

Return of the ‘Bottomless Pool’ in Yosemite Creek, North Katoomba, Blue Mountains

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Key Points

- In the Blue Mountains sandstone environment, urban runoff causing erosion and sedimentation has resulted in the infilling of pools, habitat loss and biodiversity decline.
- Restoration can be successful if sufficient resources are allocated and a whole of catchment approach is adopted.
- Collaboration by agencies together with a genuine approach to engaging and empowering the local community is essential to the success and sustainability of restoration works.

This waterfall was christened in 1889 by a lover of Longfellow: "from the waterfall he named her Minnehaha — Laughing Water".

Abstract

Yosemite Creek in North Katoomba represents a microcosm of the challenges faced by urban creeks, in a catchment with sewerage infrastructure, a major highway, sealed and dirt roads, residential and industrial development, schools, ovals, disused quarries, a Council depot and a waste management facility. Decades of urban stormwater runoff resulted in sedimentation, massive instream erosion, decline of the creek’s water quality, loss of instream habitat and subsequent impact on the aquatic macroinvertebrate communities. Local residents lamented the loss of their favourite swimming hole, as the ‘bottomless pool’ at the base of Minnehaha Falls, once more than 30 metres deep, filled with sediment and essentially transformed into a beach.

A whole of catchment approach was adopted, starting with a community vision in 2002 of restoring the pools along Yosemite Creek. A North Katoomba Catchment Restoration Program was created focussing on treating point and diffuse sources of sediment at key nodes throughout the system. Stormwater treatment devices were installed at the headwaters of all tributaries with the aim to slow velocities, capture rubbish and remove sediment. Extensive riparian restoration works stabilised banks and recreated chains of pools and riffles complemented by weed removal and significant native vegetation plantings. A ‘Save our Swamps’ program restored extensive Temperate Highland Peat Swamps on Sandstone (THPSS) systems that were being incised by stormwater runoff. A Living Catchments community engagement program offered sustainability training and courses for local residents and a business stormwater program targeted all industries in the catchment with audits and business action plans. It was this coordinated and collaborative approach of government agencies, businesses and the local community that resulted in the successful restoration of Yosemite Creek and the return of the pools.

Annual monitoring between 2006 and 2015 showed a significant recovery towards a healthy assemblage of aquatic macroinvertebrates, with a shift from 12 family taxa to 22, and from AUSRIVAS Band B to Band A. Most importantly for the local community, the plunge pool at the base of the Falls is considered ‘bottomless’

once more (measured at over 25 M deep) and the site has rapidly become one of the most popular swimming holes in the Blue Mountains and thanks to social media is now a 'Wild Swim' destination.

Keywords

Catchment restoration, community engagement, Yosemite creek, urban runoff, sedimentation

Introduction

The pool below Minnehaha Falls on Yosemite Creek in North Katoomba in the City of Blue Mountains was once thought to be 'bottomless' by local residents. People reported that they could jump from half way up the waterfall without risk of touching the bottom. This perception was reinforced by an article in the Blue Mountains Gazette in the 1970's that reported a Council officer had attempted to measure the depth of the pool by tying a brick to a rope and ran out of rope at 90 feet (approximately 30m) without hitting the bottom. Another article appeared showing a local resident in a row boat in a large pool upstream of the falls and local residents and visitors enjoyed swimming in the pools during the hot summer months.

Rapid changes in urban development and subsequent urban runoff laden with sediment resulted in the deep pools infilling with sediment in a relatively short 25 year span. The highly erosive nature of the predominately sandstone catchment meant all works carried out in the catchment had a cumulative negative effect on the creek system and contributed to the rapid infilling.

Key catchment issues

A catchment sediment audit in 2002 identified a number of key point source inputs which included two disused sandstone quarries, the North Katoomba Waste Management Facility (WMF), Council's works depot, the North Katoomba Waste Water Treatment Plant and the widening of the Great Western Highway (GWH). Diffuse sources of sediment came from the many kilometres of unsealed roads and fire trails in the catchment, numerous steep unsealed driveways and road verges in the rapidly expanding residential area, sports ovals and an expanding industrial complex that borders directly onto Yosemite Creek. Another contributor of sediment came from bushfires and hazard reduction burns in the catchment which made the bushland more susceptible to erosion, especially during large rainfall events.

Several major state government infrastructure programs were underway that all contributed sediment resulting in the 'death by a thousand cuts' and the infilling of the pools along Yosemite Creek. As part of Sydney Water's plan to decommission all the upper mountains Waste Water Treatment Plants, a 3 metre diameter, unlined sewerage tunnel was constructed starting from North Katoomba. During construction a large drilling rig was lost during a directional drill in North Katoomba and never recovered. In that same catchment, which flowed to Yosemite Creek, several more tunnels were installed intercepting shallow aquifers and resulting in a decline in groundwater levels. Groundwater levels above Marmion Swamp in North Katoomba dropped approximately 9 metres and the local Bushcare group working in the area observed dieback in the hanging swamp vegetation which they attributed to the lowered water table. At the same time the Waste Water Treatment Plant in North Katoomba was decommissioned, the infrastructure removed, extensive tunnelling works were being carried out throughout the catchment and there were reports of sediment leaving these sites from the .

The Roads and Maritime Services (formerly RTA) had been upgrading the Great Western Highway through the Blue Mountains to improve traffic flows to the west. Several times during the construction of the Katoomba/Leura section, large storm events resulted in tonnes of sediment being exported into local streams. Sediment basins and detention ponds overtopped and frequently the local creeks ran brown with silt

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and sediment. The local community volunteers in the Bushcare network raised the issue at public consultation meetings and through their lobbying, the RTA agreed to install an instream sediment basin to capture sediments and to fund a multi-year riparian weed removal program (G. Smith, personal communications, 2007).

BMCC also contributed to sediment making its way into Yosemite Creek through the operation of the North Katoomba Waste Management Facility (NK WMF) and South Street Works Depot. Both facilities were constructed with large batters of unconsolidated sandstone which eroded during large storm events. Council responded to community concerns by improving the vegetation along the batters, installing instream sediment basins below the WMF and by lining all new cells to prevent leachate and sediment from entering the creek system. Council's works depot was upgraded with sedimentation basins, wash down bays, oil and grease traps, an artificial wetland and erosion control works along the steep batter that bordered onto the creek. The NK WMF was also closed in 2010 and transformed into a Waste Transfer Station.

The North Katoomba Catchment Restoration Program

North Katoomba was selected as a priority sub-catchment in 1996 under the State Government's Blue Mountains Urban Runoff Control Program (BMURCP, 2004). The aim of the BMURCP was to implement a range of on-ground, catchment improvement actions to address some of the key environmental issues related to stormwater and urban runoff. The program while having a large bush regeneration component, also targeted degraded lands, the rehabilitation of 2 disused quarries, the sealing of unformed roads and verges, and the installation of a range of stormwater treatment systems. Baffle boxes and other stormwater gross pollutant traps were installed throughout the catchment to reduce the amount of sediment entering the local streams.

A key part of the North Katoomba URCP program was an extensive road sealing program that included curb and guttering and new stormwater infrastructure. This created additional impervious surfaces and concentrated the stormwater flows into pipes that discharged directly into the sandstone based water courses. The resulting increased flows and velocities of the stormwater caused massive in-stream erosion and large instream head cuts and bank collapses. Within a relatively short time of the completion of the road sealing program, instream head-cuts began appearing in the tributaries and in the main creek line. Banks collapsed and Yosemite Creek became clogged with sediments which resulted in the infilling of the pools throughout the system. These pools along the creek once used for wading became shallow channels and the 'bottomless' plunge pool below the falls once used for diving and swimming filled entirely with sediment (above the water line) allowing locals to walk under the falls for the first time in living memory. It was estimated that over 55,000 tonnes of sediment was deposited in the 'bottomless' pool below Minnehaha Falls.

In response to community concerns, and from meetings with the local Bushcare groups which had been actively engaged for many years, Council began a North Katoomba Catchment Restoration Program (NKCRP) in 2002. A key aim of the NKCRP was to restore the pools along Yosemite Creek by involving key stakeholders and the North Katoomba community in a whole of sub-catchment restoration program. The program commenced with the formation of a community focus group that created a vision for the catchment (to restore the pools in Yosemite Creek), to identify key environmental issues and develop a long term action plan. Several new community volunteer groups were formed to monitor water quality and participate in rehabilitation programs for the catchment. Council formed collaborations with state government agencies that addressed community concerns in order to deliver better environmental and social outcomes for the

catchment. Community catchment days were held regularly to educate and engage residents in on ground projects being undertaken. Catchment pledges were developed that encouraged the community in making changes on their own property and adopt more sustainable practices.

Remediation works were undertaken to conserve local scheduled and vulnerable, threatened or endangered ecological communities and species in the catchment, including Temperate Highland Peat Swamps on Sandstone (THPSS), Blue Mountains Water Skink *Eulamprus leuraensis*, Giant Dragonfly *Petalura gigantea* and Giant Burrowing Frog *Helioporus australicus*. Bushland restoration works were designed and carried out systematically in order to improve habitat connectivity and wildlife corridors. Instream works focussed on bank stabilisation, the restoration of pools and riffles to improve instream habitat and enhance aquatic biodiversity.

Council embarked on a federally and state funded (with matching funds from Council's Environment Levy) Save our Swamps Program (SOS). Soft engineering techniques designed to restore hanging swamps (THPSS) were trialled throughout the catchment including those that were adversely affected by the sewer tunnelling and bushfires. Demonstration days were held to train staff, volunteers and contractors in using coir logs, straw bales and timber to repair channels in peat layers and to create a series of check dams to slow the stormwater runoff, raise the water table and rehydrate the swamps.

One of the key factors for the success in obtaining State and Federal grant funding for the program was being able to demonstrate the large amount of in-kind volunteer time and effort. Having active community groups to carry out some of the ongoing maintenance of the sites once the primary contract work had finished also proved to be very influential in obtaining successful grants.

The community groups themselves were also successful in attracting funding through programs such as the Environmental Trust Grants. Local volunteers in North Katoomba put together a comprehensive weed removal program for the catchment specifically targeting scotch broom. The community was also successful in attracting grant funding for Water Sensitive Urban Design (WSUD) projects in the North Katoomba Community Gardens and the Katoomba Men's Shed. The Katoomba Men's Shed works with men and youth in the area in a range of hand-on mentoring programs including environmental restoration projects. This is particularly important as North Katoomba has some of the lowest socio-economic indicators in the Blue Mountains and Western Sydney.

Outcomes

The large number of outcomes achieved by the NKCRP were only made possible through the ongoing involvement of the local community and included the following (Figure 1);

- Formation of a North Katoomba focus group and a shared vision for the catchment;
- Collaboration with a number of state agencies including the RMS, Sydney Water and the URCP which invested over \$5m in the North Katoomba catchment;
- Council procurement of over \$500k in state and federal grant funding for the NKCRP;
- Council's depot upgrade to include stormwater retention basins, an artificial wetland and improved sediment controls and specialised storage for unconsolidated materials;
- Installation of six new stormwater quality improvement devices (SQIDs) at key nodes throughout the catchment and improved maintenance schedules for existing devices;
- 500m of instream stabilisation work using rock lining which restored pools and riffles and coir logs to stabilise banks improving habitat and enhancing biodiversity;
- Sealing of 5km of eroding dirt road edge; and 3km of bare road verges mulched/turfed;

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- 15km of unused trails closed and rehabilitated in Mike Eades Reserve, North Katoomba;
- Illegal vehicular access to reserves blocked at 15 points to prevent damage from 4WDs;
- Severely degraded walking tracks in the catchment restored reducing, erosion and sedimentation;
- Two disused Council quarries rehabilitated in North Katoomba and North Leura;
- Volunteers and Council removed weeds and rehabilitated over 15km of riparian corridor;
- Over 10,000 hours of volunteer work completed;
- Over 5,000 native species planted in riparian zones by contractors and Bushcare groups;
- Volunteers closed off and brush matted unformed roads leading into hanging swamps;
- Streamwatch groups and a remote Bushcare group established for Yosemite and Katoomba Creeks;

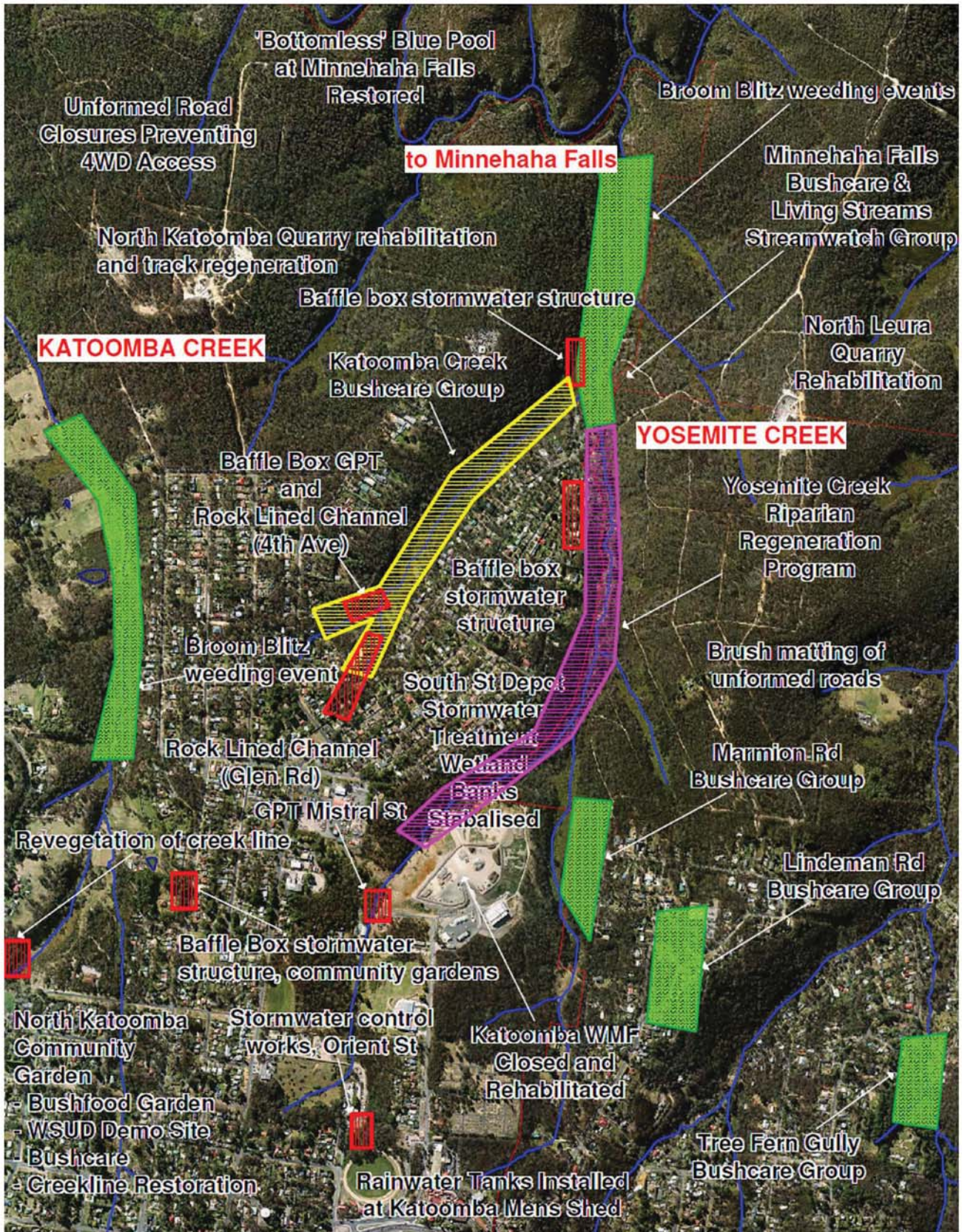


Figure 1. Map of North Katoomba Catchment Restoration Program outcomes

- Blue Mountains Living Catchments sustainability courses conducted with over 100 residents in North Katoomba which provided hands on training and advice on reducing their ecological footprint.
- Over 40 driveways sealed or stabilised by local residents to stop erosion;
- Joint Council/Sydney Water initiative resulted in 55 houses installing rainwater tanks;
- 25 households joined the Bush Backyards program and prepared property plans;
- Council conducted regular catchment crawls with local school students and residents;
- Catchment newsletters sent to all residents detailing remediation efforts and the outcomes;
- Over 200 catchment pledges signed by residents promising to implement sustainable actions;
- A waterwise gardening and WSUD demonstration site established at the Nth Katoomba Organic Community Gardens with rainwater tanks, drip irrigation, no dig gardening, free mulch, permaculture and organic gardening workshops;
- The Aboriginal community established a Bush Foods Botanic Garden with support from the World Heritage Institute and the Aboriginal Cultural Resource Centre;
- Sustainable living festivals held annually with a range of workshops and entertainment with an environmental and water theme;
- THPSS rehabilitation throughout catchment as part of a 'Save our Swamps' program and
- Pools and riffles along Yosemite Creek restored including the 'Bottomless' Blue Pool at the base of Minnehaha Falls.

One of the best long-term outcomes for this program has been the improvement in instream biodiversity. Annual surveys showed steady increases in the overall number of aquatic macroinvertebrate families and the number of mayfly, stonefly and caddisfly (EPT) families found at Yosemite Creek (Figure 2). Macroinvertebrate families increased from 12 taxa in 2008 to 22 taxa in 2015, while EPT taxa increased from 5 to 8 families over the same period. The site also improved from an AUSRIVAS Band B rating in 2008 and 2009 to a consistent Band A rating during 2012-2015.

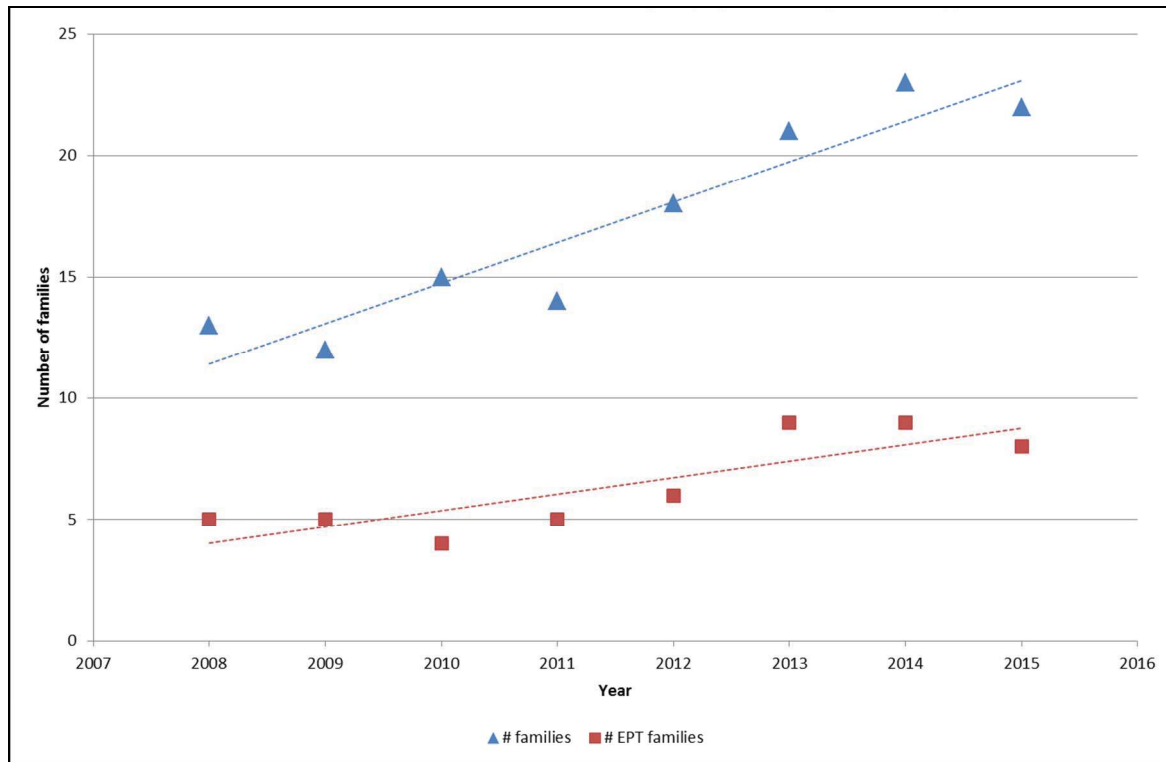


Figure 2. Yosemite Creek Aquatic Macroinvertebrate Diversity 2008-2015

Conclusions

The North Katoomba Catchment Restoration Project was deemed successful for many reasons including: measured improvements in waterway health; number and scope of on-ground works; partnerships and associations that were created; collaboration between all stakeholders; high level of community engagement and the subsequent empowerment of the community. Through its whole-of-catchment approach and multi-disciplinary methodology the NKCRP is being adopted as a model for how Blue Mountains City Council sustainably manages its natural resources on a sub catchment scale.

One of the biggest reasons for the long term success was actively engaging and supporting the local community and volunteers and adopting their vision for their catchment. The behavioural changes adopted by Council, local businesses and local residents were crucial for reducing new inputs of sediment. The ongoing monitoring and maintenance of the restoration sites by the community volunteers proved invaluable.

Key learnings from the NKCRP that are being applied in other catchment programs include allowing sufficient time and resources in order to achieve long term environmental restoration outcomes. In this case BMCC was willing to commit to a long term program because the local community endorsed a special variation through a 10 year Environmental Levy and recently endorsed a longer term Special Rate Variation with an environmental component. In this case it took over 10 years to see the positive changes manifest on ground and the catchment restored.

A 1 in 50 Average Recurrence Interval (ARI) storm event provided the final piece to the pool restoration puzzle. For the first time in decades, this large storm event was able to scour out the pool instead of depositing further sediment. Sand pushed out of the pool below the falls was deposited along the creek banks for several hundred metres.

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As a result the 'bottomless' pool at the base of Minnehaha Falls has returned and was recently measured at over 30 metres in depth. Through social media and word of mouth it has rapidly become one of the most popular wild swimming holes in the Blue Mountains (Figure 3).

The NKCRP has improved the water quality in Yosemite and Katoomba Creeks, restored the riparian habitat and increased the instream biodiversity. The rise in instream biodiversity demonstrated that environmental trends can be reversed and the saying "if you build it they will come" became a reality.

As the only city in the southern hemisphere within a World Heritage listed National Park, all improvements in this catchment are having beneficial effects on the Grose Valley Wilderness Area and the Greater Blue Mountains World Heritage Area downstream.

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Figure 3. 'Bottomless Pool' at Minnehaha Falls: 1960's, 2006, 2016.