Ecological infrastructure
Case study 1

Keep municipal waste water infrastructure, like sewage systems and storm water drains, properly maintained. This supports healthy rivers and wetlands, and improves water quality, thereby boosting human health.

A stream ran through it

MTHINZIMA STREAM, HOWICK, KWAZULU-NATAL

How a healthy river system cleans up effluent and improves water quality to the economically important Midmar Dam.
The Mthinzima Stream may not be a large watercourse, but together with all the other veins that feed into the Midmar Dam near Pietermaritzburg, it forms one of the critical small tributaries that meander through the KwaZulu-Natal Midlands and feed into a dam that supplies water to one of the largest economic hubs in the country.

At its headwaters, the Mthinzima’s water quality is excellent, seeping into the streambed from a relatively pristine catchment. But, as it meanders towards the dam, it picks up large volumes of raw sewage which trickle down into the stream from some of the poorly serviced townships that have been built on the surrounding hillsides.
According to local Wildlife and Environment Society of South Africa (WESSA) environmental educator, Dr Jim Taylor, the quality of the water downstream is ‘appalling’.

The bacterial load in the water is of grave concern, since it can contribute to the kind of diarrhoeal diseases that are the global leading cause of death amongst children under the age of five. Another worry is the potentially toxic build-up of nutrients in the water that will eventually make the dam’s water expensive to treat and recover.

When large volumes of excess nutrients flush into a water course – be it from over-fertilisation of farmlands or raw sewage leaking into the system – it’s like putting too much fertiliser on your lawn, says local environmental consultant Dr Mark Graham. ‘The more you put on, the more the grass grows, the more you have to mow the lawn,’ he explains.

In a river system, it means that the influx of phosphates and nitrates from the sewage provide massive amounts of food for algae to grow. As this aquatic ‘lawn’ blooms, it strips oxygen from the water, effectively suffocating the microscopic animal life (zooplankton) and bigger animals like fish in the water.

These algal blooms can also flush the water with potent toxins that have been known to kill animals that drink the water.
Meanwhile, the dense algae can clog up pumps and water filters in treatment plants. This kind of eutrophication has made parts of the Hartbeespoort Dam in the North West Province unusable. A clean-up operation of this magnitude is expected to cost up to hundreds of millions of rands.

According to Taylor and Graham, eutrophication in the Midmar Dam is expected within just 15 years if the current rate of nutrient pollution continues.

But something remarkable is also happening here – a sign of nature’s resilience that emphasises the importance of services that a working natural system would offer us. It also serves to emphasise the need to help watercourses like the Mthinzima Stream to stay healthy and functional.

Graham and colleagues at the consulting firm Ground Truth have been working with WESSA and local communities over several months to test the quality of water in the Mthinzima Stream.
Starting at the point where it meets the Midmar Dam, and working steadily up towards the headwaters, various teams sampled the water and tested it to see how abundant the small animal life (micro-invertebrates or little insects) was. If there’s abundant life, the river is healthy; if not, it’s taken a hammering.

All this information was loaded into a new tool available to such researchers called the Stream Assessment Scoring System (miniSASS), which then overlays the information onto an aerial photograph of the stream system. Images of crabs flag areas where the stream was sampled.

If the sample shows the water is healthy, the site is flagged with a blue crab. If the water is beginning to deteriorate, the crab’s colour changes to orange. If water quality is very poor – meaning there is very little small animal life in the water – the crab will show up as red.

If the current rate of pollution continues, the water from the Midmar Dam will be undrinkable within 15 years by 2028.

Reference: http://www.minisass.org
Too much raw sewage puts terrible strain on the river’s clean-up systems and there is only so much a river can be expected to carry before it collapses, affecting people, livestock and crops. This is where the astonishing thing comes in. Looking at the aerial photograph of the Mthinzima Stream, the graphic of the crab at its headwaters is blue—healthy. As the water runs down through Mpophomeni township outside Howick, the crab flagging the testing site lights up with an angry red, indicating insect life in the river is collapsing. However, further downstream the crab colour softens to a less aggressive yellow, meaning the river is recovering, and animal life responsible for processing the sewage is bouncing back again.

Here, according to Dr Mark Graham, is what’s going on at a scale too small for the naked eye to see: river systems have their own ecological pyramid. It’s just like in the Kruger National Park where you have grass and trees, impala and other grazing animals, lions killing the herbivores, and vultures picking apart the remains.
Similarly, in a healthy river system you have algae growing on rocks, minute grazing organisms eating the algae, reeds and other plant-based sediments. There are mayflies and dragonflies, the latter being predators, that eat these creatures, all the way up to the fish at the top of the food chain. The crabs and shrimps are analogous to vultures and scavengers in this aquatic 'veld'.

When raw sewage leaks into the river, aquatic insects in larval stages eat the nutrients in the sewage, reducing the solid waste to their very basic components, namely nitrates and phosphates. Some insects shred the solid matter while others suck it up and pass it on to fish as they themselves are eaten.

This suite of small animals are cleaning, processing and filtering the water. Some of the reeds and other water plants will use these nutrients to grow, banking them away in their stems and leaves. These plants may be eaten by grazing animals or fall into the river and get trapped in the mud, becoming locked away for a period of time.

Some insects metamorphose into their adult stages and fly away from the river, 'exporting' those nutrients from the system. It’s a vast, dynamic and often invisible process.

But when the system is overloaded with nutrients, the algae grow abundantly, just like an over-fertilised lawn. In the process, they strip the water of oxygen, leaving the micro-invertebrates to suffocate. As they die, the miniSASS crab turns red.
However, further downstream the yellow crab indicates that animal life in the stream has somehow been able to recover, in spite of the water being overloaded with nutrients from sewage. But by the time the water reaches the Midmar Dam, the miniSASS crab turns back to red because of the additional build-up of pollution in the water.

Two lessons emerge from this story. Firstly, a tool like miniSASS is a ‘game-changer’, says Graham. Previously, water quality testing was usually done by municipalities, and the resulting water management decisions remained with the authorities. ‘This created a “power gradient” between people on the ground, and government officials responsible for managing their water,’ maintains Taylor.

‘In all my years in aquatic science, this is the first time we’ve been able to represent water health in such a simple way, so that you can show a municipal manager or a politician, and they can see immediately what’s going on in the water system,’ explains Graham.

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MiniSASS is a way of allowing citizen scientists to feed trustworthy data into a mapping system that everyone can see. A visual representation of changing water quality, in this way, makes it immediately obvious to the viewer what’s going on in the river. Here, citizen science helps democratise water management – the citizens know what’s going on in the water system, and they can hold their water managers accountable for decisions made on their behalf.

Secondly, the clean-up services freely offered to us by healthy functioning rivers are the very basis for keeping water safe and clean. But there’s only so much workload any river can be expected to carry before it collapses under the strain.

If the tributaries of the Midmar Dam continue to be the default sluice for under-serviced communities in the surrounding catchments, the entire eThekwini water system will be compromised in the very near future. Storm water drains and sewage infrastructure must be maintained so they don’t fail and spill out their contents into nearby streams and rivers.

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Municipalities around the country need to take urgent action to ensure that sanitation and service delivery to historically neglected communities are prioritised, that storm water drains and sewage infrastructure don’t fail and spill their contents into nearby streams and rivers, and that the tributaries feeding important water sources are conserved.

The situation, as it is, is a ‘time bomb’, according to Graham.

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