

# Wetland 'treatment train' improves water quality and runoff from agricultural land: A holistic approach to water quality treatment

Matt Moore, Senior Fisheries Biologist, Catchment Solutions Pty Limited

Catchment Solutions, in collaboration with Reef Catchments NRM and Mackay sugar cane farmer Shane Cowley, joined forces in 2014 to construct a treatment train of wetlands. The project team took a holistic approach to wetland design by incorporating both water quality treatment and biodiversity outcomes.

Multiple water quality treatment chambers were constructed to capture and improve water quality flowing from adjacent sugar cane farms prior to discharging into the Bakers Creek estuary and eventually the Great Barrier Reef.

The treatment train of wetlands was constructed within a 'cane drain' immediately upstream of a degraded lowland wetland in Mackay, Central QLD. During rainfall events, water high in nutrients, herbicides and pesticides draining 500 hectares of sugar cane would enter the wetland via the drain before flowing into Bakers Creek estuary and through to the Great Barrier Reef. Previously, the wetland was used to irrigate sugar cane, and would often be pumped right down in the heat of summer. Low water levels combined with poor water quality exacerbated wetland impacts, potentially leading to fish kills.



*Nature-like rock ramp fishway connecting the wetlands with downstream receiving waters. (Matt Moore)*

## Water quality treatment

The treatment train of wetlands was designed to capture and treat the first runoff event (30–40 millimetres) leading into the annual wet season. The first runoff event usually occurs between October and December after a long dry season, and is particularly high in nutrients and herbicides. The treatment train wetland design consisted of three water quality treatment chambers: sediment basin, deep-water macrophyte zone and detention/irrigation re-use chamber alongside rehabilitation of the existing wetland. The deep (1.5 – 2 metres) sediment detention basin formed the first chamber, and was designed to drop out sediment, including particulate nitrogen and phosphorus. The second chamber consisted of a deep-water macrophyte zone (min 800 millimetres), enhancing nutrient uptake via algae, microbes and fungi that grow together on the reeds and sedges. Aquatic plants also provided habitat for fish, frogs and aquatic insects. The third chamber consisted of a deep (4 metres) irrigation re-use/detention basin, which the landholder uses to irrigate sugar cane, prior to discharging into the existing wetland. Each chamber is separated by a rock riffle or rock cross vane structure, which re-oxygenates the water, further assisting nutrient uptake while increasing dissolved oxygen levels critical for aquatic life.

## Habitat rehabilitation

Wetland habitat values were increased by planting over 3000 endemic riparian plant species, removing declared weed species including hymenachne, para grass and penny leaf, and placing large logs in the water. An often overlooked but important design feature of constructed wetlands is connectivity with downstream aquatic habitats. Connectivity issues are confounded by the construction of wetland riser outlets, which block fish passage. Wetlands provide critical nursery habitats for many fish species, including economically important fish species such as barramundi. To further increase biodiversity values of the wetland system, a 23 ridge nature-like rock-ramp fishway was constructed to provide connectivity with downstream aquatic habitats.

## Monitoring

Water quality monitoring was undertaken over two years using fixed auto-samplers located at the inlet and outlet of the wetland. Electrofishing and fishway trap monitoring were undertaken to monitor fish communities. The results have been outstanding with significant reductions in nutrients and herbicides at the outlet compared to the inlet and large increases in native fish community abundance.

For more information, visit:

[catchmentsolutions.com.au/this-train-is-a-treat/](http://catchmentsolutions.com.au/this-train-is-a-treat/)



*From top: Pre and post wetland construction works. (Matt Moore)*



# Yangebup Lake solar power nutrient stripping trial

Christopher Beaton, Environment Manager, City of Cockburn

After limited success with a number of strategies to tackle an annoying midge problem, the City of Cockburn is harnessing the power of the sun and engaging the local community to make a difference.



The City of Cockburn is a peri urban local government authority on the outskirts of Perth. Yangebup Lake is part of the Beeliiar chain of wetlands which lie within the City's boundary. The lake is highly nutrient rich due to past development activities and current stormwater inflow. Nutrients within the lake support algal blooms which decay and provide a food source for high numbers of nuisance midge. The midges are attracted to city lights and when present in high numbers, severely impact local residents.

Chemicals have been used in the past to address the midge problem.



To reduce the need for chemicals and address the problem of nutrients, the City has undertaken extensive revegetation around and within the lake and converted incoming drains into living streams. Community education has also been undertaken to help reduce fertiliser use. Although showing some promising results, these actions have not been sufficient to substantially improve water quality and reduce nuisance midge.

Something else needed to be done.



*Left column, from top: Habitat Creation, 1 Feb 2016 (Linda Metz). Early Growth, 7 July 2015 (Linda Metz). Basin Construction, Riffle placement, 3 June 2015 (Chris Beaton).*

*Right column: Meet the Locals, November 2015 (Linda Metz)*



The City has developed a novel trial to help address the nutrients in the wetland. A solar pump is used to withdraw nutrient rich water from the wetland. The water is then passed through a specially designed nutrient stripping basin that allows nutrients to be removed by plants (many of which were planted by local schools and community groups) prior to it flowing back into the lake. Rocks and logs have been strategically placed to establish riffles and ponds in the basin where the water is aerated and slowed. The water also gets a chance to settle, as the solar pump shuts down once the sun goes down and starts again when the sun comes up. Early results are very encouraging with plans to build a second stripping basin at another site near the lake.

Nutrient stripping basins have been shown to be very effective in treating stormwater and reducing the nutrients entering wetlands. Unfortunately many rely on rainfall to function. Using a solar power to pump water through the basins means it can function 365 days a year with minimal maintenance costs.

The added bonus is the creation of an education resource for local schools as well as much needed habitat for local wildlife as the basin was established in a previously degraded area.

For further information on the project, contact Christopher Beaton at the City of Cockburn on (08) 94113444



*Top: Aerial Photo, 23 Jan 2016 (Nearmaps)*

*Bottom: Basin Looking South, January 2016 (Paul McGovern)*



# Marrambidya Wetland—Creating an environmental resource from redundant Council assets

Tony Phelps, Environmental Coordinator, Wagga Wagga City Council

Close to Wagga Wagga's central business district some of the city's sewerage treatment ponds have been transformed into a valuable community resource.

The Marrambidya Wetland is located on the flood plains of the Murrumbidgee River in NSW, within 5 minutes' drive of Wagga Wagga's CBD. The Murrumbidgee is a regulated river. A large percentage of its winter flows are captured in storage dams and then released in summer for irrigation. The resulting high summer flows and low winter flows are opposite to the flow regime that was experienced before river regulation. The altered flow regime creates a number of environmental issues:

- thermal pollution – release of cold water from dams
- reduced occurrences of medium to large flood events
- changes to natural seasonal flow patterns
- reduced inundation of wetlands near the river channel

These changes all impact on feeding, breeding and survival of native flora and fauna.

In 2010 Wagga Wagga City Council developed a conceptual plan to rehabilitate redundant tertiary sewerage treatment ponds into constructed wetland ponds. Ponds were reshaped, pond walls removed and large and small cobbles and clay were placed at different depths within the ponds and on the banks to create a wide diversity of niche aquatic and riparian habitats.

Water is supplied to the Marrambidya Wetland as treated effluent from the adjacent sewerage treatment facility. Its quality more than meets the threshold parameters required by the Environment Protection Authority. The 22,000 riparian and aquatic plants that have been planted in the wetland provide an additional bio-remediation process to the treated water.



*Construction works reshaping ponds and installing woody debris (Tony Phelps)*





*Ducks on emergent timber at wetlands* (Tony Phelps)

As the source water into the wetland is from the Council owned treatment facility, Council officers have the ability to manage the water levels within the wetland independently of river levels and rainfall events. This makes the constructed wetland almost drought proof, as the supply of treated water into the wetland ensures that even in extended drought periods the ponds will have a typical wetting and drying cycle. The wetland is now a valuable resource for wetland fauna and flora in a climate of uncertain weather patterns.

In addition to being a valuable resource within the natural environment Council's vision is that the wetland will be used for:

- environmental education
- promoting Indigenous culture
- tourism and passive recreation
- show-casing best practice in water management and site rehabilitation
- breeding habitat for endangered native fish.

For further information, contact Tony Phelps at [phelps.tony@wagga.nsw.gov.au](mailto:phelps.tony@wagga.nsw.gov.au) or visit [www.wagga.nsw.gov.au/city-of-wagga-wagga/environment/marrambidya-wetland](http://www.wagga.nsw.gov.au/city-of-wagga-wagga/environment/marrambidya-wetland)



# Revegetation of the Griffin Environmental Reserve

Moreton Bay Regional Council

Moreton Bay Regional Council and Unitywater are working in partnership with the local community to revegetate the Griffin Environmental Reserve, on the Pine River, south east Queensland. The suburb of Griffin is rapidly developing and the reserve plays an important role in increasing natural wildlife habitats and buffering the Pine River system and Moreton Bay from the negative impacts of stormwater flows and urban development.

The lower parts of the Pine River lie within the internationally recognised Moreton Bay Ramsar wetland, and are part of a declared Hays Inlet Fish Habitat Area. The Pine River provides habitat for numerous resident and migratory shorebird species. Adjacent to the Pine River and next door to the Griffin Environmental Reserve, Moreton Bay Regional Council operates the Osprey House Environmental Education Centre which helps to educate the community, especially school groups and young children, about the important values and ecosystem services that the Pine River wetlands provides.

In 2013, Moreton Bay Regional Council partnered with Unitywater as part of their *Creekside Greening Program* to engage the local community in a staged revegetation of the Griffin Environmental Reserve. Over a four-year period, volunteers have planted some 6000 seedlings at the 24 hectare reserve, helping reduce sediment loads and nutrients entering the Pine River being transported to Moreton Bay.



*Top: New revegetation at the Griffin Environmental Reserve, 2016 (Jessica Mowat)*

*Bottom: Established revegetation at the Griffin Environmental Reserve, 2014 (Jessica Mowat)*



Annual planting days have been conducted over consecutive years and returning volunteers can observe the progress of the previous year's revegetation work. The staged revegetation approach ensures that each planting is at a scale that can be managed and maintained to a high standard. The cumulative benefits of several plantings at the reserve is evident. The plantings are enhancing wildlife habitat for multiple species including koalas, birds and reptiles, creating a habitat movement corridor and increasing the vegetation buffer along the Pine River. The project is empowering local residents and community groups and providing lasting benefits to the wider community.

The plantings are part of a long term Master Plan for the reserve, developed by Moreton Bay Regional Council, which will see the area fully regenerated with opportunities for nature-based recreation.

For further information, contact Jessica Mowat, Moreton Bay Regional Council, on 3205 0555 or at [jessica.mowat@moretonbay.qld.gov.au](mailto:jessica.mowat@moretonbay.qld.gov.au).



*Aerial Map showing staged revegetation at Griffin Environmental Reserve, 2013 (Morton Bay Regional Council)*



# Sydney's 'Hawkesbury Environment Network' prepares for urban expansion with conservation and community

Justin Pepito and Robin Woods

The Hawkesbury-Nepean riverine area of greater Sydney is a uniquely dynamic place where rural lifestyles meet metro-suburban amenities in ways that challenge community, culture, and conservation. While some of the region's property developers and primary producers in market gardens and turf have cleared vital wetland buffer zones and even some wetlands themselves, several community members are spearheading efforts to make lowland wetland damage more clear and meaningful to the expanding urbanised community.

The Hawkesbury Environment Network (HEN)— the primary grassroots environmental organisation in the region— believes it can foster a connection between Sydneysiders and neighbouring landowners in order to build an appreciation for wetland conservation. Robin Woods, a HEN committee member, believes that in order for better interest in conservation and restoration management to unfold into the future, community stakeholders must take action to inspire, educate and engage *with* each other in ways that may seem intuitively contradictory.

Sydney Polo Club, which recently won a bid to host the 2017 World Polo Championship, is one of these stakeholders whose property borders lagoons. The club's mown lawns currently extend to the lagoon rim with no fringing zone of vegetation to protect the banks from slumping and to filter effluent from the nearby horse stables. HEN is currently partnering with the club's land management staff to establish appropriate buffer zones to protect the lagoon. The club is also planning some positive community engagement activities in the lead up to their high profile events. These include University and TAFE ecosystems field classes and carp fishing classes for pest management.



*Carp are a huge problem throughout the Hawkesbury wetlands. (Hawkesbury Environmental Network)*



HEN has also teamed up with the Green Army to mobilise “Wetland Warriors.” The warriors, many of whom are western Sydney locals aged between 17 and 25, feel the advancing pressure of urbanisation in their communities, and believe that the best management involves getting community members to act as one. The group was recently dispatched to Sydney Polo

Club to revamp its lagoon banks with native species. Robin and HEN believe that Wetland Warriors venture will, in the face of Sydney’s future expansion, sustain HEN’s work into the future.

For further information, contact Robin Woods at [robin@hen.org.au](mailto:robin@hen.org.au) or visit [www.hen.org.au/](http://www.hen.org.au/)



*Currently the polo club mows to the water's edge. Green Army Wetland Warriors will revegetate this area to create a riparian buffer. (Hawkesbury Environmental Network)*

# Recycled hardwood logs for riverbank stabilisation

David Keast, Catchment Management Officer, City of Gold Coast

The City of Gold Coast (City) has trialled an innovative technique using recycled large hardwood logs with intact rootballs to protect the riverbank of Tallebudgera Creek.

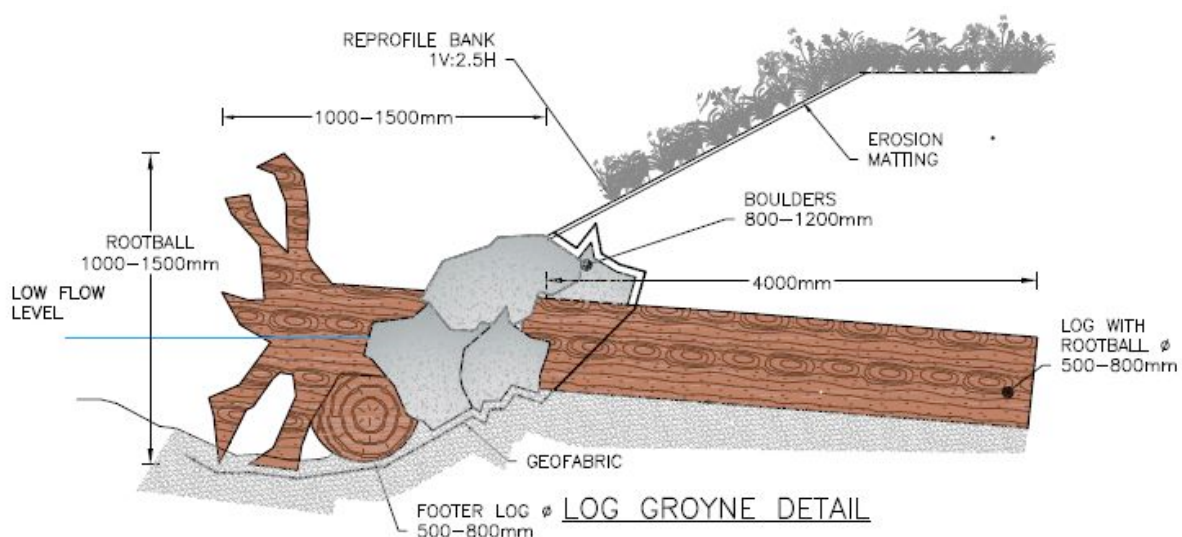
Smales Park is a community recreational reserve on Tallebudgera Creek which had been experiencing severe erosion along a 70 metre stretch of riverbank.

Tallebudgera Creek has undergone significant changes since European settlement. The removal of riparian vegetation and in-stream large wood and the construction of a dam in the 1950's has resulted in geomorphic degradation of the river channel.

At Smales Park, Tallebudgera Creek is partially confined by the valley margins, with the discontinuous floodplains consisting primarily of highly erodible fine sands and silts. The altered hydrology of the creek in conjunction with limited riparian vegetation had resulted in scouring and failure of the riverbank at Smales Park. The channel width had increased from 10 metres in 2009 to 15 metres in 2014, and an estimated 1200 cubic metres of sediment was exported downstream.

The City engaged Alluvium Consulting to design and implement riverbank stabilisation works using large hardwood logs. As well as protecting the reserve, the project was an opportunity to demonstrate alternate riverbank stabilisation techniques to rock rip rap, which is currently the predominant riverbank protection method.

Hardwood footer logs were laid along the excavated toe (lowest part) of the riverbank to protect it from scour. Additional logs were placed on the footer logs at a 45° angle, with the root ball extending upstream around one metre into the channel. The logs were secured with large boulders and the backfilled spoil, and the riverbank was battered and replanted to reflect the remnant riparian vegetation on the opposite bank.



*Typical detail of the log structure used to stabilise the riverbank and create aquatic habitat at Smales Park.*



The protruding root ball is designed to reduce flow velocity near the river bank and maximise aquatic habitat within the creek by creating changes in the physical form of the channel such as scour holes and deposition zones. A particularly pleasing aspect of the project was that the hardwood logs were recycled from a development site, and would have otherwise been converted to woodchips.

Monitoring of the site in the two years since construction has demonstrated the effectiveness of the technique in halting riverbank erosion. The logs have also created variability in the physical form of the river, providing additional aquatic habitat, and the vegetation is now well on its way to replicating natural systems.

For further information, contact David Keast at the Catchment Management Unit, City of Gold Coast on 07 5581 7399 or visit [www.cityofgoldcoast.com.au/catchments](http://www.cityofgoldcoast.com.au/catchments)



*Looking downstream at the completed large wood riverbank stabilisation and revegetation works at Smales Park.*  
(Catchment management Unit, City of Gold Coast)



# Reducing acidic discharge into Bungawalbyn Creek, NSW

Department of Primary Industries NSW

A drained coastal wetland at Bungawalbyn Creek has been partly re-flooded to minimise the discharge of extremely acidic water into the downstream waterways.

The property at Boggy Creek, Bungawalbyn is 10 kilometers west of Woodburn on the Richmond River, NSW. It is a former natural back-swamp that was first drained in the 1920s, the drainage network later being expanded for tea tree production.

Unfortunately, this work also exposed the underlying acid sulfate soils to oxidation; which generated toxic quantities of sulfuric acid. Chronic discharges of acidic water severely affected aquatic life including Australian bass, eel-tailed catfish and freshwater shrimp. On-farm effects were also noticed with vegetation scalding and cattle suffering from debilitating scour.

In the early 2000s NSW Agriculture were approached for some technical advice. They established a monitoring program to examine the nature and scale of the problem, while identifying potential solutions. pH levels of 3 to 4 were commonplace (classed as extremely acidic). The research recommended raising the water table, however this reduced the ability to grow tea tree in the lowest parts of the wetland and the trial was abandoned.



*Newly installed weir with wetland flows discharging downstream (Simon Walsh)*





*Water now covers a previously scalded area (Simon Walsh)*

After several years, the property owner recognised that tea tree production at the lowest elevations would always be compromised by the area's tendency to become inundated when wet and scalded when dry. The project concept was re-visited in 2015–16, this time by NSW Department of Primary Industries (Fisheries) with our project partners WetlandCare Australia (now Conservation Volunteers Australia) and North Coast Local Land Services. Discussions highlighted that raising water levels in the lowest parts of the wetland would simultaneously raise groundwater in the slightly higher tea tree paddocks and increase their productivity.

In June 2016, a low-level weir was fabricated and installed in the drainage system. The weir was designed to retain maximum water in the wetland without infringing on the surrounding tea tree crops or other farm infrastructure. The property is located in the upper estuary of the Richmond River, where although influenced by the tide, the water is of low salinity. The weir was built with two flap gates to allow

high tides to 'recharge' the wetland with freshwater, but then stop it from leaving again. In this way the wetland is prevented from drying out completely (and re-oxidising the sulfidic sediments) as it did during previous droughts.

DPI (Fisheries) is continuing to work with the landholder and project partners on the site. A 12 month monitoring program has now commenced to gauge the effects of the weir on water levels and changes to the wetland vegetation communities. Two field days have also been held on site to showcase the benefits for neighbouring farmers who wish to improve their on-farm productivity, while also enhancing natural wetland values.

For further information on this project, please contact Simon Walsh at [simon.walsh@dpi.nsw.gov.au](mailto:simon.walsh@dpi.nsw.gov.au)