



MIDCOAST
council



**MANNING
RIVER
ESTUARY &
CATCHMENT**



**MONITORING, EVALUATION AND REPORTING PROGRAM:
WATER QUALITY AND ECOSYSTEM HEALTH
2021**

Annexure L

Acknowledgement of country

We acknowledge the traditional custodians of the land on which we work and live, the Gathang-speaking people and pay our respects to all Aboriginal and Torres Strait Islander people who now reside in the MidCoast Council area. We extend our respect to elders past and present, and to all future cultural-knowledge holders.

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1. Introduction

1.1 Background

The Manning River estuary on the mid-north coast of New South Wales is fed by a vast catchment covering 8,420 square kilometres (km²) from the mountains to the sea. There are sixteen subcatchments and almost 29,000 km of waterways converging to exit at two ocean mouths (depending on conditions): Harrington (which is permanently open to the ocean) and Farquhar (which is manually opened during high water events) Inlets. The ecological health of the Manning River estuary and catchment is under pressure as a result of past and present land management practices and the impacts of climate change including prolonged drought, more extreme flood events and rising sea level.

MidCoast Council will implement a broadscale environmental monitoring, evaluation, reporting and improvement (MERI) program to support the management goal of the Manning River Estuary and Catchment Management Program (the ECMP) which is:

“The Manning River, its tributaries and the estuary give life to our community connecting the mountains to the sea. Together we manage the catchment holistically and respond to a changing climate – safeguarding environmental, social, cultural and economic values.”

MidCoast Council’s MERI program will provide a high-level assessment of the status of environmental quality to ensure environmental values are maintained across the Manning River estuary and catchment.

1.1.1 The Need for a MERI Plan

Community consultation, scientific advice and risk assessment during development of the ECMP identified the following pressures as posing the greatest risk to the health of the Manning River estuary and catchment ecosystems:

- Low levels of understanding about estuary and catchment pressures and absence of stewardship
- Intensification of rural land use
- Clearing of riparian vegetation
- Urban development
- Low-lying agricultural land drainage
- Climate change – sea level rise, temperature, rising CO₂, storm frequency, rainfall intensity Sediment runoff

Environmental stressors that occur as a result these pressures include:

- Sediment runoff
- Nutrient runoff (from both urban and rural sources)

- Acid Sulfate Soil (ASS) runoff
- Pathogens
- Inundation
- High water temperatures
- CO2 acidification
- Litter and plastics

These pressures are conceptually shown in Figure 1 below.

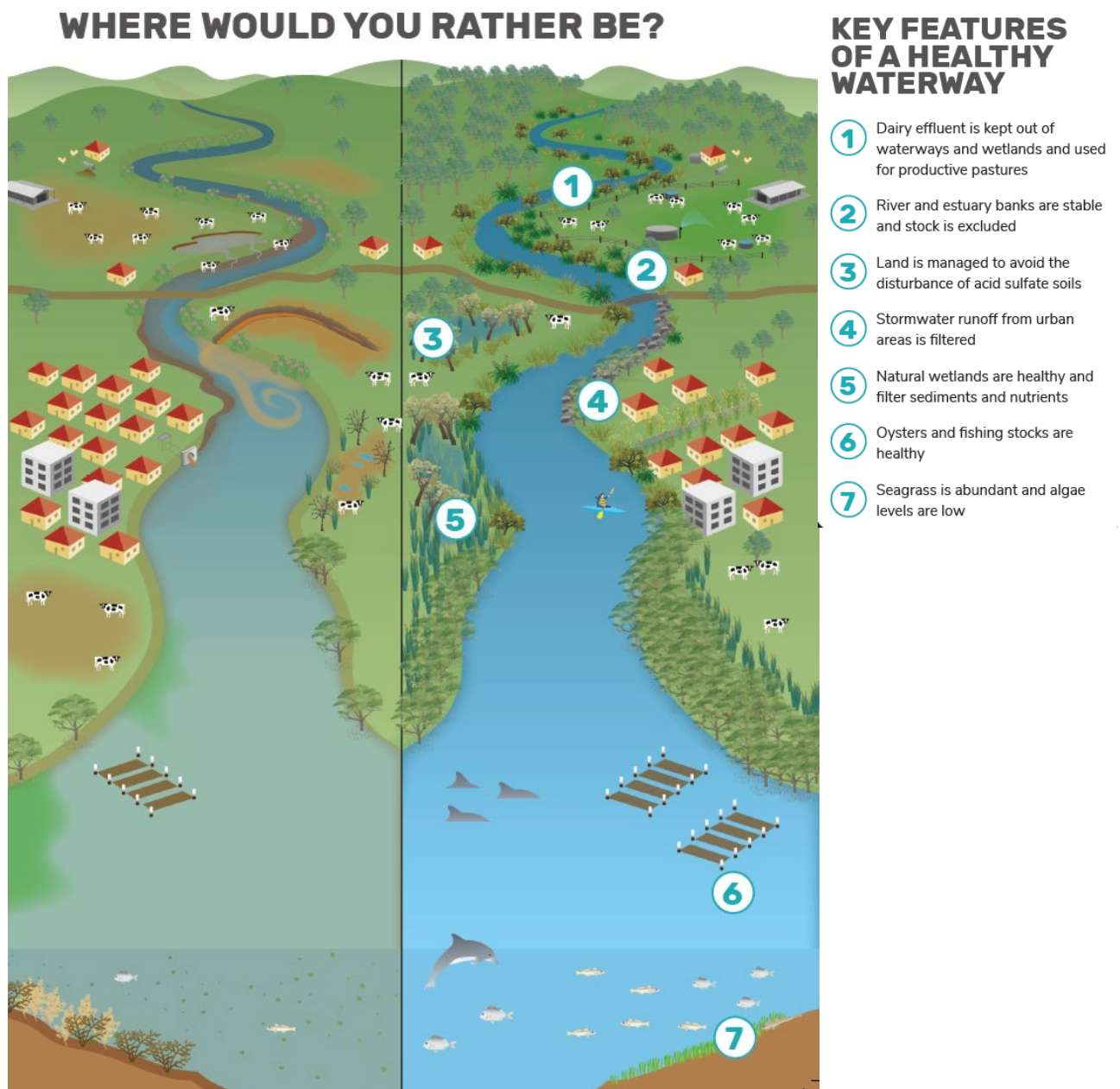


Figure 1: Conceptual diagram of an impacted waterway with poor water quality compared to a healthy waterway.

The impact of these pressures on the freshwater and estuarine ecosystems is complex and varies spatially across the Manning River estuary and catchment. Risks differ depending on the individual pollutant, its source and type of environmentally sensitive receptors impacted. Implementing this MERI Plan will assist MidCoast Council and its stakeholders to detect changes (positive or negative) in water quality over time, and establish a baseline of data to continue monitoring the ecological health in the Manning River estuary and catchment in the long-term.

1.2 Purpose

This MERI Plan outlines MidCoast Council's approach for delivery of a MERI program in the Manning River estuary and catchment. The intent behind this MERI Plan is to illuminate decision-making to address the ECMP focus problem: declining water quality, ecosystem health and resilience. This MERI Plan constitutes the science program defined in the ECMP Program Logic Model (see Section 3.2 of ECMP) and has been designed to understand the response of estuaries to the key pressures and stressors driving condition. The implementation of this MERI Plan fulfils Action 2.13 of the ECMP.

1.3 Scope

The scope of this MERI Plan includes monitoring, evaluation and reporting on both ECMP and water quality objectives in:

- The Manning River estuary upstream to the limit of tidal influence; and
- The catchments of the Manning River estuary (riparian and aquatic zones).

1.4 Principles

This MERI Plan adopts the following Principles (adapted from DPIE 2020):

- **Uses SMART Objectives** – Specific, Measurable, Achievable, Realistic, Time-bound
- **Relies on an agreed program logic** – robust methodology to ensure outcomes can be effectively measured
- **Uses Best Practice** - current best practice and scientific knowledge and multiple (environmental indicator) lines of evidence
- **Adopts a risk-based approach** – assists MidCoast Council to prioritise monitoring of ecological responses and stressors that pose the highest risk to ecological health.
- **Emphasises collaboration** – builds on existing programs to improve efficiency and reduce duplication in effort
- **Transparent reporting** – offers open access to information
- **Adaptive Management** – adopts a systematic approach to improving natural resource management by learning from management outcomes and making changes to improve the ecological response and reduce stressors
- **Values cultural knowledge** – recognises the importance of cultural knowledge holders in increasing understanding of the condition and health of the Manning River estuary and catchment and the influence environmental change may have on physical and non-physical elements of cultural heritage

- **Values local knowledge** – recognises the value of local knowledge in understanding and interpreting scientific results about the health and condition of the Manning River estuary and catchment
- **Values citizen science** – recognises the role of citizen science programs in filling knowledge gaps and increasing understanding of the condition and health of the Manning River estuary and catchment.

1.5 Data Sharing – A Collaborative Approach

MidCoast Council uses a range of data sets to inform its understanding of the environmental condition of the Manning River estuary and catchment. The data used includes those collected directly by MidCoast Council and those drawn from existing sources, including partner organisations.

MidCoast Council recognises that the responsibility for environmental management and assessment of its outcomes is shared between organisations and so adopts a collaborative approach to data sharing. Many of the programs proposed rely on understanding the data that is available prior to undertaking detailed design. Further work is required and MidCoast Council will work with its project partners to establish a formal arrangements for data sharing (refer to Action 2.13b of ECMP). MidCoast Council will investigate all data sets and use this information to improve understanding of the Manning River estuary and catchment, and continually refine its MERI programs.

By integrating existing data sets into the MERI program, MidCoast Council is able to take a holistic view of catchment and estuary health. In doing so, this MERI Plan complements (rather than duplicates or replaces) existing MERI activities by other organisations. This allows collaboration on delivery of the MERI program outcomes for the social, environmental and economic benefit of the local community.

1.6 Adaptive Management

MidCoast Council is committed to using adaptive management to improve on-ground management decisions in order to meet the water quality objectives of the Manning River ECMP. Adaptive management allows MidCoast Council and stakeholders to adjust our approach in response to current climatic conditions, new information and local knowledge. The features of this approach are planning, implementing and assessment as shown in Figure 2. Adaptation can happen at any one of these stages.

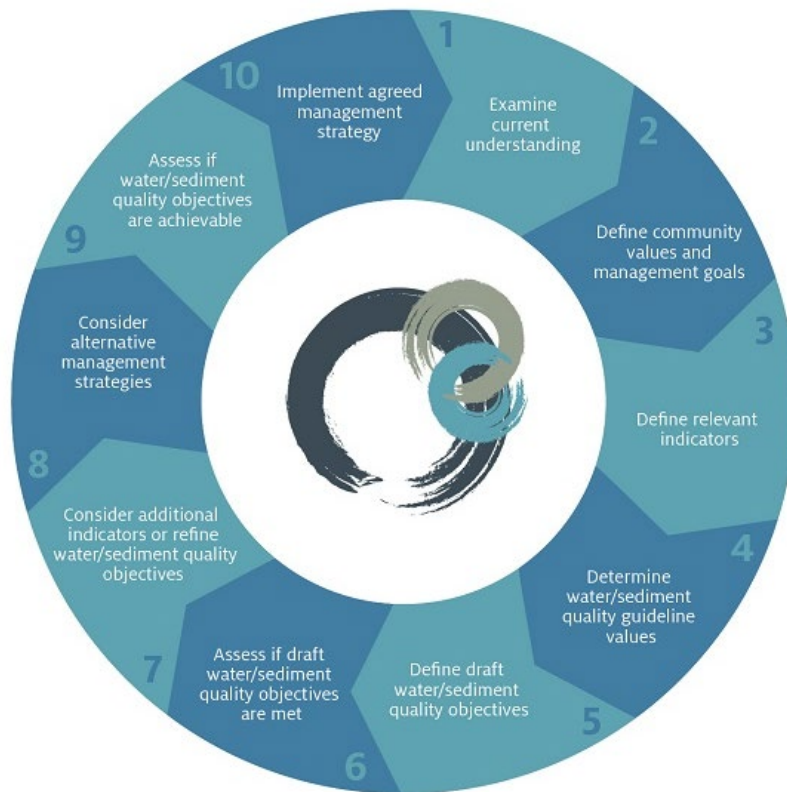


Figure 2: Continual Improvement of the Water Quality Management Framework for this MERI Plan through Adaptive Management Processes (ANZG 2018)

2. MERI for the Manning River Estuary and Catchment

2.1 Approach

The approach to development of the MERI program for the Manning River estuary and catchment included the following steps:

- **Examining current understanding** - to inform decisions at subsequent steps, MidCoast Council developed conceptual models of how the Manning River estuary and catchment waterway systems work, the issues they face and how to manage them
- **Defining community values and management objectives** - community values and more specific management goals (including level of protection) were defined for the Manning River estuary and catchment at stakeholder involvement workshops
- **Defining relevant indicators** - indicators were selected for relevant pressures identified for the system, the associated stressors and the anticipated ecosystem receptors
- **Determining water quality guideline values** - MidCoast Council determined the water quality guideline values for each of the relevant indicators required to provide the desired level of protection to meet the management goals of the Manning River estuary and catchment

- **Implement management strategy** - MidCoast Council developed this MERI program to document its approach to achieving the water quality objectives and the environmental monitoring programs for implementation.

This approach was based on the principles and guidelines of the National Water Quality Management Strategy (NWQMS 2018), with regard to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018). The focus of the approach is on maintaining existing water quality, identifying where management and/or remediation actions may be required and measuring the effectiveness of these actions.

The water quality management framework adopted in the MERI program is shown in Figure 3.

2.2 Environmental Values

Environmental values are defined as particular values or uses of the environment that are important for a healthy ecosystem or for public use of our waterways (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating) which require protection from the effects of pollution (ANZG 2018).

The environmental values for the Manning River estuary and catchment were established through stakeholder consultation during the ECMP development (MidCoast Council 2020a). The top three values for the Manning River estuary and catchment are:

- Ecosystem Health
- Visual Amenity
- Cultural and Spiritual

Other environmental values for the Manning River estuary and catchment identified during consultation (refer to Figure 12 of ECMP) include:

- Recreational use – Primary Contact
- Recreational use – Secondary Contact
- Primary Industries.

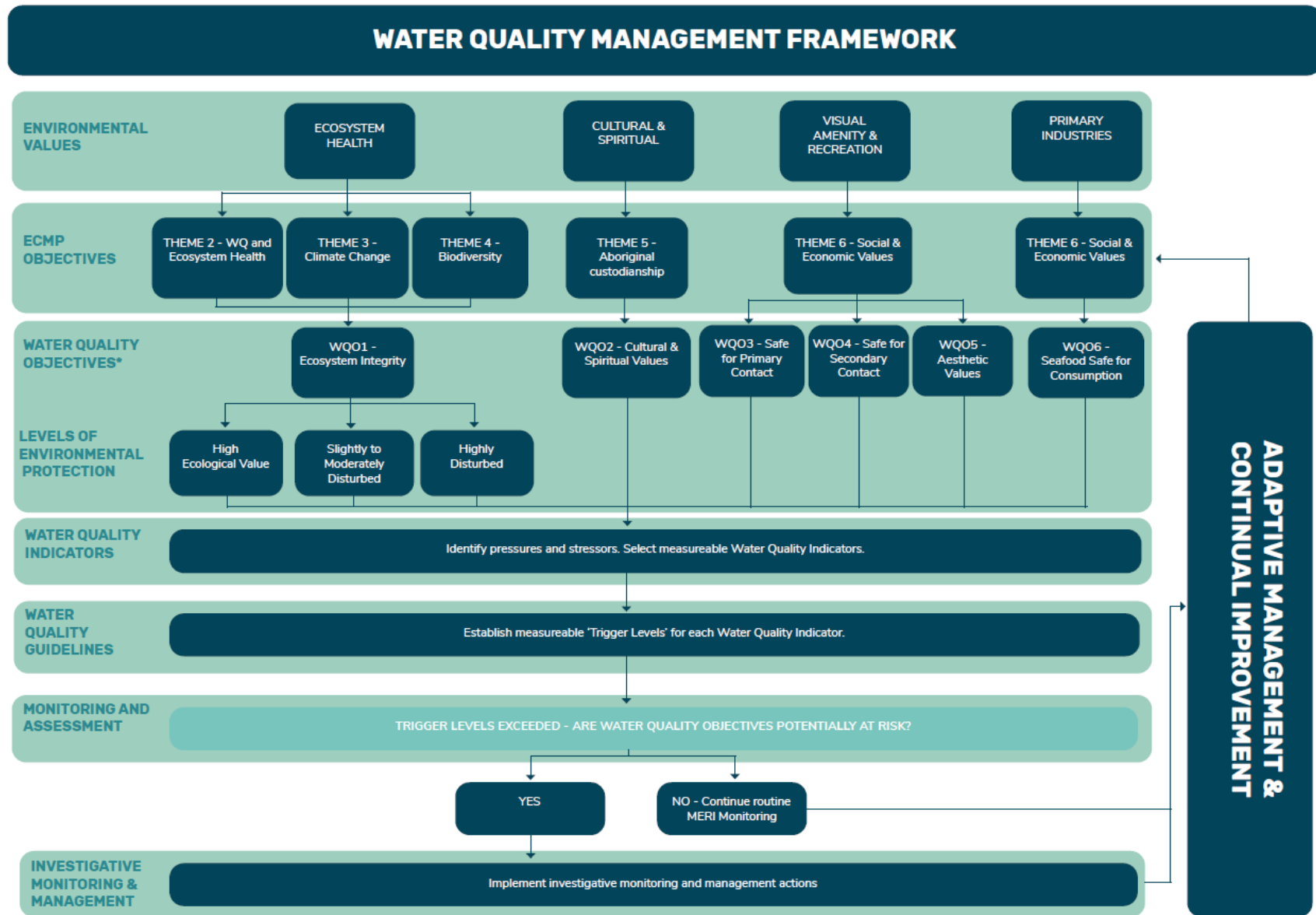


Figure 3: Water Quality Management Framework for the Manning River Estuary and Catchment

2.3 Objectives

The ECMP has defined an objective for each identified 'Theme' that describes what must be achieved to meet the ECMP's management goal. The Water Quality Objectives (WQOs) are narrative statements that describe what must be achieved to protect each environmental value. Meeting each WQO supports the achievement of each ECMP objective and ensures environmental values of the Manning River estuary and catchment are protected. The relationship between environmental values, ECMP Objectives and WQOs is shown in Table 1.

Table 1 Environmental Values, ECMP Objectives and Water Quality Objectives applicable for the Manning River Estuary and Catchment

Environmental Values	ECMP Objective	Water Quality Objectives
Aquatic Ecosystem Health	<p>Theme 2: Water Quality and Ecosystem Health – Manage the Manning River catchment and its estuary holistically to maintain and improve water quality and ecosystem services.</p> <p>Theme 3: Climate Change – Understand, mitigate, adapt and build resilience to current and future hazards including the impacts of climate change.</p> <p>Theme 4: Biodiversity – Protect and conserve natural character and biological diversity.</p>	WQO1: Maintain and improve ecosystem integrity based on the Level of Ecological Protection in the Manning River catchment and its estuary.
Cultural & Spiritual Values	Theme 5: Aboriginal Custodianship – Acknowledge and support Aboriginal peoples' spiritual, social, customary and economic connection to the Manning River catchment and its estuary.	WQO2: Cultural and spiritual values of the Manning River catchment and its estuary are protected.
Visual Amenity & Recreation	Theme 5: Social and Economic Values – Manage the Manning River catchment and its estuary to maintain and improve social, cultural, and economic opportunities and benefits.	<p>WQO3: Water quality is safe for primary contact recreation (e.g. swimming).</p> <p>WQO4: Water quality is safe for secondary contact recreation (e.g. fishing and boating).</p> <p>WQO5: Aesthetic values of the aquatic environment are protected.</p>
Primary Industries	Theme 5: Social and Economic Values – Manage the Manning River catchment and its estuary to maintain and improve social, cultural, and economic opportunities and benefits.	WQO6: Seafood is of a quality safe for human consumption.

2.4 Levels of Ecological Protection

The 'level of protection' is the degree of protection afforded to a water body based on its ecosystem condition (current or desired health status of an ecosystem relative to the degree of human disturbance). The level of protection informs the acceptable water and/or sediment quality for a waterway and only applies to aquatic ecosystems.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality specify three levels of protection corresponding to whether the condition of the particular ecosystem is:

- of high ecological/conservation value,
- slightly to moderately disturbed; or
- highly disturbed (see Figure 4).

The level of protection adopted in the MERI program for the Manning River estuary and catchment is that for slightly to moderately disturbed waterways.

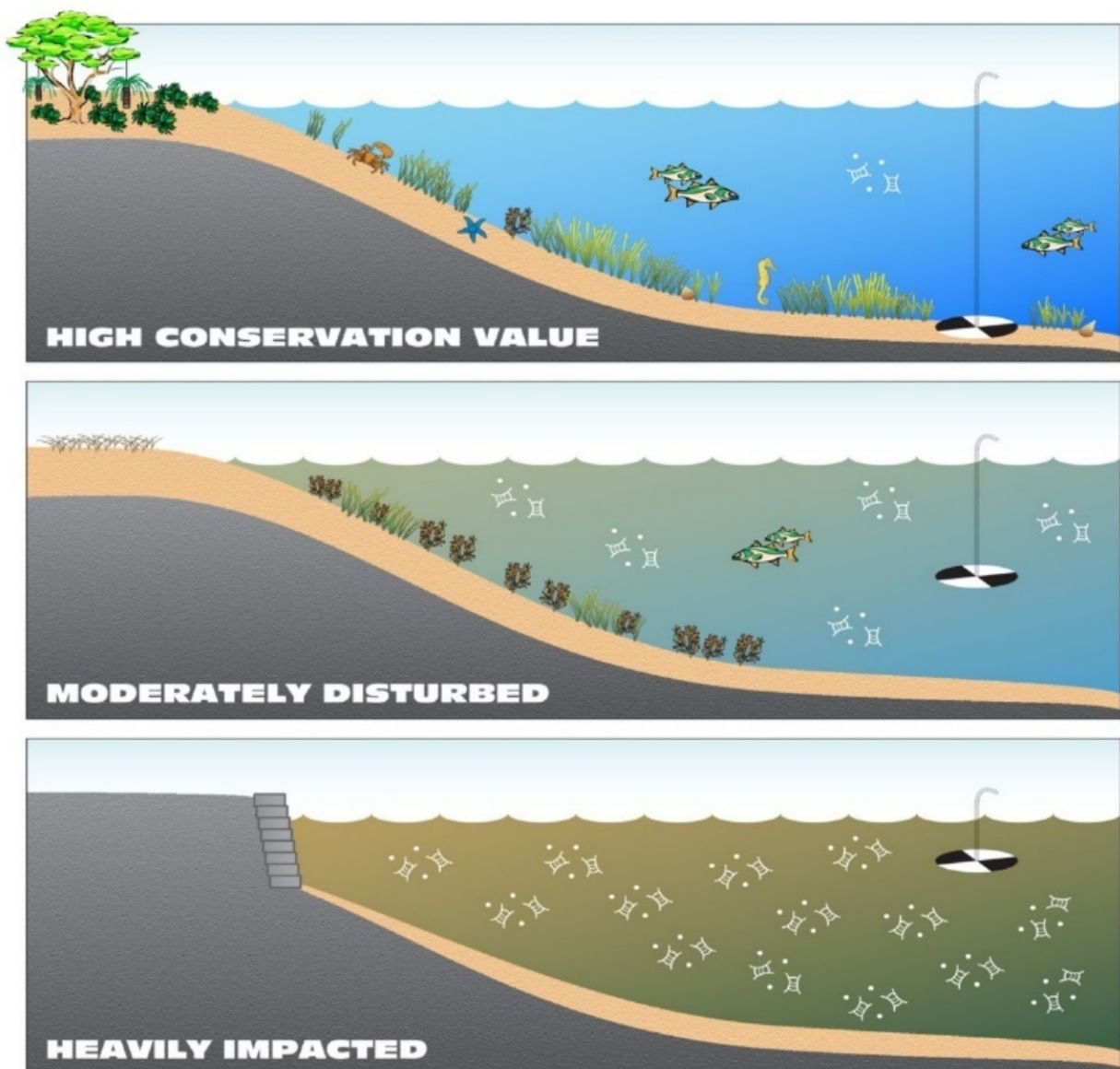


Figure 4: Conceptual Diagram depicting the three Levels of Ecological Protection

2.5 Water Quality Indicators

Water quality indicators are measurable parameters selected to monitor changes in environmental quality for each water quality objective. Indicators are selected for the relevant pressures identified for the waterway system, their associated stressors and anticipated ecosystem receptors. The proposed indicators for the Manning River estuary and catchment are presented in Table 2.

2.6 Water Quality Guidelines

Water quality guidelines or “trigger levels” are a measurable quantity (threshold) or condition of an indicator for a specific community value below or, for some stressors, above which we consider to be a low risk of unacceptable effects occurring.

2.6.1 Ecosystem Health

Water quality guidelines for the environmental value ‘Ecosystem Health’ have been developed in accordance with the Water Quality Guidelines (ANZG 2018) based on site-specific or default guideline trigger values and unimpacted background levels for estuarine and freshwaters in the Manning River estuary and catchment. The proposed water quality guidelines applicable to the environmental value ‘Ecosystem Health’ and corresponding WQO1 ‘Maintenance of ecosystem integrity’ are summarised in the MERI Program Tables (see Attachment 1).

2.6.2 Cultural and Spiritual

The environmental value, ‘Cultural and Spiritual Values’ recognises the cultural and spiritual values of the Manning River estuary and catchment to the Biripi people. Protecting and managing this system is a custodial and intergenerational responsibility. This MERI Plan will test whether the water quality management strategies implemented to maintain ecosystem integrity (WQO1), allow people to recreate safely (WQO3 & WQO4), and maintain aesthetic values (WQO5) are appropriate to meet WQO2 and protect the Cultural and spiritual values of the Manning River Catchment and Estuary. MidCoast Council will continue to refine the management measures implemented to protect cultural and spiritual value in consultation with indigenous knowledge holders in accordance with the principle of adaptive management.

2.6.3 Visual Amenity and Recreation

MidCoast Council notes that there are a number of management strategies in place to maintain the environmental value of ‘Visual Amenity and Recreation’ and the corresponding WQOs of ‘Water quality is safe for primary contact recreation (e.g. swimming)’ (WQO3) and ‘Water quality is safe for secondary contact recreation (e.g. fishing and boating)’ (WQO4) including:

- assessment by technical specialists of any development that may impact on the recreational use of the Manning River estuary and catchment, including applying conditions of consent for approvals granted;
- sewage treatment plant water quality compliance monitoring;
- on-site sewage management inspection programs; and
- pollution incident investigation and response.

MidCoast Council is also a member of the [Regional Algal Coordinating Committee](#) who is responsible for the response to local management of algal blooms and issue alerts to its web page for recreational water use.

Currently, MidCoast Council monitor water quality at water supply offtakes in accordance with the *Public Health Act 2010* and sewage treatment plant discharges in accordance with licences issued by the Environmental Protection Authority. The monitoring program identifies triggers to protect WQO3 and WQO4 'primary and secondary contact' and the monitoring occurs in locations in the Lower Manning River where primary and secondary recreation occur.

The proposed water quality guidelines applicable to WQO5 - 'Aesthetic values of the aquatic environment are protected' are summarised in the tables for the Citizen Science Monitoring 'Waterwatch' program and Stormwater Gross Pollutant Trap Monitoring program (see Attachment 1).

2.6.4 Primary Industries

Inclusion of the environmental value, 'Primary Industries' in this Plan recognises the value of the Manning River estuary and catchment to the agricultural, forestry, oyster growing and fishing communities. MidCoast Council notes that comprehensive monitoring of oyster quality is currently undertaken by the NSW Food Authority as part of its [Shellfish Management Program](#) through the Quality Assurance Program. As oysters are an aquatic species that are very sensitive to any change in water quality, MidCoast Council is of the view that the results of Shellfish Management Program are appropriate to inform whether WQO2 'Seafood is of a quality safe for human consumption' has been met. Accordingly, no additional monitoring programs are proposed as part of this Plan.

2.7 MERI Programs

MERI programs to be implemented for the Manning River estuary and catchment are summarised in Table 2.

Further information on monitoring program design is included as Attachment 1. All monitoring programs will be continually evaluated during implementation (see Section 2.9) according to the principle of adaptive management.

2.8 Investigative Monitoring and Management Action

In the event a water quality guideline 'Trigger Value' is reached and the cause is not determined to be due to natural variability, further monitoring and investigation will be undertaken to provide increased understanding of the possible cause and whether the relevant WQO is likely to be achieved. Where a WQO is considered likely to be at risk, or the risk is uncertain, management response options based on scientific advice will be evaluated in consultation with ECMP Stakeholders.

Table 2: Summary of the MERI Programs to be implemented for the Manning River Estuary and Catchment

Environmental Monitoring Program	Environmental Value	ECMP Objective	Environmental Issue	The 'Why' – Questions driving the monitoring program	Indicators	Triggers/Thresholds*	Monitoring Frequency
Estuary Ecological Health Report Card Monitoring	Ecosystem Health	Theme 2: Water Quality and Ecosystem Health Theme 4: Biodiversity	Erosion and sedimentation Urban stormwater quality Litter, plastics and marine debris Floodplain drainage and ASS Biodiversity loss Agricultural Impacts	<ul style="list-style-type: none"> What is the ecological health of the Manning River estuary? How does the condition of the Manning River estuary compare to past conditions? Is the environmental value 'ecosystem health' being maintained? Does the condition of the estuarine reaches of the Manning River change following the implementation of the ECMP? 	Turbidity Chlorophyll-a Seagrass depth range	<p>A requirement for further investigation will be triggered if:</p> <ul style="list-style-type: none"> there is a decline in the overall grade at any site, there is a decline in the score (for turbidity or chlorophyll-a) within a grade, and/or poor grades are recorded for the stressors at a site. <p>Investigation will be stepwise and include analysis of climatic conditions, the stressor data, potential pressures (through catchment investigations) followed by more detailed sampling and spatial analysis to determine the location and nature of the impact that could be contributing to the change in grade and score.</p>	Annually
Freshwater Ecological Health Report Card Monitoring	Ecosystem Health	Theme 2: Water Quality and Ecosystem Health Theme 4: Biodiversity	Erosion and sedimentation Agricultural Impacts Biodiversity loss Loss and degradation of riparian vegetation	<ul style="list-style-type: none"> What is the ecological condition of the freshwater reaches of the Manning River? How does the ecological condition of the freshwater reaches of the Manning River compare to past condition? Is the environmental value 'ecosystem health' being maintained in the freshwater reaches of the Manning River catchment? Does the condition of the freshwater reaches of the Manning River change following the implementation of the ECMP? 	Turbidity Chlorophyll-a Macroinvertebrates Riparian condition Reach condition	<p>A requirement for further investigation will be triggered if:</p> <ul style="list-style-type: none"> there is a decline in the overall grade at any site, there is a decline in the score (for macroinvertebrates, chlorophyll-a, riparian condition and/or geomorphic condition) within a grade, and/or poor grades are recorded for the stressors at a site. <p>Investigation will be stepwise and include analysis of climatic conditions, the stressor data, potential pressures (through catchment investigations) followed by more detailed sampling and spatial analysis to determine the location and nature of the impact that could be contributing to the poor score on the stressor data or change in grade and score.</p>	Twice in 10 years: base-line and program completion

Environmental Monitoring Program	Environmental Value	ECMP Objective	Environmental Issue	The 'Why' – Questions driving the monitoring program	Indicators	Triggers/Thresholds*	Monitoring Frequency
Freshwater Water Quality Monitoring	Ecosystem Health	Theme 2: Water Quality and Ecosystem Health Theme 4: Biodiversity	Erosion and sedimentation Agricultural Impacts Low and modified flow	<ul style="list-style-type: none"> What are the baseline water quality levels at key locations within the freshwater reaches of the Manning River catchment? How does the water quality at key locations in the freshwater reaches of the Manning River catchment compare to past measurements? How is water quality in the freshwater reaches of the Manning River catchment affected by climate (rainfall, drought, climate change)? 	Turbidity Chlorophyll-a Salinity Nutrients	Water quality trigger levels are the default guideline values (ANZG 2018) for slightly to moderately disturbed systems.	Quarterly
Acid Sulfate Runoff Monitoring	Ecosystem Health	Theme 2: Water Quality and Ecosystem Health	Floodplain drainage and ASS	<ul style="list-style-type: none"> What is the quality of the water draining off the Big Swamp floodplain into the Lower Manning estuary? Is the rehabilitation of the Big Swamp floodplain influencing the water quality draining into the Lower Manning estuary? 	pH Dissolved oxygen Electrical conductivity Temperature	Water quality trigger levels are the default guideline values (ANZG 2018) for slightly to moderately disturbed systems.	Annually
Climate Change Baseline Monitoring	Ecosystem Health	Theme 3: Climate Change	Climate Change	<ul style="list-style-type: none"> How is climate change affecting waterway conditions - salinity, temperature and tidal influence in the Manning River estuary? Does salt intrusion become more prevalent over time at different locations along the Manning River as a result of climate change? 	Water level Salinity Temperature (measured at depth and at the surface)	Not applicable - data for this program is being collected to understand climate change impacts in this locality.	Annually

Environmental Monitoring Program	Environmental Value	ECMP Objective	Environmental Issue	The 'Why' – Questions driving the monitoring program	Indicators	Triggers/Thresholds*	Monitoring Frequency
Stormwater Gross Pollutant Trap Monitoring	Ecosystem Health Visual Amenities & Recreation	Theme 2: Water Quality and Ecosystem Health Theme 5: Social and Economic Values	Urban stormwater quality Litter, plastics and marine debris	<ul style="list-style-type: none"> What is the condition of the gross pollutant traps in the Manning River estuary and catchment? Are the gross pollutant traps in the Manning River estuary and catchment being maintained to MidCoast Council standards? When is the optimum time to clean out the gross pollutant traps? 	Measured pollution as a percentage of sump volume	Measured gross pollutant traps pollution volume is >80% sump volume.	Bi-monthly
Citizen Science Monitoring – Waterwatch	Ecosystem Health Visual Amenities & Recreation	Theme 2: Water Quality and Ecosystem Health Theme 5: Social and Economic Values	Erosion and sedimentation Litter, plastics and marine debris Agricultural Impacts	<ul style="list-style-type: none"> What is the condition of water quality at Waterwatch sites in the Manning River estuary and catchment and do these change over time? 	Macroinvertebrates Turbidity Oil/Debris/Wrack	Water quality trigger levels are the default guideline values (ANZG 2018) for slightly to moderately disturbed systems.	Ad Hoc by community volunteers
Water Quality Monitoring – Recreational Use (Human Health)	Visual Amenities & Recreation	Theme 5: Social and Economic Values	Pathogens	<ul style="list-style-type: none"> Is the water quality in the Manning River estuary and catchment safe for primary contact recreation (e.g. swimming)? Is the water quality in the Manning River estuary and catchment safe for secondary contact recreation (e.g. fishing and boating)? 	Faecal Coliform	Water quality trigger levels are the default guideline values (NHMRC 2008) for recreational use.	Varies depending on purpose (e.g. weekly, bi-monthly, event based)

Environmental Monitoring Program	Environmental Value	ECMP Objective	Environmental Issue	The 'Why' – Questions driving the monitoring program	Indicators	Triggers/Thresholds*	Monitoring Frequency
Event Based Monitoring	Ecosystem Health	Theme 2: Water Quality and Ecosystem Health Theme 3: Climate Change Theme 4: Biodiversity	Erosion and sedimentation Urban stormwater quality Litter, plastics and marine debris Agricultural Impacts Flood, coastal & tidal inundation Biodiversity loss Floodplain drainage and ASS	<u>Ecosystem Health</u> <ul style="list-style-type: none"> How does the ecological health of the Manning River estuary respond to flood conditions, fire or drought? How long does it take for the estuary to return to baseline conditions? <u>Estuary hydrodynamics</u> <ul style="list-style-type: none"> How far does the tide extend into the Manning River estuary under normal conditions and following moderate to major floods? How quickly does the flood wave propagate downstream following moderate to major floods? How does data collected during floods correlate with flood modelling results? Does opening Farquhar affect water levels of the estuary? 	Indicators differ depending on the type of event (e.g. flood, bushfire, drought) and the waterway responses MidCoast Council seeks to monitor (e.g. pH for acid events)	Not applicable - data for this program is being collected to understand the impact of major flooding, fire or drought events on estuary health and hydrodynamics.	Coincides with extreme weather events

* The trigger values for different indicators of water quality may be given as a threshold value or as a range of desirable values (DEC, 2006).

2.9 Evaluation and Continual Improvement

The MERI program will be continuously reviewed to:

- **Assess if water quality objectives are met** - Use measurements from monitoring of each relevant indicator to assess whether water quality meets the water quality objectives
- **Consider additional indicators or refine water quality objectives** - Assess the need to revise or add to the lines of evidence or indicators and the water quality guideline values
- **Consider alternative management strategies** - Evaluate the effectiveness of current management strategies to address the identified water quality issues and recommend possible improvements. Improved or alternative management strategies are formulated, assessed and prioritised
- **Assess if water quality objectives are achievable** - Use information gained to assess whether the water quality objectives are achievable.

2.10 Reporting

MidCoast Council is committed to open access to information. The results of implementing the MERI Plan for the Manning River estuary and catchment will be reported to the ECMP Reference Group and community through established engagement methods (e.g. Water Quality Report Card, Creek to Coast newsletters).

Implementation of this MERI Plan forms a component of the ECMP Actions. MERI activities undertaken by MidCoast Council will also form part of the Monitoring and Evaluation Program for the ECMP (refer to Section 10.2 of ECMP).

References and informing documents

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Attachment 1 – MERI Programs for the Manning River Estuary and Catchment

Estuary Ecological Health Report Card Monitoring	
Value	Ecosystem Health
ECMP Objectives	<p>Theme 2: Water Quality and Ecosystem Health – Manage the Manning River catchment and its estuary holistically to maintain and improve water quality and ecosystem services.</p> <p>Theme 4: Biodiversity – Protect and conserve natural character and biological diversity.</p>
Monitoring Questions	<ul style="list-style-type: none"> • What is the ecological health of the Manning River estuary? • How does the condition of the Manning River estuary compare to past conditions? • Is the environmental value 'ecosystem health' being maintained? • Does the condition of the estuarine reaches of the Manning River change following the implementation of the ECMP?
Environmental Indicators	<p>Turbidity Chlorophyll-a Seagrass depth range</p> <p><i>Additional data on stressors (e.g. Salinity, Temperature) is also collected to assist with data interpretation.</i></p>
Method	<p>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 requires further investigation.</p> <p>Samples are taken in accordance with the New South Wales Monitoring, Evaluation and Reporting protocols which are described in full in Roper et al. (2011).</p> <p>The measured values of all indicators are summarised into one value which can then be compared between different reporting zones.</p> <p>Two calculations are performed for each zone:</p> <ul style="list-style-type: none"> • 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.

Estuary Ecological Health Report Card Monitoring

Using these results a final Report Card grade is assigned (see Figure A); these grade definitions are linked to the environmental values and are structured to allow easy comparison between each system and over time. 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).

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

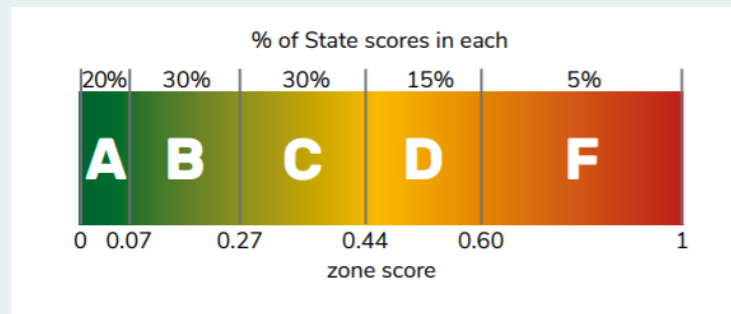


Figure A: Example Report Card Grades

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, details of the sampling methodology are outlined in the MidCoast Council 2020 Technical Report - Waterway and Catchment Report Card.

In addition to the monitoring of the ecological indicators, monitoring of additional stressors is undertaken as part of this project. This includes pH, temperature, dissolved oxygen, nutrients (phosphates, total dissolved nitrogen, ammonia) salinity and silica. These results are not reported on in the annual Report Card, however can be used as further information when undertaking stepwise investigations and interpreting the ecological indicator results.

Monitoring locations

Monitoring Locations:

- Upper Manning Estuary
- Mid Manning Estuary
- Lower Manning Estuary
- Dawson River Estuary
- Farquhar Inlet
- Browns Creek

Estuary Ecological Health Report Card Monitoring



Figure B: Estuary Ecological Health Report Card Monitoring Locations

There is potential for additional sites to be included to monitor change in areas identified as 'high risk' in the spatial risk assessment (e.g. locations such as the estuarine reaches of the Lansdowne River).

Trigger levels / Thresholds

A requirement for further investigation will be triggered if:

- there is a decline in the overall grade at any site,
- there is a decline in the score (for turbidity or chlorophyll-a) within a grade, and/or
- poor grades are recorded for the stressors at a site.

Investigation will be stepwise and include analysis of climatic conditions, the stressor data, potential pressures (through catchment investigations) followed by more detailed sampling and spatial analysis to determine the location and nature of the impact that could be contributing to the change in grade and score..

If a site scores poorly (D-E) or if there is a declining trend in the overall grade, results of further investigations which occur as a result of reaching a trigger level will be used to revise or add management actions to the ECMP.

Frequency

Annually (The data is collected fortnightly over the summer months October – March each year.)

How will data be reported?

Ecological health results will be presented in the Annual Report Card, Technical Report, through community engagement events and on the MidCoast Council website.

Lead Agency

MidCoast Council with scientific work undertaken by the NSW Department of Planning, Industry and Environment (DPIE)

Cost

\$45,000 annually including presentation of the Report Card

Supporting Information

MidCoast Council 2020 Technical Report - Waterway and Catchment Report Card. [2020 Waterways and Catchment Report Card - MidCoast Council \(nsw.gov.au\)](https://www.mccouncil.nsw.gov.au/2020-Waterways-and-Catchment-Report-Card-MidCoast-Council)

Roper T, Creese B, Scanes P, Stephens K, Williams R, Dela-Cruz J, Coade G, Coates B and Fraser M (2011), Assessing the Condition of Estuaries and Coastal Lake Ecosystems in NSW: Technical Report – NSW State of the Catchments 2010, Department of Environment, Climate Change and Water NSW, Sydney – www.environment.nsw.gov.au/resources/soc/20110717EstuariesTRS.pdf

Freshwater Ecological Health Report Card Monitoring

Values	Ecosystem Health
ECMP Objectives	<p>Theme 2: Water Quality and Ecosystem Health – Manage the Manning River catchment and its estuary holistically to maintain and improve water quality and ecosystem services.</p> <p>Theme 4: Biodiversity – Protect and conserve natural character and biological diversity.</p>
Monitoring Questions	<ul style="list-style-type: none"> • What is the ecological condition of the freshwater reaches of the Manning River? • How does the ecological condition of the freshwater reaches of the Manning River compare to past condition? • Is the environmental value 'ecosystem health' being maintained in the freshwater reaches of the Manning River catchment? • Does the condition of the freshwater reaches of the Manning River change following the implementation of the Manning River ECMP?
Environmental Indicators	<p>Turbidity Chlorophyll-a Macroinvertebrates Riparian condition Reach condition</p> <p><i>Additional data on stressors (e.g. Salinity, Temperature) is also collected to assist with data interpretation.</i></p>
Method	<p>Sites will be selected as per the methodology (monitoring locations) below and at each identified site the following will be undertaken:</p> <ul style="list-style-type: none"> • collect water samples for analysis of nutrients, chlorophyll-a and total suspended solids; • use a calibrated water quality meter to measure water temperature, pH, conductivity, turbidity and dissolved oxygen; • use field titration to measure alkalinity; • collect aquatic macroinvertebrates in accordance with AUSRIVAS protocols; • photograph each stream reach; • describe local land use and visible condition of stream habitat; • describe the geomorphological condition of each reach; and • assess the condition of the riparian zone vegetation. <p>The results of this sampling are then calculated into a zone score and a report card grade. In each catchment zone there will be between one and four sites. The macroinvertebrate and chlorophyll-a scores for these groups of sites are averaged and rounded up to a whole number to provide the ecological score and Report Card grade for each area of the catchment.</p> <p>Note: <i>Department of Planning, Industry and Environment are currently working on refining the methodology for freshwater ecological surveys and this methodology may be updated accordingly.</i></p>

Freshwater Ecological Health Report Card Monitoring

Monitoring locations	Sites will be selected across the catchment to represent different land use categories and least impacted sites. This will involve desktop assessment of subcatchments in GIS considering land use (ALUMv8), Riverstyles, and existing data for water quality and macroinvertebrates to guide site selection. Sites will be based on previous data collected (AUSRIVAS) and sites included in the <i>Manning River Estuary and Catchment Rapid Site Assessment</i> (2020). Sites will also include known locations of high risk within the freshwater reaches of the catchment (e.g. Dingo Creek).
Trigger levels	<p>Report scorecard grades will be based on water quality criteria (ANZG 2018) and AUSRIVAS Australian River Assessment System criteria.</p> <p>A requirement for further investigation will be triggered if:</p> <ul style="list-style-type: none"> • there is a decline in the overall grade at any site, • there is a decline in the score (for macroinvertebrates, chlorophyll-a, riparian condition and/or geomorphic condition) within a grade, and/or • poor grades are recorded for the stressors at a site. <p>Investigation will be stepwise and include analysis of climatic conditions, the stressor data, potential pressures (through catchment investigations) followed by more detailed sampling and spatial analysis to determine the location and nature of the impact that could be contributing to the poor score on the stressor data or change in grade and score.</p>
Frequency	<p>Twice in 10 years: base-line and program completion</p> <p>Note: <i>Three monitoring events in 10 years is recommended if resources allow for better assessment of change over time.</i></p>
Reporting	Ecological health results will be presented in a Report Card, Technical Report, through community engagement events and on the MidCoast Council website.
Lead Agency	MidCoast Council in partnership with scientists from other Government Agencies and incorporating collection of data through citizen science programs.
Cost	\$150,000 each monitoring event (2 monitoring occasions)
Supporting Information	<p>Swanson, R. 2020. <i>Manning River Estuary and Catchment Rapid Site Assessment. A snapshot of stream condition in the Manning River Estuary and its catchment from the ground truthing program.</i> Environment, Energy and Science. NSW Government, Sydney.</p> <p>NSW Water Quality Objectives for the Manning River Estuary and Catchment</p>

Freshwater Water Quality Monitoring	
Values	Ecosystem Health
ECMP Objectives	<p>Theme 2: Water Quality and Ecosystem Health – Manage the Manning River catchment and its estuary holistically to maintain and improve water quality and ecosystem services.</p> <p>Theme 4: Biodiversity – Protect and conserve natural character and biological diversity.</p>
Monitoring Questions	<ul style="list-style-type: none"> • What are the baseline water quality levels at key locations with the freshwater reaches of the Manning River catchment? • How does the water quality at key locations within the freshwater reaches of the Manning River catchment compare to past measurements? • How is water quality in the freshwater reaches of the Manning River catchment affected by climate (rainfall, drought, climate change)?
Environmental Indicators	<p>Chlorophyll-a Turbidity Salinity Nutrients</p> <p><i>Additional data on stressors (e.g. Temperature) is also collected to aid data interpretation.</i></p>
Method	Water quality will be monitored for Nutrients, Turbidity and Salinity against ANZECC criteria. Sampling will be in accordance with Water NSW and MidCoast Council's standard collection methods.
Monitoring locations	<p>Water quality monitoring will be undertaken at the following sites:</p> <ul style="list-style-type: none"> • Little Manning River (Gloryvale Reserve) • Barrington River (Rocky Crossing, Barrington Bridge) • Barnard River (Bretti Reserve) • Nowendoc River
Trigger levels	Water quality trigger levels are the default guideline values (ANZG 2018) for slightly to moderately disturbed systems.
Frequency	Quarterly
Reporting	Annually to the ECMP Reference Group
Lead Agency	MidCoast Council in partnership with scientists from other Government Agencies and incorporating collection of data through citizen science programs
Cost	\$7,200 annually
Supporting Information	<p>Swanson, R. 2020. Manning River Estuary and Catchment Rapid Site Assessment. A snapshot of stream condition in the Manning River Estuary and its catchment from the ground truthing program. Environment, Energy and Science. NSW Government, Sydney.</p> <p>NSW Water Quality Objectives for the Manning River Estuary and Catchment</p>

Acid Sulfate Runoff Monitoring	
Value	Ecosystem Health
ECMP Objective	Theme 2: Water Quality and Ecosystem Health – Manage the Manning River catchment and its estuary holistically to maintain and improve water quality and ecosystem services.
Monitoring Questions	<ul style="list-style-type: none"> What is the quality of the water draining off the Big Swamp floodplain into the Lower Manning estuary? Is the rehabilitation of the Big Swamp floodplain having an effect on the water quality draining into the Lower Manning estuary?
Environmental Indicators	pH Dissolved oxygen Salinity (Electrical conductivity) Temperature
Method	Six multi-sensor water quality loggers are installed at strategic locations across the Big Swamp area. The water quality loggers are programmed to measure pH, temperature, electrical conductivity (EC) and water levels on an hourly basis. In addition, water quality loggers located at Angelina Mouth, Angelina Swamp and the Eastern Swale Drain record dissolved oxygen (DO). Further, an elevated remote camera is programmed to take daily photographs of changes occurring within the remediated tidal wetland at Big Swamp.
Monitoring locations	Big Swamp Monitoring Locations: <ul style="list-style-type: none"> Cattai Creek Coralville Bridge Angelina Mouth Eastern Swale Drain Cockatoo Island Manning River (at Cattai Creek)
Trigger levels	Water quality trigger levels are the default guideline values (ANZG 2018) for slightly to moderately disturbed systems.
Frequency	Annually
How will data be reported?	An annual report of the monitoring program is produced as part of the Big Swamp Rehabilitation Project. This report will be provided to the ECMP Reference Group.
Lead Agency	MidCoast Council with scientific work undertaken by UNSW Water Research Laboratory
Cost	\$30,000 annually
Supporting Information	Ruprecht, J.E., Harrison, A.J., Glamore, W.C. (2021) <i>Big Swamp Rehabilitation Project: 2020 Annual Monitoring Report</i> , Water Research Laboratory, UNSW Sydney. Rehabilitation of Acid Sulfate Soils - MidCoast Council (nsw.gov.au)

Climate Change Baseline Monitoring	
Value	Ecosystem Health
ECMP Objective	Theme 3: Climate Change – Understand, mitigate, adapt and build resilience to current and future hazards including the impacts of climate change.
Monitoring Questions	<ul style="list-style-type: none"> • How is climate change affecting waterway conditions - salinity, temperature and tidal influence in the Manning River estuary? • Does salt intrusion become more prevalent over time at different locations along the Manning River as a result of climate change?
Environmental Indicators	Water level, salinity and temperature (measured at depth and at the surface).
Method	<p>To ensure that this monitoring program is well informed, a conceptual model describing the conditions under which a salt wedge is likely to form, how far it would travel upstream and how deep the salt wedge is likely to be should be developed prior to installing additional salinity and temperature recorders.</p> <p>Continuously recording near surface and near bed instruments should be installed at a minimum of 3 sites (5 locations would be preferable) and integrated into the existing monitoring program. Salinity at the upstream end of the estuary is of interest, particularly with a rising mean sea level. This information may assist with managing any future impacts at the potable water supply offtake upstream of Wingham.</p> <p>At present, five tidal water level stations are maintained in the Manning Estuary at Wingham, Taree, Cundletown, Croki and Harrington. This data has been collected under the NSW Coastal Data Network Program managed by the Climate Change and Sustainability Division of the Department of Planning, Industry and Environment (CCSD). Two sites at Wingham and Taree West collect salinity and temperature data. As noted in the ECMP actions, a platform for sharing data among agencies will be required.</p>
Monitoring locations	TBA based on existing sites and conceptual analysis (above). Note: MHL and Water NSW have an established network of sensors.
Trigger levels	Not applicable - data for this program is being collected to understand climate change impacts in this locality.
Frequency	Annually
How will data be reported?	Annually to the ECMP Reference Group
Lead Agency	MidCoast Council – Transport Assets
Cost	<p>\$11,000 in Year 1 to set up.</p> <p>\$2,000 annually for ongoing for maintenance.</p>

Stormwater Gross Pollutant Trap Monitoring	
Values	Ecosystem Health Visual Amenity & Recreation (Aesthetic values only)
ECMP Objectives	Theme 2: Water Quality and Ecosystem Health – Manage the Manning River catchment and its estuary holistically to maintain and improve water quality and ecosystem services. Theme 5: Social and Economic Values – Manage the Manning River catchment and its estuary to maintain and improve social, cultural, and economic opportunities and benefits.
Monitoring Questions	<ul style="list-style-type: none"> • What is the condition of the gross pollutant traps in the Manning River estuary and catchment? • Are the gross pollutant traps in the Manning River estuary and catchment being maintained to MidCoast Council standards? • When is the optimum time to clean out the gross pollutant traps?
Environmental Indicators	Measured pollution as a percentage of sump volume
Method	Gross pollutant traps contain holding chambers where materials collected from stormwater runoff are contained until they are emptied. The depth to pollution within the chamber is measured using a surveying staff. The percentage full for the device is then calculated using a formula specific to the device type. Monitoring will be completed bi-monthly by MidCoast Council staff in accordance with the specific data sheet for each device.
Monitoring locations	Monitoring will be undertaken at all gross pollutant trap sites throughout the Manning catchment.
Trigger Level	Measured gross pollutant traps pollution volume is >80% sump volume
How will data be reported?	Data will be recorded in MidCoast Council's asset management system.
Frequency	Bi-monthly
Lead Agency	MidCoast Council – Operations team
Cost	Operational task – no additional cost
Supporting information	MidCoast Council Gross Pollutant Trap Cleaning Specifications.

Citizen Science Monitoring - Waterwatch	
Values	Ecosystem Health Visual Amenity & Recreation (Aesthetic values only)
ECMP Objectives	Theme 2: Water Quality and Ecosystem Health – Manage the Manning River catchment and its estuary holistically to maintain and improve water quality and ecosystem services. Theme 5: Social and Economic Values – Manage the Manning River catchment and its estuary to maintain and improve social, cultural, and economic opportunities and benefits.
Monitoring Question	<ul style="list-style-type: none"> What is the condition of water quality at Waterwatch sites in the Manning River estuary and catchment and do these change over time?
Environmental Indicators	Macroinvertebrates Turbidity Oil/Debris/Wrack
Method	<p>The methodology for water quality testing is laid out in the Senior Waterwatch Manual 2010. Waterwatch training can be undertaken with interested community groups including landholders, school groups and community groups e.g. MRTG and OzFish. Waterwatch kits can be provided to these groups as loans or permanent kits.</p> <p>The presence of Macroinvertebrates to assess creek condition is undertaken using the Australian River Assessment System (AUSRIVAS) sampling methods.</p>
Monitoring locations	Throughout the catchment, particularly in areas where schools and community groups are active.
Trigger levels	Water quality trigger levels are the default guideline values (ANZG 2018) for slightly to moderately disturbed systems.
Frequency	Ad Hoc by community volunteers
How will data be reported?	Water quality data will be uploaded to the Waterwatch database and reported annually to the ECMP Reference Group.
Lead Agency	MidCoast Council
Cost	\$10,000 annually
Supporting Information	NSW Waterwatch Citizen Science Program

Water Quality Monitoring – Recreational Use (Human Health)

Value	Visual Amenity and Recreation
ECMP Objectives	Theme 5: Social and Economic Values – Manage the Manning River catchment and its estuary to maintain and improve social, cultural, and economic opportunities and benefits.
Monitoring Questions	<ul style="list-style-type: none"> Is the water quality in the Manning River estuary and catchment safe for primary contact recreation (e.g. swimming)? Is the water quality in the Manning River estuary and catchment safe for secondary contact recreation (e.g. fishing and boating)?
Environmental Indicators	<p>Faecal Coliform</p> <p><i>Note: Additional water quality data is collected as required by Environmental Licences.</i></p>
Method	<p>It is considered that the monitoring undertaken to meet the licencing requirements for water supply and sewage treatment plants addresses the water quality objectives for primary and secondary contact recreation.</p> <p><i>Water Supply Offtakes</i> Water quality is monitored at water supply offtakes within the Manning River catchment in accordance with MidCoast Council's Drinking Water Quality Management System (DWQMS). The DWQMS has been developed in accordance with the Australian Drinking Water Guidelines (2011), the <i>Public Health Act 2010</i> and <i>Public Health Regulation 2012</i>.</p> <p><i>Sewage Treatment Plants</i> Standards for wastewater are set out in the individual licences for each sewage treatment plant. These licences are issued by the NSW Environment Protection Authority (EPA). Licence conditions are related to the volume of the receiving waters and the sensitivity of the environment, including recreational use. The number of tests, frequency of reporting and acceptable levels for each test vary, depending where the plant discharges its treated effluent. Testing of the water in the receiving environments including surface, estuarine and groundwater, is done to ensure the effluent is returned safely into the natural water cycle.</p> <p>Pollution incidents from sewage reticulation systems are managed according to MidCoast Councils Pollution Incident Response Management Plans.</p> <p>In accordance with the Water Quality Management Framework (Figure 3) if the water quality objectives for primary and secondary contact recreation are at risk, MidCoast Council will undertake further investigation consistent with the <i>Guidelines for Managing Risks in Recreational Water</i>, National Health and Medical Research Council, Australian Government (2008).</p>
Monitoring locations	<p>Sites (including those for EPA licences) are situated in the Lower Manning River where much of the primary and secondary recreation occurs.</p> <p>Monitoring locations include:</p> <ul style="list-style-type: none"> compliance monitoring locations set out in the individual EPA licences for each sewage treatment plant; and identified key recreational locations in the Manning River Catchment (event based - as required).

Water Quality Monitoring – Recreational Use (Human Health)

Trigger levels	Water quality trigger levels are the default guideline values (NHMRC 2008) for recreational use.
Frequency	Varies depending on purpose (e.g. weekly, bi-monthly, event based)
How will data be reported?	Data will be reported to the ECMP Reference Group and made available on MidCoast Council's website.
Lead Agency	MidCoast Council
Cost	Operational task – no additional cost
Supporting Information	Sewerage services - MidCoast Council (nsw.gov.au) Drinking Water Quality - MidCoast Council (nsw.gov.au) NHMRC 2008. <i>Guidelines for Managing Risks in Recreational Water</i> , Australian Government National Health and Medical Research Council.

Event Based Monitoring

Value	Ecosystem Health
ECMP Objectives	<p>Theme 2: Water Quality and Ecosystem Health – Manage the Manning River catchment and its estuary holistically to maintain and improve water quality and ecosystem services.</p> <p>Theme 3: Climate change – Understand, mitigate, adapt and build resilience to current and future hazards including the impacts of climate change.</p> <p>Theme 4: Biodiversity – Protect and conserve natural character and biological diversity.</p>
Monitoring Questions	<p><u>Ecosystem Health</u></p> <ul style="list-style-type: none"> • How does the ecological health of the Manning River estuary respond to flood conditions, fire or drought? • How long does it take for the estuary to return to baseline conditions? <p><u>Estuary hydrodynamics</u></p> <ul style="list-style-type: none"> • How far does the tide extend into the Manning River estuary under normal conditions and following moderate to major floods? • How quickly does the flood wave propagate downstream following moderate to major floods? • How does data collected during floods correlate with flood modelling results? • Does opening Farquhar affect water levels of the estuary?
Environmental Indicators	<p>Indicators differ depending on the type of event (e.g. flood, bushfire, drought) and the waterway responses MidCoast Council seeks to monitor (e.g. pH for acid events):</p> <p><u>Ecosystem Health</u></p> <p><i>Flood</i> - After a flood event indicators would include: pH (to assess acid runoff); chlorophyll-a (to assess algal growth) turbidity (to assess sediment influx), salinity, nutrients (to assess nutrient inputs in the catchment), DO (to assess oxygen levels that could lead to blackwater events that can result in fish kills). Measurements will include depth profiles to determine the degree of stratification within the water column.</p> <p><i>Drought</i> - During a drought event, longer term monitoring may need to be undertaken and useful indicators will include salinity (to assess issues such as the extent of the salt wedge within the estuary, in this case monitoring at depth would be important) pH (to assess acid runoff); chlorophyll-a (to assess algal growth) turbidity (to assess water clarity), nutrients (to assess baseline nutrient inputs in the catchment), DO (to assess oxygen levels required by flora and fauna)</p> <p><i>Bushfire</i> - After a fire event useful indicators would include pH (to assess changes in acid levels from the soil and associated runoff); chlorophyll-a (to assess algal increases from the breakdown of materials) turbidity (to assess changes in clarity from the addition of sediments and other organic materials), salinity (to assess stratification), nutrients (to assess nutrient inputs from the catchment), DO (to assess oxygen levels that could lead to fish kills etc)</p> <p><u>Estuary hydrodynamics</u></p> <p>Indicators will include changes to the entrance bathymetry and sediment between Harrington and Croki as well as salinity, water levels and temperature (as noted in the 'climate change' methodology).</p>

Event Based Monitoring

Method	<p><u>Ecosystem Health</u> Methodology and frequency of monitoring will need to be tailored based on the large-scale event that is the trigger for monitoring. The methodology to monitor ecosystem health will be based on scientific advice will be evaluated in consultation with ECMP Stakeholders.</p> <p><u>Estuary Bathymetry and Sediments</u> Monitoring will include the collection of bathymetric data for Farquhar and Harrington entrances annually and following moderate and major floods. This assessment will include measuring the depth of sediment at the entrance at Harrington to Croki. This data will be used to interpret and provide insight into the water levels / tidal range, salinity levels (including migration of the salt wedge) and temperature data collected during the ongoing 'climate change' monitoring program (before and after flooding events).</p>
Monitoring locations	Monitoring locations will be determined based on the area impacted by the event.
Trigger levels	Not applicable, data for this program is being collected to understand the impact of major flooding, fire or drought events on estuary health and hydrodynamics.
Frequency	<p>Coincides with extreme weather events</p> <p>Bathymetry survey undertaken twice in 10 years.</p>
How will data be reported?	Data recorded after a flood event will be reported on as part of regular MERI projects such as the Report Card or event-based reports can be produced as necessary for the ECMP Reference Group.
Lead Agency	<p>MidCoast Council – Transport Assets (Hydrodynamics)</p> <p>MidCoast Council – Natural Systems (Estuary Health)</p> <p>MidCoast Council – Environmental Health (Human Health)</p>
Cost	<p>\$40,000 annually for bathymetry survey (2 x surveys)</p> <p>\$50,000 for ecological event monitoring over 10 years (based on 7 visits to estuary monitoring sites)</p>