Great Lakes Council

2013 waterway & catchment report

Great Lakes Council 2013 Waterway and Catchment Report

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Introduction

The Great Lakes region depends heavily on the health of local waterways and their catchments. The waterways form the basis of the region's economy (supporting tourism and primary production), contribute to our way of life and amenity, and provide habitat for extraordinary biological systems. The region's catchments are under increasing environmental pressure from pollution and impacts associated with catchment land use, development and tourism, potentially resulting in a decline in the health of our waterways.

In 2002, the majority of our waterways were classified as "generally healthy-modified" by the Healthy Rivers Commission (now the Natural Resources Commission).

Between 2005 and 2007, the Great Lakes Water Quality Improvement Plan ranked Wallis Lake as moderately disturbed with some areas as high conservation value, Smiths Lake as high conservation value; and, the Myall Lakes ranged between moderately disturbed and high conservation value.

All our local waterways are critically susceptible to increasing environmental pressures; a Hepatitis A event in oysters in Wallis Lake in 1997, reoccurring blue-green algae in Myall Lakes and episodic fish kills are all examples of what can go wrong.

This report has been presented to accompany the 2013 Waterway and Catchment Report Card. It provides the technical information on how the Report Card scores were calculated as well as providing more details on the results. A summary of the management responses undertaken in each estuary to address water quality have also been presented here.

The Goal for our waterways is to maintain or improve their condition in order to protect biological diversity and maintain ecological processes

Water quality - ecological health

The health of the waterways in the Great Lakes region is fundamental for achieving the Vision set out in the community strategic plan 'Great Lakes 2030': "A unique, sustainable and enhanced environment with quality lifestyle opportunities created through clever development and appropriate infrastructure and services". Since 2008 the NSW Government Office of Environment and Heritage have undertaken an ecological health monitoring program in Wallis Lake as part of the state-wide Monitoring, Evaluation and Reporting Strategy (MER). As part of the Strategy, Wallis Lake was selected as one of seven estuaries across the state to be sampled each year to track inter-annual variability in two ecological health indicators; chlorophyll a (the amount of algae) and turbidity (the amount of sediment). In 2011-2013 Great Lakes Council, the State Government Estuary Program and the Federal Government (through their Caring for our Country Program) provided funding to expand this monitoring program to cover additional sites across the Great Lakes Local Government area. The Office of Environment and Heritage have as a result, provided an independent scientific evaluation on the ecological health of Wallis Lake, Smiths Lake, Myall Lake and the Bombah Broadwater in the Myall Lakes.

Ecological health does not refer to environmental health issues such as drinking water quality, safety for swimming, heavy metal contamination, disease, bacteria, viruses or our ability to harvest shellfish or fish.

Figure 1.1.1 Myall Lake looking south

Ecological health results presented in easy to understand Report Card

The results of ecological health monitoring have been presented in a Catchment and Waterways Report Card which grades the health of the waterways in a similar way to school Report Cards with a grade ranging from A (excellent) to F (very poor). This Report Card documents how Great Lakes Council is tracking towards their 2030 Vision and is included in Appendix 1.

The information provided below includes the background details for the Report Card including the objectives, methods and a detailed description of the results.

Report Card objectives

The objectives for the Report Card are:

1. To report on ecological health.
2. To track progress on management actions.

These objectives are specifically achieved by:

- Providing information to assist in the current and ongoing protection of "high conservation" areas that currently provide substantial water quality and biodiversity benefits to the rivers and estuaries.
- Providing information to guide and report on the remediation of areas that have high pollutant loads and highlight areas that may require further action.
- Providing information to help protect all areas of Wallis, Smith and Myall Lakes against further declines in water quality.

In addition to the ecological results, management actions being undertaken in the catchments are also presented in the Report Card. A more detailed description of the management actions is provided in this report. These management actions have been developed to target specific environmental values which Council and the community have determined as important to the region.

Environmental values

The environmental values that management actions in the catchment are aiming to achieve are:

1. Minimal algal growth.
2. Minimal sediment inputs and maximum clarity.
3. Intact aquatic habitats like seagrass, macrophyte and riparian vegetation.

Figure 1.1.2 Clear waters with minimal algal growth and maximum clarity support key habitats such as seagrass

Methods

Development of Report Card grades

The monitoring program has assessed the ecological health of Wallis and Smiths Lake, Bombah Broadwater and the Myall Lakes. There are a number of steps taken to determinine the score for each zone and subsequent Report Card grade:

1. Selecting the indicators.
2. Identifying the trigger levels.
3. Collecting the data.
4. Calculating the zone score.
5. Allocating the Report Card grade.

1. Selecting the indicators

In order to meet the objectives of the Report Card, indicators must report on ecological health but also be able to report on the outcomes of management actions. The management actions are linked to the environmental values set for the region (listed above), and the indicators selected have been shown to be responsive to catchment management actions.

Algal growth can be measured by assessing chlorophyll a levels in the water and sediment inputs assessed by measuring the turbidity (see side box). These indicators are easy to measure and directly relate to the environmental values.

While the extent of seagrass beds, macrophytes and riparian vegetation are not currently measured, low chlorophyll and turbidity levels are necessary to ensure healthy habitats. Expansion of the program in the future is likely to include assessment of these habitats.

There are many different estuary reporting programs world-wide, with indicators specifically chosen to suit local conditions or issues. Chlorophyll and turbidity are commonly used as they are proven to be very informative and responsive indicators Table 1.1.1.

Table 1.1.1 Indicators used in various estuarine monitoring programs

Monitoring Program	Chlorophyll a	Turbidity	Dissolved Oxygen	Nutrients	Riparian vegetation	Seagrass	Other critical habitats (e.g coral)
South East Queensland Ecosystem Health Monitoring Program	✓	✓	✓	✓	✓	✓	✓
Chesapeake Bay EcoCheck program	✓	✓	✓			✓	✓
Northern Rivers CMA Ecohealth	✓	✓	✓		✓		
NSW Monitoring, Evaluation and Reporting Program *	✓	✓	F		F	✓	
Great Lakes Council Report Card (this program)	✓	✓	F		F	F	

F - future

* NSW Monitoring, Evaluation and Reporting Program also samples fish in a limited number of sites

The NSW Monitoring, Evaluation and Reporting Program, based on the findings of Scanes et al. (2007) concluded that measurement of chlorophyll a and turbidity provides an effective measure of the short-term response of estuary health to management actions. Seagrass and other macrophytes provide a long-term integration of estuary health.

Dissolved oxygen has been widely used as an indicator of the amount of oxygen in the water column with many critical aquatic processes dependent on a healthy level and minimal variability. Great Lakes and NSW Monitoring, Evaluation and Reporting Program both acknowledge that dissolved oxygen is an important variable to measure but have not done so to date due to logistical reasons. There are plans to include this indicator in future monitoring activities.

2. Identifying the trigger levels

A healthy ecosystem refers to a system which has normal ranges of diversity and function. These 'normal' ranges have been established from extensive monitoring of estuaries across NSW as part of the NSW Monitoring, Evaluation and Reporting program. To establish these ranges, sites that represent a variety of ecological conditions from pristine (reference) sites to highly degraded have been sampled over a number of years. The data for pristine (reference) sites have been used to establish the trigger values which are fundamental for ranking the ecological health of a site.

The National Water Quality Management Strategy (ANZECC 2003) suggests that the suitable method for deriving a trigger value is to determine the 80th percentile value (i.e. the value that is met 80% of the time) for an indicator at reference sites. A trigger value is the value which indicates that a variable is outside the "normal range" and could trigger further investigation. In our context, we have used the trigger value to indicate conditions which are not desirable for continued waterway health.

Algae

Algae or microscopic plants are always present in waterways but if conditions change and are suited to algal growth, blooms can occur. Blooms may occurr if there is a lot of nutrients in the water which can come from urban stormwater, fertiliser runoff from farms and gardens and seepage from septic tanks. Algal blooms can reduce the amount of light reaching seagrass beds limiting their growth. When blooms of algae die and start to decay, the resulting bacterial activity can reduce oxygen concentrations in the water column, possibly leading to fish kills. Chlorophyll is a good measure of the amount of algae in the water as all alga have chlorophyll in their cells giving them their green colour.

Chlorophyll a

Chlorophyll a is a pigment found in plants and is an essential molecule for the process of photosynthesis (the conversion of light energy to chemical energy resulting in the consumption of carbon dioxide and the production of oxygen and sugars). In estuarine and marine waterways, chlorophyll a is present in phytoplankton such as cyanobacteria, diatoms and dinoflagellates. Because chlorophyll a occurs in all phytoplankton it is commonly used as a measure of phytoplankton biomass. (EHMP 2008)

Sediment

Sediment from the land can be washed into waterways when it rains. If land is not properly managed with trees and groundcover, large amounts of sediment can wash into our waterways. Sediment also comes from roads and pathways washing directly into the stormwater and then the estuaries.

Too much sediment in the water reduces the amount of light reaching the bottom and is detrimental to seagrass which require light for growth. Seagrass is critical for the health of estuaries as it provides essential habitat for fish and invertebrates which support bird life and subsequently influence the local tourism and aquaculture industries. Excess amounts of suspended particles can also smother benthic organisms like sponges and seagrass, irritate the gills of fish and transport contaminants. Turbidity provides a measure of sediment in the water.

Turbidity

Turbidity is the measure of light scattering by suspended particles in the water column, providing an indication of the amount of light penetration through the water column (EHMP 2008).

A trigger value is specific to different types of estuary, in this study, Wallis Lake, Pipers Creek, Charlotte Bay, Smiths Lake, Bombah Broadwater and Myall Lake were all classified as "Lakes" and Wallamba River and the Lower Myall River, Tea Gardens as a "River estuary" (Roper et al. 2011).

Table 1.1.2 Trigger Values for NSW Estuaries (from Roper et al. 2011)

	Turbidity (NTU)	Chlorophyll (µg/L)
Lake	6.7	2.5
River estuary (mid)	1.9	2.2

3. Collecting the data

The Great Lakes region has been divided up into eight reporting zones. A zone is actually a broad area within the estuary rather than a discrete point (see maps in Results Section) and may be represented by a single sample or by multiple samples. Four zones were sampled in Wallis Lake estuary (Wallamba River, Pipers Creek, Wallis Lake, Charlottes Bay). There is one zone in Smiths Lake and one zone in the Myall Lake and one zone in Myall Lakes at the Bombah Broadwater.

Samples were collected on six occasions between summer and autumn from December to March. This represents the part of the year when the highest chlorophyll concentrations are expected.

Figure 1.1.3 Office of Environment and Heritage staff carry out the monitoring of the waterways in the Great Lakes Region

At each of the selected sites, samples were taken in accordance with the NSW Monitoring, Evaluation and Reporting protocols which are described in full in Roper et al. (2011). At each of the "Lake" sites, turbidity was measured using a calibrated probe suspended at a depth of 0.5 metres for five minutes as the boat drifted or was motored (generally covering a distance of at least 300 metres), logging data every 15 seconds. The final value for the "site" sampled was the average of all the logged data. During the drift, at least five samples of the top 1m of the water column were collected and combined in a bucket. At the end of the drift, a single 200 millilitre sample for chlorophyll a analysis was taken from the composite in the bucket.

For the river estuary sites, an "underway sampler" is used to pass water past the probe whilst the boat travels at a regulated speed along a transect upstream from the middle to the upper part of the estuary. The turbidity is calculated as the mean of logged values for the transect. At two sites along the transect, composite water samples are collected for chlorophyll a analysis.

Chlorophyll a samples are immediately filtered (within one hour) under mild vacuum and the filter frozen until analysis. Chlorophyll a is extracted into acetone and chlorophyll a concentration determine by spectrometry.

4. Calculating the zone score

The measured values of all indicators need to be summarised into one value which can then be compared between different reporting zones.

Two basic calculations have been performed for each zone:

- Non-compliance score – are the indicator values non-compliant with the trigger value?
- Distance from the benchmark score – how far from the trigger value are the indicator values?

The distance measure is a recognition that the trigger values only allow for two possible states, compliant and non-compliant. The distance measure provides for more sensitivity for ecological condition along the gradient from good to poor.

Calculating the non-compliance score

The non-compliance score was simply calculated by taking the number of samples that are above the trigger value as a proportion of the total number of samples taken in the sampling period. The non-compliance score is then expressed as a value between 0 and 1 with 0 equal to none of the values being non-compliant (i.e. all compliant) and 1 equal to all values being non-compliant.

Non-compliance score equals the number of samples non-compliant with trigger value divided by the total number samples.

Calculating the distance from benchmark score

The distance score has been expressed as a proportion between 0 and 1 to be standardised with the non-compliance score. To do that the distance score is expressed as a proportion of the worst expected value (WEV) with a score of 0 equal to the benchmark value and 1 equal to the worst expected value for each of the indicators.

The worst expected value has been determined by examination of a data set for all of NSW. The 98th percentile value was selected as the worst expected value Table 1.1.3. In the small number (2 %) of circumstances where measured values were greater than worst expected value, the distance measure became 1 (which is the highest possible value).

Table 1.1.3 Worst expected value for Condition Calculations

	Turbidity WEV (NTU)	Chlorophyll WEV (µg/L)
Lake	20	30
River (mid)	60	30
Lagoon	20	30

WEV = worst expected value

Distance of each non-compliant value equals: (measured value – trigger value) / (worst expected value – trigger value)

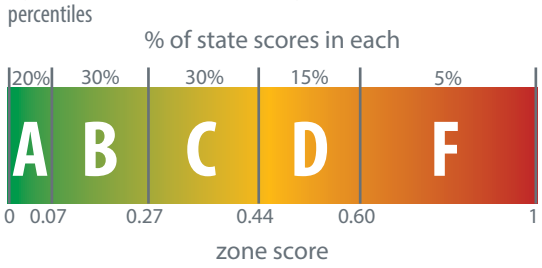
The distance score is calculated as the mean distance from the trigger of those values that are non-compliant for the reporting period.

Once the non-compliance and distance score have been calculated, the geometric mean of both scores is calculated to arrive at a single score that can be used to assess the condition of each indicator in that zone.

$$\text{Final Score for indicator} = \sqrt{(\text{non-compliance} \times \text{distance score})}$$

The final "zone score" for each reporting zone is then the simple average of the indicator scores.

Figure 1.1.4 Relationships between grades, zone scores and state percentiles



5. Allocating the Report Card Grade

Defining the Report Card grade is an important step in the development of the Report Card. The grade definitions below are linked to the environmental values outlined above and are structured to allow easy comparison between each system and over time. It is important that the cut-off values for each grade reflect the condition of each zone in comparison to a broader scale of condition across all NSW estuaries. (i.e. an "Excellent" grade represents an excellent condition for a NSW estuary). To assist with the derivation of cut-offs, scores were calculated for 130 zones across a wide range of NSW estuaries using the same triggers and worst expected values as the Great Lakes analyses. Cut-offs were then defined as representing a percentage of the scores for the state Table 1.1.4. For example, a zone score less than 0.07 defined the 20% of best zone scores in the state and this became our "Excellent" grade (see Table 4 for other cut-offs). We did not use a score of 0 as excellent because, as a consequence of how the trigger values are calculated, we expect that even pristine reference sites will exceed trigger values 20% of the time. The definition of the grades and description are shown in Figure 1.1.4.

Table 1.1.4 Report Card results, definitions, descriptions and cut-off

Grade	Result	Definition	Description
A	Excellent	All environmental values met (The indicators measured meet all of trigger values for almost all of the year)	The best 20% of scores in the state
B	Good	Most environmental values met (The indicators measured meet all of the trigger values for most of the year)	Next 30% of good scores
C	Fair	Some of the environmental values met (The indicators measured meet some of the trigger values for some of the year)	Middle 30% of scores
D	Poor	Few of the environmental values met (The indicators measured meet few of the trigger values for some of the year)	Next 15% of poorer scores
F	Very Poor	None of the environmental values met (The indicators measured meet none of the trigger values for almost all of the year)	The worst 5% of scores in the state

Summary of the process for calculating the zone score

In summary, the process for calculating the zone involved:

- Calculating the proportion of time that the measured values of the indicator are above the adopted guideline limits or Trigger Values.
- Calculating the distance/departure from the guidelines for that indicator - the extent the data extends past the trigger value and approaches the worst expected value (WEV) for that indicator.
- Calculating the geometric mean of the non-compliance and distance scores to get a final score for that indicator for each zone.
- Averaging the scores for the two indicators at each site – this gives the "zone score".
- Grade the zone based on the zone score as A, B, C, D, F.

Rainfall results

The amount of rainfall that occurs around the period of sampling for the Report Card (September – March each year) influences the Report Card results. If there is more rain, there is more runoff in the catchment resulting in greater quantities of sediment and nutrients entering our waterways. This year (2012/13), rainfall was slightly less than what was recorded between 2006/07 and 2010/11 and much less than the levels recorded 2011/12.

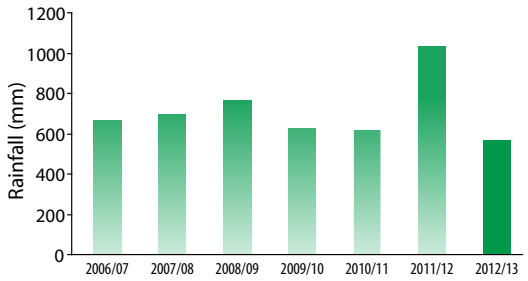


Figure 1.1.5 Data presented includes total rainfall September to March each year. The rainfall data is taken from the Forster Bureau of Meteorology rainfall station (Tuncurry Marine Rescue) (www.bom.gov.au/climate/data). The same trends were seen in data from Wootton and Bungwahl stations.

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Acknowledgements

The methodology presented here was developed by the Office of Environment and Heritage, Scientific Services Section with input from Hodge Environmental and the International Water Centre.

Figure 1.1.6 Coomba Aquatic Wetland

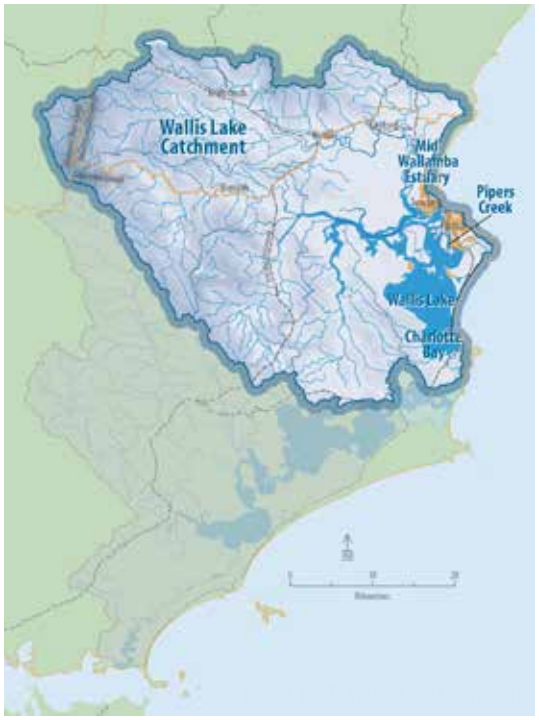
Wallis Lake

Catchment description

The Wallis Lake catchment extends over 1400 square kilometres and is shared between the Great Lakes Council LGA (65%) and the Greater Taree City Council LGA (35%). This catchment includes the region's major urban centre of Forster-Tuncurry.

Wallis Lake is one of the most significant producers of Sydney Rock Oysters in Australia and is also central to the local tourism industry, valued at over $120m per year. The lake is one of NSW's top three producing estuarine fisheries and is utilised extensively for recreation including boating, fishing and swimming.

The Wallis Lake catchment contains habitat for threatened and international migratory species and contains 20% of the seagrass beds of NSW, the State's single largest concentration of seagrass.



Management actions

A number of key management activities occur across the Wallis Lake Catchment influencing the overall health of the estuary, these are summarised below.

Sustainable Farming Program

The Great Lakes Sustainable Farming Program was a collaborative project between Great Lakes Council, Karuah Great Lakes Landcare, Greater Taree City Council and the Hunter Central Rivers Catchment Management Authority. The aims of the program are to facilitate sustainable, productive land use across the Great Lakes catchments. The program involved rural land managers in "action learning" using localised networking, participatory learning, on-farm trials and "Best Practice Farms" to help encourage land managers to develop locally adapted solutions for sustainable agriculture.

A key element of the Sustainable Farming Program was the establishment of localised Sustainable Farming Groups. Since 2008, six (6) Sustainable Farming Groups have been established in the Wallis Lake Catchment, these being Wang Wauk/ Wallamba, Coomba, Topi Topi and Wootton, as well as a broader geographical group focusing on farm biodiversity namely Land for Wildlife.

Since 2008, the groups have held a total of 61 meetings to discuss topics such as soil health, farm dam water quality, sub-soil ploughing, electric fencing, and pasture species identification to name a few.

In addition to the these localised Sustainable Farming Groups, the Sustainable Farming Program incorporated a number of professional workshops, practical hands-on field days, on-farm trials and demonstration sites. Since 2008, there have been 62 field days and workshops held, 33 on-farm trials established and five (5) Best Practice Farms undertaken in the Wallis Catchment.

Of this total, one (1) Sustainable Farming Group was established, and 33 field days/workshops and four (4) Best Practice Farms were accomplished in 2012/13.

The Great Lakes Sustainable Farming Program was funded through 'Caring for our Country' grants secured in 2008 and 2010, the program has been running for five years with the most recent grant concluding in June 2013. Great Lakes Council has recently completed a review of the program which involved landholder surveys, focus groups and expert panel discussions.

The Bi-annual landholder survey completed in November 2012 had 53 respondents. In summary, 87% landholders reported improved land management practices on their rural properties as a result of the program. Results showed 80% of landholders reported that information on pasture improvement/groundcover management was the most useful. Types of practices being undertaken included:

- soil and erosion management (53%),
- weed management (47%),
- tree planting (26%),
- riparian fencing (36%),
- pasture improvement (75%),
- biological fertilizer use (40%),
- rotational grazing (57%) and
- water quality management (45%).

The results received in this survey and the additional feedback provided by landholders during the phone survey and workshops put Council and Karuah Great Lakes Landcare in a strong position to apply for funding to continue with aspects of the program. Currently, Sustainable Farming groups are starting to become independent entities with many of them signing up to become subgroups of Karuah Great Lakes Landcare. These groups continue to meet regularly to discuss sustainable land management issues.

Protection from development and re-development

Council have focussed on protecting all waterways in the Local Government Area through its application of water quality targets for development and re-development. These water quality targets are implemented through the Water Sensitive Design Development Control Plan. For new developments (greenfield sites) water quality targets ensure that there is a neutral or beneficial effect on water quality which means nutrients are not allowed to increase above current levels. To achieve this, developers are required to present a stormwater strategy including measures such as rain gardens and rain water tanks. In 2011/12 small scale infill development including individual houses and dual occupancies were included in the development control plan providing further protection from nutrient and sediment inputs to our waterways.

Rubbish removal

Council have taken action to minimise the harmful impacts that debris (litter) has on marine wildlife. Great Lakes Council secured funding through 'Caring for our Country' and the Hunter-Central Rivers Catchment Management Authority for a clean-up project in Wallis Lake. During May 2013, sixty (60) volunteers from the Great Lakes contributed 280 hours of their own time to remove rubbish from 100km of Wallis Lake Islands and estuary foreshore. A total of three and a half (3.5) tonnes of rubbish including large quantities of plastic supermarket bags, bait bags, plastic drink bottles and food wrappers were removed from Wallis Lake. This work has built on a previous clean-up carried out in 2010 that involved 100 volunteers who removed approximately 7 tonnes of rubbish from Wallis Lake.

Removal of aquatic weeds

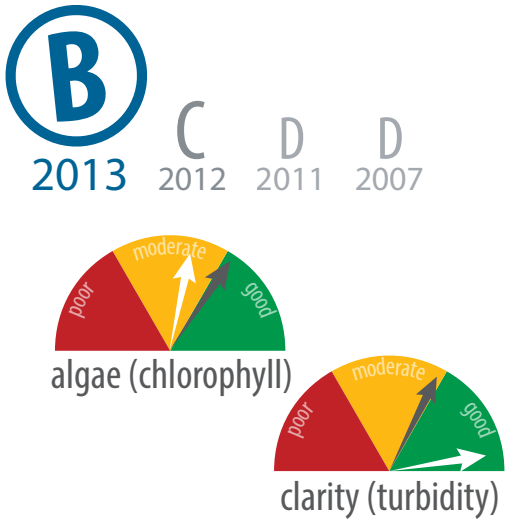
Sixteen (16) hectares of Cabomba infested waterways treated in the Wallis Lake Catchment. The treatments form part of the second year of a two-year project funded under the federal government's Caring for our Country Program. The project complements another federally funded project to conduct trials, leading to the registration of a suitable herbicide for the effective control of Cabomba. Year two of the work program commenced in early December 2012 with a monitoring and pre-treatment program conducted over a number of weeks. Follow up and monitoring works are ongoing during the 2013/14 financial year to ensure adequate controls are maintained.

Key stats

- Erosion control on 37.9ha of land
- 903ha of wetlands protected and enhanced
- 32.8km of stream bank protected plus
- 351ha of native vegetation protected and enhanced
- 10ha of infested water treated for aquatic weeds
- 240m of roadside stabilised to reduce erosion

The key stats presented here are a summary of the projects undertaken by landholders and agencies with funding from the Hunter Central Rivers Catchment Management Authority between 2007 and 2013.

Mid Wallamba Estuary



Ecological health is now good

This year the waters of the Wallamba River Estuary were very clear but algal growth is still higher than desired. The clear waters provide lots of light, which combined with nutrients from the catchment resulted in much higher algal levels than last year.

Rainfall during the sampling period in 2012/13 was near to or even below average. This means that the amount of fine soils and clays that can wash from bare earth in areas where vegetation cover has been removed, from unsealed roads and from eroding or collapsing stream banks is considerably less than last year. The outcome is clearer waters. The turbidity levels exceeded the trigger value in only 6% of the samples collected, and the exceedances were generally quite small, resulting in an excellent score for water clarity.

Algal (chlorophyll) levels exceeded trigger values in 70% of samples collected and exceedances were moderate. Unhealthy growth of small algae in the waters is stimulated by nutrients washed from urban areas and pastures, or from stock directly accessing waterways. If this continues, then algae may reach levels in the water which are detrimental to fish, humans and livestock. Even though the rainfall was less this year, the clear waters provide plenty of light and this combines with the nutrient loads to grow undesirable amounts of algae.

Great Lakes Council has initiated actions to control sediments and nutrients from the catchment as part of the Water Quality Improvement Plan. The results for 2013 continue the trend for improvement seen in the 2012 data. It is too early to tell whether this represents a permanent shift in the condition. The chlorophyll data show that targeted work in the catchment is still required.

Estuary description

The Mid Wallamba Estuary sub catchment covers almost one third of the Wallis Lake catchment (550 km^2). The catchment is one of the most modified sub catchments in Wallis Lake. Agriculture is the dominant land use with a small urban centre at Nabiac. The Mid Wallamba Estuary faces additional localised pressures from the erosion and collapse of stream banks due to its popularity for water sports over the summer period.

The water quality sampling occurs in the estuarine reaches of the river from Wallamba Island to Failford.

Management actions

Protection and rehabilitation of key habitats

Council have acquired and are conserving 763ha of wetlands at Darawakh, Minimbah and Lower Wallamba / North Tuncurry to protect water quality and biodiversity. The process of acquisition for public conservation is one of the most effective forms of protecting and restoring critical environmental services functions of the natural landscape, protecting against changed or intensified private land uses. The acquired landscapes are (or will be) all protected as Community Land under the Local Government Act, zoned for Environmental Protection in the applicable Local Environmental Plan and subject to permanent protection by way of a Conservation Property Vegetation Plan. Further, Council actively protects and restores the landscapes by direct and targeted actions, as funding permits.

Council has also restored pre-disturbance hydrology to over 90% of the Darawakh Creek / Frogalla Swamp through the infilling or decommissioning of 22.2km of artificial drains and removal of 1.5km of artificial levees to remediate a significant acid sulfate floodplain wetland system. Monitoring has indicated that the works are having measurable success regarding the protection of the Lower Wallamba River from toxic acid and metal discharges. Further, there has been substantial biodiversity outcomes associated with the program.

Bank stabilisation

5.1 km of the Wallamba River have been stabilised with rock protection, 8,000 native plants have been planted, and bush regeneration and maintenance are ongoing to conserve 9.5km of streambank.

Rock walls that allow establishment of mangroves have been constructed to reduce bank erosion. The Wallamba River is exposed to severe bank erosion due to past vegetation clearance, ongoing cattle grazing and wash from boats. Monitoring from Great Lakes Council has indicated an erosion rate of up to 1m per year along 12km of river. Sedimentation downstream is impacting on the health of the Wallis Lake oyster and fishing industry contributing to turbidity levels and in turn affecting the Report Card scores. Sedimentation directly affects oyster leases and turbidity reduces the depth at which seagrass will grow, thus reducing fish habitat.

The Wallamba River Memorandum of Understanding brokered an innovative agreement to the management and remediation of these significant riverbank erosion issues affecting the banks of the lower Wallamba River. The MOU was amended in 2010 to address the increasing impact of wash from wake enhancing activities. The MOU amendments were negotiated with key stakeholders including caravan park businesses, landholders, waterway users and government agencies. Importantly, the amendments provide a designated area for wakeboarding and other wake enhancing activities within Wallis Lake in an area

Figure 1.1.8 Conserving wetlands at Minimbah

on the western side of Wallis Island and maintains the existing ski zone within the Wallamba River. It enacted responsibilities on land management agencies and river users to adopt actions and protocols to care for and restore the riverbank landscape to maintain the health of the river and its responsibilities including management of the riparian zone, protection and restoration of the downstream estuary and consider and manage aquatic habitat. Great Lakes Council, with the support of other land management agencies, has been implementing activities that relate to riverbank protection and stabilisation and associated riparian enhancement. Outputs have included installation of 5.1 kilometres of riverbank armouring (rock fillets/revetment), enhancement and re-establishment of riparian vegetation and mangroves, and stock exclusion fencing.

Bush rehabilitation

There is a group of active volunteers undertaking bush regeneration around Nabiac. Some 12 members of Nabiac Landcare meet weekly to tackle a range of weeds in a six hectare area of River Flat Sclerophyll Forest at Bullocky Wharf on the Wallamba River. In 2012/13, the group completed 652 hours of regeneration works, and planted 467 endemic tubestock at the site. The group have cleared vast areas of woody weeds such as lantana, small leaved privet and camphor laurel. Also present at the site are the more problematic madeira vine, asparagus fern and trad.

Figure 1.1.9 Erosion protection works on the Wallamba River

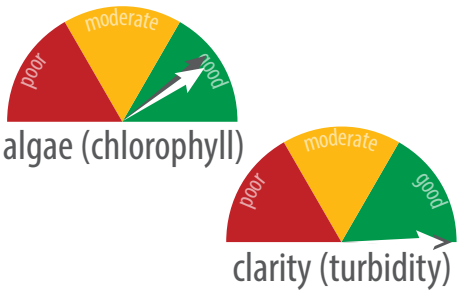
Pipers Creek

B 2013

B 2012

B 2011

B 2007



Algae still higher than desired

The ecological health in Pipers Creek continues to be good, with results similar to 2011 and 2012. Waters in Pipers Creek remained clear. The nutrient loads from the urban catchment of Forster resulted in algal levels that were still higher than desired, but slightly less than last year.

Ecological health in Pipers Creek is strongly influenced by inputs from the large urban catchment. Nutrients from houses, lawns and pets, wash into the creek through stormwater and continue to stimulate algal growth to levels which are higher than desired for this type of waterway. The trigger value for chlorophyll was exceeded in 50% of the samples collected, though the exceedences were not large. Similar to 2011 and 2012, this shows a constant pattern of mild excess algal growth rather than the occasional very large bloom. The slightly better chlorophyll score in 2013 (compared to 2012) resulted from slightly fewer exceedances rather than higher algal levels.

Water clarity was excellent with turbidity levels less than trigger values all of the time. This maintains the improvement seen from 2007 and 2011 and to 2012. Low turbidity levels are critical for the protection of important habitats such as seagrass beds which enhance the biodiversity of the system. This was a good result for Pipers Creek and shows that with the additional efforts being made to control nutrient runoff from the catchment, it may be possible for Pipers Creek to achieve excellent water quality in the future. Recent improvements made to water quality should not be lost as a consequence of future development or re-development in this catchment. There should therefore be a continued emphasis on achieving water quality targets for all development and protection of existing native vegetation.

Estuary description

The majority of the Forster township is located in Pipers Creek Catchment. The rainfall that once infiltrated into the ground through native vegetation now meets impervious surfaces (roofs, roads and footpaths) and runs directly into stormwater drains and Pipers Creek. This stormwater runoff carries with it pollutants such as sediments and nutrients from houses, lawns and pets. In the past, Pipers Creek and Pipers Bay have experienced large algal blooms and shown signs of poor ecological health. Following large rainfall events, the water from Pipers Creek and Pipers Bay can reach Wallis Lake and Charlotte Bay areas. Reducing the impacts of stormwater from the Pipers Bay Catchment therefore has benefits across the whole of Wallis Lake.

The samples for this Report Card are taken next to Big Island adjacent to Forster Keys.

Management actions

Water sensitive urban design

Over the past four years Great Lakes Council have been building water quality gardens in the Pipers Creek Catchment to filter the sediments and nutrients out of the stormwater prior to flowing out into Wallis Lake. Six gardens have been built in the Palms Estate drainage reserve between Kularoo Drive and the Southern Parkway. An additional garden was built out the front of Council on Breese Parade as a demonstration, filtering water from the road, further protecting Pipers Creek. In 2013, another quality garden was constructed at the Forster campus of Great Lakes College, the number of gardens constructed now totals eight (8).

The water quality gardens work by slowing down the stormwater so that large particles like soil drop out of suspension. The water then flows over a planted area and the microscopic alga (biofilms) which grow on the plant roots remove the nutrient nitrogen. The sandy loam soil that the plants grow in also acts as an additional filter removing other pollutants like heavy metals, petrochemicals and phosphorus. The water that then flows into the stormwater drain is cleaner prior to flowing into Wallis Lake.

Urban engagement – sustainable gardening

In July 2012 Council initiated a Sustainable Gardening Program. Over twelve (12) months, participants have been led through a series of workshops and outdoor training sessions with local gardening experts. The objectives of the program were to work with urban residents to help them to reduce their individual impact on water quality by taking actions in their garden to reduce nutrient application, utilise water and hold water in their soil so that it would not runoff into our waterways. Many actions to achieve this objective have been undertaken by participants including composting, worm farming, mulching and establishing gardens. Many participants indicated that being involved in the Program gave them the confidence to 'have a go' and become more relaxed about learning by doing.

Initially, there were 46 urban residents involved in the Program and of these 22 members are very active and interested in continuing as a group and becoming independent of Council. In the near future the group will sign up as a subgroup to Karuah Great Lakes Landcare. This project was funded by the federal government through the Caring for our Country Program and Great Lakes Council's Environmental Special Rate.

Figure 1.1.10 Sustainable gardening workshop

School engagement – incorporating local water quality issues into the curriculum

Over the last two years, Council has developed a strong partnership with Great Lakes College Forster Campus to design a program to embed local water quality and catchment issues into the geography curriculum for Years 7 - 10.

The students are supported in their learning through tailor-made resources and field trips made possible with funding assistance from the federal government's Caring for our Country program and Council's Stormwater Levy.

Over 120 students at Great Lakes College (Forster Campus) have learnt about catchment management, threats to water quality in natural areas and water quality improvement gardens. The class room theory sessions culminate in a field trip that demonstrates some of the management actions in their school catchment and to observe some of the issues in the field.

Great Lakes College (Forster Campus) have begun water quality monitoring at their school site with the Waterwatch program, and have also constructed a water quality improvement garden on-campus for both water quality improvement and as a practical demonstration of the types of actions that can be taken to improve water quality in urban catchments.

This program has been designed so that it will continue at the College indefinitely to ensure ongoing engagement and awareness of local catchment and water quality management.

Figure 1.1.11 Palms Estate water quality garden

Bush rehabilitation

Three volunteer bush regeneration groups currently exist in the Pipers Creek Catchment, working on a variety of vegetation types and weeds.

At the southern end of Little Street, a single volunteer maintains a small (0.4ha) public reserve containing remnant floodplain rainforest and SEPP14 wetland (Saltmarsh) on Wallis Lake foreshore. The area was overrun with woody weeds, such as lantana and senna, but also contains vine weeds such as climbing asparagus and morning glory. Native vines are also present, and in this highly disturbed landscape, are over-growing old growth rainforest trees. Ongoing support is needed to complete meaningful restoration of the site.

The Community Garden volunteers at Pennington Creek continue to maintain the banks of the creek, when they can spare time away from their vegetable plots. The volunteers clean up rubbish, as well as removing weeds. Woody weeds such as lantana, senna, vamphor laurel and date palms once dominated the site, but volunteers are now into the maintenance phase for these species. The ongoing challenge for the group is to manage the more persistent weeds such as asparagus weeds, madeira vine, fishbone fern and invasive grasses from dominating the creek banks.

The site includes mangroves, old-growth remnant rainforest trees, sclerophyll species, as well as natives planted to help outcompete the weeds.

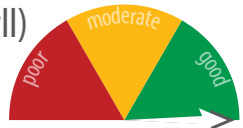
The Sanctuary is a 6ha remnant of swamp sclerophyll forest adjacent to the golf course in Forster. Two volunteers have maintained this area since 2005, in which time the area has been transformed from a degraded camphor laurel forest with weed understorey, to an active regeneration site full of native regrowth. Garden escapes (from green waste dumping) are now the main focus of works here.

Wallis Lake

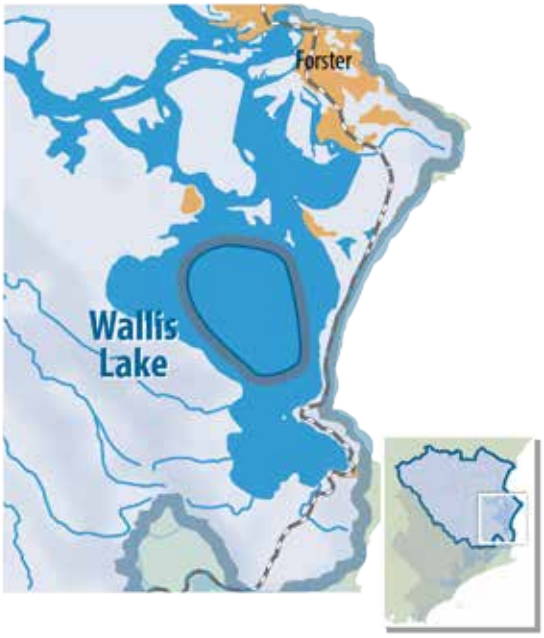
B 2012 A 2011 A 2007

2013

algae (chlorophyll)



clarity (turbidity)



Wallis Lake scores as good as last year but moderate algal growth remains

Wallis Lake is of a high conservation value, with abundant seagrass and high biodiversity. Ecological health was good, but has remained below that from 2011. Water clarity was excellent but there was mild growth of algae indicating ongoing inputs of nutrients.

Wallis Lake has long been recognised as having high environmental values due to its extensive seagrass beds. Seagrass beds are important estuarine habitats that not only support biodiversity but provide essential ecosystem services such as nursery areas for aquatic bugs, fish and many other species. Seagrass beds in turn, support a healthy community of larger animals such as turtles, large bodied fish, crabs, birds and dolphins. Healthy seagrass beds depend on good ecological health to survive.

The 2013 score was the same as 2012, when ecological condition in Wallis Lake slipped slightly from excellent in 2011 to good. All turbidity samples remained below trigger values meaning the waters are very clear, allowing plenty of light to penetrate the water, this means that seagrasses can survive to greater depths and maintain a large area of coverage. Greater than desired growth of algae occurred in 70% of the samples, but the levels were only just above the trigger levels. This situation has not improved despite the lower rainfall this year indicating there is an on-going low-level issue with the nutrient inputs that stimulate algal growth.

These results remind us that if there is not a continued effort to prevent of excessive nutrient inputs to the lake excessive algal growth could occur quickly.

Estuary description

Wallis Lake is in the centre of the estuary and receives runoff from a narrow catchment immediately surrounding the lake. Adjoining areas directly influencing Wallis Lake include Coomba Park, Green Point and the rural residential land on the western side of Wallis Lake. During large rainfall events, water from the major rivers and the Pipers Creek catchment flow into this area carrying pollutants with it.

Sampling in Wallis Lake takes place in the centre of the estuary between Yahoo Island in the north and Earps Island in the south.

Management actions

Bush rehabilitation

Four volunteer groups are actively regenerating their local bushland reserves in the Wallis catchment.

Green Point Coastcare has been meeting weekly since 1996 to reduce weeds along the foreshore of Wallis Lake. Their intial work involved clearing vast tracts of lantana and bitou bush, now the remaining four members are tackling vine weeds, asparagus fern and invasive grasses. In 2013 the group have contributed 975 hours and planted 2557 tubestock. The group mainly focus on a 2ha area that has casuarinas fringing the lake's edge, with rainforest and eucalypt canopy in some areas.

Two volunteer groups are active at Coomba Park. One group, with six volunteers, works on a 3ha site at Coomba Aquatic Gardens This area contains a Sclerophyll Forest on the headland point, and a large area of Saltmarsh with mangroves fringing the lake. The site was heavily infested with lantana when the group commenced in 1994. The woody weeds (lantana and senna) are mostly under control. However, vine weeds (passionfruit, morning glory) and garden escapes are proving more problematic in the long-term management of the area. Over the past 12 months, this group have completed 435 hours and planted 17 native plants.

The Coomba Foreshore group has 12 members who meet weekly to work in a 1.5km long foreshore reserve that contains both Sclerophyll Forest and Saltmarsh. In 2013, the group completed 725 hours of on-ground works in their area. Woody weeds, such as lantana and senna have been systematically removed, and the group is now working on asparagus weeds (ground and climbing), vine weeds, including morning glory, madeira vine, moth vine and passionfruit vines (two species). Garden escapes and grass weeds are also a problem at this site. The group works in a 7ha area on Wallis Lake.

Figure 1.1.12 Volunteers revegetating the Coomba Foreshore

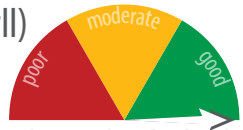
These two Coomba groups have been supported recently by bush regeneration contractors, funded by a NSW State Government Environmental Trust Grant.

A small group of locals at Wootton started working along creek banks of Carrington Creek in 2009. Large tracts of privet (both large and small leaved varieties), as well as moth vine and annual pasture weeds over-ran the area. Two volunteers now maintain the regenerated area with occasional working bees. Ongoing support for this group is needed to see sustainable regeneration outcomes at this site .

Charlotte Bay

2013 A 2012 A 2011 A 2007

algae (chlorophyll)



clarity (turbidity)

Charlotte Bay remains in excellent condition

Charlotte Bay is of high conservation value, with abundant seagrass and high biodiversity. Ecological health remained excellent, algal growth is at very low levels, reversing the small increase in algal levels seen last year. Water clarity was excellent.

Charlotte Bay was identified in the Water Quality Improvement Plan as having high environmental values primarily due to its extensive seagrass and macrophyte beds, which support possibly the highest diversity of sponges and associated animals in NSW estuaries. Good water quality, particularly clear water, were identified as being important in protecting this unique ecosystem.

The water quality results for Charlotte Bay have remained excellent, with no exceedences of turbidity trigger values for any samples in 2011. The waters are very clear, allowing plenty of light to reach the seagrasses and associated sponges.

Greater than desired growth of algae occurred in just 10% of the samples, but the levels were barely above the trigger levels. These levels were ranked as excellent. The average rainfall means that the inputs of nutrients are reduced to a level where Charlotte Bay can remain in excellent condition.

These results justify Council's position in relation to water quality targets for new development which prevent further nutrient inputs to the lake. The results from 2012 show that if there is not a continued effort to prevent of excessive nutrient inputs to the lake, excessive algal growth could occur quickly, but when pressure is reduced conditions will improve.

Estuary description

Charlotte Bay covers the southern most part of the Wallis Lake estuary. There is limited mixing between the northern and southern parts of Wallis Lake, therefore the condition of this area is influenced mainly by the surrounding catchment. The catchment is largely vegetated with a small amount of residential, commercial and rural residential land.

Sample collection in Charlotte Bay occurs in the middle of the water body south of Earps Island.

Management actions

Bush rehabilitation

Two volunteers meet every second week at the wetland behind the Community Hall at Pacific Palms. The group commenced in 2009 on the four hectare site. In 2013, they completed 61 hours at this site, which contains a mixture of saltmarsh species, old-growth mangroves and orchid-bearing casuarinas; as well as dense stands of cabbage-tree palms, grey gums and swamp mahoganies. Regeneration after primary weeding has been excellent, and the group are now working on secondary weeds throughout the wetland.

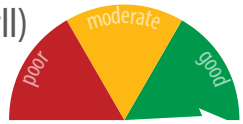
Environmental Trust funding has supported the restoration of this important wetland area. The site is a natural wetland, doing vital work in filtering water coming off the adjacent village and infrastructure. The removal of weeds at this site has seen a proliferation of native rushes and sedges, and subsequently improved functioning of this important natural system.

Figure 1.1.13 Pacific Palms volunteers undertaking bush regeneration activities

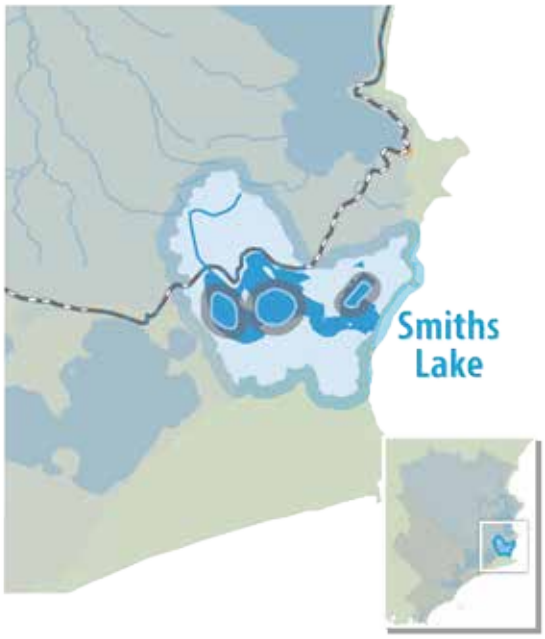
Smiths Lake

2013 NA 2012 A 2011

algae (chlorophyll)



clarity (turbidity)



Smiths Lake in excellent condition despite some algal growth

Smiths Lake continues to be in excellent ecological health with very clear waters to allow growth of seagrass. There was slightly more algal growth than desired in some parts of the lake but this did not affect the overall score.

Smiths Lake is part of the Port Stephens Great Lakes Marine Park and a large part is Sanctuary Zone. It has high environmental values primarily due to its extensive seagrass and macrophyte beds. Good water quality, particularly clear water, were identified as being key in protecting this important ecosystem.

Water clarity was excellent at all sites within Smiths Lake with no recorded exceedances of turbidity trigger values. Chlorophyll values were above trigger values 22% of the time in Wamwarra Bay (which is within the Sanctuary Zone) but the values only barely elevated, resulting in an excellent score for chlorophyll in this location. In the central basin and Symes Bay, chlorophyll scores were only good, exceedances occurred in 45 – 55% of samples and exceedances were greater, though still small. This indicates that these sites, which are closer to the urban development, may be getting greater nutrient inputs. If there is not a continued effort to prevent excessive nutrient inputs to the lake, excessive algal growth could occur. However, when the chlorophyll scores are combined with the excellent turbidity scores, the overall grade was excellent.

No data was presented in the 2012 Report Card as the lake was open to the ocean during the sampling period, therefore this year's results cannot be compared to last year's.

Estuary description

Smiths Lake has a catchment area of 35.89km^2. It is an intermittently closed and open coastal lagoon and the lake entrance is artificially opened when levels approach 2.1m above sea level to prevent flooding of low-lying areas. The catchment of Smiths Lake has a good cover of native vegetation with a significant proportion of the catchment under conservation within the Wallingat and Myall Lakes National Parks. The Smiths Lake township and tourism facilities are situated near the lake's mouth, with impervious surfaces (roofs, roads and footpaths) increasing stormwater runoff into the lake. This stormwater runoff can carry with it pollutants such as sediments and nutrients from houses, lawns, unsealed roads and pets.

Samples for Smiths Lake were taken from three locations: Wamwarra Bay, Central Smiths Lake and Symes Bay. These data have been averaged to provide an overall score for Smiths Lake.

Management actions

Volunteers active in bush regeneration

Smiths Lake foreshore group commenced in 2006 to formalise foreshore accessways and rehabilitate the surrounding vegetation. The group has had up to 20 members, but active members currently number three people. In 2012/13 the group were active in bush regeneration at one site contributing 300 volunteer hours. The group removes woody weeds, such as lantana and bitou bush, but also various scramblers and vines, such as ground asparagus and coastal morning glory.

Stream and drainage stabilisation

Great Lakes Council have stabilised 2090 metres of roadside to reduce erosion and subsequently the amount of sediment reaching the lake.

In the Smiths Lake catchment, significant activity in the area of roadside erosion control has been undertaken over the past year, the particular focus has been along the Lakes Way near Tarbuck Bay. In 2012/13, 1801 metres of roadside was stabilised adjacent to road works utilising rock lining, curb and gutter and rock bunds. In previous years, Amaroo Drive has had significant erosion control works including the rock lining of the roadside drains for approximately 200 metres. At Patsys Flat Road, erosion control has included installing curb and gutter along 109 metres of road.

Protection from development and redevelopment

Council have focussed on protecting all waterways in the Local Government Area through its application of water quality targets for development and re-development. These water quality targets are implemented through the Water Sensitive Design Development Control Plan. For new developments (greenfield sites) water quality targets ensure that there is a neutral or beneficial effect on water quality, which means nutrients are not allowed to increase above current levels. To achieve this, developers are required to present a stormwater strategy including measures such as rain gardens and rain water tanks. In 2011/12 small scale infill development including individual houses and dual occupancies were included in the development control plan providing further protection from nutrient and sediment inputs to our waterways.

Figure 1.1.14 Rock lined drain and inlet pit at Tarbuck Bay

Figure 1.1.15 Gravel road sealing and table drain upgrade, Tarbuck Bay

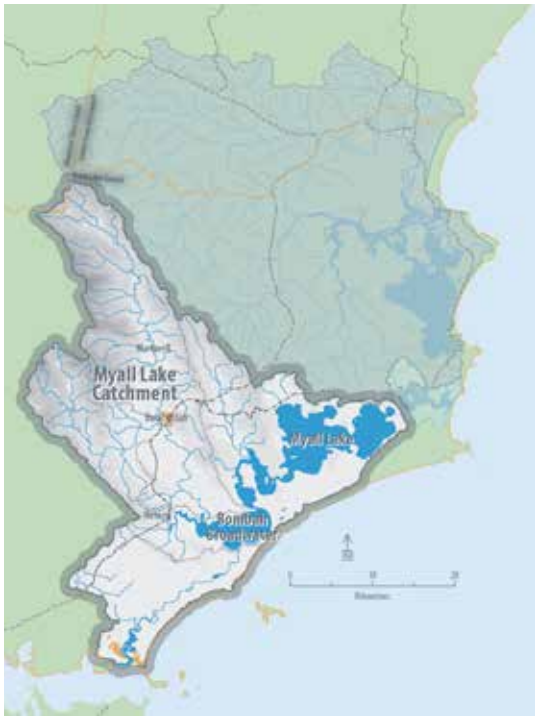
Myall Lakes

Catchment description

The Myall Lakes catchment covers 440 square kilometres. Its major tributary is the Myall River, whose headwaters extend to Craven Nature Reserve and the Kyle Range. The catchment is largely occupied by agricultural land, with forestry and protected vegetation in the steeper areas and a small amount of urban land in the townships of Bulahdelah and the well-known tourist destinations of Tea Gardens-Hawks Nest.

The Myall Lakes and Myall River in particular are part of a large tourism and recreation industry which includes Myall Lakes National Park, one of NSW's most visited National Parks with estimated annual visitor numbers of 250,000.

Major issues for the Myall Lakes system include the impacts of rural runoff on water quality including nutrients, noxious weeds and other pathogens. Urban runoff and the impacts from tourism and recreation uses of the lakes and estuaries are more prevalent in the lower reaches of the catchment.



Management actions

Sutstainable Farming Program

The Great Lakes Sustainable Farming Program was a collaborative project between Great Lakes Council, Karuah Great Lakes Landcare and the Hunter Central Rivers Catchment Management Authority. The aims of the program are to facilitate sustainable, productive land use across the Great Lakes catchments. The program involved rural land managers in "action learning" using localised networking, participatory learning, on-farm trials and "Best Practice Farms" to help assist land managers to develop locally adapted solutions for sustainable agriculture.

Key stats

- Erosion control on 23.7ha of land
- 396ha of wetlands protected and enhanced
- 10km of stream bank protected
- 403ha of native vegetation protected and enhanced
- 138ha of infested water treated for aquatic weeds

The key stats presented here are a summary of the projects undertaken by landholders and agencies with funding from the Hunter Central Rivers Catchment Management Authority between 2007 and 2013.

A key element of the Sustainable Farming Program was the establishment of localised Sustainable Farming Groups. Since 2008, two (2) Sustainable Farming Groups have been established in the greater Myall Lakes catchment, these being in the localities of Crawford and Myall.

Since 2008 the groups have held a total of 26 meetings to discuss relevant topics such as soil health, farm dam water quality, sub-soil ploughing, electric fencing, and pasture species identification to name a few.

In addition to the these localised Sustainable Farming Groups, the Sustainable Farming Program incorporated a number of professional workshops, practical hands-on field days, on-farm trials and demonstration sites. Since 2008, there have been 16 field days and workshops held, 22 on-farm trails established and one (1) Best Practice Farm undertaken in the Myall Lakes catchment.

Of this total, 12 field days/workshops and one (1) Best Practice Farms were held in the Myall in 2012/13.

The Great Lakes Sustainable Farming Program was funded through Caring for our Country grants secured in 2008 and 2010, the program has been running for five years with the most recent grant concluding in June 2013. Great Lakes Council has recently completed a review of the program which involved landholder surveys, focus groups and expert panel discussions. Results of this review are summarised in the Wallis Lake section of this report.

Removal of aquatic weeds

Aquatic weeds were monitored along 46 kms of streambank in the Myall catchment. No treatments were conducted over the past year due to unfavourable environmental conditions during optimum treatment times. Ongoing monitoring revealed significant reductions in densities and occurrences of the target weed parrots feather.

One and a half (1.5) hectares of alligator weed was treated at Tea Gardens Landfill. A newly discovered infestation of alligator weed was also detected at Tea Gardens Waste Management Centre. The infestation is currently under an intensive integrated weed management program.

One and a half (1.5) hectares of salvinia infested water bodies were treated at Tea Gardens, this is part of a continuation of an integrated program for its management focusing on water retention ponds in the area. The main pond infestation has been reduced to >0.1% and hand removal efforts are ongoing. The use of biological controls and a containment barrier in the creek leading to the pond is maintaining weed densities and the eradication program will extend to this area in subsequent years.

One (1) hectare of land has been treated for longleaf willow primrose and the integrated management program for longleaf willow primrose in drainage areas of Tea Gardens is ongoing.

Erosion control

Since 2008 the NSW National Parks and Wildlife Service have undertaken a program of track rationalisation and rehabilitation to reduce erosion and sediment reaching the Myall Lakes. In total, 74km of trails and roads have been treated with 39km closed and rehabilitated and the remaining 35km the trails have been improved including with erosion and sediment controls.

Sites for rehabilitation were identified based on the steepness, level of erosion and their location in the catchment. To rehabilitate the roads trails were re-shaped to match the contour of the land, where possible the natural drainage was reinstated and erosion and sediment controls were put in place to reduce sediment transport. Staff were trained in best practice erosion and sediment control to assist with future management of gravel roads.

In the areas where the roads were closed, signs, gates and bollards were constructed, trees were left across the track and the surface of the land was roughened to promote vegetation growth. These areas have begun to revegetate naturally.

Outside of the National Park, erosion hot spots on gravel roads in the catchment have begun to be addressed. On Old Inn Road a concrete causeway was constructed across the Wild Cattle Creek along with sealing of the road on the approaches to the creek combined with geofabric and rock lining of the table drain significantly reducing sediment loads and turbidity to the creek.

Figure 1.1.16 Closure and rehabilitation of trails in the Myall Lakes National Park

Protection from development and redevelopment

Council have focussed on protecting all waterways in the Local Government Area through its application of water quality targets for development and re-development. These water quality targets are implemented through the Water Sensitive Design Development Control Plan. For new developments (greenfield sites) water quality targets ensure that there is a neutral or beneficial effect on water quality which means nutrients are not allowed to increase above current levels. To achieve this, developers are required to present a stormwater strategy including measures such as rain gardens and rain water tanks. In 2011/12 small scale infill development including individual houses and dual occupancies were captured by the development control plan providing further protection from nutrient and sediment inputs to our waterways.

Protection and rehabilitation of key habitats

The Water Quality Improvement Plan recognised the critical role that wetland protection and restoration plays in the maintenance and improvement of water quality and aquatic health. Functional floodplain wetlands are particularly important in the protection of receiving waterways from catchment runoff. Given that algae concentrations remain an issue in the Myall Lakes system, it is important that Myall River Floodplain wetland systems are appropriately protected and managed. One example of a floodplain wetland restoration project is the acquisition and restoration of the Bulahdelah Plain Wetland. This 371 hectare area is located on the Myall River Floodplain above the Myall Lakes Ramsar Site. It was acquired by Great Lakes Council and with support from the NSW Estuary Grants and the Hunter Central Rivers Catchment Management Authority. The public acquisition of this wetland system has ensured that the important ecosystem services functions are protected against changed or intensified private land use. Further, the wetland is being

Figure 1.1.17 Wetland conservation and restoration, Bulahdelah

actively restored so that ecosystem services functions are improved. Council has benefitted from the funding support of the Commonwealth Biodiversity Fund, NSW Environmental Trust and NSW Estuary Grants programs and is revegetating previously cleared areas of the land, controlling weeds and feral animals and excluding stock. The works will safeguard downstream waterways and will conserve an important area of habitat for significant biodiversity, including threatened species and endangered ecological communities.

Protection and rehabilitation of key habitats (Lower Myall)

Whilst no data has been collected for the Lower Myall Estuary in Tea Gardens, actions in the catchment have continued and are presented below.

Council is a strategic partner in a project to establish connected habitat corridors and preserve and restore native vegetation over degraded farmland at Durness Station, Tea Gardens. The Durness – Borland Landcare Corridor project involves the establishment of corridors of native vegetation linking the northern foreshores of Port Stephens with habitats in Nerong State Forest and Myall Lakes National Park. The corridors protect 92ha of land, which contains 20ha of remnant native vegetation. The remaining 72ha of land in the protected corridors is being revegetated by the establishment of environmental plantings. Over 65,000 native plants have been established in these corridor areas, to restore functional native vegetation to previously cleared areas. The project is associated with the establishment of stock exclusion fencing and riparian restoration on the trunk and tributaries of Kore Kore Creek as well as the remediation of active gully and sheet erosion sites and un-vegetated steep lands. This will deliver significant water quality benefits to Kore Kore Creek and the lower Port Stephens estuary. The project is being delivered as part of a major re-development of the agricultural production system on Durness to ensure greater sustainability including the establishment of a rotational grazing system and farm-scale off-stream watering network. The project site will be utilised for education and awareness activities. The Durness – Borland Landcare Corridor is being delivered by Landcare Australia Ltd and the landowner (Nepean Group) with funding provided by a bequest from the estate of the Late Raymond Borland. Council and the Hunter Central Rivers Catchment Management Authority are significant contributing partners. As a further contribution to this project, Council has acquired and conserved 122ha of land to protect water quality and biodiversity in the Kore Kore Creek catchment. This land is a core conservation node and protects a landscape important for water quality protection. Beneficial, low-intensity uses shall be developed in the Kore Kore Conservation Reserve, including walking trails and signage to encourage stewardship and awareness. The Kore Kore Conservation Area has been subject to primary weed controls to enhance the condition and function of the native vegetation of the land.

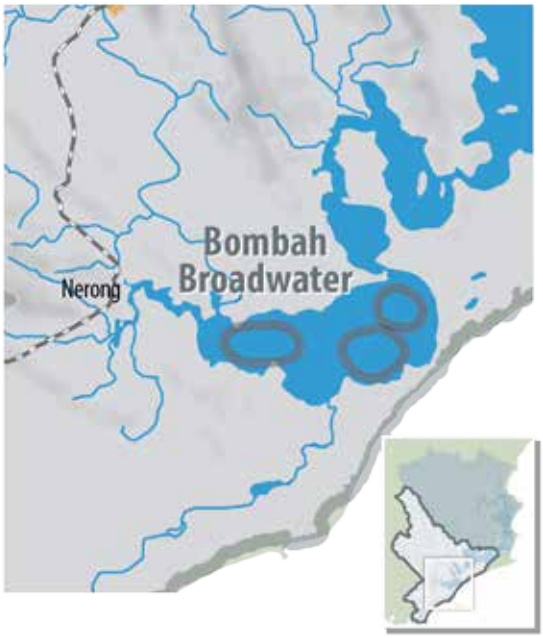
Figure 1.1.18 Large Mangrove in Kore Kore Creek Reserve

Bombah Broadwater

2013 D 2012 B 2011 B 2007

algae (chlorophyll)

clarity (turbidity)



Good grade but algal growth remains a problem in Bombah Broadwater

The Bombah Broadwater is part of the Myall Lakes National Park. Overall ecological health has improved markedly from last year. This is mainly due to a large improvement in water clarity in the Bombah Broadwater. However large amounts of algae over summer, whilst less than last year, still remain a concern.

Excessive algal growth in Bombah Broadwater, as a consequence of nutrient inputs from the upper Myall River catchment, has been a concern in Bombah Broadwater for at least a decade. High levels of algae threaten the conservation values of the Broadwater and adjoining Myall Lake.

There was a marked improvement in ecological health of the Broadwater in 2013, primarily as a consequence of an improvement in water clarity and slight reduction in algal growth.

The algal growth from 2012 has persisted, though it has remained below bloom levels. As a consequence, every chlorophyll sample was greater than the desired level though exceedances were only moderate. This still resulted in a fair to poor grade for chlorophyll. The good news is that water clarity has improved markedly, with all samples less than trigger values. This is a consequence of less runoff and a reduction in the large blue-green algal cells which can also lead to turbidity.

The continuing high level of algal growth indicates that more needs to be done to control nutrient levels entering the Broadwater and the short-term target is to reduce the frequency and severity of these extended blooms.

Estuary description

The Bombah Broadwater and Myall Lake are part of the Myall Lakes system which is comprised of four linearly connected brackish to freshwater basins: Myall Lake, Two Mile Lake, Boolambayte Lake and the Bombah Broadwater. The Myall Lakes National Park surrounds the lakes and is listed as a Ramsar wetland of international importance.

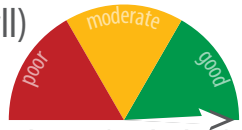
While the Bombah Broadwater itself is surrounded by National Park, it receives the majority of its inflow from the Upper Myall River and Crawford River catchments which together drain an area of approximately 440km^2. These catchments are largely occupied by agricultural land with forestry and protected vegetation in the steeper areas and a small amount of urban land in the township of Bulahdelah.

Samples were taken from three sites in the Bombah Broadwater and were combined to give an overall score for the health of the system.

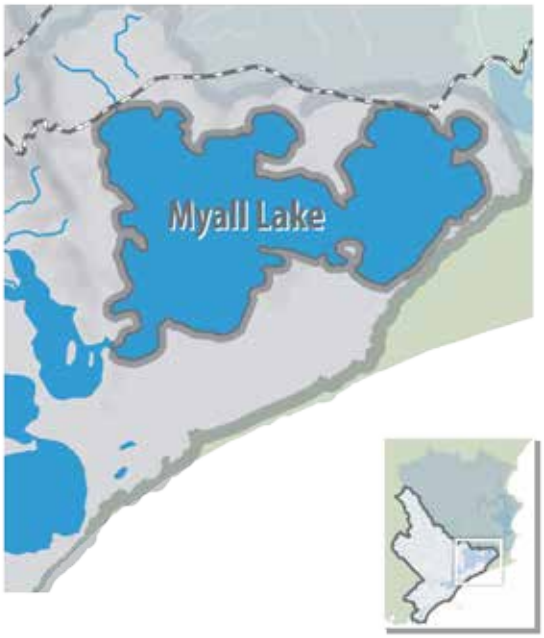
Myall Lake

2013 B 2012

algae (chlorophyll)



clarity (turbidity)



Good grade but algal growth still an issue in Myall Lake this year

Myall Lake has high conservation values, it is an internationally listed protected wetland and is part of Myall Lakes National Park. Overall, the health has remained good. Water clarity in the Myall Lake was excellent but there continues to be some undesirable growth of algae.

Myall Lake was identified in the Water Quality Improvement Plan as having very high environmental values primarily due to its extensive macrophyte beds and listing as an internationally significant wetland under the Ramsar convention. Good water quality, particularly clear water, were identified as being important in protecting this unique ecosystem.

The water quality results for Myall Lake were good overall. The clarity was excellent with no exceedences of turbidity trigger values for any samples in 2013. The waters are very clear, allowing plenty of light to reach the macrophytes on the lake floor.

Greater than desired growth of algae occurred in all samples, but the levels were only slightly above the trigger levels. Water moving from the Broadwater to Myall Lakes, carrying with it nutrients and algae, is believed to have contributed to greater than desired levels of algae this year.

The higher than desired level of algal growth in Myall Lake emphasises the ongoing need to control nutrient levels entering the Myall Lakes system via the upper Myall River.

Estuary description

Myall Lake along with the Bombah Broadwater is part of the Myall Lakes system which is comprised of four linearly connected brackish to freshwater basins: Myall Lake, Two Mile Lake, Boolambayte Lake and the Bombah Broadwater.

The Myall Lakes National Park surrounds the lakes and is listed as a Ramsar wetland of international importance.

Myall Lake is directly influenced by a small fringing catchment which is contained within the Myall Lakes National Park. During times of high rainfall however, water from the Broadwater (and therefore the Upper Myall River and Crawford River catchments) influences Myall Lake by carrying with it nutrients and algae.

Samples were taken from two sites in Myall Lake and were combined to give an overall score for the health of the system.

Appendix 1

2013 Waterway & Catchment Report Card for Wallis, Smiths and Myall Lakes

2013 waterway & catchment report card

for Wallis, Smiths and Myall Lakes

Great Lakes COUNCIL

NSW Office of Environment & Heritage

Hunter - Central Rivers CMA Catchment Management Authority

Greater Taree City Council

Landcare

Water quality improvement projects are made possible by the Great Lakes Environmental Special Rate

Wallis Lake
Water quality report card

Pipers Creek

The ecological health in Pipers Creek continues to be good, with results similar to 2011 and 2012. Waters in Pipers Creek remained clear. The nutrient loads from the urban catchment of Forster resulted in algal levels that were still higher than desired, but slightly less than last year.

Wallis Lake

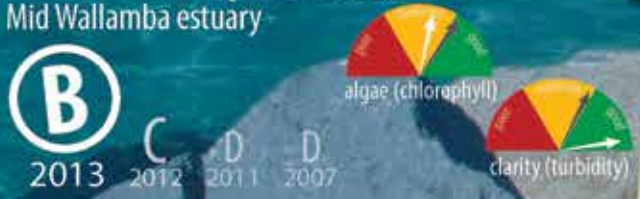
Wallis Lake is of a high conservation value, with abundant seagrass and high biodiversity. Ecological health was good, but has remained below that recorded in 2011. Water clarity was excellent but there was mild growth of algae indicating on-going inputs of nutrients.

Charlotte Bay

Charlotte Bay is of high conservation value, with abundant seagrass and high biodiversity. Ecological health remained excellent, algal growth is at very low levels, reversing the small increase in algal levels seen last year. Water clarity was excellent.

Mid Wallamba estuary

Great improvement!



This year the waters of the Wallamba River Estuary improved and are very clear but algal growth is still higher than desired. The clear waters provide lots of light, which combined with nutrients from the catchment resulted in much higher algal levels than last year.

Management actions 2007-2013

Removal of aquatic weeds

16 hectares of Cabomba infested waterways treated

Sustainable farming practices

86 landholders participating in 4 Sustainable Farming/Sustainable Living Groups, 32 landholders in Land for Wildlife

Sustainable gardening practices

22 urban residents active in Sustainable Gardening

Protection and rehabilitation of key habitats

Acquiring and conserving 763ha of wetlands at Darawakh, Minimbah and Lower Wallamba/ North Tuncurry to protect water quality and biodiversity

Water sensitive urban design

Eight water quality gardens and two wetlands built to treat 37.5 hectares of land in the Pipers and Muddy Creek Catchments

Bush rehabilitation

43 volunteers active in bush regeneration at ten sites

Working with students

Incorporated water quality and catchment management issues into the Great Lakes College Geography curriculum for years 7-10

Rubbish removal

160 volunteers remove 11 tonnes of rubbish from Wallis Lake Foreshore

Bank stabilisation

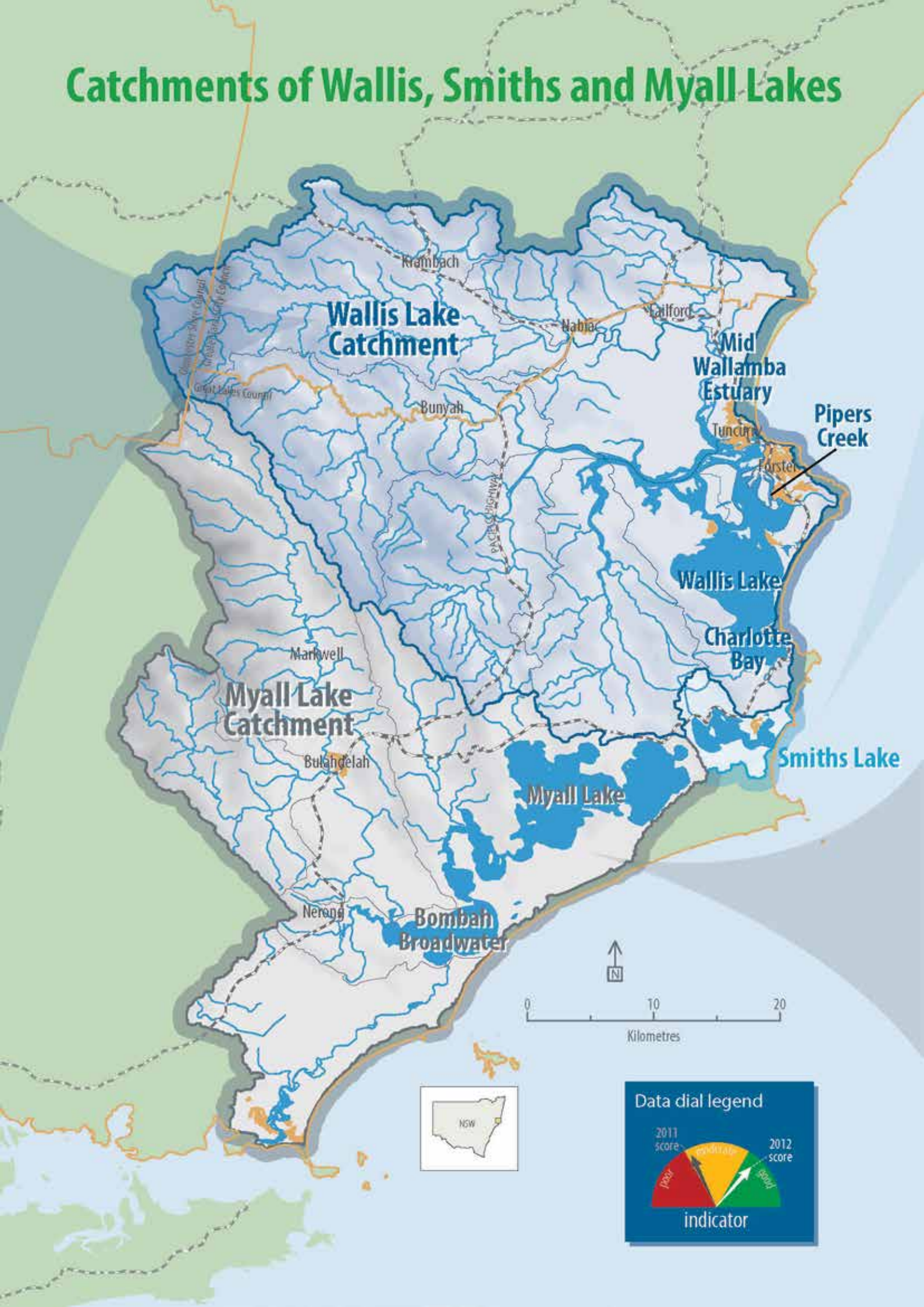
Stabilising 5.1km of the Wallamba River with rock protection, planting 8,000 native plants and conserving 9.5km of streambank

Key stats

- Erosion control on 37.9ha of land
- 903ha of wetlands protected and enhanced
- 32.8km of stream bank protected plus
- 351ha of native vegetation protected and enhanced
- 10ha of infested water treated for aquatic weeds
- 240m of roadside stabilised to reduce erosion

Projects funded by the Hunter Central Rivers Catchment Management Authority

Catchments of Wallis, Smiths and Myall Lakes



Smiths Lake
Water quality report card

Excellent!

2013	2012	2011
A	NA	A

Smiths Lake continues to be in excellent ecological health with very clear waters to allow growth of seagrass. There was slightly more algal growth than desired in some parts of the lake but this did not affect the overall score.

Management actions 2007-2013

Bush rehabilitation
3 volunteers active in bush regeneration at one site contributing 300 hours

Roadside stabilisation
2090m of roadside stabilised reducing the amount of sediment reaching the lake

Myall Lakes
Water quality report card

Myall Lake

Good score!

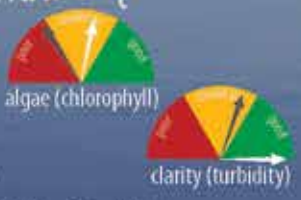
2013	2012
B	B

Myall Lake has high conservation values, it is an internationally listed protected wetland and is part of Myall Lakes National Park. Overall, the health has remained good. Water clarity in the Myall Lake was excellent but there continues to be some undesirable growth of algae.

Bombah Broadwater

Terrific improvement!

2013	2012	2011	2007
B	D	B	B



The Bombah Broadwater is part of the Myall Lakes National Park. Overall ecological health has improved markedly from last year. This is mainly due to a large improvement in water clarity in the Bombah Broadwater. However large amounts of algae over summer, whilst less than last year, still remain a concern.

Management actions 2007-2013

Removal of aquatic weeds
Aquatic weeds monitored along 46 kms of streambank and 4 hectares of waterways treated

Erosion control
74km roads and trails closed, rehabilitated and maintained to reduce erosion and sedimentation in Myall Lakes National Park

Sustainable farming practices
31 landholders participating in 2 Sustainable Farming Groups

Protection and rehabilitation of key habitats
Acquiring 371ha of wetlands in the Bulahdelah area, creating a major wildlife corridor at Dumess protecting 90 hectares of land and revegetating 70 hectares to protect water quality and biodiversity

Key stats

- Erosion control on 23.7ha of land
- 396ha of wetlands protected and enhanced
- 10km of stream bank protected
- 403ha of native vegetation protected and enhanced
- 138ha of infested water treated for aquatic weeds

Projects funded by the Hunter Central Rivers Catchment Management Authority

Report Card Overview

Further details on the information contained in this report card are available in the 2013 Water Quality Report www.greatlakes.nsw.gov.au/Environment/Plans_and_Strategies

Introduction

This is the third Report Card for the waterways and catchments of Wallis, Smiths and Myall Lakes. The water quality data presented here was collected during the summer of 2012/13.

Each waterway has received a grade based on the data which tells us the condition of the waterways this year. As more and more data is collected, we should be able to establish whether the waterways are changing. We will also be able to evaluate the impacts of extreme events (such as floods) and identify areas in need of protection and rehabilitation.

Methods

This Report Card is intended to read like a report card a student might receive at school. It assesses the condition or health of the waterways compared with what we would like it to be. A healthy waterway can be characterised by clear water and low levels of algae. It would provide habitat for a wide range of plants and animals.

This report card is rated for ecological health rather than other human health issues such as drinking water quality, safety for swimming, bacteria, viruses or our ability to harvest shellfish or fish.

To calculate the Report Card grade, scientists have assessed the condition of particular parts of the waterways using indicators. Just as your body temperature is used as an indicator that something may be wrong with your own health, indicators are used to show if something is out of balance or unhealthy in the system.

Two indicators have been used to assess the condition of the waterways. Chlorophyll a is the amount of microscopic algae in the water and high levels indicate high inputs of nutrients. Turbidity, or water clarity, is a measure of the amount of sediment or dirt suspended in the water. Sensors are used by scientists to collect the information.

Measurements were taken six times over the 2012-2013 summer at seven sites across the region. The condition of each site is established by comparing the indicator levels to a benchmark level measured from an undisturbed, healthy site of a similar type.

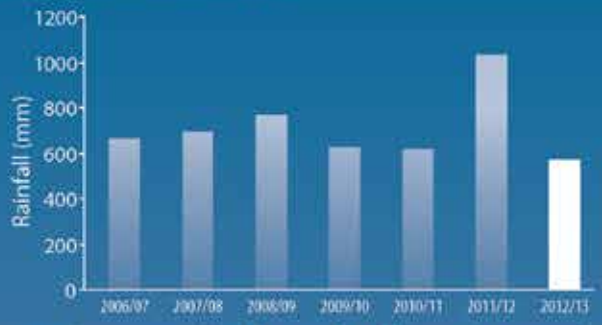
The information collected is converted into a grade. Grades have been set after looking at scores from over 130 sites across the state. The grade indicates where a site ranks in comparison to the other sites.

Grade	Result	Description
A	Excellent	The highest 20% of scores in the state
B	Good	Next 20% of high scores in the state
C	Fair	Middle 40% of scores in the state
D	Poor	Lower 15% of scores in the state
F	Fail	Lowest 5% of scores in the state

This report card presents the ecological health for 2013 and (where available) also shows data from 2011 and 2012 for comparison. The sliding scale bar from poor to good shows how indicator levels have changed from the 2011/12 reporting period to 2012/13.

Rainfall results

The amount of rainfall that occurs around the period of sampling for the report card (September – March) influences the report card results. If there is more rain, there is more runoff in the catchment resulting in greater quantities of sediment and nutrients entering our waterways. 2012/13 rainfall was significantly less than recorded in 2011/12.



Note – Data presented includes total rainfall September to March from Forster Bureau of Meteorology rainfall station

Seagrass - the cornerstone of waterway health

Water plants like seagrass are critical for waterway health. Seagrass provide essential habitat for fish and invertebrates, food for sea turtles and support bird life in rivers and estuaries. Algal blooms and excess sediments reduce the amount of light reaching the bottom, leading to the death of seagrass which require plenty of light to grow. This process turns our waterways from healthy thriving systems into places with low biodiversity and ecological values and therefore, low social value. Excess nutrients that runoff our land are the main culprits when it comes to algal blooms.

A well managed catchment has a lot of vegetation cover which slows runoff and uses up nutrients. It has landholders who farm their pasture so that the soil is healthy and there is a lot of ground cover to filter runoff from their land. It has an urban community who reduce fertiliser use and create water quality gardens to filter stormwater from streets and houses. A well managed catchment has extensive natural wetlands protected and restored so that they will continue to filter nutrients and sediments naturally. The result is better water clarity and less algae, and therefore, improvements in our Report Card grades.

Healthy cattle and healthy waterways

Local farmers Felicity Carter and Julie Brady have been working with Great Lakes Council and Karuah Great Lakes Landcare to demonstrate how farming in the Wallis Lake Catchment can produce healthy cattle whilst protecting the health of our waterways. Felicity and Julie are two of over 100 landholders involved in Council's Sustainable Farming Program. These landholders work towards improving soil health and ground cover to achieve both production benefits and improvements in water quality. Improving soil health and ground cover increases the lands ability to absorb water and filter run off.

Felicity and Julie have a view of Wallis Lake that most people would dream of. Near the village of Coomba Park at Rose Point, they have 400 acres of land perched on top of a hill overlooking the mouth of the Coolongolook River and Wallis Island. With lush green grass in the foreground they have healthy cattle drinking out of troughs strategically placed across the paddocks.

Over the past few years Julie and Felicity have put in place a number of strategies to improve their farm:

- troughs in their paddocks so that cattle no longer drink from dams
- fencing so that the animals can be rotated around the farm every one to two days
- compost tea applied to pastures improving the condition of the soil
- redirecting the overflow from the dam to prevent erosion
- working with the contours of the land to keep water on their property and
- fencing cattle out of 3.5km of Wallis Lake foreshore.

Production benefits are seen in healthy cattle, a result of healthy pastures

Researchers from the Office of Environment and Heritage have studied the impact of excluding stock from the saltmarsh along the lake foreshore. The study found that, even in the first 12 months, plants in the areas that were not grazed were taller, had more mass and covered more of the ground. Protecting these wetland areas increases the ability of the saltmarsh to intercept nutrients and sediments in runoff. Fencing the saltmarsh along the foreshore keeps nutrients on the paddocks where they are needed.

Julie and Felicity say that their cattle are healthier as a result of this approach. The diversity of plant species in the paddocks has improved from two or three up to 11, making the pasture much more nutritious. Providing troughs for drinking not only keeps the cattle out of the waterways but reduces their susceptibility to diseases such as liver fluke.

Sustainable grazing on Julie and Felicity's farm maintains high grass cover for clean waterways

Great Lakes
COUNCIL

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