



MIDCOAST
council



WATERWAY AND CATCHMENT REPORT

2019



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MidCoast Council 2019 Waterway and Catchment Report
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Introduction

The MidCoast Council 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 provide habitat for extraordinary biological systems. The region's catchments are under continued pressure from pollution and impacts associated with catchment land use, development and tourism. If unmanaged this has the potential to result in a decline in the health of our waterways.

All our local waterways are critically susceptible to 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 2019 Waterway and Catchment Report Card. It provides the technical information on how the Report Card scores were calculated as well as providing more detail on the results.

Water quality - ecological health

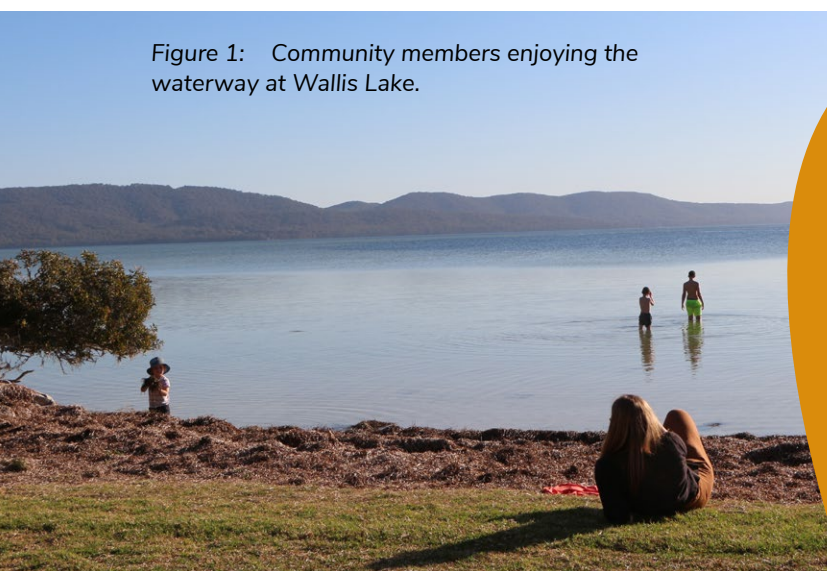
Good management of our lakes, rivers and estuaries requires understanding of how they work, predictions about future conditions and informed choice about actions to get the outcome the community wants. MidCoast Council and Department of Planning, Industry and Environment - Environment Science (DPIE-ES) have worked together to put these principles into action. International best practice suggests that research, modelling, management and monitoring should all use the measures of condition and success. DPIE-ES research allowed the development of a solid understanding of the impacts of catchment activities on lake health. It also concluded this abundance of algae and water clarity would be good indicators for the future. Council used the scientific understanding to form the Water Quality Improvement Plan in 2009, which was designed to achieve a number of specific outcomes, expressed in terms of water clarity and algal abundance. Progress towards these outcomes has been measured using the same measures in the annual report cards.

The MidCoast Council community value the health of our waterways and the Waterway and Catchment Report Card is a tool that Council use to monitor how we are tracking. DPIE-ES have undertaken an ecological health monitoring program in Wallis Lake and Khappinghat as part of the state-wide Monitoring, Evaluation and Reporting Strategy (MER). As part of the strategy, these estuaries were selected as two of seven 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).

Since 2011 the monitoring program has been expanded to cover other key sites across the MidCoast Council area. DPIE-ES have provided an independent scientific evaluation on the ecological health of Wallis Lake, Smiths Lake, Karuah River Estuary, Myall Lakes, Khappinghat Estuary and the Manning River Estuary.

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: Community members enjoying the waterway at Wallis Lake.



Healthy waterways support our local towns and communities, they keep them thriving. They put food on our tables, support our outdoor lifestyle, local economy and provide homes for wildlife, trees and plants of every sort. With healthy waterways our communities have a healthy vibrant future

Introduction

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 (see Appendix) 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).

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 provide substantial water quality and biodiversity benefits to the rivers and estuaries.
- Guide and report on the remediation of areas that have high pollutant loads and highlight areas that may require further action.
- Help protect all waterways against further declines in water quality.

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.

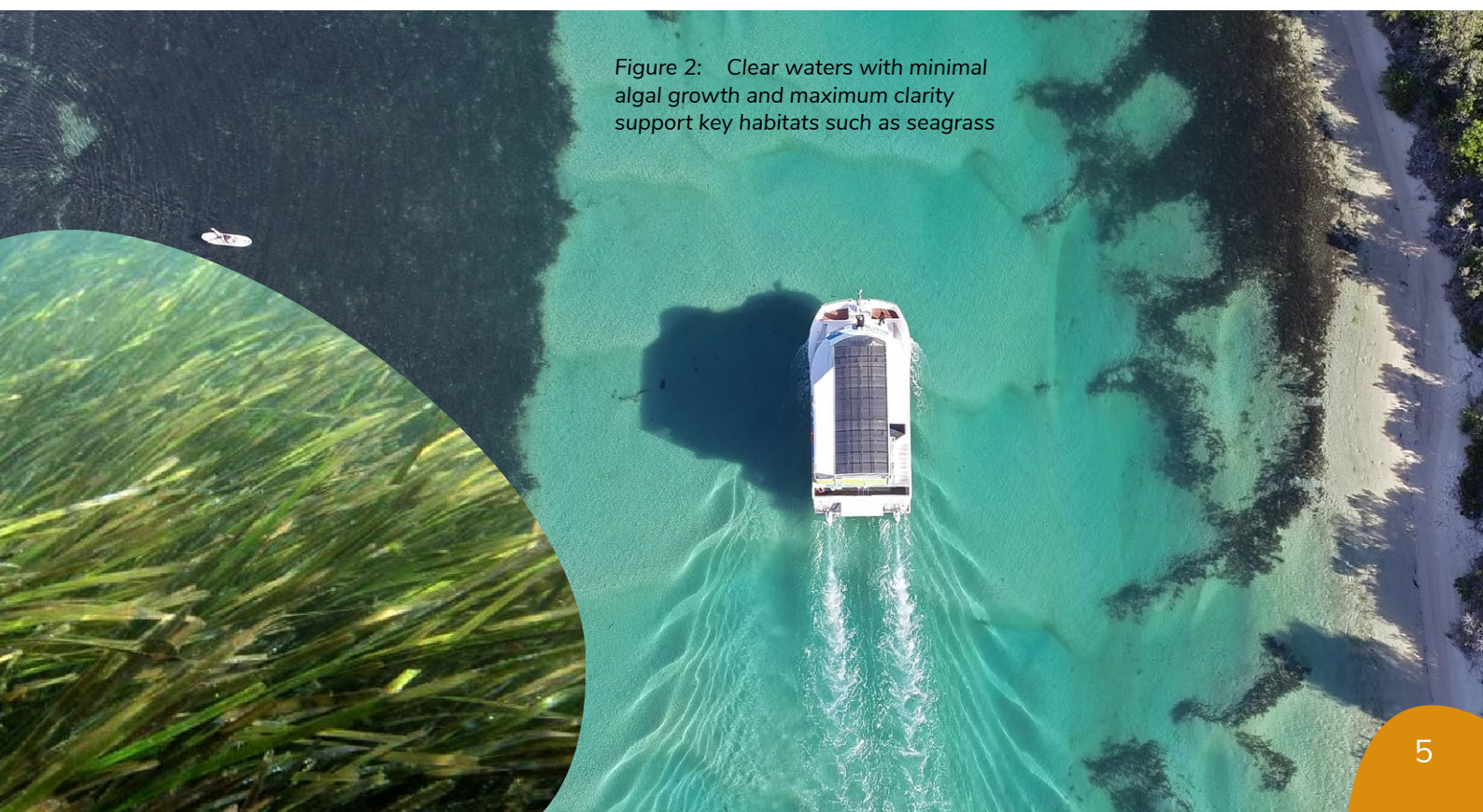


Figure 2: Clear waters with minimal algal growth and maximum clarity support key habitats such as seagrass

Methods

Development of Report Card grades

The monitoring program has assessed the Ecological health of Wallis, Smiths and Myall Lakes, Manning and Karuah River Estuaries and the Khappinghat Estuary. There are a number of steps taken to determine 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.

Selecting the indicators

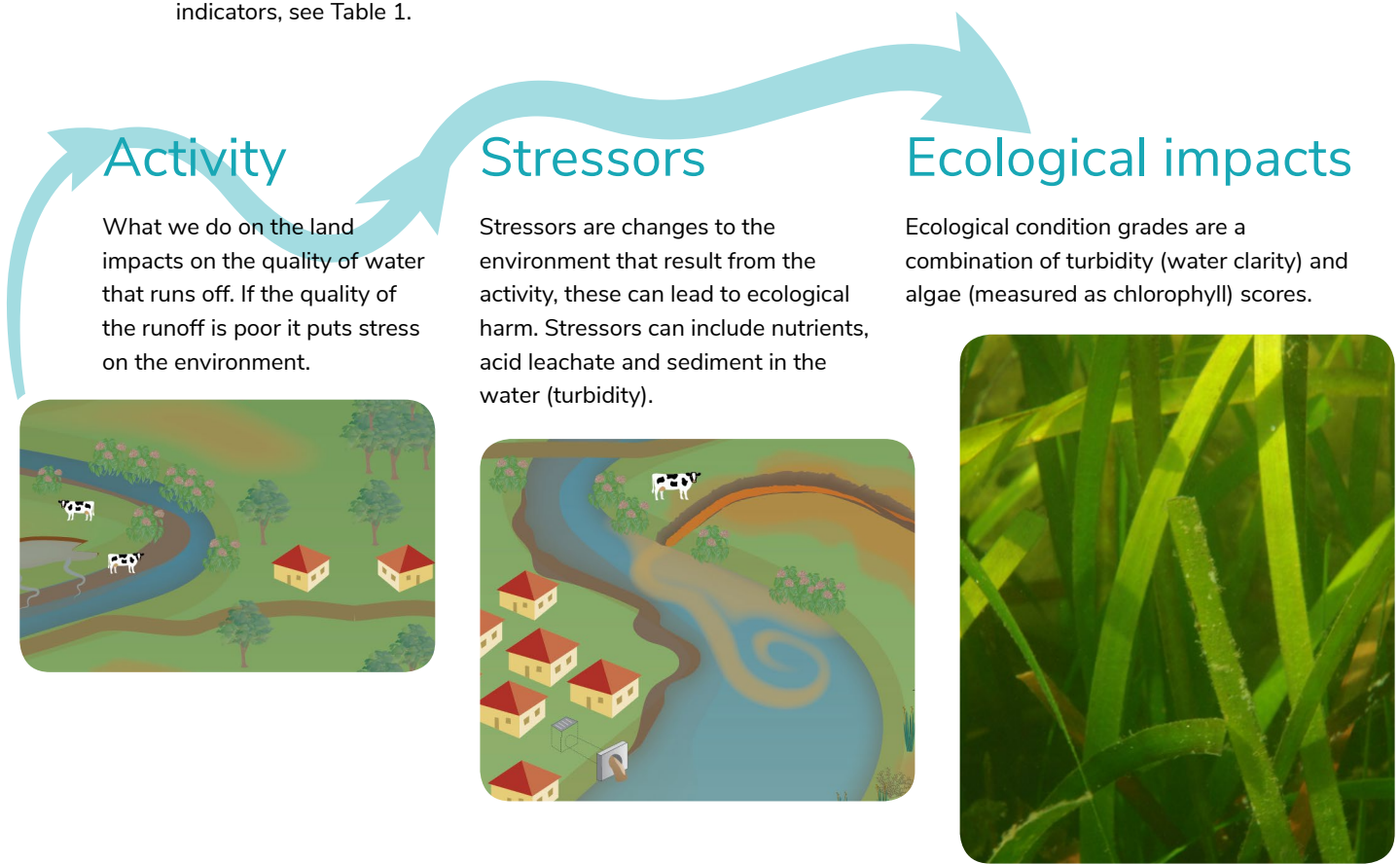
In order to meet the objectives of the Report Card, indicators must report on ecological health but also be able to report on the outcomes of management actions. The management actions are linked to the environmental values set for the region (listed above), and the indicators selected have been shown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

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, see Table 1.

Why a Report Card?

Report Cards are an effective way to check on the health of our waterways. They help us compare current conditions with the condition we would like them to be. Scientists use indicators to 'health check' our waterways. 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. The indicators are selected to assess the overall health or ecological condition. The results of the Report Card are used to guide future management actions and ensure long-term ecological health of our catchments.



Methods

Algal growth can be measured by assessing chlorophyll a levels in the water and sediment inputs are assessed by measuring the turbidity (see feature box). These indicators are easy to measure and directly relate to the environmental values. The extent of seagrass beds is also an excellent ecological indicator of a healthy functioning ecosystem (see feature box).

Seagrass is the basis of the food web in healthy estuaries. Seagrass provides essential habitat and food for marine life. Where seagrass is abundant so is aquatic life and as such, it is an excellent indicator of ecological health. Seagrass growth is affected by a number of factors including nutrient levels, algal growth, physical removal and water clarity. Water clarity (turbidity) is directly linked to seagrass growth and can be used as a surrogate for ecological health. When water clarity is high, seagrass is abundant as there is plenty of light for it to thrive.

While 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.

Table 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	✓	✓	✓		✓		
New South Wales Monitoring, Evaluation and Reporting Program *	✓	✓	F		F	✓	
MidCoast Council Report Card (this program)	✓	✓	F		F	F	

F - future

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

The New South Wales Monitoring, Evaluation and Reporting Program, 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. MidCoast Council and the New South Wales 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.

Methods

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 New South Wales. 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.

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.

A trigger value is specific to different types of estuary. In this study, Wallis Lake, Pipers Creek, Charlotte Bay, Bombah Broadwater and Myall Lake were all classified as 'Lakes', Wallamba River, Karuah Estuary, Wallamba Cove, Dawson River, Farquhar Inlet, Branch Estuary, Lower Myall River and Upper, Mid and Lower Manning Estuary River were classified as a 'River estuary' and Khappinghat was classified as a 'Creek estuary' (Roper et al. 2011).

Table 2: Trigger Values for NSW Estuaries (from Roper et al. 2011)

	Turbidity (NTU)	Chlorophyll ($\mu\text{g/L}$)	pH
Lake	6.7	2.5	
River estuary (mid)	1.9	2.2	

Figure 3: Algal growth in the Manning Catchment.

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 occur 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 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).



Methods

Collecting the data

The MidCoast Council region has been divided up into 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. Six zones were sampled in Wallis Lake estuary (Wallamba River, Coolongolook River, Wallamba Cove, Pipers Creek, Wallis Lake and Charlotte Bay). There are five zones in the Manning River Estuary (Middle, Upper and Lower Estuary, Dawson River and Farquhar Inlet), three zones in the Myall Lakes (Myall Lake, Bombah Broadwater and Lower Myall Estuary), two zones in Karuah (Karuah Estuary and Branch Estuary) and one zone in the Khappinghat and one zone in Smiths Lake.

Samples were collected on six occasions between summer and autumn from October 2018 to April 2019. This represents the part of the year when the highest chlorophyll concentrations are expected.

At each of the selected sites, samples were taken in accordance with the New South Wales 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 1 metre 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 is determined by spectrometry.



Figure 4: Office of Environment and Heritage staff carry out the monitoring of the waterways in the MidCoast Region

Methods

Seagrass depth range is calculated by measuring water depth at the shallow limit and deep limit of seagrass cover across three transects at a sampling site. One transect is a routine transect used in the survey each year. The remaining two transects are randomly located within 50 m each side of the routine transect. The mean shallow limit is subtracted from the mean deep limit to give the depth range for that site. All depths are standardised to a number of standard height markers in proximity to the sampling sites within the lake to remove potential errors from changing water levels.

A report card grade is calculated following the analysis method outlined in the New South Wales sampling and reporting protocols (OEH, 2016). Briefly, the seagrass depth range scores are based on not only the recorded depth range for a specific year, but also how that compares to the previous year, meaning how seagrass has progressed, recovered or regressed over time since the previous survey. The seagrass score is presented separately in the report card and does not affect the overall ecological health grade.

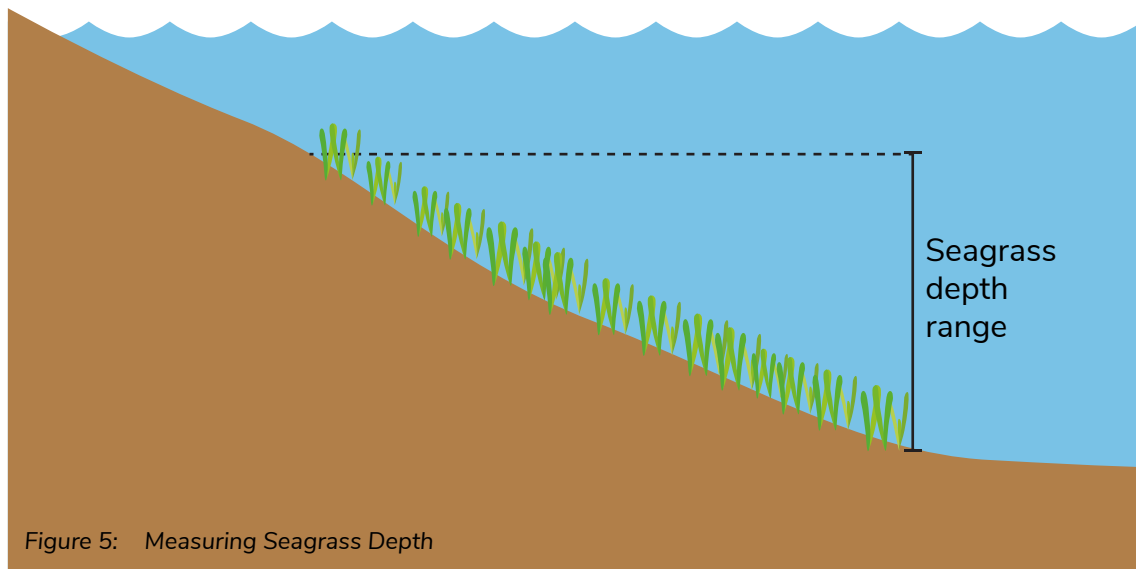


Figure 5: Measuring Seagrass Depth

Figure 6: Roadside sediment runoff

Sediment

Sediment from the land can be washed into waterways when it rains. If land is poorly managed, 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 the local tourism and aquaculture industries. Excess amounts of suspended particles can also smother benthic organisms like sponges, irritate the gills of fish and transport contaminants.

Turbidity

Turbidity provides a measure of sediment in the water. It 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).



Methods

Calculating the zone score

The measured values of all indicators are 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 is 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 of 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 New South Wales. The 98th percentile value was selected as the worst expected value Table 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 3: Worst expected value for Condition Calculations

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

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.

Methods

Allocating the Report Card Grade

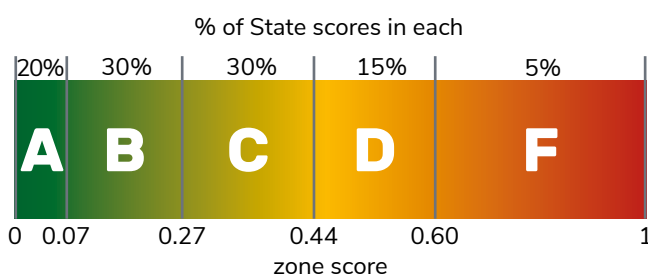
Defining the Report Card grade is an important step in the development of the Report Card. The grade definitions below are linked to the environmental values outlined above and are structured to allow easy comparison between each system and over time.

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 New South Wales estuaries (i.e. an 'Excellent' grade represents an excellent condition for a New South Wales estuary). To assist with the derivation of cut-offs, scores were calculated for 130 zones across a wide range of New South Wales estuaries using the same triggers and worst expected values as the MidCoast analyses. Cut-offs were then defined as representing a percentage of the scores for the state (Table 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 4.

Table 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

Figure 7: Relationships between grades, zone scores and state percentiles



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.

Methods

- 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.

The sampling period in 2018-19 was very dry, rainfall was among the lowest 5% of totals since the 1950s, and lowest recorded since 2009.

The rainfall data is taken from the Forster Bureau of Meteorology rainfall station (Tuncurry Marine Rescue) (www.bom.gov.au/climate/data). Similar trends were seen in data throughout the MidCoast Area.

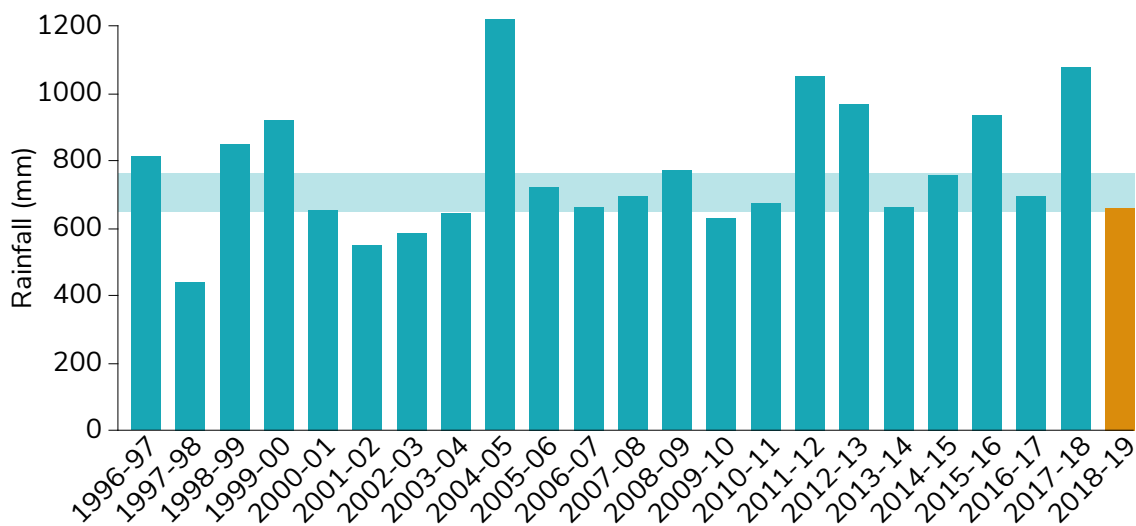


Figure 8: Data presented includes total rainfall

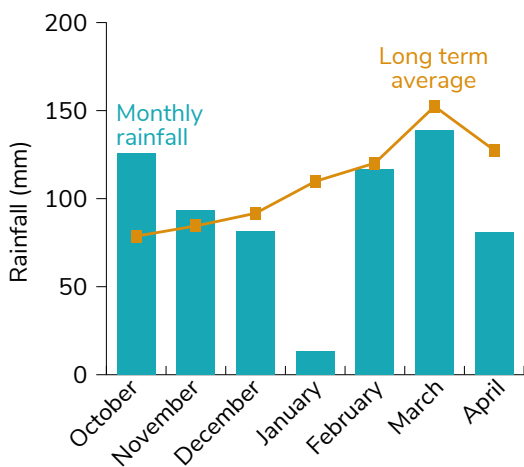


Figure 9: Monthly observed and long term average rainfall during the 2018-2019 monitoring program at Tuncurry Marine Rescue (bom.gov.au)

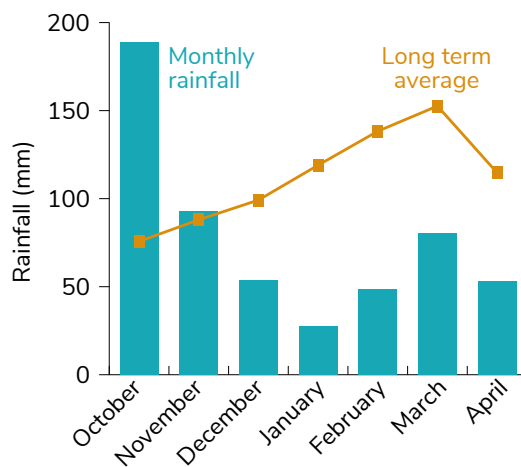


Figure 10: Monthly observed and long term average rainfall during the 2018-2019 monitoring program at Taree Airport (bom.gov.au)

Methods

References

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Acknowledgements

The methodology presented here was developed by the Department of Planning, Industry and Environment - Environment Science (DPIE-ES) with input from Hodge Environmental and the International Water Centre.

Figure 11: Dawson River



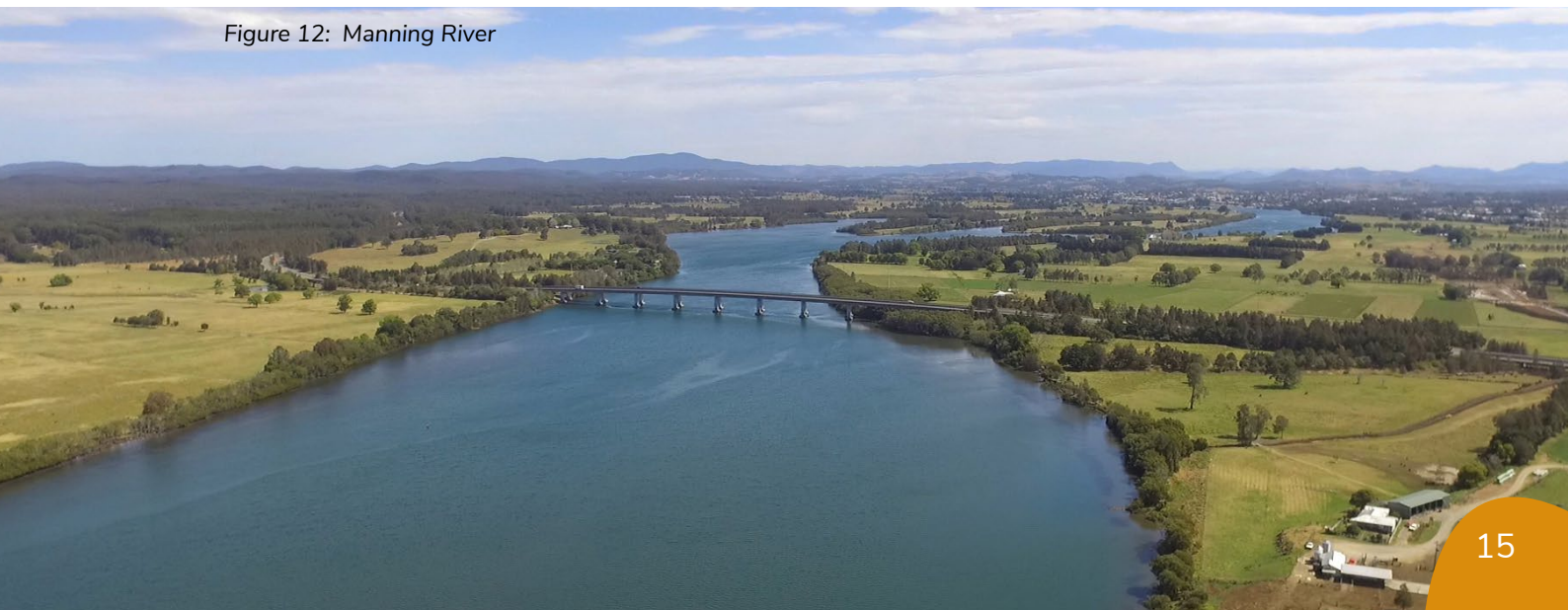
Manning River Estuary

Catchment description

The Manning River has a catchment area of 8,420 square kilometers, which makes it the sixth largest on the coast of NSW. The Manning River is unique on the NSW coast because it is a double delta with two river entrances at Harrington and Old Bar. The main land uses within the catchment are urban development, beef cattle grazing, dairying, oyster growing and forestry. Significant areas of the catchment are also conserved within National Parks and Nature Reserves. The majority of the catchment's population live in the estuarine zone around the town centres of Taree, Wingham, Cundletown, Harrington and Old Bar.



Figure 12: Manning River



Manning River Estuary



Upper Manning River Estuary

Good grades continue in the Upper Manning

The good water clarity seen last year declined slightly in this year's sampling period. Elevated algae concentrations seem to be an ongoing issue in this part of the estuary. Algae concentrations in the sampling period were similar to last year. The algae trigger value was exceeded by a small – moderate amount in half of the samples. The water clarity trigger value was exceeded around one third of the time by a very small amount during the sampling period. The extended dry period would have maintained the water clarity due to the minimal amount of catchment runoff entering the estuary, but the higher algal levels can also result in water clarity.

Seagrass disappeared from the upper river for unknown reasons.

Estuary description

The upper estuary includes the section of river from Tinonee to the western end of Dumaresq Island.



Dawson River

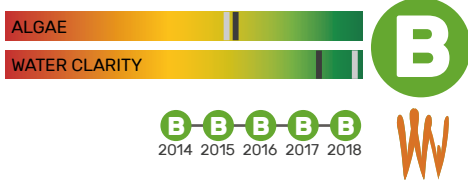
Dawson River in good ecological condition during first sampling period

This was the first time the Dawson River was sampled and it was graded as good, but it is on the edge of poorer scores. Water clarity exceeded triggers in every sample by a small amount and algae exceeded triggers in 80% of samples by a small to moderate amount. Clearly there is a need for nutrient and water clarity management in the Dawson catchment.

Estuary description

Dawson River is a tributary of the Manning River. It enters downstream of Taree and receives runoff from Taree's industrial areas as well as a sewage discharge.

Manning River Estuary



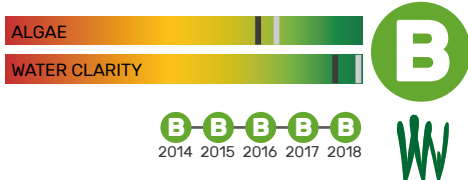
Mid Manning River Estuary

Mid Manning holding the line with a good score

In the Mid Manning Estuary algae concentrations were similar to last year for most of the sampling period but water clarity was slightly worse. The water clarity trigger value was exceeded for three quarters of the sampling period by a small amount, whereas the algae trigger value was exceeded in just over half of the sampling period. Generally, these exceedances were small. Algae concentrations would have increased during this time period, as the dissolved nutrients in the system and the abundant light would have provided suitable growing conditions for phytoplankton. There was a slight decrease in the seagrass depth range compared to last year and overall the depth is poor for this type of estuary.

Estuary description

The middle estuary is the river from the western end of Dumaresq Island to the confluence with the Lansdowne River in the north channel, and to the confluence with Warwiba Creek in the south channel of the river. The middle estuary also extends into Scotts Creek to the confluence with Bukkan Bukkan Creek.



Lower Manning River Estuary

Good grade in the Lower Manning

There was a slight reduction in the water clarity and slight increase in the algae concentration throughout the sampling period compared to last year. The water clarity trigger value was exceeded for about one quarter of the sampling period. The algae trigger value was exceeded by a small to moderate amount in over three quarters of the samples. The water clarity trigger value was exceeded around two thirds of the time by a small amount during the sampling period. There was moderate improvement in the extent of the seagrass depth range this year which influenced the overall grade in the lower part of the estuary.

Estuary description

The lower estuary is from the Lansdowne River confluence to the river mouth at Harrington, and from the Warwiba and Bukkan Bukkan Creek confluences to the river mouth at Farquhar Inlet

Manning River Estuary



B

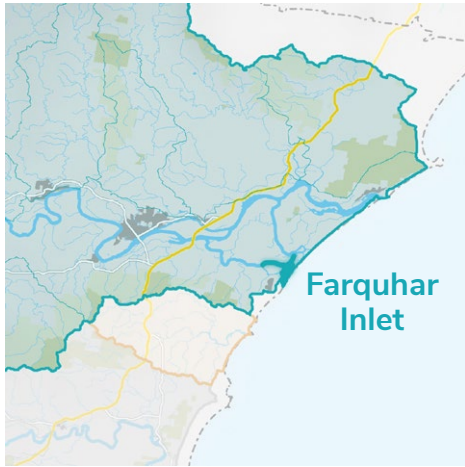
Farquhar Inlet

Farquhar Inlet in good ecological condition

This was the first time we have sampled the Farquhar Inlet and it was graded as good, verging on excellent. Turbidity was low, exceeding chlorophyll and turbidity triggers by a very small amount in only one third of samples. Salinity typically ranged from 23 to 28, making it more similar to the mid estuary sites than the lower estuary sites.

Estuary description

Farquhar Inlet is a secondary entrance to the Manning River system that is intermittently open. It is a broad, shallow sand delta at the junction of the Manning River South Arm and Scotts Creek. It is surrounded by agricultural lands and receives runoff from the town of Old Bar.



Khappinghat Estuary



B



Khappinghat grade continues to be impacted by water clarity.

The Khappinghat estuary, located in Saltwater National Park is surrounded by Khappinghat Nature Reserve and is typically in excellent ecological condition, this year it received a good score. Algal growth was low, 2 out of 12 samples exceeding trigger values, but only by a very small amount. Water clarity was poorer than expected. One third of samples exceeded the guidelines by a small amount, leading to continuation of the good grade, rather than the excellent grade expected. The source of this sediment is not known.

There was no evidence of broadscale increases in acidity from local sources in the waters of Khappinghat Creek, though it is known that tannin waters are naturally slightly acidic, resulting in a good grade.



Wallis Lake

Catchment description

The Wallis Lake catchment extends over 1400 square kilometers and 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 \$315m per year. The lake is one of New South Wales' top three producing estuarine fisheries, it produces 80% of the states commercial crabs and is utilised extensively for recreation including boating, fishing and swimming.

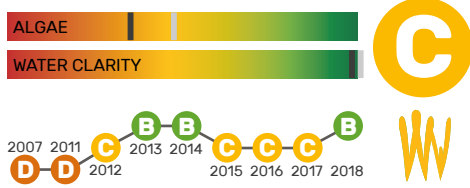
The Wallis Lake catchment contains habitat for threatened and international migratory species and contains 35% of the seagrass beds of New South Wales, as well as the second largest representation of saltmarsh in the State.



Figure 13: Revegetating degraded floodplain on Gereeba Island, Wallamba catchment, Wallis Lake.



Wallis Lake



Mid Wallamba Estuary

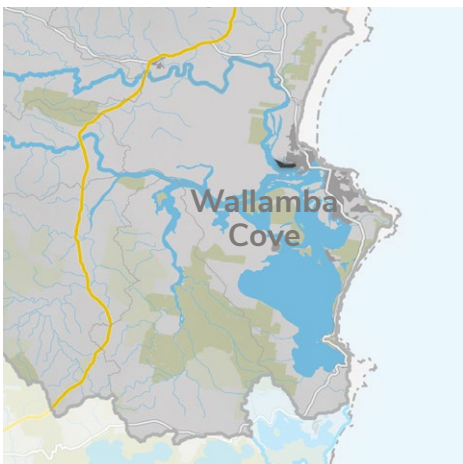
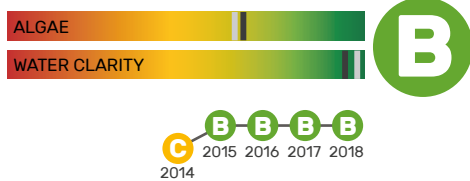
Algal growth still too high in Mid Wallamba Estuary

The Mid Wallamba Estuary has continued to maintain the significant improvements that were first observed in 2013. As has been seen in past years, the water clarity has remained excellent with almost 100% of samples below trigger values. Since sampling commenced in 2007, seagrass has re-established in the Mid Wallamba Estuary, particularly near the rock fillets which were established to manage boat wash and bank erosion. Despite this, it appears that the water clarity is still restricting seagrass growth in deeper waters and as such the seagrass depth range recorded was still poor. The algal abundances continue to be much greater than desired with all samples exceeding trigger values by a large amount. There remains a need for improvements to nutrient management in the catchment.

Estuary description

The Mid Wallamba Estuary sub catchment covers almost one third of the Wallis Lake catchment (550 km²). 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.



Wallamba Cove

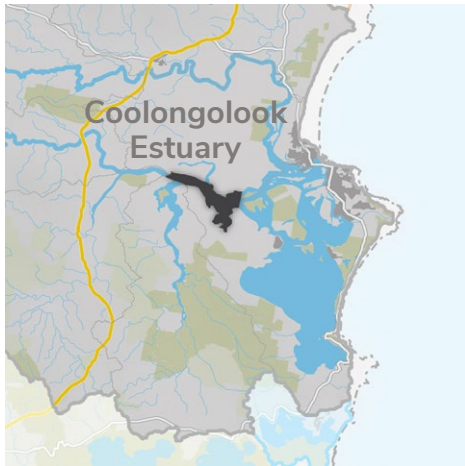
Wallamba Cove remains in good condition

Wallamba Cove receives urban runoff from Tuncurry and its impact is evident. This was particularly the case at the upstream site where all but one sample exceeded algal trigger values by a moderate amount and half the samples exceed water clarity trigger values by a small to moderate amount. The impacts at the downstream sites are less, due to either dilution by the river or distance from catchment input.

Wallis Lake



B



Coolongolook Estuary

Algal growth still too high in Coolongolook Estuary

The Coolongolook Estuary continued to show a large amount of algal growth but in general, water clarity was acceptable. All samples exceeded trigger values for algae by a moderate amount and 50% of samples exceeded water clarity trigger values by a small amount. These results show that there is a need for improved nutrient management in upstream catchments.

Estuary description

The Coolongolook Estuary receives water from the Coolongolook and Wang Wauk Catchments which contains modified landscapes predominantly used for agriculture. All lands within the Coolongolook catchment are on erodible soils. The catchment contains a small urban service centre with a population of around 417.

The water sampling occurs in the estuarine reaches of the river.



A



Pipers Creek

Pipers Creek improves from good to excellent condition

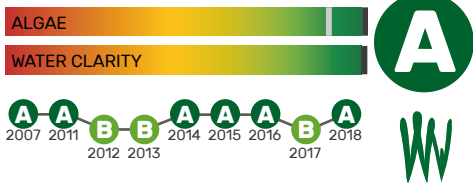
This year Pipers Creek has an excellent score, continuing the good performances that have been achieved since work commenced on implementing actions from the Water Quality Improvement Plan. There is still a need for ongoing control of upstream nutrients, with one third of samples exceeding the algae trigger values by a small amount. All samples were below water clarity trigger values. Seagrass depth improved on last year and is near the maximum that can be expected in this part of the lake.

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, roads and pathways. 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.

Wallis Lake



Wallis Lake

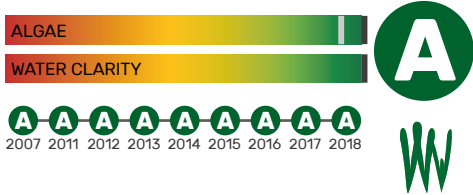
Wallis Lake remains in excellent ecological condition

Wallis Lake grade remained excellent this year. Water clarity samples were all below the trigger value, and none of the algae samples exceeded the trigger value. Seagrass depth is at the maximum that can be expected in this part of the lake system.

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.



Charlotte Bay

Charlotte Bay remains most outstanding site in Wallis Lake

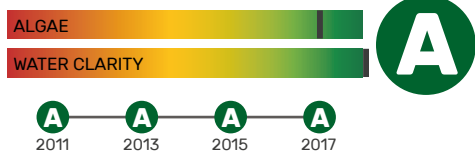
Charlotte Bay continues to rate as the most outstanding site in Wallis Lake, with no exceedances for water clarity or algae. Seagrass depth was exceptional with seagrass extending from one shore to the other across the lake floor. This was the best seagrass habitat recorded across the MidCoast Council area.

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.

Smiths Lake



Smiths Lake remains in excellent ecological condition despite extended dry period

Smiths Lake has remained in excellent condition despite an extended dry period which resulted in a dramatic drop in lake levels. Low rainfall and little runoff resulted in clear waters and low nutrient inputs.

Waters in Wamwarra Bay and central Smiths Lake were slightly saltier than seawater, water clarity was excellent and there was no excessive growth of algae. In Symes Bay, waters were slightly less salty than seawater, clarity was excellent and there were some signs of algal growth, overall grades were still excellent.

Estuary description

Smiths Lake has a catchment area of 35.89 square kilometers. It is an intermittently closed and open coastal lagoon and the lake entrance is artificially opened when levels approach 2.1 meters 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.

Myall Lakes

Catchment description

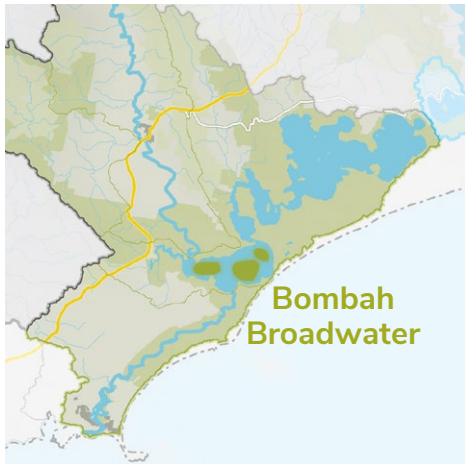
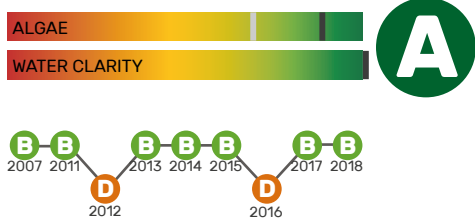
The Myall Lakes catchment covers 440 square kilometres. Its major tributary is the Myall River, whose headwaters extend to Craven Nature Reserve and the Kyle Range. The catchment is largely occupied by agricultural land, with forestry and protected vegetation in the steeper areas and a small amount of 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 New South Wales' 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.



Myall Lakes



Bombah Broadwater

Nutrient inputs continue to cause algal growth in Bombah Broadwater

The grades for Bombah Broadwater improved from last year's good condition to excellent this year. The condition of Bombah Broadwater is strongly influenced by runoff from the Myall River catchment. The continuing dry conditions meant that there was little runoff during the sampling times, resulting in clear waters and small amounts of algae. Just under half of the samples in Bombah Broadwater exceeded trigger levels by a small amount. This shows that Bombah Broadwater is under continual pressure from nutrient inputs. All samples were less than trigger levels for water clarity. The marked variability in condition, swinging from good to poor and back to excellent emphasises the strong response to catchment inflows and the need to continue to control nutrients from the catchment of the upper Myall River. Dry conditions also mean the lakes have become more saline, with the Broadwater approaching half the salinity of seawater.

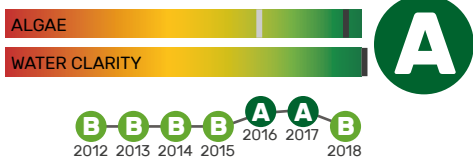
Estuary description

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 440 square kilometres. 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 Lakes



Myall Lake

Myall Lake score improved back to excellent

The grades for Myall Lake improved from last year's good condition to excellent this year. The condition Myall Lake is strongly influenced by runoff from the Myall River catchment. The continuing dry conditions meant that there was little runoff during the sampling times, resulting in clear waters and small amounts of algae. Only one out of 12 samples in Myall Lake exceeded trigger levels by a small amount. All samples were less than trigger levels for water clarity. The marked variability in condition, swinging from good to poor and back to excellent emphasises the strong response to catchment inflows and the need to continue to control nutrients from the catchment of the upper Myall River. Dry conditions also mean the lakes have become more saline with Myall Lake becoming slightly saline.

Estuary description

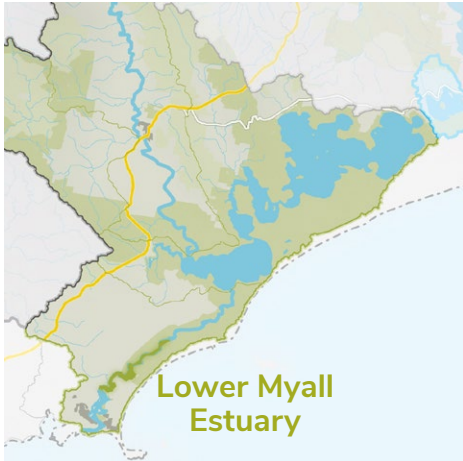
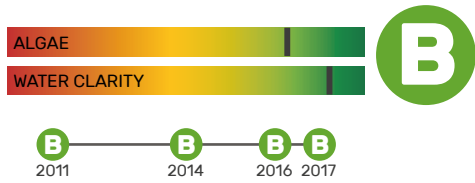
Myall Lake along with the Bombah Broadwater is part of the Myall Lakes system which is comprised of four linearly connected brackish to freshwater basins: Myall Lake, Two Mile Lake, Boolambayte Lake and the Bombah Broadwater.

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.

Myall Lakes



B

Lower Myall Estuary

Lower Myall remains in good ecological condition

The condition of the Lower Myall Estuary upstream of Tea Gardens was good. This area is usually strongly influenced by the condition of the outflow from the Bombah Broadwater, but when there is little runoff, the main control is due to waters moved by the tides. Salinities vary from half seawater on run-out tides to near seawater on incoming tides. Algal levels varied from moderate to good and exceeded triggers by a small amount in half of the samples. Water clarity was good, also exceeding triggers by a small amount in half of the samples.

Estuary description

The Lower Myall Estuary near Tea Gardens is the mouth of the Lower Myall River and is situated in an area of highly mobile sand features. The river discharges into the moderately sheltered waters of Port Stephens but the river entrance is exposed to swell from the south-east coming through the entrance of the Port. The Lower Myall Estuary receives water from the urban area of Tea Gardens and Hawks Nest and is strongly influenced by the waters of the Bombah Broadwater following rainfall.

Karuah River

Catchment description

The Karuah River Catchment is approximately 1460 square kilometres, largely comprised of grazing land, forest and woodland and is sparsely populated, the largest settlements being Karuah (pop.~1000), located at the mouth of the river, and Stroud (pop.~700), located in the centre of the catchment.

Land use in the Karuah River Catchment has undergone continuous change since European settlement beginning with land clearing for forestry and agriculture from the late 19th century. The landscape today is a mosaic of rural landuse, including forestry, grazing industries, poultry production, mining, aquaculture and rural residential areas.

Trends from past water quality monitoring shows periods of high sediment and nutrient loads within the Karuah River; whilst at the same time displaying a range of in-stream biological diversity. In 2011 the Karuah River estuary and Catchment was assessed as being in a moderate ecological condition, but with some significant threats to the system.

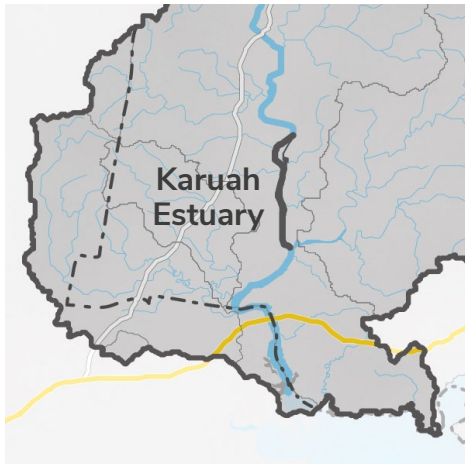
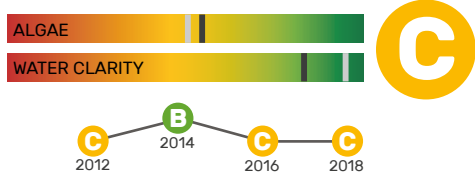


The Branch is a subcatchment of the wider Karuah River Catchment and is approximately 211 square kilometres. The Branch subcatchment is a mosaic of floodplain environments, with steep ridgelines traversing from the upper catchment through to the tidal zone of the river. The subcatchment is sparsely populated, without any settlements. Landuse is primarily grazing land with some forest and woodland in the upper catchment.

Figure 14: Karuah is the largest settlement within the Karuah River Catchment.



Karuah River Estuary



Karuah River Estuary

Karuah River Estuary continues to be impacted by high algal growth

The Karuah River Estuary continued to show signs of significantly impaired estuary health with much higher than desired algal growth. In the Karuah Estuary, every sample but one exceeded algae trigger values by a large to moderate amount. Water clarity in the Karuah Estuary was good with half to two-thirds of samples exceeding trigger values by only a small amount. As with last year, there was no seagrass in the Karuah River Estuary which is thought to be a consequence of past and present conditions.

Estuary description

The Karuah River Estuary is a priority oyster production area which has suffered periodic water quality issues associated with catchment runoff. The Karuah River Estuary discharges into the north western part of Port Stephens, and is the only significant source of sediment to this system.

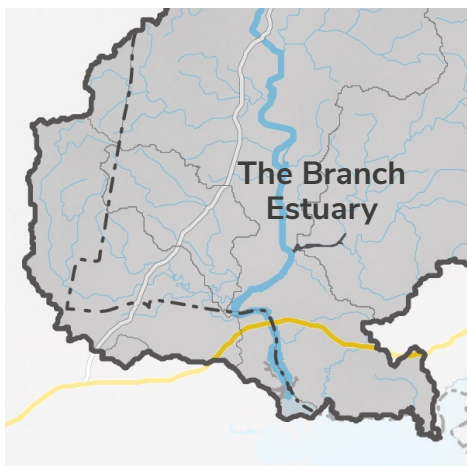
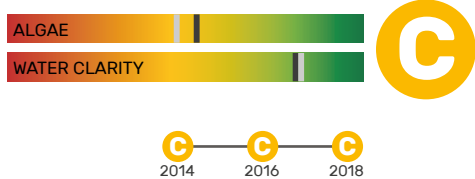
There are substantial areas of mangrove and saltmarsh habitats in the Karuah River Estuary, which provide food sources and nursery areas to fish, but only very small areas of seagrass (seagrass extent has decreased by almost 80% between 1985 and 2009). Low light availability, due to high turbidity is the most likely reason for the lack of seagrass in the Karuah River Estuary.

The extent of saltmarsh over this time has also reduced, while mangrove has increased. Similar to many estuaries in New South Wales it is suggested that mangrove assemblages have increased at the expense of saltmarsh.

The samples for this Report Card have been obtained from three sites within the estuary. They are:

- Above Allworth (1 site)
- The Karuah River Estuary upstream of the Karuah Bridge between Branch River junction and Allworth (1 site)
- The Branch River (1 site)

Karuah River



The Branch Estuary

The Branch Estuary remains in moderate condition

Like the main river The Branch Estuary continued to show signs of significantly impaired estuary health with much higher than desired algal growth. Water clarity was good in the Branch with two thirds of samples exceeding by a small amount. Excess nutrients from catchment runoff, clear water and low flows strongly influenced these grades.

Estuary description

The tidal zone of The Branch River extends to slightly south of the Branch Lane, and discharges into the wider Karuah Estuary and ultimately into the north western corner of Port Stephens Estuary. The estuary is bounded by substantial areas of mangrove and saltmarsh habitats. The Branch is used as a nursery for juvenile oyster production, whilst landuse within The Branch Estuary is largely grazing lands for beef production and rural lifestyle living.

Management Actions occurring across the Local Government Area



Land for Wildlife

Land for Wildlife is a voluntary program that encourages landholders to manage biodiversity and wildlife habitat on their properties, focusing on the value of bushland in maintaining healthy catchments and supporting agriculture.

In the MidCoast area there are currently over 60 properties participating in the program. With properties ranging from Bulliac and Upper Landsdowne in the Manning Catchment, all the way down to Limeburners Creek and Pindimar in the Myall, there is now some 2500 hectares of land being managed by landholders for the benefit of our environment.

In the MidCoast area Karuah Great Lakes Landcare and Manning Landcare have worked together with Council over many years to provide site visits and assessments for landholders as well as stage training and field days.



Figure 15: Land for Wildlife field day



Litter and Marine Debris

Marine Debris is one of the biggest environmental issues facing us today. It is the rubbish from our everyday lives that washes into our creeks, rivers and oceans creating unhealthy waterways.

Council are working in partnership with government agencies and the local community to reduce litter sources and remove established litter along our waterways.

Marine debris is a big issue and to achieve broad scale reduction in litter, the entire community need to be involved. Council are members of the Midcoast Plastic Pollution Reduction Project and are working with great organisations like Tangaroa Blue, Take 3, Australian Marine Debris Initiative, JR Richards and Sons, Local Land Services, Taree Indigenous Development and Employment and Friends of Browns Creek to address litter issues and help reduce them at the source. This group has identified current activities in the region and is constructing cohesive messaging and scoping out opportunities for collaboration in the future.

With the aim to inspire the youngest members of the community to reduce pollution, Council are also working with Take 3 to implement a number of education programs. These programs target primary school aged children as well as early childhood educators.

Council is also encouraging the community to keep the environment clean through the Picitup program, providing free anti-litter kits to any interested members of the community who would like to undertake their own cleanup. The program is being run in conjunction with Midwaste and is a simple but effective way of helping people clean up litter as well as track down where it comes from.



Figure 16: Community members participating in a litter cleanup in Browns Creek

Management Actions occurring across the Local Government area



Management of aquatic weeds

Aquatic weed management remains a focus for Council with a variety of high priority weeds including alligator weed and Senegal tea plant infestations in the Karuah and Manning catchments being monitored and managed where required under integrated weed management programs.

Council are strategically managing camphor laurel, a species that affects water quality through the toxicity in its leaves and outcompetes native species on riverbanks, throughout the region.



Sediment and erosion control

The construction and maintenance of roads, bridges and new development can result in the erosion of soil and sediment generation. Increased sediment runoff results in a decrease in water clarity reducing the light available for seagrass to grow. Seagrass is the basis of the estuarine food web and is very important habitat for fish and aquatic bugs. Excessive sediment directly impacts on the oyster, professional and recreational fishing industries by smothering the gills of fish and creating additional stressors in their environment reducing their ability to fight disease. Council works to reduce erosion and sediment reaching lakes and waterways, implementing erosion and sediment controls on all Council projects and developments in the area.

Council have developed an erosion and sediment control field guide that lays out the ways in which erosion and sediment should be controlled on all of Councils construction works and staff are trained in best practice erosion and sediment control practices. Developments within MidCoast Council must plan and manage all aspects of sediment while undertaking on-ground works. All sites less than 2 500m² are required to prepare and implement an Erosion and Sediment Control Plan while sites over this size must prepare a Soil and Water Management Plan.

Council has also undertaken a number of erosion control projects along gravel roadsides in an effort to reduce the amount of sediment entering our waterways. In 2018 Council undertook reconstructing works on a section of The Lakes Way through the village of Bungwahl. The work involved upgrading a 500 metre length of The Lakes Way with significant improvements to the road width, drainage and pavement condition.

A number of roads throughout the LGA have also been sealed helping to reduce sedimentation including in Pindimar, Bombah Point, Bungwahl, and Gloucester.



Applying water sensitive urban design to new development

When it rains stormwater flows into our waterways untreated off our urban landscape. Before the land was developed, rain would have soaked into the ground and nutrients like nitrogen that occurs naturally in rainfall would have been used up by the vegetation. Hard surfaces in urban areas including roofs, roads and pathways cause an increase in runoff fast tracking a variety of nutrients directly into our waterways picking up additional pollutants such as sediments, petrochemicals, faecal coliforms, and heavy metals along the way.

When nitrogen is in excess in our estuaries it fuels algal blooms. Too much algae reduces the amount of light reaching seagrass, limiting its growth. Seagrass is the basis of the estuary food web and is very important habitat for fish and aquatic bugs, it oxygenates the water. Compared to algae, seagrass is long lived and when algae decompose oxygen from the water body is consumed resulting in low oxygen conditions, impacting on the health of aquatic life. Sediment from the land smothers seagrass, clogs the gills of fish and aquatic bugs. When the condition of the aquatic environment is compromised its inhabitants become stressed and are more prone to disease causing issues such as red spot in fish. Our community value the waterways and they not only support our lifestyle but also a thriving fishing, oyster

Management Actions occurring across the Local Government area

growing and tourism. Council is focused on protecting waterways from the effects of urban development through the implementation of a water sensitive design policy that makes up part of the Development Control Plan (DCP). This policy requires all new developments to design and install water quality treatments such as raingardens and water tanks to help filter nutrients and sediment out of stormwater before it enters our waterways. In large developments like subdivisions, there is a target in the DCP to ensure that there are no new impacts on our waterways this is called a neutral or beneficial effect target. Since 2015/16, 26 large subdivisions have achieved the 'no new impact' target. In the 2018/19 financial year 4 large subdivisions across the MidCoast region and an additional 10 large developments such as commercial, industrial and multi dwellings have also been assessed.

Small scale, infill developments such as single dwellings are also included in the DCP providing further protection from nutrient and sediment input to our waterways, these controls are only applied to the Great Lakes region. Since 2015, 596 individual houses have been approved that were required to address water sensitive design. It is estimated that by reducing pollutant loads to the required standard on these lots through raingardens, swales and rainwater tanks we have prevented 147 kg of total nitrogen and 18 kg of total phosphorous from being washed into our waterways annually. In addition to the nutrient reductions, it is estimated that 9 tonnes of sediment has been intercepted by these water quality treatments on single dwellings each year.

These figures are considered to be conservative as additional nutrient and sediment removal will be achieved on the dual occupancies and other developments such as commercial and industrial development during this time frame.

Council have continued to refine the water sensitive design section of the DCP to ensure that developments are utilising best practice methodology and providing the best possible water quality outcomes. Improvements have included simplifying the water sensitive design chapter of the DCP and establishing a wider range of standard drawings for single dwellings, mapping the location of priority areas and pre-existing stormwater strategies, education materials and guidelines. As a result of these improvements customers have clear information on what water quality information needs to be prepared for development application. These improvements resulted in MidCoast Council receiving the National Stormwater Award for Policy or Education in 2018.

Figure 17: Raingarden installed in the Forster area



Management Actions - Manning Catchment



Manning Coastal Management Program – Manning Catchment and Estuary planning

The Manning River Catchment and Estuary is one of the greatest assets in the MidCoast region and is vital to the local economy providing social and cultural values that benefit the people that live, visit and work in the region. The ecological health of the Manning River Estuary is under pressure as a result of past and present land management practices. MidCoast Council is developing the Manning River Estuary Coastal Management Program (Manning River ECMP) to provide strategic direction for future management of the Manning. The Manning River ECMP will ultimately protect and improve the ecological health of the catchment and support the social, cultural and economic values of the region. It will take a whole-of-catchment approach while meeting the requirements of the NSW Coastal Management Act 2016. The NSW Government is assisting development of the Manning ECMP with grant funds under its Coastal Management Program.

The issues that the Manning River ECMP will focus on include:

- Agricultural and urban diffuse source runoff
- Degradation of riparian areas, existing native vegetation within the catchment and wetlands
- Floodplain drainage (acid runoff)
- Impacts of climate change on catchment and estuary health

The first stage of the program was finalised in January 2018 with completion of the Manning River Estuary Coastal Management Program Scoping Study (2018). This study included a preliminary spatial risk model and analysis of knowledge gaps. An engagement strategy was also completed to ensure effective stakeholder representation and involvement in plan development. Several ecological and social science-based studies are being undertaken in 2019 as part of Stage 2. These studies will help fill knowledge gaps and guide development of a catchment and estuary plan that will see effective and relevant actions implemented for improved environmental, social and economic benefits.

Ecological studies include refining the spatial risk model for the Manning River Estuary, developed in collaboration with Department of Planning Industry and Environment - Estuaries and Catchments Science Division (DPIE). The model is designed to provide an assessment tool to help identify strategic priorities for managing nutrient and sediment runoff within the catchment. As part of improving model accuracy, an intensive program of additional data collection in riparian assessments was undertaken throughout the catchment over 5 weeks, this data will be added to the model and is providing useful insights into key issues and actions for the plan.

One of the other knowledge gaps identified for the Manning was up-to-date and accurate mapping of coastal wetlands in the Manning catchment, including salt marsh and coastal forested wetlands. These communities are amongst the most sensitive and significant vegetation formations in the MidCoast Council (MCC) and other parts of the NSW coast, and provide important ecosystem services particularly in relation to water quality and carbon absorption. Despite their importance, coastal wetlands are under significant threat from multiple pressures including the impacts of climate change, and many are listed as Endangered Ecological Communities under NSW biodiversity conservation legislation. MidCoast Council have engaged a consultant to map and describe these wetlands, to better understand their distribution and condition and to help model the anticipated effects of sea level rise and develop strategies to avoid, mitigate or offset predicted impacts. Results will be available at the end of September 2019 and will be incorporated into State planning policies and climate change risk modelling.

Other projects in Stage 2 include social science research evaluating agricultural land management practices that impact on water quality. A consultant has been engaged to interview 24 primary producers and facilitate two focus groups to help the project team understand the drivers and challenges for beef

Management Actions - Manning Catchment

and dairy producers when it comes to managing land and water. The survey results will inform catchment management and guide future support to help landholders protect water quality.

A community engagement program is underway for this project and is inviting residents of the Manning Valley to identify and map the values of the catchment. What do they love, what's important and what are their hopes for the river in the future? Spatial mapping of values will help identify the objectives for the plan.

While development of the Manning River ECMP is underway, MidCoast Council continues to implement an established program of works to protect ecosystem health. These actions will be integrated into the plan as it develops.



Rehabilitation of Acid Sulfate Soils

Acid sulfate soils are natural sediments that contain iron sulfides. When disturbed or exposed to air these soils can release acid and other heavy metals, which can have severely damaging effects on aquatic ecosystems. Council continues to address the remediation of a State recognised acid sulfate soil (ASS) hotspot through the staged implementation of the Big Swamp project. The Big Swamp is a 2000 hectare coastal floodplain at Coralville which has been extensively cleared and drained for agriculture. This has resulted in the generation and discharge of ASS pollution into the Manning River Estuary, which has adverse impacts on water quality, aquatic ecology, oyster production and commercial and recreational fishing.

With funding provided through the NSW Estuary Management Program and Council's Environmental Levy, Council has recently purchased an additional 170 hectares of ASS affected land, building on the 700 hectares of land already acquired and remediated through the project to date. Remediation activities have included extensive drain modification works to reinstate the natural hydrology of the landscape and introduce tidal flows to reduce the amount of acid runoff entering the River. As a result of the works, both saltwater and freshwater wetlands are now re-establishing at the site and improvements in water quality are already evident.

The newly acquired land is also high in biodiversity value with a recent vegetation survey discovering a significant population of the endangered plant Noah's False Chickweed growing on the site.

The acquisition of this land complements work undertaken at Cattai Wetlands, where an additional 500 hectares of land have been remediated and has also been instrumental in securing into public ownership a regional wildlife corridor which links habitat within the adjoining Crowdy Bay National Park to the forests of the Lansdowne escarpment.



Figure 18: Black-necked stork at Cattai Wetlands

Management Actions - Manning Catchment



Bank stabilisation

With the assistance of NSW Department of Primary Industries Habitat Action Grants, MidCoast Council has been working closely with local landholders to solve riverbank erosion problems across the Manning Catchment and to improve habitat conditions for native fish. 2018/2019 saw the construction of 1.3 km of rock fillets to protect our riverbanks. Rock fillets create mini lagoons that provide a sheltering environment for aquatic vegetation such as mangroves and saltmarsh to establish. The immediate reduction of sedimentation performed by rock fillets also create an environment suitable for the establishment of seagrass communities. Mangroves, saltmarsh and seagrass vegetation are of paramount importance in providing habitat structure and ecological requirements for fish stocks in our estuary. Hand in hand with riparian re-vegetation, landholders have also fenced off over 2 km of river bank and planted over 2000 native trees. Once established the root system of these trees will help bind the bank together creating further resilience against erosion and the insects that drop off these trees into the river will become an additional tasty resource for our fish. The Habitat Action Grants are funded from the Recreational Fishing Trusts with the purpose of onground actions to improve fish habitat for recreational fishing in NSW. Currently, 350 m of actively eroding riverbank is being protected at Dumaresq Island with 420 m of stock exclusion fencing and the planting of 500 native trees. This complements the 2 kilometres of stabilisation and restoration works Council has already undertaken in the Manning River Estuary over the past 3 years. Ongoing bush regeneration and maintenance will ensure the benefits of these works are sustained well into the future.



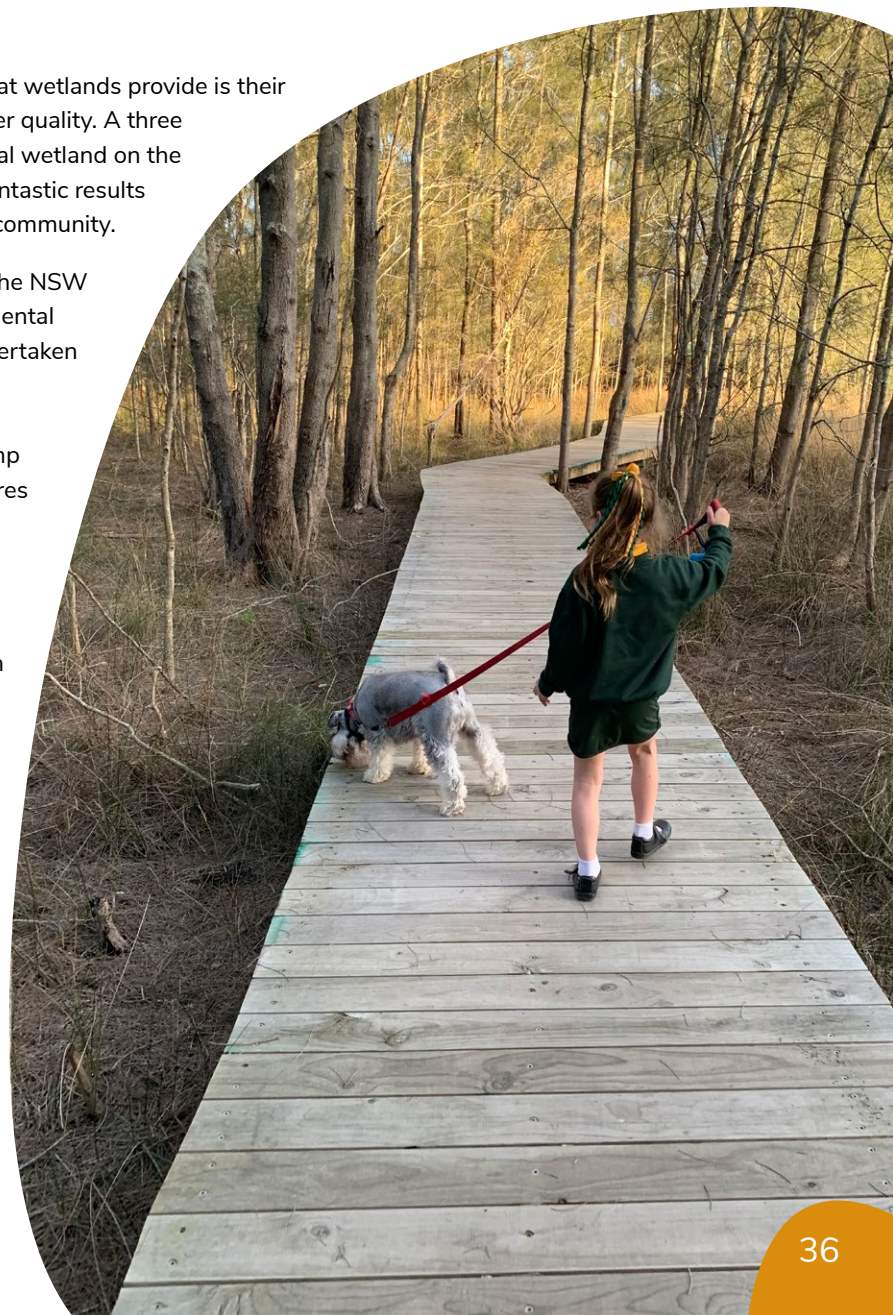
Wetland Restoration

One of the most important benefits that wetlands provide is their capacity to maintain and improve water quality. A three year project to restore an endangered coastal wetland on the Dawson River is nearing completion with fantastic results achieved for both the environment and the community.

With funding assistance provided through the NSW Environmental Trust and Council's Environmental Special Rate, significant work has been undertaken to remove invasive weeds and encourage the regeneration of threatened vegetation communities including Saltmarsh and Swamp Oak Forest. Primary weeding on 13.7 hectares of the site removed species such as lantana, asparagus fern, camphor laurel, creeping ruellia, morning glory, cassia, balloon vine, prickly pear, madeira vine, moth vine and tecoma. To prevent edge effects and erosion 1217 native tubestock were planted in weeded areas.

To promote the ecological significance of the area and the importance of wetlands, this project also involved the construction of a 430m raised boardwalk through the wetland down to the Dawson River, and the installation of a series of interpretive signs.

Figure 19: Community members enjoying the raised boardwalk at Dawson River



Management Actions - Manning Catchment



Lowland Rainforest Regeneration

Lowland Rainforest is an endangered ecological community with just 1% of this rainforest type remaining in NSW. In the MidCoast area we are lucky to have a number of different reserves where Lowland Rainforest occurs and Council recognises it is important to regenerate these areas to conserve this rare ecosystem.

With funding from the NSW Environmental Trust and Council's environmental levy, Council have spent the last two years restoring three important riverside reserves: Wingham Brush, Andrews Reserve and Flanagan's Creek Spit.

Wingham Brush contains one of the largest remaining remnants of Lowland Rainforest and it is hoped the regeneration of the adjoining reserve will help to expand the rainforest and provide additional habitat for the grey-headed flying fox, which is also endangered in NSW.

Restoration work that has been undertaken in the Wingham foreshore area has included the control of 8 hectares of invasive exotic weed species that have been severely impacting upon the resident native vegetation and the restoration works that have previously occurred on site. Site vandalism, flooding and rampant weed growth have created a work site that is very difficult to access, with impenetrable curtains of vine covering nearly all established woody vegetation on site. So far, 934 supertubes, 475 tubestock and 30 translocations have been planted to reduce competition from fast growing weed species and to close down canopy gaps.

Andrews Reserve in Taree has also benefitted from regeneration works and 515 hours of hand weeding and spraying has gone into the first primary breakdown of weeds along the riparian stretch on the 2 hectare site.

The final site is known as Flanagan's Creek Spit and is located within the Manning Waters Reserve, Taree West. This site has seen weeding across 6 hectares as well as planting of 794 tubestock to connect isolated trees into corridors and islands of vegetation to reduce weed edge effects. Other methods of re-establishing vegetation have been trialled including direct seeding of treated pioneer species such as Red Ash. These methods were implemented to reduce the amount of opportunistic grazing of the planted trees by the local resident hare, as well as other methods of encouraging the hare to move elsewhere.

These three reserves and a number of others on the Manning River floodplain form part of the broader Stepping Stone Project, a long-term initiative of Council that aims to create a linkage of rainforest remnants on the Manning in partnership with local environmental groups such as Taree Landcare.

One of the major threats to these rainforests are invasive weeds, particularly riparian vine weeds such as madeira vine, cats claw creeper and balloon vine, which smother and outcompete native vegetation. The introduction of an intensive weed control program and the replanting of a variety of rainforest species will contribute to the recovery of these important ecosystems.

Figure 20: Balloon vine prior to treatment at Wingham Brush



Figure 21: Balloon vine following treatment at Wingham Brush



Management Actions - Manning Catchment



Management of aquatic weeds

Senegal tea plant is a priority aquatic weed species and its management remains a focus in the Manning Catchment.

Introduced from South America it grows and spreads very quickly, it can rapidly cover marshy sand banks and water bodies with a floating mat, excluding other plants and the animals. Where Senegal Tea has invaded the Manning River, it is capable of smothering the sand banks which are nesting sites for the endangered Manning River turtle. Water quality may decline if large amounts of Senegal tea plants die off and rot under water, resulting in low oxygen conditions with the potential to impact on a range of fish and aquatic bugs.

Surveys conducted across the MidCoast region have revealed infestations of this high priority weed species scattered along approximately 80km of the Manning River (160km stream banks) from Gloucester to Wingham. Council has continued surveillance of the species and Weeds Officers are assisting in identification and removal with the long term goal of eradication.

Given the species is present in limited distribution and abundance elimination of the biosecurity risk posed by this weed is a reasonably practical objective.

Kidney leaf mud plantain AKA *Heteranthera reniformis* is a weed of limited distribution in the MidCoast area currently only found in the Gloucester area. Kidney leaf is currently under an intensive chemical management program with the long-term goal of eradication.



Figure 22: A range of methods are utilised while undertaking weed management works in the Manning



Protection and rehabilitation of key habitats

Wetland protection and restoration plays an important role in the maintenance and improvement of water quality and aquatic health. In 2018, Council was successful in securing a 40ha parcel of private rural land at Brimbin into public ownership. This property fronts the ecologically significant Dawson River conserving a tract of riparian vegetation which helps to maintain the water quality within the Dawson River and the Manning River Estuary. It also reduces exposure of an area of potential acid sulfate soils, which if disturbed, can have harmful impacts on water quality and aquatic ecology. Good water quality is also essential to maintaining the productivity of a number of industries within the Manning River Estuary including oyster farming, commercial fishing and tourism.

The Brimbin property also contributes to the protection of biodiversity forming part of a vast ecological corridor which is recognised by ecologists as a 'Biodiversity Hotspot'. The property contains a diverse range of vegetation types and provides potential habitat for a number of threatened species including Australian owllet-nightjar, squirrel gliders, brush-tailed phascogales, koalas, glossy-black cockatoos and powerful owls. It also supports one of the largest populations of the endangered narrow-leaved red gum (*Eucalyptus seeana*), a favoured koala food tree.

Obtaining the support of Council to purchase the property at Brimbin was based on one of the fundamental principles of best-practice environmental management, which is to "protect first and restore and rehabilitate second". This approach is based on the evidence that it is almost always more cost effective to protect rivers in good condition, rather than undertaking long term, expensive and often complex restoration and rehabilitation activities. The allocation of funding in the past has been heavily focussed on rivers where degradation was visible, rather than those in good condition, however much greater emphasis is now placed on the lower cost option of preventing the deterioration of rivers and catchments.



Figure 23: Australian owllet-nightjar at Brimbin

Management Actions - Manning Catchment



Sharing our Shore

The beaches at Manning Point, Harrington and Farquhar Inlet are stunning natural areas which we all enjoy. These beaches are also dynamic and environmentally sensitive, supporting a range of migratory and threatened bird species, ecosystems and culturally significant sites. Some of the birds travel incredible journeys as far away as Russia, Japan and Canada to feed and or breed such as eastern curlew, grey plovers and little terns. Farquhar Inlet is the only known location in Australia for the Aleutian tern which makes the long flight from Alaska each year – sightings of this species have attracted bird watching enthusiasts from afar and provided significant economic boosts to the local economy.

Shorelines, beaches and inlets in the region support two endangered ecological communities. Littoral rainforest fringe the landward side of dunes provide habitats and shelter for a range of fauna and flora species, including a high number of native orchids. Coastal wetlands (including saltmarsh) provide rich habitat, abundant food supply and important ecosystem services to the Manning Estuary. The mudflats, mangrove and estuary mouth provide rich and important fish, crab and prawn nursery areas. Coastal processes such as wind and wave action make our shorelines and landforms dynamic and ever-changing.

Almost 20 years ago, work began as part of a multi-agency response to protect the threatened shorebirds and the values of this special area. In 2000 a monitoring program for little terns, beach stone curlews and pied oystercatchers, and a targeted fox control program was established at Farquhar and Manning Point. To help protect the significant environmental values, in 2009 4WD management and dog-exclusion zones were implemented. Permanent and temporary fencing is installed each breeding season to reduce disturbance and protect nesting birds, eggs and chicks from trampling and being crushed by 4WDs away from high tide areas. Temporary fencing is realigned each season according to nest locations that may vary with geomorphology or dune changes. Council is continuing to enforce the 4WD exclusion zones and other aspects of the Vehicles on Beaches Policy to protect these important places.

Figure 25: Aleutian terns at Old Bar



Figure 24: Stakeholders working together to protect shorebirds at Farquhar



Management Actions - Manning Catchment



Protecting our waterways from Litter

Litter and marine debris are one of the biggest environmental issues facing us today. It is the rubbish from our everyday lives that washes into our creeks, rivers and oceans creating unhealthy waterways.

Council are working in partnership with government agencies and the local community to reduce litter sources and remove established litter along our waterways. In the Taree area Council have been working with Friends of Browns Creek, Taree Indigenous Development and Employment (TIDE), Tangaroa Blue and Hunter Local Land Services and have been successful in removing over 980 kgs of material from within the Catchment.

Council has also been working to combat the issue in the Taree CBD, which is a major litter source, and has installed a Stormwater Quality Improvement Device (SQID) or litter trap on a key stormwater outlet located within the grounds of the Taree High School Agricultural Farm. The litter trap will result in less pollution entering Browns Creek and the Manning River and help to improve water quality.

The project was funded through Council's Environmental Special Rate and the NSW Estuary Management Program. Taree High School have also assisted in the project planting a variety of native riparian species from Council's nursery along the sides of the drain to help stabilise the soil.

The new trap complements established Stormwater Quality Improvement Devices located throughout the Manning Catchment including Gross Pollutant Traps (20), side entry litter baskets (97) and constructed wetlands (2).

Management Actions - Khappinghat Estuary

Khappinghat Estuary is an intermittently open coastal estuary located near the village of Wallabi Point. The Estuary itself is surrounded by National Park and high conservation value terrestrial habitat as well as littoral rainforest in the lower catchment. The majority of the land surrounding Khappinghat Estuary is managed by the NSW National Parks and Wildlife Service. There are also a number of private land holdings towards the upper extent of the catchment. The intermittent lagoon at the mouth of the estuary is a popular location used for recreational fishing, swimming and boating.

While no management actions were undertaken by Council in the Khappinghat Estuary in 2018/19 Council is currently in the planning phase of a bush regeneration project working with NSW National Parks and Wildlife Service and the Taree Indigenous Development and Employment (TIDE) group.

Figure 26: Khappinghat Estuary



Management Actions - Wallis Lake



Bank stabilisation

Erosion is a significant environmental issue affecting the health and stability of our waterways. The Wallamba River Estuary is exposed to severe bank erosion in many areas due to past vegetation clearance, ongoing cattle grazing and wash from boating activities. Sediments from this erosion reduce water clarity in Wallis Lake impacting on its ecological health. Excessive sediments directly impact on the oyster, professional and recreational fishing industries by smothering the gills of fish and creating additional stressors in their environment reducing their ability to fight disease. Reduced water clarity limits the depth at which seagrass will grow, seagrass is the basis of the estuary food web and is very important habitat for fish and aquatic bugs. By reducing sediment loads this project will enhance aquatic habitat for fish and crustaceans.

On-ground works commenced in July 2018 to address riverbank erosion and enhance riparian vegetation in the lower Wallamba River at Darawank with the construction of 840 metres of rock protection along a 2.15 kilometre stretch of degraded riverbank. The riverbanks had previously been subject to long term, unrestricted cattle grazing which had resulted in substantial damage to mangroves and saltmarsh in an important area for oyster production, recreational and commercial fishing. Grazing and the impacts of boat wash had seen erosion rates of up to 1m per year resulting in high levels of sediments and nutrients entering the waterway. Mangroves provide a highly effective buffer against shoreline erosion and the construction of rock fillets will allow for the natural recruitment of mangroves that will ensure the banks are sufficiently stabilised.

Stock exclusion fencing has been installed along the riverbank which will help to facilitate the recovery of mangrove and saltmarsh communities that are important nursery grounds for juvenile fish and crustaceans. Revegetation of the riparian zone has also been completed with 2,000 native tube-stock planted. In the long term this will help to stabilise the banks, improve water quality through increased buffering and filtering of runoff and provide habitat for ground and tree dwelling mammals, while also enhancing roosting and feeding habitat for birds of prey including the threatened white-bellied sea-eagle and eastern osprey.

The works have been made possible with funds from the Recreational Fishing Trusts Habitat Action Grants and MidCoast Council's Environmental Special Rate.

This project compliments a number of projects that have come together over the years to stabilise 9.8 kilometres of the Wallamba River. These projects have been funded through a combination of Councils Environmental Special Rate, Environmental Trust grants and Recreational Fishing Trust habitat action grants.

Figure 27: Rock fillet work along the Wallamba River



Management Actions - Wallis Lake



Lower Wallamba River Wetland and Foreshore Restoration

Invasion of native bushland by weed species can have a serious effect on the environment, impacting on biodiversity as well as reducing nutrients available for plants.

Works to restore wetland and foreshore habitat in the Lower Wallamba River have delivered positive benefits for water quality and biodiversity with a three year project funded by the NSW Government through its Environmental Trust completed at the end of August 2019. The final stages of action have involved follow-up bush regeneration works targeting priority weeds across 165 hectares of sensitive foreshore lands fronting the Wallamba River at Darawank/ Minimbah. Final monitoring as part of the project has shown a high level of native regeneration enabled through the targeted removal of invasive weeds.

Pressures on native wildlife has also been reduced through a month long fox control program throughout the project area and surrounding lands including the Tuncurry Waste Management Facility, Halliday's Point Wastewater Treatment Plant and Council lands at Minimbah Road and Aerodrome Road during July and early August 2019. Monitoring of nest boxes in August highlighted a high level of usage by native fauna, especially occupation by sugar gliders, brush-tailed and ring-tailed possums, and an exciting discovery in the final year of the project was the presence of a NSW listed vulnerable species, the brush-tailed phascogale in nest boxes on Council land at Aerodrome Road.



Figure 28: brush-tailed phascogale in a nesting box



Installation of Oyster Reefs

Since 2015, Local Land Services (LLS) and MidCoast Council have been working with the oyster and fishing industries to understand the changing nature of Wallis Lake and develop practical adaptation responses. LLS has now delivered the first year of its Climate Ready Aquaculture project funded by the Australian Government's National Landcare program. Over the next four years LLS will help oyster farmers plan their adaptation to climate change and then implement in-water changes through small grants. Projects in Wallis Lake, Manning River and Port Stephens estuaries to date have reduced the use of tar-treated timber, reduced waste generation and helped protect seagrass habitats.

Uniquely, the Climate Ready Aquaculture project is helping the oyster industry and fishing industries co-adapt by monitoring how changes to infrastructure affects fish habitat values and by creating new habitat. Both industries have been working with LLS, MidCoast Council and Taree Indigenous Development and Employment (TIDE) to construct an oyster reef in the Wallamba River to protect the riverbank on Gereeba Island. Oyster reefs have been decimated across the world by destructive harvesting practices, poor water quality, diseases and pests and there are now many projects across the country and the world restoring these ecosystems.

It was acknowledged by Council that bank protection work at Gereeba Island using coir logs and mangrove planting was only partially successful with most mangroves surviving but the coir logs disintegrating or being washed away. To ensure the young mangroves weren't washed away, the project trialled new ways of providing wave protection involving the placement of waste shell from oyster production along the bank. Live oysters harvested from oyster leases were also added to encourage and possibly accelerate the creation of a living structure. Slowing erosion of the riverbank will reduce the amount of sediment entering the Wallamba River and improve water quality. Oyster reefs also provide good habitat for a range of fish and other marine life, including species targeted by recreational and commercial fishers such as bream and mullet.

Management Actions - Wallis Lake

Site monitoring is being done by LLS, TIDE and the University of Newcastle and early results are promising with live oysters surviving and growing and the structure continuing to protect the young mangroves and the riverbank. Oysters are filter feeders and as their filtration helps improve water clarity it is hoped that the oysters at Gereeba Island will survive and thrive alongside mangroves with both providing habitat for fish and invertebrates. MidCoast Council and LLS are now scoping out additional sites where these methods could be applied successfully and will be working with the University of the Sunshine Coast to map existing oyster reefs and better understand how fish utilise different estuarine habitats and move between them.

Figure 29: Erosion on the riverbank prior to installation of the Oyster Reef



Figure 30: Erosion on the riverbank following installation of the Oyster Reef



Wallis Lake Estuary processes and seafood production

Drops in oyster production and other fisheries have been observed in Wallis Lake and nearby NSW estuaries over the last 10 years. To understand the factors driving drops in production and to guide investment in adapting their farming practices to improve production into the future, a partnership led by Local Land Services involving MidCoast Council, oyster farmers, professional fishers and research organisations has been developed.

To build a better understanding of how Estuary processes are impacting on seafood production this partnership has funded three discrete information gathering and research projects. These projects and their progress are summarised below:

1. Developing an understanding of Estuary processes by collecting information at a finer scale on temperature, salinity and tidal movements using data loggers at key locations. This project will provide reference information that can assist with future research. Data collection is now complete and is currently being collated for use in future projects.
2. Understanding how Wallis Lake has changed through the collection of oral histories from oyster farmers and professional fishers. This information will be used to target research and other programs to assist oyster and fishing industries to adapt. Oral histories from eight local fishers and oyster farmers have been collected and reported, these stories will be available in local libraries in the near future.
3. Establishing if oyster farms benefit estuarine fisheries in Wallis Lake. This project involves determining the overall importance of oyster farms to key fish and invertebrate species, exploring the effect of oyster farm removal and construction on fish and invertebrates and assessing the role of farm infrastructure as habitat. The University of Newcastle has been appointed to undertake this project and data collection has commenced.

Management Actions - Wallis Lake



Control of feral species along the Wallamba River Estuary

Feral species such as foxes compete with native species for food and resources. Native wildlife in the Lower Wallamba area have benefitted from multiple fox control programs run in 2018/19. The program targeted areas in Darawank and North Tuncurry as well as the Tuncurry Waste Management Facility, Halliday's Point Wastewater Treatment Plant and Council lands at the southern end of Minimbah Road and also Aerodrome Road. Council's nesting box program continues to show results with monitoring undertaken during August identifying that consistent usage rates by hollow dwelling native animals including sugar gliders and both brush-tailed and ring-tailed possums. An exciting find was that of the NSW listed vulnerable species, the brush-tailed phascogale.



Figure 31: Remote cameras assist in feral species control programs



Backyard Bushcare - Pacific Palms

Weeds are a serious threat to the Australian environment. They reduce the biodiversity and balance of ecosystems, displace native species, create soil disturbance and erosion issues affecting water quality and once established become difficult to remove. About 65% of the weeds that are currently invading bushland areas have escaped from urban gardens.

With assistance from the NSW government MidCoast Council is running a three year program in Pacific Palms which encourages the local community to work together to remove weeds from their own backyards and help protect the surrounding natural bushland.

The initiative commenced in December 2017 with 999 properties inspected in Blueys, Boomerang and Elizabeth Beaches as well as Charlotte Bay. Of the properties inspected 237 were found to be weed free. The remainder of the properties had a variety of different species present with seven main ones topping the list including Bitou Bush, Senna, Indian Hawthorn, Umbrella Tree, Morning Glory, Viburnum and Asparagus.

Asparagus was the most common species found on 43% of properties and as such was chosen as a target species for the project, along with Bitou Bush. These species were chosen as they do not have a long lived seed bank meaning that when mature plants are removed reinfestation is unlikely to occur unless the seed is transported in from other areas.

In order to involve the community in the project the results of the inspections and the on-going targets of the project were presented at a weed, wine and dine event with 50 community members attending.

The project has continued through 2018-19 with bi-monthly emails to residents containing hints and tips on removing weeds from their gardens and creating bushland friendly spaces.

Figure 32: Community members participating in a weeding techniques workshop at Pacific Palms



Management Actions - Wallis Lake

A number of workshops and attendance at community events have also been undertaken to assist with building the capacity of residents to undertake works on their properties. A tour of the Pacific Palms Wetlands was undertaken in November 2018 in order to demonstrate the work being undertaken by local bush regeneration groups and the importance of removing weeds from private property in order to protect public lands.

Community members were also invited to attend a number of weeding workshops with local experts to learn how to appropriately remove weeds from their backyards.

The Backyard Bushcare program will continue with education, community involvement and ongoing positive environmental outcomes until 2020.



Protecting our Waterways from litter

Litter and marine debris are one of the biggest environmental issues facing us today. It is the rubbish from our everyday lives that washes into our creeks, rivers and oceans creating unhealthy waterways.

Council are working in partnership with government agencies and the local community to reduce litter sources and remove established litter along our waterways. In the Forster area over the past three years there has been a lot of work undertaken in Penenton Creek in where over a number of working days over 4700kg of material has been removed, preventing it from reaching Wallis Lake.

Council is also currently in the process of auditing all of the Stormwater Quality Improvement Devices around the Wallis Lake area. By undertaking an audit of this nature Council can ensure that all the devices are working to their maximum capacity and protecting the lake from litter.



Incorporating local water quality issues into the curriculum

In 2012-2013 Council worked 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. This work has continued with Great Lakes College and each year Council assist the school to run a field day with Year 10 Geography students.

As a result of these field days over 480 students have learnt about Catchment management, threats to water quality / estuary health and actions that can be taken to reduce human impacts on water quality. Class room theory lessons are combined with a specially-designed field day which includes demonstrations of the catchment trailer, dip-netting for macroinvertebrates and undertaking water quality monitoring in Pipers Creek.

Great Lakes College have begun water quality monitoring using Waterwatch kits at their school and have partnered with Council to construct a rain garden on-campus to improve stormwater quality. These initiatives are excellent practical demonstrations of the actions that can be taken to improve and monitor water quality in urban catchments.

In 2019, 60 students from Holy Name Primary School also participated in multiple education days to learn about catchments, threats to water quality and actions that can be undertaken to help protect Wallis Lake. They also participated in a litter cleanup event along Wallis Lake foreshore collecting more than 20kg worth of debris.

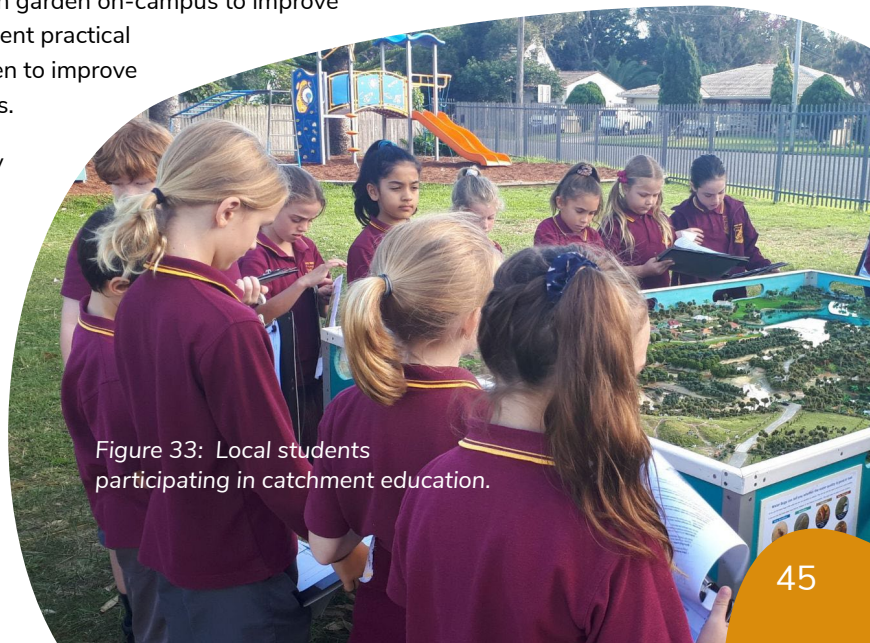


Figure 33: Local students participating in catchment education.

Management Actions - Wallis Lake

Management of aquatic weeds

Amazon Frogbit is a floating freshwater plant from Central and South America, introduced into Australia as a decoration for fish ponds, aquariums and water features. It can rapidly invade and smother waterways and is a serious biosecurity threat.

The infestations discovered at Green Point near Forster in May 2017 have received three treatments to date. They are monitored on a bimestrial basis (every two months) with their current status being declared as Frogbit free.



Management of weeds

Council have been working on a major project with its partners to address Honey locust (*Gleditsia triacanthos*), a weed species introduced into Australia from North America. It is a serious problem along many river systems where it grows quickly and spreads incredibly efficiently thanks to its sweet seed pods which cattle love to eat.

The species is a priority for MidCoast Council due to its limited distribution along the Wallamba River, where projects to remove plants from along the riverbank have been underway since 2006. A co-operative program was initiated between Council, Karuah Great Lakes Landcare, Taree Indigenous Development and Employment (TIDE) and local landholders to continue efforts to eradicate the species along the river.

In 2019 works were again undertaken by TIDE rangers on 32 individual properties along the river. Using multiple control techniques and an integrated approach the rangers started at upstream sites and worked their way along the bank treating all existing honey locust trees. The rangers worked through the summer undertaking 295 man hours treating 21 km of riverbank.

Glenn Jonas from TIDE who led the ranger team was impressed with how well the project went and how quickly the trees responded to treatment. "This was a great project to work on and it's so satisfying knowing we've had such a positive effect. Almost immediately we saw the death of those trees which had been treated and its fantastic knowing the teams hard work has helped to get rid of such a terrible pest species."

Works have now been completed however monitoring of this species will continue and further treatments will be undertaken if necessary.

The project is an example of how important collaboration and partnerships are and what can be achieved when we work together. It wouldn't have been the success that it was without the assistance of the 32 landholders who allowed rangers access to their properties, Karuah Great Lakes Landcare who supported with materials and community links and the TIDE rangers who undertook the on-ground works.

In 2019 there has been a focus on addressing weeds in Penenton Creek. Weed tree management through the creek area has been undertaken and has included the removal of several large camphor laurels, cocos palms and Canary Island date palm in the park, creek area and community garden.



Figure 34: TIDE ranger undertaking eradication works

Management Actions - Wallis Lake



Stormwater quality improvement

Sediments in our Estuary reduce the amount of light available for seagrass to grow and excess nutrients fuel algal blooms leading to habitat loss which can impact on fish and aquatic bug populations. The health of Wallis Lake has received a recent boost with the newly constructed Arlington Wetlands designed to remove sediment and filter nutrients from urban runoff prior to discharge into the Lake. Stormwater runoff from urban areas is one of the major impacts threatening our waterways.

The wetland receives stormwater inflow from 7.1 hectares of the surrounding urban area that previously drained untreated into Pipers Bay. Pipers Bay has been identified in the Waterway and Catchment Report Card as an area for water quality improvement for a number of years.

Since its installation in 2017 the wetland vegetation has begun to establish and water quality treatment will continue to increase, enhancing the quality of water flowing out of the wetland into Wallis Lake. The constructed wetland, funded through the NSW Government's Estuary Management Program and Council's Stormwater Levy.

This project compliments the other wetlands (8), raingardens (11) and gross pollutant traps (2) that have been constructed on public land in the Wallis Lake Catchment.

Figure 35: Stormwater quality improvement- Arlington Wetlands



Management Actions - Smiths Lake



Community conversations, Smiths Lake

Smiths Lake is an Intermittently Closed and Open Lake or Lagoon (ICOLL). ICOLLs naturally open to the ocean in response to water levels in the Lake, and they close as a result of sand movement from waves, tides and wind. They are significantly different from bays, harbours or inlets which are permanently open to the sea.

The Lake is currently closed to the ocean and climatic conditions including high temperatures, below average rainfall and continual strong north easterly winds over the 2018/19 summer resulted in declining water levels. The unprecedented low water levels currently seen in Smiths Lake are a natural phenomenon and there are no practical management actions that can be undertaken to return water to the Lake.

The low water levels have changed the ways in which community members and visitors to the area interact with the lake. In order to address some of the questions that have arisen a community drop in session was held on the foreshore of Smiths Lake in March 2019.

The event was an initiative of the community members on the Wallis and Smiths Lake Estuary and Coastal Committee and involved staff from MidCoast Council, DPI - Marine Parks and Oceanwatch Australia. The objective of the event was to raise awareness of how Smiths Lake is managed and also to highlight the impacts of illegal driving on the lake.

The event was highly successful with over 100 residents and visitors attending. The event allowed for a number of valuable conversations with community members and highlighted the need for everyone to play a role in protecting the Lake.

A co-ordinated compliance campaign was undertaken by Council and Marine Parks over the Easter school holidays to help combat the issues of driving on the Lake. Driving on the lake bed causes damage to protected marine vegetation, crustaceans and disturbs wading birds. Signs were erected to advise the public that driving on the lake is illegal and fines are issued by MidCoast Council and Marine Parks for this activity.

Improved communication along with the compliance activities had a great result with a marked reduction in the number of people driving on the lake bed.

Figure 36: Community members at the Smiths Lake drop in session



Management Actions - Smiths Lake



Management of weeds

Priority weeds under management in the Smiths Lake Catchment include bitou bush and camphor laurel.

Bitou is currently managed using a variety of integrated pest management disciplines depending on the weeds distribution and density. Various biological controls for bitou bush are established and widespread providing long term ecosystem functions, while individual areas are under other forms of management by Council staff, bush regeneration contractors and volunteer groups.

Camphor laurel is in limited distribution in the Smiths Lake catchment with all known trees being managed. If you are aware of camphor laurel trees in the Smiths Lake Catchment please notify Council.



Figure 37: Bitou bush is a focus of the Smiths Lake weed mangement program



Incorporating local water quality issues into the curriculum

Staff from MidCoast Council were involved in the Great Lakes College Tuncurry Campus Field Day at Smiths Lake. Approximately 50 Year 10 Marine Studies students were in attendance at a session that covered the management of Smiths Lake, the management plan and role of the Wallis and Smiths Lake Coast and Estuary committee, hydrological processes (catchment runoff, lake opening/closing), ecological importance and the measures undertaken in the area to mitigate threats to the lake.



Community engagement in Smiths Lake

To generate interest within the community and promote the work of landcare & volunteers, a native vs weed identification walk was held at Smiths Lake, from Frothy Coffee to Eagle Nest Parade and back. Thirty eight interested community members enjoyed a stroll along the foreshore learnt more about native plants and weeds (and how to treat the weeds), with a few signing up to the local landcare group to assist in the war on weeds.

Figure 38: Smiths Lake



Management Actions - Myall Lakes



Wetland protection and rehabilitation

Wetland protection and restoration plays an important role 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 366 hectare area is located on the Myall River Floodplain above the Myall Lakes Ramsar site. It was acquired by Council with support from the New South Wales Estuary Grants and the Hunter Local Land Services. 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 actively restored so that ecosystem services functions are improved. Council has benefitted from the funding support of the Commonwealth Biodiversity Fund, New South Wales Environmental Trust and New South Wales Estuary Grants programs and is revegetating previously cleared areas of the land, controlling weeds and feral animals and excluding stock.

In May 2019, council in partnership with Kleinfelder bushfire consultants commenced a low intensity ecological burn at Bulahdelah Plain Wetland. Ecological burning is an essential management tool designed to promote regeneration of endemic plant communities which in turn provides habitat for native animals.

The Bulahdelah Plain wetland is an important ecological asset which is home to a diverse array of native fauna and flora. Threatened species including the long-nosed potoroo, new-holland mouse, squirrel glider and spotted-tailed quoll have all been found on the site. Many threatened birds have also been recorded including the black-necked stork, white-bellied sea-eagle, spotted harrier, little lorikeet and varied sitella. The grey-headed flying-fox and wallum froglet are also known residents.

To protect and enhance habitat for these species and other native fauna, Council initiated the ecological burn for over 20-hectares of conservation lands at the wetland. The burn was designed and undertaken for a variety of reasons including managing the land to deliver habitat variability and successional/seral staging as well as to provide significant fuel management strategically across the Wetlands. This assists in mitigating potential for a single wild fire event to adversely impact the whole Reserve area and particularly an area of biodiverse revegetation plantings (that would be susceptible to a wild fire event).

Favourable weather conditions made for a successful stage one burn. Spot fires were lit strategically utilising prevailing winds to ignite the ground fuel layer across approximately five hectares within the northern section of the burn area. The fire progressed well across the site and an effective and well contained burn was achieved. Stage two of the burn scheduled for the following day had to be postponed due to strong westerly winds. Burning was completed in late July.

Council will implement post burn monitoring utilising motion cameras to observe fauna movement and to detect any potential increased feral animal activity, particularly foxes and cats. On-going vegetation monitoring will also be conducted.



Figure 39: Ecological Burning at Bulahdelah Plain Wetland

Management Actions - Myall Lakes



Conservation Partnerships

The works being undertaken at the Bulahdelah Plain Wetland also complement a significant private conservation outcome that protects and manages 373 hectares of wetland and native vegetation on nearby landholding, and which was delivered using the innovative clause 4.1B exceptions to minimum lot sizes for ecological protection in Great Lakes Local Environment Plan 2014. In addition a further 50 hectares of private conservation is currently under assessment. These works combine to assist in safeguarding downstream waterways and conserve a large and important area of habitat for significant biodiversity. The site is already home to a number of threatened species including the wallum froglet, spotted-tailed quoll, squirrel glider, long nosed potoroo, black-necked stork (jabiru), new Holland mouse, little lorikeet and an active nest of the white-bellied sea-eagle.

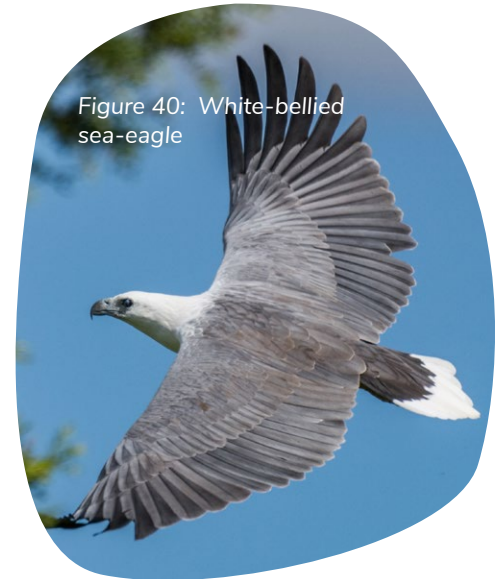


Figure 40: White-bellied sea-eagle



Protection, connection and rehabilitation of key habitats

Council has recently collaborated with leading researchers in the field of corridors to map priority wildlife linkages across the Myall Lakes and Karuah River catchments. In 2018, Council commissioned the Landscape Ecology and Conservation Lab from the University of Nottingham (Malaysia) to identify and map the locations of important corridors for wildlife movements in the two southern catchments of the MidCoast Council area.

The stimulus for this work was the outstanding Durness Borland Landcare Corridor collaboration as well as the broad recognition of the values of well-planned wildlife corridors for catchment health and biodiversity protection. The Durness Borland Landcare Corridor was a partnership project between the landholder, Council, Landcare Australia and the Hunter Local Land Services that has protected and enhanced over 92-hectares of corridors between the northern foreshore of Port Stephens and Nerong State Forest. The project showcased the value of collaboration and demonstrated what can be achieved for water quality and biodiversity protection in agricultural production landscapes through best practice land management.

In order to best manage and protect biodiversity and the ecosystem services values that natural areas provide it is important to understand the condition and function of the catchment landscape. The corridors report found that the Karuah and Myall catchments are generally well-connected at present, however there is fragmentation associated with the cleared valley floors of the river systems. It also found that there are natural areas of the catchments which have no protection status yet are very important for connecting the landscape. The report concluded that east-west linkages across the cleared valley floors should be prioritised to ensure future connectivity and identified three priority focus areas:

- The Glen Nature Reserve west to Avon River State Forest
- Karuah National Park north-east to Myall River State Forest
- Karuah National Park to Monkerai Nature Reserve

The wildlife corridor analysis report and its associated mapping provides important spatial data to assist Council and other agencies design and implement local and sub-regional connectivity conservation projects. The delivery of these corridor projects will benefit the environment through enhanced ecosystem services values and the broader MidCoast community.



Figure 41: Wildlife corridors help protect threatened species like the koala

Management Actions - Myall Lakes



Management of aquatic weeds

Aquatic weeds are known to displace natural vegetation, destroy aquatic life and reduce habitat available to fish. In the Myall Catchment, aquatic weeds were monitored and treated along 46 kilometres of stream bank. The ongoing monitoring program has revealed significant reductions in densities and occurrences of the target weed parrots feather.

One and a half hectares of alligator weed received multiple treatments at the obsolete landfill area contained within Tea Gardens Waste Management Centre. This infestation is currently being managed under an intensive, ongoing, integrated weed management program.

Unseasonably favourable conditions including high nutrient levels and factors beyond Councils control have provided for a growth spurt in the one and a half hectare salvinia infestation at Tea Gardens. This pond is unfortunately at 100% weed density with management works planned to bring infestation back into control and establish biological control until a permanent solution can be realised.

Amazon frogbit is a floating freshwater plant from Central and South America, introduced into Australia as a decoration for fish ponds, aquariums and water features. It can rapidly invade and smother waterways and is a serious biosecurity threat.

In April 2019, a resident was visiting a Bulahdelah cafe with his family. While there his 10 year old son discovered frogbit growing in a water feature, they reported it NSW Invasive species hotline. Investigations traced the plants back to a property bordering high value wetlands at Bulahdelah. Council is currently working with the property owner, NSW Department of Primary Industries and Hunter Local Land Services to eradicate the infestation.



Figure 42: Amazon frogbit found in a Bulahdelah cafe

Management Actions - Karuah and The Branch Estuary



Karuah River Catchment Management Plan

The Karuah River Catchment Management Plan identified that habitat fragmentation is reducing the resilience of ecosystems within the catchment and that poor water quality is impacting the health of the river and wider Port Stephens Estuary. The economic and social fabric of the catchment - including agriculture, oyster farming, lifestyle and tourism activities - is inherently linked to the condition and function of the natural environment and the sustained delivery of environmental services.

Council is presently in the planning phase for the development of a large scale catchment management project in partnership with Landcare Australia Ltd, Local Land Services and Karuah Great Lakes Landcare.

Midcoast Council has been working with Local Land Services to identify locations where on ground action could help to implement the NSW Marine Estate Management Strategy in the Karuah Catchment. This project will support protection of riparian lands on private properties in The Branch and Karuah Estuaries as well as sediment and erosion control works on The Branch Lane.

Midcoast Council has been partnering with Hunter Local Land Services to work with Poultry farms in the region to reduce impacts on the water quality of the Karuah river. This includes the development of individual farm nutrient profiles, followed by funding for onground works to reduce farm impacts on water quality. This project will expand over the next three years with funding from the NSW Environmental Trust.



Management of aquatic weeds

The weed of National Significance (WoNS) alligator weed is present and has been managed on properties along 8km's of Lewis Creek at Girvan for more than thirty years. Alligator weed will grow in ponded and flowing waterways, on the banks of waterways, on floodplains and poorly drained land, and less commonly in drier situations above flood level. It restricts access to and use of water, blocking and damaging pumps and other infrastructure. Mats of alligator weed can impede stream flow and lodge against structures promoting sedimentation which contributes to flooding and structural damage.

Alligator weed is difficult to control. Any infestations should be reported immediately to your local council weed officer. Do not try to control alligator weed without their expert assistance. Control effort that is poorly performed or not followed up can actually help spread the weed and worsen the problem. Control methods and their application will vary depending on the management aim. While containment and prevention of spread will be necessary in all infestations, controls should be closely aligned with management aims.

Figure 43: Alligator weed in the Karuah Catchment.



Figure 44: Water hyacinth is a target species in the Karuah catchment.

Management Actions - Karuah and The Branch Estuary



Protection, connection and rehabilitation of key habitats

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The wildlife corridor analysis report and its associated mapping provides important spatial data to assist Council and other agencies design and implement local and sub-regional connectivity conservation projects. The delivery of these corridor projects will benefit the environment through enhanced ecosystem services values and the broader MidCoast community.



Figure 45: Wildlife corridors help protect species like the feathertail glider



MIDCOAST
council



WATERWAY AND CATCHMENT REPORT CARD

2019

Reporting on data
October 2018 to April 2019



This project is supported by the New South Wales Government through its Coast and Estuary Program, Department of Planning, Industry and Environment and Local Land Services.

MANNING RIVER ESTUARY

The Manning River Estuary maintained good overall ecological condition. Water clarity was excellent throughout the estuary, however algal levels continued to be excessive. The high algal levels reflect optimum growing conditions of clear warm water and abundant sunlight throughout the sampling period, which allowed the algae to utilise nutrient runoff from the catchment following summer storms.

The depth range where seagrass is able to grow increased in the lower reaches to an excellent grade, the best results seen so far. Seagrass depth reduced slightly in the mid reaches and remained poor. Seagrass disappeared from the upper reaches for the first time since sampling began.

KHAPPINGHAT ESTUARY

Khappinghat Estuary was in good ecological condition. Algal growth was low but there continues to be poorer than expected water clarity leading to continuation of the good grade, rather than the excellent grade expected.

KARUAH RIVER ESTUARY

The Karuah River and The Branch Estuaries continued to show signs of significantly impaired estuary health with much higher than desired algal growth. These grades reflect excess nutrients from catchment runoff, clear water and low flows in the catchment. As with last year, there was no seagrass in the mid to upper reaches of the Karuah River Estuary, likely a consequence of past and present conditions.

RESULTS

Dawson Ri

ALGAE
WATER CLARITY

Upper Manning Estuary

B



WW

Khappinghat

B



The Branch Estuary

C



Karuah Estuary

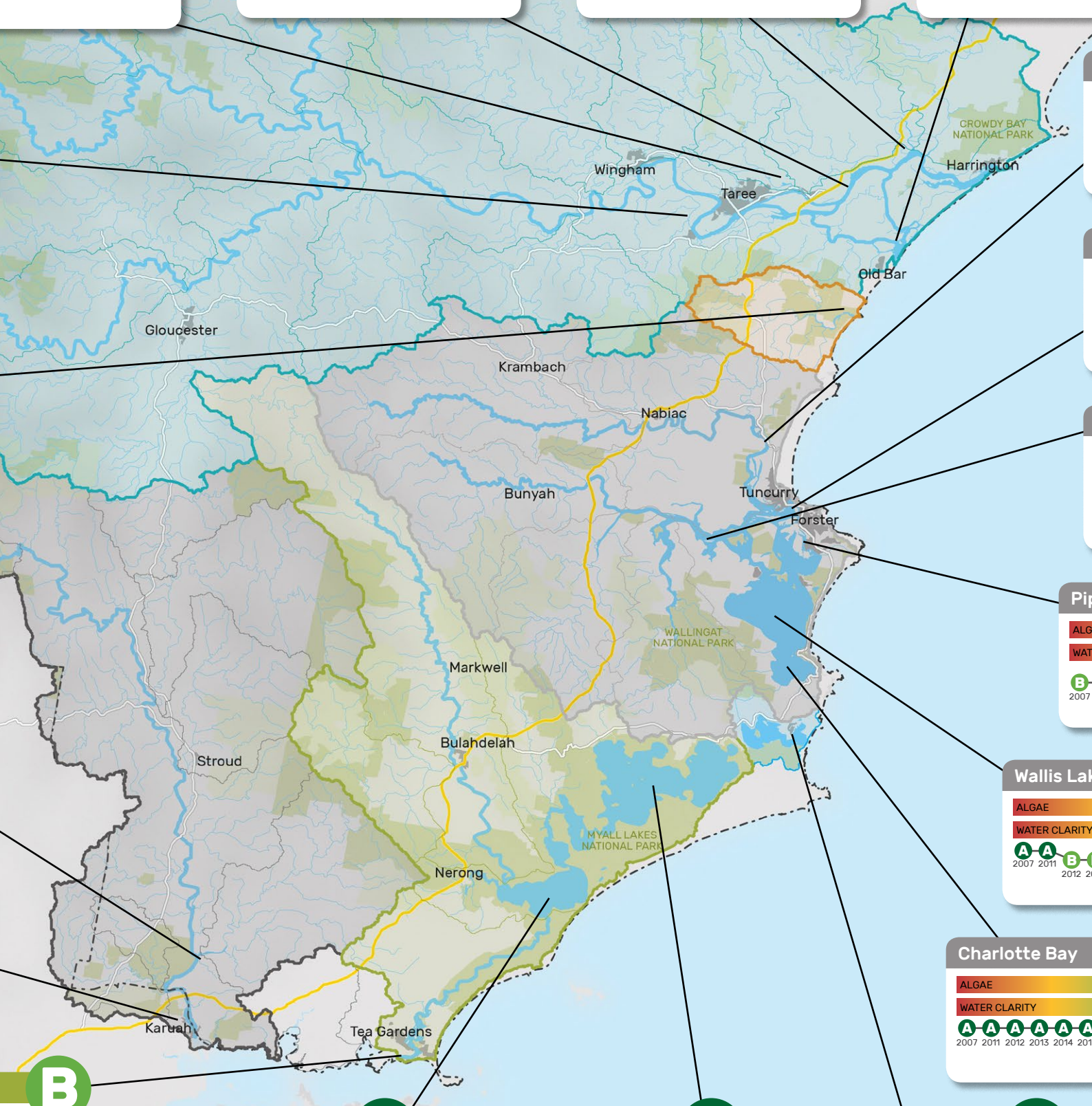
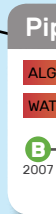
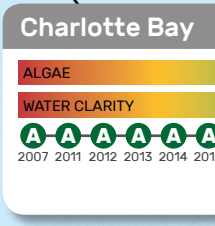
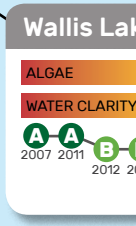
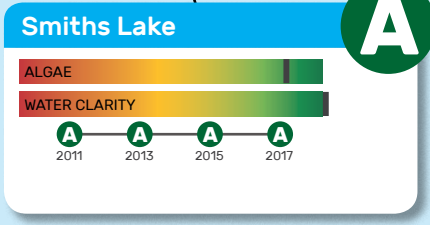
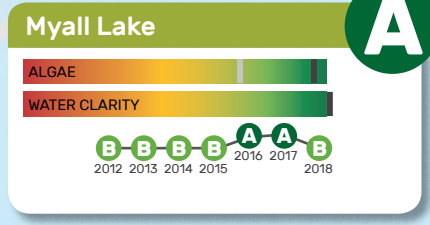
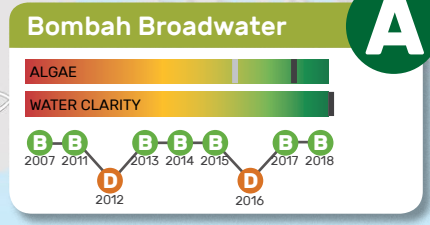
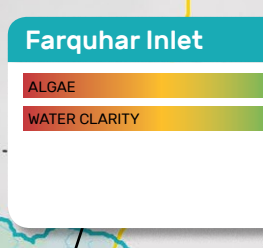
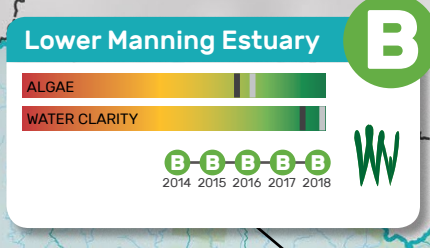
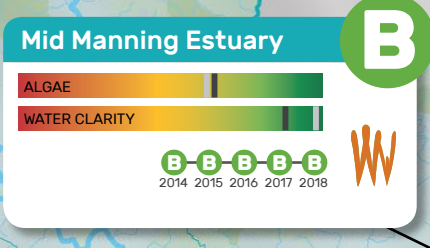
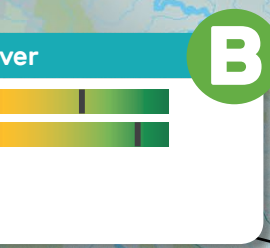
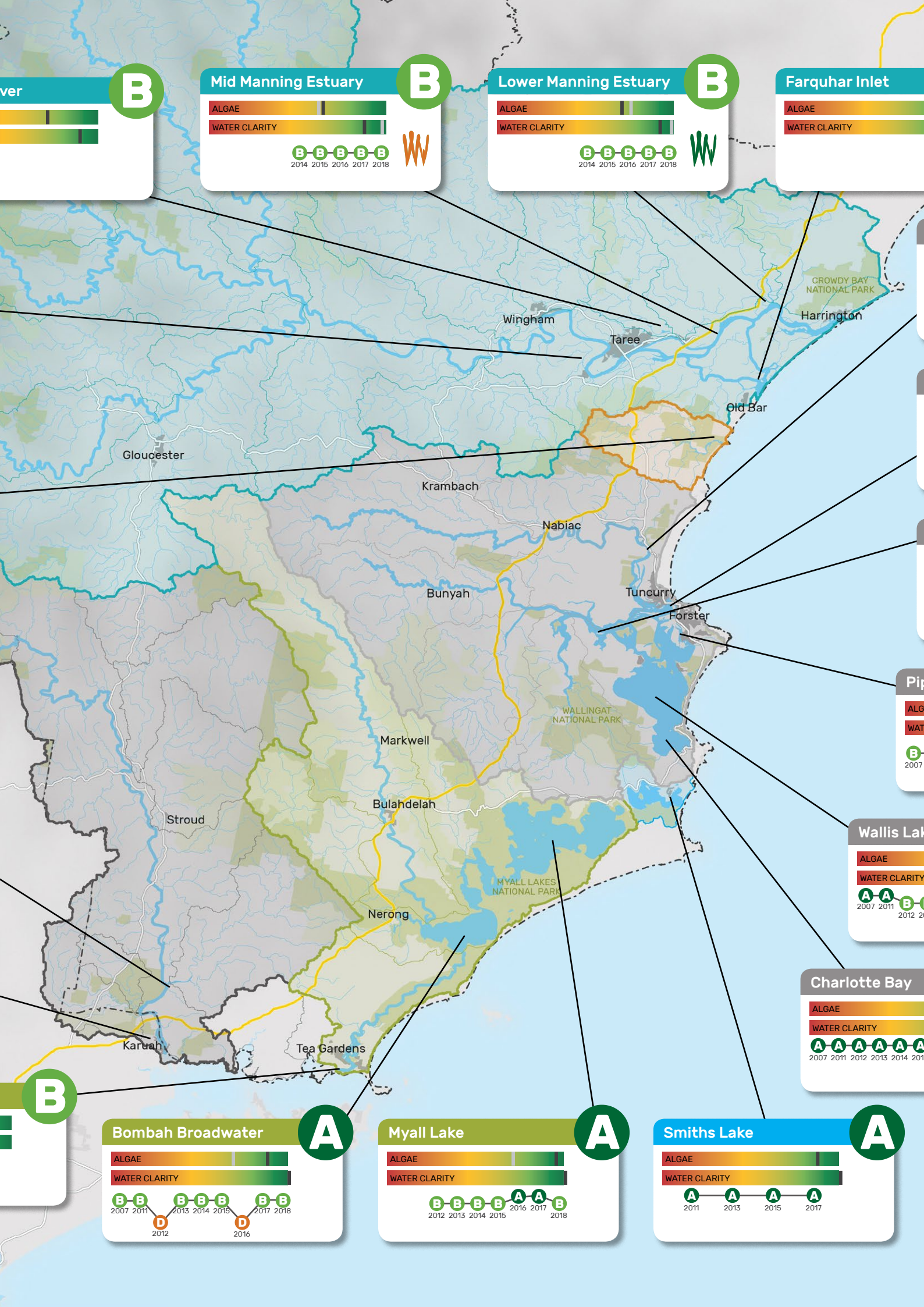
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Lower Myall Estuary

ALGAE
WATER CLARITY







B

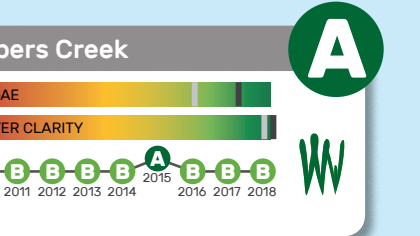
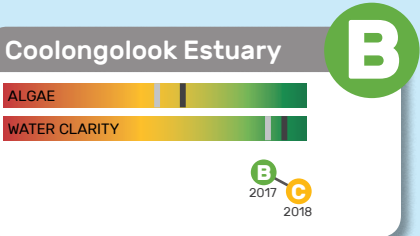
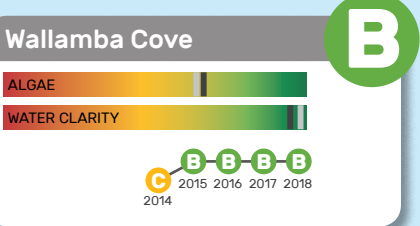
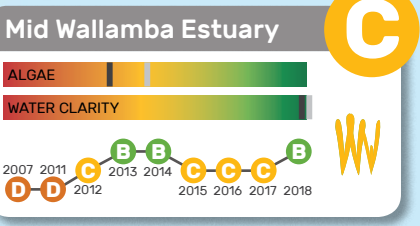


WALLIS LAKE

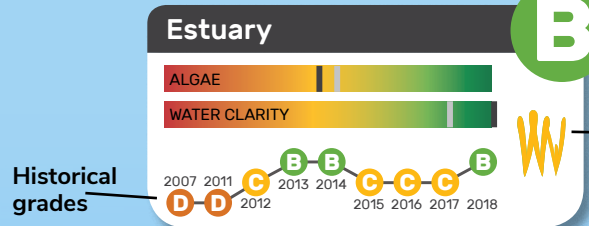
Grades for Wallis Lake and Pipers Creek were excellent this year and this was the case for both water clarity and algae. While water clarity in the Mid Wallamba Estuary was good, higher than desired algal growth from excess nutrients, clear water and low flows resulted in a poorer overall grade this year.

The Coolongolook Estuary continued to show significant algal growth but water clarity was generally acceptable. Higher levels of algal growth in Wallamba Cove shows it continues to be affected by stormwater runoff from Tuncurry.

The depth where seagrass is able to grow improved at most sites and was excellent in Wallis Lake, but remained poor in the Mid Wallamba Estuary.



ESTUARY SCORE KEY



Overall grade: This represents ecological condition, it is a combination of algae and water clarity scores. Where there is no grade, no data was collected at these locations.

Seagrass depth range score: The seagrass score indicates how deep the seagrass is growing and if the seagrass area is expanding or contracting. Where there are no seagrass results, no data was collected at these locations.

For more details see the Waterway and Catchment Technical Report 2019 found at www.midcoast.nsw.gov.au/reportcard




SMITHS LAKE

Smiths Lake remained in excellent condition despite an extended dry period which resulted in a dramatic drop in lake levels. Low rainfall and little runoff resulted in clear waters and low nutrient inputs.

MYALL LAKES

Grades for Myall Broadwater and Myall Lake improved from good condition to excellent this year. As the Myall Broadwater, and to some extent Myall Lake, is strongly influenced by runoff from the Myall River catchment, continuing dry conditions meant that there was little runoff during the sampling times, resulting in clear waters and small amounts of algae. The marked variability in condition swinging from good to poor and back again emphasises the role of inputs from the upper Myall River and the need to continue to reduce nutrients from land use activities in the catchment.

The Myall River Estuary upstream of Tea Gardens was in good ecological health, algae levels varied from moderate to good and water clarity was good. This area is usually strongly influenced by the condition of the outflow from the Broadwater, but with limited runoff from rainfall, waters moved by tides have a greater influence on water quality.



“For me it's all about water.
Living near it, being
surrounded by it and
working on it for a living.”

Peter Mannow
Tourism operator

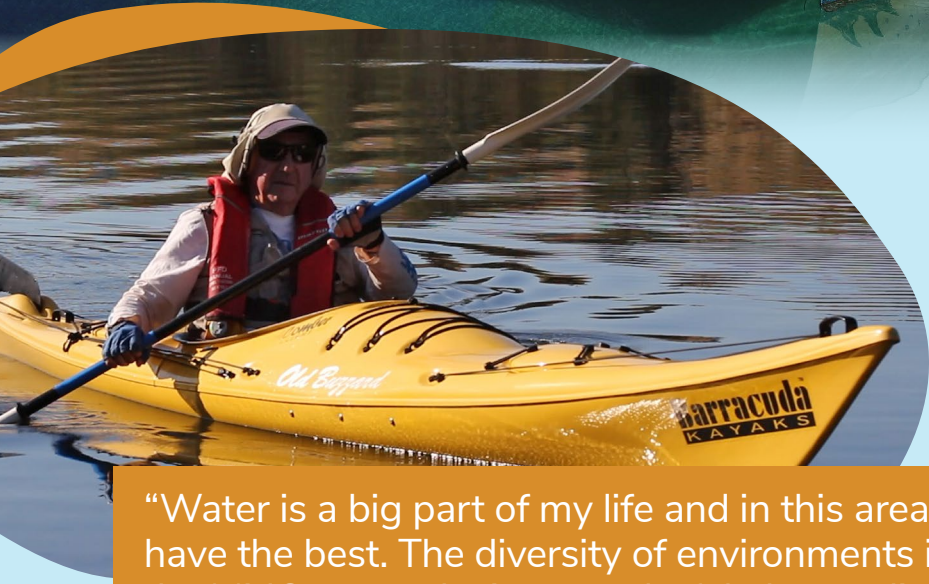


“I love going snorkelling
and seeing all the fish.”

Melaleuca - Age 5

“My favourite thing to
do is go riding on the
river in Pop's boat.”

Cameron - Age 7



“Water is a big part of my life and in this area we
have the best. The diversity of environments in
the MidCoast make it a wonderful place to live!”

John Dorrington, Member of the Wednesday Kayak Group



“If I had one wish for our
waterways it is for them to
remain healthy for our future
generations to enjoy.”

Brad Verdich - Oyster Farmer



HOW CAN YOU CARE FOR YOUR LOCAL WATERWAYS?



Explore your local parks, rivers, creeks and lakes, create new memories – stick to trails and take all your rubbish with you



Pick up after your pets so their waste doesn't end up in our waterways



Help improve our natural areas by getting involved in community groups such as landcare and dunecare



Plant local natives in your garden and remove weeds to help improve water quality and provide habitat for animals



If you have creek or river frontage fence out livestock and have off-stream watering



Build a raingarden to slow and filter stormwater from your property before it reaches our waterways



Pick up litter before it gets washed down the drain



Wash your car on the grass or at a car wash



Why a Report Card?

Report Cards are an effective way to check on the health of our waterways. They help us compare current conditions with the condition we would like them to be. Scientists use indicators to 'health check' our waterways. 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. The indicators are selected to assess the overall health or ecological condition. The results of the Report Card are used to guide future management actions and ensure long-term ecological health of our catchments.



PATHWAYS OF IMPACT

Activities

What we do on the land impacts on the quality of water that runs off. If the quality of the runoff is poor it puts stress on the environment.

Stressors

Stressors are changes to the environment that result from the activity, these can lead to ecological harm. Stressors can include nutrients, acid leachate and sediment in the water (turbidity).

Ecological impacts

REPORT CARD INDICATORS

Seagrass is the basis of the food web in healthy estuaries. Seagrass provides essential habitat and food for marine life. Where seagrass is abundant so is aquatic life and as such, it is an excellent indicator of ecological health. Seagrass growth is affected by a number of factors including nutrient levels, algal growth, physical removal and water clarity. Water clarity (turbidity) is directly linked to seagrass growth and is used as a surrogate for ecological health. When water clarity is high, seagrass is abundant as there is plenty of light for it to thrive.

Algae are microscopic plants that can grow excessively with high levels of nutrient inputs. Nutrients are delivered to estuaries from urban stormwater, fertiliser, runoff from farms, gardens and seepage from effluent disposal and septic tanks. Algal blooms can reduce the amount of light reaching seagrass beds limiting their growth. When algal blooms die and start to decay, the resulting bacterial activity can reduce oxygen levels in the water body and lead to fish kills. Measuring the amount of algae in a water body is an indicator of ecological health, chlorophyll is a measure used to determine the amount of algae in a water body.