



**MIDCOAST**  
council



**MANNING  
RIVER  
ESTUARY &  
CATCHMENT**



# **MANAGEMENT OPTIONS EVALUATION REPORT 2021**

Annexure K

# Manning River Management Options Evaluation to Support the Manning River Catchment Management Program

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## Executive Summary

MidCoast Council (MCC) engaged a consulting team led by Salients and including the Centre for International Economics (CIE), the University of Newcastle (UoN), and Alluvium Consulting, to assess a suite of management options proposed for the Manning River Catchment Management Program (CMP). The CMP was being prepared in accordance with the requirements of the *Coastal Management Act 2016* (CM Act).

Initially, a long list of 117 management options was provided to the study team. These were reviewed during a series of workshops with MCC and other stakeholders and subsequently filtered down to a short list of 45 options for assessment.

The 45 options were subjected to varying degrees of assessment for acceptability, feasibility and viability, depending on complexity and magnitude as follows:

- 1 31 options were identified as “*Direct Progression*” options. These included options that involved studies to inform future management, community engagement activities and cheaper actions with a good track record of successful implementation. Cost estimates for these options were made and a multi-criteria analysis was completed to confirm consistency with the CM Act.
- 2 Eight (8) options were identified for moderate level assessment. These included options where there was some expense involved, complexity or uncertainty relating to feasibility or overall viability. For those options, the multi-criteria assessment, described under the first dot point, was completed alongside a more rigorous, but still qualitative, consideration of feasibility and a more robust assessment of costs.
- 3 The remaining six (6) options were subjected to study by the Centre for International Economics (CIE). These options were selected during the initial workshops and refined. The analyses of CIE, depending on the option being considered, comprised detail between that of the moderate level assessment (see dot point 2) to an “intermediate” level assessment, under the classification outlined in Figure B3.26 of the *Coastal Management Manual*. The report of CIE is provided as Appendix E.

All options put forward were inherently “Acceptable”, having arisen from an extensive stakeholder consultation effort.

All options are “Feasible” in the sense that there is no key impediment from a legal, technical or engineering perspective. In some cases, future study to better direct actions at specific sites and/or follow up engineering design may be required as the

CMP is implemented. In that case, those “on-ground” actions should be deferred until the required studies have been completed.

All options, except for one (Option 2.05: to study the buyback of water licenses) are “Viable” in that they have been assessed as being good value for money. Importantly though, none of the options have been subjected to a full cost benefit analysis where attempts are made to quantify, in \$ terms, the full suite of benefits arising from the management option being assessed. Viability has been assessed, in part, by considering the amounts that would normally be spent on similar activities.

For two of the management options subjected to more detailed assessment by the CIE, it was determined that these demonstrated a potential to result in net benefits, but that this would be dependent on the actual sites where these are applied. Accordingly, the CIE report recommends that site specific evaluation be undertaken before completing works at each site. The two management options where this is the case are:

- Option 2.03: Relating to improving riparian and estuarine bank vegetation.
- Option 4.01: Relating to addressing barriers to fish passage.

We note that the activities represented by these options have a track record of providing successful outcomes if executed with experienced judgement. While site specific evaluation is recommended, the smaller scale of the individual sites at which these actions will be implemented does not warrant a separate additional detailed economic evaluation. Nevertheless, site selection should be well informed and based on sound science. Both options 2.03 and 4.01 are assessed as being viable, subject to the above caveat.

Even if a management action is considered “Acceptable”, “Feasible” and “Viable”, this does not mean that it can be automatically carried out as part of the CMP. The existing funding environment is constrained and varies from year to year, depending on government priorities and other factors.

Funding availability, prioritisation of management actions and sequencing, where relevant, have all been considered in timetabling management actions within the business plan that accompanies the CMP.

A summary of the 45 options, including a description of the option and the assessment method used, is presented in Table 1. Importantly, negotiations during development of the CMP, following the work reported herein, have resulted in several changes to management options, with some options modified, some ‘no regrets’ options added, and some options amalgamated. This means that not all options assessed as being feasible were ultimately carried forwards to the CMP. The CMP should be referenced for the final adopted list of management actions.



**Table 1 Summary of Final Options**

Final Option No.	Final Option Description	Assessment Method	Justification
1.01	Undertake a needs assessment, develop and deliver an engagement program to build understanding of ecosystem values and services; the environmental, social and economic impacts of poor land and water management; regulations and responsibilities for land management; how to report illegal activities and the integrated benefits of good management practice and sustainable behaviours.	Direct Progression	Section 8A of the Local Government Act 1993 notes that councils should “ <i>actively engage with the community</i> ”, “ <i>recognise diverse local community needs and interests</i> ”, and that “ <i>decision-making should be transparent</i> ”. The Coastal Management Act 1993 has an object to “ <i>Support public participation and greater public awareness</i> ”.
1.02	Establish a Best Environmental Management Practice framework for whole farm planning in the Manning catchment including the estuary.	Direct Progression	During workshops undertaken to analyse issues associated with agricultural practice, the need for environmental ‘best practice’ to enable premium pricing of produce from the area was identified. However, it was also recognised that what constitutes ‘best practice’ is not well defined or agreed upon.
1.03	Partner with farmers on the floodplain to undertake and evaluate field trials of best management and innovative practices to maintain productivity and ecosystem services at a range of elevations and soil types.	Direct Progression	This option follows & complements option 1.02.
1.04	Promote and facilitate establishment of 30 private conservation agreements covering 1500 ha in the Manning catchment by 2030, through Land for Wildlife and Biodiversity Conservation Trust.	Direct Progression	Protecting and enhancing vegetation coverage of the catchment will help reduce erosion and sedimentation from runoff. The work is consistent with Goal 3 of Hunter LLS’s Local Strategic Plan “ <i>Healthy, diverse, connected natural environments</i> ”. This option is relatively low cost.
1.05	Adopt a set of significant flagship and indicator species with Aboriginal and community input to use in monitoring and community engagement programs.	Direct Progression	This is another relatively low-cost option. The concept has been utilised in conservation biology for some time. However, the usefulness of adopting flagship species as a community education/engagement tool has more recently been acknowledged through research.
1.06	Establish an annual citizen science BioBlitz through the Atlas of Living Australia to document aquatic and riparian biodiversity of the Manning River and estuary.	Moderate	Suitable for progression to CMP, refer to Section 4.2.
1.07	Develop a litter and stormwater pollution source control program: - Monitor and report annually on the volume, type and location of litter collected during GPT maintenance and clean-up days. - Utilise this data for targeted education and engagement campaigns. - Develop source control plans for identified hot spot locations. - Support community and industry groups to complete a minimum of one litter clean up event each year in identified hot spot locations.	Moderate	Suitable for progression to CMP, refer to Section 4.3.
1.08	Develop and distribute education material and guidelines to promote and improve erosion and sediment control (ESC) on private land including better management of driveways, earthworks and dam walls.	Direct Progression	Sediment eroded from the catchment is a key waterway pollutant. Pollution of waterways is an offence under the <i>Protection of the Environment Operations Act 1997</i> . These materials proposed would both educate and help rural landowners avoid committing an offence.
1.09	Improve erosion and sediment control (ESC): - Develop a comprehensive erosion and sediment control management system within MCC. Identify improvements required; set benchmarks; undertake audits and share results to build capacity. - Develop and implement an ESC capacity building program for designers, builders, engineering consultants and developers. Follow up with a proactive, targeted compliance program by 2025.	Direct Progression	Justification for this action is similar to that for 1.08. However, the target for this action is developing an effective system for Council internally and to educate builders, consultants and developers.
2.01	Implement key priority acid sulfate soil management actions from the Manning River Floodplain Prioritisation Study 2021 including: - Reinstate 1550 ha of coastal wetlands on public and private land subject landholder agreement. - Audit, upgrade or replace Council floodgates within the Lower Manning Floodplain and add them to MCC's Asset Management Program.	Intermediate	Suitable for progression to CMP, refer to Section 5.2.

Final Option No.	Final Option Description	Assessment Method	Justification
2.02	Protect and/or rehabilitate coastal wetlands, including the restoration of intertidal hydrology to previously drained areas: - Undertake field investigations and implement actions to exclude stock and restore tidal flushing at three coastal wetland sites on Mitchell Island in partnership with landholders by 2025, as recommended by the Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment. - Protect and restore a further 100 ha on both public and private land by 2030.	Intermediate	Suitable for progression to CMP, refer to Section 5.3.
2.03	Improve the condition, extent and connectivity of riparian and estuarine bank vegetation on private and public land by protecting and/or restoring 100 km of buffer vegetation by 2030.	Intermediate	Suitable for progression to CMP, refer to Section 5.4.
2.04	Model good catchment management practice on public land by (1) Establishing a demonstration site for coastal wetland management on public land showcasing agricultural best management practice and maintenance of ecosystem services by 2025; (2) ensure new grazing permits license conditions include appropriate controls to prevent stock impacts on riparian vegetation and coastal wetlands; and (3) undertake annual inspections to monitor compliance.	Moderate	Suitable for progression to CMP, refer to Section 5.5.
2.05	Prepare a report assessing the feasibility, viability and acceptability of purchasing and retiring un-used water licenses to secure environmental water.	Intermediate	<b>Not suitable</b> for progression to CMP, refer to Section 5.6.
2.06	Implement the Manning River Taskforce Recommendation 1: that the proposed Manning River Entrance Project is entered into the Infrastructure NSW Investor Assurance and NSW Treasury business case process. The development of a Strategic Business Case (SBC) is required to further analyse the optimal engineering outcome, the broader impacts of intervention in the area, and the relative costs and benefits of the identified options. If the benefits are found to outweigh the costs of the project, a more rigorous engineering, constructability, and environmental impact assessment should be undertaken in a Final Business Case prior to a decision to invest in a permanent solution.	Direct Progression	This recommendation has arisen from the separate Manning River Taskforce process and is being pursued by Transport for NSW.
2.07	Implement the Manning River Taskforce Recommendation 2: that any future process should be supported by an extensive stakeholder consultation process that includes the local community and impacted industries and stakeholders as well as consideration of progress in the development of Mid-Coast Council's two CMPs.	Direct Progression	Similar to option 2.06, this is a recommendation of the Manning River Taskforce report and is consistent with the objects of the Coastal Management Act 2016.
2.08	Implement a systematic approach to maintaining stormwater quality improvement devices: - Refurbish 5 proprietary Stormwater Quality Improvement Devices to achieve their full working capacity by 2022. - Incorporate Water Sensitive Design devices in the MCC asset management system by 2023 and implement the monitoring, maintenance and renewal program. - Complete a report on the upgrade of Wingham Wetland, including feasibility, budget and scope of works. Implement resulting actions by 2025.	Intermediate	Suitable for progression to CMP, refer to Section 5.7.
2.08 (Part) 2.09	Review, revise and supplement MCC's current stormwater guidelines, policies and procedures and seek opportunities to incorporate Water Sensitive Urban Design into MCC's new and upgraded infrastructure.	Direct Progression	Urban stormwater discharge is a key waterway pollutant. Pollution of waterways is an offence under the <i>Protection of the Environment Operations Act 1997</i> . The formal inclusion of stormwater devices draining to the Manning River and tributaries within council's asset management system and upgrade of Council's varied policies and procedures relating to stormwater and Water Sensitive Urban Design will help mitigate pollution.
2.10	Revise the Greater Taree urban stormwater Management Plan (2000) by 2025, adding the township of Gloucester. Implement resulting Actions.	Direct Progression	This aims to upgrade the outdated Greater Taree Urban Stormwater Management Plan. As for Option 2.08/2.09, the aim is to reduce the Pollution of Waterways.
2.11	Complete a study which prioritises sensitive estuarine riverbank areas for management. Follow up by stabilising 7.5 km with engineering structures by 2030.	Moderate	Suitable for progression to CMP, refer to Section 5.8.

Final Option No.	Final Option Description	Assessment Method	Justification
2.12	Monitor and report on recreational boating frequency in subcatchments where boatwash erosion is identified as high risk (2.11). Consider introducing additional no-wash zones when the Manning River Boating Strategy is reviewed.	Direct Progression	The Coastal Management Manual refers to the potential impact of boat wash on foreshore erosion as being an issue in some locations. During consultation for the CMP, boat wash was identified as being of some concern within the Lansdowne River. However, the scale of the issue is not well understood at present.
2.13	Identify, assess and prioritise sediment hotspots from unsealed roads. Remediate 30 sites by 2030.	Moderate	Suitable for progression to CMP, refer to Section 5.9.
2.14	Complete MCC's Onsite Sewerage Management System (OSSM) Audit and Compliance Strategy by 2022 and implement with a proactive inspection program in identified high-risk locations.	Direct Progression	Under the Local Government (General) Regulation 2005, MCC has an obligation to administer the installation, construction, alteration and operation of on-site sewerage management systems. A lack of capacity within MCC to audit and comply with council's obligations was identified and this option's aim is to address that shortfall.
2.15	Undertake monitoring, evaluation and reporting of ecosystem health to guide adaptive management: - Implement the Manning CMP MER Program - Ecosystem Health; - Establish a platform for data sharing between agencies.	Direct Progression	A programme for Monitoring, Evaluation and Reporting on the delivery of the CMP is a mandatory requirement of the CMP. This action covers off on the activities required to deliver the required MER program.
3.01	Use research data identifying retreat buffer zones for coastal wetlands and littoral rainforest under sea-level rise scenarios to develop a forward plan to retain suitable buffers in partnership with landholders.	Direct Progression	<i>Coastal Wetlands and littoral rainforests</i> are more highly ranked than the other coastal management areas in the coastal management act. Resilience of these features <i>including opportunities for migration</i> is one of the objectives for coastal wetlands and littoral rainforests.
3.02	Commission a study that identifies Council assets at risk from SLR (e.g., roads, stormwater systems, and river access facilities) and develops appropriate standards, cost estimates and forward plans for upgrade and replacements through Council's Asset Management Program.	Direct Progression	Sea level rise has the potential to exacerbate the tidal inundation coastal hazard on built assets owned by Council. Several of the coastal vulnerability objectives in the Coastal Management Act require the consideration of these impacts. The extent of these impacts is not yet well understood, and this must be understood before suitable actions can be identified and pursued.
3.03	Identify Sea Level Rise thresholds at which existing coastal inundation emergency strategies will cease to be effective. Engage with the State Emergency Service to build capacity for long-term emergency plans responsive to climate change impacts.	Direct Progression	Flood risk on the Manning River, is presently dominated by catchment processes. Over time, with sea level rise, the downstream end of the river will be increasingly affected by tidal and storm surge inundation. The potential impact of this on emergency management needs to be discussed and studied, in partnership with the SES.
3.04	Work collaboratively with landholders and other stakeholders to develop an adaptation plan to mitigate the long-term (50-100 years) risk of climate change impacts on the floodplain, including management of productivity, coastal wetlands, acid sulfate soil and blackwater events.	Direct Progression	This is a long term (20-50 year and beyond) plan for how land use will need to change and the communities along the lower floodplain will need to adapt to climate change. It matches the CM Act vulnerability objectives of improving resilience and reducing exposure to coastal hazards and understanding what the impact of sea level rise might be on coastal environment area values, such as acid generation and blackwater events.
4.01	Address 10 priority sites and/or re-connect 200 km of fish passage by removing or re-designing priority barriers identified in the audit by DPI-Fisheries.	Intermediate	Suitable for progression to CMP, refer to Section 7.2.
4.02	Coordinate (HLLS) and participate (MCC) in the Manning River Helmeted Turtle Steering Committee to support and remain informed about efforts to conserve the species.	Direct Progression	There is strong community support for action to help save the Manning River Helmeted Turtle, an endangered species under the Biodiversity Conservation Act. This is a relatively cheap option which will help Council identify and contribute any relevant initiatives or efforts.
4.03	Develop and implement cross-tenure integrated pest and weed control plans to protect priority natural assets within the Manning River and its catchment.	Direct Progression	This action reflects a need to integrate the efforts of Council, LLS and other agencies in tackling both feral pests and weeds within the Manning Catchment. Weed and pest management fall under Goals 2 and 3 of Hunter LLS's present Strategic Plan and the NSW biosecurity strategy highlights that responsibility is to be shared among all levels of government.
4.04	Implement recommendations of the Manning Catchment Refugia Study 2021, working in partnership with private landholders to assess, protect, restore and monitor hydrological refugia in 10 priority reaches in the Barnard and Dingo Creek subcatchments.	Moderate	Suitable for progression to CMP, refer to Section 7.3.



Final Option No.	Final Option Description	Assessment Method	Justification
5.01	Involve Aboriginal traditional knowledge and personnel in management of the river, catchment and estuary: - Support the Conservation and Ecosystem Management TAFE course for Aboriginal Rangers by providing guest speakers. - Issue field work contracts to engage Aboriginal Rangers on conservation and land management in the Manning catchment. - Conduct cultural burns on Council land to reduce fuel loads and maintain ecological processes.	Direct Progression	This action broadly covers all actions within the CMP. However, it importantly addresses the key Object of the CM Act <i>“to acknowledge Aboriginal peoples’ spiritual, social, customary and economic use of the land”</i> . Involvement of local Aboriginal peoples’ in caring for their Country is seen to directly align with this object.
5.02	Install interpretive signage and facilitate cultural activities to share the story of the Manning River's significance to Birrbay people.	Direct Progression	As for 5.01, this is an acknowledgement of Aboriginal peoples’ connection to the land. In this case, however, it also has educational benefit for the broader local community.
5.03	Engage Aboriginal people including school students and commercial fishers in water quality monitoring.	Direct Progression	Justification is as outlined for 5.01.
5.04	Involve Aboriginal people in implementation of the Manning CMP by appointing two Aboriginal representatives to the management committee (See Action 8.01) and inviting Council's Aboriginal Community Development Officer to attend meetings.	Direct Progression	Justification is as outlined for 5.01.
5.05	Collaborate with Aboriginal Traditional Owners to manage threats to coastal wetlands in the National Park estate.	Direct Progression	This action directly addresses the objective of the Coastal Wetland Area to support the social and cultural values of those wetlands, with focus on Aboriginal traditional cultural values. The action is specifically related to coastal wetlands within the National Parks Estate.
6.01	Use monitoring data, results of Oyster Transformation study and field investigations to characterise the source and risk rating for pathogens in each area. Develop and implement site-specific pathogen source control plans for high-risk oyster growing areas.	Moderate	Suitable for progression to CMP, refer to Section 9.1.
6.02	Develop a strategic mix of family-friendly passive recreational facilities including nature-based experiences that improve access while encouraging understanding and conservation of environmental and Biripai cultural values (e.g., picnic areas, birding routes, boardwalks, river walks and interpretive signage).	Moderate	Suitable for progression to CMP, refer to Section 9.2.
7.01	Provide evidence, undertake landholder consultation and submit a planning proposal recommending amendments to the Coastal Management SEPP to support purchase, rezoning and remediation of coastal wetlands to improve ecosystem services.	Direct Progression	Modification and update of CM SEPP maps is an integral part of the CMP process. In this instance, all necessary information to inform the required Planning Proposal will not be provided by this CMP in isolation. Therefore, the action needs to be carried forwards as an action within the CMP.
7.02	Prepare mapping of the Tidal Inundation Coastal Vulnerability Area and undertake stakeholder consultation to inform a future planning proposal recommending amendments to the Coastal Management SEPP.	Direct Progression	No Coastal Vulnerability maps are available in NSW at the time of writing. MCC will need to prepare coastal vulnerability maps to support Action 7.01.
7.03	Use the Risk Based Framework to identify water quality objectives and associated management targets for development within the Manning River Catchment. Develop and include stormwater quality targets in MCC's LEP and DCP.	Direct Progression	This study / assessment is needed as a precursor to inform future management action. It requires application of the <i>“Risk Based Framework”</i> to set appropriate objectives and management targets, within a framework consistent with the Water Quality Australia Guidelines.
8.01	Establish a multi-stakeholder management committee to coordinate implementation of the Manning River CMP, with representation from government agencies, NGOs, industry groups, business and community.	Direct Progression	The CMP is expected to be an adaptable process and successful execution of the required actions will need oversight. MCC will oversee review and monitoring of the delivery of the CMP, but this will be facilitated through a stakeholder committee that helps with coordination and reporting. This action is required to underpin CMP delivery.
8.02	Participate in the MEMS Action 9.1 to improve co-ordination and integration across all levels of government by developing a governance framework at catchment scale.	Direct Progression	1See also 8.01. Inclusion of this action is consistent with Initiative 9 of the Marine Estate Management Strategy ( <i>Delivering Effective Governance</i> ).
8.03	Build the capacity of compliance programs to enforce regulations relating to CMP risks and issues. Promote regulations and information about how to report illegal activities.	Direct Progression	Compliance issues arose in several forums during development of the CMP in relation to diverse matters such as land clearing, water theft and on-site sewerage management. This action requires oversight of these diverse matters including disseminating information on how different non-compliance issues should be dealt with. Council is often the first point of call for a range of non-compliance issues, including those for which they aren't responsible.

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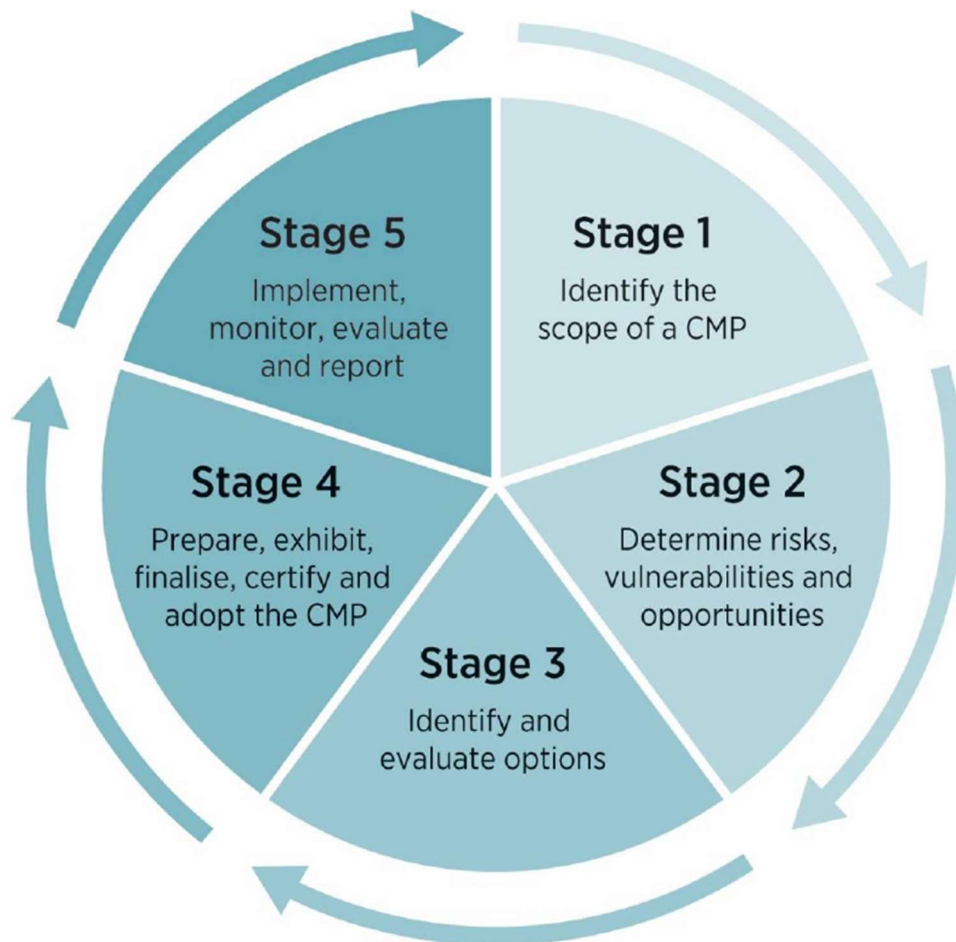
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# 1 Introduction

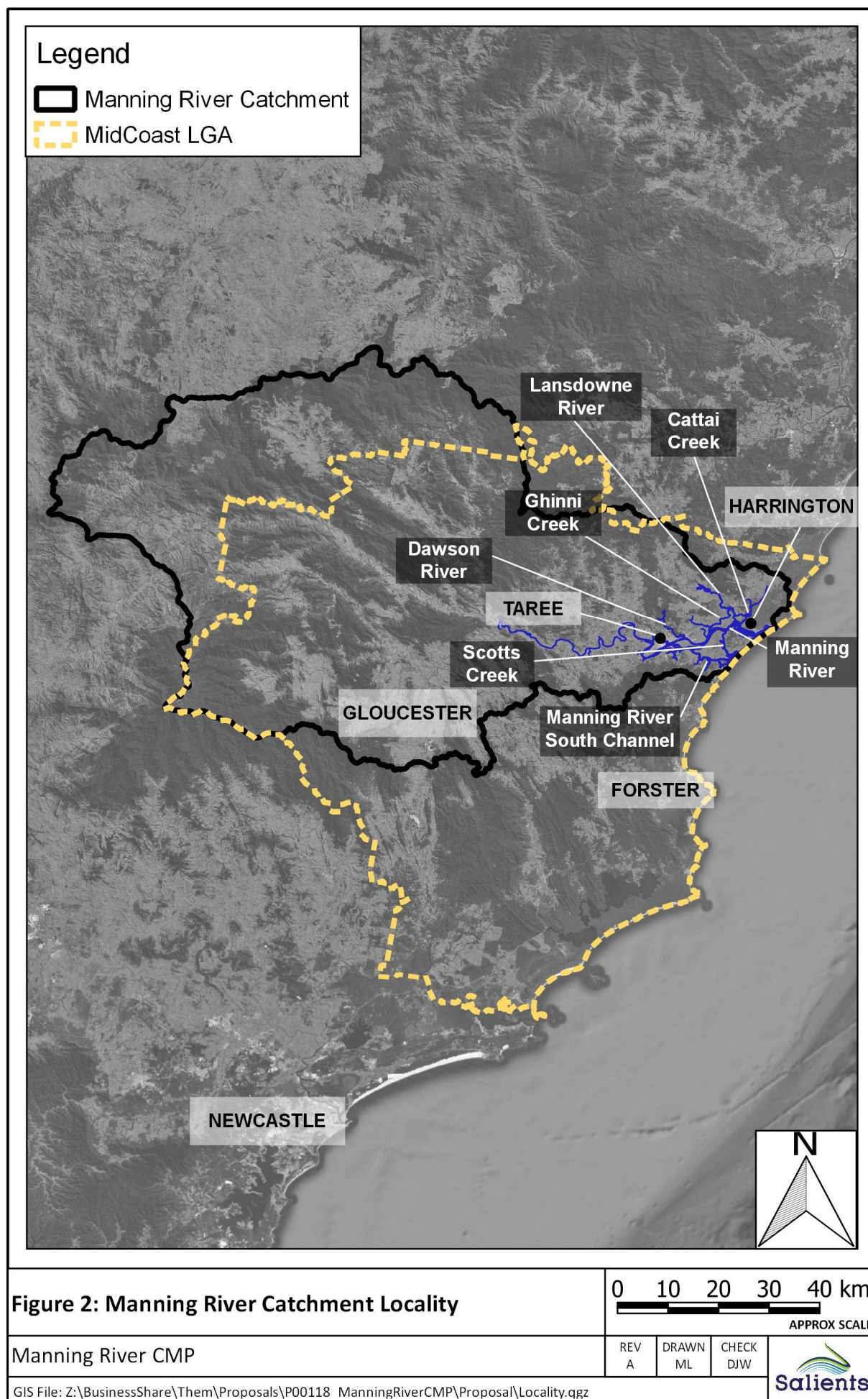
Salients, in partnership with the Centre for International Economics (CIE), the University of Newcastle (UoN) and Alluvium, was engaged by MidCoast Council to assist with the preparation of a Catchment Management Program for the Manning River. The Catchment Management Program will, in effect, be a Coastal Management Program (CMP) prepared using the guidance of the *Coastal Management Act 2016* (CM Act) and the *NSW Coastal Management Manual* (CMM).

The CMM outlines a five-stage process for developing a CMP as illustrated in Figure 1.



**Figure 1 Stages in Preparing and Implementing a CMP**  
(Source: NSW Government, 2018a)

The area under consideration by the CMP comprises the entire Manning River catchment excluding the 2km wide (approximately) coastal strip containing the townships of Harrington and Old Bar. These excluded areas will be covered in a separate coastal management program covering the open coast. The catchment and its relationship to the MidCoast Council LGA are shown in Figure 2.





The catchment covers the northern half of the MidCoast Council Local Government Area (LGA) and extends westwards beyond the LGA boundary. The estuarine reaches of the river extend upstream beyond Taree, reportedly to Abbots Falls, near Wingham (Webb, McKeown & Associates Pty. Ltd., 1997). Uniquely for NSW, the River has two predominantly open ocean entrances: at Old Bar, and the larger entrance at Harrington.

At the time Salients was commissioned, MidCoast Council, the local community, and other stakeholders had already undertaken extensive work contributing to Stages 1 through 3 of the process presented in Figure 1.

The major task within Salients commission was to evaluate a long list of management options which had been generated from the work already undertaken by MidCoast Council. It is that evaluation which forms the focus of this report. The report contains:

- Section 2 which outlines preliminary filtering and consolidation of the management options. A total of 117 management options had been identified prior to inception of the project reported herein. These ‘original’ options are listed in Appendix A. Through the filtering process, a final ‘short list’ of 45 management options was developed for assessment. This final list is presented in Appendix C3.
- Section 3 which describes the methodology that has been used by our study team to assess the short-listed options. Different methods of assessment were utilised depending on the characteristics of any given option. These methods and their applicability are introduced in Section 3. The concepts of “Acceptability”, “Feasibility” and “Viability” are addressed in Section 3.
- Sections 4 through 11 present the assessment outcomes and relevant discussion for management options, with each section addressing different ‘themes’ or ‘categories’ as developed by MCC, namely:
  - Stewardship Options (Section 4).
  - Water Quality and Ecosystem Health Options (Section 5).
  - Climate Change Options (Section 6).
  - Biodiversity Options (Section 7).
  - Aboriginal Custodianship Options (Section 8).
  - Social and Economic Value Options (Section 9).
  - Land Use Planning Options (Section 10).
  - Governance Options (Section 11).

To maintain a reasonably brief report, much of the analysis arising from the tasks laid out in the following sections is presented in appendices.

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## 2 Preliminary Filtering of Options

At the beginning of the project, the consulting team were provided with an initial list of 117 management options. The list of raw, unfiltered options is presented in Appendix A.

These options had been derived from extensive previous consultation work and some explanation and rationalisation was required to properly inform the study team. This was the primary purpose of a set of preliminary, online workshops conducted in February and March 2021.

The workshops were jointly facilitated by MCC and Salients and were attended by representatives from other key stakeholder organisations such as Hunter Local Land Services and Department of Primary Industries (Fisheries). A list of attendees and details of the different workshop sessions is presented in Appendix B. The session number at which each management option was discussed is presented in Appendix A.

As the consulting team was new to the Manning CMP development process, the key aim of the workshops was to ensure that study team members had a clear concept of the management options being put forward and the context and background relating to their inclusion in the initial list of options. During the workshop's consulting team members took notes and asked questions for the purpose of clarification.

Those notes were subsequently developed into the management option descriptions by the study team with those descriptions provided back to MCC. MCC subsequently developed "*Specific, Measurable, Assignable, Realistic and Time-related*" (S.M.A.R.T) descriptions for the management options which were ultimately short-listed. Those descriptions are presented in Appendix C3 and have been used throughout this report where relevant.

As a result of discussions during the workshops, a significant proportion of the original management options were not carried forwards for assessment in the form originally proposed, with the most common reason being that the action was already happening or being proposed under a separate, more appropriate process, with suitable funding earmarked over the medium term. In this case, we consider that duplication of actions via separate management processes is more likely to lead to confusion and inefficiency. The list of those options that were not shortlisted for the CMP are presented in Appendix C1, which includes the reasons why actions were excluded.

A further set of management options were amalgamated with other options. This was common when the listed options formed a set of sequential, complementary actions which were designed to occur together. Details of the amalgamated options are presented in Appendix C2.

Some actions were already being delivered under a separate management process, but there remained concern over the effectiveness of implementation or adequacy of funding levels. A common approach in deriving the short list of management options has been to transform the action into one of monitoring and support for that separate management process. In some cases, options were added following discussions during the workshops.

The study team prepared a set of longer descriptions of the remaining options for review by Council. Council subsequently revised, consolidated, and renumbered options and provided the study team with the final short list of options that were to be carried forwards for review.

The consolidated, rationalised, and renumbered short list of options arising from the Workshop process is presented in Appendix C3. These are the options that have been subjected to further analysis as outlined in the remainder of this report.

In addition to formulating the consolidated and rationalised list of management options, and the scope and purpose of each action on that list, the workshops also provided an opportunity to discuss further details. These details were geared towards helping development of a business plan to support the CMP, and included:

- The likely lead agency and partner organisations.
- How much the option was likely to cost.
- The likely timing involved.
- Any interactions with and/or opportunities for sequencing to maximise benefits.
- Where more detailed financial/economic analyses were warranted as part of subsequent Assessment.



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## 3 Assessment Methodology for Filtered Options

### 3.1 Assessment Requirements of the Coastal Management Manual

“Stage 3” of the process outlined in the Coastal Management Manual (CMM, NSW Government, 2018b) relates to both the identification and evaluation of management options. Prior to the involvement of our study team, an exhaustive process had been followed by MidCoast Council in identifying those management options which could be considered for the final CMP. Accordingly, while workshops were undertaken to filter and rationalise the long list of management options, it was uncommon for new actions to be identified and the involvement of our study team has focussed primarily on assessment of the resulting short list.

Section 3.8 of Part B of the CMM relates specifically to the evaluation of management options, discussing evaluation against the three broad themes of ‘feasibility’, ‘viability’ and ‘acceptability’. Within the CMM, there is significant overlap in the discussion of these three themes. An overarching principle of the CMM is, however, that the process adopted by a Council should be structured and transparent.

A discussion of these three assessment themes and their applicability when examining options for the Manning River CMP is provided in the following subsections.

#### 3.1.1 Assessment of Acceptability

The CMM indicates that evaluation steps would ‘normally’ be conducted sequentially, with feasibility assessments, followed by viability assessments and then acceptability assessments. The approach taken by MidCoast Council, with extensive up-front community and stakeholder consultation, means that all actions proposed are inherently acceptable. As noted above, there are substantial overlaps between the terms suggested to assess acceptability in the CMM and the outcomes of the assessment of viability and feasibility. For example:

- Questions of impacts and their distribution, proportionality to risks, value for money and efficient use of resources are all the subject of economic (i.e., ‘viability’) assessments.
- Questions relating to effectiveness of an action in reducing risks relate to engineering feasibility (i.e., Will it work?).
- Questions relating to sustainability, consistency with coastal management objectives and the long-term strategic direction of Council relate to obligations under the environmental legislation generally, the *Coastal Management Act 2016*, and the *Local Government Act 1993*, respectively. Hence, these are related to legal feasibility.

Ultimately, the overarching concern for this theme is whether there is broad acceptability among community and stakeholders and this needs to be determined through consultation.

Consultation has been consistent and extensive during the CMP preparation process. Within our assessment, we have assumed from the outset that all short-listed actions are Acceptable. Under the direction of MCC, we have limited our assessment to the consideration of feasibility and viability. A more detailed consideration of Acceptability has been outlined by MCC as part of the CMP.

### **3.1.2 Assessment of Feasibility**

A feasibility assessment is required to consider whether the action can be completed in technical, engineering and/or legal terms.

As a first stage of our assessment every management option has been subjected to a multi-criteria assessment to assess feasibility. The purpose of a CMP is to give effect to the objectives of the *Coastal Management Act 2016*. For this reason, the objects/objectives of the CM Act and, by extension, the *Marine Estate Management Act 2014* were used as the criteria against which each of the management option have been assessed. In assessing how well each action is likely to perform against those objectives, the following points, paraphrased and simplified from the CMM, have been considered:

- Is the option consistent with statutory and policy requirements, including the principles of ecologically sustainable development?
- If relevant, could a physical intervention (e.g., engineered structure) be practically constructed using presently available methods and locally available skill sets? Will it be effective at reducing those risks it is intended to mitigate?
- Are there any potential or likely negative consequences?
- Can an action be effectively maintained? If relevant, is the option amenable to adaptation over time, for example in response to a changing climate? Does it preclude effective adaptation at some future date?
- Is the action otherwise justifiable? For example, does it represent the inexpensive trial application of new, promising methods where no reasonable alternative options exist?

These questions have been used as contextual signposts to support scoring of the management options against the relevant objectives. The multi criteria assessment was completed independently by staff from MidCoast Council and members of the study team.

Where options were identified as being suitable for direct progression (typically low cost, low regrets, high confidence of success, see Section 3.2), the multi criteria assessment was applied as a confirmatory feasibility assessment. In that case, a brief description of the legal, policy or other justification for directly proceeding with these actions has also been provided. The multi-criteria assessment is presented in the tables provided as Appendix D.

For other, more complex or expensive actions, the feasibility assessment also involved more detailed consideration including, at least, a qualitative evaluation of potential shortcomings and benefits. A discussion of the outcome of that process is described under each applicable management option within Sections 4 through 11.

Several options were identified during the management action workshops as requiring more detailed financial and economic analyses (Section 3.6 and Appendix E). That detailed assessment has also incorporated further discussion of overall feasibility for some options. Where this is the case, a summary of the outcomes of that analysis is also provided under each applicable management option within Sections 4 through 11.

### **3.1.3 Assessment of Viability**

Within the CMM, the assessment of viability focusses on economic and financial considerations. These essentially aim to answer the following questions:

- Is the option justifiable in terms of improving overall wellbeing (economic assessment)?
- Is it possible to fund the option?

If the answer to the first question is “Yes”, the option should be considered as part of the business planning process and there should be some mechanism to carry it forward as an opportunistic action into the CMP, even if there is no viable funding mechanism presently available. The funding environment changes from year to year and the CMP should be able to take advantage of any funding opportunities that might make an action viable in future, even if a present funding pathway cannot be readily identified. The cost of different actions will have an impact on the timing of actions as they are carried forwards through the business planning process.

As a minimum, all short-listed options have had a cost estimate derived, based largely on the experience of study team members, assisted by staff from MCC and Hunter Local and Services. When this cost estimate is combined with the qualitative multi-criteria analysis feasibility assessment, it constitutes a “Simple Economic Assessment” (in the terminology of the CMM).

For those options subjected to more detailed financial and economic assessment, a more detailed cost estimate has been prepared.

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The highest level of economic assessment promoted by the CMM is a detailed cost benefit analysis (CBA). Under present state government guidance, this is generally required for options that cost more than \$1M. For the present assessment:

- Detailed cost-benefit analyses were not required as actions were not, typically, expected to exceed \$1M in cost.
- Where the capital outlay is expected to exceed \$1M (e.g., Option 2.01), an indicative cost benefit analysis has already been completed to inform and support that action.

Regardless, more detailed financial assessment has been undertaken for several management options, with a specialist report prepared by the Centre for International Economics (CIE, Appendix E). Where this is the case, the options examined have been subjected to assessments of varying complexity, up to an “*Intermediate Level Assessment*” in the terminology of the CMM. The more complex options assessed by The CIE were subject to *Rapid CBA* assessment which follows the same framework as a detailed CBA, except that it allows the use and consideration of qualitative assessments and is more accepting of imperfect data or data gaps.

The methods applied in the assessment of the short-listed options are described in the following section.

### 3.2 Direct Progression

Around two thirds of the short-listed options were identified for “Direct Progression” into the CMP. Those options were subjected to confirmatory assessment comprising:

- Multi-criteria assessment to confirm alignment with the objectives/objects of the CM Act, as described in Section 3.3.
- Estimation of cost.

The types of options identified included:

- Actions that were relatively cheap and/or for which there was a high confidence of success due to previous experience. These included the extension of programs that had been successful in the past.
- Studies and/or the development of management plans. Often, additional work is required to fill in knowledge gaps before the details of management options can be appropriately determined. Ideally, these knowledge gaps would be filled during Stage 2 of the overall CMP process (Figure 1) but the gaps may not become apparent until management options have been identified during Stage 3. Studies and management plans have an inherent benefit as they contribute new knowledge required to achieve the objectives of the CM Act.



- 
- Community engagement activities and development of materials to engage with the community. Community engagement is a key responsibility of local councils in NSW. Further, one of the objects of the CM Act is: “to support public participation in coastal management and planning and greater public awareness, education and understanding of coastal processes and management actions”.

Due to the degree of consultation that preceded the management option assessment described in this report, most of the actions which were short listed and all that have been earmarked for direct progression are:

- Consistent with Ecologically Sustainable Development (ESD) principles.
- Able to be implemented in terms of available capacity, engineering constraints and the existing planning and policy framework.
- Will contribute to addressing issues identified by the CMP.

The benefits of these actions are typically not quantifiable. Justification for their inclusion, including policy and legal reasons is provided in tables presented in Sections 4 through 11.

### 3.3 Multi-Criteria Assessment

A multi-criteria assessment was completed for all short-listed management actions. The tables resulting from that assessment are presented in Appendix D. As part of the multi criteria assessment, each management option was scored against each object of the CM Act, the objectives for each Coastal Management Area from the CM Act, and the objects of the *Marine Estate Management Act 2014*.

For this CMP, areas beyond the presently mapped *Coastal Zone* are being addressed, namely the floodplain associated with the estuary, and the broader catchment. For these additional areas, actions tend to align with improving environmental values within the estuary and are most relevantly considered as actions which align with the objectives of the *Coastal Environment Area*. Even so, most management options align well against objectives in several of the Coastal Management Areas specified in the CM Act.

Within Appendix D, options were scored against the object/objectives using the scoring scale presented in Table 2. While negative scores are provided for in Table 2, the use of these has been very rare, as the consultation and filtering undertaken during earlier stages has removed those options which do not align with the objects of the CM Act.

**Table 2      Scoring Scale for Alignment of Options against Objects/Objectives of CM Act**

Score	Alignment Descriptor
-2	Poor (Counterproductive) Alignment
-1	Negative Alignment
0	Neutral / Not Relevant
1	Positive Alignment
2	Excellent Alignment

Appendix D scores options against the scale of geographic impact as presented in Table 3. This needs to be considered as an option may align extremely well with the objectives of the CM Act, but with limited geographical extent, the value obtained from that implementing that option would also be limited. It is important to understand this when assessing the action against the expected cost of implementation.

**Table 3      Scoring of Geographical Impact Scale for Management Options**

Score	Scale Descriptor
1	Localised Impact
2	River Reach / Embayment Impact
3	Estuarine, Floodplain or Catchment Zone
4	Entire Estuary and/or Catchment

Multi-criteria scoring was undertaken by members of the study team and staff from Council with the resulting scores averaged.

### 3.4 Cost Estimation

The study team has obtained costs from several sources:

- During the preliminary workshop, where time allowed, attendees were asked to provide estimates of expected costs. Follow up consultation with MCC and other stakeholders was also completed for some actions.
- Source rates for on – ground works, based on previous budgets, were provided by Hunter LLS.
- In some cases, published estimates for works for which preliminary planning and assessment had been undertaken were adopted.
- Other information relating to, for example, the market value of land requiring purchase.

- Experience of the study team in pricing consultancy and construction projects and miscellaneous data from other sources, including values from industry standard publications such as Rawlinsons.

Cost estimation was also informed by an impression of the scale of the action gained from discussions held during the preliminary workshops. Initial draft estimates were provided to MCC for checking and subsequent revision.

Excepting the options subject to Moderate (Section 3.5) and Intermediate (Section 3.6) assessment, the cost estimates have been provided to an indicative, preliminary level, but tend to err conservatively (i.e., at the more expensive end of our expected range of cost).

Regardless, the ultimate price of any management action will be sensitive to decisions made at implementation time, such as the scope included in a consultancy brief. The cost estimate should be reviewed in more detail at the time of implementation to account for any changes to circumstances which may affect the price.

### 3.5 Moderate Level Assessment

Several management options fell between those identified for direct progression (Section 3.2) and Intermediate Level Assessment (Section 3.6). For those options, the multi-criteria assessment was completed. However, a more detailed, but primarily qualitative consideration of the overall feasibility from a legal and technical viewpoint was undertaken. Furthermore, a more rigorous cost estimate has been prepared, with the quality of that estimate dependant on available information.

The “Moderate” level assessment of those options is described in standalone sub-sections of this report, as outlined in Table 4.

**Table 4 Moderate Level Assessment Options**

Option No.	Option Short Description	Report Section
1.06	Establish Annual Citizen Science BioBlitz	Section 4.2
1.07	Develop a Litter and Stormwater Pollution Source Control Program	Section 4.3
2.04	Model Good Catchment Management Practice	Section 5.5
2.11	Study and Prioritise Sensitive Estuarine Riverbank Areas for Management	Section 5.8
2.13	Study Unsealed Road Sediment Hotspots	Section 5.9
4.04	Implement Recommendations of Refugia Study	Section 7.3
6.01	Site-Specific Pathogen Source Control Plans for High-Risk Oyster Growing Areas	Section 9.1
6.02	Family-Friendly Passive Recreational Facilities	Section 9.2

### 3.6 Intermediate Level Financial and Economic Assessment

As described in Section 3.1.3 several options were identified for testing via a more detailed viability (Financial and Economic) assessment, corresponding to the “Intermediate” level of assessment outlined in the Coastal Management Manual. In addition to the viability assessment a qualitative assessment of feasibility has also been completed as part of the intermediate assessment.

The “Intermediate” level assessment of those options is described in standalone sub-sections of this report, as outlined in Table 5. The underpinning viability assessment prepared by CIE are provided in Appendix E.

**Table 5 Intermediate Level Assessment Options**

Option No.	Option Short Description	Report Section
2.01	Implement Key Priority ASS Management Actions	Section 5.2
2.02	Protect and/or Rehabilitate Coastal Wetlands	Section 5.3
2.03	Improve Riparian and Estuarine Bank Vegetation	Section 5.4
2.05	Prepare Report Assessing the Purchase and Retiring of Un-used Water Licences	Section 5.6
2.08	Implement a Systematic Approach to Maintaining SQIDs	Section 5.7
4.01	Address Barriers to Fish Passage	Section 7.2



## 4 Stewardship Options

### 4.1 Stewardship Options for Direct Progression

The *Stewardship* options that have been identified for direct progression to the CMP are summarised, alongside relevant justification, in Table 6. More detailed, S.M.A.R.T descriptions of these options are provided in Appendix C3. The results of a multi-criteria analysis testing the consistency of options with the objects and objectives of the Coastal Management Act is presented in Appendix D.

**Table 6 Stewardship Options for Direct Progression**

Final Option Number	Option Title	Justification
1.01	Develop and Deliver an Engagement Program	Section 8A of the Local Government Act 1993 notes that councils should “ <i>actively engage with the community</i> ”, “ <i>recognise diverse local community needs and interests</i> ”, and that “ <i>decision -making should be transparent</i> ”. The Coastal Management Act 1993 has an object to “ <i>Support public participation and greater public awareness</i> ”.
1.02	Best Management Practice Framework for Whole Farm Planning	During workshops undertaken to analyse issues associated with agricultural practice, the need for environmental ‘best practice’ to enable premium pricing of produce from the area was identified. However, it was also recognised that what constitutes ‘best practice’ is not well defined or agreed upon.
1.03	Undertake and Evaluate Field Trials of Best Management and Innovative Practices for Farmers	This option follows & complements option 1.02.
1.04	Promote and Facilitate Establishment of Private Conservation Agreements	Protecting and enhancing vegetation coverage of the catchment will help reduce erosion and sedimentation from runoff. The work is consistent with Goal 3 of Hunter LLS’s Local Strategic Plan “ <i>Healthy, diverse, connected natural environments</i> ”. This option is relatively low cost.
1.05	Adopt Flagship and Indicator Species	This is another relatively low-cost option. The concept has been utilised in conservation biology for some time. However, the usefulness of adopting flagship species as a community education/engagement tool has more recently been acknowledged through research <sup>12</sup>

<sup>1</sup> Schlagloth, R., Golding, B., Thomson, H., 2018. Why is it Important to Use Flagship Species in Community Education? The Koala as a Case Study. *Animal Studies Journal* 7, 127–148.

<sup>2</sup> Jepson, P., Barua, M., 2015. A theory of flagship species action. *Conservation and Society* 13, 95–104.

Final Option Number	Option Title	Justification
1.08	Develop and Distribute Education Material and Guidelines for ESC	Sediment eroded from the catchment is a key waterway pollutant. Pollution of waterways is an offence under the <i>Protection of the Environment Operations Act 1997</i> . These materials proposed would both educate and help rural landowners avoid committing an offence.
1.09	Improve Erosion and Sediment Control	Justification for this action is similar to that for 1.08. However, the target for this action is developing an effective system for Council internally and to educate builders, consultants, and developers.

## 4.2 Option 1.06 – Establish Annual Citizen Science BioBlitz

**Option Description:** Establish an annual citizen science ‘BioBlitz’ through the Atlas of Living Australia to document aquatic and riparian biodiversity of the Manning River and estuary.

The Atlas of Living Australia (ALA)<sup>3</sup> is an online database and supporting tools which collates Australian biodiversity data from many different sources and aims to make that data accessible and reusable. The ALA is funded by the Australian Government through CSIRO.

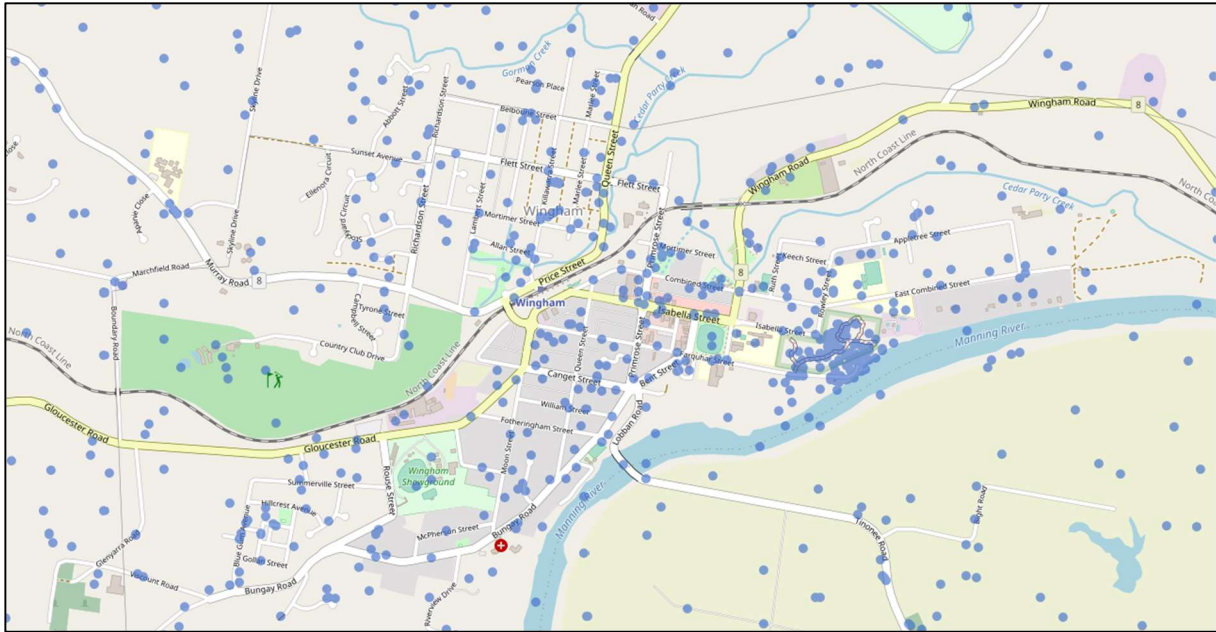
The types of tools supported by the ALA include those for data collection and analysis. Apps such as one published by the international iNaturalist network, supported by the National Geographic Society can be used to feed data into this database through sharing arrangements between iNaturalist and ALA. The online spatial interface from which information can be downloaded from the ALA is shown in Figure 3.

A BioBlitz is a citizen science field event where scientists and the community work together over a specified period (24-48 hours) to record as many species as possible within a set area. Guidance on running a BioBlitz is available from the Australian Citizen Science Association web page<sup>4</sup>.

Costs involved typically comprise promotional and personnel costs plus materials to support the activity including IT equipment, scientific and survey equipment, and equipment to set up a base camp – noting that survey and recording activities occur overnight. Involving appropriately qualified scientists helps to enable collected data to be verified.

<sup>3</sup> <https://www.ala.org.au/about-ala/>

<sup>4</sup> <https://citizenscience.org.au/the-australian-bioblitz-hub/>

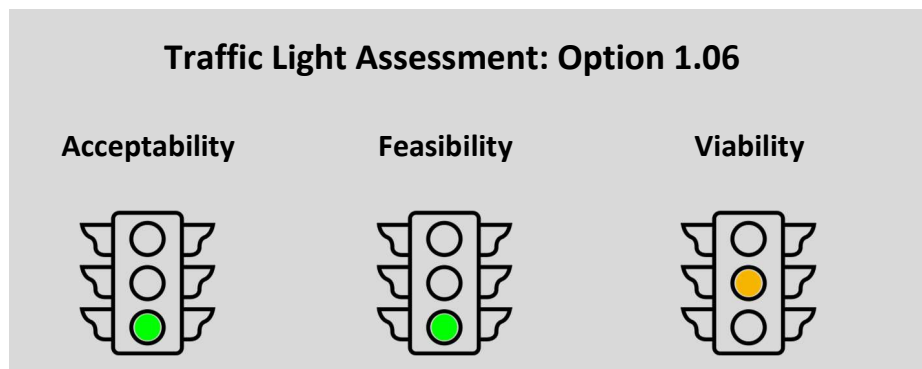


**Figure 3** Threatened species sightings around Wingham, as recorded on the Atlas of Living Australia (accessed 19 July 2021)

The action aligns well with the objects of the Coastal Management Act and an estimated cost of \$50,000 was provided by attendees at the preliminary workshop where this option was discussed.

There are no practical impediments to managing such an event, but care should be taken to ensure the health and safety of participants and that appropriate Public Liability and Professional Indemnity insurances are taken out to cover the activity.

It is recommended that a BioBlitz be organised during the first two years of the CMP, and that the outcomes be assessed to whether the event should repeat annually.



### 4.3 Option 1.07 – Develop a Litter and Stormwater Pollution Source Control Program

**Option Description:** Develop a litter and stormwater pollution source control program:

- Monitor and report annually on the volume, type and location of litter collected during GPT maintenance and clean-up days.
- Utilise this data for targeted education and engagement campaigns.
- Develop source control plans for identified hot spot locations.
- Support community and industry groups to complete a minimum of one litter clean up event each year in identified hot spot locations.

This option has intrinsic value in that it aims to reduce pollution from stormwater infrastructure. The focal point for this option is Taree, the largest town within the Manning River Catchment and therefore the most significant contributor of urban stormwater pollution.

The option aligns strongly with Management Initiative 1 of the Marine Estate Management Strategy (*Improving water quality and reducing litter*) and leverages several of the mechanisms identified in that strategy to implement that initiative, namely:

- Policy / Program / Planning
- Education / Awareness
- Research / Monitoring / Mapping
- Data / Reporting
- Collaboration

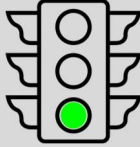
In addition, the source control program may well identify on-ground works that will eventually need to be implemented.

The actions identified in the program should also be assessed for acceptability, feasibility, and viability before incorporating those into a future revision of the CMP. The activities described by this option, however, are intrinsically achievable and considered viable, with an estimated up-front cost of \$80,000 to develop the source control plans for the identified hot spots.

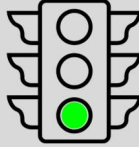


### **Traffic Light Assessment: Option 1.07**

**Acceptability**



**Feasibility**



**Viability**



## 5 Water Quality and Ecosystem Health Options

### 5.1 Water Quality and Ecosystem Health Options for Direct Progression

The *Water Quality and Ecosystem Health* options that have been identified for direct progression to the CMP are summarised, alongside relevant justification, in Table 7. More detailed, S.M.A.R.T descriptions of these options are provided in Appendix C3. The results of a multi-criteria analysis testing the consistency of options with the objects and objectives of the Coastal Management Act is presented in Appendix D.

**Table 7 Water Quality and Ecosystem Health Options for Direct Progression**

Final Option Number	Option Title	Justification
2.06	Enter the Manning River Entrance Project into the NSW Investor Assurance and Business Case Process	This recommendation has arisen from the separate Manning River Taskforce process and is being pursued by Transport for NSW <sup>5</sup> .
2.07	Ensure Manning River Entrance Process includes Extensive Stakeholder Consultation	Similar to option 2.06, this is a recommendation of the Manning River Taskforce report and is consistent with the objects of the Coastal Management Act 2016.
2.08 (Part) 2.09	Review, Revise and Supplement MCC's Current Stormwater Guidance	Urban stormwater discharge is a key waterway pollutant. Pollution of waterways is an offence under the <i>Protection of the Environment Operations Act 1997</i> . The formal inclusion of stormwater devices draining to the Manning River and tributaries within council's asset management system and upgrade of Council's varied policies and procedures relating to stormwater and Water Sensitive Urban Design will help mitigate pollution.
2.10	Revise the Greater Taree Urban Stormwater Management Plan	This aims to upgrade the outdated Greater Taree Urban Stormwater Management Plan. As for Option 2.08/2.09, the aim is to reduce the Pollution of Waterways.
2.12	Monitor and Report on Recreational Boating in High-Risk Boat wash Erosion Areas	The Coastal Management Manual refers to the potential impact of boat wash on foreshore erosion as being an issue in some locations. During consultation for the CMP, boat wash was identified as being of some concern within the Lansdowne River. However, the scale of the issue is not well understood at present.
2.14	Onsite Sewerage Management System Audit and Compliance Strategy	Under the Local Government (General) Regulation 2005, MCC has an obligation to administer the

<sup>5</sup> Manning River Taskforce, 2020. Investigating options to improve safety and navigability of the Manning River entrance.

Final Option Number	Option Title	Justification
		installation, construction, alteration, and operation of on-site sewerage management systems. A lack of capacity within MCC to audit and comply with council's obligations was identified and this option's aim is to address that shortfall.
2.15	MER for Ecosystem Health	A programme for Monitoring, Evaluation and Reporting on the delivery of the CMP is a mandatory requirement of the CMP. This action covers off on the activities required to deliver the required MER program.

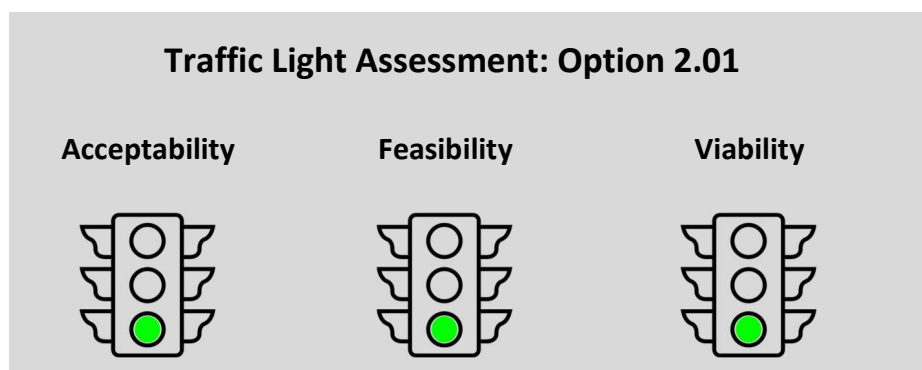
## 5.2 Option 2.01 – Implement Key Priority ASS Management Actions

**Option Description:** Implement key priority acid sulfate soil management actions from the Manning River Floodplain Prioritisation Study 2021 including:

- Reinstate 1550 ha of coastal wetlands on public and private land subject landholder agreement.
- Audit, upgrade or replace Council floodgates within the Lower Manning Floodplain and add them to MCC's Asset Management Program.

The CIE (Appendix E) assessed this action using a 'rapid CBA' approach. Previous work of Harrison et al. (2019) contained substantial data on the ecological benefits, remediation costs, loss of agricultural value and other matters and these were assessed as being directly applicable to Option 2.01. Of the 1550 ha in the target, 655 ha will be remediated by Council and the remaining 895 ha will be remediated by a third party as an offset. The CIE's analysis is based on rehabilitation of 655 ha, which will use public funds.

When analysed over a 30-year period, in accordance with NSW Treasury guidelines, the analysis indicated a net benefit of \$14.5 million and benefit cost ratio (BCR) of 2.97. When compared to a status quo of not undertaking the option, it is concluded that society will be better off and hence the option is viable.



### 5.3 Option 2.02 – Protect and/or Rehabilitate Coastal Wetlands

**Option Description:** Protect and/or rehabilitate coastal wetlands, including the restoration of intertidal hydrology to previously drained areas:

- Undertake field investigations and implement actions to exclude stock and restore tidal flushing at three coastal wetland sites on Mitchell Island in partnership with landholders by 2025, as recommended by the Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment.
- Protect and restore a further 100 ha on both public and private land by 2030.

The CIE (Appendix E) assessed this action using a ‘rapid CBA’ approach. The identified works are to occur across three sites around Pelican Bay:

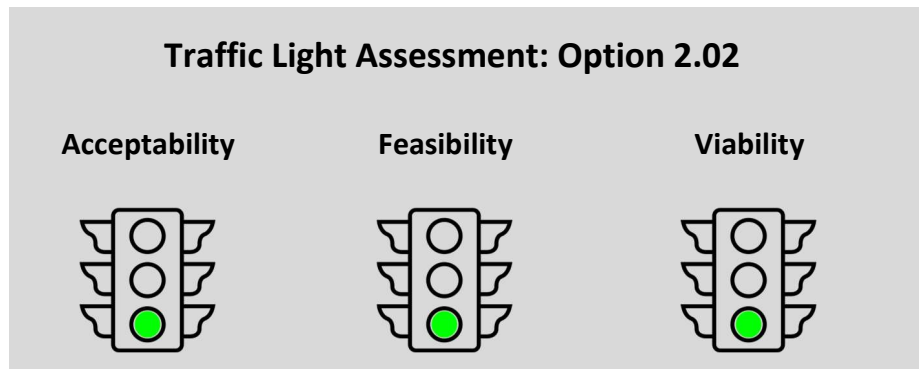
- Site 1: Fencing of two areas and the optimisation of a culvert to improve connectivity, plus investigation of connectivity under Beale Avenue and Pelican Bay Road, Mitchell Island.
- Site 2: Opening of Flood Gates on Millers Creek (Manning Point Road) to increase extent of tidal inundation.
- Site 3: Fencing of an existing 4.7ha wetland finger extending north from Sheather Creek and under Manning Point Road, including construction of an adjacent pathway for stock and culvert extension under Manning Point Road.

Following initial consideration of this option, the culvert was identified as being a disproportionately expensive part of this action. In the action carried forwards to the CMP, and described herein, the culvert has been excluded from the analysis.

When analysed over a 30-year period, in accordance with NSW Treasury guidelines, the results indicate a net benefit of \$1.2 million and benefit cost ratio of 3.43, from undertaking coastal wetland rehabilitation on a 14.7-hectare site in Pelican Bay, compared to a status quo of not undertaking the option.

The rapid CBA results did not include the benefit of improved water quality on oyster farming productivity. Based on the qualitative discussion of improved water quality on oyster farming productivity accordingly, if this benefit were quantified and included, the calculated total net benefit and benefit cost ratio would be even more favourable. For comparison, the net benefit and benefit cost ratio for the scenario with the culvert extension included would be -0.1M and 0.94, respectively.





## 5.4 Option 2.03 – Improve Riparian and Estuarine Bank Vegetation

**Option Description:** Improve the condition, extent, and connectivity of riparian and estuarine bank vegetation on private and public land by protecting and/or restoring 100 km of buffer vegetation by 2030.

Council has identified the following priority sites for protection and rehabilitation:

- Priority sub catchments with proximity to the estuary: Manning River, Scotts Creek, South Arm.
- Priority sub catchments for natural regeneration: Ghinni Ghinni Creek, Killabakh Creek, Lansdowne River, Dingo Creek, Mooral Creek, Cedar Party Creek.
- Priority sub catchments in the upper catchment: Barnard River, Gloucester River, Barrington River.

The CIE (Appendix E) assessed this action using a ‘rapid CBA’ approach.

For the assessment, a total buffer width of 20m (10m either side of the river) was assumed. For the stated 100km length, this results in treatment of 200 hectares of rehabilitated riparian buffer area, with 20 hectares being rehabilitated per year leading to 2031. Costs for the rehabilitation and subsequent maintenance were determined based on discussions with Hunter LLS staff.

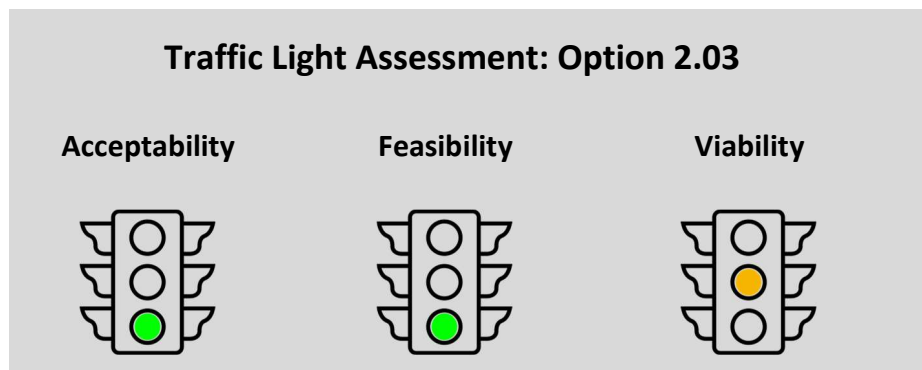
The results of the rapid CBA are sensitive to the value adopted for “Willingness to Pay” (WTP) in the CBA calculation. When estimated using a high estimate of WTP, a net benefit of \$2.3M and benefit cost ratio of 1.23 results. Conversely, a ‘mid-point’ estimate of WTP results in net benefit and benefit cost ratio of -\$2.5M and 0.75, respectively.

Clearly, if sites are selected using a well-reasoned and informed process, the option can provide positive results for society. The CIE concluded that site specific evaluation should be undertaken, based on:

- the relatively high cost of this option compared to others discussed in this report.
- assumed rehabilitation and maintenance costs based on annual Local Land Service budgets, which may not be representative for the specific program of works for this option.
- high variance in quantified WTP estimated benefits of undertaking riparian vegetation, with WTP estimate values dependent on rehabilitation site location **and** respondent location.

The funding situation for this scenario needs to be acknowledged. Presently, Hunter LLS receives an estimated \$225,000 from the Marine Estate Management Strategy per annum to implement riparian rehabilitation works within the Manning Catchment. The loss of riparian vegetation is acknowledged as a statewide priority threat for the Marine Estate (Marine Estate Management Authority, 2017) and riparian revegetation works to address diffuse pollution from catchments is identified as a key deliverable within the most recent implementation plan for the MEMS (Marine Estate Management Authority, 2021). These works are a priority and benefits of delivery relating to policy direction have not been quantified within The CIE's analysis.

The approach proposed is a compromise. Riparian revegetation works will continue. However, there is a need to have a clear prioritisation of river reaches based on, for example, the findings of Pietsch et al. (2019). This will help ensure that those reaches targeted for rehabilitation will provide maximum benefit.



## 5.5 Option 2.04 – Model Good Catchment Management Practice

**Option Description:** Model good catchment management practice on public land by:

- 1. Establishing a demonstration site for coastal wetland management on public land showcasing agricultural best management practice and maintenance of ecosystem services by 2025.**
- 2. Ensuring new grazing permits licence conditions include appropriate controls to prevent stock impacts on riparian vegetation and coastal wetlands; and**
- 3. Undertaking annual inspections to monitor compliance.**

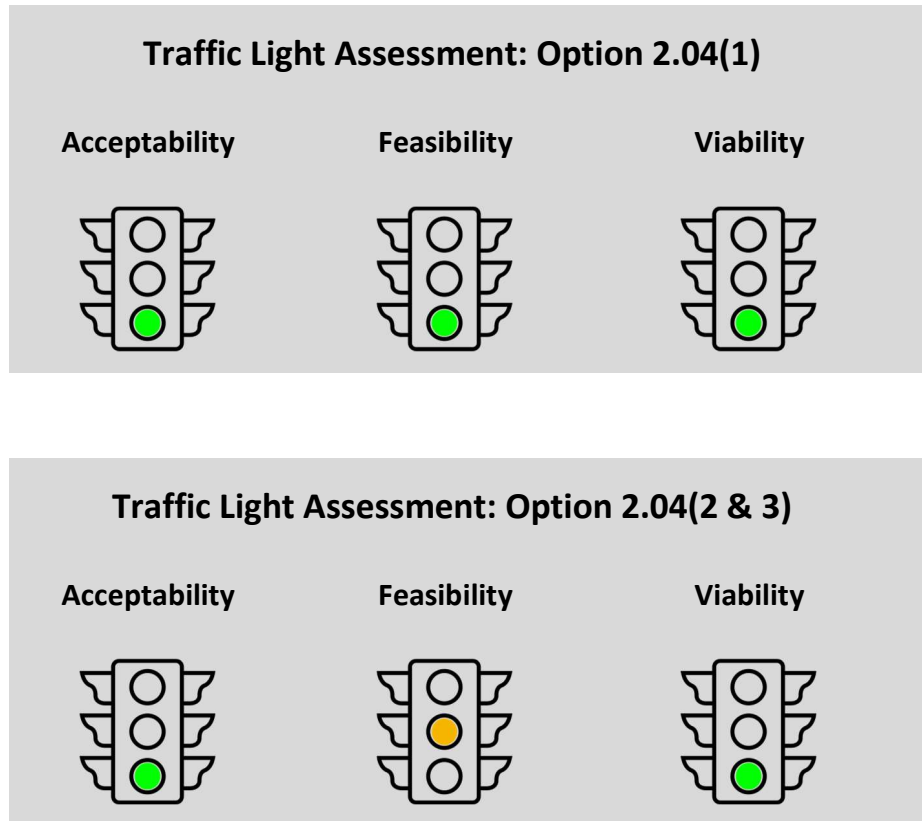
The key target for sub-item 1 is coastal wetlands, which are given the highest level of protection under the Coastal Management Act and the Coastal Management SEPP. It is important that public authorities model behaviours which reflect this level of importance. One key issue is that coastal wetland vegetation within private land holdings which is not mapped as part of the SEPP are not afforded the same level of protection as wetlands on public land. Historically, grazing within wetlands has resulted in substantial degradation.

However, wetlands have surprising resilience and experience has shown that a vibrant mix of wetland vegetation re-establishes reasonably quickly if suitable areas are fenced off and stock are excluded from accessing these areas. The following steps are required for sub-item 1:

- Council to liaise with state agencies controlling public land (such as Crown Lands and TfNSW) to identify suitable land for a demonstration site.
- Fence off that site (herein approx. 300m of fencing enclosing, say 1 ha of degraded wetland is estimated).
- Undertake regular maintenance including weeding.
- Holding field days with local farmers, at regular intervals, to demonstrate how environmental repair/regeneration works are proceeding.

Sub-items 2 and 3 relate to sub-item 1, but also cover riparian vegetation more broadly. Riparian vegetation helps in several ways to improve environmental conditions within the waterway. In this case, however, standard conditions of licensing or leasing of a parcel of crown land by a crown land manager will need to be developed for those parcels of land which contain low lying, degraded wetland. Additional consultation is required between agencies to unravel the legal implications and possibilities associated with these matters.

The management of areas fringing estuaries and other affected waterways will become increasingly important with future sea level rise. Providing for the future upslope migration of coastal wetlands through pre-emptive and protective licensing conditions seems a sensible approach to help retain these important ecosystems.



## 5.6 Option 2.05 – Prepare Report Assessing the Purchase and Retiring of Un-used Water Licences.

**Option Description:** Prepare a report assessing the feasibility, viability, and acceptability of purchasing and retiring un-used water licences to secure environmental water.

While this action relates to preparing a report, The CIE (Appendix E) has completed a preliminary assessment of viability for purchasing unused “sleeper” licenses. More detailed assessment could be considered, but a standalone study would be required.

The cost of purchasing licences is based on available water trading data, which provide a proxy for the value that other licence holders place on the licences. However, the trading data also reflects the specific use of each license. Using a trade price of \$1 000 per ML and a total of 47 819 ML of sleeper licence entitlement purchased evenly over

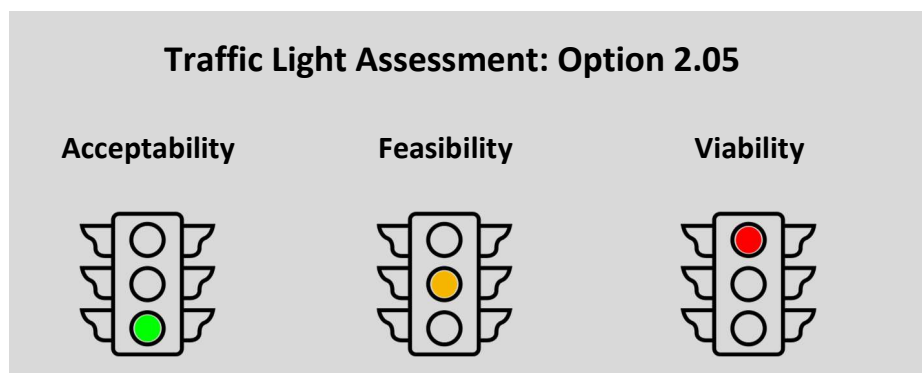
ten years (~4780 ML of purchased entitlements per year, for 10 years), results in a present value cost of \$35.9 million to purchase and retire unused water licences.

We conclude there is limited value buying-back sleeper licences at this stage as:

- the estimated costs are very high (more than \$35 million (present value)), and
- there is substantial uncertainty around how the purchase of sleeper licences would result in increased environmental flows (above current levels) under future water sharing plan (WSP) rules.

The situation could be reconsidered when the WSP is revised.

There is also value in delaying any purchase decision until there is an indication of an environmental flow ‘problem’ if sleeper licences are activated. Given the expected cost of purchasing/retiring these licences there is value in delaying the decision, rather than pre-emptively acting where the ‘problem’ may not eventuate.



## 5.7 Option 2.08 – Implement a Systematic Approach to Maintaining SQIDs

**Option Description:** Implement a systematic approach to maintaining stormwater quality improvement devices:

- Refurbish 5 proprietary Stormwater Quality Improvement Devices to achieve their full working capacity by 2022.
- Incorporate Water Sensitive Design devices in the MCC asset management system by 2023 and implement the monitoring, maintenance, and renewal program.
- Complete a report on the upgrade of Wingham Wetland, including feasibility, budget, and scope of works. Implement resulting actions by 2025.

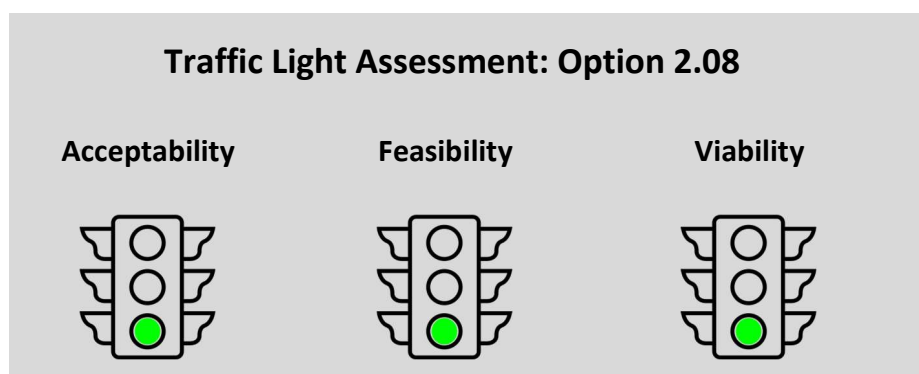


The CIE (Appendix E) considered the refurbishment costs of this option (\$250,000) and ongoing maintenance requirements.

In conclusion, we recommend that this option should be included in the CMP, subject to further investigation. A design objective should be adopted which allows for performance evaluation against estimated costs and anticipated benefits throughout Wingham Wetland's lifecycle.

The conclusion is based on:

- the relatively low cost of \$0.3 million (present value) to implement this option, compared to other capital works projects put forward for the CMP.
- the likely range of benefits the constructed Wingham Wetland may achieve, such as:
  - water quality improvement
  - water borne pollutant removal, and
  - litter removal



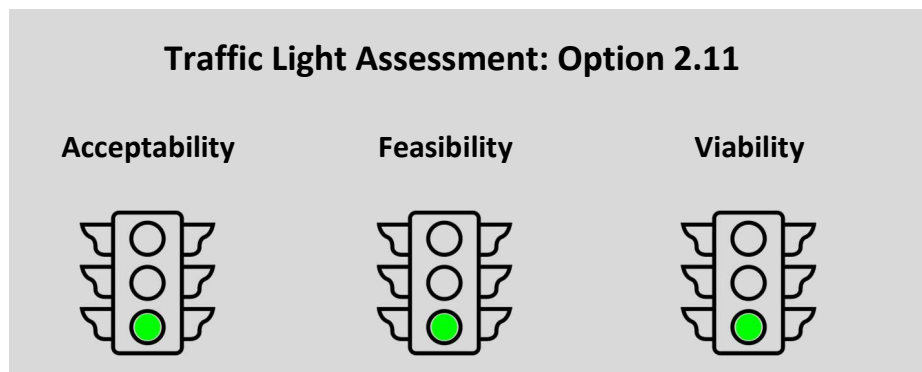
## 5.8 Option 2.11 – Study and Prioritise Sensitive Estuarine Riverbank Areas for Management

**Option Description:** Complete a study which prioritises sensitive estuarine riverbank areas for management. Follow up by stabilising 7.5 km with engineering structures by 2030.

There have already been studies during Stage 2 of the CMP preparation that have considered the state of riverbanks, riparian zones and the presence of erosion (Pietsch et al., 2019; Swanson, 2020). The aim of this action is to build upon those previous studies and to set clear prioritisation for different lengths of eroding foreshore which require protection. In addition, reconnaissance inspections and data collection should be undertaken in response to the floods of March 2021 to identify any additional areas. The prioritised list of mapped foreshore lengths should then be used to provide a

justifiable base for proceeding with works, while remaining flexible to protecting other priority areas that may arise.

Utilising rates from past budgets, around 700m / year would cost some \$410,000 annually. The prioritisation study would cost in the vicinity of up to \$75,000. Over the long term, the money to undertake this prioritisation study is well justified. At present, funding is being made available from the Marine Estate Management Strategy Implementation, via LLS. In recent years, MidCoast Council has also implemented bank protection works by leveraging funding from DPI's Fish Habitat Action Grants and revenue derived from its environment levy<sup>6</sup>. This track record points to both feasibility and viability of similar activities in coming years.



**Figure 4 MidCoast Council has had Recent Success in the Implementation of Riverbank Erosion Protection Works**

<sup>6</sup> <https://www.midcoast.nsw.gov.au/Part-of-your-everyday/Council-Projects/Riverbank-Stabilisation>, indicates that 3.5km of riverbank was protected within the Manning over a 5-year period.

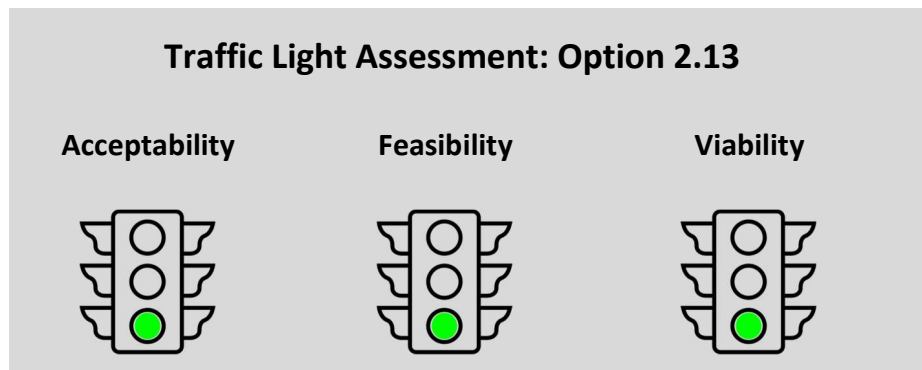
## 5.9 Option 2.13 – Study Unsealed Road Sediment Hotspots

**Option Description:** Identify, assess, and prioritise sediment hotspots from unsealed roads. Remediate 30 sites by 2030.

Works to improve unsealed roads, including waterway crossings were funded during the most recent stage (Stage 2) of the implementation plan for the Marine Estate Management Strategy (Marine Estate Management Authority, 2021). This activity is listed under Initiative 1, and for the year 2020-21, a total of 15 sites over three LLS regions, including the Hunter, were funded. In addition to the activities of LLS, MCC also works on the sealing of roads to reduce sedimentation.

In this context, the expectation that three sites per year could be funded for the next 10 years seems reasonable. Estimates of costs range from \$50,000 to \$90,000 per site and a forward budget of \$300,000 per annum, split 50/50 between Council and LLS seems reasonable, at least in the medium term.

There is nothing unusual from either an engineering or technical feasibility perspective; these types of works already sit within the remit of activities carried out by both Council and LLS. Similar to Option 2.11, however, it is recommended that a prioritisation study (~\$50,000) be completed soon to ensure that the works are most appropriately targeted.



## 6 Climate Change Options

All *Climate Change* options that have been identified for direct progression to the CMP. These are summarised, alongside relevant justification, in Table 8. More detailed, S.M.A.R.T descriptions of these options are provided in Appendix C3. The results of a multi-criteria analysis testing the consistency of options with the objects and objectives of the Coastal Management Act is presented in Appendix D.

**Table 8 Climate Change Options for Direct Progression**

Final Option Number	Option Title	Justification
3.01	Identify Retreat Buffer Zones for Coastal Wetlands and Littoral Rainforest	<i>Coastal Wetlands and littoral rainforests</i> are more highly ranked than the other coastal management areas in the coastal management act. Resilience of these features <i>including opportunities for migration</i> is one of the objectives for coastal wetlands and littoral rainforests.
3.02	Identify Council Assets at Risk from Sea Level Rise	Sea level rise has the potential to exacerbate the <i>tidal inundation</i> coastal hazard on built assets owned by Council. Several of the coastal vulnerability objectives in the Coastal Management Act require the consideration of these impacts. The extent of these impacts is not yet well understood, and this must be understood before suitable actions can be identified and pursued.
3.03	Examine Future Effectiveness of Coastal Inundation Emergency Strategies	Flood risk on the Manning River, is presently dominated by catchment processes. Over time, with sea level rise, the downstream end of the river will be increasingly affected by tidal and storm surge inundation. The potential impact of this on emergency management needs to be discussed and studied, in partnership with the SES.
3.04	Long Term Adaptation Plan for Manning Floodplain	This is a long term (20-50 year and beyond) plan for how land use will need to change and the communities along the lower floodplain will need to adapt to climate change. It matches the CM Act vulnerability objectives of improving resilience and reducing exposure to coastal hazards and understanding what the impact of sea level rise might be on coastal environment area values, such as acid generation and blackwater events.

## 7 Biodiversity Options

### 7.1 Biodiversity Options for Direct Progression

The *Biodiversity* options that have been identified for direct progression to the CMP are summarised, alongside relevant justification, in Table 9. More detailed, S.M.A.R.T descriptions of these options are provided in Appendix C3. The results of a multi-criteria analysis testing the consistency of options with the objects and objectives of the Coastal Management Act are presented in Appendix D.

**Table 9 Biodiversity Options for Direct Progression**

Final Option Number	Option Title	Justification
4.02	Involvement in the Manning River Helmeted Turtle Steering Committee	There is strong community support for action to help save the Manning River Helmeted Turtle, an endangered species under the Biodiversity Conservation Act. This is a relatively cheap option which will help Council identify and contribute any relevant initiatives or efforts.
4.03	Develop Integrated Pest and Weed Control Plans	This action reflects a need to integrate the efforts of Council, LLS and other agencies in tackling both feral pests and weeds within the Manning Catchment. Weed and pest management fall under Goals 2 and 3 of Hunter LLS's present Strategic Plan and the NSW biosecurity strategy <sup>7</sup> highlights that responsibility is to be shared among all levels of government.

### 7.2 Option 4.01 – Address Barriers to Fish Passage

**Option Description:** Address 10 priority sites and/or re-connect 200 km of fish passage by removing or re-designing priority barriers identified in the audit by DPI-Fisheries.

The CIE (Appendix E) considered an audit of barriers to fish passage completed in 2006 and, following advice from DPI Fisheries, undertook a preliminary assessment of addressing the following high priority sites:

- Hicks Lane on the Cooplacurripa River resulting in 163km of upstream fish passage gains.

<sup>7</sup> <https://www.dpi.nsw.gov.au/biosecurity/managing-biosecurity/nsw-biosecurity-strategy-2021>



- Duffys Forest Road on Rowleys River resulting in 39 km of upstream fish passage gains.
- Cells River Road on Rowleys River, resulting in 54 km of upstream fish passage gains.

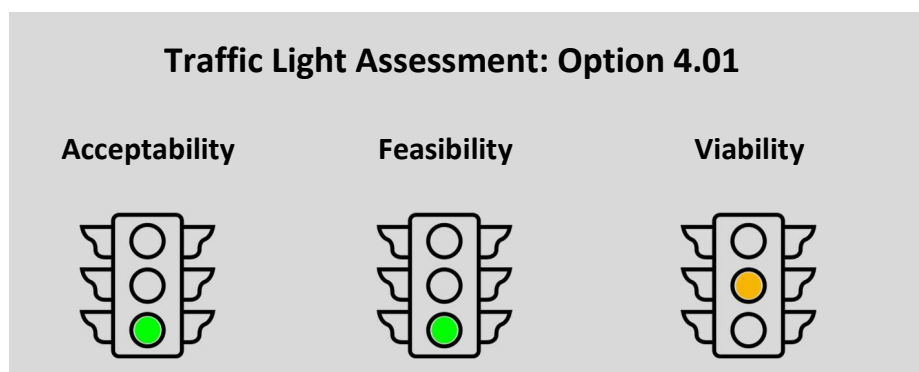
The reconnection of fish passage is an action specified in the Marine Estate Management Strategy and the activity is led by DPI Fisheries. Assessment is challenging, as each site has different characteristics that need to be examined in detail and assessed individually for viability before proceeding.

In an average sense, it was estimated that around \$350,000 per site would be required to replace barriers with an appropriate bridge structure.

We conclude remediating fish passage, with the goal of remediating 10 structures and/or 200km of fish passage, should be subject to further site-specific evaluation. Although DPI Fisheries undertook a fish passage assessment in 2006, it is unclear what 10 fish passage sites will be targeted for remediation, specific works undertaken and their associated costs. The option is viable, providing that the target sites are selected based on robust information.

Remediation of the three sites listed above will achieve close to the stated 200 km target. Assumptions include that each site will have a culvert structure replaced by a bridge, as per DPI Fisheries preferred approach. Site specific evaluation is required to confirm that culvert replacement with a bridge is appropriate for these sites, including discussions and agreement with Transport for NSW, as well as to confirm costs.

Technology and management practices have evolved since the 2006 DPI Fisheries fish passage audit<sup>8</sup> and implementation of some subsequent fish passage remediation works is described in the bringing back the fish report of 2010<sup>9</sup>.



<sup>8</sup> NSW Government 2006, 'Reducing the impact of road crossings on aquatic habitat in coastal waterways – Hunter/Central Rivers, NSW. Report to the New South Wales Environmental Trust. NSW Department of Primary Industries', [https://www.dpi.nsw.gov.au/\\_data/assets/pdf\\_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf](https://www.dpi.nsw.gov.au/_data/assets/pdf_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf)

<sup>9</sup> NSW Government 2010, 'Bringing Back the Fish Project reports', Appendix-B-Hunter-Central-Rivers-part-1.pdf; [https://www.dpi.nsw.gov.au/\\_data/assets/pdf\\_file/0009/634617/5.-Appendix-B-Hunter-Central-Rivers-part-2.pdf](https://www.dpi.nsw.gov.au/_data/assets/pdf_file/0009/634617/5.-Appendix-B-Hunter-Central-Rivers-part-2.pdf)

## 7.3 Option 4.04 – Implement Recommendations of Refugia Study

**Option Description:** Implement recommendations of the Manning Catchment Refugia Study 2021, working in partnership with private landholders to assess, protect, restore, and monitor hydrological refugia in 10 priority reaches in the Barnard and Dingo Creek subcatchments.

Following the bushfires of 2019/2020, large areas of the Manning Catchment were burned. The landscape was dry, and the drought had caused the Manning to stop flowing upstream of Wingham. There was substantial concern for some species which relied on the presence of pools of freshwater for refuge, which were drying out and becoming uninhabitable. A focal species of concern was the endangered Manning River Helmeted Turtle. A study of refugia was subsequently completed and priority sites identified.

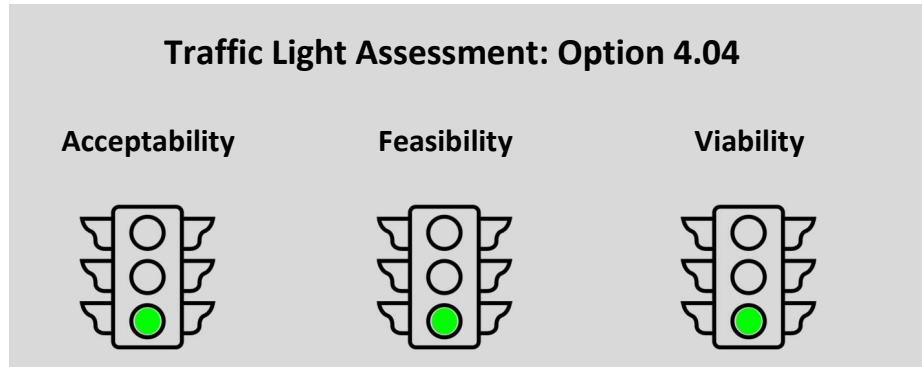
Funding has recently been acquired by MidCoast Council, partnering with the Manning River Turtle Conservation Group to address sites in the Nowendoc River Catchment. Ongoing funding is also forecast from Hunter LLS and from MCCs normal revenue sources. Beyond the Nowendoc Catchment there is a need to protect and restore drought refuge pools in 10 priority reaches of the Barnard and Dingo Creek subcatchments. Works will involve site assessment, stock exclusion, bank stabilisation, regeneration and revegetation, and pest and weed control.



**Figure 5** Following drought and bushfires in 2019/2020, concern for the endangered Manning River Helmeted Turtle intensified.

The restoration of freshwater refuges is also expected to have benefits for platypus, small crayfish, threatened frogs and the Australian Bass.

A total of \$125,000 is earmarked for expenditure over the next two years, followed by around \$50,000 per annum thereafter. Overall engineering and hydrological feasibility will need to be assessed as each site is addressed, but there is nothing technically novel or overtly challenging about the required works.



## 8 Aboriginal Custodianship Options

### 8.1 Aboriginal Custodianship Options for Direct Progression

All *Aboriginal Custodianship* options have been identified for direct progression to the CMP. These are summarised, alongside relevant justification, in Table 10. More detailed, S.M.A.R.T descriptions of these options are provided in Appendix C3. The results of a multi-criteria analysis testing the consistency of options with the objects and objectives of the Coastal Management Act is presented in Appendix D.

**Table 10 Aboriginal Custodianship Options for Direct Progression**

Final Option Number	Option Title	Justification
5.01	Involve Aboriginal Community in Management of the River, Catchment and Estuary	This action broadly covers all actions within the CMP. However, it importantly addresses the key Object of the CM Act “to acknowledge Aboriginal peoples’ spiritual, social, customary and economic use of the land”. Involvement of local Aboriginal peoples’ in caring for their Country is seen to directly align with this object.
5.02	Install Interpretive Signage and Facilitate Cultural Activities	As for 5.01, this is an acknowledgement of Aboriginal peoples’ connection to the land. In this case, however, it also has educational benefit for the broader local community.
5.03	Engage Aboriginal People in Water Quality Monitoring	Justification is as outlined for 5.01.
5.04	Involve Aboriginal People in Implementation of the Manning CMP	Justification is as outlined for 5.01.
5.05	Collaborate with Aboriginal Traditional Owners to Manage Coastal Wetlands	This action directly addresses the objective of the Coastal Wetland Area to support the social and cultural values of those wetlands, with focus on Aboriginal traditional cultural values. The action is specifically related to coastal wetlands within the National Parks Estate.

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## 9 Social and Economic Values Options

### 9.1 Option 6.01 – Site-Specific Pathogen Source Control Plans for High-Risk Oyster Growing Areas

**Option Description: Use monitoring data, results of Oyster Transformation study and field investigations to characterise the source and risk rating for pathogens in each area. Develop and implement site-specific pathogen source control plans for high-risk oyster growing areas.**

The presence of pathogens in the water of the Manning River continues to be a concern for oyster farmers. Direct harvesting of oysters from the Manning River is presently prohibited, with oysters needing to be translocated to a different estuary, or onshore for finishing in depuration tanks prior to harvest and sale.

Work is ongoing to try and address this issue state-wide, including:

- Research by the Food Agility CRC (NSW Food Authority in partnership with UTS) where permanent data collection devices and genomic tracing of pathogens is being completed to better inform closures.
- The investigation of management actions addressing perceived risks (See Option 2.02 in Pelican Bay).
- Risk assessment work relating to Council's *"Development Assessment Framework"* for managing on-site sewerage systems.

Based on the issue paper dealing with sewerage systems and septic tanks, it is understood that the NSW Food Authority has mapped and ranked critical risk locations. This work would act as a starting point for identifying high risk locations that need action. However, it will take time for conclusions to be reached as part of ongoing research to further inform the levels of risk present at different sites.

Once research has concluded, a nominal amount should be spent on consolidating the existing information and research, and to identify (map) the high-risk areas that are to be targeted. Follow up field investigations could be completed for three sites with source control plans developed and subsequently implemented.

Costs for undertaking the risk assessment are expected to be around \$20,000, with around \$20,000 each required to develop source control plans for around 3 high-risk sites.



### Traffic Light Assessment: Option 6.01

Acceptability



Feasibility



Viability



## 9.2 Option 6.02 – Family-Friendly Passive Recreational Facilities

**Option Description:** Develop a strategic mix of family-friendly passive recreational facilities including nature-based experiences that improve access while encouraging understanding and conservation of environmental and Biripai cultural values (e.g., picnic areas, birding routes, boardwalks, river walks and interpretive signage).

MCC is prepared a destination management plan for the entire LGA (MidCoast Council, 2017). As part of that initiative, a set of “Game Changer Projects” are identified including a broad initiative associated with *Outdoor and Nature Based Recreation*. The initiative includes the promotion of a range of experiences and tours. One aspect of the initiative is to prioritise investment into the infrastructure that would support these experiences, such as maintaining or enhancing existing trails. A second “Game Changing” initiative *Celebrating Culture on Country* is associated with developing Aboriginal cultural tourism experiences within the area.

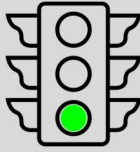
Option 6.02 targets projects which combine these two initiatives. At this stage, the physical nature of the projects to be implemented is uncertain. Council is preparing an Open Space and Recreation Needs Analysis (due June 2021) with the aim of producing an Open Space and Recreation Strategy (end 2022). Option 6.02 will assist with the implementation of key projects from the Open Space and Recreation Strategy.

As part of that strategy, projects within the Manning Catchment that are consistent with the objectives of the Coastal Management Act would be identified for inclusion. The examples identified in the option description are generally consistent with passive recreational opportunities that would be appropriate.

In costing and considering the appropriateness of this option, we have assumed that two projects would be delivered by 2026 for around \$300,000 each (\$50,000 for design and planning, \$250,000 for implementation). An updated assessment of feasibility and viability should be undertaken for each project as part of its identification.

### Traffic Light Assessment: Option 6.01

**Acceptability**



**Feasibility**



**Viability**



## 10 Land Use Planning Options

### 10.1 Land Use Planning Options for Direct Progression

All *Land Use Planning* options have been identified for direct progression to the CMP. These are summarised, alongside relevant justification, in Table 11. More detailed, S.M.A.R.T descriptions of these options are provided in Appendix C3. The results of a multi-criteria analysis testing the consistency of options with the objects and objectives of the Coastal Management Act is presented in Appendix D.

**Table 11 Land Use Planning Options for Direct Progression**

Final Option Number	Option Title	Justification
7.01	Submit a Planning Proposal for CM SEPP	Modification and update of CM SEPP maps is an integral part of the CMP process. In this instance, all necessary information to inform the required Planning Proposal will not be provided by this CMP in isolation. Therefore, the action needs to be carried forwards as an action within the CMP.
7.02	Preparing Mapping of Coastal Vulnerability Area for Tidal Inundation	No Coastal Vulnerability maps are available in NSW at the time of writing <sup>10</sup> . MCC will need to prepare coastal vulnerability maps to support Action 7.01.
7.03	Identify Water Quality Objectives and Management Targets	This study / assessment is needed as a precursor to inform future management action. It requires application of the “ <i>Risk Based Framework</i> ” to set appropriate objectives and management targets, within a framework consistent with the Water Quality Australia Guidelines.

<sup>10</sup> No maps have yet been published [NSW Coastal Management State Environmental Planning Policy Maps](#) as of 20 April, 2021.

## 11 Governance Options

### 11.1 Governance Options for Direct Progression

All *Governance* options have been identified for direct progression to the CMP. These are summarised, alongside relevant justification, in Table 12. More detailed, S.M.A.R.T descriptions of these options are provided in Appendix C3. The results of a multi-criteria analysis testing the consistency of options with the objects and objectives of the Coastal Management Act is presented in Appendix D.

**Table 12 Governance Options for Direct Progression**

Final Option Number	Option Title	Justification
8.01	Establish Multi-Stakeholder Management Committee	The CMP is expected to be an adaptable process and successful execution of the required actions will need oversight. MCC will oversee review and monitoring of the delivery of the CMP but this will be facilitated through a stakeholder committee that helps with coordination and reporting. This action is required to underpin CMP delivery.
8.02	Improve Coordination and Integration Across all Levels of Government	See also 8.01. Inclusion of this action is consistent with Initiative 9 of the Marine Estate Management Strategy <sup>11</sup> ( <i>Delivering Effective Governance</i> ).
8.03	Build the Capacity of Compliance Programs	Compliance issues arose in several forums during development of the CMP in relation to diverse matters such as land clearing, water theft and on-site sewerage management. This action requires oversight of these diverse matters including disseminating information on how different non-compliance issues should be dealt with. Council is often the first point of call for a range of non-compliance issues, including those for which they aren't responsible.

<sup>11</sup> <https://www.marine.nsw.gov.au/marine-estate-programs/marine-estate-management-strategy> accessed 20/04/2021.

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## 12 Summary and Progression to Business Planning

45 short listed options for inclusion in the Manning River Catchment Management Program were subjected to varying degrees of assessment for acceptability, feasibility and viability, depending on option complexity and magnitude as follows:

- 1 31 options were identified as “*Direct Progression*” options. These included options that involved studies to inform future management, community engagement activities and cheaper actions with a good track record of successful implementation. Cost estimates for these options were made alongside multi-criteria analyses to confirm consistency with the CM Act.
- 2 Eight (8) options were identified for “*Moderate Level Assessment*”. These included options where there was some expense involved, or additional complexity and/or uncertainty relating to overall feasibility or viability. For those options, the multi-criteria assessment, as described for the *Direct Progression* options, was completed alongside a more rigorous, but still qualitative consideration of feasibility. Typically, a more robust assessment of costs was also completed.
- 3 The remaining six (6) options were subjected to financial and economic assessment by The Centre for International Economics (The CIE). These options were selected during the initial workshops held to clarify the long list of options, and subsequently refined. The analyses of CIE, depending on the option being considered, comprised detail between that of the moderate level assessment described above and an “intermediate” level assessment, as per the classification outlined in Figure B3.26 of the *Coastal Management Manual*. CIE’s report is provided as Appendix E.

All 45 options were inherently “Acceptable”, having arisen from an extensive stakeholder consultation effort.

All options were found to be “Feasible” in the sense that there is no key impediment from a legal, technical or engineering perspective. In some cases, future study to better direct actions at specific sites and/or follow up engineering design may be required as the CMP is implemented. In that case, “on-ground” actions should be deferred until the required preceding tasks are completed.

All options except for one (Option 2.05: to study the buyback of water licenses) were also found to be “Viable” in that they have been assessed as being good value for money. Importantly though, none of the options have been subjected to full cost benefit analysis (CBA). Full CBA would typically include efforts to quantify, in \$ terms, the full suite of benefits arising from the management option being assessed. For the present assessment, viability has been partly assessed by comparing cost estimates



against the amounts that would normally be considered justifiable for comparable activities.

Even if a management action is considered “Acceptable”, “Feasible” and “Viable”, this does not mean that it can be automatically carried out as part of the CMP. The existing funding environment is constrained and varies from year to year, depending on government priorities and other factors.

As an example, bushfire recovery funding which has followed the 2019/2020 bushfire disaster is presently earmarked to complete initial stages of some actions put forward for the CMP. Conversely, it could be expected that the impact of COVID-19 on federal, and subsequent State finances will also impact on the availability of grant funding over the next few years.

While a best estimate of expected funding can be made, this becomes highly uncertain beyond a timeframe of 2-3 years. Mechanisms whereby management actions can be put on a ‘reserve’ list for funding if the future opportunity arises should be considered in the CMP. Similarly, a thorough review of funding arrangements at around 5 years into CMP delivery (~ mid 2026) is recommended to re-align expected delivery with the funding environment at the time.

Funding availability, prioritisation of management actions and sequencing, where relevant, have all been considered in timetabling management actions within the business plan that accompanies the CMP.

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## Appendix A Initial List of Management Options

Management Option No.	Description	Preliminary Workshop No.
1.14	Take an integrated approach to the management of stormwater quantity and quality, seek opportunities to incorporate water quality treatment into infrastructure upgrades and new infrastructure.	1.1
1.15	Review the Taree, Wingham and Gloucester stormwater management plans integrating water quality and quantity controls, implement actions.	1.1
1.16	Implement the MCC wide approach to maintaining stormwater quality improvement devices, including maintenance arrangements, asset monitoring and renewal (including Wingham Wetland).	1.1
1.17	Adopt a strategic approach to the management of riverbank erosion by identifying sensitive riverbank areas, investing in bank protection in priority areas and working with key users and regulators to improve source-control of boat wash erosion.	1.1
1.18	Remediate and control erosion of unpaved roads, tracks and creek crossings on public land in priority areas.	1.1
1.19	Stabilise priority riverbanks using best practice methods identified by Department of Primary Industries.	1.1
1.20	Support sediment and erosion control programs in public and private agriculture and forestry operations.	1.1
1.25	Model sediment inputs from significant sources across the catchment to prioritise management actions.	1.1
3.18	Monitor the volume, type and location of litter and stormwater pollutants. Set targets and monitor progress.	1.1
3.19	Utilise this data for targeted education and engagement campaigns including the use of source control plans that promote responsible behaviour.	1.1
3.20	Provide support for community and industry groups involved in litter removal and clean-up programs.	1.1
3.21	Apply lessons learnt at Browns Creek to develop clean-up programs in new areas	1.1
3.22	Reassess historical community stormwater education and advocacy campaigns and implement a new program for the general community.	1.1
3.23	Work in partnership with rural landholders to improve ESC on private land including better management of driveways, earthworks and dam walls.	1.1
3.24	Build the capacity of designers, builders, engineering consultants and developers to plan and implement ESC for developments.	1.1
3.25	Undertake proactive, targeted compliance program across private and public land.	1.1
3.26	Review Councils approach to ESC, identify and implement improvements, set benchmarks, establish audits.	1.1

Management Option No.	Description	Preliminary Workshop No.
3.27	Promote understanding and commitment to erosion and sediment control in agriculture and forestry.	1.1
3.43	Implement MCC's OSSM Audit and Compliance Plan to inform a proactive inspection program in high-risk locations.	1.1
4.06	Incorporate Aboriginal cultural knowledge into stormwater treatment options, such as plant selection for constructed wetlands.	1.1
5.02	Identify and map high risk areas for pathogen contamination. Use monitoring data, results of Oyster Transformation study and field investigations to characterise the source and risk rating for pathogens in each area.	1.1
5.03	Develop site-specific pathogen management plans for high-risk oyster growing areas.	1.1
1.10	Evaluate the value and investigate the opportunities to secure water supply for users and purchase un-used water licences and water sharing plan and establish a program to purchase and retire un-used water licences. (NB: This may not be an appropriate action for the CMP in terms of it becoming certified, more consideration needed, discuss further with Water Services.)	1.2
1.11	Minimise water loss through the continued upgrade of MCC water infrastructure to maximise water efficiency.	1.2
1.12	Continue MCC programs to support implementation of the Smart Water Advice Audit for large water users, e.g., caravan parks, abattoir, dairy industry, hospital.	1.2
1.13	Complete review and implementation of MCCs Integrated Water Cycle Management Plan to improve drought security and protect environmental flows. Consider expanding use of treated effluent for stock purposes and farm use.	1.2
3.28	Promote uptake of Best Management Practice to conserve water and improve drought resilience on farms.	1.2
3.29	Develop Best Management Practice for water conservation on Council open space and use as demonstration projects.	1.2
3.30	Continue MCC programs with residents to promote water efficiency, e.g., water restrictions, ongoing education, pricing mechanisms.	1.2
3.31	Liaise with the Manning Water Users Association to regulate extraction during drought.	1.2
3.32	Liaise with NRAR to report illegal extraction.	1.2
3.42	Promote cease-to-pump thresholds and river-level monitoring information. Improve compliance with domestic water rights and extraction licence conditions. Promote understanding of how to report illegal extraction to NRAR.	1.2
5.04	Ensure STP management is effective, and capacity matches new residential demand.	1.2

Management Option No.	Description	Preliminary Workshop No.
6.01	Use the Rural Strategy, Local Environment Plan (LEP) and DCP to encourage appropriate land use, reduce agricultural impacts and improve environmental outcomes.	1.3
6.02	Use land-use planning to protect the alluvial river flats and arable land for farming and food production including aquaculture.	1.3
6.03	Use Council's strategic planning framework to implement planning controls to protect wetlands (Rural Strategy, SEPP, LEP, and DCPs).	1.3
6.04	Provide evidence and propose amendments to the Coastal Management SEPP to support purchase, rezoning and remediation of coastal wetlands to improve ecosystem services.	1.3
6.05	Update the MCC LEP and DCPs to reflect the MCC On-site Sewage Development Assessment Framework.	1.3
6.06	Implement development controls to protect terrestrial and riparian native vegetation in Councils DCP and LEP.	1.3
6.07	Review and consider riparian native vegetation in Councils DCP and LEP	1.3
6.08	Review and update subdivision controls and lot sizes on waterfront land to avoid fragmentation and stock access in riparian vegetation.	1.3
6.09	Use development controls and land use zoning through the MCC Rural Strategy to improve drought resilience by mitigating the impact of future development on water demand and domestic extraction.	1.3
6.11	Require developments within potable water sub-catchments and groundwater aquifers identified in the LEP to be integrated developments.	1.3
6.12	Identify, prioritise and provide evidence to support amendments to the LEP and DCP for the protection of wildlife habitats and corridors.	1.3
6.13	Prepare mapping to inform a future planning proposal for a Coastal Vulnerability Area to be added to the Coastal Management SEPP, LEP and DCP.	1.3
6.10	Include water quality controls in the MidCoast LEP and DCP clearly identifying targets and development types where water quality controls apply.	1.3
3.33	Adopt a set of significant flagship and indicator species with Aboriginal and community input to use in monitoring and community engagement programs.	2.1
3.34	Develop an interagency, multi-media communication package and education and training materials to promote awareness, appreciation, understanding and skills to conserve wildlife in urban and rural settings.	2.1
3.35	Promote and facilitate private conservation agreements through Land for Wildlife and Biodiversity Conservation Trust.	2.1
3.36	Establish an annual citizen science BioBlitz through the Atlas of Living Australia to document biodiversity of the Manning catchment.	2.1



Management Option No.	Description	Preliminary Workshop No.
3.38	Deliver an annual nature discovery program to raise awareness and commitment to conservation.	2.1
3.39	Support private and community-based wildlife conservation initiatives.	2.1
4.01	Adopt a set of significant flagship and indicator species with Aboriginal community input to use for monitoring and community engagement programs.	2.1
5.11	Collaborate with fishers to document local knowledge on ecology of the fishery including identification of nursery areas to inform future management regulation.	2.1
7.01	Develop Conservation Action Plans for priority aquatic and riparian fauna and flora – e.g., platypus, Manning River helmeted turtle.	2.1
7.02	Develop and implement local integrated weed control plans to protect priority assets.	2.1
7.03	Develop and implement a cross-tenure Feral Pest Control Plan to protect priority assets.	2.1
7.04	Promote and enforce biosecurity regulations and responsibilities to prevent exotic fish infestation (e.g., carp).	2.1
7.05	Restore fish passage by removing or re-designing barriers identified as medium-high and high priority by NSW Fisheries.	2.1
7.06	Protect and restore drought refuge pools for aquatic fauna habitat.	2.1
7.07	Improve condition, extent, connectivity of riparian vegetation for wildlife habitat on public and private land.	2.1
7.08	Assess risk and implement risk mitigation strategies to reduce impacts of major disasters, particularly those associated with climate change (e.g., drought, fire).	2.1
7.09	Complete a refugia modelling study to identify, map and prioritise freshwater refuge pools.	2.1
7.10	Sponsor an e-DNA research project to characterise aquatic fauna abundance, diversity and presence of exotic species.	2.1
1.01	Implement the NSW best practice guidelines and key priorities within the Lower Manning River Drainage Remediation Action Plan to mitigate the risk from Acid Sulfate Soils in the estuary, including public purchase and remediation in priority hot spots.	2.2
1.02	Remediate priority acid soil hotspots and explore opportunities to reinstate coastal wetlands for water quality improvement, ecosystem services and community benefit.	2.2
1.03	Remediate and restore intertidal hydrology on priority public land and in partnership with landholders on private land.	2.2
1.04	Continue to improve design and management of floodgates with minimum inverts to maintain soil moisture.	2.2
1.05	Manage coastal wetlands on public land for ecosystem services and/or as demonstration sites for agricultural best management practice (Crown lands, TfNSW).	2.2

Management Option No.	Description	Preliminary Workshop No.
1.07	Implement an integrated weed and pest management program in partnership between land management agencies and private landholders.	2.2
1.08	Protect and restore the condition, extent and connectivity of riparian vegetation and coastal wetlands on private and public land.	2.2
1.09	Investigate opportunities to establish riparian conservation reserves to improve connectivity and extent of buffer vegetation for multiple benefits.	2.2
1.24	Sponsor a research project on the distribution, risk factors and management for seagrass, saltmarsh and mangroves.	2.2
1.26	Use historic records and intact remnants of riparian vegetation to identify reference sites and target distribution of vegetation communities for monitoring and restoration.	2.2
3.14	Continue education and engagement about ASS, how it occurs, impacts and management practices on public and private land.	2.2
3.16	Build relationships, offer training and share research with the Drainage Unions to improve management of ASS on the floodplain.	2.2
3.17	Review MCC's guidelines for drain management (2005) and use these as a tool to engage with landholders and promote Best Management Practice for management of ASS.	2.2
5.05	Implement the Pelican Bay sub catchment Improvement Program to improve water quality.	2.2
1.06	Evaluate the financial and environmental effectiveness and build on existing trials of floodplain and wetland management in partnership with farmers to demonstrate Best Management Practice for different elevations and soil types on the floodplain: e.g., liming, re-flooding, wetland rehabilitation, farming on the ASS, wet pasture, shallow drains. Undertake cost-benefit analysis and promote return on investment.	2.3
3.01	Provide communication and education to build understanding of ecosystem values and services; the environmental, social and economic impacts of poor land and water management; regulations and responsibilities for land management; and the integrated benefits of good management practice.	2.3
3.02	Install interpretive signs at boat ramps and recreation reserves to remind people about their responsibilities for looking after our waterways.	2.3
3.03	Formalise and coordinate partnership programs between MCC, LLS and Landcare to provide a cohesive and cost-effective capacity building program for landholders.	2.3
3.04	Identify and undertake a needs assessment of river users and key target audiences for engagement to promote Best Management Practice for productivity, biodiversity and catchment values.	2.3
3.05	Establish a Best Management Practice framework for whole farm planning, conservation and land management. Include practices to improve pasture cover, soil carbon, riparian vegetation, off stream watering, shade, irrigation, farm dams, drainage, diffuse source	2.3

Management Option No.	Description	Preliminary Workshop No.
	run-off, pathogens and cattle impacts on the riparian zone. Include cost benefit analysis and return on investment.	
3.06	Develop co-branded, multi-media training and education resources promoting understanding and commitment to Best Management Practice in the region, to be shared across agencies.	2.3
3.07	Develop and implement a targeted landholder outreach and incentive program guided by the prioritisation tool and Best Management Practice framework.	2.3
3.08	Build the capacity of new landholders to understand the environmental/economic and social impacts of poor management practice and undertake Best Management Practice of their land, target property buyers in high priority areas.	2.3
3.09	Develop a coordinated education and awareness program including case studies and field events to promote coastal wetland and native vegetation ecosystem services, Best Management Practice and sustainable land use.	2.3
3.10	Use public and private land to demonstrate agricultural Best Management Practice.	2.3
3.11	Support the Sustainable Farming Groups and farmer-to-farmer learning.	2.3
3.12	Investigate options for stewardship payments for landholders for Best Management Practice of farming land.	2.3
3.13	Support innovation within the farming community to improve landscape hydration and catchment health.	2.3
3.15	Work with farmers and support whole-farm planning for climate change, Sea Level Rise (SLR), ASS and coastal wetland management. Disseminate research to build farmers understanding of how the landscape will change.	2.3
3.40	Promote reporting and undertake compliance to address illegal clearing on public and private land, with a focus on mangroves and riparian vegetation.	2.3
3.41	Enforce compliance with conditions on Crown Land grazing permits.	2.3
5.01	Build capacity for landholders to safeguard and recover from drought, flood and fire.	2.3
3.37	Develop nature-based tourism experiences that promote the environmental values of the Manning River Catchment and Estuary e.g., birding routes, hides, boardwalks, river walks.	3.1
5.06	Develop a program to build the link between premium produce, a healthy environment and sustainable farming practices (e.g., Manning Valley Naturally).	3.1
5.07	Explore opportunities to promote reorientation of riverfront towns to face the river and take advantage of the views.	3.1
5.08	Provide a strategic mix of recreation opportunities to spread use through the system and promote connection to the river and wellbeing.	3.1

Management Option No.	Description	Preliminary Workshop No.
5.09	Calculate the economic value of coastal wetlands for commercial and recreational fisheries and aquaculture.	3.1
5.10	Assess the overall economic benefit of a healthy river and estuary to the MidCoast LGA. If we repair legacy issues, what will be the economic value to the valley as a whole?	3.1
1.21	Undertake event-based tidal gauging study at multiple locations examining flows, salinity and updated bathymetry to develop a reliable catchment and hydrodynamic baseline model for all future research and planning.	4.1
1.22	Establish a platform for integrated monitoring and data sharing.	4.1
1.23	Undertake Hydrological modelling of catchment to identify opportunities to influence water storage, water cycling, drought resilience, buffering, restoring the landscape.	4.1
2.01	Work collaboratively with landholders and other stakeholders to develop an adaptation plan to mitigate the risk of climate change impacts on the floodplain, including management of Acid Sulfate Soil and blackwater events.	4.1
2.02	Complete the MCC Climate Change Adaptation Framework to manage climate risks on Council infrastructure assets such as roads, stormwater systems, and river access facilities.	4.1
2.03	Address SLR threats to stormwater infrastructure through adaptation planning by asset managers.	4.1
2.04	Identify Sea Level Rise thresholds at which existing coastal inundation emergency strategies will cease to be effective. Develop adaptation and mitigation strategies.	4.1
2.05	Engage with the State Emergency Service to build capacity for long-term emergency plans responsive to climate change impacts.	4.1
2.06	Build community awareness, understanding and preparedness for climate change impacts on flooding and inundation, fire, drought, and water availability consistent with Adapt NSW guidelines.	4.1
2.07	Ensure Council floodgate maintenance and replacement is included in MCC's asset maintenance system.	4.1
2.08	Complete modelling to identify retreat buffer zones to retain coastal wetland ecosystem services and littoral rainforest under sea-level rise scenarios.	4.1
4.02	Build capacity for Aboriginal involvement in NRM by supporting accredited Conservation and Land Management training and issuing field work contracts.	4.2
4.03	Engage Aboriginal Rangers in an ongoing conservation and land management program for the Manning Catchment	4.2
4.04	Incorporate Aboriginal traditional knowledge in management of the river, catchment and estuary, for example through cultural burns to reduce fuel.	4.2
4.05	Manage threats to coastal wetlands in the National Park estate and adjacent lands, in collaboration with Aboriginal Traditional Owners.	4.2

## **Appendix B Preliminary Workshops**



**Table B1 List of Workshop Attendees**

<b>Name</b>	<b>Organisation</b>	<b>Position</b>	<b>Initials</b>
Louise Duff	MidCoast Council	Catchment Management Coordinator	LD
Prue Tucker	MidCoast Council	Water Quality and Estuary Management Program Coordinator	PT
Adam Turville	MidCoast Council	Asset Planning Coordinator	AT
Alexandra Macvean	MidCoast Council	Senior Land Use Planner	AMc
Harry Lloyd	MidCoast Council	Graduate Planner	HL
Mat Bell	MidCoast Council	Senior Ecologist	MB
Karen Bettink	MidCoast Council	Catchment Officer – Ecosystem Management	KB
Belinda Kennewell	MidCoast Council	Environmental Office	BK
Alicia Madsen	MidCoast Council	Catchment Officer	AMd
Gerard Tuckerman	MidCoast Council	Manager Natural Systems and Acting Manager Land Use Planning	GT
Tanya Cross	MidCoast Council	Sustainability and Natural Assets Coordinator	TC
Robyn Brennan	MidCoast Council	Economic Development Coordinator	RB
Deb Tuckerman	MidCoast Council	Manager Growth, Economic Development and Tourism	DT
Dan Aldridge	MidCoast Council	Manager Community Spaces, Recreation and Trades	DA
Sharon Bultitude	MidCoast Council	Destination Management Coordinator	SB
Evan Vale	MidCoast Council	Team Leader Coastal Flooding and Drainage	EV
Hannah Earley	MidCoast Council	Aboriginal Liaison Officer	HE
Brian Hughes	Hunter Local Land Services	Senior Land Services Officer Aquatic Agriculture Estuaries	BH
Reegan Walker	Hunter Local Land Services	Senior Land Services Officer NRM Extension	RW
Albert Mullen	Hunter Local Land Services	Senior Land Services Officer Sustainable Agriculture	AM
Rye Gollan	Hunter Local Land Services	NRM Projects Officer	RG
Toby Whaleboat	Hunter Local Land Services	Aboriginal Communities Officer	TW
Scott Carter	Department of Primary Industries - Fisheries	Senior Fisheries Manager, Aquatic Ecosystems	SC

Name	Organisation	Position	Initials
Kylie Russell	Department of Primary Industries - Fisheries	Senior Manager, Coastal Systems, Aboriginal Fishing, Marine and Coastal Environment	KR
Joedie Lawler	Purfleet/Taree Local Aboriginal Land Council	Chief Executive Officer	JL
Chris Sheed	TIDE	Program Manager	CS
David Wainwright	Salients	Director / Coastal and Estuary Engineer	DW
Maddy Leary	Salients	Junior Coast and Flood Engineer	ML
Nigel Rajaratnam	Centre for International Economics	Director / Economist	NR
Mark Wainwright	Alluvium	Senior Water Resources Engineer	MW
Troy Gaston	University of Newcastle	Associate Professor, Ecologist, School of Environmental and Life Sciences	TG

**Table B2 Workshop Details**

Session Number	Title	Date	Time	Attendees
1.1	Water Services Consultation: Water Quality-Ecosystem Health and Stewardship	16-Feb-21	8:00-10:00	LD, AT, PT, DW, MW, ML, NR.
1.2	Strategic Planning	16-Feb-21	10:30-12:30	LD, PT, HL, TC, Amc, DW, ML, NR.
1.3	Stormwater and ESC - Water Quality-Ecosystem Health and Stewardship	16-Feb-21	12:30-14:30	LD, PT, BK, BH, DW, MW, ML, NR.
2.1	Biodiversity	17-Feb-21	8:00-9:30	PT, AMd, MB, KB, RW, SC, DW, ML, TG, NR.
2.2	Stewardship - working with landholders	17-Feb-21	10:00-12:30	LD, PT, KB, AM, DW, ML, TG.
2.3	Water Quality and Ecosystem Health (Acid sulfate soil remediation, coastal wetlands, riparian veg)	17-Feb-21	13:00-15:30	LD, PT, RG, TC, KR, GT, AM, DW, ML, TG.
3.1	Social and Economic Values	24-Feb-21	10:00-12:00	LD, PT, RB, DT, DA, SB, DW, ML, NR.
4.1	Climate Change, MER & Scientific Research Program	10-Mar-21	10:30-12:30	LD, PT, GT, TC, EV, DW, NR.
4.2	Aboriginal Custodianship	16-Mar-21	10:00-12:00	LD, HE, TW, PT, TC, CS, DW, NR.

## Appendix C1 Options Relocated or Moved to Complementary Programs

Of the initial unfiltered list of management options, a significant subset did not progress to the short list for assessment for reasons including the following:

- The action was a duplicate of another action.
- The action was already being managed by /or was more appropriately relocated to a complementary program.

These actions are listed in the following table, with the original action number, description of the action, and the reason for relocation/reconsideration.

Original Option No.	Description	Reason for Non-Progression
1.07	Implement an integrated weed and pest management program in partnership between land management agencies and private landholders.	This action is a duplicate of action 7.02.
1.11	Minimise water loss through the continued upgrade of MCC water infrastructure to maximise water efficiency.	This is already being managed through MCCs Integrated Water Cycle Management Strategy and Water Resilience Team.
1.12	Continue MCC programs to support implementation of the Smart Water Advice Audit for large water users, e.g., caravan parks, abattoir, dairy industry, hospital.	This is already being managed through MCCs Integrated Water Cycle Management Strategy and Water Resilience Team.
1.13	Complete review and implementation of MCCs Integrated Water Cycle Management Plan to improve drought security and protect environmental flows. Consider expanding use of treated effluent for stock purposes and farm use.	This is already being managed through MCCs Integrated Water Cycle Management Strategy and Water Resilience Team.
1.21	Undertake event-based tidal gauging study at multiple locations examining flows, salinity and updated bathymetry to develop a reliable catchment and hydrodynamic baseline model for all future research and planning.	This is to be moved to the Science Program.
1.22	Establish a platform for integrated monitoring and data sharing.	This is to be moved to the MER Program.
1.23	Undertake Hydrological modelling of catchment to identify opportunities to influence water storage, water cycling, drought resilience, buffering, restoring the landscape.	This is to be moved to the Science Program.

Original Option No.	Description	Reason for Non-Progression
1.24	Sponsor a research project on the distribution, risk factors and management for seagrass, saltmarsh and mangroves.	This is already being managed by DPI-Fisheries (Emma Asbridge).
2.06	Build community awareness, understanding and preparedness for climate change impacts on flooding and inundation, fire, drought, and water availability consistent with Adapt NSW guidelines.	This is to be managed through the Climate Adaptation Policy and MCC Community Resilience Program.
3.28	Promote uptake of Best Management Practice to conserve water and improve drought resilience on farms.	This is already being managed through MCCs Integrated Water Cycle Management Strategy and Water Resilience Team.
3.29	Develop Best Management Practice for water conservation on Council open space and use as demonstration projects.	This is already being managed through MCCs Integrated Water Cycle Management Strategy and Water Resilience Team.
3.30	Continue MCC programs with residents to promote water efficiency, e.g., water restrictions, ongoing education, pricing mechanisms.	This is already being managed through MCCs Integrated Water Cycle Management Strategy and Water Resilience Team.
3.31	Liaise with the Manning Water Users Association to regulate extraction during drought.	This is already being managed through MCCs Integrated Water Cycle Management Strategy and Water Resilience Team.
3.32	Liaise with NRAR to report illegal extraction.	This does not require a specific action. MCCs Environmental Staff are to follow up directly with customer service section. Council already liaises with the Natural Resource Access Regulator (NRAR) regarding illegal extraction.
3.34	Develop an interagency, multi-media communication package and education and training materials to promote awareness, appreciation, understanding and skills to conserve wildlife in urban and rural settings.	This is already managed by the Biodiversity Framework and existing activities of Council.
3.38	Deliver an annual nature discovery program to raise awareness and commitment to conservation.	This is already managed by the Biodiversity Framework and existing activities of Council.
3.39	Support private and community-based wildlife conservation initiatives.	This is already managed by MCCs Natural Systems core business.
3.42	Promote cease-to-pump thresholds and river-level monitoring information. Improve compliance with domestic water rights and extraction licence conditions. Promote understanding of how to report illegal extraction to NRAR.	This is outside the scope of the CMP. Cease to pump rules are set in the relevant water sharing plan under the Water Management Act 2000. Compliance of any breaches of law relating to water extraction are managed by the Natural Resources Access Regulator.

Original Option No.	Description	Reason for Non-Progression
5.04	Ensure STP management is effective, and capacity matches new residential demand.	This is a basic engineering consideration that is taken when planning for STP construction and/or upgrading. Council already has processes in place to manage this through its Water Services section.
5.06	Develop a program to build the link between premium produce, a healthy environment and sustainable farming practices (e.g., Manning Valley Naturally).	Already being taken care of/covered by DPOP and Destination Management Plan for the Barrington Coast.
5.07	Explore opportunities to promote reorientation of riverfront towns to face the river and take advantage of the views.	This is going to be carried out through Councils ongoing recreational needs analysis and delivery via DPOP. These processes will need to consider objectives of the Coastal Use Area via the CM SEPP.
5.09	Calculate the economic value of coastal wetlands for commercial and recreational fisheries and aquaculture.	This is already being completed as a research activity from LLS (via UoN).
5.10	Assess the overall economic benefit of a healthy river and estuary to the MidCoast LGA. If we repair legacy issues, what will be the economic value to the valley as a whole?	This option was seen as being with merit but too ambitious to tackle at this stage. The current estuary management framework in NSW encourages economic assessment on a project-by-project basis and this will be reflected in the CMP.
5.11	Collaborate with fishers to document local knowledge on ecology of the fishery including identification of nursery areas to inform future management regulation.	This action is to be put into the research program.
6.01	Use the Rural Strategy, Local Environment Plan (LEP) and DCP to encourage appropriate land use, reduce agricultural impacts and improve environmental outcomes.	This is a basic planning consideration that is already considered when developing and implementing EPI's.
6.02	Use land-use planning to protect the alluvial river flats and arable land for farming and food production including aquaculture.	This is already managed through normal planning considerations such as the Biophysical Strategic Agricultural Land Maps and, to a certain extent by SEPP No. 62 Sustainable Aquaculture. A suite of other controls including Measures under the <i>Fisheries Management Act 1994</i> and the <i>Marine Estate Management Act 2014</i> .



Original Option No.	Description	Reason for Non-Progression
6.03	Use Council's strategic planning framework to implement planning controls to protect wetlands (Rural Strategy, SEPP, LEP, and DCPs).	This already occurs. The Coastal Management SEPP's coastal wetland area already provides a very high level of protection, the Fisheries Management Act provides a high level of protection to vegetation. Coastal Saltmarsh is classified as an endangered ecological community under the Biodiversity Conservation Act.
6.05	Update the MCC LEP and DCPs to reflect the MCC On-site Sewage Development Assessment Framework.	This action need not be incorporated into the CMP as it is already happening.
6.06	Implement development controls to protect terrestrial and riparian native vegetation in Councils DCP and LEP.	Native vegetation is already managed under separate processes within the Biodiversity Conservation Act and Local Land Services Act.
6.07	Review and consider riparian native vegetation in Councils DCP and LEP	This matter is already considered by Council's Rural Strategy and Environmental Planning instruments, alongside the Biodiversity Conservation Act and the Local Land Services Act.
6.08	Review and update subdivision controls and lot sizes on waterfront land to avoid fragmentation and stock access in riparian vegetation.	There are limited ways of limiting stock access when waterfront land is used for grazing. This is being dealt with via other actions associated with stewardship, including education programs and best practice guidance. Minimum lot sizes are already being re-assessed as part of the Rural Strategy.
6.09	Use development controls and land use zoning through the MCC Rural Strategy to improve drought resilience by mitigating the impact of future development on water demand and domestic extraction.	This is already handled through Council's Land Use Planning.
6.11	Require developments within potable water sub-catchments and groundwater aquifers identified in the LEP to be integrated developments.	This is already handled through Council's Land Use Planning.
6.12	Identify, prioritise and provide evidence to support amendments to the LEP and DCP for the protection of wildlife habitats and corridors.	This is already being managed by separate processes in council, including the development of a Biodiversity Framework and MCC's Delivery Program and Operational Plan.

Original Option No.	Description	Reason for Non-Progression
7.04	Promote and enforce biosecurity regulations and responsibilities to prevent exotic fish infestation (e.g., carp).	This process is already being managed through other processes at both state and national level through DPI Fisheries Biosecurity.
7.07	Improve condition, extent, connectivity of riparian vegetation for wildlife habitat on public and private land.	This action is a duplicate of action 1.08.
7.08	Assess risk and implement risk mitigation strategies to reduce impacts of major disasters, particularly those associated with climate change (e.g., drought, fire).	This is core business already managed through LLS. Furthermore, Council is also implementing actions in response to the 2019/2020 fires.

## Appendix C2 Amalgamated Options

Several of the original management options were amalgamated. Where this has occurred the original option number, the original option it was incorporated into and the final, short listed option containing the proposed action are detailed in the following table.

Original Option No.	Description of Amalgamation	Final Option No.
1.02	Incorporated in action 1.01.	2.01
1.03	Incorporated in action 1.08.	2.02
1.04	Incorporated in action 1.01.	2.01
1.09	Incorporated in action 1.08.	2.02
1.19	Incorporated in action 1.17.	2.11
1.20	Incorporated in action 3.01.	1.01
1.25	Put into research program (see research program sheet).	Research Program
1.26	Incorporated in action 1.08 (as one of the tools to inform).	2.02
2.03	Incorporated in action 2.02.	3.02
2.04	Incorporated in action 2.05.	3.03
2.07	Incorporated in action 1.01.	2.01
3.02	Incorporated in action 3.01.	1.01
3.03	Implicit in Action 3.01 partnership approach.	1.01
3.04	Incorporated in action 3.01.	1.01
3.06	Incorporated in action 3.01.	1.01
3.07	Incorporated in action 3.01.	1.01
3.08	Incorporated in action 3.01.	1.01
3.09	Incorporated in action 3.01.	1.01

Original Option No.	Description of Amalgamation	Final Option No.
3.10	Incorporated in action 3.01.	1.01
3.11	Incorporated in action 3.01.	1.01
3.12	Incorporated in action 3.01.	1.01
3.13	Incorporated in action 3.01.	1.01
3.14	Incorporated in Action 3.01.	1.01
3.15	Incorporated in action 3.01.	1.01
3.16	Incorporated in Action 3.01.	1.01
3.17	Incorporated in action 3.05.	1.02
3.19	Incorporated in action 3.18.	1.07
3.20	Incorporated in action 3.18.	1.07
3.21	Incorporated in action 3.18.	1.07
3.22	Incorporated in action 3.18.	1.07
3.24	Incorporated in action 3.26.	1.09
3.25	Incorporated in action 3.26.	1.09
3.27	Incorporated in action 3.05.	1.02
3.37	Combined with 5.08. Moved into social and economic value options.	6.02
3.41	Added to 1.05.	2.04
4.01	Part of Action 3.33.	1.05
4.03	Incorporated in action 4.02.	5.01
4.04	Incorporated in action 4.02.	5.01
4.06	Included in the descriptive text for Action 1.16.	2.08
NEW	Amalgamate with 5.08, added text to the description.	6.02

Original Option No.	Description of Amalgamation	Final Option No.
5.01	Added resilience to 3.01.	1.01
5.03	Incorporated in action 5.02.	6.01
5.05	Amalgamated with 1.08B, as a sub action.	2.02
7.03	Incorporated in action 7.02.	4.03
7.09	This study is already occurring.	-
7.10	Put into research program (see Appendix C4).	Research Program

## Appendix C3 Short Listed Options

Original Option No.	Final Option No.	Final S.M.A.R.T Option Description
3.01	1.01	Undertake a needs assessment, develop and deliver an engagement program to build understanding of ecosystem values and services; the environmental, social and economic impacts of poor land and water management; regulations and responsibilities for land management; how to report illegal activities and the integrated benefits of good management practice and sustainable behaviours.
3.05	1.02	Establish a Best Environmental Management Practice framework for whole farm planning in the Manning catchment including the estuary.
1.06	1.03	Partner with farmers on the floodplain to undertake and evaluate field trials of best management and innovative practices to maintain productivity and ecosystem services at a range of elevations and soil types.
3.35	1.04	Promote and facilitate establishment of 30 private conservation agreements covering 1500 ha in the Manning catchment by 2030, through Land for Wildlife and Biodiversity Conservation Trust.
3.33	1.05	Adopt a set of significant flagship and indicator species with Aboriginal and community input to use in monitoring and community engagement programs.
3.36	1.06	Establish an annual citizen science BioBlitz through the Atlas of Living Australia to document aquatic and riparian biodiversity of the Manning river and estuary.
3.18	1.07	Develop a litter and stormwater pollution source control program: <ul style="list-style-type: none"> <li>- Monitor and report annually on the volume, type and location of litter collected during GPT maintenance and clean-up days.</li> <li>- Utilise this data for targeted education and engagement campaigns.</li> <li>- Develop source control plans for identified hot spot locations.</li> <li>- Support community and industry groups to complete a minimum of one litter clean up event each year in identified hot spot locations.</li> </ul>
3.23	1.08	Develop and distribute education material and guidelines to promote and improve erosion and sediment Control (ESC) on private land including better management of driveways, earthworks and dam walls.
3.26	1.09	Improve erosion and sediment control (ESC): <ul style="list-style-type: none"> <li>- Develop a comprehensive erosion and sediment control management system within MCC. Identify improvements required; set benchmarks; undertake audits and share results to build capacity.</li> <li>- Develop and implement an ESC capacity building program for designers, builders, engineering consultants and developers. Follow up with a proactive, targeted compliance program by 2025.</li> </ul>
1.01	2.01	Implement key priority acid sulfate soil management actions from the Manning River Floodplain Prioritisation Study 2021 including: <ul style="list-style-type: none"> <li>- Reinstate 1550 ha of coastal wetlands on public and private land subject landholder agreement.</li> <li>- Audit, upgrade or replace Council floodgates within the Lower Manning Floodplain and add them to MCC's Asset Management Program.</li> </ul>



Original Option No.	Final Option No.	Final S.M.A.R.T Option Description
1.08B	2.02	Protect and/or rehabilitate coastal wetlands, including the restoration of intertidal hydrology to previously drained areas: - Undertake field investigations and implement actions to exclude stock and restore tidal flushing at three coastal wetland sites on Mitchell Island in partnership with landholders by 2025, as recommended by the Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment. - Protect and restore a further 100 ha on both public and private land by 2030.
1.08A	2.03	Improve the condition, extent and connectivity of riparian and estuarine bank vegetation on private and public land by protecting and/or restoring 100 km of buffer vegetation by 2030.
1.05	2.04	Model good catchment management practice on public land by (1) establishing a demonstration site for coastal wetland management on public land showcasing agricultural best management practice and maintenance of ecosystem services by 2025; (2) ensure new grazing permits licence conditions include appropriate controls to prevent stock impacts on riparian vegetation and coastal wetlands; and (3) undertake annual inspections to monitor compliance.
1.10	2.05	Prepare a report assessing the feasibility, viability and acceptability of purchasing and retiring un-used water licences to secure environmental water.
NEW	2.06	Implement the Manning River Taskforce Recommendation 1: that the proposed Manning River Entrance Project is entered into the Infrastructure NSW Investor Assurance and NSW Treasury business case process. The development of a Strategic Business Case (SBC) is required to further analyse the optimal engineering outcome, the broader impacts of intervention in the area, and the relative costs and benefits of the identified options. If the benefits are found to outweigh the costs of the project, a more rigorous engineering, constructability, and environmental impact assessment should be undertaken in a Final Business Case prior to a decision to invest in a permanent solution.
NEW	2.07	Implement the Manning River Taskforce Recommendation 2: that any future process should be supported by an extensive stakeholder consultation process that includes the local community and impacted industries and stakeholders as well as consideration of progress in the development of Mid-Coast Council's two CMPs.
1.16	2.08	Implement a systematic approach to maintaining stormwater quality improvement devices: - Refurbish 5 proprietary Stormwater Quality Improvement Devices to achieve their full working capacity by 2022. - Incorporate Water Sensitive Design devices in the MCC asset management system by 2023 and implement the monitoring, maintenance and renewal program. - Complete a report on the upgrade of Wingham Wetland, including feasibility, budget and scope of works. Implement resulting actions by 2025.

Original Option No.	Final Option No.	Final S.M.A.R.T Option Description
1.14	2.09	Review, revise and supplement MCC's current stormwater guidelines, policies and procedures and seek opportunities to incorporate Water Sensitive Urban Design into MCC's new and upgraded infrastructure.
1.15	2.10	Revise the Greater Taree urban stormwater Management Plan (2000) by 2025, adding the township of Gloucester. Implement resulting Actions.
1.17	2.11	Complete a study which prioritises sensitive estuarine riverbank areas for management. Follow up by stabilising 7.5 km with engineering structures by 2030.
1.17B	2.12	Monitor and report on recreational boating frequency in subcatchments where boat wash erosion is identified as high risk (2.11). Consider introducing additional no-wash zones when the Manning River Boating Strategy is reviewed.
1.18	2.13	Identify, assess and prioritise sediment hotspots from unsealed roads. Remediate 30 sites by 2030.
3.43	2.14	Complete MCC's Onsite Sewerage Management System (OSSM) Audit and Compliance Strategy by 2022 and implement with a proactive inspection program in identified high-risk locations.
1.22	2.15	Undertake monitoring, evaluation and reporting of ecosystem health to guide adaptive management: - Implement the Manning CMP MER Program - Ecosystem Health; - Establish a platform for data sharing between agencies.
2.08	3.01	Use research data identifying retreat buffer zones for coastal wetlands and littoral rainforest under sea-level rise scenarios to develop a forward plan to retain suitable buffers in partnership with landholders.
2.02	3.02	Commission a study that identifies Council assets at risk from SLR (e.g., roads, stormwater systems, and river access facilities) and develops appropriate standards, cost estimates and forward plans for upgrade and replacements through Council's Asset Management Program.
2.05	3.03	Identify Sea Level Rise thresholds at which existing coastal inundation emergency strategies will cease to be effective. Engage with the State Emergency Service to build capacity for long-term emergency plans responsive to climate change impacts.
2.01	3.04	Work collaboratively with landholders and other stakeholders to develop an adaptation plan to mitigate the long-term (50-100 years) risk of climate change impacts on the floodplain, including management of productivity, coastal wetlands, acid sulfate soil and blackwater events.
7.05	4.01	Address 10 priority sites and/or re-connect 200 km of fish passage by removing or re-designing priority barriers identified in the audit by DPI-Fisheries.
7.01	4.02	Coordinate (HLLS) and participate (MCC) in the Manning River Helmeted Turtle Steering Committee to support and remain informed about efforts to conserve the species.
7.02	4.03	Develop and implement cross-tenure integrated pest and weed control plans to protect priority natural assets within the Manning River and its catchment.

Original Option No.	Final Option No.	Final S.M.A.R.T Option Description
7.06	4.04	Implement recommendations of the Manning Catchment Refugia Study 2021, working in partnership with private landholders to assess, protect, restore and monitor hydrological refugia in 10 priority reaches in the Barnard and Dingo Creek subcatchments.
4.02	5.01	Involve Aboriginal traditional knowledge and personnel in management of the river, catchment and estuary: - Support the Conservation and Ecosystem Management TAFE course for Aboriginal Rangers by providing guest speakers. - Issue field work contracts to engage Aboriginal Rangers on conservation and land management in the Manning catchment. - Conduct cultural burns on Council land to reduce fuel loads and maintain ecological processes.
NEW	5.02	Install interpretive signage and facilitate cultural activities to share the story of the Manning River's significance to Biripai people.
NEW	5.03	Engage Aboriginal people including school students and commercial fishers in water quality monitoring.
NEW	5.04	Involve Aboriginal people in implementation of the Manning CMP by appointing two Aboriginal representatives to the management committee (Action 8.01) and inviting Council's Aboriginal Community Development Officer to attend meetings.
4.05	5.05	Collaborate with Aboriginal Traditional Owners to manage threats to coastal wetlands in the National Park estate.
5.02	6.01	Use monitoring data, results of Oyster Transformation study and field investigations to characterise the source and risk rating for pathogens in each area. Develop and implement site-specific pathogen source control plans for high-risk oyster growing areas.
5.08	6.02	Develop a strategic mix of family-friendly passive recreational facilities including nature-based experiences that improve access while encouraging understanding and conservation of environmental and Biripai cultural values (e.g., picnic areas, birding routes, boardwalks, river walks and interpretive signage).
6.04	7.01	Provide evidence, undertake landholder consultation, and submit a planning proposal recommending amendments to the Coastal Management SEPP to support purchase, rezoning and remediation of coastal wetlands to improve ecosystem services.
6.12	7.02	Prepare mapping of the Tidal Inundation Coastal Vulnerability Area and undertake stakeholder consultation to inform a future planning proposal recommending amendments to the Coastal Management SEPP.
6.10	7.03	Use the Risk Based Framework to identify water quality objectives and associated management targets for development within the Manning River Catchment. Develop and include stormwater quality targets in MCC's LEP and DCP.
New	8.01	Establish a multi-stakeholder management committee to coordinate implementation of the Manning River CMP, with representation from government agencies, NGOs, industry groups, business, and community.

Original Option No.	Final Option No.	Final S.M.A.R.T Option Description
New	8.02	Participate in the MEMS Action 9.1 to improve co-ordination and integration across all levels of government by developing a governance framework at catchment scale.
3.40	8.03	Build the capacity of compliance programs to enforce regulations relating to CMP risks and issues. Promote regulations and information about how to report illegal activities.

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## Appendix C4 Research Program

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Original Option No.	Short Description
1.21	Undertake event-based tidal gauging study at multiple locations examining flows, salinity and updated bathymetry to develop a reliable catchment and hydrodynamic baseline model for all future research and planning.
1.25	Model sediment inputs from significant sources across the catchment to prioritise management actions.
5.11	Complete an oral history study on the ecology of the Manning River Fishery.
7.10	Sponsor an e-DNA project to study the status of aquatic fauna in the Manning River.

## **Appendix D Assessment Tables**



Management Option Assessment - Manning River Estuary

No.	Management Option	Criteria (Objects/Objectives from CM Act and MEM Act)																																						Impact Scale	Scaled Impact Score	Total 5 year cost	Rank (based on impact per unit cost)										
		CM Act Objects												MEM Act Objects						Wetlands			Environment					Use				Vulnerability																					
		Coastal Processes/Values	Social and Cultural Values	Aboriginal Values/Uses	Coastal Economies	Ecologically Sustainable Development	Coastal Hazards / Climate Change	Ambulatory Recognition	Integrated Planning/Management	Resilience of Coastal Assets	Co-ordinated Management Activities	Public Participation/Understanding	Identify Land for Protection	Biologically diverse and healthy	Economic Opportunities	Cultural, Social, Recreational	Ecosystem Integrity	Scientific Research and Education	Promote Coordination	Management of Marine Parks	Natural Biodiversity/Integrity	Rehabilitation/Restoration	Resilience/Migration	Social/Cultural Values	Promote State Policies/Programs	Environmental Values/Processes	Resilience of Coastal Waters	Water Quality	Social/Cultural Values	Beaches / Dunes / Natural Features	Public Access/Amenity	Natural Scenic Quality	Cultural / Built Environment Heritage	Urban Design	Public Open Space	Use of Surf Zone	Urbanised and Natural Coastline	Public Safety	Mitigate Coastal Hazards					Maintain Beaches	Public Amenity	Sensible Land Use	Reduce Hazard Exposure	Do no harm	Essential Infrastructure	Resilient Development			
1.01	Develop and Deliver an Engagement Program	1.7	2	1	1.3	0.7	0.3	0	0.7	0	0.3	2	0	1	0.3	2	0.7	1.3	1.3	0	0.3	0.3	0.3	1.7	1	0.3	0.3	0.3	1.7	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	93	\$	200,000.00	15		
1.02	Best Management Practice Framework for Whole Farm Planning	1.7	1	0.7	1.7	1.7	0.7	0.3	0.7	0.3	0.3	2	0	1.3	1.7	0.7	1.3	1.3	0.7	0	1	1.3	1.3	1	0	1.3	1.3	1.7	1	0	0	0.3	0	0	0	0	0	0	0	0	0.3	0	0	0.7	0.3	0	0	0.3	3.67	110	\$	30,000.00	2
1.03	Undertake and Evaluate Field Trials of Best Management and Innovative Practices with Farmers on the floodplain	1.3	1	0.3	1.3	1.7	0.7	0.3	0.7	0.3	0.3	1.7	0	1	1.3	0.7	1	2	0.7	0	1	1	1.3	0.3	0	1.3	1.3	1.3	0.7	0	0	0.3	0	0	0	0	0	0	0	0.3	0	0	0.7	0.3	0	0	0.3	2.67	71	\$	150,000.00	14	
1.04	Promote and Facilitate Establishment of Private Conservation Agreements	1	0.3	0.7	0.7	1.3	0.3	0	0	0	0.3	1.7	0.7	1.3	0.3	0.3	1.3	0.7	0.3	0	1.7	1.3	1.3	0.3	1.3	1.3	1.3	1	0.7	0.3	0	0.3	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0	3.33	76	\$	25,000.00	4	
1.05	Adopt Flagship and Indicator Species	0.7	1	1.7	0	0.7	0	0	0	0	0	2	0	0.7	0	1	0.7	1.3	0	0	1	0	0	0.7	0.3	1	0	0	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	42	\$	20,000.00	5	
1.06	Establish Annual Citizen Science BioBlitz	1.3	1.3	0.7	0	0.3	0	0	0	0	0.3	2	0	0.7	0	1.7	0.7	2	0.3	0	1	0	0	1	0.3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	63	\$	20,000.00	3		
1.07	Develop a Litter and Stormwater Pollution Source Control Program	1	1.3	0.7	0.7	1	0	0	0.3	0	0.3	2	0	0.7	0.3	1	1	1.7	0.7	0	0.3	0.3	0.3	1	1.3	1	0.7	1.7	1.3	0.3	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	65	\$	200,000.00	20	
1.08	Develop and Distribute Education Material and Guidelines for ESC	0.7	0	0	0.3	1	0	0	0	0	0	2	0	1	0.3	0.3	0.7	0.7	0	0	0.7	0.3	0.3	0	0	1.3	1	1.3	0	0	0	0.3	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	3.67	46	\$	5,000.00	1	
1.09	Improve Erosion and Sediment Control	1	0.7	0.3	0.7	1.7	0.3	0	0.7	0	0.7	0.7	0	1.3	0.3	0.7	0.7	0.7	0	0	1	1	0.7	0.3	0.7	1.7	1.3	1.7	0.7	0	0	0.3	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.67	73	\$	225,000.00	19
2.01	Implement Key Priority ASS Management Actions	2	1	1	1.7	1.3	0.7	0.7	0.7	0.7	0	0.3	1.3	2	1	0.3	2	1	0	0	2	2	1.7	1.3	2	2	2	2	1	0.7	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	106	\$	6,341,250.00	31
2.02	Protect and/or Rehabilitate Coastal Wetlands	2	1	0.7	1.7	1	0.7	0.7	0.7	0.7	0	0.3	2	2	0.7	0.3	2	1	0	0	2	2	1.7	1.3	1.7	2	2	2	1	0.7	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	104	\$	1,725,500.00	25	
2.03	Improve Riparian and Estuarine Bank Vegetation	1.3	1	0.7	1.3	1	0.7	0.7	0	0.7	0	0.3	1.3	2	0.7	0.7	2	0.3	0.3	0	1.7	1.7	0.7	1	1.3	2	2	2	1	0.7	0	0.7	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	3.33	101	\$	2,150,000.00	26	
2.04	Model Good Catchment Management Practice	1.3	0.7	0	0.7	1	0	0.7	0	0.7	0	0.7	0.7	1.3	0	0.7	1.3	1	0.7	0	1.7	1.7	1	0.7	1.7	1.3	1.3	1.3	1	0.7	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.33	32	\$	17,500.00	6		
2.05	Prepare Report Assessing the Purchase and Retiring of Un-used Water Licences (Eliminated)	0.7	0	0	0.3	0.7	0.7	0	0.7	0.3	0	0	0.3	0.7	0.3	0	1	0	0	0	0.3	0.3	0.3	0.7	0.3	1.3	1	0.7	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.33	37	\$	-	0	
2.06	Enter the Manning River Entrance Project into the NSW Investor Assurance and Business Case Process	-1	0.7	-1	0.3	1	0	0	0	0	0	0	0	-1	0.7	0.7	-1	0.3	0	0	-1	0	0	0	-1	-0	-0	0.3	0.7	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.33	0.8	\$	-	0		
2.07	Ensure Manning River Entrance Process includes Extensive Stakeholder Consultation	0.7	1.3	1.3	0.3	1	0	0	0	0	0	2	0	0.3	0.7	1.3	0.3	0.7	0	0	0	0	0	1	0.3	0	0	0	1.7	0	0.3	0	0.3	0	0.3	0	0	0	0	0	0	0	0	0	0	0	2.33	32	\$	-	0		
2.08	Implement a Systematic Approach to Maintaining SQIDs	1	0.3	0	0.7	0.7	0	0	1.3	0	0.7	0	0	1	0.3	0.7	1.3	0.3	0.7	0	1.7	0.7	1	1	0.3	1.7	1	1.7	1.3	0.3	0.7	0.3	0	1	0.3	0	0	0	0	0	0	0.3	0.3	2.33	53	\$	1,190,000.00	27					
2.09	Review, Revise and Supplement MCC's Current Stormwater Guidance	0.7	0.3	0	0.7	1.3	0.3	0	1.3	0.3	0.7	0	0	1	0	0.7	1	0	0.7	0	1	0	0.7	0.3	0	1	1	1.3	0.7	0.3	0.3	0.3	0.3	0.3	1.3	0.3	0	0	0	0	0	0	0	0.3	0.3	2.33	44	\$	100,000.00	16			
2.10	Revise the Greater Taree Urban Stormwater Management Plan	1	0.7	0	1	0.7	0.3	0	1.3	0.3	1	0	0.3	1	0.3	0.7	1.3	0	0.7	0	1	0	1	0.7	0	1.7	1	1.7	1	0.3	0.7	0.3	0	1.7	0.3	0	0	0	0	0	0	0	0.3	0.3	2.67	60	\$	150,000.00	17				
2.11	Study and Prioritise Sensitive Estuarine Riverbank Areas for Management and Stabilise 7.5 km	1.3	0.3	0.3	0.3	0.7	0.3	0.3	1	1	0.3	0	1	1.3	0.3	0.3	2	0.3	0.3	0	0.7	0.7	1	0.3	0.7	2	2	1.7	1.3	0.3	0.3	0.3	0.3	0	0	0	0	0	0	0.3	0.3	0	0	0	0	0	2.67	64	\$	2,125,000.00	29		
2.12	Monitor and Report on Recreational Boating in High Risk Boatwash Erosion Areas and Consider Source Control	1	0.7	0	0	0.7	0	0	0.3	0.7	0.7	0	1	1	0	0.7	1.7	0.7	0.3	0	0.3	1	0.7	0.3	0.3	1.7	1	1	0.3	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.33	39	\$	120,000.00	21		
2.13	Study Unsealed Road Sediment Hotspots and Remediate Hotspots	1.3	0.3	0	0	0.7	0	0	0.7	0	0.3	0	0.7	1.7	0	0.3	1.7	0	0	0	0.3	0.3	0.3	0	0.7	1.7	0.7	1	0.3	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	2.33	31	\$	1,500,000.00	30			
2.14	Complete and Implement Onsite Sewerage Management System Audit and Compliance Strategy	1.7	0.7	0.7	0.7	1.3	0	0	0.7	0	0.7	0	0	1.7	1	1.3	1.7	0.3	0.3	0	0.7	0	0	0.7	0.7	1.7	1	1.7	1	0	0.7	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	4	84	\$	-	0			

No.	Management Option	Criteria (Objects/Objectives from CM Act and MEM Act)																																				Impact Scale	Scaled Impact Score	Total 5 year cost	Rank (based on impact per unit cost)														
		CM Act Objects												MEM Act Objects						Wetlands			Environment					Use			Vulnerability																								
		Coastal Processes/Values	Social and Cultural Values	Aboriginal Values/Uses	Coastal Economies	Ecologically Sustainable Development	Coastal Hazards / Climate Change	Ambulatory Recognition	Integrated Planning/Management	Resilience of Coastal Assets	Co-ordinated Management Activities	Public Participation/Understanding	Identify Land for Protection	Biologically diverse and healthy	Economic Opportunities	Cultural, Social, Recreational	Ecosystem Integrity	Scientific Research and Education	Promote Coordination	Management of Marine Parks	Natural Biodiversity/Integrity	Rehabilitation/Restoration	Resilience/Migration	Social/Cultural Values	Promote State Policies/Programs	Environmental Values/Processes	Resilience of Coastal Waters	Water Quality	Social/Cultural Values	Beaches / Dunes / Natural Features	Public Access/Amenity	Natural Scenic Quality	Cultural / Built Environment Heritage	Urban Design	Public Open Space	Use of Surf Zone	Urbanised and Natural Coastline					Public Safety	Mitigate Coastal Hazards	Maintain Beaches	Public Amenity	Sensible Land Use	Reduce Hazard Exposure	Do no harm	Essential Infrastructure	Resilient Development					
2.15	MER for Ecosystem Health	1.3	0.3	0.3	0.3	1	0	0.7	1.3	0.7	0	1	0.7	1.3	0.3	0.3	1.3	1.3	0.3	0	1	1	1	0.3	1	1.3	1	1.3	0.7	0.7	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	91	\$	660,000.00	23			
3.01	Identify Retreat Buffer Zones for Coastal Wetlands and Littoral Rainforest	1.7	0	0.3	0.7	0.7	0.7	0.7	1.3	1.3	0.7	0	1.7	2	0.7	0.3	2	0.7	1	0	2	1	2	1	1.3	2	2	1	0.7	0.7	0.3	0.7	0	0	0	0	0	0	0	1	0	0	0.7	0.7	0	0	0.7	3	102	\$	-	0			
3.02	Identify Council Assets at Risk from Sea Level Rise	0	1.3	0.3	1.3	0.7	2	0	1	2	0.7	0	0.3	0	1.3	1	0	0	0	0	0	0	0.7	0.7	0	0	1	0.7	1	0	0	0.3	0	0.3	0	0.7	0	0	0	0	0.7	1	0	0.3	1	0.7	0	1.3	0.7	2	45	\$	50,000.00	8	
3.03	Examine Future Effectiveness of Coastal Inundation Emergency Strategies	0	1	0	1	0	1.7	0	0.7	0.7	0.3	0	0	0	1.3	1	0	0	0.3	0	0	0	0.7	0	0	0	0.3	0	0.3	0	0.7	0	0.3	0	0	0.7	0	0.7	0	0	0	0.7	1.3	0	0	0.7	0.7	0	0.3	0.7	3	45	\$	-	0
3.04	Long Term Adaptation Plan for Manning Floodplain	2	1	0	2	1	2	0.7	1.3	2	0.7	1.3	2	2	1.3	1	1.3	0.7	1	0	2	0.3	2	1.7	0.3	1.7	1.7	1.7	1.7	0.7	0.3	0.7	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0.7	3	122	\$	-	0			
4.01	Address Barriers to Fish Passage	1.7	1	0.7	1	0.7	0	0	0	0.3	0.3	0	0	2	0	1	2	0	0	0	0.7	0.3	0.3	0.7	0.7	2	0.3	0	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.67	45	\$	1,155,000.00	28		
4.02	Involvement in the Manning River Helmeted Turtle Steering Committee	1	1	0	0	0.7	0	0	0	0	0	1.3	0	1.3	0	0.3	1	1	1	0	0	0	0	0	0.7	1.3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.67	19	\$	-	0		
4.03	Develop Integrated Pest and Weed Control Plans	1.7	0.7	0.3	0	0.3	0	0	0.7	0	0.3	0	0.7	2	0	0.3	2	0.3	0.3	0	1.3	1.3	1.3	0.3	0.7	2	0.7	0	0.3	0.7	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	76	\$	150,000.00	13		
4.04	Implement Recommendations of Refugia Study	1	1	0	0	0.7	0.3	0	0	0	0	0.7	0	2	0	0.3	1.7	1	0.3	0	0.3	0.3	0.3	0	0	1.3	0	0	0.3	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.33	16	\$	150,000.00	24			
5.01	Involve Aboriginal Community in Management of the River, Catchment and Estuary	1.3	1.7	2	0	0.7	0	0	0	0.7	0	1.3	0.7	1.3	0.7	1.7	1.3	0.3	0.7	0	0.7	1	0.7	1	1	0.7	0.7	0.7	1.7	0.7	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.67	87	\$	100,000.00	9			
5.02	Install Interpretive Signage and Facilitate Cultural Activities	0.7	1.7	1.7	0	0	0	0	0	0	0	1.7	0	0	0	2	0	0.7	0	0	0	0	1	0.3	0	0	0	0	2	0	1.3	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.33	32	\$	52,500.00	12			
5.03	Engage Aboriginal People in Water Quality Monitoring	1.3	1.3	2	0	0.3	0	0	0	0	0.7	1.7	0	0.7	0	1.3	0.7	1	0	0	0	0	1	0.3	0.7	0.7	1	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.67	43	\$	-	0			
5.04	Involve Aboriginal People in Implementation of the Manning CMP	1.3	1.3	2	0	0.7	0.7	0	0	0.7	0	2	0.7	0.7	0	1.3	0.7	0.3	1	0	0.7	1	0.7	1	1	1	1	0.7	0.7	1.7	0.7	0	0.7	0.7	0	0	0	0	0	0	0	0	0	0	0	0	3.67	87	\$	-	0				
5.05	Collaborate with Aboriginal Traditional Owners to Manage Coastal Wetlands in Crowdy NP	1.3	1	2	0	0.7	0.7	0	0	0.7	0	1.3	0.7	1.7	0	1.3	1.3	0	0.7	0	1.3	1.7	0.7	2	1.3	1.3	1.3	1	1.3	0.7	0.3	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.33	90	\$	-	0				
6.01	Develop & Implement Site-Specific Pathogen Source Control Plans for High-Risk Oyster Growing Areas	2	0.7	0.3	1.3	0.3	0	0	0.3	0	0	0.3	0.7	1.7	2	0.3	1.7	0.3	0.3	0	0	1.3	0	0	0.7	2	0.7	2	1.3	0	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.33	49	\$	60,000.00	10				
6.02	Family-Friendly Passive Recreational Facilities	0.3	2	1.3	0.3	0.7	0	0	0	0	0	1	0	0	1.3	2	0.7	0	0	0	0	0	2	0	0.7	0	0	1.3	0	1.3	0.7	0.7	0	1.3	0	0	0	0	0	0	0	0	0	0	0	0	2.67	47	\$	300,000.00	22				
7.01	Submit a Planning Proposal for CM SEPP	1.7	0	0.3	0.7	1.3	1.3	0	0.7	1.3	0.7	0	1.3	1.7	0.3	0.3	1.7	0.3	0	0	1	0.7	1.3	0.3	2	2	1.3	1	0.7	0.7	0	0.3	0	0	0	0	0	0	0	0	0.7	0.7	0	0.7	0.7	0	0	3.33	90	\$	50,000.00	7			
7.02	Preparing Mapping of Coastal Vulnerability Area for Tidal Inundation	1	1	0.3	1	1.7	1.3	0.7	0.3	1	0.7	0	2	0.7	0.3	0.7	0.7	0.7	0	0	0.3	0	0.7	1.3	2	0.7	0.7	0	0.3	0.7	0	0	0	0	0	0	0	0	1.3	1.3	0.7	0.7	1.3	1.3	0.7	0.7	2.67	78	\$	100,000.00	11				
7.03	Identify Water Quality Objectives and Management Targets	1	0.7	0	0.3	1.3	0	0	1.3	0.7	0	0	0.3	1.3	0	0.7	1.3	0.3	0	0	0.7	0.3	0.7	1	0.7	1.3	1	1.7	0.7	0	0	0.3	0	1	0	0	0	0	0	0	0.3	0	0	0	0	0	0	3.67	70	\$	200,000.00	18			
8.01	Establish Multi-Stakeholder Management Committee	1	1.3	1.3	1	1.3	1.3	0.7	2	0.7	1.7	1.3	0.7	1	0.7	1.3	1	1	2	0.7	1	1	1	1	1	1	1	1	1	1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	4	169	\$	-	0			
8.02	Improve Coordination and Integration Across all Levels of Government	1.3	1	0.7	1	1.3	1.3	0.7	2	0.7	2	0.7	0.7	1	1	1	1	0.7	2	0.7	1	1	1	1	1.7	1	1	1	1	1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	4	167	\$	-	0			
8.03	Build the Capacity of Compliance Programs	0.7	1	0.7	0.3	1	0	0	1	0	0.7	1	0	1	0	0.7	1.3	0.7	0.7	0	1	0	0.3	0.3	0.3	1.3	0.3	1.7	1	0	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	71	\$	-	0				

## **Appendix E Financial and Economic Assessment**



**FINAL REPORT**

# Economic and Financial Assessment

Manning River Estuary Catchment Management Program

*Prepared for  
MidCoast Council  
20 July 2021*

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The Centre for International Economics is a private economic research agency that provides professional, independent and timely analysis of international and domestic events and policies.

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## Executive Summary

### The task

The CIE has been commissioned by Salients, on behalf of MidCoast Council (Council), to conduct a financial analysis of a subset of shortlisted management actions to protect and improve the ecological health of the Manning Estuary and its catchment (figure 1.1).

The subset comprises six actions, summarised in table 1<sup>1</sup>, from a shortlist of 45. While all actions are being assessed by Salients, these actions were selected for more detailed financial and, where appropriate, economic analyses.

### 1 Manning River Estuary management options for economic assessment

Action Number	Estuary Management option	Description
2.01	<p>Implement key priority Acid Sulphate Soils (ASS) management actions from Rayner, D.S et al. (2021)<sup>2</sup> in the Manning River Floodplain, including:<sup>3</sup></p> <ul style="list-style-type: none"> <li>Reinstate coastal wetlands on public and private land subject to landholder agreement.</li> <li>Audit, upgrade or replace Council floodgates within the Lower Manning Floodplain and add them to MCC's Asset Management Program.</li> </ul>	<p>Based on advice from Council, this management action has been limited to the following:<sup>4</sup></p> <ul style="list-style-type: none"> <li>total of 655 hectares of area to be rehabilitated into a coastal wetland in the lower Manning floodplain, at a cost of \$6.3 million, and</li> <li>capital work upgrades for two Council owned floodgates located in the lower Manning floodplain (refer to figure A.1 for locations).</li> </ul>

- 
- Further management action details are described in Appendix A, with further information provided in Salients 2021 Salients 2021, 'Manning River Management Options Evaluation to Support the Manning River Catchment Management Program', Final Version
  - Rayner, D. S., Ruprecht, J. E., Harrison, A. J., Tucker, T. A., Lumiatti, G., Rahman, P.F. & Glamore, W. C. 2021 (draft), 'Manning River Floodplain Prioritisation Study WRL TR 2020/09', Water Research laboratory, University of New South Wales.
  - Taken from the excel spreadsheet, 'Copy of ListofFinal\_Proceed\_ManagementActions\_Queries\_Answered', provided by Salients on 9 April 2021.
  - Email from Council to David Wainwright on 9 April 2021

Action Number	Estuary Management option	Description
2.02	<p>Protect and/or rehabilitate coastal wetlands, including the restoration of intertidal hydrology to previously drained areas:</p> <ul style="list-style-type: none"> <li>■ Undertake field investigations and implement actions to exclude stock and restore tidal flushing at three coastal wetland sites on Mitchell Island in partnership with landholders by 2025, as recommended in Rayner, D.S et al. (2020)<sup>5</sup>.</li> <li>■ Protect and restore a further 100 ha on both public and private land by 2030.</li> </ul>	<p>A desktop study completed by the University of New South Wales<sup>6</sup> identified several on-ground management actions aimed at restoring and protecting the environment of coastal wetlands surrounding Pelican Bay. The identified works are segregated into three sites and include:</p> <ul style="list-style-type: none"> <li>■ Site 1: Fencing of two areas and the optimisation of a culvert to improve connectivity, plus investigation of connectivity under Beale Avenue and Pelican Bay Road, Mitchell Island.</li> <li>■ Site 2: Opening of Flood Gates on Millers Creek (Manning Point Road) to increase extent of tidal inundation.</li> <li>■ Site 3: Fencing of an existing 4.7ha wetland finger extending north from Sheather Creek and under Manning Point Road, including construction of an adjacent pathway for stock and culvert extension under Manning Point Road.</li> </ul> <p>Refer to figure A.13 for details.</p>
2.03	<p>Improve the condition, extent and connectivity of riparian and estuarine bank vegetation on private and public land by protecting and/or restoring 100 km of buffer vegetation by 2030.</p>	<p>Council has identified the following priority sites for protection and rehabilitation:</p> <ul style="list-style-type: none"> <li>■ Priority sub catchments with proximity to the estuary: Manning River, Scotts Creek, South Arm.</li> <li>■ Priority sub catchments for natural regeneration: Ghinni Creek, Killabakh Creek, Lansdowne River, Dingo Creek, Moorall Creek, Cedar Party Creek.</li> <li>■ Priority sub catchments in the upper catchment: Barnard River, Gloucester River, Barrington River.</li> </ul>
2.05	<p>Prepare a report assessing the feasibility, viability and acceptability of purchasing and retiring un-used water licenses to secure environmental water.</p>	<p>The Manning River Estuary is characterised by a large amount of unused ("sleepers") licences. Council is concerned that, if activated, the sleeper licenses could pose a risk to environmental flows, particularly in years of low rainfall. The purpose of this action is to investigate the viability of purchasing some of the unused water licenses and, if appropriate, develop a business case.</p>
2.08	<p>Implement a systematic approach to maintaining Storm Water Quality Improvement Devices across the Manning River Catchment.</p>	<p>Involves three standalone components:</p> <ol style="list-style-type: none"> <li>1 Refurbish 5 proprietary Stormwater Quality Improvement Devices to achieve their full working capacity by 2022.</li> <li>2 Incorporate Water Sensitive Design devices in the MCC asset management system by 2023 and implement the monitoring, maintenance and renewal program.</li> <li>3 Complete a report on the upgrade of Wingham Wetland, including feasibility, budget and scope of works. Implement resulting actions by 2025.</li> </ol>

<sup>5</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

<sup>6</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW



Action Number	Estuary Management option	Description
		Further clarification from Council <sup>7</sup> advises the economic assessment is to only evaluate the upgrade of Wingham Wetland.
4.01	Address 10 priority sites and/or re-connect 200 km of fish passage by removing or re-designing priority barriers identified in the audit by DPI-Fisheries.	<p>An audit of barriers to fish passage was conducted by DPI Fisheries, which identified and prioritised 194 constructed barriers in the Manning catchment.<sup>8</sup> Structures included road crossings, floodgates and three weirs. Of these, 23 have been rectified to restore fish passage, including weirs on the Lansdowne River and Cedar Party Creek. Reconnecting fish passage is a sub-action under Action 2.4 of the Marine Estate Management Strategy<sup>9</sup> (MEMS), which will re-establish resilient coastal floodplains and connectivity within coastal catchments.</p> <p>DPI Fisheries advise the following high priority sites, which, if removed, would significantly improve fish passage:</p> <ul style="list-style-type: none"> <li>■ Brett Trail Road causeway on the Barnard River, resulting in 361km of upstream fish passage gains.</li> <li>■ Hicks Lane on the Cooplacurripa River resulting in 163km of upstream fish passage gains.</li> <li>■ Duffys Forest Road on Rowleys River resulting in 39 km of upstream fish passage gains</li> <li>■ Cells River Road on Rowleys River, resulting in 54 km of upstream fish passage gains.</li> </ul> <p>Refer to table A.23 for further details on the high priority sites.</p> <p>The required effort is led by DPI Fisheries, according to their policy, research and regulations. MidCoast Council would be the project manager on structures owned by Council, while opportunities to work with private landholders will also be explored.</p>

Source: Salients: CIE.

<sup>7</sup> Email from Council to David Wainwright on 9 April 2021







<sup>8</sup> NSW Government 2006, 'Reducing the impact of road crossings on aquatic habitat in coastal waterways – Hunter/Central Rivers, NSW. Report to the New South Wales Environmental Trust. NSW Department of Primary Industries', [https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf)

<sup>9</sup> NSW Government 2018, 'NSW Marine Estate Management Strategy 2018-2028', Marine Estate Management Authority, [https://www.marine.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0007/815596/Marine-Estate-Management-Strategy-2018-2028.pdf](https://www.marine.nsw.gov.au/__data/assets/pdf_file/0007/815596/Marine-Estate-Management-Strategy-2018-2028.pdf)

## Conclusion and recommendations

Table 2 outlines our conclusion and recommendations.

### 2 Conclusion and recommendations

Management option	Costs	Benefits	Net benefit	BCR	Recommendations
	\$m, PV	\$m, PV	\$m, PV		
2.01	7.3	21.8	14.5	2.97	
2.02	0.5	1.6	1.2	3.43	
2.03	9.9	12.3	2.3	1.23	
2.05	35.9	Not quantified	N/A	N/A	
2.08	0.3	Not quantified	N/A	N/A	
4.01	1.4	Not quantified	N/A	N/A	

Notes: Present values (PV) discounted using a 7 per cent discount rate over 30 years. Totals may not sum due to rounding.

Source: CIE

**KEY:**      **Proceed to next steps**     **Undertake further site-specific evaluation**     **Re-consider/delay** 

In summary:

- **Proceed to next steps for management options 2.01, 2.02 and 2.08.** These management options demonstrate a high likelihood of net benefits and improved societal welfare.
- **Undertake further site-specific evaluation for management options 2.03 and 4.01.** These management options demonstrate a potential for net benefits and improved societal welfare, however site-specific information is required on key costs/benefits.
  - management option 2.03:
    - ... assumes rehabilitation and maintenance costs based on annual Local Land Service budgets, which may not be representative for the specific program of works for this option, and
    - ... incorporates high variance in quantified (willingness-to-pay) WTP estimated benefits of undertaking riparian vegetation, with WTP estimate values dependent on rehabilitation site location and respondent location.
    - ... we have estimated benefits using the Hawkesbury-Nepean catchment (the highest WTP estimate). When we use the mid-point WTP estimates, the results indicate -\$2.5 million net benefits and a BCR of 0.75.
  - management option 4.01:
    - ... despite DPI Fisheries undertaking a fish passage assessment in 2006<sup>12</sup>, it is unclear what fish passage sites will be targeted for remediation, specific works to be undertaken and their associated costs.

<sup>12</sup> NSW Government 2006, 'Reducing the impact of road crossings on aquatic habitat in coastal waterways – Hunter/Central Rivers, NSW. Report to the New South Wales Environmental Trust. NSW Department of Primary Industries',

- **Reconsider/delay management option 2.05** due to its high cost, unclear environmental benefits under future Water Sharing Plan (WSP) rules, and value in delaying the decision, rather than pre-emptively acting where the ‘problem’ may not eventuate.

### ***This report and evaluation approach***

Alongside supporting the required decisions, this report:

- Provides an overview of ‘the problem/opportunity’, noting:
  - Council has undertaken extensive work to identify and define the objectives and risks to be addressed within the Manning River Estuary and Catchment Management Program (Manning CMP), as part of prior activities leading towards development of the CMP.
- Describes the types of costs and benefits of different options considered in the analysis.
- Outlines the source of information used to quantify/value the costs and benefits.
- Evaluates the identified estuary management actions as far as is practicable, noting Council specified the appropriate level of assessment should be selected to meet the matrix shown in chart 1.2<sup>13</sup>, taken from the Coastal Management Manual.<sup>14</sup>

Importantly, the six management actions assessed within this report have been subjected to assessments which span between qualitative and quantitative (via rapid cost benefit analysis (CBA)) (table 3). All other management actions have been assessed to a simple level of detail within the report accompanying this financial assessment (Salients, 2021),<sup>15</sup> to which this assessment report is attached.

The proposed management actions have significant cross-over in geographical location. We have assumed the proposed management actions are stand alone, not undertaken as part of a portfolio of works.

### **3 Adopted assessment approach for the subset of Manning CMP management options**

Management action	Economic assessment approach
2.01 Acid sulphate soil management actions	Rapid CBA
2.02 Protect and/or rehabilitate coastal wetlands	Rapid CBA

[https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf)

<sup>13</sup> MidCoast Council 2020, ‘Manning River Estuary Catchment Management Program Request for Proposal’, Appendix 1 Draft Objectives for the Manning CMP; MidCoast Council 2020, ‘Manning River Estuary Catchment Management Program Request for Proposal’, pp 10-11.

<sup>14</sup> NSW Government 2018, ‘Our Future on the Coast NSW Coastal Management Manual Part B: Stage 3 – Identify and evaluate options’, Office of Environment and Heritage, p. 44

<sup>15</sup> Salients 2021, ‘Manning River Management Options Evaluation to Support the Manning River Catchment Management Program’, Final Version

Management action	Economic assessment approach
2.03 Protect and/or rehabilitate riparian zones	Rapid CBA
2.05 Purchase and retire unused water licenses	Qualitatively evaluate the benefits against estimated quantified costs.
2.08 Maintain stormwater quality improvement devices (Wingham Wetland upgrade)	Qualitatively evaluate the benefits against estimated quantified costs.
4.01 Remediating fish passages	Qualitatively evaluate the benefits against estimated quantified costs.

Source: CIE.

The methodology used for rapid CBA is the same as for the detailed CBA. However, the estimates for a rapid CBA are less precise, due to the preliminary nature of the project assessment, and/or lack of site-specific data.

Rapid appraisal is a cost-effective way of gauging whether an initiative is likely to pass a detailed appraisal. A 'rapid CBA' is often used to support a preliminary/strategic business case, while a 'detailed CBA' is applied for a final business case.

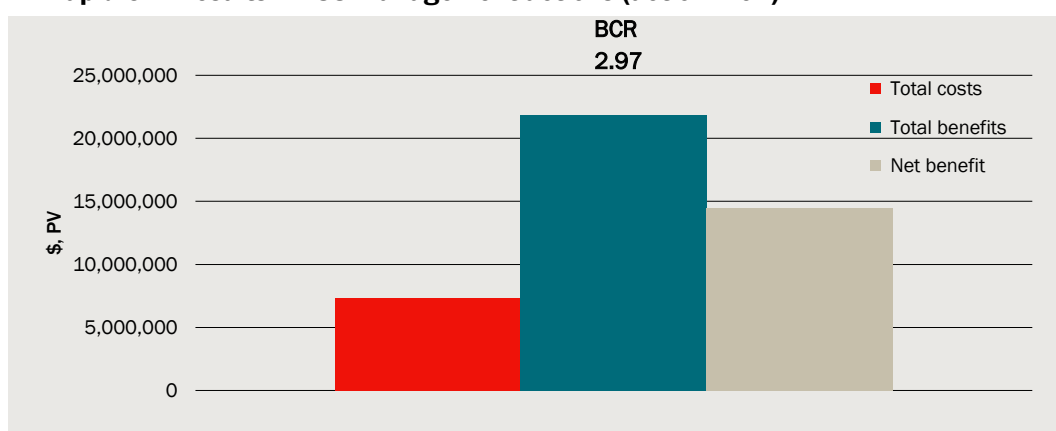
Significant externalities should be re-estimated at the detailed CBA stage, with site-specific data and modelling, to obtain a more detailed value of the externalities. For detailed CBAs, studies may be required to obtain indicative-specific unit values for externalities.

## Summary economic evaluation results

### Acid Sulphate Soil (action 2.01)

Chart 4 shows the rapid CBA result of undertaking option 2.01.

#### 4 Rapid CBA results – ASS management actions (action 2.01)



Note: Present value calculated using a 7 per cent discount rate over 30-years.

Data source: CIE

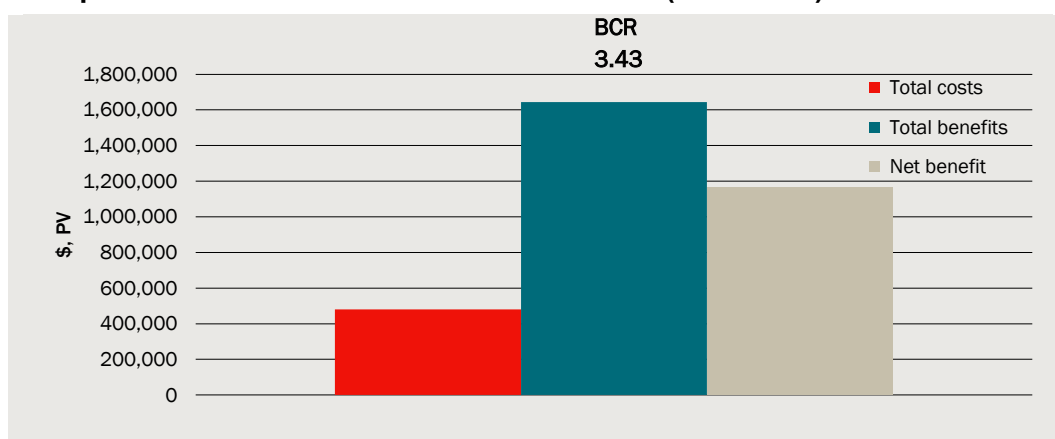
The rapid CBA results indicate a net benefit of \$14.5 million and benefit cost ratio (BCR) of 2.97, from undertaking ASS remediation on 655 hectares of land in the Lower

Manning Floodplain, compared to a status quo of not undertaking the option. Society will therefore be better off.

### *Coastal wetland rehabilitation (action 2.02)*

Chart 5 shows the rapid CBA result of undertaking option 2.02.

#### **5 Rapid CBA results –coastal wetland rehabilitation (action 2.02)**



Note: Present value calculated using a 7 per cent discount rate over 30-years.

Data source: CIE

The rapid CBA results indicate a net benefit of \$1.2 million and benefit cost ratio of 3.43, from undertaking coastal wetland rehabilitation on a 14.7-hectare site in Pelican Bay, compared to a status quo of not undertaking the option.

The rapid CBA results are a lower bound, as they do not include the benefit of improved water quality on oyster farming productivity. Based on the qualitative discussion of improved water quality on oyster farming productivity in chapter 4, if included, would further improve the net benefit and BCR results.

Based on the CBA we recommend proceeding to the next steps for coastal wetland restoration at Pelican Point. However, consideration should be given to the most cost-effective method to protect the channel from stock impacts. We have excluded the extension of the existing Sheather Creek (Site 3) culverts (or bridge, or similar) in the central case analysis, following advice from Council regarding financial viability concerns.

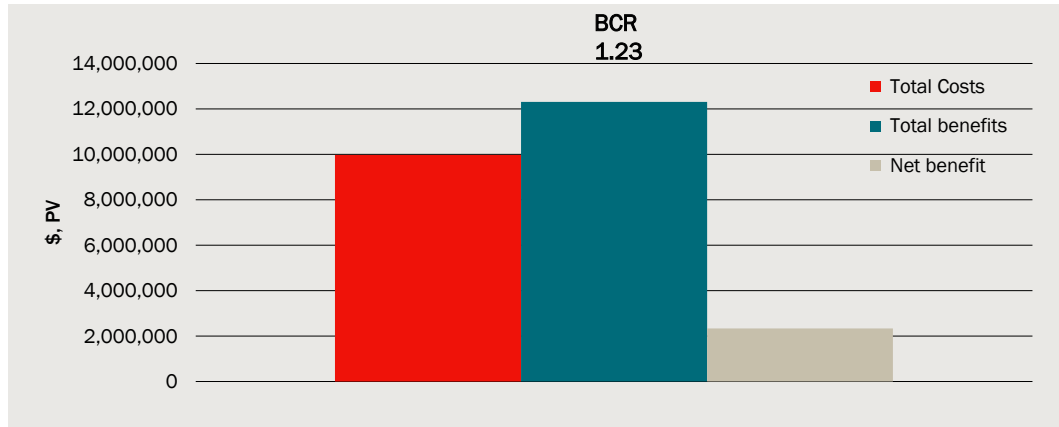
For the central case we have assumed a stock path option involving fencing, appropriate reinforcement of the banks and a concrete apron at bed level could be constructed substantially cheaper (~20 per cent) of the overall cost of a full culvert extension. We note there are likely other options that could be considered, when it comes to final decision making and implementation.

Sensitivity analysis confirms a higher net benefit and positive BCR is achieved if the culvert extension at Site 3 is replaced with a cheaper alternative.

### ***Protect and/or rehabilitate riparian zones (action 2.03)***

Chart 6 shows the rapid CBA result of undertaking option 2.03.

#### **6 Rapid CBA results – Protect and/or rehabilitate riparian zones (action 2.03)**



Note: Present value calculated using a 7 per cent discount rate over 30-years.

Data source: CIE

The rapid CBA results indicate a net benefit of \$2.3 million and benefit cost ratio of 1.23, from undertaking riparian zone protection and/or rehabilitation on a total of 100km in the Manning catchment, compared to a status quo of not undertaking the option.

We have estimated benefits using the Hawkesbury-Nepean catchment (the highest WTP estimate). When we use the mid-point WTP, the results decrease to -\$2.5 million net benefits and a BCR of 0.75.

We conclude site specific evaluation should be undertaken to determine site specific costs and benefits for this option. Our recommendation is based on:

- the relatively high cost of this option compared to others discussed in this report
- assumed rehabilitation and maintenance costs based on annual Local Land Service budgets, which may not be representative for the specific program of works for this option, and
- high variance in quantified WTP estimated benefits of undertaking riparian vegetation, with WTP estimate values dependent on rehabilitation site location **and** respondent location.

### ***Purchase and retire unused water licences (action 2.05)***

The cost of purchasing the licences is based on available water trading data which provides a proxy for the value that other licence holders place on the licences. However, the trading data reflects the value of the licences for specific use. Using a trade price of \$1 000 per ML and a total of 47 819 ML of sleeper licence entitlement is purchased equally over ten years (47 819 purchased entitlements per year, for 10 years), results in a present value cost of \$35.9 million to purchase and retire unused water licences.

We conclude there is limited value buying-back sleeper licences at this stage. Our conclusion is based on:



- the estimated high cost (more than \$35 million (present value)) to purchase sleeper licence, and
- uncertainty around how the purchase of sleeper licences would result in increased environmental flows (above current levels) under a future WSP rules.

Council could reconsider this issue after the future WSPs are remade.

There is also value in delaying any purchase decision until there is an indication of an environmental flow 'problem' if sleeper licences are activated. Given the expected cost of purchasing/retiring these licences there is value in delaying the decision, rather than pre-emptively acting where the 'problem' may not eventuate.

### ***Maintain stormwater quality improvement devices, Wingham Wetland upgrade, (action 2.08)***

We conclude upgrading Wingham Wetland should proceed to further development, subject to undertaking and publishing a robust design objective. The published design objective allows for performance evaluation against estimated costs and anticipated benefits throughout Wingham Wetland's lifecycle.

Our conclusion is based on:

- the relatively lower cost of \$0.3 million (present value) to implement this option, compared to other management options discussed in this report, and
- the likely range of benefits the constructed Wingham Wetland may achieve, such as:
  - water quality improvement
  - water borne pollutant removal, and
  - litter removal
- the potential for disbenefits, namely mosquito borne diseases which should be considered as part of the Wingham Wetland design and ongoing monitoring/maintenance.

### ***Remediating fish passages (action 4.01)***

We conclude remediating fish passage, with the goal of remediating 10 structures and/or 200km of fish passage, should be subject to further site-specific evaluation. Although DPI Fisheries undertook a fish passage assessment in 2006, it is unclear what 10 fish passage sites will be targeted for remediation, specific works undertaken and their associated costs.

We have evaluated three of the top four sites, as advised by DPI Fisheries in recent communication to Council, based on the premise that remediating these sites will achieve close to the stated 200 km target. We also assumed each site will have a culvert structure replaced by a bridge, as per DPI Fisheries preferred approach. Site specific evaluation is required to confirm that culvert replacement with a bridge is appropriate for these sites, including discussions and agreement with Transport for NSW, as well as to confirm costs.

The highest priority site identified by DPI Fisheries in recent communication with Council, Brett Trail, will achieve the greatest fish passage remediation of 361 kilometres. However, a site-specific evaluation is required to determine the most appropriate works and associated costs and was therefore not included in the evaluation.

Further, technology and management practices have evolved since the 2006 DPI Fisheries fish passage audit<sup>25</sup> and implementation of some subsequent fish passage remediation works described in the bringing back the fish report.<sup>26</sup>

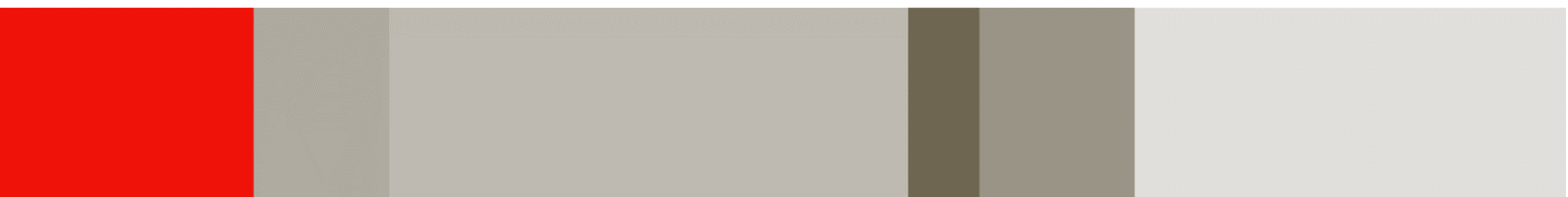
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<sup>25</sup> NSW Government 2006, 'Reducing the impact of road crossings on aquatic habitat in coastal waterways – Hunter/Central Rivers, NSW. Report to the New South Wales Environmental Trust. NSW Department of Primary Industries', [https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf)

<sup>26</sup> NSW Government 2010, 'Bringing Back the Fish Project reports', Appendix-B-Hunter-Central-Rivers-part-1.pdf; [https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0009/634617/5.-Appendix-B-Hunter-Central-Rivers-part-2.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/634617/5.-Appendix-B-Hunter-Central-Rivers-part-2.pdf)

## PART I

### Introduction

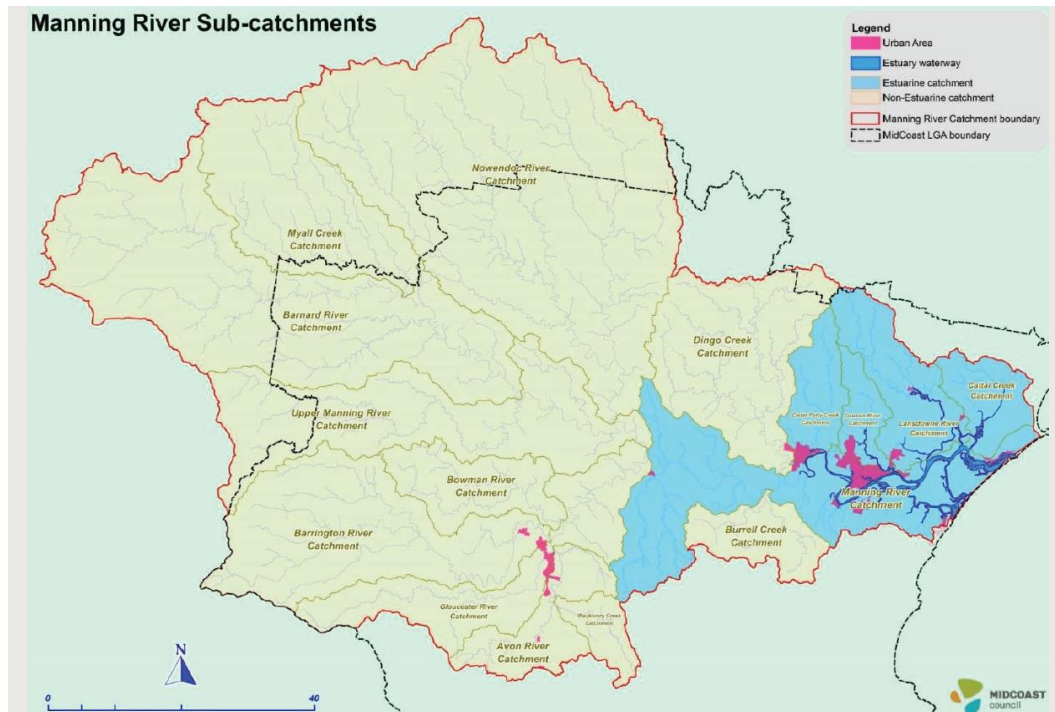


# 1 Purpose of this report

The CIE has been commissioned by Salients, on behalf of MidCoast Council (Council), to conduct a financial analysis of a subset of shortlisted management actions to protect and improve the ecological health of the Manning Estuary and its catchment (figure 1.1). The subset comprises six actions from a shortlist of 45. While all actions are being assessed by Salients, these actions were selected for more detailed financial and, where appropriate, economic analyses.

The financial analysis is one aspect of a suite of inputs used to inform the Manning River Estuary and Catchment Management Program (Manning CMP), which aspires to protect and improve the ecological health of the Manning Estuary and its catchment, and in doing so support the social, cultural and economic values of the region. The Manning CMP is being prepared in accordance with the *Coastal Management Manual* and the *Coastal Management Act 2016 (NSW)*.

## 1.1 Manning Estuary and its catchment



Note: The scope of the Manning CMP will cover issues and management actions for all Coastal Management Areas mapped in the Coastal Management SEPP 2018 within the planning area. The planning area also covers the catchment, commencing 2 km inland from the open coast and extending to the headwaters of all 16 subcatchments.

Data source: MidCoast Council 2020, 'Manning River Estuary Catchment Management Program Request for Proposal', p.7

Alongside supporting the required decisions, this report:

- Provides an overview of 'the problem/opportunity', noting:

- Council has undertaken extensive work to identify and define the objectives and risks to be addressed within the Manning CMP, as part of prior activities leading towards development of the CMP.
- Describes the types of costs and benefits of different options considered in the analysis.
- Outlines the source of information used to quantify/value the costs and benefits.
- Evaluates the identified estuary management actions as far as is practicable, noting Council specified the appropriate level of assessment should be selected to meet the matrix shown in chart 1.2,<sup>27</sup> taken from the Coastal Management Manual.<sup>28</sup>

## 1.2 Matrix of risk and complexity for selecting the level of economic assessment

		Complexity	
		Low	High
Risks and impacts	Low	<ul style="list-style-type: none"> <li>Limited number of stakeholders</li> <li>Little or no quantitative data</li> </ul>	<ul style="list-style-type: none"> <li>Disagreement or conflicting views among stakeholders</li> <li>Difficulty defining beneficiaries or apportioning costs</li> <li>Good quantitative data</li> </ul>
	High	<b>Simple economic assessment</b> These assessments ask similar questions as the more complex analysis, but use qualitative analysis and expert opinion rather than quantitative data.	<b>Intermediate level assessment</b> These assessments ask the same questions as the more complex analysis, but may use detailed costings.
Risks and impacts	Low	<ul style="list-style-type: none"> <li>Limited spatial scale</li> <li>Low risk and low impact</li> </ul>	<b>Simple economic assessment</b> These assessments ask similar questions as the more complex analysis, but use qualitative analysis and expert opinion rather than quantitative data.
	High	<ul style="list-style-type: none"> <li>Addressing high or extreme risks</li> <li>An option involves major investment (see <a href="#">Treasury Guideline 2017</a>)</li> </ul>	<b>Intermediate level assessment</b> Monte Carlo modelling or significant social analysis may not be necessary, but some detailed costing, e.g. for maintenance, is required.
Risks and impacts	Low	<ul style="list-style-type: none"> <li>Limited spatial scale</li> <li>Low risk and low impact</li> </ul>	<b>Detailed cost-benefit analysis</b> This may involve a systematic comparison of all foreseeable costs and benefits and the probability that they will arise over the planning period.
	High	<ul style="list-style-type: none"> <li>Addressing high or extreme risks</li> <li>An option involves major investment (see <a href="#">Treasury Guideline 2017</a>)</li> </ul>	<b>Detailed cost-benefit analysis</b> This may involve a systematic comparison of all foreseeable costs and benefits and the probability that they will arise over the planning period.

Data source: NSW Government 2018, 'Our Future on the Coast NSW Coastal Management Manual Part B: Stage 3 – Identify and evaluate options', Office of Environment and Heritage, p. 44

<sup>27</sup> MidCoast Council 2020, 'Manning River Estuary Catchment Management Program Request for Proposal', Appendix 1 Draft Objectives for the Manning CMP; MidCoast Council 2020, 'Manning River Estuary Catchment Management Program Request for Proposal', pp 10-11.

<sup>28</sup> NSW Government 2018, 'Our Future on the Coast NSW Coastal Management Manual Part B: Stage 3 – Identify and evaluate options', Office of Environment and Heritage, p. 44

## 2 *Assessed Management Actions, evaluation approach and key complexities*

### *Assessed Management Actions*

The six estuary management actions, and details of their assessment are presented in the following chapters.

Briefly, the management options assessed herein are:

- 1 Option 2.01: Key priority ASS management actions from the Coastal Floodplain Prioritisation Study (Rayner, D. S. et al. 2021),<sup>29</sup> including the reinstatement off coastal floodplains and rehabilitation of two floodgates.
- 2 Option 2.02: Protect and/or rehabilitate coastal wetlands, including the restoration of intertidal hydrology to previously drained areas around Pelican Bay and Mitchell's Island (as per Rayner, D.S et al. (2020)<sup>30</sup> and to protect and restore further wetland areas by 2030.
- 3 Option 2.03: Improve the condition, extent and connectivity of 100 km of bank vegetation by 2030.
- 4 Option 2.05: Assessing the feasibility, viability and acceptability of purchasing and retiring un-used water licenses to secure environmental water.
- 5 Option 2.08: Upgrade Wingham Wetland.
- 6 Option 4.01: Address 10 priority sites and/or re-connect 200 km of fish passage as identified by DPI Fisheries.

### *Evaluation approach*

Importantly, the six management actions assessed within this report have been subjected to assessments which span between “simple” and “intermediate” levels (table 2.1). All other management actions have been assessed to a simple level of detail within the report accompanying this financial assessment (Salients, 2021).<sup>31</sup>

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<sup>29</sup> Rayner, D. S., Ruprecht, J. E., Harrison, A. J., Tucker, T. A., Lumiatti, G., Rahman, P.F. & Glamore, W. C. 2021 (draft), ‘Manning River Floodplain Prioritisation Study WRL TR 2020/09’, Water Research laboratory, University of New South Wales. (Pietsch, T et al. (2019)

<sup>30</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, ‘Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment’, July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

<sup>31</sup> Salients (2021) Manning River Management Options Evaluation to Support the Manning River Catchment Management Program, Final Version



The proposed management actions have significant cross-over in geographical location. For our assessment, we have assumed the proposed management actions are stand alone, not undertaken as part of a portfolio of works.

## 2.1 Adopted assessment approach for the subset of Manning CMP management options

Management action	Economic assessment approach
2.01 Acid sulphate soil management actions	Rapid CBA (box 2.2)
2.02 Protect and/or rehabilitate coastal wetlands	Rapid CBA (box 2.2)
2.03 Protect and/or rehabilitate riparian zones	Rapid CBA (box 2.2)
2.05 Purchase and retire unused water licenses	Qualitatively evaluate the benefits against estimated quantified costs.
2.08 Maintain stormwater quality improvement devices (Wingham Wetland upgrade)	Qualitatively evaluate the benefits against estimated quantified costs.
4.01 Remediating fish passages	Qualitatively evaluate the benefits against estimated quantified costs.

Source: CIE.

## 2.2 Rapid CBA

A detailed CBA is not appropriate in the early-stage project assessments of many projects. To limit the cost of assessing many options in the early stages of identifying and sifting potential initiatives and options, a simpler 'rapid' assessment process is typically undertaken. This also applies to smaller initiatives where the consequences of a wrong decision are relatively small.

The methodology used for rapid CBA is the same as for the detailed CBA. However, the estimates for a rapid CBA are less precise, due to the preliminary nature of the project assessment, and/or lack of site-specific data. For example:

- cost estimates are based on expert opinion and/or previous projects of similar nature
  - the expected margin for error in rapid CBAs for investment costs is -20 per cent to +40 per cent
- 'default values', such as previous studies are used to estimate externalities
- non- monetised benefits and costs are explored at an indicative level, and
- benefits and costs that are small, or difficult to estimate, are omitted altogether.

Rapid appraisal is a cost-effective way of gauging whether an initiative is likely to pass a detailed appraisal. A 'rapid CBA' is often used to support a preliminary/strategic business case, while a 'detailed CBA' is applied for a final business case.

Significant externalities should be re-estimated at the detailed CBA stage, with site-specific data and modelling, to obtain a more detailed value of the externalities. For detailed CBAs, studies may be required to obtain indicative-specific unit values for externalities.

Source: Australian Transport Assessment and Planning, 'What is cost-benefit analysis?', <https://www.atap.gov.au/tools-techniques/cost-benefit-analysis/1-introduction>; Infrastructure Australia 2018, 'Assessment Framework: For initiatives and projects to included in the Infrastructure Priority List', March, p. 82, <https://www.infrastructureaustralia.gov.au/publications/assessment-framework-initiatives-and-projects>: CIE.

## Key complexities

The evaluation of economic costs and benefits requires a thorough understanding of three interconnected parameters.

### 1 Proposed management actions/ecological interventions - type, location, timing and scale

- a) Salients and Council have summarised the proposed management outcomes following consultation with partner agencies and Council staff.<sup>32</sup> In consultation with Salients and Council, we have used our professional judgement to estimate

<sup>32</sup> Refer to ListofFinal\_Proceed\_ManagementActions\_Queries\_Answered', provided by Salients on 9 April 2021

the relevant parameters, where it has not been explicitly described in the management option summaries.

**2 Identifying the nature of the causal link between management actions the resulting changes to water quality and ecological outcomes** – type, location, timing and amount:

- a) Council and others have undertaken significant work to understand the current problems/opportunities for improved ecological health within the case study area.
- b) However, a **causal** link between the proposed management actions and marginal changes to water quality and subsequent ecological outcomes has not always been studied in detail. Typical studies would be detailed and site-specific, to identify the anticipated marginal change with regards to established thresholds<sup>33</sup>.
- c) Acknowledging the limitation of b), we have discussed plausible causal links with relevant experts, including those within the study team and representatives of DPI Fisheries and Local Land Services.

**3 Quantification of the causal link between the change in water quality/ecological outcome**

- a) Again, this typically occurs via detailed site-specific studies, and/or extrapolation from relevant and appropriate studies from other sites/locations (known as benefits transfer).

We recognise not all data is available to undertake a first principles, site specific quantification. Therefore, modification/simplification is required to undertake this step. For example, the Ecosystem Value Database<sup>34</sup> provides one source of benefits transfer data. We have applied professional judgement to determine the suitability of these values for each management action, and the anticipated marginal ecological change.

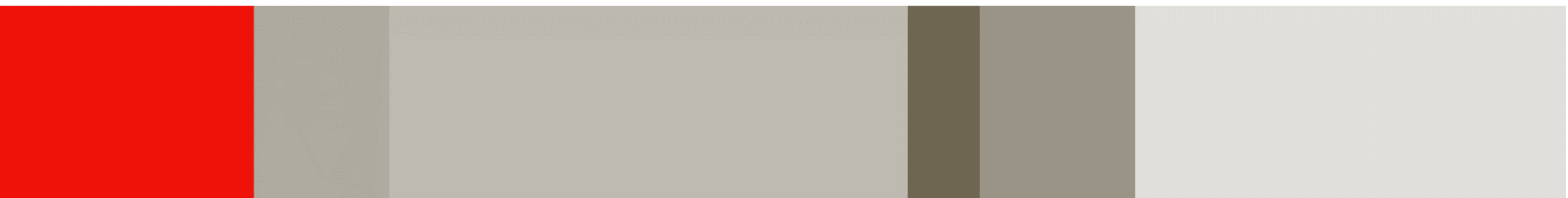
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<sup>33</sup> For example: 'Guidelines for water quality management',  
<https://www.waterquality.gov.au/guidelines>

<sup>34</sup> <https://www.es-partnership.org/esvd/>

## PART II

# Assessment



### 3 *Acid sulphate soil management actions (action 2.01)*

#### *Description*

The management action description reads,<sup>35</sup>

*“Implement key priority ASS management actions from the Manning River Floodplain Prioritisation Study 2021<sup>36</sup>, including:*

- *reinstate 1 550 ha of coastal wetlands on public and private land subject landholder agreement.*
- *audit, upgrade or replace Council floodgates within the Lower Manning Floodplain and add them to MCC's Asset Management Program.”<sup>37</sup>*

Refer to appendix A for further details.

Further clarification from Council advised the economic assessment for this management action is limited to:

- total of 655 hectares<sup>38</sup> of area to be rehabilitated into a coastal wetland in the lower Manning floodplain, at a cost of \$6.3 million, and
- capital work upgrades for two Council owned floodgates located in the lower Manning floodplain (refer to the teal circles in figure A.1 for locations).

#### *Evaluation parameters*

A rapid CBA assessment was completed for this management option. Key considerations for assessing this option are to understand the:

- ASS remediation actions that will be undertaken, and where in the catchment these will occur
- capital and maintenance costs of the proposed ASS remediation actions
- improvement to water quality directly attributable to undertaking the proposed remediation actions, and floodgate upgrades, and

<sup>35</sup> Taken from the excel spreadsheet, ‘Copy of ListofFinal\_Proceed\_ManagementActions\_Queries\_Answered’, provided by Salients on 9 April 2021

<sup>36</sup> Pietsch, TJ et al. (2019), ‘Riparian and Shoreline Vegetation in the Manning, Great Lakes and Karuah Catchments: Report to Hunter Local Land Services’, Precision Erosion & Sediment Management Research Group, Griffith University

<sup>37</sup> Email from Council to David Wainwright on 9 April 2021

<sup>38</sup> We note here that the total of 1 550 ha was stated in the management description. Council advise that 655 ha to be remediate by Council with public funds and 895 ha to be remediated by a third party.

- ecological benefit from undertaking the ASS actions.

In the absence of site-specific ASS remediation details for this option, we have utilised analyses from Harrison, A et al. (Water Research Laboratory) 2019<sup>39</sup>, for some cost and benefit estimates, as well as other sources where available. As per NSW Treasury guidelines<sup>40</sup>, we have used a 30-year assessment period and a 7 per cent discount rate. Sensitivity analysis has been undertaken using 3 per cent and 10 per cent discount rates.

Table 3.1 outlines the evaluated costs and benefits for this option.

### 3.1 Evaluated costs and benefits to implement ASS management

Cost/benefit	Value	Data source
<b>Costs</b>		
Area for remediation	655 hectares	Council
Upfront remediation costs	\$6.3 million	Council
Remediation monitoring and maintenance costs	\$50 000 per annum	Harrison, A et al. (Water Research Laboratory) 2019
Lost value of agricultural production	<ul style="list-style-type: none"> <li>■ Gross agricultural production value \$350/ha/year</li> <li>■ Agricultural costs \$273/ha/year</li> <li>■ Resulting in net loss of agricultural value \$77/hectare/year</li> </ul>	Harrison, A et al. (Water Research Laboratory) 2019
Council Floodgate upgrade costs	\$40 000 over four years	Council email to David Wainwright dated 9 April 2021. Note, two floodgate structures identified in need of upgrade, costed at \$20 000 each
<b>Benefits</b>		
Post intervention ecological outcome <sup>a</sup>	<ul style="list-style-type: none"> <li>■ Mangroves &lt;0.6m AHD               <ul style="list-style-type: none"> <li>– 1 hectare</li> </ul> </li> <li>■ Saltmarsh 0.6 – 0.9m AHD               <ul style="list-style-type: none"> <li>– 103 hectares</li> </ul> </li> <li>■ Freshwater Wetland/Grassland 0.9 - 1.2m AHD               <ul style="list-style-type: none"> <li>– 199 hectares</li> </ul> </li> <li>■ Flood buffer/Grassland 1.2 – 2m AHD               <ul style="list-style-type: none"> <li>– 120 hectares</li> </ul> </li> <li>■ Agricultural land &gt;2m AHD</li> </ul>	Assumed hectares based on the proportions used in Harrison, A et al. (Water Research Laboratory) 2019, scaled to match the hectares identified for this option.

<sup>39</sup> Harrison, A et al. (Water Research Laboratory) 2019, 'Cost Benefit Analysis of Big Swamp Restoration Project', UNSW

<sup>40</sup> NSW Government 2017, 'NSW Government Guide to Cost-Benefit Analysis: Policy and Guidelines Paper (TPP 17-03),' March, Treasury, available at [https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf\\_0.pdf](https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf_0.pdf)

Cost/benefit	Value	Data source
	– 232 hectares	
Improvement to ecological health	\$/hectare wetland value ▪ Mangroves – \$12 392/ha/year ▪ Saltmarsh – \$12 392/ha/year ▪ Freshwater Wetland/Grassland – \$5 551/ha/year ▪ Flood buffer/Grassland – \$182/ha/year	Harrison, A et al. (Water Research Laboratory) 2019, 'Cost Benefit Analysis of Big Swamp Restoration Project', UNSW
Floodgate upgrades	Qualitative discussion	NSW Government 2007, 'The Assessment and Management of Floodgates on the NSW South Coast', Department of Primary Industries

<sup>a</sup> Assumed that vegetation will begin to have positive environmental benefits after five years, as per Harrison, A et al. (Water Research Laboratory) 2019

Source: As stated in the table.

## Results

### Costs

The total present value costs are shown in table 3.2.

#### 3.2 Present value costs – ASS management actions (action 2.01)

Cost item	Amount
	\$2021, PV
Upfront remediation costs	6 300 000
Remediation monitoring and maintenance costs	620 452
Lost value of agricultural production	404 338
Council Floodgate upgrade costs	36 243
<b>Total</b>	<b>7 324 790</b>

Note: Present value calculated using a 7 per cent discount rate over 30-years.

Source: CIE

### Benefits

The total present value benefits are shown in table 3.3.



### 3.3 Present value benefits – ASS management actions (action 2.01)

Benefit item	Amount
	\$2021, PV
Improvement to coastal wetlands	21 852 510
Floodgate upgrades	Not quantified
<b>Total</b>	<b>21 852 510</b>

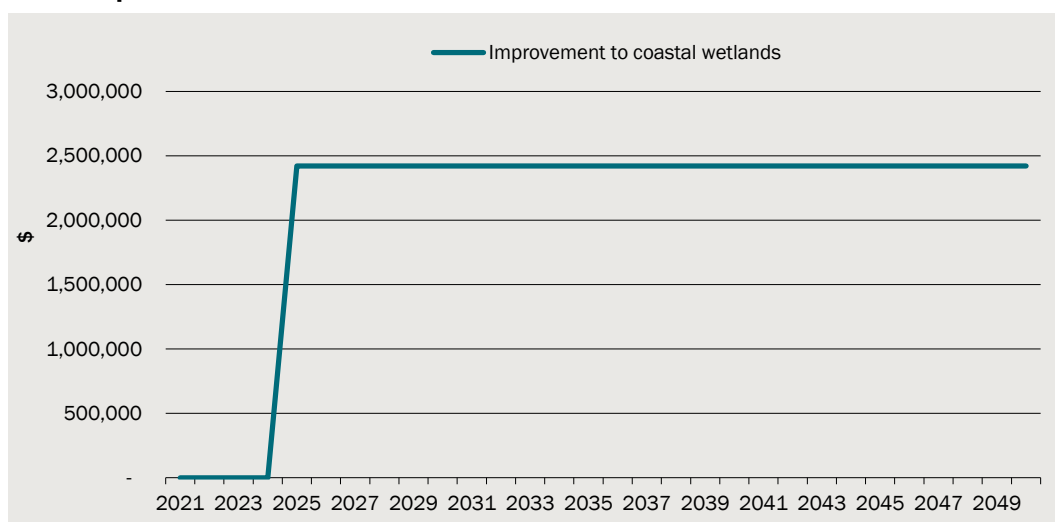
Note: Present value calculated using a 7 per cent discount rate over 30-years.

Source: CIE

#### *Improvement to coastal wetlands*

Undertaking ASS remediation on a 655-hectare site in the Lower Manning Floodplain is estimated to result in \$2.4 million per annum in ecological benefits associated with improved coastal wetlands, as shown in chart 3.4. It is assumed that vegetation will begin to have positive environmental benefits after five years, as per Harrison, A et al. (Water Research Laboratory) 2019.<sup>41</sup>

### 3.4 Improvement to coastal wetlands



Data source: CIE

#### *Floodgate upgrades*

A floodgate is a top-hinged flap installed across a waterway to prevent water entering particular areas.<sup>42</sup> Two Council owned hinged-flap floodgates have been identified for assessment as part of this management option, one located at Catai Creek and the other at Lansdowne River (refer to A.1 for details).

<sup>41</sup> Harrison, A et al. (Water Research Laboratory) 2019, 'Cost Benefit Analysis of Big Swamp Restoration Project', UNSW

<sup>42</sup> <https://www.dpi.nsw.gov.au/fishing/habitat/rehabilitating/floodgate>

Standard floodgates operate passively as one-way valves. Water is prevented from flowing upstream by the hinged flap but can flow downstream when the upstream water level is higher than that downstream. Floodgates are designed to prevent inundation of low-lying land by high tides or flood events.<sup>43</sup>

Two possible flood gate intervention approaches are available:

- 1 removal of redundant structures, and
- 2 active floodgate management via floodgate redesign/replacement to allow the on-demand controlled opening of floodgates.

We understand the identified council floodgates are still required for flood mitigation purposes, and therefore it is not considered appropriate for their complete removal. However, active floodgate management intervention strategies are considered appropriate, especially for hinged-flap floodgates, as identified in NSW Department of Primary Industries (2007).<sup>44</sup>

Active floodgate management increases the frequency and duration of time the structure allows water to pass through outside of flood periods. This in turn enhances:<sup>45</sup>

- fish passage and connectivity between estuarine and drainage habitats
- ASS management by maintaining moisture to ASS sites
- the control of aquatic weeds, and
- water quality by:
  - increasing stable dissolved oxygen levels, and
  - decreasing acidity, iron and aluminium flocs nutrients and algal blooms.

Table 3.5 lists 5 flood gates within the Lansdowne River and Cattai Cree identified by NSW Department of Primary Industries (2007) for active management.<sup>46</sup> Extrapolating these figures to the Council identified floodgates suggest benefits could be achieved for up to 70 km of upstream habitat, and 2 100 hectares of coastal wetlands.

<sup>43</sup> <https://www.dpi.nsw.gov.au/fishing/habitat/rehabilitating/floodgate>

<sup>44</sup> NSW Department of Primary Industries (2007). 'The Assessment and Management of Floodgates on the NSW South Coast.' Report to the Natural Heritage Trust. NSW Department of Primary Industries, Sydney

<sup>45</sup> Johnston, S., Kroon, F., Slavich, P., Cibilic, A. and Bruce, A. (2003). 'Restoring the Balance Guidelines for Managing Floodgates and Drainage Systems on Coastal Floodplains.' NSW Agriculture, Wollongbar, NSW referenced in NSW Department of Primary Industries (2007). 'The Assessment and Management of Floodgates on the NSW South Coast.' Report to the Natural Heritage Trust. NSW Department of Primary Industries, Sydney, p. 5

<sup>46</sup> NSW Department of Primary Industries (2007). 'The Assessment and Management of Floodgates on the NSW South Coast.' Report to the Natural Heritage Trust Appendix D: Floodgate Data for High Priority Structures in the HCRCMA Region.' NSW Department of Primary Industries, Sydney, pp. 37-39.

### 3.5 Lansdowne River and Cattai Creek identified floodgates for active management and possible benefits

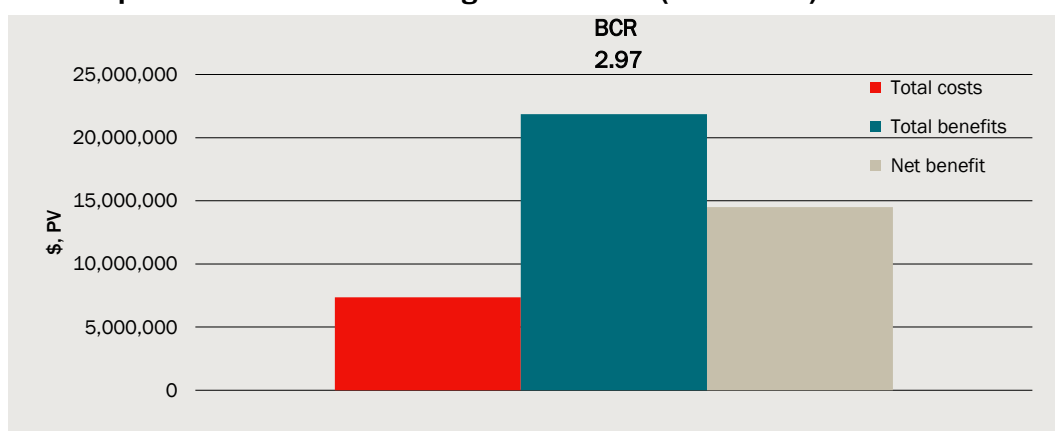
Waterway	Structure type	Habitat up stream km	Wetland upstream hectares
off Lansdowne River	Hinged Flap	9	0
off Lansdowne River	Hinged Flap	28.5	0
off Lansdowne River	Hinged Flap	9	0
off Cattai Creek	Hinged Flap	22	600
off Cattai Creek	Hinged Flap	1.5	1 500
<b>Total</b>		<b>70</b>	<b>2 100</b>

Source: NSW Department of Primary Industries (2007). 'The Assessment and Management of Floodgates on the NSW South Coast.' Report to the Natural Heritage Trust Appendix D: Floodgate Data for High Priority Structures in the HCRCMA Region.' NSW Department of Primary Industries, Sydney, pp. 37-39.

### Rapid CBA results

Chart 3.6 shows the rapid CBA result of undertaking option 2.01.

### 3.6 Rapid CBA results – ASS management actions (action 2.01)



Note: Present value calculated using a 7 per cent discount rate over 30-years.

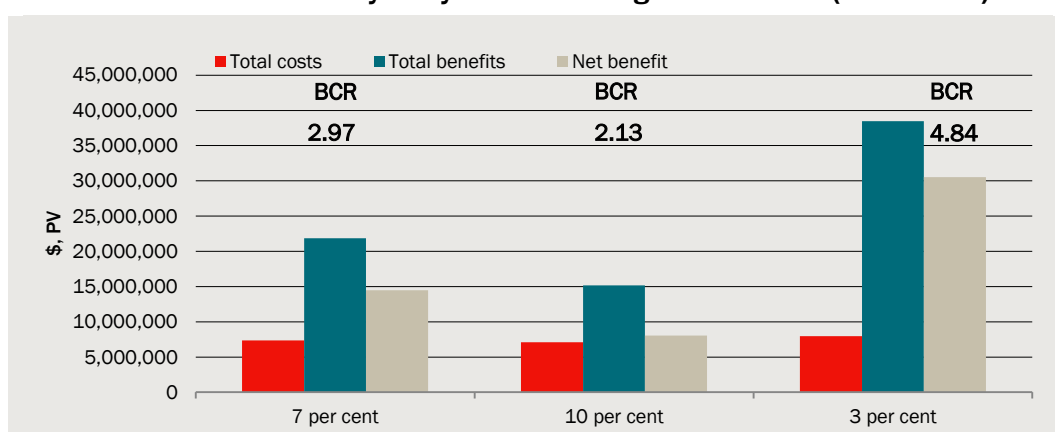
Data source: CIE

The rapid CBA results indicate a net benefit of \$14.5 million and BCR of 2.97, from undertaking ASS remediation on 655 hectares of land in the Lower Manning Floodplain, compared to a status quo of not undertaking the option. Society will therefore be better off.

## Sensitivity analysis

Chart 3.7 shows the sensitivity CBA results using 3 per cent and 10 per cent discount rates, as per NSW Treasury CBA Guidelines.<sup>47</sup> The Rapid CBA results improve under the 3 per cent discount rate, with the net benefit doubling as the stream of future ecological benefits are subject to a lower discount rate. The rapid CBA results decline under the 10 per cent discount rate, but still produce a positive net benefit and BCR greater than 1.

### 3.7 Discount rate sensitivity analysis - ASS management actions (action 2.01)



Note: Present value calculated using over 30-years.

Data source: CIE

## Results conclusion

Proceed to next steps for management option 2.01, as this options demonstrates a high likelihood of net benefits and improved societal welfare.

<sup>47</sup> NSW Government 2017, 'NSW Government Guide to Cost-Benefit Analysis: Policy and Guidelines Paper (TPP 17-03),' March, Treasury, available at [https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf\\_0.pdf](https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf_0.pdf)

## 4 *Protect and/or rehabilitate coastal wetlands (action 2.02)*

### *Description*

The management action description reads,

“Protect and/or rehabilitate coastal wetlands, including the restoration of intertidal hydrology to previously drained areas:

Undertake field investigations and implement actions to exclude stock and restore tidal flushing at three coastal wetland sites on Mitchell Island in partnership with landholders by 2025, as recommended in Rayner, D.S et al. (2020)<sup>48</sup>.

Protect and restore a further 100 ha on both public and private land by 2030.”

A desktop study completed by the University of New South Wales<sup>49</sup> identified several on-ground management actions aimed at restoring and protecting the environment of coastal wetlands surrounding Pelican Bay. Refer to appendix A for further details.

The identified works are segregated into three sites and include:

- Site 1: Fencing of two areas and the optimisation of a culvert to improve connectivity, plus investigation of connectivity under Beale Avenue and Pelican Bay Road, Mitchell Island.
- Site 2: Opening of Flood Gates on Millers Creek (Manning Point Road) to increase extent of tidal inundation.
- Site 3: Fencing of an existing 4.7ha wetland finger extending north from Sheather Creek and under Manning Point Road, including construction of an adjacent pathway for stock and culvert extension under Manning Point Road.

Refer to figure A.13 for details.

### *Evaluation parameters*

A rapid CBA assessment was completed for this management option. Key considerations for assessing this option are to understand:

- what rehabilitation actions would be undertaken, and where they will occur.

<sup>48</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, ‘Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment’, July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

<sup>49</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, ‘Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment’, July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

- tables A.14, A.15 and A.16 summarise the works identified in Rayner, D.S et al. 2020<sup>50</sup>, and we have used these as our reference, along with expert judgment to define a specific set of works for inclusion in the economic assessment (table 4.1).
- the capital and maintenance costs of the proposed wetland rehabilitation actions
- the improvement to water quality directly attributable to undertaking the proposed water quality improvement actions, and
- the ecological benefit from undertaking the water quality improvement wetland rehabilitation actions
- The is work is expected to increase coastal wetland areas and benefit local oyster farmers, primarily by excluding stock from some areas of nearby wetlands and reducing the pathogen load entering the waterway.

#### 4.1 Set of works included in the coastal wetland protection/rehabilitation management option

Set of works	Source
Install 4.54 kilometres (4 540 metres) of stock exclusion fencing across three sites as follows: <ul style="list-style-type: none"> <li>■ 2.4 kilometres (2 400 metres) on property Lot: DP590266 (located within Site 1, downstream of Pelican Bay Road)</li> <li>■ one kilometre (1 000 metres) in the Millers Creek floodgates site (Site 2), and</li> <li>■ 1.14 kilometres (1 140 metres) in the Sheathers Creek Site (Site 3).</li> </ul>	Assumption, to create at least 14.7 hectares of stock exclusion zones as follows: <ul style="list-style-type: none"> <li>■ 10-hectares (approximately 25 per cent of the property Lot: DP590266) in Site 1.</li> <li>■ An unspecified area in the Millers Creek floodgates site (Site 2), and</li> <li>■ 4.7-hectares in the Sheathers Creek Site (Site 3).</li> </ul> Exclusion zone sizes stated in D S Rayner, G Lumiatti, W C Glamore and B Henderson (2020).
Review and optimise six structures that limit upstream tidal flows from the Manning River within the Pelican Bay sub-catchment area study sites.	D S Rayner, G Lumiatti, W C Glamore and B Henderson (2020).
Drain clearing and removal of sediment barriers and in channel vegetation within the existing Sheather Creek (site 3) drainage system.	
Establish a dedicated stock access path directly adjacent to Manning Point Road located in Sheather Creek (site 3).	
Extension of the existing Sheather Creek (Site 3) culverts (or bridge, or similar) <sup>a</sup> .	

<sup>a</sup> We have excluded the extension of the existing Sheather Creek (Site 3) culverts (or bridge, or similar) in the central case analysis, following subsequent advise from Council regarding financial viability concerns. Economic analysis including culverts is shown as a sensitivity.

Source: As stated in the table.

In the absence of site-specific coastal wetland details and ecological outcomes for this option, we have utilised analyses from D S Rayner, G Lumiatti, W C Glamore and

<sup>50</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

B Henderson (2020)<sup>51</sup> and Harrison, A et al. (Water Research Laboratory) 2019<sup>52</sup>, for some cost and benefit estimates, as well as other sources where available. As per NSW Treasury guidelines<sup>53</sup>, we have used a 30-year assessment period and a 7 per cent discount rate. Sensitivity analysis has been undertaken using 3 per cent and 10 per cent discount rates.

Table 4.2 outlines the proposed costs and benefits associated with Pelican Bay Coastal Wetlands restoration.

## 4.2 Evaluated costs and benefits of Pelican Bay Coastal Wetlands restoration

Cost/benefit	Value	Data source
<b>Costs</b>		
Coastal Wetland exclusion zone	14.7 hectares	D S Rayner, G Lumiatti, W C Glamore and B Henderson (2020).
Stock exclusion fencing	■ 4.54 kilometres (4 540 metres)	Assumption, to create at least 14.7 hectares of stock exclusion zones across the three sites.
Stock exclusion fencing installation	<ul style="list-style-type: none"> <li>■ Material <ul style="list-style-type: none"> <li>– \$4.50 per metre</li> </ul> </li> <li>■ Incidentals <ul style="list-style-type: none"> <li>– \$100 per km</li> </ul> </li> <li>■ Labour hours <ul style="list-style-type: none"> <li>– 27.24</li> </ul> </li> <li>■ Labour hourly rate <ul style="list-style-type: none"> <li>– \$40</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>■ Local Land Services, 'MEMS Incentives guide for riparian and bank protection works'</li> <li>■ Assumed 6 hours per km for labour hours,</li> </ul>
Annual stock exclusion fencing maintenance	\$160 per km	Local Land Services, 'MEMS Incentives guide for riparian and bank protection works'
Review and optimise six structures that limit upstream tidal flows	\$120 000 over four years	Extrapolated from the Council email to David Wainwright dated 9 April 2021. Note, six structures identified in need of optimisation, assumed to cost \$20 000 each over four years.

<sup>51</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

<sup>52</sup> Harrison, A et al. (Water Research Laboratory) 2019, 'Cost Benefit Analysis of Big Swamp Restoration Project', UNSW

<sup>53</sup> NSW Government 2017, 'NSW Government Guide to Cost-Benefit Analysis: Policy and Guidelines Paper (TPP 17-03),' March, Treasury, available at [https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf\\_0.pdf](https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf_0.pdf)



Cost/benefit	Value	Data source
Extension of the existing Sheather Creek (Site 3) culverts (or bridge, or similar) <sup>a</sup>	\$1.4 million (2013); \$1.6 million (\$2021)	Costplan Pty Ltd 2014, 'Brown Hill Keswick Creek Stormwater Management Plan: Part B Report, Appendix 17 Estimated costs of high flow bypass culverts', September, <a href="https://bhkcstormwater.com.au/wp-content/uploads/2014/09/Appendix-17-estimated-costs-of-high-flow-bypass-culverts-A4.pdf">https://bhkcstormwater.com.au/wp-content/uploads/2014/09/Appendix-17-estimated-costs-of-high-flow-bypass-culverts-A4.pdf</a>
Manning Point Road stock path located in Sheather Creek (Site 3)	\$318 828	Assumed to cost 20 per cent of the culvert extension, based on discussions with Salients.
Sheather Creek (Site 3) drain system clearing and sediment barrier/vegetation removal	\$1 100 per annum	Harrison, A et al. (Water Research Laboratory) 2019, 'Cost Benefit Analysis of Big Swamp Restoration Project', UNSW, scaled to the assumed exclusion zone size
Lost agricultural land	7.35 hectares	Assumption that 50 per cent of the proposed stock exclusion zones were previously used for agricultural production
Lost value of agricultural production	<ul style="list-style-type: none"> <li>Gross agricultural production value \$350/ha/year</li> <li>Agricultural costs \$273/ha/year</li> <li>Resulting in a net loss of agricultural value \$77/hectare/year</li> </ul>	Harrison, A et al. (Water Research Laboratory) 2019, 'Cost Benefit Analysis of Big Swamp Restoration Project', UNSW
<b>Benefits</b>		
Post intervention ecological outcome <sup>b</sup>	<ul style="list-style-type: none"> <li>Improvement of 14.7 hectares of Saltmarsh Coastal Wetlands</li> </ul>	Assumed hectares and coastal wetland type based on D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020
Improvement to ecological health	<ul style="list-style-type: none"> <li>\$12 392/ha/year associated with Saltmarsh Coastal Wetland rehabilitation</li> </ul>	Harrison, A et al. (Water Research Laboratory) (2019)
Improved oyster farming productivity	<ul style="list-style-type: none"> <li>Qualitative discussion</li> </ul>	Improved water quality in Pelican Bay sub-catchment has the potential to increase local oyster farm productivity and may be particularly beneficial if direct harvest is allowed in Pelican Bay at some time in the future. The Food Agility Cooperative Research Centre are undertaking studies in this area. We have discussed this research with relevant authors and DPI-Fisheries.

<sup>a</sup> We have excluded the extension of the existing Sheather Creek (Site 3) culverts (or bridge, or similar) in the central case analysis, following subsequent advice from Council regarding financial viability concerns. Economic analysis including culverts is shown as a sensitivity. <sup>b</sup> Assumed that vegetation will begin to have positive environmental benefits after five years, as per Harrison, A et al. (Water Research Laboratory) 2019

Source: As stated in the table.

Table 4.2 shows \$1.6 million (91 per cent) of the cost used in this analysis is attributed to a single culvert extension to prevent stock crossing a drainage channel at site 3 from impacting the vegetation and ecology. We have excluded the extension of the existing Sheather Creek (Site 3) culverts (or bridge, or similar) in the central case analysis, following subsequent advise from Council regarding financial viability concerns.

Therefore, an alternative, less expensive stock path option should be investigated. For the central case we have assumed a stock path option involving fencing, appropriate reinforcement of the banks and a concrete apron at bed level could be constructed substantially cheaper (~20 per cent) of the overall cost of a full culvert extension. We note there are likely other options that could be considered, when it comes to final decision making and implementation.

Economic analysis including an extension of the existing Sheather Creek (Site 3) culverts (or bridge, or similar) is shown as a sensitivity below.

## Results

### Costs

The total present value costs are shown in table 4.3.

#### 4.3 Present value costs –coastal wetlands rehabilitation (action 2.02)

Cost item	Amount
	\$2021, PV
Stock exclusion fencing	21 974
Stock exclusion fencing maintenance	9 014
Review and optimise structures that limit upstream tidal flows	108 729
Sheather Creek (Site 3) drain system clearing and sediment barrier/vegetation removal	14 075
Lost value of agricultural production	7 023
Manning Point Road stock path located in Sheather Creek (Site 3)	318 828
<b>Total</b>	<b>479 643</b>

Note: Present value calculated using a 7 per cent discount rate over 30-years.

Source: CIE

### Benefits

The total present value benefits are shown in table 4.4.

#### 4.4 Present value benefits – coastal wetlands rehabilitation (action 2.02)

Benefit item	Amount
	\$2021, PV
Improvement to coastal wetlands	1 643 438
Improved oyster farming productivity	Not quantified
<b>Total</b>	<b>1 643 438</b>

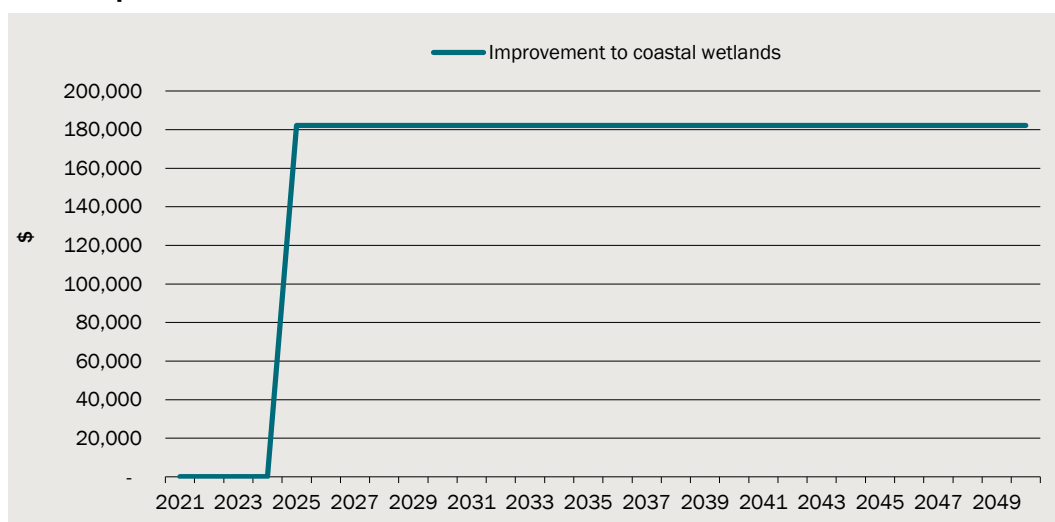
Note: Present value calculated using a 7 per cent discount rate over 30-years.

Source: CIE

##### *Improvement to coastal wetlands*

Undertaking coastal wetland protection and rehabilitation on a 14.7-hectare site in Pelican Bay is estimated to result in \$0.2 million per annum in ecological benefits associated with improved coastal wetlands, as shown in chart 4.5. It is assumed that vegetation will begin to have positive environmental benefits after five years, as per Harrison, A et al. (Water Research Laboratory) 2019.<sup>54</sup>

#### 4.5 Improvement to coastal wetlands



Data source: CIE

##### *Improved oyster farming productivity*

The factors that affect oyster productivity vary spatially and temporally within an estuary. The NSW oyster industry uses the spatial variations in estuarine environments for various stages of the farming cycle.<sup>55</sup>

<sup>54</sup> Harrison, A et al. (Water Research Laboratory) 2019, 'Cost Benefit Analysis of Big Swamp Restoration Project', UNSW

<sup>55</sup> Ogburn, D. (2011). The NSW Oyster Industry: 'A Risk Indicator of Sustainable Coastal Policy and Practice'. Australian National University.

Oysters, like most shellfishes are filter feeders dependent on phytoplankton and particulate matter from the surrounding water in which they grow.<sup>56</sup> Therefore, oysters are vulnerable to the level of nutrient (food availability) in an area and the quantity and quality of the water column in which it is farmed.

Other factors that affect growth of oysters are temperature, salinity, turbidity, water flow, stocking density and method of culture, that is intertidal or sub-tidal.<sup>57</sup>

Thus, knowledge of current flow rates and directions, freshwater inputs and tidal exchanges are important factors for assessing the level of food availability and water quality and its impact on oyster production.

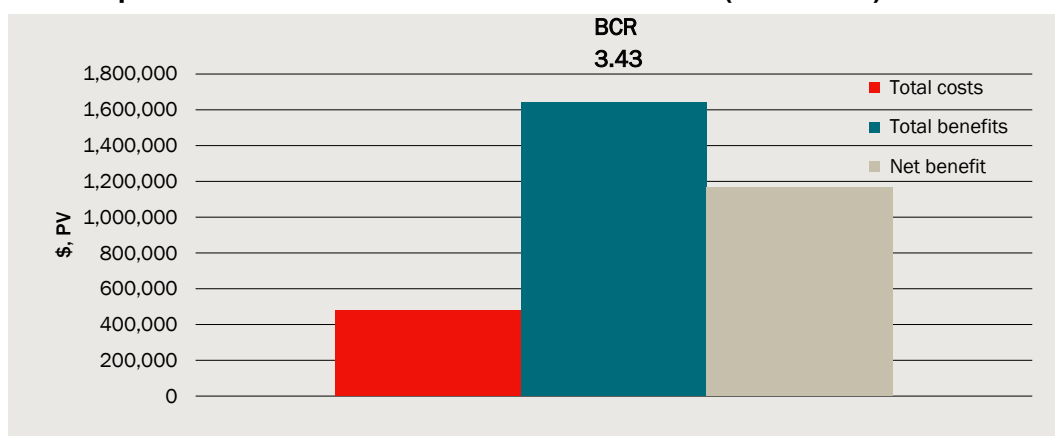
Environmental stress on coastal wetlands can manifest itself in reduced water quality and nutrient depletion, over time which affect oyster farming. Oysters cultivated on downgraded harvest areas need to be depurated in a facility for longer durations to be fit for sale for human consumption.<sup>58</sup>

Therefore, undertaking rehabilitation of coastal wetlands can increase oyster production given it improves food availability and water quality of estuaries and reduces length of depuration.

### ***Rapid CBA results***

Chart 4.6 shows the rapid CBA result of undertaking option 2.02.

#### **4.6 Rapid CBA results – coastal wetlands rehabilitation (action 2.02)**



Note: Present value calculated using a 7 per cent discount rate over 30-years.

Data source: CIE

<sup>56</sup> Mitchell, I. M. (2001). 'Relationship between water quality parameters (nutrients, seston, chlorophyll a), hydrodynamics and oyster growth in three major Pacific oyster (*Crassostrea gigas*) growing areas in southern Tasmania (Australia)', University of Tasmania

<sup>57</sup> Mitchell, I. M. (2001). 'Relationship between water quality parameters (nutrients, seston, chlorophyll a), hydrodynamics and oyster growth in three major Pacific oyster (*Crassostrea gigas*) growing areas in southern Tasmania (Australia)', University of Tasmania

<sup>58</sup> DPIE NSW, Net Returns of Real-Time Sensors and Salinity-Based Management Plans in NSW Oyster Production

The rapid CBA results indicate a net benefit of \$1.2 million and BCR of 3.94, from undertaking coastal wetland rehabilitation on a 14.7-hectare site in Pelican Bay, compared to a status quo of not undertaking the option.

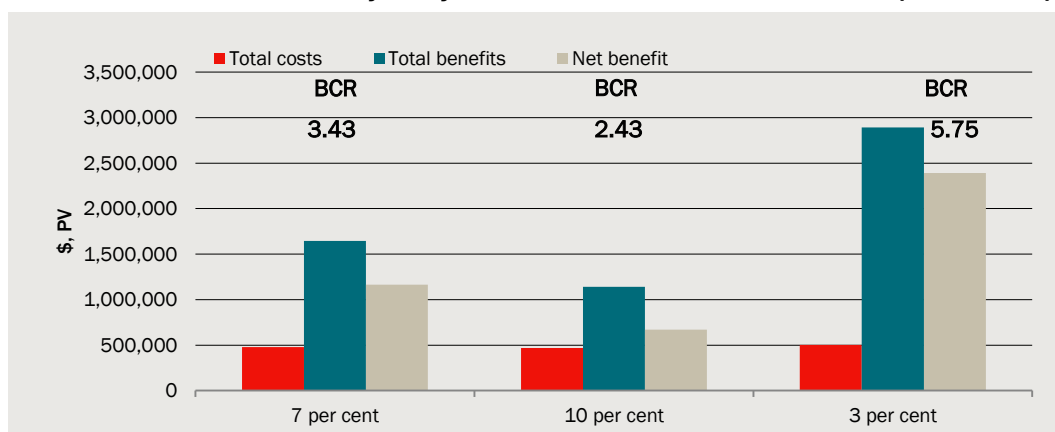
The rapid CBA results are a lower bound, as they do not include the benefit of improved water quality on oyster farming productivity. Based on the qualitative discussion of improved water quality on oyster farming productivity above, if included, would further improve the net benefit and BCR results.

## Sensitivity analyses

### Discount rates

Chart 4.7 shows the sensitivity CBA results using 3 per cent and 10 per cent discount rates, as per NSW Treasury CBA Guidelines.<sup>59</sup> The Rapid CBA results improve under the 3 per cent discount rate and decline under the 10 per cent discount rate.

#### 4.7 Discount rate sensitivity analysis - coastal wetlands rehabilitation (action 2.02)



Note: Present value calculated using over 30-years.

Data source: CIE

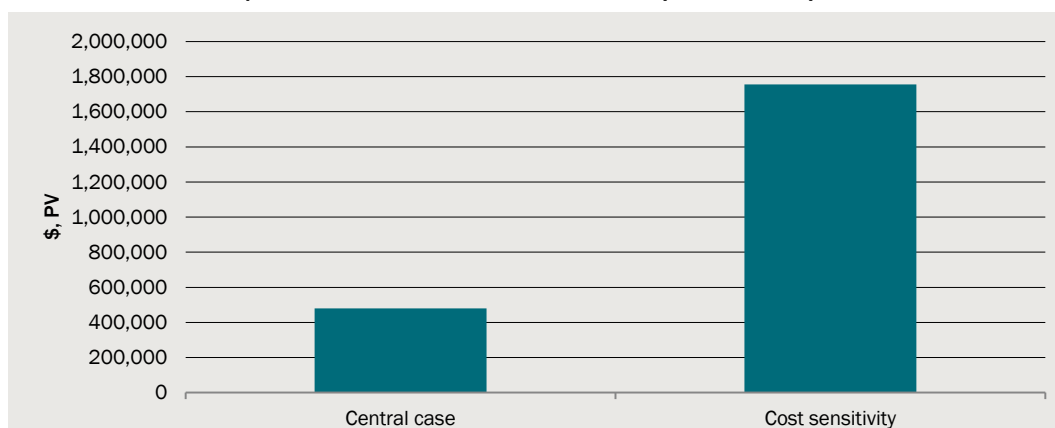
### Cost sensitivity inclusion of Sheather Creek culvert extension (or similar)

Chart 4.8 shows the sensitivity present value costs including \$1.6 million (2021) for a culvert extension (or similar) across Sheather Creek to prevent stock crossing a drainage

<sup>59</sup> NSW Government 2017, 'NSW Government Guide to Cost-Benefit Analysis: Policy and Guidelines Paper (TPP 17-03),' March, Treasury, available at [https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf\\_0.pdf](https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf_0.pdf)

channel at site 3 from impacting the vegetation and ecology, as recommended by Rayner, D.S et al. 2020.<sup>60</sup>

#### 4.8 Cost sensitivity inclusion of Sheather Creek culvert (or similar) present value costs – Protect and/or rehabilitate coastal wetlands (action 2.02)

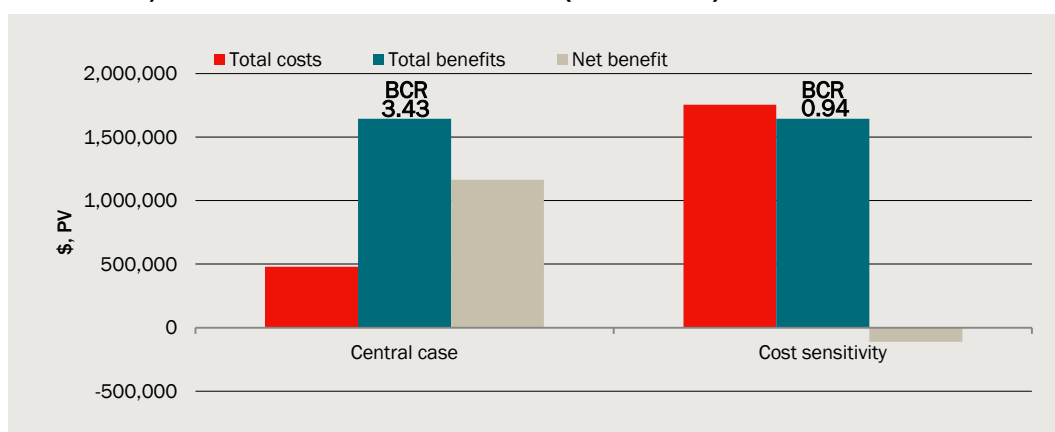


Data source: CIE

The present value costs increase from \$0.5 million under the central case, to \$1.8 million under the cost sensitivity.

Chart 4.9 shows the sensitivity CBA results including \$1.6 million (2021) for a culvert extension (or similar) across Sheather Creek, compared to the central case without the culvert extension.

#### 4.9 Cost sensitivity inclusion of Sheather Creek culvert (or similar) CBA results – Protect and/or rehabilitate coastal wetlands (action 2.02)



Note: Present value calculated using over 30-years.

Data source: CIE

The Rapid CBA results decline with the added culvert extension costs, to a net benefit of -\$0.1 million and BCR 0.94. However, as noted above the CBA sensitivity results do not

<sup>60</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

include the benefit of improved water quality on oyster farming productivity. Based on the qualitative discussion of improved water quality on oyster farming productivity, if included, would exceed \$0.1 million in PV terms, and therefore result in a positive net benefit and BCR greater than 1 for this option under the cost sensitivity.

### ***Results conclusion***

Based on the CBA we recommend proceeding to the next steps for coastal wetland restoration at Pelican Point. Consideration should be given to the most cost-effective method to protect the channel from stock impacts. A higher net benefit and positive BCR is achieved if the culvert extension at Site 3 is replaced with a cheaper alternative.



## 5 *Protect and/or rehabilitate riparian zones* (action 2.03)

### *Description*

The management option reads,

“Improve the condition, extent and connectivity of riparian and estuarine bank vegetation on private and public land by protecting and/or restoring 100 km of buffer vegetation by 2030.”

Council has identified the following priority sites based on the assessment by Pietsch, T et al. (2019)<sup>61</sup> for protection and rehabilitation:

- Priority sub catchments with proximity to the estuary: Manning River, Scotts Creek, South Arm.
- Priority sub catchments for natural regeneration: Ghinni Ghinni Creek, Killabakh Creek, Lansdowne River, Dingo Creek, Moorah Creek, Cedar Party Creek.
- Priority sub catchments in the upper catchment: Barnard River, Gloucester River, Barrington River.

Refer to appendix A for further details.

### *Evaluation parameters*

A rapid CBA assessment was completed for this management option.

The goal of this action is to protect and/or restore 100 km of buffer vegetation by 2030. No details are provided on the desired riparian buffer zone width. Following discussion with Local Land Services staff, a 10-metre buffer zone has been adopted on both sides of the river (20 metres total), resulting in a total 200-hectare riparian buffer zone (20 metre total width, multiplied by the stated 100km length). We assume 20 hectares of riparian vegetation is rehabilitated each year between 2021 and 2030 to achieve the 100km length target by 2030.<sup>62</sup>

A riparian zone rehabilitation cost of \$31 000 per hectare and maintenance cost of \$6 000 per kilometre, per year, has been adopted, following discussions with Local Land

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<sup>61</sup> Pietsch, T et al. (2019), ‘Riparian and Shoreline Vegetation in the Manning, Great Lakes and Karuah Catchments: Report to Hunter Local land Services’, Precision Erosion & Sediment Management Research Group, Griffith University

<sup>62</sup> Assuming riparian rehabilitation commences in 2021.

Services staff.<sup>63</sup> It is noted that the cost of riparian restoration varies significantly depending on the method used, for natural regeneration, assisted regeneration or revegetation.

Riparian zone benefits have been incorporated based on a literature review, as well as discussions with Local Land Services staff. Key parameters of interest for the qualitative and quantitative benefit assessment are:

- the improvement to water quality (changes to nutrient and sediment loads) directly attributable to undertaking riparian actions
- enhanced vegetation cover, and
- prevention of land erosion.

Waterway health may be improved by:

- improvement and protection of native vegetation along waterways, by removing nutrients and preventing erosion
- water dependent vegetation, by removing nutrients and preventing erosion
- improved stormwater treatment, reducing the nutrient load of stormwater entering the waterway, and
- improved stormwater infrastructure, reducing the volume of stormwater entering the waterway.

## Results

### Costs

The total present value costs are shown in table 5.1. Riparian rehabilitation costs account for 47 per cent of total present value costs and riparian maintenance costs account for the remaining 53 per cent.

#### 5.1 Present value costs – Protect and/or rehabilitate riparian zones (action 2.03)

Cost item	Amount
	\$2021, PV
Riparian zone rehabilitation cost	4 659 444
Riparian zone maintenance cost	5 315 624
<b>Total</b>	<b>9 975 068</b>

Note: Present value calculated using a 7 per cent discount rate over 30-years.

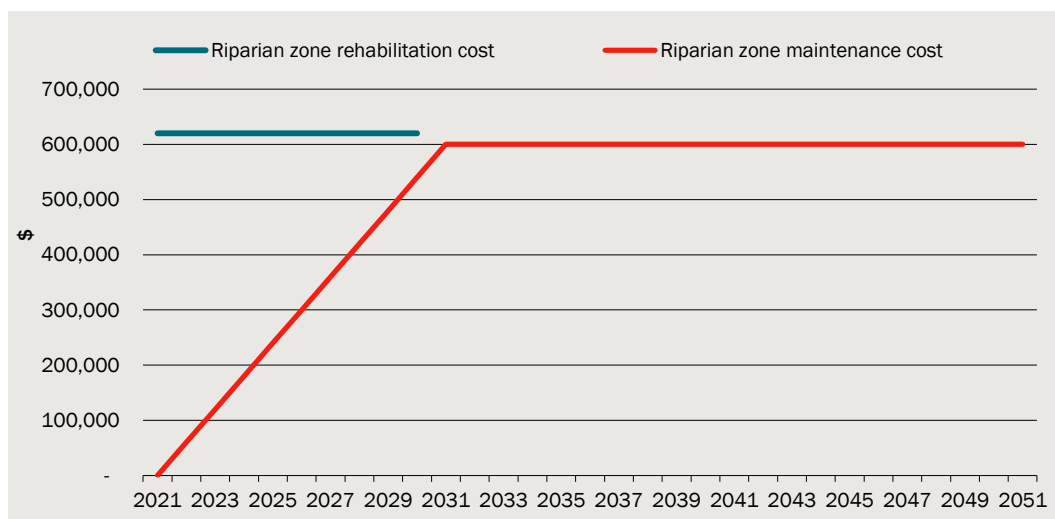
Source: CIE

Annual rehabilitation and maintenance costs are shown in chart 5.2. Annual riparian vegetation costs occur as implementation is undertaken between 2021 and 2030. Annual

<sup>63</sup> These figures are based on a 1-year budget for the Manning Estuary and is likely to underrepresent the amount required to achieve the specified management action. Site specific evaluation is required to determine a more representative amount for this option.

riparian maintenance costs are assumed to occur the year post implementation, with the full 100km length subject to maintenance from 2031.

## 5.2 Annual riparian rehabilitation and maintenance costs



Note: Annual riparian vegetation costs occur as implementation is undertaken between 2021 and 2030. Annual riparian maintenance costs are assumed to occur the year post implementation, with the full 100km riparian length subject to maintenance from 2031.

Data source: CIE

## Benefits

A previous study considered a range of different water quality outcomes of the Hawkesbury-Nepean river.<sup>64</sup> Given water quality itself may not have a salient value for individuals, the study considered derived demand for water quality which included:

- riverside vegetations – length of river (km) which has vegetated river banks
- suitability for swimming – length of the river (km) which has water quality meeting minimum quality standards for direct contact recreation such as swimming.
- time taken to catch a Bass fish – this is an indicator of how many Bass are in the river, which is a good indicator of the total number of native fish in the river.
- clear of non-native water weeds – length of the river (km) that is not infested with invasive water weeds. Weeds can be unsightly from the bank and a nuisance to people swimming and boating. They are also one of the reasons for reduced native plant and animal life in the river.

Improvements in water quality are valued based on information from another WTP study for three different NSW catchments (Lachlan, Namoi, Hawkesbury-Nepean River) (table 5.3).<sup>65</sup> The benefit associated with protecting and/or rehabilitating riparian zones

<sup>64</sup> Bennett J., Cheesman J., Blamey R. and Kragt M., 2015, *Estimating the non-market benefits of environmental flows in the Hawkesbury-Nepean River*, Journal of Environmental Economics and Policy, p. 4.

<sup>65</sup> Mazur, Kasia & Bennett, Jeffrey W., 2009. *Location differences in communities' preferences for environmental improvements in selected NSW catchments: A Choice Modelling approach*, 2009

is measured using the WTP of the community for healthy riverside vegetation. This may include use value (i.e. the value households derive visiting areas of vegetation) as well as non-use values (i.e. the option value of having the choice to visit native vegetation, or the value of knowing areas of vegetation exists etc.).

Note we have only measured benefits based on the length of watercourses which are expected to have vegetation protected or improved. Native vegetation is only one dimension of water quality.

### 5.3 Riverside vegetation, value per additional km in 20 years

	WTP per km	WTP per km
	\$2009	\$2021
Namoi	\$0.11	\$0.14
Lachlan	\$0.83	\$1.05
Hawkesbury-Nepean	\$0.90	\$1.13
Average	\$0.61	\$0.77

Note: WTP per Mid Coast household.

Source: Mazur, Kasia & Bennett, Jeffrey W., 2009. *Location differences in communities' preferences for environmental improvements in selected NSW catchments: A Choice Modelling approach*, 2009 Conference (53rd), February 11-13, 2009, Cairns, Australia 47946, Australian Agricultural and Resource Economics Society.

The benefit is estimated by multiplying the average benefit parameter by the amount of riverside vegetation provided in 20 years (the final amount of vegetation provided as part of the project); multiplying this by the number of households in Mid Coast adjusted for non-response. The adjustment for non-response accounts for the fact that individuals who partake in WTP surveys may have higher WTP than the general population. We use the approach outlined in Morrison, which recommends applying WTP values for one third of non-respondents.<sup>66</sup> Given the survey the primary WTP study had a response rate of 45 per cent, we apply the WTP parameter to 63 per cent of households.<sup>67</sup>

Furthermore, we have adjusted the WTP for inflation, but also to account for the scope of the original study. Previous work has found that “scope” and “scale” effects in WTP studies can have a large impact on WTP parameters, where:<sup>68</sup>

- Scope relates to the geographic scope over which an amenity improvement was offered. For instance, Mazur and Bennett (2009) elicit household preferences for a change in native vegetation, given the context of there already been 1 million hectares of native vegetation

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Conference (53rd), February 11-13, 2009, Cairns, Australia 47946, Australian Agricultural and Resource Economics Society.

<sup>66</sup> Morrison, M. 2000, Aggregation biases in stated preference studies, Australian Economic Papers, 39(2).

<sup>67</sup>  $\left(45\% + \left(\frac{45\%}{3}\right)\right)$ .

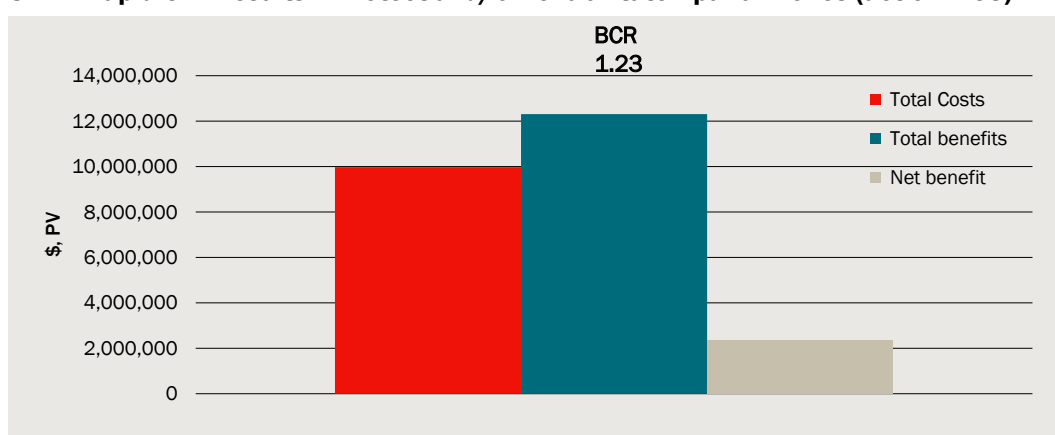
<sup>68</sup> Rolfe J., Windle J., Bennett J. and Mazur, K. 2013, Calibration of values in benefit transfer to account for variations in geographic scale and scope: Comparing two choice modelling experiments, contributed paper presented at the 57th Australian Agricultural and Resource Economics (AARES) 2013 Annual conference.

- Scale refers to the quantity of the amenity being considered (i.e. the change in amenity offered in the WTP survey)

## Rapid CBA results

Chart 5.4 shows the rapid CBA result of undertaking option 2.03.

### 5.4 Rapid CBA results – Protect and/or rehabilitate riparian zones (action 2.03)



Note: Present value calculated using a 7 per cent discount rate over 30-years.

Data source: CIE

The rapid CBA results indicate a net benefit of \$2.3 million and benefit cost ratio of 1.23, from undertaking riparian zone protection and/or rehabilitation on a total of 100km in the Manning catchment, compared to a status quo of not undertaking the option.

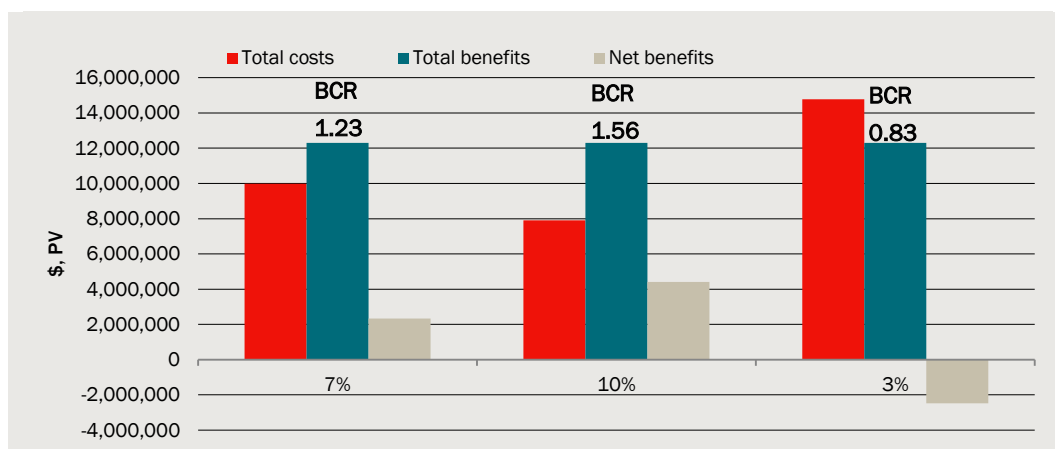
However, we have estimated benefits using the Hawkesbury-Nepean catchment (the highest WTP estimate). When we use the mid-point WTP estimates the results indicate -\$2.5 million net benefits and a BCR of 0.75.

## Sensitivity analysis

Chart 5.5 shows the sensitivity CBA results using 3 per cent and 10 per cent discount rates, as per NSW Treasury CBA Guidelines.<sup>69</sup> The Rapid CBA results decline under the 3 per cent discount rate and improve under the 10 per cent discount rate.

<sup>69</sup> NSW Government 2017, 'NSW Government Guide to Cost-Benefit Analysis: Policy and Guidelines Paper (TPP 17-03),' March, Treasury, available at [https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf\\_0.pdf](https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf_0.pdf)

### 5.5 Discount rate sensitivity analysis - Protect and/or rehabilitate riparian zones (action 2.03)



Note: Present value calculated using over 30-years.

Data source: CIE

### Result Conclusion

Given the financial commitment required to complete riparian restoration, we recommend more detailed site prioritisation and field investigations prior to commencing work. Prioritisation decisions should be based on the best information available at the time. Specifically, site specific:

- rehabilitation and maintenance costs, instead of proxy estimates based on annual Local Land Service budgets, which may not be representative for the specific program of works for this option, and
- WTP estimated benefits of undertaking riparian vegetation, noting WTP estimate values are dependent on rehabilitation site location and respondent location.
  - We have estimated benefits using the Hawkesbury-Nepean catchment (the highest WTP estimate). When we use the mid-point WTP estimates the results indicate -\$2.5 million net benefits and a BCR of 0.75.

## 6 *Purchase and retire unused water licences (action 2.05)*

### *Description*

The management option reads,

“Prepare a report assessing the feasibility, viability and acceptability of purchasing and retiring un-used water licenses to secure environmental water.”

The Manning River Estuary is characterised by a large amount of unused (“sleeper”) licences. Council is concerned that, if activated, the sleeper licenses could pose a risk to environmental flows, particularly in years of low rainfall. The purpose of this action is to investigate the viability of purchasing some of the unused water licenses and if appropriate, develop a business case.

Refer to appendix A for further details.

### *Evaluation parameters*

As part of our assessment, we have qualitatively evaluated the benefits for this option against estimated quantified costs. A full assessment of this option would justify a standalone study. In the current environment surrounding water entitlements, this would likely need to consider societal impacts and would require substantial community consultation. The assessment undertaken here aims to put broad parameters around the issue and to identify whether it is worthwhile to progress with that study.

The approach we have taken allows for commentary on possible benefits, and formulation of conclusions on how significant in dollar terms those benefits need to be to improve societal welfare.

Table 6.1 outlines the identified costs and benefits associated with implementing the purchase and retirement of unused water licenses. Key considerations for assessing this option are to understand the:

- amount in megalitres (ML) of proposed licences to be purchased.
- foregone use/value of those purchased licences (depending on whether the licences are currently used or proposed to be used), and
- post intervention ecological outcome/benefit.



## 6.1 Evaluated costs and benefits of retiring unused water licences

Cost/benefit	Value	Data source
<b>Costs</b>		
Quantity of purchased licences	<ul style="list-style-type: none"> <li>■ 47 819 ML<sup>a</sup> of proposed licence purchases:               <ul style="list-style-type: none"> <li>– Determined based on water entitlement and usage data</li> </ul> </li> </ul>	Tables A.19 and A.20 and chart A.21 reveal unregulated licences as the key risk where an increase in water use could occur if these sleeper licences were activated.
Foregone value of purchased licences	<ul style="list-style-type: none"> <li>■ \$1 000 per mL value of foregone value:               <ul style="list-style-type: none"> <li>– NSW \$/ML entitlement trade data available at <a href="http://www.bom.gov.au/water/dashboards/#/water-markets/">www.bom.gov.au/water/dashboards/#/water-markets/</a></li> </ul> </li> </ul>	The estimated cost of acquiring the licences is equal to the foregone value. The estimated licence entitlement, multiplied by the market entitlement \$/ML trade price, has been used as a proxy for the estimated foregone marginal benefit of the acquired water. Note, this assumes the price paid for water is equal to the willingness to pay for additional water.
<b>Benefit</b>		
Post intervention ecological outcome	<ul style="list-style-type: none"> <li>■ Qualitative discussion.</li> </ul>	<p>The description states that, “the sleeper licenses pose a significant risk to environmental flows and, potentially, water supply during a drought, if these licenses were to be activated.”</p> <p>We have evaluated water entitlement, allocation, and licence usage time series data, as well as undertaken a literature review to determine:</p> <ul style="list-style-type: none"> <li>■ what risk to environmental flows sleeper licences cause, and</li> <li>■ the likelihood of water supply shortages.</li> </ul>

<sup>a</sup> Equals 100 per cent of unregulated entitlements within the Manning Catchment. This is likely to be an upper bound, as not all unregulated entitlements may be required for purchase. A sensitivity in which the cost of purchasing 50 per cent (23 910 ML) of the Manning River Catchment entitlement purchases was also modelled.

Source: CIE.

## Results

### Costs

The cost of purchasing the licences can be estimated by the price of the permanent trades of water. The Bureau of Meteorology has collected data on the trades of water throughout Australia. Table 6.2 presents data on the volume and number of trades over the past decade. There are a significant number of trades where the reported value is zero or \$1/ML, therefore, we have grouped the data into two categories.

## 6.2 Entitlement trades, unregulated North Coast (number and volume)

Year	Zero or \$1/ML trades		Greater than \$1/ML	
	Trades	Quantity	Trades	Quantity
.	no.	ML	no.	ML
2010	2	102	4	90
2011	4	227	4	168
2012	29	740	7	759
2013	53	2 102	6	87
2014	49	1 885	15	247
2015	66	3 952	20	1 653
2016	113	4 929	32	2 083
2017	130	4 145	39	2 932
2018	136	4 539	41	4 733
2019	121	5 215	53	4 844
2020	139	7 096	13	332
2021	37	1 499	0	0

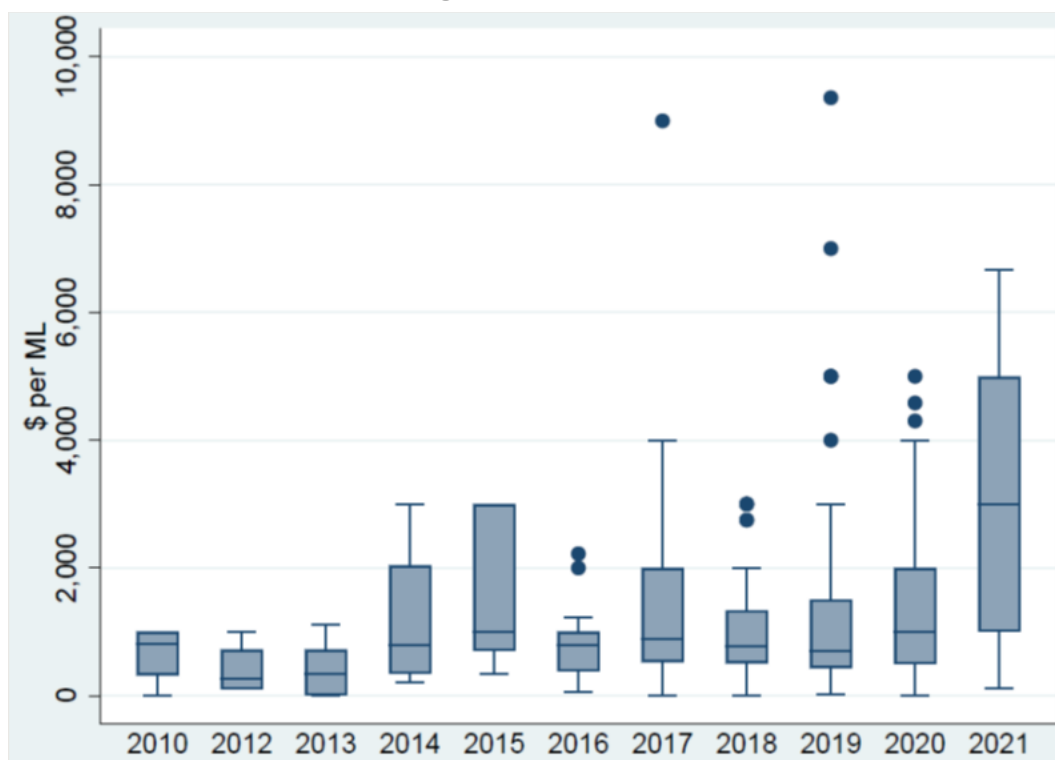
<http://www.bom.gov.au/water/dashboards/#/water-markets/map>

Chart 6.3 summarises the entitlement (i.e. permanent) trades on the unregulated rivers on the NSW North Coast over the past decade), excluding trades of zero or \$1/ML.<sup>70</sup> The boxplots are a useful way to examine the trading data.<sup>71</sup> The median price is likely to be the best measure of the price which the Council would need to purchase the licences. The median price in 2020 was \$1 000/ML.

<sup>70</sup> There was only 5 recorded water trades in the Lower and Mid-Manning water sources over the past decade. No price was recorded for these trades.

<sup>71</sup> A description of box-plots is available at the following site  
<https://towardsdatascience.com/understanding-boxplots-5e2df7bcbd51>

### 6.3 Entitlement trade price, unregulated North Coast



Note: For the 2015 year, the box plot appears truncated due to some large trading values (greater than \$10 000/ML). The chart excludes trade prices less than \$2/ML.

Data source: <http://www.bom.gov.au/water/dashboards/#/water-markets/map>

There is significant variability in the trading price. In part this could reflect regional differences but it would also reflect water availability. Water allocation data, however, indicates that for the Lower North Coast region domestic and stock, local water utility and major water utility water access licence holders have received 100 per cent of their allocation in 2016-2020 which does not explain the differences in the trading price over this period.

Rainfall data for the Taree region was also extracted to understand whether the trading price was influenced by climate (chart 6.4). In 2020, when rainfall was higher than average, the water trading price was above 2019 which experienced lower rainfall. The specific relationship between water trading prices and allocation/climate is likely to be complex and challenging to establish without a detailed study.

#### 6.4 Rainfall patterns (Taree Airport)



Data source:

[http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p\\_nccObsCode=136&p\\_display\\_type=dailyDataFile&p\\_startYear=&p\\_c=&p\\_stn\\_num=060141](http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=060141)

For the purposes of this study, a trading price of around \$1,000/ML is reasonable, although it could be lower (or higher) than this amount based on the specific circumstance. If the Council purchased 47 819 ML of licence entitlement then this equates to around \$48 million. We assume an equal amount of entitlement is purchased over 10 years, resulting in an annual cost of \$4.8 million and present value cost of \$36 million.

#### *Benefits*

Council envisages that the benefits of purchasing the sleeper licences are expected to result in improved environmental flows.

The benefits (in terms of increased environmental flows) of purchasing sleeper licences is challenging to estimate. Modelling to establish the link between the changes in flows and resulting changes in river health and ecological outcomes is required.<sup>72</sup> Further, this needs to be seen in a probabilistic context, reflecting that there is only some chance that sleeper licences would be activated in the future. In the event that the licences are activated in the future, then there would be no gains from purchasing the licences.

Further, any licence purchases need to be undertaken in the context of potential future changes to the Water Sharing Plans (WSPs) for the region. The WSPs currently include rules on pumping which relate to the flow in the river. If changes to the WSPs, for example, limit the daily volume of water pumped at a point, then this would constrain future extraction even if some sleeper licences were activated in the future. Therefore, it is

<sup>72</sup> The following report discusses some of the linkages between changes to flows and economic outcomes: The CIE 2011, 'Economic benefits and costs of the proposed Basin Plan – Discussion and Issues, July, <https://www.mdba.gov.au/sites/default/files/archived/basinplan/1500-economic-benefits-cie.pdf>

not clear how purchases of sleeper licences would result in increased environmental flows (above current levels) under a future WSP rules.

### ***Results conclusion***

We conclude there is limited value buying-back sleeper licences at this stage. Our conclusion is based on:

- the estimated high cost (more than \$35 million (present value)) to purchase sleeper licence, and
- uncertainty around how the purchase of sleeper licences would result in increased environmental flows (above current levels) under a future WSP rules.

Council could reconsider this issue after the future WSPs are remade.

There is also value in delaying any purchase decision until there is an indication of an environmental flow ‘problem’ if sleeper licences are activated. Given the expected cost of purchasing/retiring these licences there is value in delaying the decision, rather than pre-emptively acting where the ‘problem’ may not eventuate.

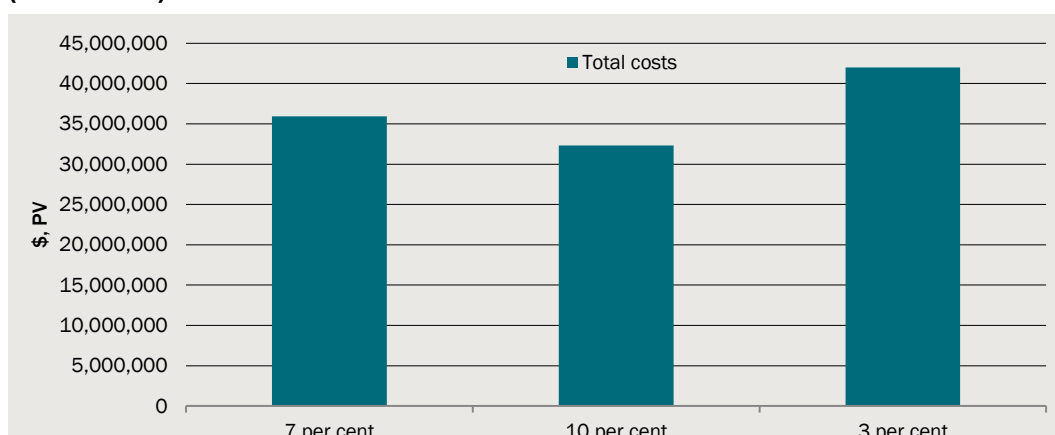
## ***Sensitivity analysis***

### ***Discount rate***

Chart 6.5 shows the sensitivity present value costs using 3 per cent and 10 per cent discount rates. The present value costs:

- decrease to 32.3 million under the 10 per cent discount rate, and
- increase to \$42.0 million under the 3 per cent discount rate.

### **6.5 Discount rate sensitivity analysis - Purchase and retire unused water licences (action 2.05)**



Note: Present value calculated using over 30-years.

Data source: CIE

### *Cost and quantities*

Table 6.6 shows the estimated costs of purchasing different amounts of sleeper licences ranges from \$54 million to \$4.5 million (present value) under different quantity and unit price scenarios:

- 1 Purchasing lower amounts of identified sleeper licence entitlements than the assumed 47 819 ML of entitlements (equal to 100 per cent of identified sleeper licences)
  - a) 35 864 ML (75 per cent of sleeper licences)
  - b) 23 910 ML (50 per cent of sleeper licences), and
  - c) 11 955 ML (25 per cent of sleeper licences)
- 2 Purchasing sleeper licences at:
  - a) a higher price of \$1 500 per ML, and
  - b) lower price of \$500 ML, compared to the \$1 000 per ML used in the central case.

### **6.6 Cost and quantities sensitivity –Purchase and retire unused water licences (action 2.05)**

Scenario	Quantity of purchased entitlements	Price	Cost	Present Value
	ML	\$/ML	\$	\$, PV
Central case	47 819	1 000	47 819 000	35 937 089
Lower quantity 1 (75%)	23 910	1 000	23 909 500	17 968 545
Lower quantity 2 (50%)	11 955	1 000	11 954 750	8 984 272
Higher price	47 819	1 500	71 728 500	53 905 634
Lower price	47 819	500	23 909 500	17 968 545
Lower quantity (75%) 1 & higher price	23 910	1 500	35 864 250	26 952 817
Lower quantity (75%) 1 & lower price	23 910	500	11 954 750	8 984 272
Lower quantity 2 (50%) & higher price	11 955	1 500	17 932 125	13 476 408
Lower quantity 2 (50%) & lower price	11 955	500	5 977 375	4 492 136

Source: CIE

## *7 Maintain stormwater quality improvement devices, Wingham Wetland upgrade, (action 2.08)*

### *Description*

The management option reads,

“Implement a systematic approach to maintaining Storm Water Quality Improvement Devices across the Manning River Catchment.”

This work involves three standalone components:

- 1 Refurbish 5 proprietary Stormwater Quality Improvement Devices to achieve their full working capacity by 2022.
- 2 Incorporate Water Sensitive Design devices in the MCC asset management system by 2023 and implement the monitoring, maintenance and renewal program.
- 3 Complete a report on the upgrade of Wingham Wetland, including feasibility, budget and scope of works. Implement resulting actions by 2025.

Further clarification from Council<sup>73</sup> advises the economic assessment is to only evaluate the upgrade of Wingham Wetland.

### *Evaluation parameters*

The benefits have been qualitatively evaluated against the estimated quantified costs. This has allowed us to comment on possible benefits, as well as formulating conclusions on how significant in dollar terms those benefits need to be to improve societal welfare.

Table 7.1 outlines the costs and benefits associated with the upgrade of Wingham Wetland. Key considerations for assessing this option are to understand the:

- increase in capital and maintenance costs, and
- the improvement to ecological outcomes directly attributable to the rehabilitated Wingham Wetland.

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<sup>73</sup> Email from Council to David Wainwright on 9 April 2021.



## 7.1 Evaluated costs and benefits of upgrading Wingham Wetland

Cost/benefit	Value	Data source
<b>Costs</b>		
Wingham wetland size and type	1 hectare of heavy vegetation consisting of: <ul style="list-style-type: none"> <li>■ ski-jump Gross Pollutant Trap</li> <li>■ 2 x primary ponds</li> <li>■ 2 x secondary ponds, and</li> <li>■ 1 x Tertiary pond.</li> </ul>	Council email to David Wainwright dated 9 April 2021.
Wetland refurbishment cost	\$250 000	An indicative estimate by Salients, based on a desktop site inspection, site description and comparison to historical wetland refurbishments.  Council advises a similar refurbishment at Townsend Wetland costed \$382 784.32. However, site specific differences between the two sites means this cost is not directly transferrable to Wingham Wetland refurbishment.
Annual maintenance costs	<ul style="list-style-type: none"> <li>■ \$10 000 per hectare (\$2013) in years 1 and 2; \$3 000 (\$2013) per hectare 2 years post commissioning</li> <li>■ \$11 387 per hectare (\$2021) in years 1 and 2; \$3 416 (\$2021) per hectare 2 years post commissioning</li> </ul>	Hunter G, (2013). <sup>74</sup> Experience in Western Sydney has shown that the highest maintenance costs are experienced early in the life of the wetland when weed invasion is at its highest but drops considerably as the vegetation establishes and competition from unwanted species reduces.
<b>Benefit</b>		
Post intervention ecological outcome	Qualitative discussion	Literature review.

Source: CIE.

<sup>74</sup> Hunter G, (2013), 'Constructed wetlands design construction and maintenance considerations', in Paul, S. (Ed). 2013, 'Workbook for managing urban wetlands in Australia'. 1<sup>st</sup> edn. (Sydney Olympic Park Authority), ebook <https://www.sopa.nsw.gov.au/Resource-Centre/WET-eBook-Workbook-for-Managing-Urban-Wetlands-in-Australia>, ISBN 978-0-9874020-0-4, pp. 223-249.

## Results

### Costs

The total present value costs are shown in table 7.2. Wetland refurbishment costs account for 81 per cent of total present value costs and riparian maintenance costs account for the remaining 19 per cent.

#### 7.2 Present value costs – Wingham Wetland upgrade (action 2.08)

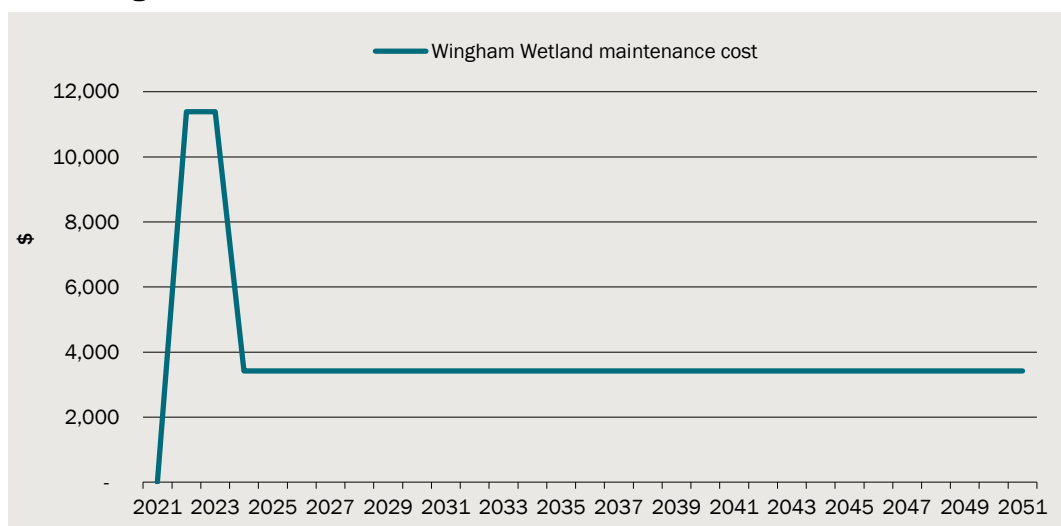
Cost item	Amount
	\$2021, PV
Wingham Wetland refurbishment cost	250 000
Wingham Wetland maintenance cost	56 801
<b>Total</b>	<b>\$306 801</b>

Note: Present value calculated using a 7 per cent discount rate over 30-years.

Source: CIE

Annual maintenance costs are shown in chart 7.3. Annual maintenance costs are assumed to occur the year post implementation.

#### 7.3 Wingham Wetland annual maintenance costs



Note: Annual maintenance costs are assumed to occur the year post implementation.

Data source: CIE

### Benefits

Hunter G, (2013)<sup>75</sup> outlines the following advantages of constructed wetlands:

<sup>75</sup> Hunter G, (2013), 'Constructed wetlands design construction and maintenance considerations', in Paul, S. (Ed). 2013, 'Workbook for managing urban wetlands in Australia'. 1st edn. (Sydney Olympic Park Authority), ebook <https://www.sopa.nsw.gov.au/Resource-Centre/WET->

- can be designed to control a range of pollutants common in stormwater runoff
- potential to provide specific aquatic and terrestrial flora and fauna habitats, and
- potential flood mitigation.

Further, Council advise the Wingham Wetland upgrade incorporates a ski-jump Gross Pollutant Trap (GPT).<sup>76</sup> GPTs are purpose-built structures that use physical processes to trap solid waste such as litter and coarse sediment. They are commonly used as the primary treatment because they mostly remove large, non-biodegradable pollutants. Given this, the Wingham Wetland upgrade also has the potential to reduce downstream litter and sediment.

The CIE 2019<sup>77</sup> estimates the following WTP values to reduce the proportion of noticeable litter in Victorian public spaces:

- \$1.36 per month to reduce the proportion of public spaces with noticeable litter from 25 per cent to 20 per cent
- \$4.54 per month to reduce the proportion of public spaces with noticeable litter from 25 per cent to 20 per cent
- \$2.88 per month to reduce the amount of drink container litter in public spaces from moderate to low, and
- \$2.62 per month to reduce the amount of other litter in public spaces from moderate to low.

The Victorian Stormwater Committee (1999) identify the potential dis-benefit of mosquito-borne diseases associated with constructed wetlands.<sup>78</sup> As such, the potential for Mosquito control should be considered as part of the Wingham Wetland design and monitoring.

### ***Results conclusion***

We conclude upgrading Wingham Wetland should proceed to further development, subject to undertaking and publishing a robust design objective. The published design objective allows for performance evaluation against estimated costs and anticipated benefits throughout Wingham Wetland's lifecycle.

Our conclusion is based on:

- the relatively lower cost of \$0.3 million (present value) to implement this option, compared to other management options discussed in this report, and
- the likely range of benefits the constructed wetland may achieve, including:

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eBook-Workbook-for-Managing-Urban-Wetlands-in-Australia, ISBN 978-0-9874020-0-4, pp. 231.

<sup>76</sup> Council email to David Wainwright dated 9 April 2021.

<sup>77</sup> The CIE 2019, 'Willingness to pay for reduced litter in Victoria: Stated Preference Research Prepared for the Victorian Department of Environment, Land, Water and Planning', May, unpublished.

<sup>78</sup> Victorian Stormwater Committee (1999), 'Urban Stormwater: Best Practice environmental Management Guidelines,' CSIRO publishing, <https://www.publish.csiro.au/book/2190/>

- water quality improvement
- water borne pollutant removal
- litter removal, and
- the potential for disbenefits, namely mosquito borne diseases, which should be considered as part of the Wingham Wetland design and ongoing monitoring/maintenance.

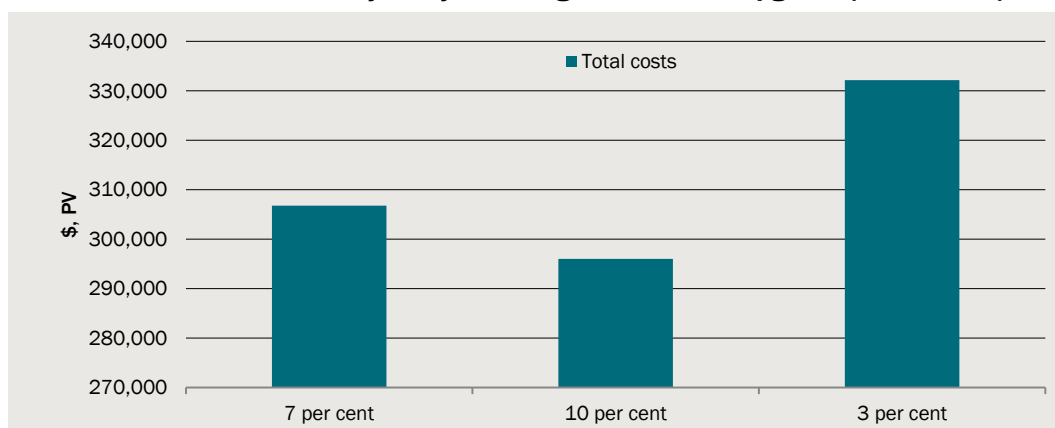
## Sensitivity analyses

### Discount rate

Chart 7.4 shows the sensitivity present value costs using 3 per cent and 10 per cent discount rates. The present value costs:

- decrease to \$0.296 million under the 10 per cent discount rate, and
- increase to \$0.332 million under the 3 per cent discount rate.

#### 7.4 Discount rate sensitivity analysis - Wingham Wetland upgrade (action 2.08)



Note: Present value calculated using over 30-years.

Data source: CIE

### Cost sensitivity

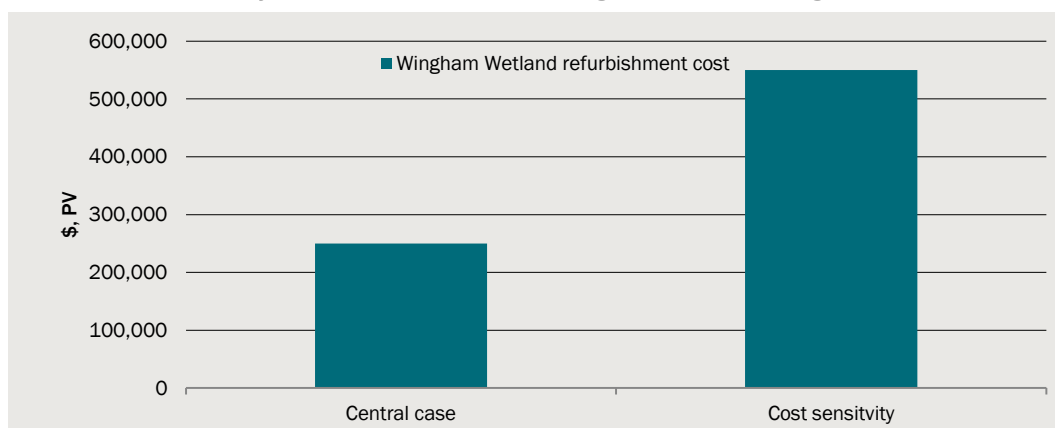
Chart 7.5 shows the sensitivity present value costs using the following cost inputs, as advised by Council:<sup>79</sup>

- \$550 000 Wingham Wetland implementation cost, consisting of:
  - \$500 000 for Wingham Wetland refurbishment, and
  - \$50 000 for a feasibility and budget study prior to implementation, and
- \$100 000 maintenance cost per annum<sup>80</sup>.

<sup>79</sup> Council requested cost sensitivity. Email from David Wainwright to CIE 29/4/2021

<sup>80</sup> Commences the year post wetland implementation.

### 7.5 Cost sensitivity present value costs – Wingham Wetland upgrade (action 2.08)



Data source: CIE

The present value costs increase from \$0.3 million under the central case, to \$1.8 million under the cost sensitivity.

Table 7.6 shows annual maintenance costs account for 81 per cent of total costs under the cost sensitivity, compared to 31 per cent under the central case.

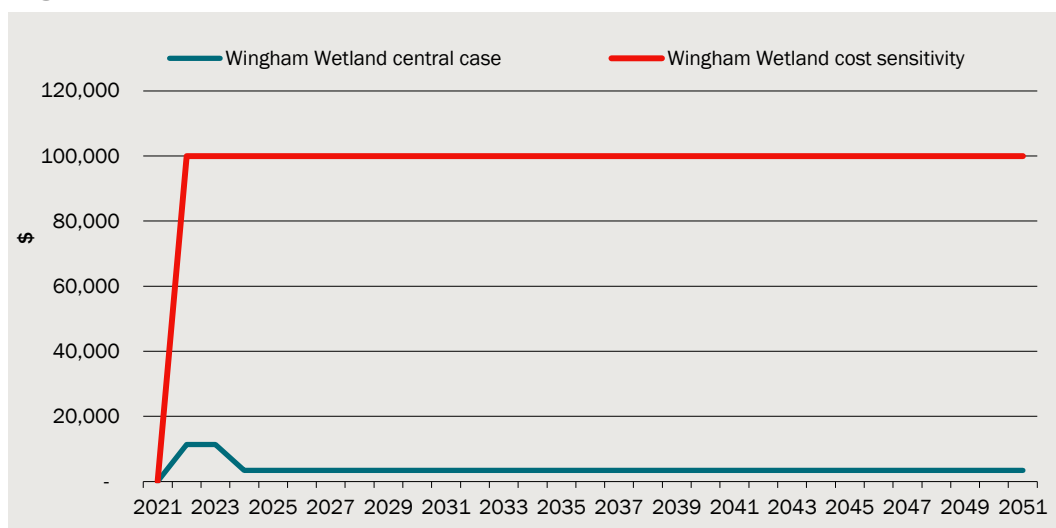
### 7.6 Cost sensitivity present value cost proportions – Wingham Wetland upgrade (action 2.08)

Cost item	Central case	Cost sensitivity	Central case proportion of total costs	Cost sensitivity proportion of total costs
	\$2021, PV	\$2021, PV	Per cent	Per cent
Wingham Wetland refurbishment cost	250 000	550 000	81	31
Wingham Wetland maintenance cost	56 801	1 240 904	19	69
<b>Total</b>	<b>306 801</b>	<b>1 790 904</b>	<b>100</b>	<b>100</b>

Source: CIE

Chart 7.7 compares annual maintenance costs between the central case (teal line) and cost sensitivity (red line), confirming maintenance costs have the greatest impact on total present value costs.

### 7.7 Cost sensitivity comparison of annual maintenance costs - Wingham Wetland upgrade (action 2.08)



Data source: CIE

## 8 *Remediating fish passages (action 4.01)*

### *Description*

The management option reads,

“Address 10 priority sites and/or re-connect 200 km of fish passage by removing or re-designing priority barriers identified in the audit by DPI-Fisheries.”

An audit of barriers to fish passage was conducted by DPI Fisheries, which identified and prioritised 194 constructed barriers in the Manning catchment.<sup>81</sup> Structures included road crossings, floodgates and three weirs. Of these, 23 have been rectified to restore fish passage, including weirs on the Lansdowne River and Cedar Party Creek. Reconnecting fish passage is a sub-action under Action 2.4 of the Marine Estate Management Strategy<sup>82</sup> (MEMS), which will re-establish resilient coastal floodplains and connectivity within coastal catchments.

DPI Fisheries advise the following high priority sites shown in figure 8.1, which, if removed, would significantly improve fish passage:

- Brett Trail Road causeway on the Barnard River, resulting in 361km of upstream fish passage gains.
- Hicks Lane on the Cooplacurripa River resulting in 163km of upstream fish passage gains.
- Duffys Forest Road on Rowleys River resulting in 39 km of upstream fish passage gains.
- Cells River Road on Rowleys River, resulting in 54 km of upstream fish passage gains.

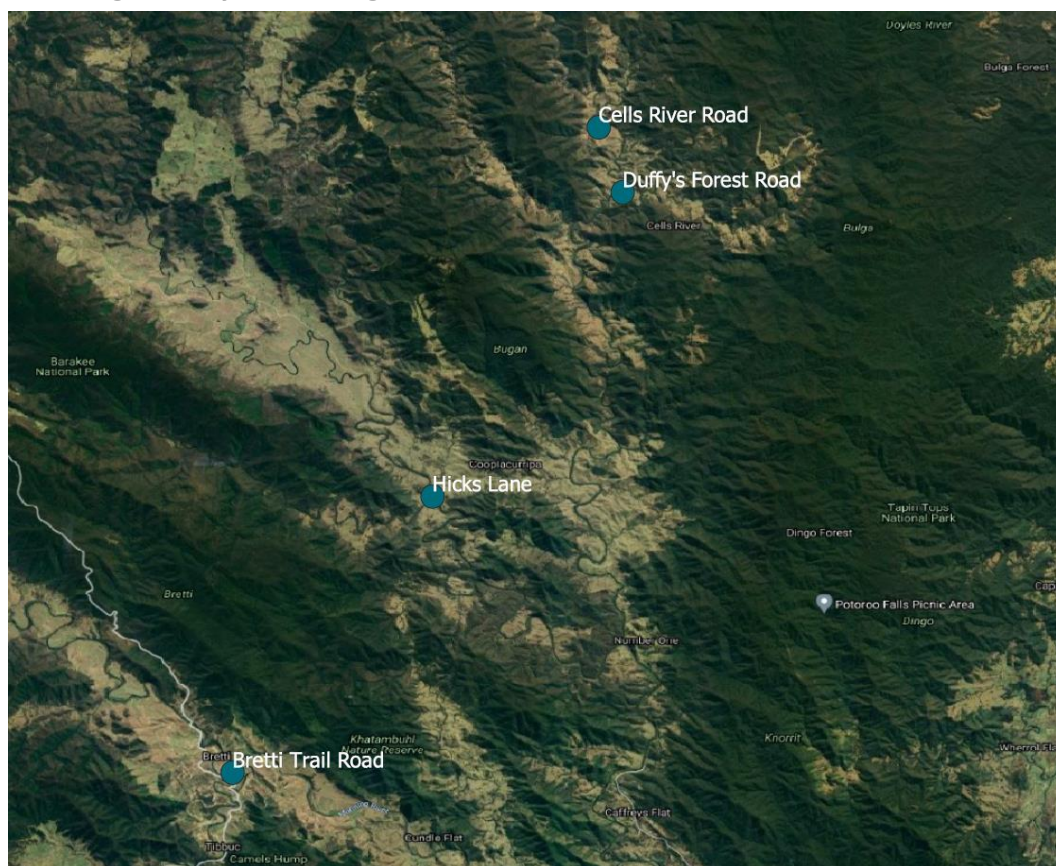
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<sup>81</sup> NSW Government 2006, ‘Reducing the impact of road crossings on aquatic habitat in coastal waterways – Hunter/Central Rivers, NSW. Report to the New South Wales Environmental Trust. NSW Department of Primary Industries’,  
[https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf)

<sup>82</sup> NSW Government 2018, ‘NSW Marine Estate Management Strategy 2018-2028’, Marine Estate Management Authority,  
[https://www.marine.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0007/815596/Marine-Estate-Management-Strategy-2018-2028.pdf](https://www.marine.nsw.gov.au/__data/assets/pdf_file/0007/815596/Marine-Estate-Management-Strategy-2018-2028.pdf)



## 8.1 High priority fish passage remediation locations



Note: Teal circles indicate High priority fish passage remediation locations.

Data source: Email from DPI Fisheries to MidCoast Council dated 24 March 2021

Refer to table A.23 and figures A.25 to A.28 for further details on the high priority sites.

The required effort is led by DPI Fisheries, according to their policy, research and regulations. MidCoast Council would be the project manager on structures owned by Council, while opportunities to work with private landholders will also be explored.

### *Evaluation parameters*

We have qualitatively evaluated the benefits for this option against estimated quantified costs. This approach has allowed us to comment on possible benefits, and to formulate conclusions on how significant in dollar terms those benefits need to be to improve societal welfare.

Table 8.2 outlines the costs and benefits associated with remediating fish passage. Key considerations for assessing this option are:

- what fish passage remediation actions will be undertaken, and where in the catchment these will occur, including an assessment of the extent of fish habitat that is reconnected by removing barriers.
- the capital and maintenance costs of the proposed remediation works, and

- the marginal improvement to fish health and productivity directly attributable to undertaking the proposed actions.

## 8.2 Evaluated costs and benefits of remediating fish passages

Cost/benefit	Value	Data source
<b>Costs</b>		
Capital costs	<ul style="list-style-type: none"> <li>▪ \$337 000 (\$2018); \$348 972 (\$2021) per fish passage remediation</li> <li>– Cost includes design &amp; management, site establishment, foundations, bridge construction and finishing works, plus demolition of existing causeway</li> <li>– assumes works undertaken close to an urban centre and therefore no travel costs.</li> <li>▪ \$20 00 (\$2021) per fish passage remediation for REF and plant/fauna survey</li> </ul>	<p>Discussions with DPI fisheries.<sup>a</sup></p> <p>Cost estimates for previous fish passage remediation works undertaken with the Hunter/Central Rivers is also available in DPI Fisheries 2009, 'Bringing Back the Fish Project reports'<sup>83</sup> and shown in table 8.3.</p> <p>DPI Fisheries note the structures listed in table 8.3 may not be optimal for this management action. Site-specific evaluation is required to determine the most appropriate fish passage remediation strategy.</p>
Maintenance costs per site	<ul style="list-style-type: none"> <li>▪ \$10 000 per annum</li> </ul>	<p>Assumption. Maintenance requirements include:</p> <ul style="list-style-type: none"> <li>▪ Annual bridge deck inspection</li> <li>▪ 2 yearly structural inspection</li> <li>▪ level 2 inspection every 5 years (checking underlying bridge components), and</li> <li>▪ damage inspection and debris removal after every significant rainfall event.</li> </ul>
<b>Benefit</b>		
Post intervention ecological outcome	Qualitative discussion	Literature review

<sup>a</sup> DPI Fisheries advise they prefer bridges to be implemented for fish passage remediation sites at locations with current culvert structures.

Source: CIE.

<sup>83</sup> DPI Fisheries 2009, 'Bringing Back the Fish Project reports', Appendix B Hunter Central Rivers Parts 1 and 2, <https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/bringing-back-the-fish-project-reports>, <https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/bringing-back-the-fish-project-reports>

### 8.3 Previous fish passage road crossing remediation actions implemented in the Hunter Central Rivers

Road crossing remediation site	Remediation works	Cost
		\$2010
Locketts Crossing, Coolongolook River, Locketts Crossing Road, Wallis Lakes	<ul style="list-style-type: none"> <li>■ Causeway tidal barrage (40 m wide)</li> <li>■ Partial-width rock-ramp fishway, with low-flow channel leading to large box culvert</li> </ul>	132 402
Clarksons Crossing, Wallamba River, Old Pacific Highway, Wallis Lakes	<ul style="list-style-type: none"> <li>■ Obsolete tidal barrage that limited saline ingress</li> <li>■ Full removal of concrete causeway and regrading of remaining cobble material to reinstate the upstream water level for upstream irrigators</li> </ul>	67 191
Flaggy Crossing, Wang Wauk River, Old Pacific Highway, Wallis Lakes	<ul style="list-style-type: none"> <li>■ Obsolete tidal barrage that limited saline ingress</li> <li>■ Full removal of concrete causeway and revegetation of adjacent banks</li> </ul>	8 914
Stantons Crossing, Gloucester River, Stantons Lane, Manning Catchment	<ul style="list-style-type: none"> <li>■ Bed control causeway crossing</li> <li>■ Insertion of partial-width rock-ramp fishway with low-flow channel</li> </ul>	34 233
Hortons Crossing, Gloucester River, Faulkland Road, Manning Catchment	<ul style="list-style-type: none"> <li>■ Bed control causeway crossing</li> <li>■ Insertion of partial-width rock-ramp fishway with low-flow channel</li> </ul>	35 957
Obsolete Crossing, Manning River, Off Curricabark Road, Manning Catchment	<ul style="list-style-type: none"> <li>■ Obsolete crossing made redundant from historic road realignment</li> <li>■ Channel spanning bedrock control structures upstream of crossing</li> <li>■ Full removal</li> </ul>	7 744

Source: NSW Government 2010, 'Bringing Back the Fish Project reports', Appendix-B-Hunter-Central-Rivers-part-1.pdf; [https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0009/634617/5.-Appendix-B-Hunter-Central-Rivers-part-2.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/634617/5.-Appendix-B-Hunter-Central-Rivers-part-2.pdf)

## Results

### Costs

We have estimated costs for this management action assuming three<sup>84</sup> of the four high priority fish passage remediation sites will be undertaken by removing the existing culvert

<sup>84</sup> Hicks Lane on the Cooplacurripa River, Duffys Forest Road on Rowleys River and Cells River Road on Rowleys River.

structures and replaced with road bridges. DPI Fisheries advise<sup>85</sup> remediating Hicks Lane, Duffys Forest Road and Cells River Road will result in a total of 256 kilometres of upstream fish passage gains, which is similar to the 200 km target stated in the management option.

We have not attempted to estimate a cost for the Bretti Trail Road Causeway due to significant uncertainty on the appropriate remediation strategy and bespoke capital and maintenance costs. DPI Fisheries advise<sup>86</sup> a site-specific evaluation is required for the Bretti Trail Road causeway to determine an appropriate fish passage remediation strategy, due to the existing culverts 40 metre width, which in turn, thinly spreads water within the river channel over a wide area of the crossing. Fish are subsequently unable to pass the culvert until it is submerged. Potential remediation actions include:

- cutting out a section and adding in a bridge deck or box culverts – both would be very prone to flood damage as they would need to be low to tie back into the rest of the road, or
- removing and relocating the entire causeway downstream to a narrower section of the river.

The total estimated present value costs are shown in table 8.4. We assume the capital costs are spread over three years, with one fish passage site remediated each year. Maintenance costs are assumed to commence the year post remediation.

Fish passage remediation costs account for 75 per cent of total present value costs and maintenance costs account for the remaining 25 per cent.

#### 8.4 Present value costs – Remediating fish passages (action 4.01)

Cost item	Amount
	\$2021, PV
Capital costs	1 036 080
Maintenance cost	344 845
<b>Total</b>	<b>1 380 925</b>

Note: Present value calculated using a 7 per cent discount rate over 30-years.

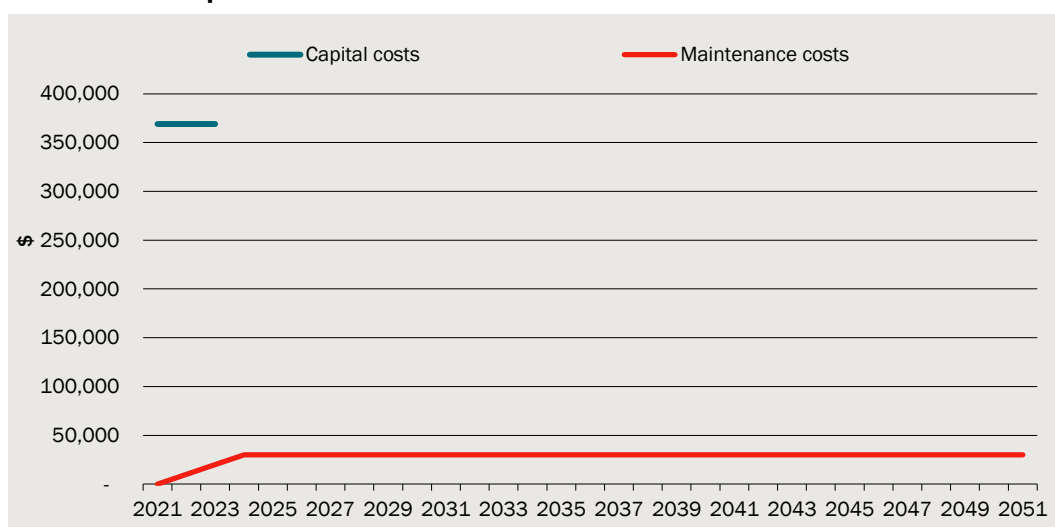
Source: CIE

<sup>85</sup> Email from DPI Fisheries to MidCoast Council 24 March 2021.

<sup>86</sup> CIE discussion with DPI Fisheries April 2021.

Annual remediation and maintenance costs are shown in chart 8.5.

### 8.5 Annual capital and maintenance costs



Note: Capital costs are spread over three years, with one fish passage site remediated each year. Maintenance costs commence the year post remediation.

Data source: CIE

### Benefits

Fish and other aquatic species cannot reproduce or build sustainable populations if they cannot migrate or access important spawning habitat. By mitigating river barriers, such as structures included road crossings, floodgates and dams, rivers are allowed to flow naturally remediating fish passage.

There are improvements in river ecosystems to be had from removing river barriers. Fish passage refers to a fish's or other aquatic species ability to migrate across an aquatic system among all habitats necessary to complete their life cycle.<sup>87</sup> Therefore, removing in-stream barriers or replacing them with structures that allow fish to pass increases total fish population in the rivers and leads to improvement in the fish species diversity.<sup>88</sup>

An increase in sustainable fish population improve scope for recreational and commercial fishing. The diverse species also increases amenity value of rivers. By rejuvenating the natural ecosystem, it creates opportunity for benefits to accrue through increased tourism for communities that lay near the rivers and waterways.<sup>89</sup> Barrier removal can also help to manage and reduce flooding.

<sup>87</sup> U.S. Fish and Wildlife Service. 'What is Fish Passage?'. <https://www.fws.gov/fisheries/fish-passage/what-is-fish-passage.html>.

<sup>88</sup> King, S et al. 2016, 'Benefits transfer and the aquatic environment: An investigation into the context of fish passage improvement', Journal of Environmental Management, Volume 183, Part 3, 1 December 2016, Pages 1079-1087

<sup>89</sup> King, S et al. 2016, 'Benefits transfer and the aquatic environment: An investigation into the context of fish passage improvement', Journal of Environmental Management, Volume 183, Part 3, 1 December 2016, Pages 1079-1087

### ***Results conclusion***

We conclude remediating fish passage, with the goal of remediating 10 structures and/or 200km of fish passage, should be subject to further site-specific evaluation. Although DPI Fisheries undertook a fish passage assessment in 2006, it is unclear what 10 fish passage sites will be targeted for remediation, specific works undertaken and their associated costs.

We have evaluated three of the top four sites, as advised by DPI Fisheries in recent communication to Council, based on the premise that remediating these sites will achieve close to the stated 200 km target. We also assumed each site will have a culvert structure replaced by a bridge, as per DPI Fisheries preferred approach. Site specific evaluation is required to confirm culvert replacement with a bridge is appropriate for these sites, including discussions and agreement with Transport for NSW, as well as to confirm costs.

The highest priority site identified by DPI Fisheries in recent communication with Council, Brett Trail, will achieve the greatest fish passage remediation of 361 kilometres. However, a site-specific evaluation is required to determine the most appropriate works and associated costs and was therefore not included in the evaluation.

Further, technology and management practices have evolved since the 2006 DPI Fisheries fish passage audit<sup>90</sup> and implementation of some subsequent fish passage remediation works described in the bringing back the fish report.<sup>91</sup>

## ***Sensitivity analysis***

### ***Discount rate***

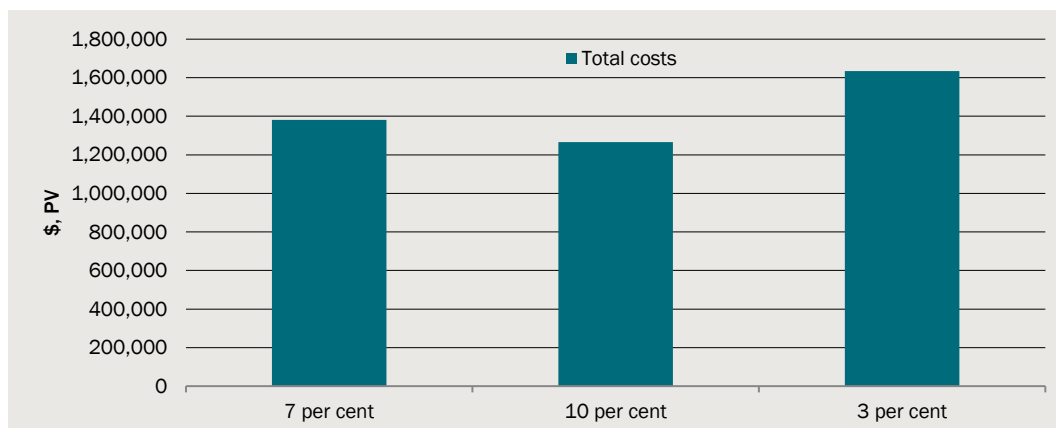
Chart 8.6 shows the sensitivity present value costs using 3 per cent and 10 per cent discount rates. The present value costs:

- decrease to \$1.3 million under the 10 per cent discount rate, and
- increase to \$1.6 million under the 3 per cent discount rate.

<sup>90</sup> NSW Government 2006, 'Reducing the impact of road crossings on aquatic habitat in coastal waterways – Hunter/Central Rivers, NSW. Report to the New South Wales Environmental Trust. NSW Department of Primary Industries', [https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf)

<sup>91</sup> NSW Government 2010, 'Bringing Back the Fish Project reports', Appendix-B-Hunter-Central-Rivers-part-1.pdf; [https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0009/634617/5.-Appendix-B-Hunter-Central-Rivers-part-2.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/634617/5.-Appendix-B-Hunter-Central-Rivers-part-2.pdf)

### 8.6 Discount rate sensitivity analysis - Remediating fish passages (action 4.01)



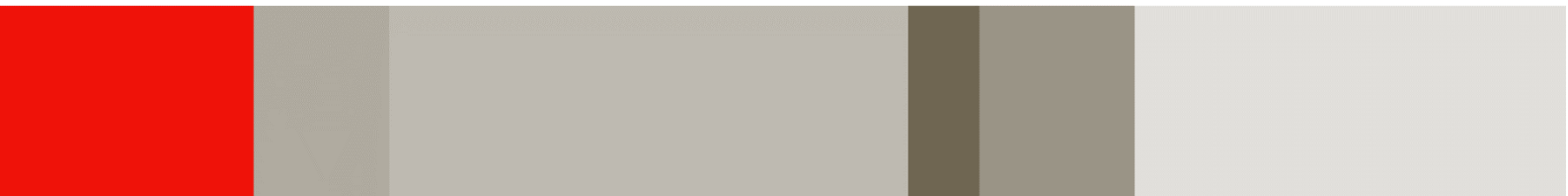
Note: Present value calculated using over 30-years.

Data source: CIE



## PART III







### Conclusion and recommendation



## 9 Conclusion and recommendations

Table 9.1 outlines our conclusions after undertaking the economic evaluation.

### 9.1 Conclusion and recommendations

Management option	Costs	Benefits	Net benefit	BCR	Recommendations
	\$m, PV	\$m, PV	\$m, PV		
2.01	7.3	21.8	14.5	2.97	
2.02	0.5	1.6	1.2	3.43	
2.03	9.9	12.3	2.3	1.23	
2.05	35.9	Not quantified	N/A	N/A	
2.08	0.3	Not quantified	N/A	N/A	
4.01	1.4	Not quantified	N/A	N/A	

Note: Present values discounted using a 7 per cent discount rate over 30 years.

Source: CIE

**KEY:**      **Proceed to next steps**     **Undertake further site-specific evaluation**     **Re-consider** 

- **Proceed to next steps for management options 2.01, 2.02 and 2.08.** These management options demonstrate a high likelihood of net benefits and improved societal welfare.
- **Undertake further site-specific evaluation for management options 2.03 and 4.01.** These management options demonstrate a potential for net benefits and improved societal welfare, however site-specific information is required on key costs/benefits.
  - management option 2.03:
    - ... assumes rehabilitation and maintenance costs based on annual Local Land Service budgets, which may not be representative for the specific program of works for this option, and
    - ... incorporates high variance in quantified (willingness-to-pay) WTP estimated benefits of undertaking riparian vegetation, with WTP estimate values dependent on rehabilitation site location and respondent location.
    - ... we have estimated benefits using the Hawkesbury-Nepean catchment (the highest WTP estimate). When we use the mid-point WTP estimates, the results indicate -\$2.5 million net benefits and a BCR of 0.75.
  - management option 4.01:

- ... despite DPI Fisheries undertaking a fish passage assessment in 2006<sup>92</sup>, it is unclear what fish passage sites will be targeted for remediation, specific works to be undertaken and their associated costs.
- **Reconsider/delay management option 2.05** due to its high cost, unclear environmental benefits under future Water Sharing Plan (WSP) rules, and value in delaying the decision, rather than pre-emptively acting where the ‘problem’ may not eventuate.

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<sup>92</sup> NSW Government 2006, ‘Reducing the impact of road crossings on aquatic habitat in coastal waterways – Hunter/Central Rivers, NSW. Report to the New South Wales Environmental Trust. NSW Department of Primary Industries’,  
[https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf)

## *A Further details and background for Manning River Catchment Management options*

### ***Acid sulphate soil management actions (action 2.01)***

The management action description reads,<sup>93</sup>

“Implement key priority ASS management actions from the Manning River Floodplain Prioritisation Study 2021<sup>94</sup>, including:

reinstate 1 550 ha of coastal wetlands on public and private land subject landholder agreement.  
audit, upgrade or replace Council floodgates within the Lower Manning Floodplain and add them to MCC's Asset Management Program.”

Further clarification from Council advised the economic assessment for this management action is limited to: <sup>95</sup>

- total of 655 hectares of area to be rehabilitated into a coastal wetland in the lower Manning floodplain, at a cost of \$6.3 million, and
- capital work upgrades for two Council owned floodgates located in the lower Manning floodplain (refer to the teal circles in figure A.1 for locations).

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<sup>93</sup> Taken from the excel spreadsheet, ‘Copy of ListofFinal\_Proceed\_ManagementActions\_Queries\_Answered’, provided by Salients on 9 April 2021

<sup>94</sup> Pietsch, TJ, Daley, JS, Stout, J, Brooks, A. 2019, ‘Riparian and Shoreline Vegetation in the Manning, Great Lakes and Karuah Catchments: Report to Hunter Local Land Services’, Precision Erosion & Sediment Management Research Group, Griffith University

<sup>95</sup> Email from Council to David Wainwright on 9 April 2021

### A.1 Location of Council owned floodgates for capital upgrades



Note: Teal circles indicate Council floodgate locations.

Data source: MidCoast Council, 'MCC Council-owned Manning Floodgates list.xls'

MidCoast Council commissioned the University of NSW's Water Research Laboratory (WRL) to produce the Lower Manning River Drainage Remediation Action Plan in 2016<sup>96</sup>. We understand the findings of the 2016 study were updated by DPI in 2021. The information below is from the 2016 Action Plan. The Action Plan recommends various on ground works to reduce or eliminate acid drainage from 15 sub catchments.

The highest priority areas for ASS remediation are:

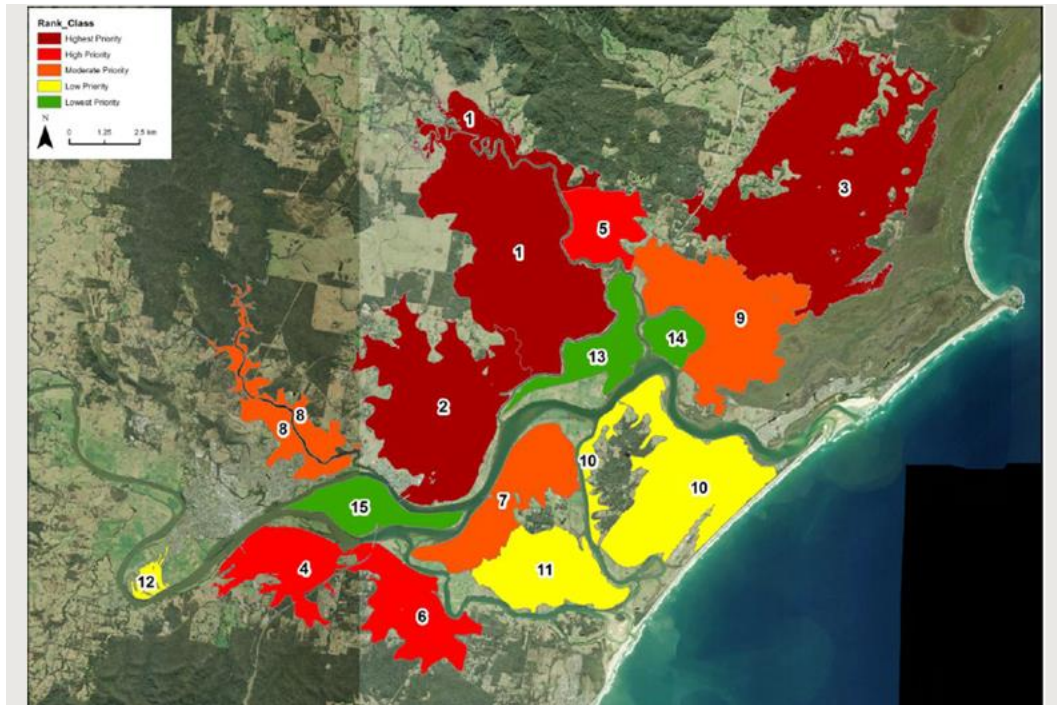
- Moto (labelled 1 in figure A.2)
- Ghinni Ghinni (labelled 2 in figure A.2), and
- Big Swamp (labelled 3 in figure A.2).

These three areas contribute 81 per cent of the overall acid drainage risk, assessed by WRL in the lower Manning wetlands. Ghinni Ghinni Creek, Dickenson's Creek, Lansdowne River and the northern arm of the Manning River downstream of Dumaresq Island are the highest acid impacted surface water areas in the estuary.<sup>97</sup>

<sup>96</sup> W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

<sup>97</sup> W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. ii

## A.2 Priority catchment ASS remediation sites



Data source: Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. v

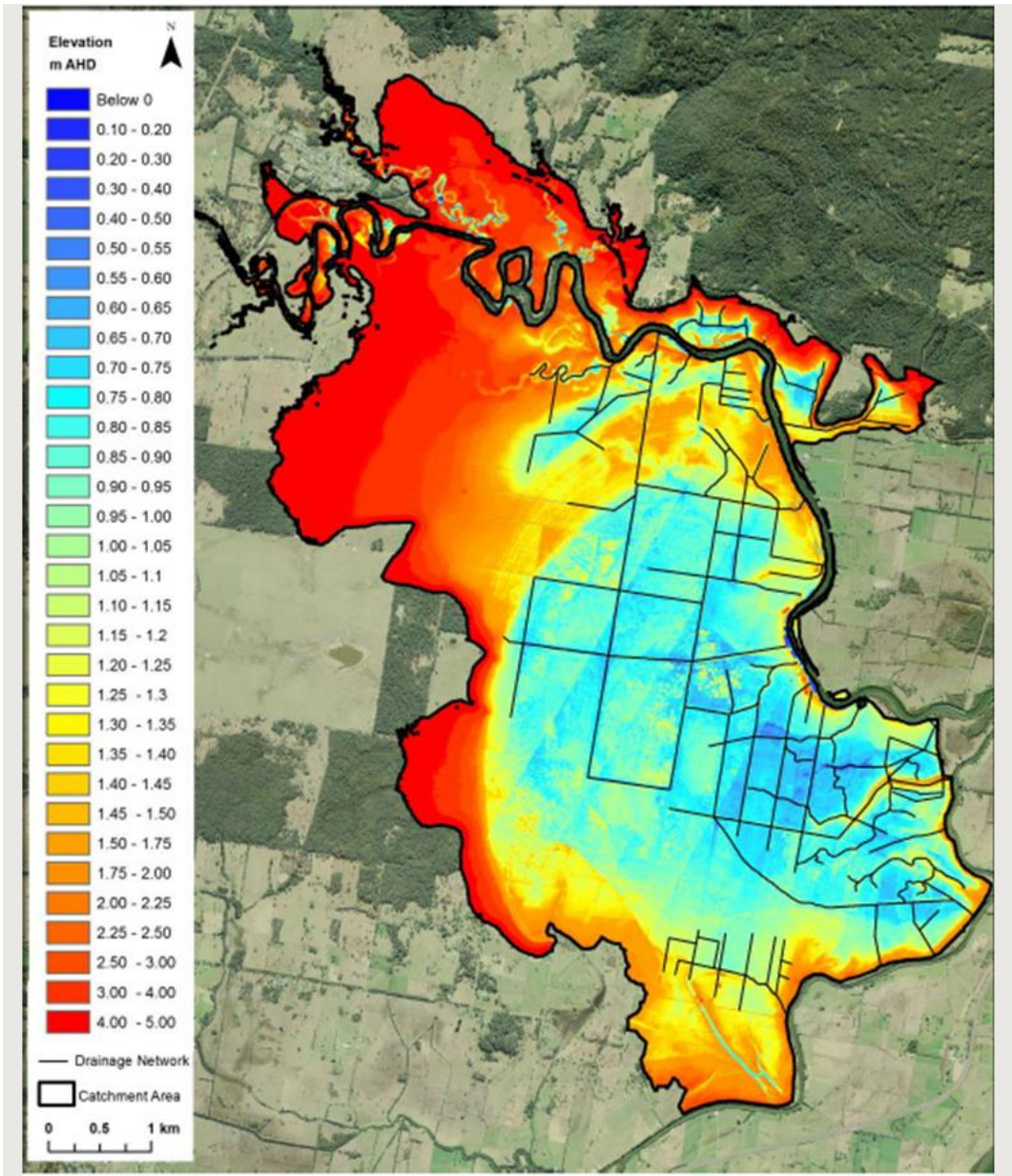
### *High Priority ASS Area 1: Moto*

The Moto ASS Priority Area is a large backswamp and associated floodplain located in the northern-central part of the Manning River estuary. The Moto ASS Priority Area covers approximately 3 500 ha below 5 m AHD. Most of the Moto floodplain is situated below 1 m AHD (figure ).<sup>98</sup>

<sup>98</sup> W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 31



**A.3 High Priority ASS Area 1: Moto location, elevation and drainage network**



Data source: Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 31

Table A.4 lists the identified preliminary ground works and indicative costs for the Moto ASS Priority area, across 16 sub-catchment drainage units, shown in figure A.5.



#### A.4 Moto Sub-Catchment Remediation Action Plans

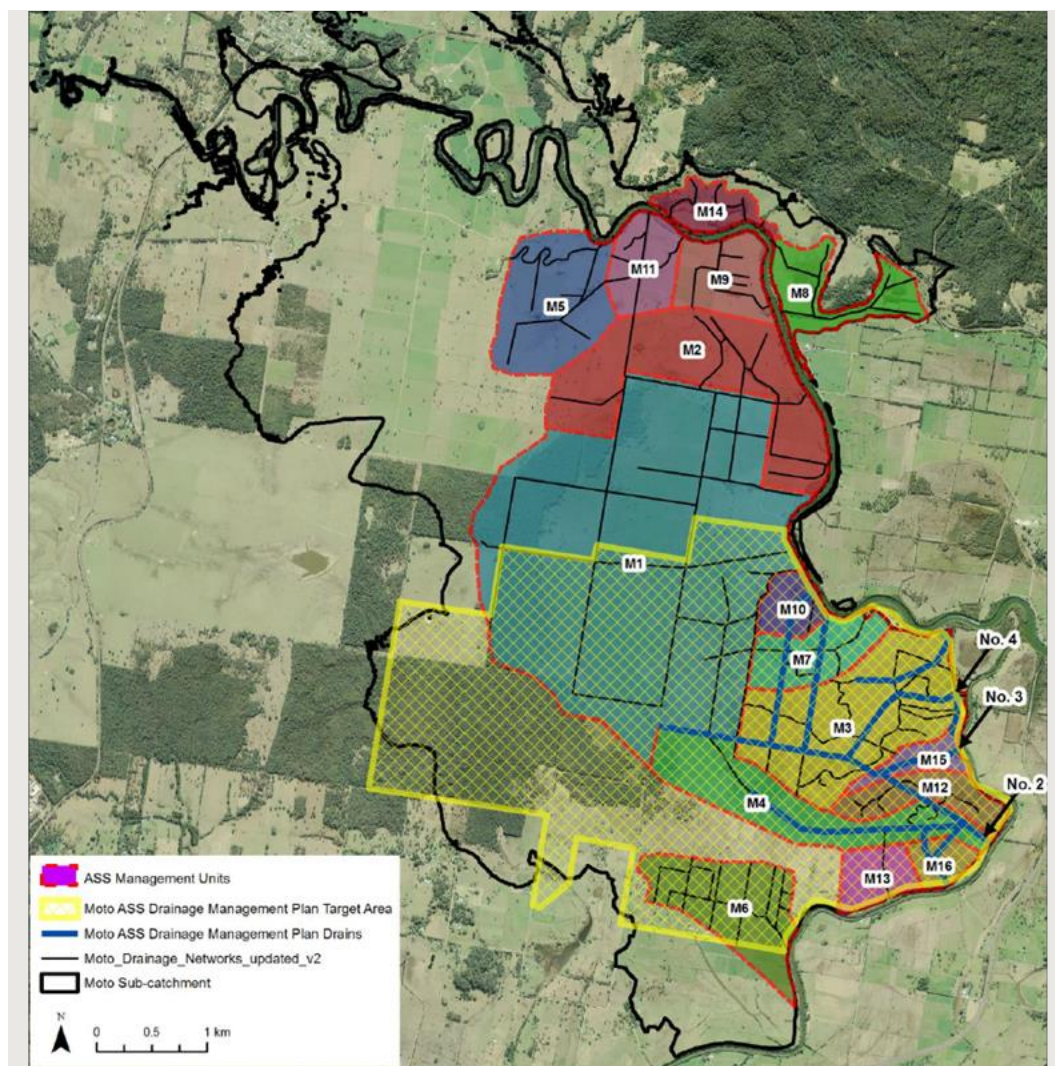
Priority Management Areas	Priority rank	Short Term Management Option	Short Term Design Cost	Short Term Implementation Cost	Short Term Annual Maintenance Cost	Long Term Management Option	Long-Term Indicative Cost
			\$2016	\$2016	\$2016		\$2016
M1	Highest	A + C	10 000	30 000 + 5 000	5 000	F	15 000 + environmental offset <sup>a</sup>
M3	Highest	A + C	10 000	30 000 + 5 000	5 000	F	15 000 + environmental offset <sup>a</sup>
M15	Highest	A + C	10 000	15 000 + 5 000	5 000	F	15 000 + environmental offset <sup>a</sup>
M8	High	A + B	10 000 + 15 000	15 000 + 120 000	5 000	E	15 000 + environmental offset <sup>a</sup>
M7	High	A + C	10 000	15 000 + 5 000	5 000	F	15 000 + environmental offset <sup>a</sup>
M2	High	A + C	10 000	15 000 + 5 000	5 000	F	15 000 + environmental offset <sup>a</sup>
M14	High	A + B	10 000 + 15 000	15 000 + 60 000	5 000	F	15 000 + environmental offset <sup>a</sup>
M6	High	A	10 000	30 000	5 000	E	15 000 + environmental offset <sup>a</sup>
M9	Moderate	A + B	10 000 + 15 000	15 000 + 100 000	5 000	D	15 000 + environmental offset <sup>a</sup>
M11	Moderate	A + B	10 000 + 15 000	30 000 + 80 000	5 000	D	15 000 + environmental offset <sup>a</sup>
M10	Moderate	A + C	10 000	15 000 + 5 000	5 000	F	15 000 + environmental offset <sup>a</sup>
M5	Moderate	A + B	10 000 + 15 000	15 000 + 180 000	5 000	D	15 000 + environmental offset <sup>a</sup>
M4	Low	A + C	10 000	15 000 + 5 000	5 000	E	15 000 + environmental offset <sup>a</sup>
M12	Low	C	-	-	-	E	15 000 + environmental offset <sup>a</sup>
M16	Low	A + C	10 000	15 000 + 5 000	5 000	E	15 000 + environmental offset <sup>a</sup>
M13	Low	A + C	10 000	15 000 + 5 000	5 000	E	15 000 + environmental offset <sup>a</sup>

<sup>a</sup> Environmental Offset may include detailed design, land acquisition, drain infilling, drain reshaping, fencing and/or infrastructure removal/modification.

Note: A = Floodgate Management B = Drain Reshaping C = Community Engagement and Training D = Wet Pasture E = Partial Rehabilitation F = Full Rehabilitation G = Groundwater Manipulation H = Drop Board Weir I = Preliminary Investigation J = Partial Land Raising K = Acquisition L = Adaptive Land Management

Source: Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 31

## A.5 High Priority ASS Area 1: Moto sub-catchments



Data source: Data source: Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 33

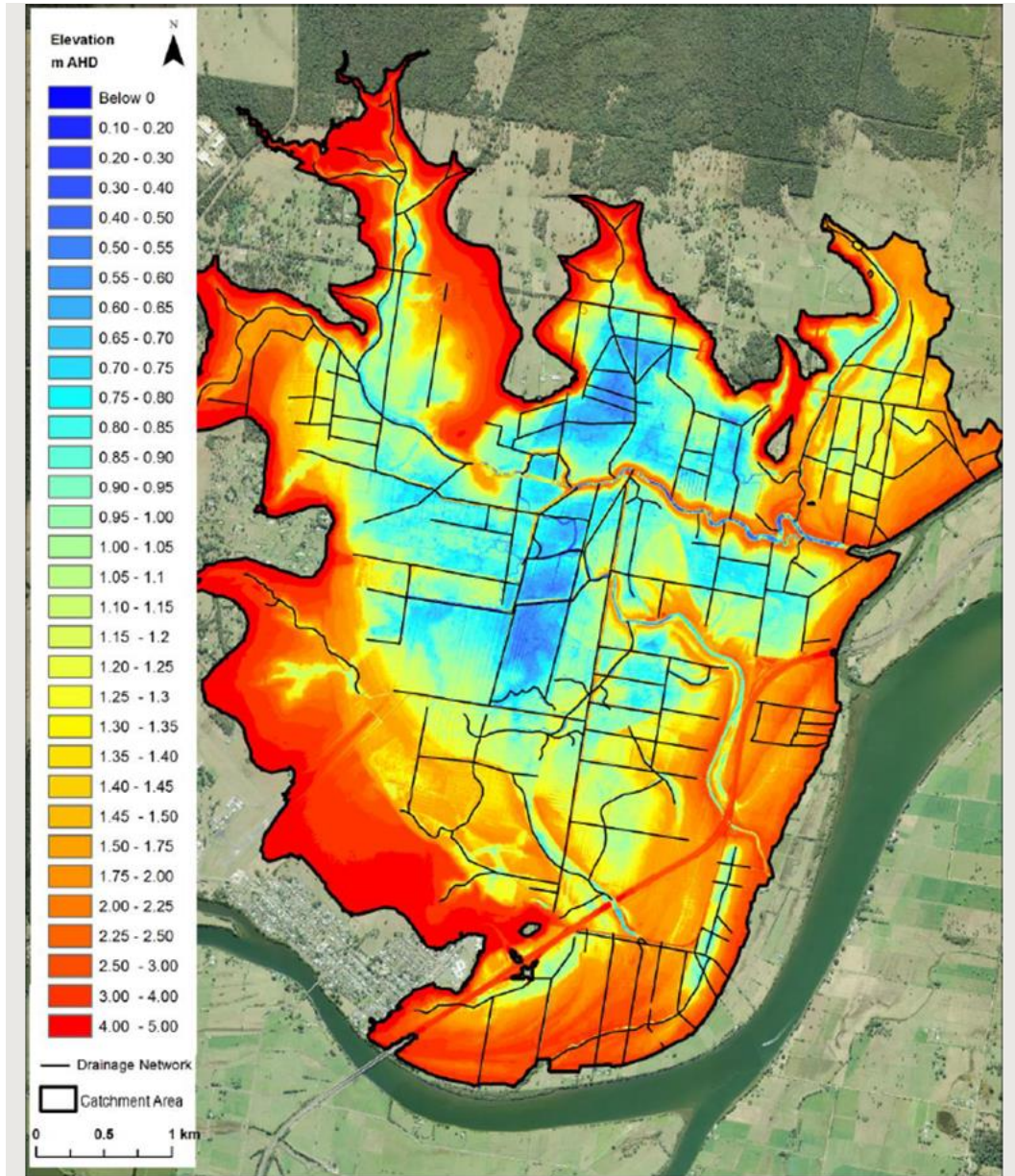
## High Priority Area 2: Ghinni Ghinni (Dickensons Creek)

The Lower Manning River Drainage Remediation Action Plan Ghinni Ghinni ASS Priority Area is in the central part of the Manning River floodplain, covering



approximately 2 500 ha below 5 m AHD, with a large portion of the floodplain situated below 1 m AHD (figure A.6).<sup>99</sup>

#### A.6 High Priority ASS Area 2: Ghinni Ghinni location, elevation, and drainage network



Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 39

<sup>99</sup> W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 39

The Lower Manning River Drainage Remediation Action Plan states,

“The Dickensons Creek and its levee divides the northern and southern parts of Ghinni Ghinni floodplain into two separate hydrological units below approximately 2 to 4 m AHD. Most of the floodplain drains through an extensive, inter-connected drainage network that discharges acidic surface waters into Dickensons Creek. Dickensons Creek discharges into the Manning River estuary via Ghinni Ghinni Creek. Paddys Creek drains a portion of the southern floodplain and discharges directly into the Manning River.”<sup>100</sup>

Table A.7 lists the identified preliminary ground works. Indicative costs for the Ghinni Ghinni ASS Priority area, across 17 sub-catchment drainage units are shown in figure A.8.

### A.7 Ghinni Ghinni Sub-Catchment Remediation Action Plans

Priority Management Areas	Priority rank	Short Term Management Option	Short Term Design Cost	Short Term Implementation Cost	Short Term Annual Maintenance Cost	Long Term Management Option	Long-Term Indicative Cost
			\$2016	\$2016	\$2016		\$2016
G8	Highest	A + B	10 000 + 15 000	15 000 + 120 000	5 000	L + F	20 000 + environmental offset <sup>a</sup>
G1	Highest	B	15 000	40 000	-	L + J + F	20 000 + design/flood assessment + environmental offset <sup>a</sup>
G12	Highest	A + B	10 000 + 15 000	15 000 + 320 000	5 000	L + F	20 000 + environmental offset <sup>a</sup>
G15	High	A	10 000	15 000	5 000	H + E	50 000 + environmental offset <sup>a</sup>
G2	High	A + C	10 000	15 000 + 5 000	5 000	L + J + F	20 000 + design/flood assessment + environmental offset <sup>a</sup>
G14	High	A + C	10 000	15 000 + 5 000	5 000	F	15 000 + environmental offset <sup>a</sup>
G5	High	A + B	10 000 + 15 000	15 000 + 60 000	5 000	L + J + F	20 000 + design/flood assessment + environmental offset <sup>a</sup>

<sup>100</sup> W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 39

Priority Management Areas	Priority rank	Short Term Management Option	Short Term Design Cost	Short Term Implementation Cost	Short Term Annual Maintenance Cost	Long Term Management Option	Long-Term Indicative Cost
			\$2016	\$2016	\$2016		\$2016
G17	Moderate	B	15 000	40 000	-	L + J + F	20 000 + design/flood assessment + environmental offset <sup>a</sup>
G13	Moderate	C + G	10 000	30 000	5 000	D	15 000 + environmental offset <sup>a</sup>
G11	Low	A	10 000	15 000	5 000	B	15 000 + 320 000
G10	Low	A	10 000	15 000	5 000	E	15 000 + environmental offset <sup>a</sup>
G16	Low	G	10 000	30 000	5 000	D	15 000 + environmental offset <sup>a</sup>
G7	Low	A	10 000	15 000	5 000	-	-
G3	Low	A	10 000	15 000	5 000	-	-
G6	Low	G	10 000	30 000	5 000	-	-
G9	Low	A	10 000	15 000	5 000	-	-
G4	Low	A	10 000	30 000	5 000	-	-

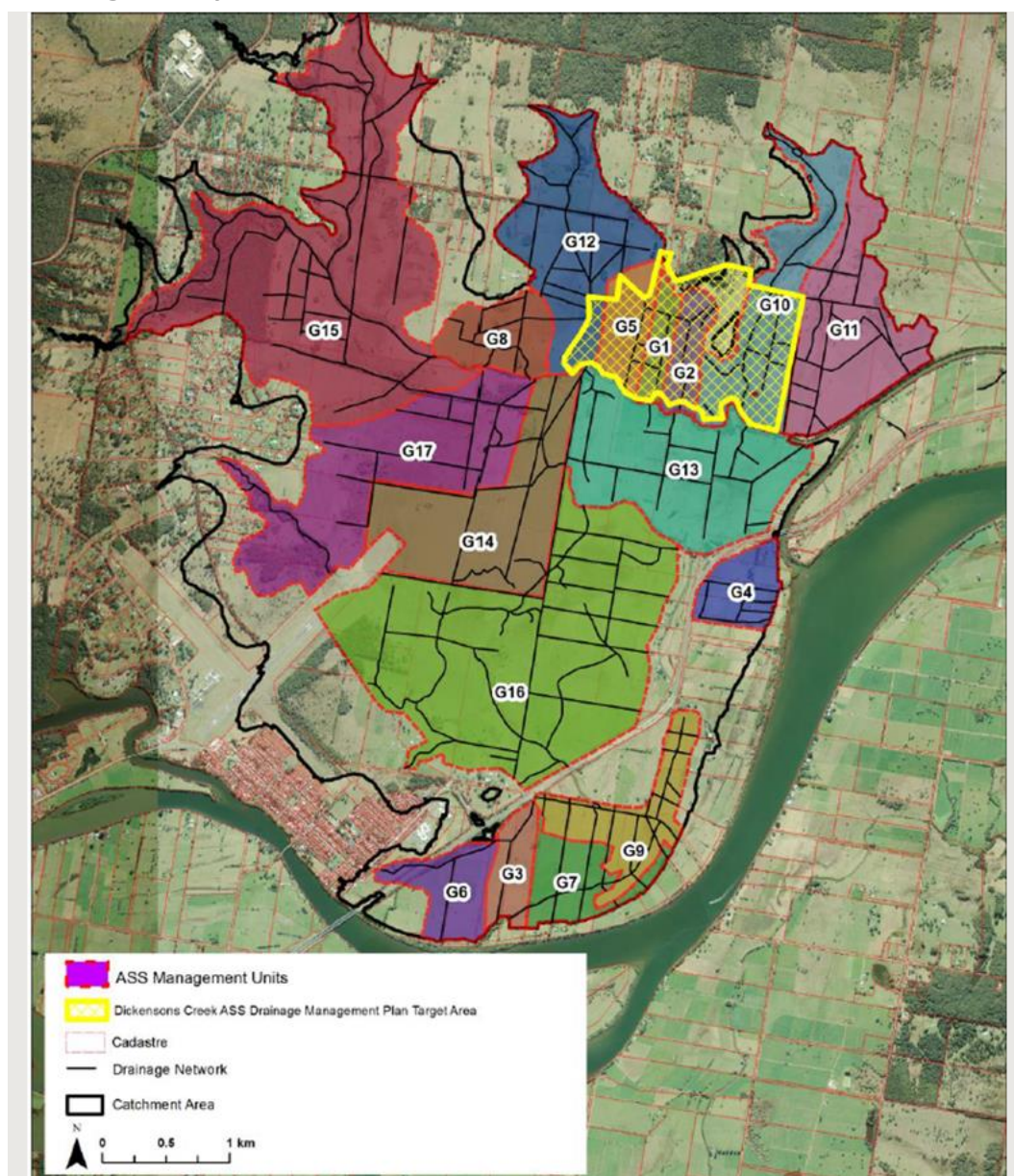
<sup>a</sup> Environmental Offset may include detailed design, land acquisition, drain infilling, drain reshaping, fencing and/or infrastructure removal/modification.

Note: A = Floodgate Management B = Drain Reshaping C = Community Engagement and Training D = Wet Pasture E = Partial Rehabilitation F = Full Rehabilitation G = Groundwater Manipulation H = Drop Board Weir I = Preliminary Investigation J = Partial Land Raising K = Acquisition L = Adaptive Land Management

Source: Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 44



### A.8 High Priority ASS Area 2: Ghinni Ghinni sub-catchments



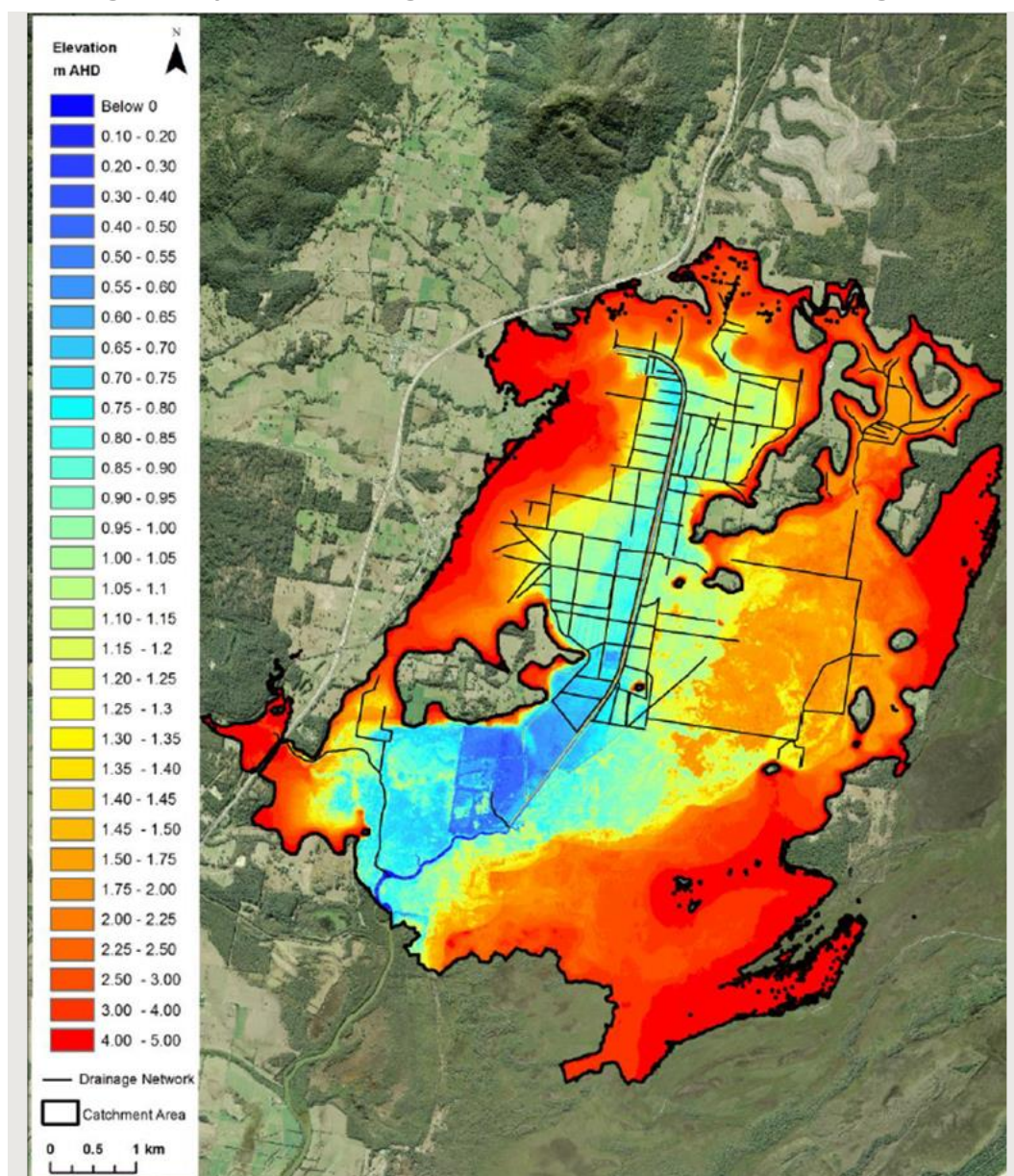
Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 40

### *High Priority Area 3: Big Swamp*

The Big Swamp ASS Priority Area covers 4 400 hectares below 5 m AHD, immediately north of Cattai Wetlands (figure A.9). Pipeclay Canal flows into Cattai Creek, a north bank tributary of the Manning River and is located 15 km upstream of the northern entrance of the Manning River.<sup>101</sup>

<sup>101</sup> W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 46

### A.9 High Priority ASS Area 3: Big Swamp location, elevation, and drainage network



Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 46

Table A.10 lists the identified preliminary ground works and indicative costs for the Big Swamp ASS Priority area, across 12 sub-catchment drainage units, shown in figure A.11.



### A.10 Big Swamp Sub-Catchment Remediation Action Plans

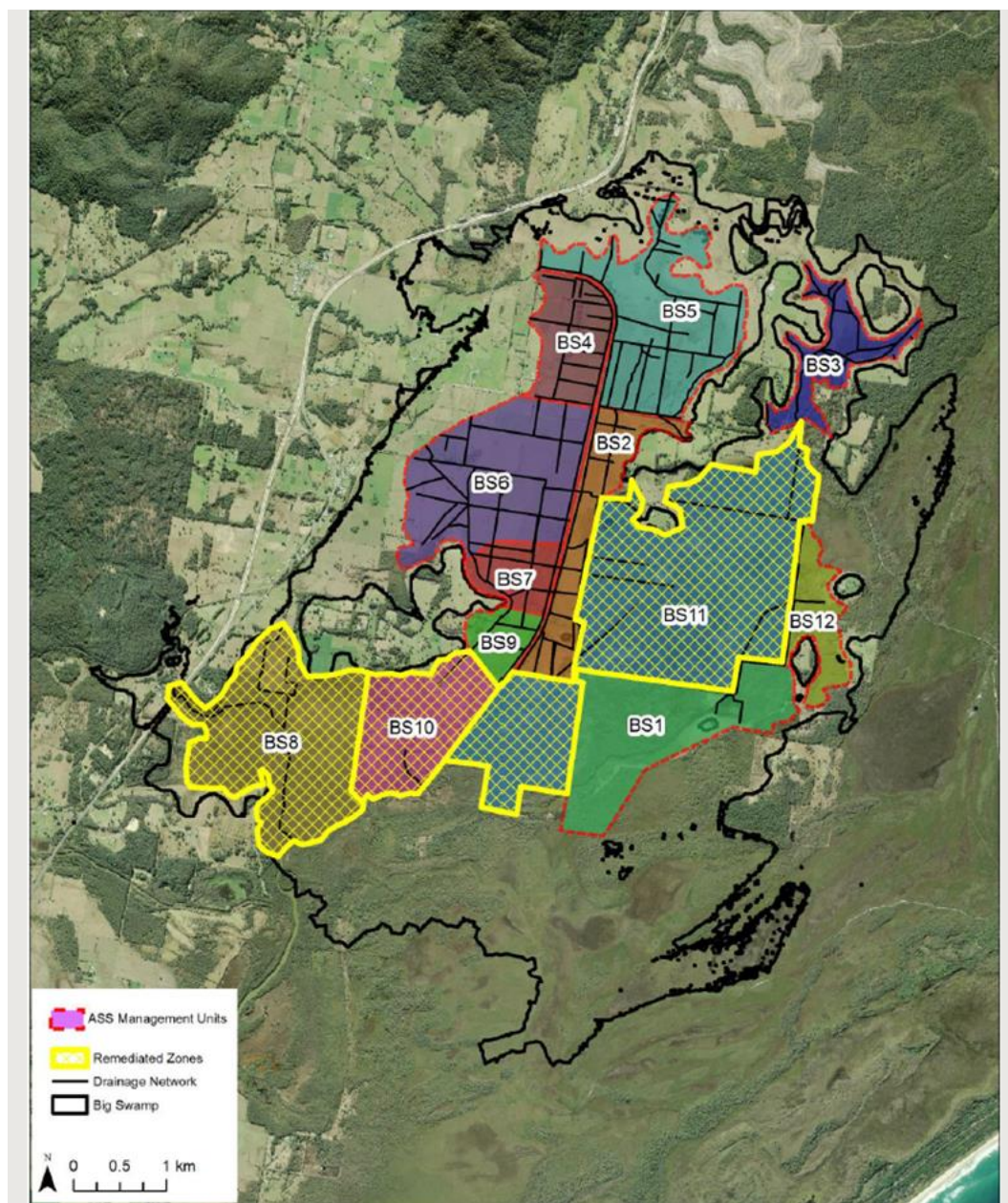
Priority Management Areas	Priority rank	Short Term Management Option	Short Term Design Cost	Short Term Implementation Cost	Short Term Annual Maintenance Cost	Long Term Management Option	Long-Term Indicative Cost
			\$2016	\$2016	\$2016		\$2016
BS5	Highest	G	10 000	30 000	5 000		15 000 + environmental offset <sup>a</sup>
BS9	Highest	K + B	15 000 + 15 000	2 000/ha + 100 000	-		20 000 +
BS2	High	K + B	15 000 + 15 000	2 000/ha + 400 000	-		20 000
BS10	High	-	-	-	-		-
BS7	High	A + B	10 000 + 15 000	15 000 + 150 000	5 000		15 000 + environmental offset <sup>a</sup>
BS6	Moderate	A + B	10 000 + 15 000	30 000 + 500 000	5 000		15 000 + environmental offset <sup>a</sup>
BS11	Moderate	-	-	-	-		15 000 + environmental offset <sup>a</sup>
BS4	Low	A + B	10 000 + 15 000	45 000 + 250 000	5 000		5 000 to 10 000 per year
BS3	Low	I	10 000 to 30 000	-	-		5 000 to 10 000 per year
BS12	Low	I	10 000 to 30 000	-	-		5 000 to 10 000 per year
BS1	Low	I	10 000 to 30 000	-	-		5 000 to 10 000 per year
BS8	Low	B	15 000	20 000 /500m	5 000		15 000 + environmental offset <sup>a</sup>

<sup>a</sup> Environmental Offset may include detailed design, land acquisition, drain infilling, drain reshaping, fencing and/or infrastructure removal/modification.

Note: A = Floodgate Management B = Drain Reshaping C = Community Engagement and Training D = Wet Pasture E = Partial Rehabilitation F = Full Rehabilitation G = Groundwater Manipulation H = Drop Board Weir I = Preliminary Investigation J = Partial Land Raising K = Acquisition L = Adaptive Land Management

Source: Data source: W C Glamore, J E Ruprecht and D S Rayner 2016, 'Lower Manning River Drainage Remediation Action Plan', August, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 44

### A.11 High Priority ASS Area 3: Big Swamp sub-catchments



a

Note:

Data source:

### *Protect and/or rehabilitate coastal wetlands (action 2.02)*

A fine-scale coastal wetland mapping study was completed during Stage 2 of the Manning CMP<sup>102</sup>. Thirteen wetland types totalling 8 906 hectares were mapped across three vegetation formations and six vegetation classes. Wetlands were generally mapped in good/excellent condition (69 per cent). Wetlands in fair condition accounted for 19 per cent of the total area mapped and poor/very poor condition wetlands comprised 12 per cent of the total.<sup>103</sup>

Pressures include agricultural and urban land use; modified hydrology; clearing and fragmentation of vegetation; stock access; climate change; weed and pest invasion; increased nutrients and sediment loads; inappropriate fire regimes and general ignorance of wetland values.

CM SEPP-listed wetlands are a priority for rehabilitation. These are listed below and shown in figure A.12:

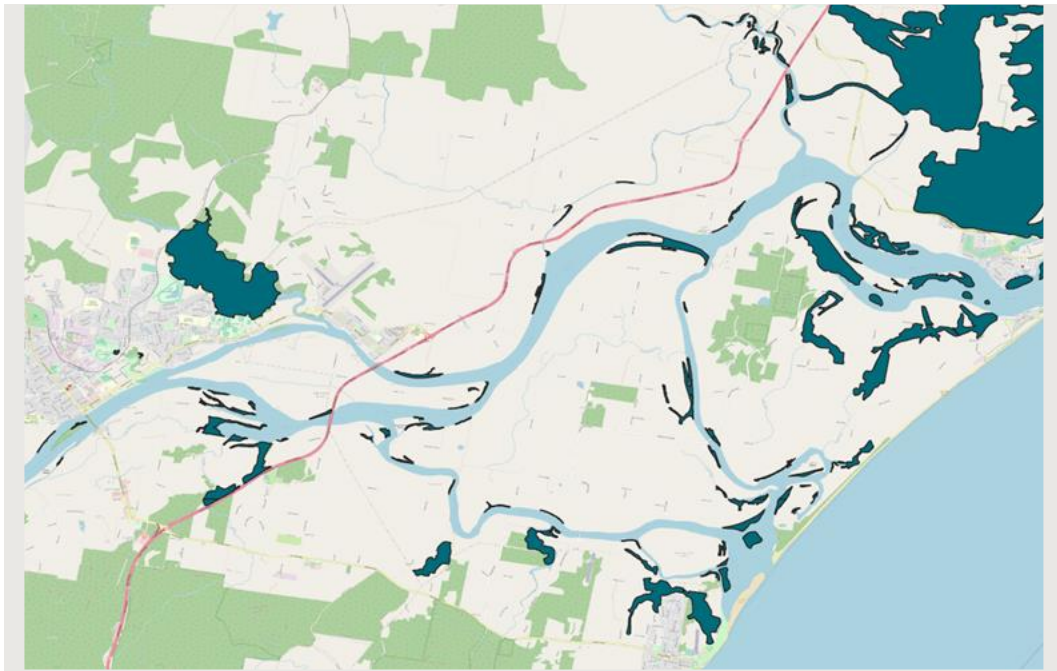
- Mitchells Island (Pelican Bay)
- Oxley Island
- Cabbage Tree Island
- Bohnock
- Pampoolah
- Lower Lansdowne River (Jones and Mamboo islands), and
- Dawson Wetlands.

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<sup>102</sup> Eco Logical Australia 2019, 'Manning River Wetlands Mapping. Prepared for MidCoast Council, July, <https://www.midcoast.nsw.gov.au/files/assets/public/document-resources/council/projects-documents/our-manning-river/manning-coastal-wetlands-mapping-final-report-2019-1.pdf>

<sup>103</sup> Mid Coast Council 2020, 'Scoping Study: Manning River Estuary And Catchment Management Plan: Final', June, p. 26, <https://www.midcoast.nsw.gov.au/files/assets/public/document-resources/council/projects-documents/our-manning-river/manning-cmp-scoping-study-final-june-2020.pdf>

### A.12 Manning River priority Coastal Wetland areas for protection/rehabilitation



Data source: NSW Government 2018, 'State Environmental Planning Policy (Coastal Management) 2018 (Coastal Wetlands)', Department of Planning Industry & environment, <https://www.planningportal.nsw.gov.au/opendata/dataset/state-environmental-planning-policy-coastal-management-2018>

Further to the wetland mapping study, a desktop study completed by the University of New South Wales identified several on-ground management actions aimed at restoring and protecting the environment of coastal wetlands surrounding Pelican Bay. The identified works described in the University of New South Wales study<sup>104</sup> are segregated into three sites (as shown in figure A.13):

- Site 1: Fencing of two areas and the optimisation of a culvert to improve connectivity, plus investigation of connectivity under Beale Avenue and Pelican Bay Road, Mitchell Island.
- Site 2: Opening of floodgates on Millers Creek (Manning Point Road) to increase extent of tidal inundation.
- Site 3: Fencing of an existing 4.7ha wetland finger extending north from Sheather Creek and under Manning Point Road, including construction of an adjacent pathway for stock and culvert extension under Manning Point Road.

<sup>104</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW

The University of New South Wales study<sup>105</sup> recommends that further investigations and landholder/stakeholder discussions be progressed based on the following priority order:

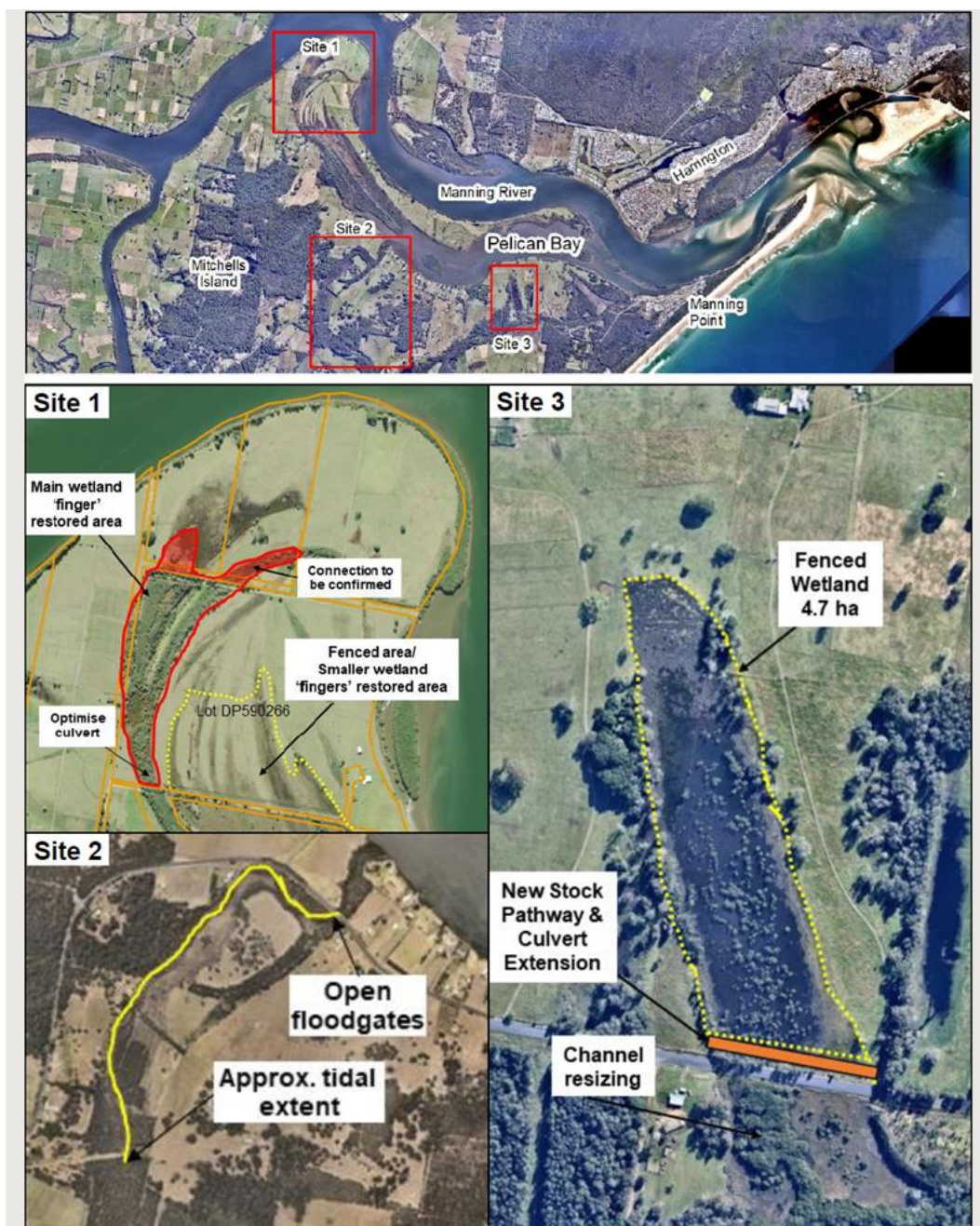
- 1 Sheather Creek wetland (Site 3)
- 2 Millers Creek floodgates (Site 2), and.
- 3 Pelican Bay Road (Site 1).

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<sup>105</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 4



### A.13 Summary of Pelican Bay sub catchment Improvement Program works



Data source: D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 5

### ***Pelican Bay Road (Site 1)***

The University of NSW study identified:<sup>106</sup>

- that Saltmarsh and intertidal vegetation communities upstream of Pelican Bay Road were observed to be limited during site inspections, as well as when compared to GIS mapping data, and
  - the limited vegetation may be caused by:
    - ... restricted tidal connectivity upstream of a single culvert, located 20 metres upstream of Pelican Bay Road on a private access road, and/or
    - ... historical culverts at Pelican Bay Road being too restrictive (note: culverts were upgraded in early 2018), and
- the construction of Pelican Bay Road has resulted in the disconnection of the smaller wetland 'fingers' from the areas downstream of the road and disconnected these potential wetland areas from unimpeded tidal influence.

Table A.14 summarises the proposed management actions for site 1 and their intended ecological outcome.

#### **A.14 Pelican Bay Road (Site 1) proposed management actions and their intended ecological outcome**

Management action	Ecological outcome
<b>Upstream of Pelican Bay Road</b>	
Reviewing and optimising the improved connectivity upstream of Pelican Bay Road	Improve tidal connectivity to increase wetland area coverage by approximately 6.5 hectares
<b>Downstream of Pelican Bay Road</b>	
Optimise the conveyance capacity of the dish drain which provides drainage for the smaller wetland 'fingers'	Improve tidal connectivity to increase wetland area coverage by a yet to be determined amount
Fencing of two areas (fence length to be determined) on lot DP590266	Stock exclusion area of approximately 10 hectares (approximately 25 per cent of the property Lot: DP590266)

Source: D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, pp. 23-24

<sup>106</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research laboratory School of Civil and Environmental Engineering University of NSW, pp. 20, 23 and 24



### *Millers Creek floodgates (Site 2)*

The University of NSW study identified:<sup>107</sup>

- The four culverts with floodgates beneath Manning Point Road that control the tidal exchange between Pelican Bay and the low-lying areas upstream of Millers Creek, are in poor condition (leak) and/or obstructed by sediment accumulated in front of the floodgate flaps. There is some upstream tidal exchange.
- The bed slope of Millers Creek is flat, with limited gradient from the southern extents to the floodgates over the approximately 4 km creek length. This causes poor drainage and susceptibility to prolonged freshwater inundation following catchment rainfall in the central low-lying areas adjacent to Millers Creek.

Table A.15 summarises the proposed management actions for site 2 and their intended ecological outcome.

#### **A.15 Millers Creek floodgates (Site 2) proposed management actions and their intended ecological outcome**

Management action	Ecological outcome
Open or remove the floodgates to allow unrestricted upstream tidal flow	<ul style="list-style-type: none"> <li>■ Tidal waters to flow approximately 1.5 km upstream and create intertidal habitat of approximately 40 hectares, similar to the area currently mapped as coastal wetlands under the Coastal Management SEPP 2018</li> <li>■ Buffering of ASS discharge</li> </ul>
Stock exclusion and fencing, with fence location and length yet to be determined	<ul style="list-style-type: none"> <li>■ Increase downstream wetland area coverage to an unspecified amount</li> <li>■ Improve water quality to an unspecified level</li> </ul>

Source: D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, pp. 32-34

### *Sheather Creek wetland (site 3)*

The University of NSW study identified:<sup>108</sup>

- that wetlands located on Lots: 1/DP79189 and 23/DP556207 have poor quality/non-existent mangroves and saltmarsh species due to poor flushing/connectivity and stock activity (unrestricting cattle grazing within the wetland), and

<sup>107</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research laboratory School of Civil and Environmental Engineering University of NSW, pp. 25-28

<sup>108</sup> D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research laboratory School of Civil and Environmental Engineering University of NSW, p. 46

- improved tidal flushing could be achieved by increasing/improving the connectivity of the existing drainage system via drain clearing and removal of sediment barriers and in channel vegetation.

Table A.16 summarises the proposed management actions for site 3 and their intended ecological outcome.

#### **A.16 Sheathers Creek floodgates (Site 3) proposed management actions and their intended ecological outcome**

Management action	Ecological outcome
Stock exclusion via fencing of the 4.7-hectare wetland area	<ul style="list-style-type: none"> <li>■ increase wetland area coverage, and</li> <li>■ improve water quality.</li> </ul>
Drain clearing and removal of sediment barriers and in channel vegetation within the existing drainage system	<ul style="list-style-type: none"> <li>■ improved tidal flushing and water quality</li> </ul>
Establish a dedicated stock access path directly adjacent to Manning Point Road (may require additional fill to raise the access above the wetland)	<ul style="list-style-type: none"> <li>■ maintain stock access to the south-eastern area of Lot: 1/DP79189</li> </ul>
Extension of the existing culverts (or bridge, or similar)	<ul style="list-style-type: none"> <li>■ maintain tidal connectivity and drainage, and</li> <li>■ inhibit stock access to the waterway.</li> </ul>

Source: D S Rayner, G Lumiatti, W C Glamore and B Henderson 2020, 'Pelican Bay Sub-Catchment Improvement Program: Tidal Restoration Feasibility Assessment', July, Water Research Laboratory School of Civil and Environmental Engineering University of NSW, p. 46

### ***Protect and/or rehabilitate riparian zones (action 2.03)***

We understand this action is associated with Pietsch, T et al. (2019).<sup>109</sup> Pietsch, T et al. (2019) concludes that few, if any areas require direct intervention, as the Delta Green data<sup>110</sup> shows that streams and shorelines will revegetate on their own accord, at rates that are acceptable over management timescales.<sup>111</sup>

The areas that do require an increase in vegetation to achieve 70 per cent<sup>112</sup> woody vegetation within the Manning Catchment are shown in table A.17, of which the Barnard River, manning River and Myall Creek collectively account for over 85 per cent.

<sup>109</sup> Pietsch, T et al. (2019), 'Riparian and Shoreline Vegetation in the Manning, Great Lakes and Karuah Catchments: Report to Hunter Local Land Services', Precision Erosion & Sediment Management Research Group, Griffith University

<sup>110</sup> Represents the change, per annum, in the percentage of "persistently green" vegetation present in an area through analysis of satellite imagery over time. The representative rate was derived through linear regression.

<sup>111</sup> Pietsch, T et al. (2019), 'Riparian and Shoreline Vegetation in the Manning, Great Lakes and Karuah Catchments: Report to Hunter Local Land Services', Precision Erosion & Sediment Management Research Group, Griffith University, p. 131

<sup>112</sup> Identified as the threshold where maximum benefits of erosion control and habitat creation will be achieved. A higher proportion of woody vegetation is likely to be too dense to facilitate further active revegetation.

### A.17 Manning River catchment riparian vegetation prioritisation areas

Location	2040 Tree coverage	Increase in woody vegetation required to reach 70 per cent <sup>a</sup>	Proportion of required riparian vegetation intervention	Investment <sup>b</sup>
	Per cent	hectares	Per cent	\$2,019
Barnard River	66	24.5	49	409 714
Manning River	69.5	9.6	19	161 132
Myall Creek	58.2	9	18	150 173
Scotts Creek	63.1	4.5	9	74 432
South Arm	67.7	1.5	3	25 528
Avon River Tributary	68.1	0.4	1	6 129
<b>Total</b>		<b>49.5</b>	<b>100</b>	<b>827 108</b>

<sup>a</sup> Identified as the threshold where maximum benefits of erosion control and habitat creation will be achieved. A higher proportion of woody vegetation is likely to be too dense to facilitate further active revegetation. <sup>b</sup> Assuming 16 700 per hectare as per Pietsch, T et al. (2019)

Note:

Source: Pietsch, T et al. (2019), 'Riparian and Shoreline Vegetation in the Manning, Great Lakes and Karuah Catchments: Report to Hunter Local Land Services', Precision Erosion & Sediment Management Research Group, Griffith University, p. 133; CIE

Outside the identified Manning Catchment prioritisation areas shown in table A.17, efforts should be directed to periodic monitoring of changes in vegetation composition and the external drivers that have enabled the increase observed over the last three decades.<sup>113</sup>

<sup>113</sup> Pietsch, T et al. (2019), 'Riparian and Shoreline Vegetation in the Manning, Great Lakes and Karuah Catchments: Report to Hunter Local Land Services', Precision Erosion & Sediment Management Research Group, Griffith University, p. 133

### *Purchase and retire unused water licenses (action 2.05)*

The water licences within the Manning River Catchment are underpinned by the *Water Sharing Plan for the Lower North Coast Unregulated and Alluvial Water Sources 2009* (Water Sharing Plan), with the geographical coverage of that Plan shown in figure A.18<sup>114</sup>. The Manning catchment comprises the northernmost of the three management units covered by that Plan.

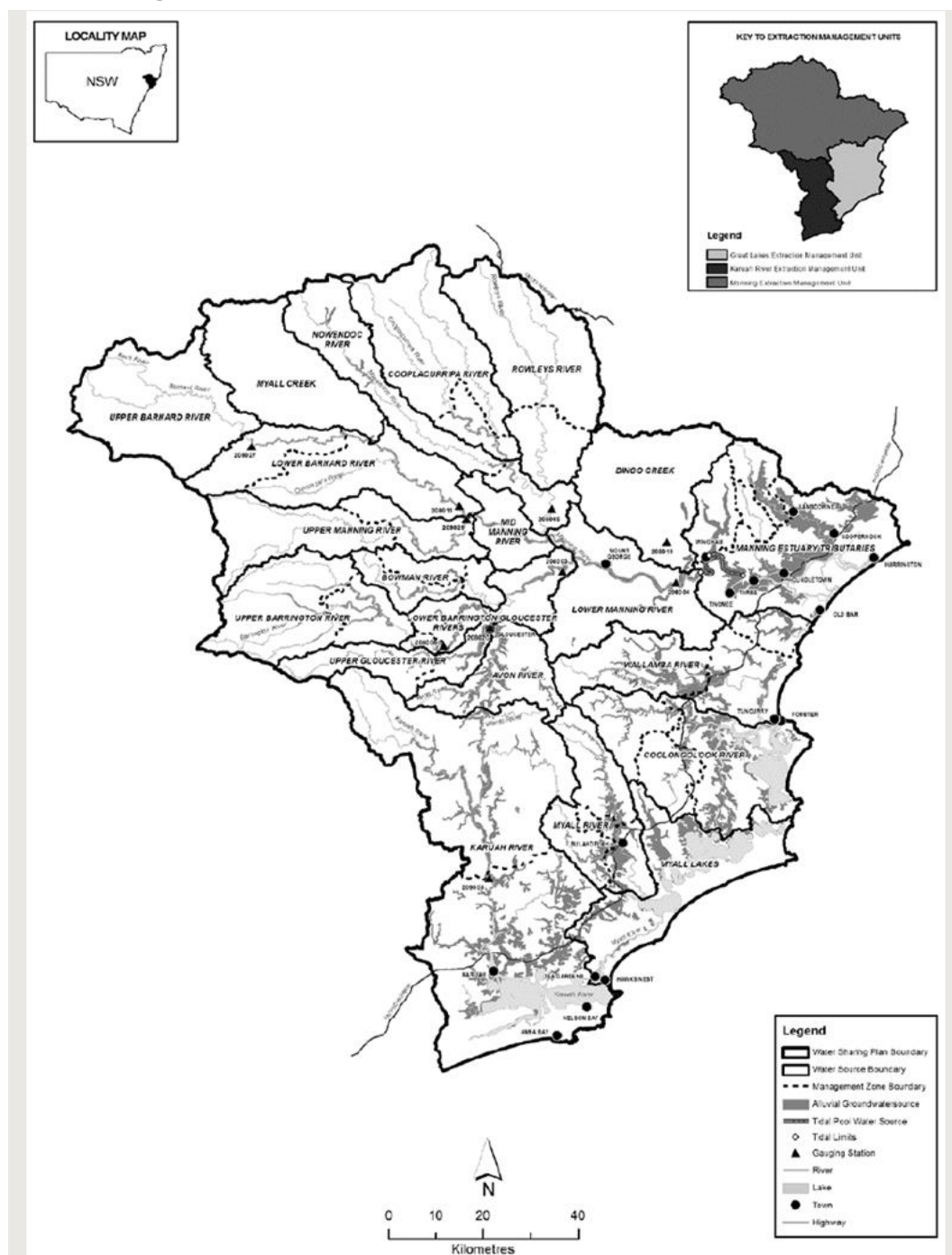
Relevant Manning River Estuary Catchment water sources within the Water Sharing Plan are:<sup>115</sup>

- Avon River
- Lower Barrington/Gloucester Rivers
- Upper Barrington River
- Bowman River
- Cooplacurripa River
- Dingo Creek
- Upper Gloucester River
- Lower Barnard River
- Manning Estuary Tributaries
- Manning River Tidal Pool
- Lower Manning River
- Mid Manning River
- Myall Creek
- Nowendoc River
- Rowleys River
- Upper Barnard River, and
- Upper Manning River.

<sup>114</sup> NSW Government 2019, 'Water Sharing Plan for the Lower North Coast Unregulated and Alluvial Water Sources', 2009, <https://www.legislation.nsw.gov.au/view/html/inforce/current/sl-2009-0348>

<sup>115</sup> NSW Government 2016, 'WSP for Lower North Coast unregulated and alluvial water sources: Background document 2016', Appendix 8: Map of the plan area, November, NSW Department of Primary Industries, Water, p. 8, [https://www.industry.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/166855/lower-nth-coast-unreg-alluvial-background.pdf](https://www.industry.nsw.gov.au/__data/assets/pdf_file/0004/166855/lower-nth-coast-unreg-alluvial-background.pdf)

### A.18 Coverage of the Lower North Coast Unregulated and Alluvial Water Sources Water Sharing Plan



Data source: NSW Government 2016, 'WSP for Lower North Coast unregulated and alluvial water sources: Background document 2016', Appendix 8: Map of the plan area, November, NSW Department of Primary Industries, Water, p. 63, [https://www.industry.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/166855/lower-nth-coast-unreg-alluvial-background.pdf](https://www.industry.nsw.gov.au/__data/assets/pdf_file/0004/166855/lower-nth-coast-unreg-alluvial-background.pdf)

Table A.19 shows the share component (water entitlement)<sup>116</sup> for each of the Manning River Catchment water sources, by licence type for 2020-21 (the latest completed) water year. The water entitlement licence types are:

- Unregulated river, with 47 819 share components (~56 per cent of total entitlements)
  - located across all water sources
- Major Utility, with 20 000 share components (~24 per cent of total entitlements)
  - located solely in the Lower Barnard River
- Local Water Utility, with 16 685 share components (~20 per cent of total entitlements)
  - located in the Manning Estuary Tributaries, Manning River Tidal Pool and Lower Manning River
- Domestic and Stock,<sup>117</sup> with 121 share components (less than 1 per cent of total entitlements)
  - located in more than half of the water sources, and
- Aquifer, with 685 share components (less than 1 per cent of total entitlements)
  - located in the Dingo Creek, Upper Gloucester River and Manning Estuary Tributaries.

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<sup>116</sup> Broadly speaking, 1 share component is equal to 1 ML of water entitlement.

<sup>117</sup> Includes the license types: Domestic and Stock, Domestic and Stock (Domestic) and Domestic and Stock (stock)

**A.19 Manning River Catchment water sources share components (entitlements)**

Water source	Domestic and stock	Unregulated river	Local Water Utility	Major Utility	Aquifer	Total
	Entitlements (ML)	Entitlements (ML)	Entitlements (ML)	Entitlements (ML)	Entitlements (ML)	Entitlements (ML)
Avon River	8	1 736	0	0	0	1 744
Lower Barrington/GloUCESTER Rivers	48	10 705	610	0	0	11 362
Upper Barrington River	0	944	0	0	0	944
Bowman River	9	2 111	0	0	0	2 120
Cooplacurripa River	0	800	0	0	0	800
Dingo Creek	11	5 020	0	0	47	5 078
Upper Gloucester River	7	5 324	0	0	18	5 349
Lower Barnard River	0	1 369	0	20 000	0	21 369
Manning Estuary Tributaries	4	3 065	575	0	568	4 212
Manning River Tidal Pool	0	0	3 000	0	0	3 000
Lower Manning River	1	7 979	12 500	0	10	20 490
Mid Manning River	0	962	0	0	0	962
Myall Creek	26	2 862	0	0	0	2 888
Nowendoc River	1	1 273	0	0	0	1 274
Rowleys River	0	277	0	0	0	277
Upper Barnard River	0	1 159	0	0	0	1 159
Upper Manning River	7	2 234	0	0	0	2 241
<b>Total</b>	<b>121</b>	<b>47 819</b>	<b>16 685</b>	<b>20 000</b>	<b>643</b>	<b>85 268</b>

Note: Figures for the 2020-21 financial year.

Sources: NSW Government 2021, Share component dashboard, NSW DPIE, <https://www.industry.nsw.gov.au/water/allocations-availability/water-accounting/share-component-dashboard>; and WaterNSW 2021, NSW Water Register: Total number of water access licences and water usage for a water source, <https://waterregister.watarnsw.com.au/water-register-frame>

Table A.20 shows 2020-21 water use across the Manning River Estuary Catchment for all licence types. Of interest:

- despite representing over 50 per cent of entitlement, unregulated water licences extracted only 1.2 per cent of the Manning's available water
- stock and domestic licence holders extracted 0 per cent of its available water, and
- major utility licence holder(s) extracted 0 per cent of its available water.



## A.20 2020-21 water use across the Manning River Catchment

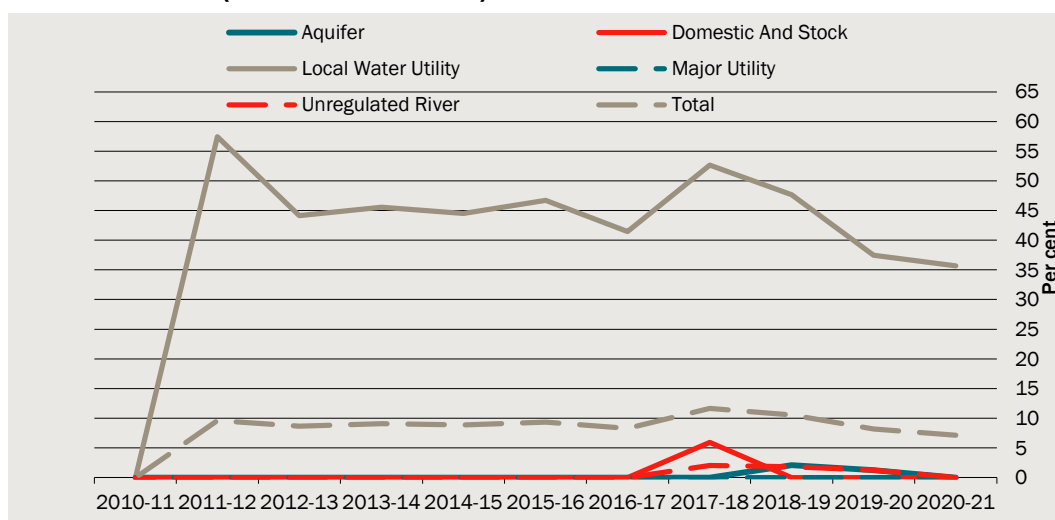
Licence type	Water made available	Usage	Proportion of available water used
	ML	ML	Per cent
Aquifer	643	0	0
Domestic and Stock	117	0	0
Local Water Utility	16 715	5 967	36
Major Utility	20 000	0	0
Unregulated water	46 345	0	0
<b>Total</b>	<b>83 820</b>	<b>5 967</b>	<b>7</b>

Note: Figures for the 2020-21 financial year. Domestic and stock includes the license types: Domestic and Stock, Domestic and Stock (Domestic) and Domestic and Stock (stock).

Source: WaterNSW 2021, NSW Water Register: Total number of water access licences and water usage for a water source, <https://waterregister.watersnsw.com.au/water-register-frame>

Chart A.21 confirms the low water usage trend over time by Aquifer, Domestic and Stock, Major Utility and Unregulated Water licences.

## A.21 Proportion of available water allocation used by licences across the Manning River Catchment (2010-11 to 2020-21)



Note: Financial years

Data source: WaterNSW 2021, NSW Water Register: Total number of water access licences and water usage for a water source, <https://waterregister.watersnsw.com.au/water-register-frame>; CIE

We note, the description of the management option reads,

“the sleeper licenses pose a significant risk to environmental flows and, potentially, water supply during a drought, if these licenses were to be activated.”

We have categorised unregulated river licences as “sleeper licences” for this report, as these licence holders are most likely to pose the “risk” identified in the management option given:

- their high proportion of total entitlements (~56 per cent), and
- persistent low usage (consistently below 2 per cent of availability).

We have not included major water utility, aquifer, and domestic and stock licences as “sleeper licences” because:

- major water utility licences are used for a specific purpose (namely electricity generation), and
- the low proportion of aquifer and stock and domestic licences (each less than 1 per cent of total entitlements) results in a very small risk to environmental water / water supply, during low water availability.

However, despite unregulated river licences categorised as sleeper licences for this report, we note the risk of usage by unregulated licence holders during low water availability is minimal. Usage during low water availability is restricted to local water utilities, licensed stock and domestic users, and licences used for food safety and essential dairy care, as stated in the Water Sharing Plan Background Document,

“... the water sharing plan imposes access restrictions on days when stream flows are low. This is achieved by establishing cease-to-pump rules that require users to stop taking water when flows fall below a set level. All surface water licences will be subject to cease to pump rules (excluding licences held by local water utilities, licensed stock and domestic users, and licences used for food safety and essential dairy care).”<sup>118</sup>

### ***Maintain stormwater quality improvement devices (Wingham Wetland upgrade), (action 2.08)***

Stormwater Quality Improvement Devices (SQIDs) include a range of devices or structures designed to remove pollutants from stormwater prior to it entering a natural water course or body. SQIDs function by detaining, retaining, harvesting, screening, filtering, infiltrating and/or biologically treating stormwater runoff to reduce the concentrations and loads of pollutants discharged to the receiving environment. SQIDs can also assist with reducing stormwater volumes and flow rates which help to reduce stream erosion potential and impacts on the wetting and drying cycles of natural wetlands.<sup>119</sup>

Management action 2.08 targets, as one of its sub actions, the upgrade and enhanced maintenance of the Wingham Constructed Wetlands, outlined in teal in figure A.22.

<sup>118</sup> NSW Government 2016, ‘WSP for Lower North Coast unregulated and alluvial water sources: Background document 2016’, Appendix 8: Map of the plan area, November, NSW Department of Primary Industries, Water, p. 4, [https://www.industry.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/166855/lower-nth-coast-unreg-alluvial-background.pdf](https://www.industry.nsw.gov.au/__data/assets/pdf_file/0004/166855/lower-nth-coast-unreg-alluvial-background.pdf)

<sup>119</sup> Lake Macquarie City Council 2013, Stormwater quality improvement devices guidelines, December, p. 1, <https://www.lakemac.com.au/files/assets/public/hptrim/traffic-and-transport-policy-engineering-guidelines-standard-drawings/sqid-guidelines-dec-2013.pdf>

## A.22 Wingham Wetland



Note: Wingham Wetland is within the teal outline.

Data source: Council

Appropriate rehabilitation is important to ensure that constructed wetlands achieve their design objectives.<sup>120</sup> One of the key measures of treatment efficacy is the hydraulic retention time (HRT) of the system. The HRT is a measurement of how long water remains within the wetland, so that the physical, chemical and biological processes which treat the water have time to act. HRT is primarily influenced by the volume of water in the constructed wetland and the rate at which water is discharged through the wetland. These two factors are the basis for initial wetland design.<sup>121</sup>

<sup>120</sup> Hunter, G. 2013. Constructed wetlands: design, construction and maintenance considerations. Ch. 2.11, Workbook for Managing Urban Wetlands in Australia, Ed. Paul, S. Sydney Olympic Park Authority, Sydney Olympic Park., <https://www.sopa.nsw.gov.au/-/media/files/sopa/sopa/publications/wet-ebook-workbook-for-managing-urban-wetlands-in-australia/211-constructed-wetlandsdesign-construction-and-maintenance-considerations.pdf>

<sup>121</sup> Harrington, S 2019, 'Calculating the hydraulic efficiency of a constructed wetland: Using Rhodamine-WT to track water flow through a constructed wetland in a Mediterranean climate', water e-journal, Volume 4 No 1 2019, Australian Water Association, <https://watersource.awa.asn.au/environment/built-environment/calculating-the-hydraulic-efficiency-of-a-constructed-wetland/>

### *Restore fish passage by removing or re-designing pre-identified barriers by DPI-Fisheries (action 4.01)*

Riverine connectivity has been disrupted through the installation of weirs, dams, road crossings, and floodgates, which in turn affect native fish by interrupting spawning and seasonal migrations, restricting access to essential habitat and food resources, and altering habitat condition and water quality.<sup>122</sup>

Reconnecting fish passage is a sub-action under Action 2.4 of the Marine Estate Management Strategy (MEMS)<sup>123</sup>, which will re-establish resilient coastal floodplains and connectivity within coastal catchments. The required effort is led by DPI Fisheries, according to their policy, research and regulations. MidCoast Council would be the project manager on structures owned by Council, while opportunities to work with private landholders will also be explored.

An audit by DPI-Fisheries (DPI 2006<sup>124</sup>) identified and audited those road crossings which negatively impacted native fish health by:

- creating a physical blockage/hydrological barrier to fish passage
  - structures with piers and footings that constrict the channel, can also affect aquatic habitat and flow conditions underneath a structure
- forming artificial conditions that act as behavioural barriers to fish
  - culvert structures increase flow velocity and turbulence and reduced flow depth which may prevent fish from swimming through the structure
- increase in sediment and other inputs from adjacent floodplains and slopes
  - for example, unsealed roads and tracks, have been identified as significant sources of runoff and sedimentation, and
- affecting instream habitat condition
  - for example, by creating shallow water depths.

194 constructed barriers have been identified and prioritised in the Manning catchment. Structures included road crossings, floodgates and three weirs. Of these, 23 have been rectified to restore fish passage, including weirs on the Lansdowne River and Cedar Party Creek, although some sites where remediation has been attempted in the past now

<sup>122</sup> Wilson, A.L., Dehaan, R.L., Watts, R.J., Page, K.J., Bowmer, K.H., & Curtis, A. 2007, 'Proceedings of the 5th Australian Stream Management Conference. Australian rivers: making a difference', Charles Sturt University, Thurgoon, New South Wales  
[https://cdn.csu.edu.au/\\_\\_data/assets/pdf\\_file/0011/748325/Gordos\\_Matthew\\_109.pdf](https://cdn.csu.edu.au/__data/assets/pdf_file/0011/748325/Gordos_Matthew_109.pdf)

<sup>123</sup> NSW Government 2018, 'NSW Marine Estate Management Strategy 2018-2028', Marine Estate Management Authority,  
[https://www.marine.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0007/815596/Marine-Estate-Management-Strategy-2018-2028.pdf](https://www.marine.nsw.gov.au/__data/assets/pdf_file/0007/815596/Marine-Estate-Management-Strategy-2018-2028.pdf)

<sup>124</sup> NSW Government 2006, 'Reducing the impact of road crossings on aquatic habitat in coastal waterways – Hunter/Central Rivers, NSW. Report to the New South Wales Environmental Trust. NSW Department of Primary Industries',  
[https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/634045/impact-of-road-crossings-hunter-central-rivers.pdf)

require reassessment as components have moved or deteriorated over time, or no longer meet current best practice. Restoring fish passage through road crossings can sometimes be carried out as roads are maintained.

Priority locations are those barriers with proximity to the estuary (noting that some fish species migrate from saltwater to freshwater to spawn) and along the mainstream Manning River and its major tributaries. DPI Fisheries have advised high priority sites as outlined in table A.22, figures A.24 to A.28, which, if removed, would significantly improve fish passage.<sup>125</sup>

### A.23 DPI Fisheries identified high priority fish passage remediation sites

Location	Fisheries ID number and coordinates	Upstream gains	Structure description	Fish Barrier description	Possible solutions
		km			
Bretti Trail Road causeway on the Barnard River	10233: -31.7912212, 151.9148274	361	200 mm height, with a 40 metre width (bank to bank)	Water within the river channel is spread thinly over a wide area of the crossing so fish can't pass until it is submerged.	<ul style="list-style-type: none"> <li>■ Cutting out a section and adding in a bridge deck or box culverts – both would be very prone to flood damage as they would need to be pretty low to tie back into the rest of the road</li> <li>■ The whole causeway could be removed and the road could be moved slightly downstream to a narrower section. of the road.</li> </ul>
Hicks Lane – links Baxters Ridge Road and Nowendoc Road	13052: -31.68417313, 151.992393	163	400 mm height. Listed as a pipe culvert, but it appears to be more of a causeway on the Cooplacurripa River	Water within the river channel is spread thinly over a wide area of the crossing so fish can't pass until it is submerged	Removal and replacement with a bridge

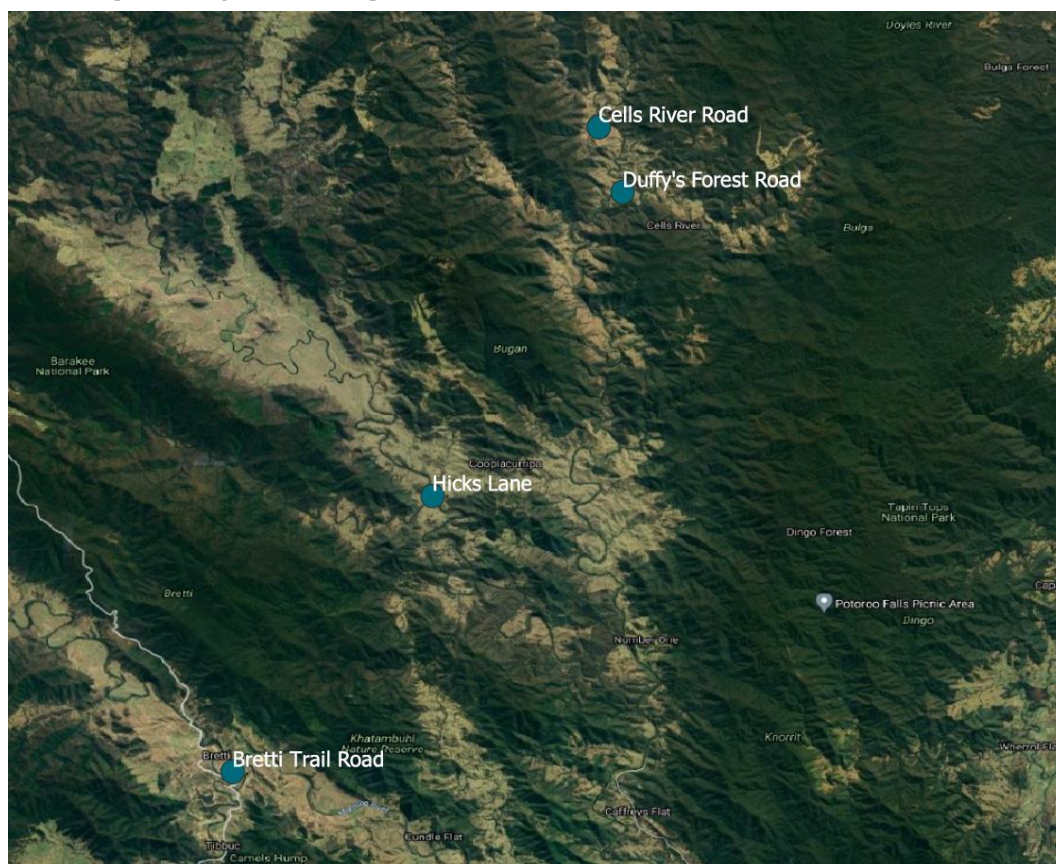
<sup>125</sup> Email from DPI Fisheries to MidCoast Council dated 24 March 2021.



Location	Fisheries ID number and coordinates	Upstream gains	Structure description	Fish Barrier description	Possible solutions
		km			
Duffys Forest Road on Rowleys River	10350: -31.56621748 152.0661494	39	Listed as pipe culverts, but are more like causeways	Water within the river channel is spread thinly over a wide area of the crossing so fish can't pass until it is submerged	Removal and replacement with a bridge
Cells River Road on Rowleys River	10531: -31.54102865 152.0568723	54	Listed as pipe culverts, but are more like causeways	Water within the river channel is spread thinly over a wide area of the crossing so fish can't pass until it is submerged	Removal and replacement with a bridge

Source: Email from DPI Fisheries to MidCoast Council dated 24 March 2021

## A.24 High priority fish passage remediation locations



Note: Teal circles indicate High priority fish passage remediation locations.

Data source: Email from DPI Fisheries to MidCoast Council dated 24 March 2021

### A.25 Brett Trail Road causeway on the Barnard River



Data source: Email from DPI Fisheries to MidCoast Council dated 24 March 2021.



**A.26 Hicks Lane – links Baxters Ridge Road and Nowendoc Road**

Data source: Email from DPI Fisheries to MidCoast Council dated 24 March 2021

### A.27 Duffys Forest Road on Rowleys River



Data source: Email from DPI Fisheries to MidCoast Council dated 24 March 2021

### A.28 Cells River Road on Rowleys River



Data source: Email from DPI Fisheries to MidCoast Council dated 24 March 2021

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