landscape sa

January/February 2014 No. 57
R50-00

Recreation Edition


The vegetated swale entry point for storm water collection after 10 weeks of growth

RAINWATER HARVESTING AT PRETORIA UNIVERSITY

As part of the development of the Mining Engineering Study Centre at the University of Pretoria (UP), a series of rain garden ponds and a storage tank have been installed as a reactive stormwater control system. It functions as a rainwater harvesting system for the irrigation of the Marnie van der Schijff Botanical Garden which covers 3,5 ha of the university's Hatfield campus.

The project is the joint brainchild of Neal Dunstan and Jason Sampson. Dunstan is the UP's resident landscape architect, Department of Facilities Management, and Sampson is the curator of the above-mentioned botanical garden, which the University is legally obliged to maintain and develop.

Design

This followed the principles of the Sustainable Sites Initiative, especially with regard to recycling and storm water management. The core of the design revolves around the concept of a rain garden: an engineered combination of specially selected plants, soils and mulch designed to collect , retain and cleanse rain water that runs off impervious surfaces such as parking lots and roof tops. The benefits of a rain garden are environmental, creating a sense of place, visual stimulation and a reduction in maintenance requirements. However due to the waterproofing issues of the lecture halls, a traditional rain garden approach could not be implemented here.

The system harvests 17 000 litres of water for every 10mm of rain off the 1700m^2 roof of the Study Centre and has transformed a previously dead space around the Engineering I building into a successful water retention facility founded on the principle of a rain garden collecting storm water from the roof of the building. Dunstan explains that the site on which the study centre has been built was previously a road, with poor soil and little infiltration capacity. In addition, the lecture halls had no waterproofing. "The estimated cost to upgrade the storm water infrastructure and to waterproof the building would have been approximately R8.5 million but we solved both of these problems for about R1.6 million by developing the pond system," he says.

Lining

To resolve the issues of water proofing and inadequate stormwater infrastructure, a UV stable, EPDM rubber liner was installed to contain the water and prevent it from seeping to the lecture halls. The entire pond system is lined with this vulcanized rubber which is chemically inert and field-proven to be resistant to UV degradation for at least 40 years. Globally the product is extensively used as a liner for many water containment applications. It is durable, flexible, has a 300% stretch capability and can shift with any ground movement that may occur without stress to the installation.

Paul De Luca of Belgro Landscaping is the distributor of the EPMD lining system in Southern Africa and undertook the installation at UP. He explained that the liner is a combination of a loose laid application and a fully adhered one, which is glued up against the walls of the pond structure. On top of the liner, a clay-rich soil growing medium was laid.

In addition to the above-mentioned facts, he gave the following advantages of the product:

- it experiences less degradation than high quality HDPE;

First *Nymphaea nouchali* in flower amongst *Marsilea schelpiana*, an aquatic fern, 10 weeks after planting

Tidal pond planting consisting of *Crinum campunalatum* "Album', *Equisetum scirpoides, Gunnera perpensa* and *Scirpus spp* "Zebrinus"

Papyrus prolifer is the matrix plant in the northern swale

Marsilea schelpiana forest of leaves just above the water line

Custom made pavers with the logo of the Department of Sciences

Vegetated swale (north side) collecting storm water from the roof and surrounding hard surfaces

Vegetated swale entry point (north side) for surface storm water collection with *Berula erecta* and some of the cycads

Vegetated swale entry point for surface storm water collection

Tidal pond collecting storm water during a rain storm

- from an aesthetic point of view, the liner, being highly flexible, enables designers to easily achieve fluid, organically shaped ponds;
- it is cheaper and more reliable than if the ponds were to be lined with concrete;
- if the ponds need to be moved, the liner can be re-used; and
- if damage does occur, it can be easily repaired.

Treatment wetland

The heart of the system revolves around the storm water being collected off the roof of the study centre and surrounding hard surfaces, and transferred to vegetated swales which act as the kidneys of the system. From here, the cleansed water flows into a permanent pond and then into the 'tidal ponds' – these are designed to be flooded in the wet seasons and partially dry in the dry seasons.

Dunstan explained that in addition to having a water harvesting function, the ponds operate as a treatment wetland and the reed beds have filtration ability. "The water from the roof and surrounding hard surfaces collects and filters through the vegetated swales, overflowing into the permanent ponds which are planted with water lilies, reeds and a few exotic (but not invasive) ornamentals. In the wet season, the tidal ponds will be able to be flooded from storm water runoff from the building and surrounding hard surfaces. The system is continuously circulated through the swales and ponds; when the tidal ponds are full, excess water will be diverted and stored in an underground tank and used to irrigate the botanical gardens," he says. The tidal pond has a valve system which allows the water level to be dropped in winter.

The water tank has a storage capacity of 130 000 litres, which will easily ensure a three week supply of water with a back-up supply from the university's boreholes.

Aquatic and terrestrial plant species are used in the spaces in and around the system. Planting is designed to facilitate the bio-remediation potential of the system, keep the water clean, soften the hard lines of the building and create habitat for wildlife.

Trees and plant material

All trees existing on the site are protected and when construction commenced were saved, with a penalty of R25 000 imposed on workmen if damage was caused to any tree. They were incorporated into the final design.

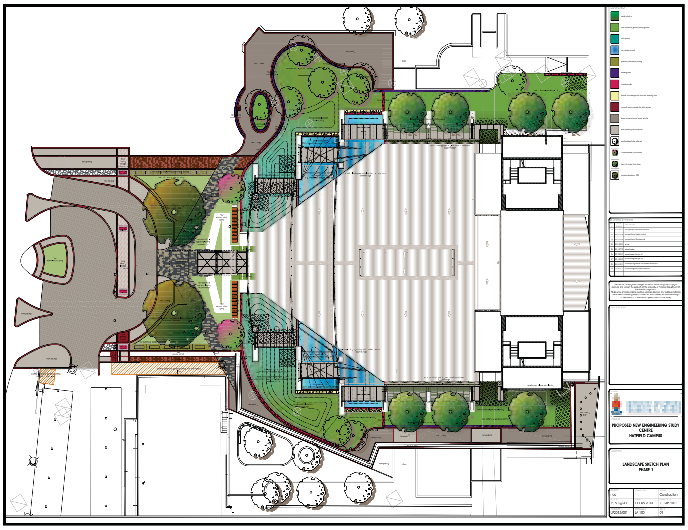
Plant material is predominantly indigenous, with the exception of some of the water plants such as the Sacred Lotus. Loffelstein concrete blocks are placed in the ponds to provide different depths for the plant material. Due to the establishment of a suitable climate, the university's tropical African cycad collection has been planted around the Study Centre.

Hard landscaping

All paving is recycled and has been re-used as permeable paving, cladding to walls in the ponds for habitat creation and energy breakers for the storm water entering the system.

Nymphaea **species in flower in the tidal pond**

A community of wetland species after 10 weeks of growth at the storm water entry point to the vegetated swale



Landscape sketch plan

Paving takes visually and physically impaired people into account. Entrances to the building and stairwells will have different textures and types of paving to enable sight-impaired people to feel different textures and sounds when tapping for direction with their walking canes. Wheelchair ramps provide access throughout the area.

Specially cast pavers depict the logos of the botanical garden (cycad cone) and the Department of Plant Sciences (baobab). These add interest and an aesthetic aspect to the expanses of concrete around the building and ponds. Grooved clay bricks that were previously used as wall cladding were also retained and used for edging and funneling of stormwater into the landscape, as well as to retain a heritage value.

To contain the deepest water bodies, seating walls were constructed in organic forms to assist the visually impaired with unobstructed movement.

Low level LED lighting has been installed but does not interfere with the natural day-night cycles of the plants, frogs and fish introduced for ecological purposes.

Green engineering

Dunstan and Sampson explain that ecology, zoology and landscape architecture students who volunteer to work on the project will directly experience 'green engineering'. The professional team went through an exercise to determine what green star rating could be achieved based on the pilot rating system for public and educational buildings. The landscape component of the project could contribute up to 35% of the points for a four star rating.

The footprint of the building falls under the Faculty of Engineering, Built Environment and Information Technology and the remaining external areas under the Faculty of Natural Sciences. "Not only will the students be exposed to the benefits of green engineering, but qualified engineers will be too. We want to encourage them to look at their science in a completely different way, by showing them that what they believe to be purely engineering issues can in fact be resolved in an aesthetically appealing and environmental way", they state.

A full weather station will be installed with sensors to determine soil moisture and evapo-transpiration rates. This data is to be used for calculating irrigation schedules on the campus.

Landscape installation

This was undertaken by Johann Niehaus of Origin Landscapes, whose scope of work involved soil preparation, planting, mulching and small scale landscaping with dumprock.

The nature of the project dictated that all building rubble, cement and solvents be removed from the site as it was to be flooded and chemicals or impurities would leach into the ponds. A vast amount of topsoil (300 m^3) was delivered to the site from another part of the campus where construction was taking place. The ponds had to be lined with soil and this was done using wheelbarrows to prevent puncturing of the liners. After leveling, 150 m^3 of compost was brought in from UP's own stockpile at their sports campus. It is manufactured from landscape waste on the campus and spread by means of a skid steer loader and wheel barrows.

The ponds were then flooded and the water plants needed to be planted as soon as possible ; this was carried out manually by volunteer landscape architecture and horticulture students and no shovels or picks were permitted due to the risk of puncturing the liner. After planting was completed, certain areas were packed with dump rock to provide some resistance to storm water and projected water flow of the system.

The entire landscaped area was mulched with over 120m^3 of shredded hardwood, spread by hand to ensure that plant material was not damaged. The liberal application of mulch meant that hardly any weeds germinated in the newly landscaped areas during the establishment phase. Niehaus says the spring rains came at exactly the right time and together with the automated irrigation system, ensured that the landscape established quickly.

Niehaus says that as the project forms part of the university's botanical garden, rare and not often used specimens were planted, including the aquatic plants. The inclusion of the entire East African cycad collection from UP provided bold focal points and were planted by a specialist. The inclusion of the project into the botanical garden meant that labeling of plants was done, mounted on timber posts throughout the landscape. This has attracted much interest from students and passers-by.

The proximity of the building to the water feature provides a close experience of a living wetland, albeit a simulated one. Indigenous fish have been added and birdlife is prolific in what was previously a 'dead 'space on the campus.

Gunnera perpensa **red data listed specie in bloom**

Irrigation

The irrigation system was designed by Pierre Brits of GWIS Irrigation and an irrigation pump has been installed in the sub-surface storage tank. The tank collects rainwater and is topped up with borehole water during dry periods. An automatic controller irrigates the entire newly landscaped area and surrounds. The storage tank and pump system have been connected to the existing irrigation mainline reticulation that covers an area of approximately 3,5 hectares. The entire botanical garden is now, almost exclusively, irrigated by rain water during the summer months.

Maintenance

Establishment of the plant material took three months and maintenance was done by Niehaus in conjunction with the university's botanical garden staff, who will assume full responsibility for it in the future. Maintenance is relatively low key but pump operation and water levels will require constant attention to ensure that the landscape functions as it should.

Pilot project

Dunstan says this is a pilot project for rainwater harvesting for the university, its first project to merge landscape and building together and create a 'living laboratory'. The landscape "is no longer only beautification, but an essential function to solve the many challenges faced by both the university and urban environment. It works towards the principles of a resilient city". **lsa**

Text by Karyn Richards, with additional information from Neal Dunstan, Jason Sampson and Johann Niehaus. Photos by Neal Dunstan.