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FOR A SUSTAINABLE BUILT ENVIRONMENT
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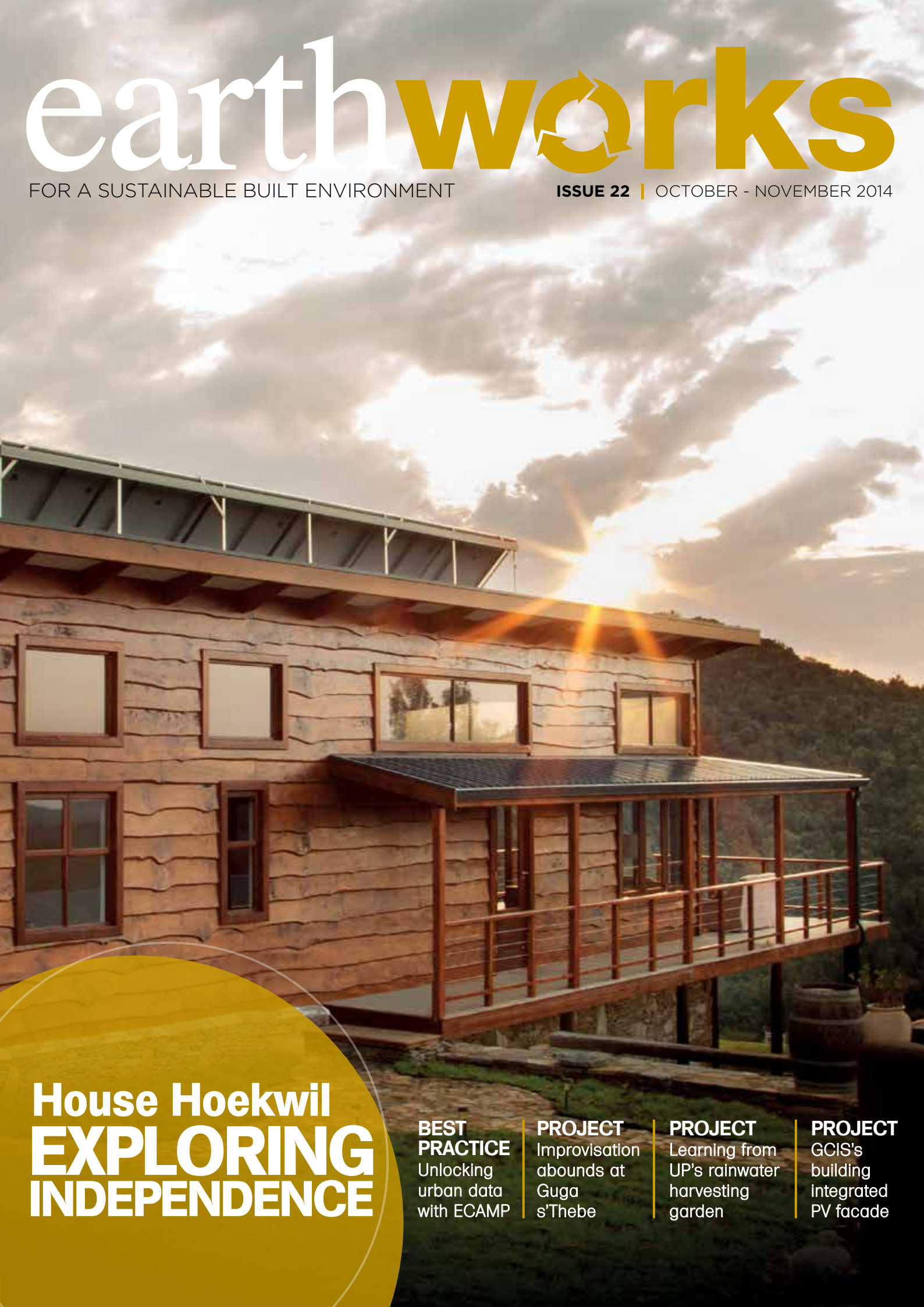

House Hoekwil EXPLORING INDEPENDENCE

BEST PRACTICE Unlocking urban data with ECAMP

PROJECT Improvisation abounds at Guga s'Thebe

PROJECT Learning from UP's rainwater harvesting garden

PROJECT GCIS's building integrated PV facade

GATHERING OF THE RAIN

A reactive storm water control system on the University of Pretoria's campus provides water for the botanical garden and doubles as a social space for students and staff.

WORDS KAREN JAYES
PHOTOGRAPHS CHRISTOPH HOFFMANN

North side “tidal pond”. The water level on these can be manipulated via a valve system to simulate seasonal wetlands.

A road at the University of Pretoria (UP), once a site with poor soil and little drainage capacity, now hosts a rainwater harvesting system that is fully integrated into the architectural design of the new Mining Engineering Study Centre. The system is made up of a series of rain garden ponds and a storage tank, which feeds the 3.5 ha Manie van der Schijff Botanical Garden. It is a bio-rich environment that has become a gathering place on campus and is an illustrative point for teaching green principles.

The system also saves considerably on costs – a conventional upgrade of the storm water system would have cost in the region of R4 – 4.5 million. The existing walls would have had to be waterproofed at an additional cost of R4 million.

"The rainwater harvesting solution solved these problems for around R1.7 million, a saving of over R6 million," says Neal Dunstan, UP's resident architect who oversaw the project with the close cooperation of Jason Sampson, curator of the botanical garden.

The system harvests 17 000L of water for every 10mm of rain off the 1700m^2 Study Centre roof. The pond system, together with a pump system, filters the water to above drinking quality, according to initial calculations by the University's Water Institute, Water@UP's.

"We have frogs breeding in the water, and when you have amphibians breeding, you know the water quality is good," says Sampson.

CHALLENGES AT THE START

"The biggest challenge was to sell the concept of the landscape being a sustainable blue-green infrastructure solution instead of purely ornamental," says Dunstan. "But once the university understood the financial and public relations benefits, it became easier. There was also a desire from the client that the previously harsh, barren and hot environment be converted to a lush green environment."

The team also had to cater for students with special needs. "We had to work around the needs of the visually impaired students who frequented this space prior to construction," he says. "The design experimented with form, materials and sounds within a tight budget, to assist such students, with mixed success."

There was the further challenge of it being an interdepartmental project. The new Study Centre, around which the harvesting system was constructed, was built for the Faculty of Engineering but the grounds fall under the Faculty of Natural and Agricultural Sciences. Getting the deans of both faculties on board was important and successful – a real life example of how green design has the potential to break down silos.

The desire to put green building principles into practice and encourage biodiversity on campus, together with a shortage of funds, formed the impetus for the project.

SAVING AND REUSING MATERIALS

"When Engineering 1 was constructed in the mid-1970s a hand-carved clay brick with a semi-circular groove (a miniature half pipe) was used as cladding for the exterior walls," says Dunstan. "We rescued as much of these bricks as possible and used them to edge the paving to channel water into the plantings. Then we used them as an anchoring edge for the liner as well as access paths in the landscape; everything in this project serves more than one purpose."

NUTSHELL

Built area • 3500m²
Cost • R1.63 million (ponds); R500 000 (soft landscaping and irrigation)
Construction period • April 2012 – January 2014

01

02

01 South side bio-swale: the "kidneys" of the system.
02 North side permanent ponds are mainly deep water habitats.
03 Water reflection on and in the Mining Industry Study Centre.
04 View from above of some of the tropical African cycad species planted in the surrounding, non-wetland areas of the rainwater harvesting garden. The area closest to the building is the bio-swale.

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01 South side tidal pond, surrounding the Study Centre.
02 Entrance to the MISC.

02

with the manner in which the contractor handled all of this," says Dunstan.

"The project used very little concrete and cement products," he adds. "The structure consists primarily of steel, glass and aluminium."

The soil for the ponds was sourced from a project on another campus, which had a high clay content that was perfect for the ponds. All compost was sourced from the university's pilot composting project.

SPECIALISED POND LINING

The pond system is lined with a vulcanised rubber, which is chemically inert and can withstand sun for 40 years without UV degradation thanks to a high level of carbon black. The product, Firestone EPMD, has been tested as a liner for water reservoirs – it has a 300% stretch capability and can shift with any ground movement that occurs. It is also cheaper than concrete, can be reused should the ponds be moved, and is easily repaired.

This didn't mean that it was without challenges. "Placing a semi rigid plastic sheet in a complex geometry such as this is almost impossible to achieve without a large amount of cut and welded panels," says Paul de Luca of Belgro, which fitted the lining. "This made EPDM the only viable choice. The EPDM liner is flexible, enabling it to easily conform to the flowing shapes and integrate into the areas where the rigid vertical walls and columns required full adhesion of the liner."

The result is a hybrid installation combining loose laid overflowing shapes and fully adhered to structures. Normally the installation of EPDM liners conforms to the usual EPDM parameters, but in the case of this project, the lining had to fit the shape and design of the pond structures.

"On two occasions, the technical advisor from Firestone international gave advice and details about how to install the liner, and it's been so successful that Firestone is using this project as part of their installer training programme," says Dunstan.

TREATMENT WETLAND AND PUMPS

"There are a number of different ways that the water is cleaned," says Sampson. "For a start it's rain water, so it's already clean. But it's run through a bio-swale, which makes up the shallow areas of the pond, consisting of reed bed systems that do most of the cleaning. The open water bodies in the permanent and tidal ponds are more habitat-based."

The water is circulated through the system for 12 hours at night. "The water is crystal clear," he says. The botanical garden has been irrigated successfully for eight months (at the time of going to print), and is already supporting a large variety of fish, plant and water life, including birds.

As for plants, the botanical garden has had success

with some endemic species and red data species. "We've also succeeded in bringing in the university's East African cycad collection, as this project has created a suitable micro-climate for them on campus," says Sampson.

"We've had tremendous success with the indigenous fish species," he says. "We have no mosquitoes in the system. We've had kingfishers fishing out of the pond. Two of the fish species are algae eaters. The system reached full ecosystem stability by January 2014 and there is virtually no maintenance."

The pump system is made of two borehole pumps that have lower electricity needs than regular pumps, but still use municipal electricity. The team considered using solar power for the pumps, but after calculations realised the pump would meet the end of its lifecycle before any meaningful payback could be made from a PV system.

"There's a pump for the irrigation system and one that does circulation, and we don't run them together," says Sampson.

"What is nice is that it's an integrated system," says Dunstan. "You don't have to have a place for rainwater tanks as the garden is your system."

The principles, he says, can be applied at any scale from residential to large commercial and industrial.

A PLACE TO TEACH GREEN PRINCIPLES

"The UP Engineering Faculty trains a vast number of engineers in the country, and we've literally wrapped the idea of green engineering around them," says Sampson.

The pond system is also a focal point for students and staff to gather, allowing academics to experience the practicalities and benefits of green principles.

"The original intention was that this would be a rain garden, meaning storm water would be collected and allowed to infiltrate the earth," says Dunstan. "Due to the water proofing issues we had to line the whole system, we now have a more permanent water body in the garden."

The pond system has initiated interdepartmental co-operation on various projects, and has garnered academic interest, both nationally and internationally.

The potential of the system to irrigate the campus itself was also demonstrated shortly after its completion. "We had three times the average rainfall in March 2014 so we suddenly had a huge amount of water entering the system," says Dunstan. "Our tank was filling so quickly that we had to pump water out and into the university's other irrigation supply tanks. For nearly two weeks the irrigation needs of the whole campus were being met by this rainwater harvesting system alone."

It has also enhanced the campus experience for many. "The most fascinating things happen when you add water to any landscape, as there's an emotional bond between humans and water," says Dunstan. "It's not only with students but staff members as well. We received an email a while back from a senior IT staff member, saying 'I just wanted to thank you for cheering up my day. Every day when I walk through the Study Centre garden, I see something new that astonishes me.'"

SOURCEBOOK

Water engineers • Aurecon • www.aurecon.co.za
Water @UP • Prof Rivka Kfir (Water Institute) • rivka.kfir@up.ac.za
GEWIS Controlled Irrigation • www.controlledirrigation.co.za
Belgro • www.belgro.co.za
Shared Energy Management (SEM) • Jason Sampson and Neal Dunstan • www.semsolutions.co.za
Pond installation • Belgro • Paul de Luca • www.belgro.co.za
Controlled Irrigation • GEWIS Controlled Irrigation • www.controlledirrigation.co.za
Electrical supply and distribution • Beckers Electrical • 012 548 0993
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