Cascade into small pond - before

All Washed Up by Stormwater & Runoff

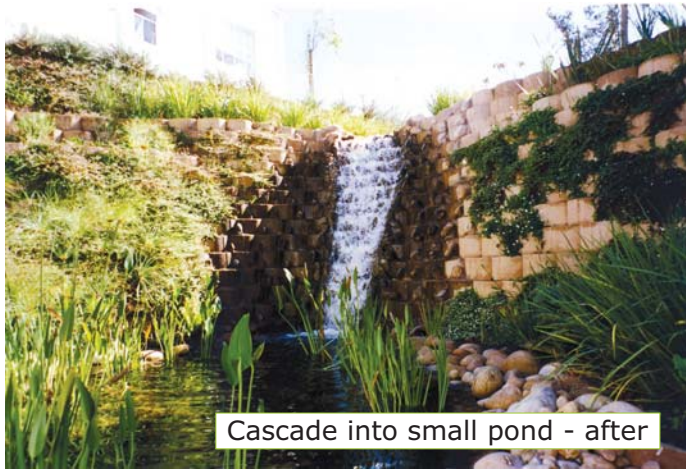
Rivers and streams that are scoured by storm water runoff in remote areas of South Africa may develop into wild and beautiful landscapes. But when storm waters degrade streams in densely populated urban areas, the results are likely to be deteriorated neighborhood aesthetics and polluted recreational areas. Karin Johns investigates why, as more and more open land gives way to residential use, the management of storm water runoff becomes crucial for the protection of human and environmental health.

According to The Department of Biodiversity & Conservation Biology, University of The Western Cape, 57% (or 21 million) of all South Africans live in towns and cities and by 2010 this figure will have risen to 73%, a staggering 43,7 million people. More people means more construction and as our natural vegetation disappears, rain falls onto impermeable surfaces instead of soaking into the ground.

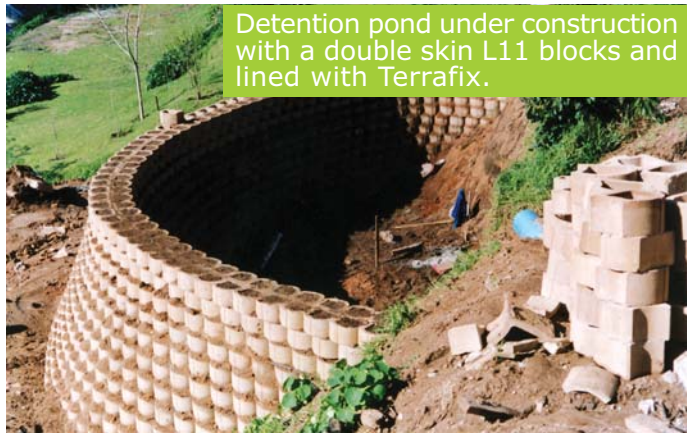
Water rushes down streets, across parking lots and into ditches, sewers or creeks, picking up all manner of pollutants - such as nutrients, bacteria, sediment, heavy metals, oils and grease - along the way. This water is contaminated, and may cause other problems because of the quantity of fast-moving water (water which would normally have been slowed or absorbed by vegetation).

This is the typical scenario where runoff is no longer delayed by minor topographic depressions, vegetative cover, or the indirect routes natural surface runoff would normally follow. Instead, runoff rates are increased due to the large area of impervious surfaces directing runoff into sewer pipe systems and more efficient drainage channels that are capable of conveying runoff to the receiving streams more rapidly than under pre-development conditions.

As a result the area available for rainfall infiltration into the soil is significantly reduced, which may result in a lowering of the water



Cascade into small pond - after



Detention pond under construction with a double skin L11 blocks and lined with Terrafix.

table and a potential reduction in the amount of groundwater recharging streams during normally low flow periods.

Increased stormwater discharge also causes erosion of the stream banks and soil due to higher flow velocities and in South Africa, the current loss of soil is estimated to be 20 times faster than the rate of soil formation. (Braune and Looser, 1989).

A fact sheet by the (CEP), Communicating the Environment Programme, published by the (SARDC) Southern African Research and Documentation Centre, shows that this can cause localised drought. In some areas of Southern Africa the amount of water that soil is able to absorb has dropped by a third, which has the same effect on crops that a 33 percent drop in rainfall would have had.

Increased water run-off also causes loss of plant nutrients. If plant nutrients such as nitrogen and phosphorus which are washed away by

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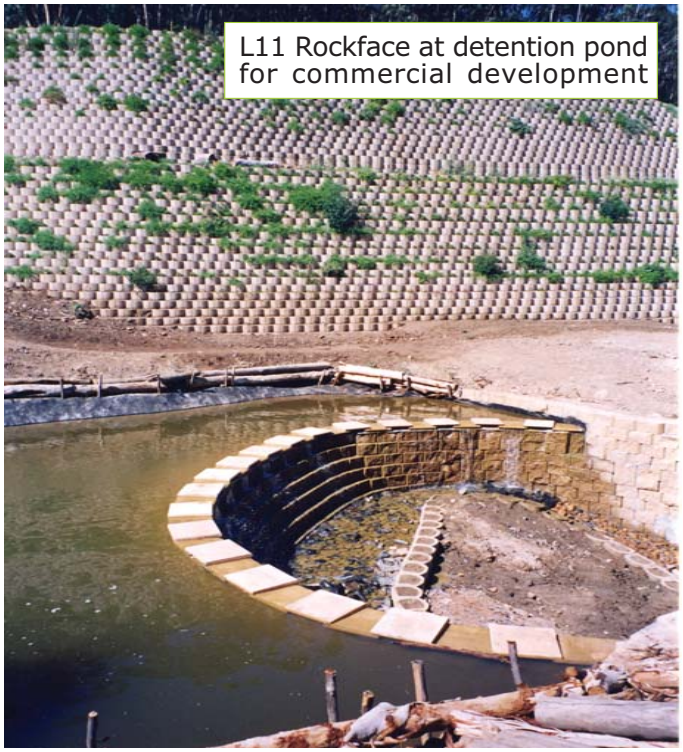

L11 Rockface at detention pond for commercial development

erosion were to be replaced by commercial fertilizer, the cost would exceed R 1000 million each year.

One of the more common, and very efficient, methods of stormwater management that has gained popularity in South Africa is the installation of stormwater retention or detention ponds in residential and industrial areas. These provide two primary services: Firstly, they retain the runoff, releasing the water at flow rates and frequencies similar to those that existed under natural conditions. Secondly, they provide pollutant removal through settling and biological uptake.

The most basic categorization of pond types is between wet and dry facilities. When designing for water quality treatment, this is one of the most important features to determine pollutant removal efficiency. For these facilities, detention time, generally a function of the travel distance or height of the outflow weir, is an important design feature for efficient pollutant removal.

A wet pond - or retention pond – is a storm water control structure that provides both retention and treatment of contaminated storm water runoff. A wet pond consists of a permanent pool of water into which stormwater runoff is directed. Runoff from each rain event is detained and treated in the pond until it is displaced by runoff from the next storm. By capturing and retaining runoff during storm events, wet detention ponds control both storm water quantity and quality.

A dry pond – or detention pond - is designed to capture and slowly release runoff water for a period of 72 hours or less after a precipitation event. Dry ponds do not treat the storm water as much as wet ponds and are typically constructed in areas where flood control is the greatest concern. (US Environmental Protection Agency, issue 71, 2003)

Locally, Holger Rust, owner of Terraforce, Cape Town based licensor specialising in modular, hollow core concrete blocks has seen his products used in many such facilities and he agrees that it is a very effective way of preventing stormwater damage: "Large, shallow facilities

V-shaped outlet and trash trap behind A 25 mm storm filled the pond 2 bricks high.

Terraforce L11 and 4x4 blocks used to create inlet cascade also used as stairway to recreational area/detention pond.

Emergency spillway and outlet

are considered to be more effective than deep ones with the same volume capacity. Most can be designed to offer recreational and aesthetic benefits: Create a place where people want to get together rather than avoid.

"Consider ways to increase the overall project value by creating a curvilinear, irregularly shaped pond with rockeries, gentle slopes, landscaping, and waterfalls or fountains. Include appropriate landscaping to help screen the pond from adjacent homeowners, provide a habitat for wildlife, or blend a pond into the surrounding development.

"Also, Inlets should be able to handle large volumes of water while at the same time being able to reduce flow velocities. As a bonus these cascades should be able to function as access routes - emergency or otherwise.

"One of the best products to fulfill these demands is the Terraforce 4 x 4 multi block. Flow-controlling outlets, such as V-notch weirs or riser overflows are usually built of concrete or masonry blocks and are often combined with sloping trash racks."

Rust also adds: "Emergency spillways, capable of handling 100 year flood events are indispensable for all detention facilities. Side slopes may be steep or shallow and need to be protected against erosion with grass cover or armouring with Terrafix erosion control blocks or Terraforce retaining blocks."

Overall, compared to other methods, retention/detention ponds use less space and are often found to be the best and cheapest way to control runoff--especially when flooding is a concern.

Yet one needs to consider that detention ponds, to be effective, need regular inspection and maintenance. Many older ponds have failed over time due to sedimentation, which reduces the pond's storage volume and/or clogs flow control systems.

Inlet in concrete, outlet in brick pillar

Attenuation pond, with gabions and Terraforce L11 blocks next to a small stream, which as a result gets protected from stormwater damage.

Says Rust: "While they may come across as nuisance measures at the tail-end of many projects, their long term benefits are numerous. Future generations will be able to say:

"Wow, these guys were thinking of us." Apart from that we can rest assured - stormwater regulations will become a lot more stringent from now on."

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Retention pond, Terraforce L11 blocks, that collects water from a natural spring. The area has become a beautiful bird sanctuary.

Inlet created with Terrafix and L11 blocks.

Here are some added technical considerations to keep in mind:

Soil conditions

Analyze soil and groundwater conditions before deciding to simply locate ponds at the low point of sites. A thorough analysis will expose potential problems for meeting detention requirements.

For example, bedrock is difficult to excavate. High ground water tables reduce the space available for storage.

Gravelly or cobbled soils may be excessively permeable so that storage and filtration capabilities are compromised. These conditions can be mitigated, but at an added cost.

Runoff rates

Carefully analyze existing runoff rates to achieve the maximum allowable on-site release rate to reduce the volumes required for detention ponds. Many times, peripheral areas of sites do not drain into the primary basin.

Some jurisdictions allow these areas (called "bypass") to be subtracted from the release rate if the flow is addressed in other ways.

Leaving such areas as open space or active recreation space means they will be considered at pre-development drainage rates, thereby reducing detention volumes and costs. Clay Loomis, Triad Associates, Environmental Outlook, 2003.

A series of Terrafix stilling basins serve as mini detention ponds

Stormwater from 12 office buildings and a golf course is harvested in this detention pond created with Terraforce L13 block. 50% of irrigation is supplied by this.

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