but there also needs to be a sensible, logical trade-off.”

Turton also presents a case study of how municipal waste impacts on wetland environments: “Ex-mining hub Mogale City in Gauteng has a solid waste dump alongside the watershed that divides the Limpopo and Orange rivers. This dump sits

directly above a naturally occurring spring, which is the source of the Wonderfontein Spruit, and which traverses to Potchefstroom, creating 120km of naturally occurring wetlands. Within the reaches of that wetland, however, lie two of the most elevated radiological active hotspots in the area, largely caused by acid mine drainage mobilisation of uranium. This is exacerbated by leachate from the Mogale City solid waste dump.”

Turton says within the next five years, and with the reprocessing of the Mogale Gold tailings dams, there exists an opportunity that will literally turn-around 120 years of negative mining impacts in the environment. “An essential component of this would be to create a green development hub using natural or engineered wetlands. I know of no other place that is more ideally suited as a ground-zero, or X-centre.”

He endorses floating islands, and Schoeman’s innovation in particular, because both work with nature as opposed to working against it. “Wetlands do for free what engineered solutions do at great cost.”





Papyrus plants proved to be the most stable at the *Metsi a Me* project at Hartebeespoort Dam.

### TRUSTED TECHNOLOGY

Floating wetlands have proven their capability at Hartebeespoort Dam in Gauteng. In 2009 the project *Metsi a Me*, loosely translated from Tswana meaning 'my water', was implemented and included floating islands. Petrus Venter from the Department of Water Affairs and Sanitation, and the programme's leader, explains that biological intervention was needed to protect and recover the destruction of diversity and aquatic ecosystems in the Dam and upper catchment, resulting from the 2.8million people living upstream. Close to 1000km of an upstream river and 56km of shoreline of the Dam has been destroyed or seriously impacted.

"Every development, be that recreational, residential or business, including historical chemical spraying of invasive Hyacinths, has essentially been oozing nutrients into the dam for decades. Trickle of polluted water with more than 720-million of litres of purified sewage per day add to the on-going pollution load flowing into Hartebeespoort Dam. In essence, it is receiving all the sins of modern civilisation."

Experimental though it was in 2009, *Metsi a Me* has become the most watched, and largest floating wetlands project globally, to Venter's knowledge, and has been recognised and supported internationally by Finland and the United Nations Education, Scientific and Cultural Organisation (UNESCO), with interest shown by China in terms of copying the project. "Trial and error has determined that despite aiming for diversity of plant species, papyrus seems to be the most stable vegetation able to withstand weather conditions. Two species are currently used on the existing 4km of 10 floating island units. The target is to sustain at least 12km, which equates to 20% of the 58km shoreline."







Shortly after installing the biggest floating islands, birds were spotted and eggs were found on an AqueousSphere in the Modderfontein Nature Reserve.



Two years ago the department halted the Dam's integrated monitoring programme after the progress report was tabled, including chemical and biological aspects. It was, says Venter, the most comprehensive monitoring report of its kind ever compiled for a dam in South Africa. The results proved that despite a dramatic deterioration of the water quality entering the dam, the water quality in the dam itself had improved. The diversity of the aquatic eco-systems, such as fish, plankton and birdlife also improved dramatically. "The Red Knobbed Coot numbers, for example, had increased from 600 in 2009 to 4 600 in the past couple of years.

"Ultimately nature at work, prodded by artificial intervention, has re-introduced oxygen to the bottom of the dam, which helps to block the nutrients released from the sediment that algae thrives on. Even historical phosphate pollution has been reduced," says Venter.

"We may not be able to control water pollution completely, that is the political state of the country unfortunately, but we can try to improve conditions

for the future and sustain those. Floating islands have the magic to help us achieve this objective."

## NATURAL ORDER

Continuing testing and monitoring is crucial, however, says Schoeman because "there is little to no research on social sustainability fused with technology that has economic benefit. There has to be public participation, else there is a chance that artificial interventions, such as AqueousSpheres, will be ineffective due to ignorance or misunderstanding.

This has led to Schoeman spearheading The Ecological Engineering Institute of Africa, which is anticipated to be a centre of excellence, research and a training facility across the continent, and will be motivating for eco- engineering post- and under-graduate degrees. "Largely we will be setting out to eliminate the skepticism that surrounds eco-engineering, particularly within municipalities that need to be swayed from concrete solutions. However, we have to bear in mind that eco-engineering is still relatively young in South Africa."

It is ironic that it is civilisation that has sped up the rate of environmental destruction and, in seeking to repent, must look to nature to find solutions that will return us to the natural order of things. ●

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