Ecological infrastructure
Case study 5

Restore degraded wetlands so that they can recover their water purification function, allowing them to be the final polishing process as we endeavour to clean up polluted water.

Scrubbing our water clean

KLIP RIVER WETLANDS, GAUTENG

Wetlands remove pollutants from water through various natural processes, making these systems invaluable allies when dealing with water contaminated by mining processes, industrial effluent, sewage and agricultural runoff. But even the most robust wetland has a breaking point.

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To the untrained eye, samples drilled out of the soggy earth along the edge of the Klip River wetlands, south of Johannesburg, may look like nothing more than messy tubes of dirt and rotten plants.

But to someone who understands wetlands, they're like time capsules. Drilling down just 3 m into the peat here is like travelling back 2 500 years.

Back in the lab, where each layer is picked apart and viewed using fine instruments, the peat samples reveal their secrets.

When geochemist Prof. Terence McCarthy from Wits University did this, he found that the top layer of peat was packed with heavy metals like uranium, mercury, cadmium, nickel, cobalt and zinc. This is how the peat recorded its own version of the Witwatersrand's history, where mining and industry have boomed for the past 120 years.

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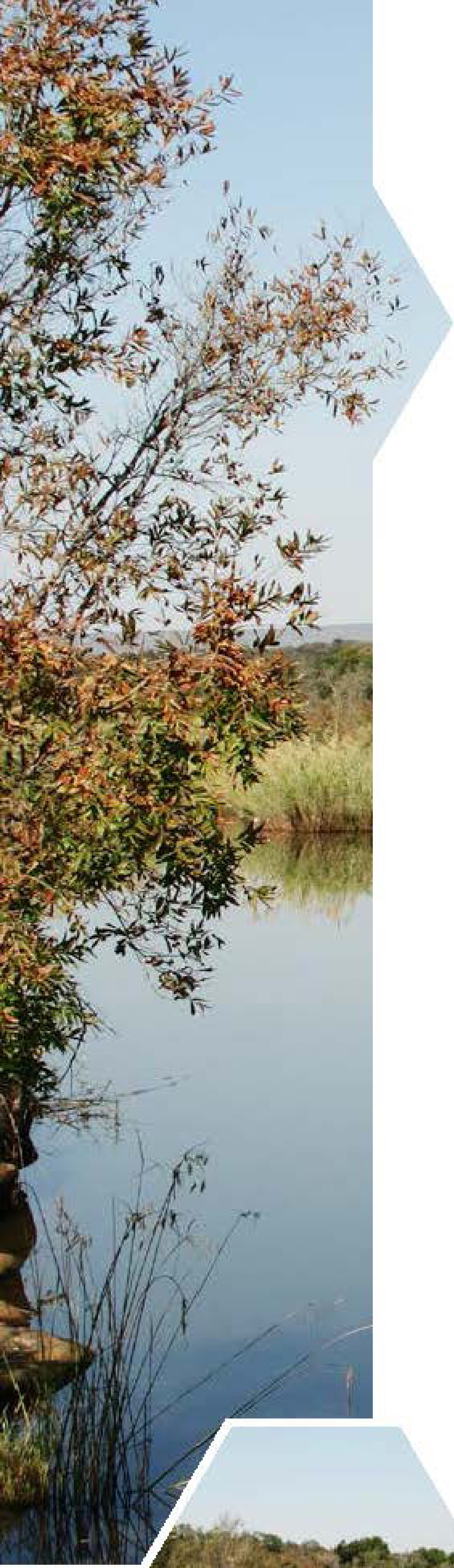


More significantly though, it shows how important wetlands are as cleaning mechanisms to scrub out some of the pollution that ends up in our water supplies due to intensive mining industries and expanding sanitation systems.

While that thin layer of peat is testament to how hard that wetland system has been working to clean dirty water running into it over the past century, it tells us that during that time it was releasing clean water back into the river system that the City of Johannesburg could then re-use. And it was doing so free of charge.

This, according to McCarthy, shows to what extent the peat has 'protected the Vaal River drainage system from extensive pollution', and is a warning to continue making sure the wetland stays functional.

PEAT: A SPECIAL KIND OF 'MUD'

When plants die and collapse into a wetland, they build up into a muddy layer. Because this build-up is in a low oxygen environment, the plant matter doesn't rot but rather forms what is known as peat.

Peat is unique to wetlands. It stores large volumes of carbon (it is a 'sink' for atmospheric carbon). Peat has exceptional water holding and purification abilities, gives a wonderful record of environmental change, and it's extremely rare in South Africa. Also, a few million years from now this peat could turn into coal.

HOW WETLANDS SCRUB OUR WATER CLEAN

Kiss of sunlight

Because water tends to flow slowly across a wide area rather than hurtle down a narrow, deep channel, this allows sunlight to stream through the entire water column, powering chemical reactions which break down certain compounds into more benign components. Some of these purifying reactions can only happen in water that's low in oxygen, which is often the case in saturated wetland soils.

Certain kinds of pollution from mines and sewage are broken down in this way, effectively adding a purification 'layer' to the water cleaning process.

Stuck in the mud

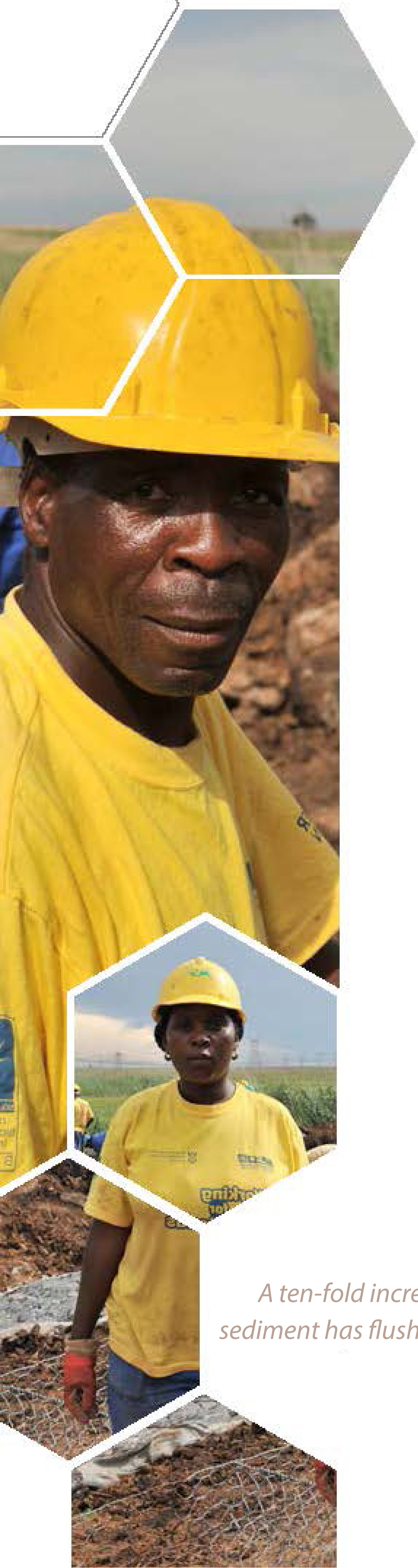
Heavy metals that get discharged into water from mining processes (e.g. mercury, lead, arsenic) are toxic to animals and humans. When contaminated water percolates down through a wetland system, some of these chemicals are bound up in the mud and become trapped there.

Peat samples taken from the Klip River wetlands show just how many heavy metals have been locked away in their muddy depths over the past century of mining. Similarly, phosphorous from domestic waste has also been locked away in this manner.

Hungry plants

Like all other plants, those that grow in wetland environments need nutrients. And if those nutrients (in this case phosphates and nitrates) are flushing into the rivers and wetlands from sewage or agricultural fertilisers, the plants will take them up from the water and use them to build their stems and leaves. The plants might then be grazed by animals or harvested by people, and their nutrients thus 'exported' from the wetland.

Fire during the dry season is another way in which nutrients are removed from the system. Alternatively, plants may die and collapse into the mud where they become part of the peat layer, once more taking harmful pollution and turning it into something useful for other plants, while 'banking' the benign nutrients away through natural processes.



The growth in mining and industry was exponential in the past few decades, writes McCarthy. Some parts of the wetland have also been changed because of human activities such as agriculture. McCarthy writes that a ten-fold increase in the surface layer of peat shows just how much sediment has flushed down into the wetland because of erosion upstream. This could have come from mining, agriculture or urban development.

Parts of the wetland also had drainage canals dug into them, to dry them out and allow for crop cultivation. Now, instead of the water trickling slowly across a wide, vegetated area, it tears down these sluices, cutting into the wet earth and changing how the entire system processes water.

Add to that the increased amount of water being poured into the system by sewage works and, instead of water moving benignly in a diffuse way, it becomes a harsh blade cutting deeper and deeper into the underlying peaty layers.

Previously, water would take days to pass through the wetland. Now the 'resident time of water ... has been reduced ... to hours,' writes McCarthy. This cuts that all-important contact time between water and plants, and between water and peat, which is necessary if the pollutants are going to be taken out of the water. Similarly, there's an increase in the amount of water being disgorged into the wetland because of sewage effluent being poured into the Klip River system.

A ten-fold increase in the surface layer of peat shows just how much sediment has flushed down onto the wetland because of erosion upstream.

Not only do these changes compromise the wetland's ability to scrub the water clean, but as the peat beds dry and erode due to channelling and an increase in the energy of water in the system, they will also begin to release all those banked-away pollutants back into the system, flushing the Vaal River with over a century's worth of stored heavy metals. This is a hard-working wetland, but there's only so much any wetland can be expected to carry before it begins to buckle under the load.

'What we've learned through the studies of the Klip River system is that wetlands need our help to keep up with the higher flow of water and the pollution going into the system,' says John Dini, director of ecological infrastructure at the South African National Biodiversity Institute (SANBI).

'Every system has a breakthrough point, where the wetland becomes so saturated that eventually whatever is coming in, it will simply flush right out again, causing the pollution to wash further down into the river system.'

Further down the Vaal River, a different riverine system is at work. It doesn't have the peaty wetlands of the Klip River, so it can't scrub water clean the way this wetland is able to do.

'Wetlands need our help to keep up with the higher flow of water and the pollution going into the system.'

Wetlands can't keep doing the clean-up work as mines, industry, sewage works and farmers continue to discharge sub-standard water into the natural environment.

Every sector should take responsibility for cleaning the water it has polluted as much as possible, before releasing it into a wetland like this, which should only be expected to do the final polishing. This will avoid incurring even greater water purification costs down the line.

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