7 ESTUARY MANAGEMENT PLAN

7.1 The Purpose and Context of This Plan

This Estuary Management Plan for Killick Creek at Crescent Head, represents the long-term strategy for environmental sustainability of the estuary. The Plan has been designed taking into consideration the ecological and social demands on the estuary. It has recognised its unique environmental setting, while acknowledging its values for local tourism and recreation, as well as agricultural floodplain management.

The Plan has been developed in accordance with the NSW Government's Estuary Management Program, and in accordance with the Estuary Management Policy 1992 and the Coastal Policy 1997. It is proposed that the Killick Creek Estuary Management Plan be reviewed annually, and completed revised within an approximate timeframe of 5 years.

7.2 Community Consultation Process

This Estuary Management Plan has been prepared following consultation with residents and stakeholders of Killick Creek. Consultation commenced as part of the Estuary Processes Study (MHL, 2002), and continued to public exhibition of this document. During the process, the community and stakeholders were engaged through the following:

- Direct mail out of information and a request for feedback to key stakeholders and community groups;
- Placement of a questionnaire in the local newspaper (Macleay Argus) regarding the study, and again requesting feedback on estuary values and relevant management issues;
- Follow-up conversations and on-site (face to face) meetings with several community members and stakeholders;
- Workshops with the Estuary Management Working Group and with the wider community regarding the issues requiring management and potential options to address them;
- Public exhibition of the draft Killick Creek Estuary Management Study and Plan document; and
- Public meeting during the public exhibition period to present the draft Plan to the community and stakeholders.

The responses from the community and stakeholders highlighted the following key issues:

- Management of the Killick floodgates. Floodgate management was linked to upstream issues as well as fish kills. Leaking of the floodgates and a lack of maintenance was noted;
- The connection of Killick Creek to the Macleay Valley Flood Mitigation Scheme, and whether Killick Creek should remain part of this scheme or be restored to a more natural state;
- Realignment of the Creek to prevent erosion of adjacent coastal foredunes;
- Development control and the impact of development on the Creek;
- Degradation of swamplands upstream of the floodgates due to salt inundation;

- Siltation and shoaling within the Creek, particularly at the entrance, which inhibits tidal flushing and recreational usage;
- Water quality, particularly the effect on local ecology and safety for activities in the Creek; and
- Current dilapidated condition of the entrance rock training wall, and the impact of dislocated rocks on general recreation within the entrance channel.

7.3 Objectives of the Plan

Objectives of the Killick Creek Estuary Management Plan have been defined as targets for the future sustainable management of the estuary. The objectives aim to rectify the problems facing the estuary, while preserving and enhancing the estuary's inherent environmental, social and economic values.

Eighteen (18) specific objectives were developed and agreed upon by the Committee, stakeholders and the general community. These objectives, as shown below, cover a wide range of issues, including Water Quality, Entrance Works, Sedimentation, Ecology and Floodplain / Agricultural Management.

(1) Reduce the urban pollutants load entering Killick Creek, with particular focus on reducing bacterial loads to the estuary

(2) Ensure that the water quality of the lower Killick Creek estuary is suitable for primary contact activities, such as swimming

(3) Manage the discharge of poor quality water from the agricultural drains upstream of the Killick Creek floodgates to prevent detrimental environmental impacts

(4) Minimise the effect of red weed in Killick Creek estuary

(5) Minimise risks to swimmers associated with strong tidal currents within the primary recreation area in the entrance of Killick Creek

(6) Manage the entrance of Killick Creek to facilitate agricultural drainage, maximize recreational opportunities and minimize environmental degradation

(7) Ensure that marine and fluvial sedimentation within Killick Creek does not compromise the environmental, social (recreational) or flood-mitigation values offered by the estuary

(8) Facilitate access to the ocean from the boatramp, particularly during peak periods

(9) Minimise any further accumulation of fine organic sediment in the upper reaches of Killick Creek

(10) Prevent further change in the estuarine tidal hydraulics that may unbalance the present ecological structure of Killick Creek

(11) Prevent any future degradation of existing aquatic and terrestrial communities and their habitats, and improve habitats in the future through targeted restoration and rehabilitation

(12) Prevent future fish kills in the Killick Creek estuary occurring from non-natural processes

(13) Prevent any unnecessary drainage of runoff waters from Belmore Swamp and Connection Creek into the Killick Creek estuary

(14) Ensure that the floodgates and drop-boards are managed effectively to optimize agricultural management and land rehabilitation needs, and to minimize degrading pressures on the downstream estuarine environment

(15) Ensure that active agricultural drains are optimized for hydraulic efficiency and water quality, and inactive drains are infilled, as appropriate and necessary

(16) Ensure that current agricultural land management within the upper Belmore Swamp area is compatible with Best Management Practice for Acid Sulfate Soil lands

(17) Ensure minimum inundation of the Kempsey – Crescent Head main road during frequent and major flood events in the Connection Creek floodplain

(18) Ensure that the entrance training wall complies with current engineering standards, and does not compromise the recreational values of the creek

7.4 Proposed Management Strategies

Twenty two (22) individual management strategies have been developed for Killick Creek, which combined, address each of the 18 management objectives defined for the estuary. The strategies can be summarised into the following categories:

- Administration: involves actions that will assist with the resourcing and administration of estuary management actions for Killick Creek;
- Planning: involves modifying existing instruments or developing new plans and policies regarding conservation, and to guide rehabilitation and future management of the estuary
- Further Investigations: to gain a better appreciation of specific processes occurring within the estuary as well as the impact of floodplain management and options for modifications to existing floodplain management practices
- Community Education: which aims to improve the general communities awareness of the environmental issues associated with the estuary, and introduce ways that they can help protect and rehabilitate the valued environment
- On-Ground Works: involves physical works within the estuary, around its foreshores, or within the catchment, to minimise future degradation of the environment and restore currently degraded parts of the estuary
- Monitoring: to measure the condition of the estuary and to gain feedback on the success of the implementation of the Plan

Different timeframes for implementation have been assigned to the different strategies included in the Estuary Management Plan covering an overall Plan duration of approximately 5 years. After a period of 5 years, the Plan will undergo a comprehensive review and update (refer Section 7.10).

Immediate tasks are to commence within a timeframe of 6-12 months from adoption of the Plan (i.e. before December 2006).

Short term tasks are to commence within a timeframe of 1-3 years (i.e. before December 2008).

Medium term tasks are to commence within a timeframe of 3-5 years (i.e. before 2011). It is envisaged that there will be a number of reviews of this Plan prior to implementation of the medium term tasks (refer Section 7.10). Therefore, there will be opportunity for modification of these strategies, as necessary, as more information becomes available through monitoring and additional investigation of the estuary.

A summary of the strategies developed for Killick Creek are provided overleaf, while detailed descriptions and guidance on their implementation are provided in Section 7.5.

Ref.	Strategy Description	Option
	To commence implementation immediately (within 6 – 12 months, i.e. before Dec 2006)	
A	Prepare and implement a formal Entrance Management Policy to guide Council on when, how and where to artificially dredge the entrance (*see Appendix A for interim protocols*)	EM-2
B	Prepare and implement a formal Floodgate Management Plan to guide Council on when to allow floodwaters into the estuary to minimise impacts on the environment and users (*see Appendix B for interim protocols*)	FM-1
C	Critically assess the actual threat to the coastal dunes to determine if Council's periodic "meander correction" dredging in the entrance is justified	EM-1
D	Install 'leaky pits' in the caravan park to reduce low-flow stormwater discharge into the lower reaches of Killick Creek (especially the area used for swimming)	WQ-3
E	Continue to monitor for bacteria (eg enterococci) for human health purposes	WQ-12
F	Continue to implement the Crescent Head Stormwater Management Plan (GHD, 2003)	WQ-1
G	Install permanent signage at the entrance advising of strong currents in the channel	EM-3
	To commence implementation in the short term (within 1 – 3 years, i.e. before Dec 2008)	
H	Remove sediment shoals in Killick Creek which inhibit tidal flushing and flood discharge	Sed-3
I	Upgrade existing Killick Creek floodgates to ensure they operate effectively	FM-2
J	Prepare a DCP for all new urban development around the estuary requiring adoption of improved watercycle management and on-site runoff management (eg rainwater tanks)	WQ-14
K	Continue trials of improved backswamp management with targeted education of agricultural landholders regarding improved land management practices	FM-6
L	Conduct an agricultural and economic assessment of land practices within the Belmore River floodplain to determine ways of possibly improving discharge to Killick Creek	FM-4
M	Carry out a water quality monitoring program for Killick Creek with a number of sites throughout the estuary to help determine ecosystem health and impacts of inputs	WQ-13
N	Restore entrance training wall to current engineering standards, including a consistent and larger rock size, a geotextile filter, and appropriate provision for stormwater outlets	FM-7
O	Undertake re-vegetation of the riparian zone around the estuary, particularly the public lands behind the southern bank between the entrance and Muddy Arm	Ecol-3
	To commence implementation in the medium term (within 3 – 5 years, i.e. before Dec 2010)	
P	Carry out an environmental flows assessment to determine the maximum amount of discharge that can be accommodated by the estuary without significant degradation	Multi-1
Q	Hydrologic and hydraulic modelling study of the Belmore Swamp area to identify efficiency of existing flood mitigation scheme and to assess possible alternatives	FM-3
R	Construct a block in the drain u/s of the floodgates to help control water levels in the drain and to induce sedimentation before agricultural sediment reaches the estuary	Sed-2
S	Assess wetland and estuarine habitat to identify critical habitat areas and Endangered Ecological Communities, and protect these areas through appropriate landuse zonings	Ecol-2
T	Rezone the Killick Creek waterway to 'Environmental Protection' as part of the Kempsey LEP review to reflect the environmental significance of the estuary	Ecol-1
U	Conduct flora and fauna surveys of the waterway and the foreshore to provide better information on ecological values, and threats to these values, including weed invasion	Ecol-5
V	Encourage on-site stormwater management for existing development within Crescent Head, including retrofitting rainwater tanks and using grass swales, where appropriate	WQ-5

7.5 Implementation Details

Implementation details for estuary management strategies are provided in the following schedules.

The following implementation schedules provide information on specific actions required to implement each strategy, as well as costs, timeframes, maintenance requirements responsibilities for implementation, and 'measurables' to define the success of implementation. Comments are also provided for each strategy, which includes background information relevant to the implementation of the strategy and cross-references to other similar strategies.

The schedules are designed to provide all the necessary information for the strategies to be readily implemented. The schedules are also designed to provide the information in a 'quick reference' format to facilitate implementation and adoption by the responsible authorities.

Strategy A	Prepare and implement a formal Entrance Management Policy to guide Council on when, how and where to artificially dredge the entrance				
Objectives addressed	2, 4, 5, 6, 7, 8, 10, 11, 12, 17 (refer Section 5)			**Option Reference**	EM-2
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Incorporate interim Entrance Management Protocols (presented in Appendix A) into a formal Entrance Management Policy that is consistent with other Council Policies and meets Council's requirements as an Environmental Planning Instrument (EPI).	2006	Staff time	Council, EMC	Amended protocols, if considered necessary	See Appendix A for Interim Entrance Management Protocols. Legal status of entrance works should be confirmed with DoP, DNR and Council planners. If necessary, an application should be made to Council and concurrent consenting authorities, accompanied by an Environmental Impact Assessment. Approximate cost of EIA is about $20,000. Consents for entrance works need to be perpetual, due to the intermittent nature of entrance closure and quick response required when works are to be done. The new Coastal Zone Management Manual (not yet released) should provide additional guidance on entrance management practices.
Follow protocols presented in formal Policy with respect to actions when entrance closes, or is imminently closed	2006 and ongoing	~$10,000 p.a. + staff time (depending on survey)	Council	Reporting in accordance with Protocols	
Amend protocols within the Entrance Management Policy, as necessary, to cater for outcomes of the "meander correction" assessment (see Strategy D)	2007	Staff time	Council, EMC	Amended protocols, if considered necessary	

See Section 6.3.1.1 for further details of this strategy.

Strategy B	Prepare and implement a formal Killick Creek Floodgate Management Policy to guide Council on when to allow floodwaters into the estuary to minimise impacts on the environment and users				
Objectives addressed	3, 9, 12, 13, 14, 15, 17 (refer Section 5)		**Option Reference**	FM-1	
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Incorporate interim Floodgate Management Protocols (presented in Appendix B) into a formal Floodgate Management Policy that is consistent with other Council Policies and meets Council's requirements as an Environmental Planning Instrument (EPI).	2006	Staff time	Council, EMC	Amended protocols, if considered necessary	See Appendix B for Interim Floodgate Management Protocols. Capital infrastructure includes new fully interlocking and sealable dropboards and associated housing, mechanism for removing and replacing dropboards easily, mechanism for locking open floodgates. It is assumed that new dropboards can be placed on upstream side of existing floodgate culvert structure. Data from the water quality monitoring station should be telemetered directly to appropriate Council officers, if not already the case.
Design and construct capital infrastructure (i.e. new dropboards and associated minor works) and follow protocols and act accordingly in response to water levels and water quality within Killick Drain	2006 and ongoing	~$60,000 for capital infrastructure, then $10,000 p.a. plus staff time	Council	Reporting in accordance with Protocols	
Continue to maintain water quality monitoring station with regular instrument calibration	2006 and ongoing	~$30,000 p.a.	Council, MHL	Instrument calibration records and reports	
Amend protocols within Floodgate Management Policy, as necessary, to cater for outcomes of the Environment Flows assessment (see Strategy P)	2010	Staff time	Council, EMC	Amended protocols, if considered necessary	
Amend Floodgate Management Protocols, as necessary, to cater for outcomes of the hydrology and hydraulics modelling study (see Strategy Q)	2011	Staff time	Council, EMC	Amended protocols, if considered necessary	

See Section 6.3.1.2 for further details of this strategy.

Strategy C	Critically assess the actual threat to the coastal dunes to determine if Council's periodic "meander correction" dredging in the entrance is justified				
Objectives addressed	6, 10, 11 (refer Section 5)			**Option Reference**	EM-1
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Carry out a ground survey of the entire entrance compartment, including the coastal foredunes for a distance of approximately 100 metres (at 10 – 20 metre spacings)	2006	~$10,000	Council	Electronic and hard copies of ground survey	Consultation will need to be carried out with local community who may expect that works will be carried out. Distinction needs to be made between "meander correction" dredging and the establishment of a navigable channel for ready boat access between the boatramp and the ocean. The morphodynamic assessment would be enhanced by a review of historical air photos of the entrance and possible photogrammetric analysis of the coastal dunes to determine any long-term erosion trends.
Allow the entrance channel to naturally meander within the entrance compartment without artificial alignment for an indicative period of 12 months (to allow for seasonal change)	2006	Nil	Council	No "meander correction" dredging within the entrance	
Repeat entrance ground surveys 3 monthly or following significant coastal storms or flood discharges	2006	~$25,000	Council	Electronic and hard copies of ground survey	
Council staff to supplement surveys by taking weekly photographs of the entrance from a fixed position and at a consistent tidal level (say low tide), and providing a written description of the channel conditions (depth, width, etc)	2006	Staff time	Council staff	Digital photos and weekly records of entrance conditions	
Assess the morphodynamics of the entrance by assessing periodic hydrosurveys and supplementary information, and recommendations for future entrance management	2007	~$15,000	Council, DNR, consultant	Report on the morphodynamics, and statement of recommendations	
Modify the protocols within the Entrance Management Policy (Strategy A) as necessary to accommodate the necessary actions	2007	Staff time	Council, EMC	Amended Entrance Management Policy	

See Section 6.3.1.3 for further details of this strategy.

Strategy D	Install 'leaky pits' in the caravan park to reduce low-flow stormwater discharge into the lower reaches of Killick Creek (especially the area used for swimming)				
Objectives addressed	1, 2 (refer Section 5)			**Option Reference**	WQ-3
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review current best practice with respect to infiltration-based stormwater pits	2006	Staff time	Council	Statement of best practice and scope for works	Works should be incorporated into the Crescent Head Caravan Park Plan of Management Designs will incorporate flap gates on the outlets to some of the drains which are positioned lower than high tide level in the creek
Design modifications of stormwater pits in the caravan park to incorporate infiltration through the base of the structure	2006	$8,000	Council	Electronic and hard copies of design drawings	
Carry out works to install new leaky pits within the caravan park in accordance with designs	2006	$20,000	Council	Completed works, in compliance with design	
Conduct regular inspections of the pits to ensure they operate according to design	2007 + ongoing	Staff time	Council	Inspection reports and maintenance works, as required	

See Section 6.3.1.4 for further details of this strategy.

Strategy E	Continue to monitor for bacteria (eg enterococci) for human health purposes				
Objectives addressed	2 (refer Section 5)			**Option Reference**	WQ-12
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Council to collect water quality samples for bacterial analysis on a weekly basis and every day for 3 days following significant rainfall, during the period early October to late April, and deliver to Council's microbiological laboratory	2006 and ongoing	~$2,500 p.a. + staff time	Council	Weekly reports on bacteria levels in Killick Creek	Bacterial monitoring is consistent with the monitoring requirements for closed entrance conditions, as defined in the Entrance Management Protocols, see Appendix A
Erect signage at the key entry points to the Killick Creek entrance channel advising that conditions may not be suitable for swimming following rainfall or when the entrance is closed.	2006	~$1,000	Council	Presence of signage at Killick Creek	
Obtain rainfall records for Crescent Head for periods corresponding to bacterial monitoring and assess results to identify any correlations between rainfall and bacteria numbers	2006 and ongoing	Staff time	Council	Report on correlation between rainfall and bacteria levels	
Adjust public health signage pending outcomes of correlations assessment	As necessary	~$300	Council	Modified signage, if necessary	

See Section 6.3.1.5 for further details of this strategy.

Strategy F	Continue to implement the Crescent Head Stormwater Management Plan				
Objectives addressed	1, 2 (refer Section 5)			**Option Reference**	WQ-1
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review the recommendations of the Stormwater Management Plan to ensure appropriateness in light of Estuary Management Plan objectives, and to identify tasks completed, address problems faced to date and reconsider future implementation approach.	2006	$5,000	Council	Statement of review, including possible modifications	Major recommendation of the SWMP include: - routine and event based water quality monitoring (see also Strategies A, E and M) - end of line treatment devices (some of which have been installed already) - more sullage disposal points within Caravan Pk (some of which have been installed already) - community education
Implement appropriate recommendations of the Plan	2006 and on-going	Refer SWMP	Council	On-ground works and other deliverables, as per SWMP	

See Section 6.3.1.6 for further details of this strategy.

Strategy G	Install permanent signage at the entrance advising of strong currents in the channel				
Objectives addressed	5 (refer Section 5)			**Option Reference**	EM-3
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Determine appropriate wording and layout for signage at Killick Creek regarding tidal currents	2006	Staff time	Council, EMC	Agreement on wording and layout for signage	Educational material regarding strong currents within the creek should also be provided to temporary residents of the Caravan Park.
Build and erect appropriate signage at key entry locations to the waterway	2006	$1,000 + $200 p.a. to maintain	Council	Presence of signage at key entry sites	

See Section 6.3.1.7 for further details of this strategy.

Strategy H	Remove sediment shoals in Killick Creek which inhibit tidal flushing and flood discharge				
Objectives addressed	2, 3, 6, 7, 9, 10, 17 (refer Section 5)			**Option Reference**	Sed-3
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Conduct a detailed up-to-date hydrosurvey of the creek to determine locations and extents of shoals to be removed	2006	$10,000	Council	Electronic and hard copy of bathymetric survey, and compare to previous survey in Appendix D	Previous hydrosurvey was carried out in July 2001 (refer Appendix D), after major flooding in March 2001, and does not necessarily represent present day conditions. Dredging should target the upstream end of the marine flood tide delta, as well as expected shallow area at confluence of northern blind arm of estuary. Marine sand extraction would be subject to the provisions of the Coastal Policy 1997, and would require disposal within the active marine environment, either inside the estuary (as sub-aerial or sub-aqueous disposal), or as nourishment on the adjacent ocean beach.
Prepare detailed design and conduct an environmental impact assessment regarding the removal of the shoal(s), including sediment disposal options	2007	$60,000	Council	Approval to carry out the works	
Carry out dredging works in accordance with design and development consent conditions	2008	$200,000	Council	Works completed in compliance with design	
Monitor the potential impacts of the works on the wider environment, including the mobility of disposed material and re-accumulation within dredged channels, based on periodic resurvey, etc	2009 + ongoing	$5,000 p.a.	Council	Periodic reports on changes to estuarine environment and recovery from dredging works	

See Section 6.3.2.1 for further details of this strategy.

Strategy I	Upgrade existing Killick Creek floodgates to ensure they operate effectively				
Objectives addressed	3, 9, 13, 14, 15, 17 (refer Section 5)			**Option Reference**	FM-2
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Conduct an existing conditions assessment of the floodgates	2006	$5,000	Council	Report on existing condition of floodgates and recommendations for upgrade	Debris barrier would be similar in design to a large trash rack, whereby buoyant debris would be diverted into a side-storage bay, out of the main flow channel. Any works could be incorporated into works contract for the construction of new dropboards and other capital infrastructure associated with Strategy B
Repair / replace floodgates, as necessary	2007	$40,000	Council	New / modified floodgates, if necessary	
Council staff to make observations of floodgates during flood conditions to determine susceptibility to blockage by debris	2007 and ongoing	Staff time	Council staff	Records of observations	
Construction of a debris barrier, if necessary	As necessary	$40,000	Council	Completed structure in place, if considered necessary	

See Section 6.3.2.1 for further details of this strategy.

Strategy	Prepare a DCP for all new urban development around the estuary requiring adoption of improved watercycle management and on-site runoff management (eg rainwater tanks)				
Objectives addressed	1, 2 (refer Section 5)			**Option Reference**	WQ-14
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review requirements of BASIX and similar Urban Water Management DCP for other LGAs, eg Lake Macquarie, Newcastle, various in Sydney	2006	Staff time	Council	Scope for new DCP, which would cover state government requirements and represent current best practice	The introduction of BASIX to Kempsey Shire on 1 July 2005 already requires water usage of new developments to be reduced by 40% and greenhouse emissions by 25%. In addition to lot-based water management, new developments may contribute to regional water management facilities, such as wetlands, through the provisions of S94 of the EP&A Act 1979.
Prepare a new DCP for the whole of Kempsey Shire, if considered appropriate, or otherwise just for Crescent Head	2007	Staff time	Council	Draft DCP on Urban Water Management	
Seek endorsement and adoption of the DCP by Council	2008	Staff time	Council	Ratification by Council	
Undertake advertising and education of new DCP within community, as per standard Council process	2008	$5,000	Council	Advertising materials and public awareness	
Council staff to consider DCP when reviewing future proposals for development	2008	Staff time	Council	Incorporation of DCP into Council development assessment check-list	

See Section 6.3.2.3 for further details of this strategy.

Strategy K	Continued trials of improved backswamp management with targeted education of agricultural landholders regarding improved land management practices				
Objectives addressed	15, 16 (refer Section 5)			**Option Reference**	FM-6
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review scope and materials of previous landholder awareness program under the Macleay Floodplain Management Program	2007	Staff time	Council, DPI, CMA, DNR	Statement of scope of past educational awareness and associated success	Significant research is underway with regard to ASS management and the best ways for individual landholders to manage risks. Upper Belmore River is a state priority area and considerable work has already been done with landholders to improve land management practices. This strategy essentially continues the existing work with landholders in the area.
Hold discussions with DPI Agriculture and DNR and review best practice techniques for management of ASS	2007	Staff time	Council, DPI, CMA, DNR	Latest best management practices techniques	
Design and prepare appropriate educational material (brochures, kits, videos etc) regarding ways to improve ASS management	2008	$40,000	Council, CMA, DNR	Educational materials of various media	
Distribute education material to landholders within Upper Belmore River area	2009	$10,000	Council, CMA	No. of landholders receiving educational materials	
Encourage adoption of best management practices by landholders using incentives as necessary	2009	Staff time	Council, DNR	No. of landholders modifying practices based on education	

See Section 6.3.2.4 for further details of this strategy.

Strategy L	Conduct an agricultural and economic assessment of land practices within the Belmore River floodplain to determine ways of possibly improving discharge to Killick Creek				
Objectives addressed	16 (refer Section 5)			**Option Reference**	FM-4
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Hold discussions with individual landholders, Council and DPI (Agriculture) to ascertain existing management practices	2007	$10,000	Council, DPI, Consultant	Statement of existing management practices	Investigation stages of this strategy could be undertaken by a suitably qualified consultant(s), including an agricultural economist Regular and considerate consultation with landholders will be essential to the success of this strategy Assessment should extend to an economic appraisal of options to provide relative benefit/cost comparisons
Conduct review of national and international literature regarding potential for sea level rise and best practice for agriculture on ASS and sea-level rise prone floodplains	2007	$15,000	Council, DPI, Consultant	Report on best practice elsewhere	
Formulate and assess options for modification of existing practices, in consultation with landholders, Council and DPI (Agriculture) in order to minimise impacts (flows and pollutant loads) on Killick Creek and to abate potential threats of sea level rise	2008	$70,000	Council, DPI, Consultant	Report on outcomes of assessment of options for improving agricultural management in Belmore Swamp	
Implement changes to existing management practices, possibly with subsidies or other incentives to encourage uptake by landholders	2008 and ongoing	Depends on incentives offered	Landholders, DPI, Council	Number of landholders that adopt new management practices	

See Section 6.3.2.5 for further details of this strategy.

Strategy M	Carry out a water quality monitoring program for Killick Creek with a number of sites throughout the estuary to help determine ecosystem health and impacts of inputs				
Objectives addressed	1, 2 (refer Section 5)			**Option Reference**	WQ-13
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Prepare a pilot water quality monitoring program	2006	$5,000	Council	Detailed program of proposed monitoring	The pilot program would have an expanded scope of works, as it would ascertain the most appropriate parameters and site for on-going monitoring Monitoring could extend to benthic sampling as well as periodic ecological assessments, such as seagrass depth surveys and conditions assessment On-going monitoring program should match resourcing and funding availability and analytical limitations of lab, as well as environmental constraints
Implement the pilot program for a period of 12 months	2007	$50,000	Council	Results of monitoring for minimum of 12 month period, reported regularly to the EMC	
Assess the outcomes of the pilot program and make adjustments, as necessary, to the monitoring program	2008	$10,000	Council	Amended monitoring program	
Implement the modified water quality program	2008	$30,000 p.a.	Council	Reports on water quality monitoring results, provided periodically to the EMC	

See Section 6.3.2.6 for further details of this strategy and suggested monitoring sites for pilot program

Strategy N	Restore entrance training wall to current engineering standards, including a consistent and larger rock size, a geotextile filter, and appropriate provision for stormwater outlets				
Objectives addressed	6, 18 (refer Section 5)			**Option Reference**	FM-7
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Undertake a formal dilapidation survey of existing structure to determine extents of wall reconstruction required	2007	$5,000	Council	Dilapidation survey report	Proposed works should aim to reuse as much of the existing rock as possible. Adequate provisions will be required for stormwater drainage outlets. Consideration could be given to rationalising the number of stormwater outlets by combining drains within the caravan park Can be carried out in concert with revegetation of the foreshore behind the rock wall (Strategy O).
Conduct a detailed survey of the foreshore for detailed design and construction purposes	2007	$3,000	Council	Survey in electronic and hard copies suitable for design and construction	
Prepare detailed design and specifications for restoration works and undertake consultation with government agencies as necessary	2008	$30,000	Council	Detailed design, specifications and consents, as necessary	
Carry out construction works in accordance with design and development consent conditions	2009	$200,000	Council	Completed works in accordance with design and specifications	

See Section 6.3.3.5 for further details of this strategy.

Strategy O	Undertake re-vegetation of the riparian zone around the estuary, particularly the public lands behind the southern bank between the entrance and Muddy Arm				
Objectives addressed	11 (refer Section 5)			**Option Reference**	Ecol-3
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Prepare a Riparian Revegetation Management Plan for Killick Creek outlining areas, priorities, species and a program of works	2007	$5,000	Council	Plan of action for revegetation works	Vegetation Plan should use endemic species and be prepared by a qualified botanist familiar with local species and environment. Revegetation should focus on public lands surrounding the estuary. Revegetation should also be incorporated into the Crescent Head Caravan Park Plan of Management, and implemented accordingly. Revegetation can be used as a passive deterrent to prevent undesirable access to the waters edge (eg adjacent to the top of the rock wall, where there is some risk to the public)
Liaise with local landcare or other community organisations regarding voluntary services for undertaking revegetation works	2007	Staff time	Council	Agreement with community groups regarding revegetation	
Provide all necessary plants and resources required for volunteers to carry out the revegetation plan	2008 and on-going	$10,000 p.a.	Council, community groups	Length of foreshore revegetated	
Maintain revegetated areas, particularly during initial stages after planting	2008 and on-going	$2,000 p.a.	Council, community groups	Survival rate of revegetated plants / trees	

See Section 6.3.2.7 for further details of this strategy.

Strategy P	Carry out an environmental flows assessment to determine the maximum amount of discharge that can be accommodated by the estuary without significant degradation				
Objectives addressed	3, 6, 9, 10, 13, 14 (refer Section 5)			**Option Reference**	Multi-1
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review existing national and international literature regarding environmental flows to estuaries	2009	~$10,000	Council, DNR, consultant	Statement / report on existing practices for determining environmental flows to estuaries	Environmental flows to estuaries are a relatively new concept in Australia. Significant work has been carried out in South Africa which may be relevant. Most environmental flows work relates to an undersupply of freshwater, whereas Killick Creek potentially has an oversupply due to the flood discharges from Belmore Swamp.
Apply relevant framework for determination of adequate environmental flows in Killick Ck	2009	~$40,000	Council, DNR, consultant	Report on the outcomes of the environmental flows assessment	
Discuss outcomes of assessment with relevant authorities, stakeholders and landholders of the Belmore Swamp area	2009	Staff time	Council	Minutes of meetings / workshops where outcomes of assessment are discussed with key stakeholders etc	
Modify Floodgate Management Plan (see Strategy B) as appropriate to achieve adequate environmental flows in Killick Ck	2010	Staff time	Council, EMC	An amended Floodgate Management Plan	
Review operation of floodgates during flood and drainage conditions to ensure that environmental flows are being achieved	2010	~$10,000	Council, DNR, consultant	Statement / report on the outcomes of changes to floodgate management with respect to environmental flows	

Components of this strategy could be completed by tendering for an external consultant.

See Section 6.3.3.1 for further details of this strategy.

Strategy Q	Hydrologic and hydraulic modelling study of the Belmore Swamp area to identify efficiency of existing flood mitigation scheme and to assess possible alternatives				
Objectives addressed	15, 16, 17 (refer Section 5)			**Option Reference**	FM-3
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review existing hydraulic models of the Macleay River and floodplains	2009	~$5,000	Council, DNR, Consultant	Statement / report on status of existing models	Completion of this strategy may be tendered to a suitably qualified consultant. Modelling should adopted recognised best practice with respect to numerical approaches. Modelling should include the entire Macleay Flood Mitigation Scheme in so far as its potential impact on the Belmore Swamp area and contributions to Killick Creek.
Liaise with Belmore Swamp landholders to identify specific flow controls and operational procedures during and after floods	2009	~$5,000	Council, DNR, Consultant	Meeting notes from discussions	
Conduct ground survey of waterways, floodplains and channels / drains, as necessary to define the hydraulics of the system	2009	~$40,000	Council, DNR, Consultant	Digital and hard copies of ground survey	
Modify existing models, if appropriate, or construct new computational models of the Belmore Swamp section of the Macleay River flood mitigation scheme	2010	~$70,000	Council, DNR, Consultant	Electronic files for input and output of new computational model	
Discuss outcomes of modelling with stakeholders / landholders and formulate a series of possible options for improving the operation of the scheme	2010	~$5,000	Council, DNR, Consultant	Notes on meeting / workshop outcomes, including list of options to be assessed	
Simulate possible options by modifying conditions within the hydrologic and hydraulic model	2010	~$30,000	Council, DNR, Consultant	Modelling output results for options chosen to be simulated	
Provide recommendations on any changes to the scheme that will result in improved conditions for Killick Creek	2010	~$5,000	Council, DNR, Consultant	Detailed report on modelling outcomes and recommendations for modifications to the flood mitigation scheme	

See Section 6.3.3.2 for further details of this strategy.

Strategy R	Construct a block in the drain u/s of the floodgates to help control water levels in the drain and to induce sedimentation before agricultural sediment reaches the estuary				
Objectives addressed	9, 11 (refer Section 5)			**Option Reference**	Sed-2
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review the outcomes of the hydrology and hydraulic study of Belmore Swamp (refer Strategy Q) and determine the appropriateness of further blocks / dropboard structures within the drains	2011	Staff time	Council	Statement of outcomes from previous study and likely impacts of block in drain	This strategy may be carried out in tandem with Strategy Q. The block(s) / dropboards can be assessed using the numerical model developed for Strategy Q. Very close consultation with landholders will be required to fulfil the objectives of this strategy.
Liaise with landholders regarding the most appropriate location(s) for blocks within the drainage system to allow greater control of water for land management purposes	2011	Staff time	Council	Outcomes / meeting notes of landholder consultation	
Preparation of environmental assessments, detailed designs and construction of block(s) within the drainage system. Blocks should be adjustable and completely removable	2011	$100,000	Council	Authority approval and presence of block(s) in drainage system in accordance with design	
In consultation with landholders, review performance of blocks during flood, post-flood and non-flood times, and adjust design as necessary	2011	Staff time	Council	Performance review report, and adjustment to block(s) as necessary	

See Section 6.3.3.3 for further details of this strategy.

Strategy S	Assess wetland and estuarine habitat to identify critical habitat areas and Endangered Ecological Communities, and protect these areas through appropriate landuse zonings				
Objectives addressed	10, 11 (refer Section 5)			**Option Reference**	Ecol-2
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Carry out a detailed ecological survey of wetland areas, mapping habitats based on standard classifications and listed ecological communities	2010 (or 2006 – see comments)	$30,000	Council	Detailed report on ecological survey	Wetland Care Australia is currently mapping and assessment wetlands within the Kempsey LGA (part of the Sustainable Coastal Wetlands Project). As Council is currently reviewing their LEP, there is considerable benefit in fast-tracking this strategy to commence immediately (2006) so that any changes required due to environmental conservation are incorporated into the current LEP review process. A draft revised LEP is expected in early 2007.
Map areas of conservation significance, including EEC, coastal wetland etc	2010 (or 2006 – see comments)	$10,000	Council	GIS mapping layers of areas requiring protection	
Prepare a revision to the Kempsey LEP that changes the landuse zoning of the mapped areas (plus sufficient buffer distance) to an appropriate environmental protection zoning, in accordance with DoP LEP template	2010 (or 2006 – see comments)	Staff time	Council	Draft LEP amendment	
Following public exhibition, adopt the LEP revision and incorporate changes into the development assessment process	2010 (or 2007 – see comments)	Staff time	Council	Inclusion of LEP amendment into development assessment process	

See Section 6.3.3.4 for further details of this strategy.

Strategy T	Rezone the Killick Creek waterway to 'Environmental Protection' as part of the Kempsey LEP review to reflect the environmental significance of the estuary				
Objectives addressed	10, 11 (refer Section 5)			**Option Reference**	Ecol-1
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review zonings of estuaries and waterways in other LGAs	2010 (or 2006 – see comments)	Staff time	Council	Statement of review and recommendations for amendment to the LEP	As per Strategy S, there will be considerable benefit in fast-tracking this strategy to commence immediately (2006) so that any proposed changes can be incorporated into the current LEP review process (particularly as implementation of this strategy requires no specific funding). A draft revised LEP is expected in early 2007.
Prepare a revision to the Kempsey LEP that changes the landuse zoning of the Killick Creek waterway area to an appropriate environmental protection zoning, in accordance with DoP LEP template	2010 or (2006 – see comments)	Staff time	Council	Draft LEP amendment	
Following public exhibition, adopt the LEP revision and incorporate changes into the development assessment process	2010 or (2007 – see comments)	Staff time	Council	Inclusion of LEP amendment into development assessment process	

See Section 6.3.3.5 for further details of this strategy.

Strategy U	Conduct flora and fauna surveys of the waterway and the foreshore to provide better information on ecological values, and threats to these values, including weed invasion				
Objectives addressed	11 (refer Section 5)			**Option Reference**	Ecol-5
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Carry out a detailed ecological survey of the flora and fauna occurring within and around the Killick Creek estuary, including endangered species as well as pests and weed species	2011 + periodically	$50,000	Council, DEC	Survey reports	It is recommended that a baseline flora and fauna survey is carried out immediately to provide a basis of comparison for future surveys. Surveys should be conducted every 5 – 10 years or after significant changes to the physical environment (including major flooding or coastal storms). Flora and fauna surveys would be best conducted at the same time as habitat mapping – see Strategy S.
Map areas of occurrence of varies species and incorporate into DEC-NPWS and Council records	2011	$20,000	Council, DEC	Maps integrated into GIS	

See Section 6.3.3.6 for further details of this strategy.

Strategy V	Encourage on-site stormwater management for existing development within Crescent Head, including retrofitting rainwater tanks and using grass swales, where appropriate				
Objectives addressed	1, 2 (refer Section 5)			**Option Reference**	WQ-5
Actions	**Timing**	**Costs**	**Responsibilities**	**Measurables**	**Comments**
Review on-site stormwater management options for existing development adopted elsewhere, eg Newcastle	2009	Staff time	Council	Statement of review and scope for options to be offered to residents	Incentives offered to residents could involve discounted purchase of on-site management techniques, rate reductions or rebates, and one-off grants for implementation. Levies for regional stormwater management may be imposed on those residents not adopting on-site water management.
Prepare educational material for existing residents of Crescent Head regarding retrofitting on-site stormwater management, such as rainwater tanks	2009	$20,000	Council	Amount of material prepared, covering a range of media types	
Distribute educational material and hold follow-up consultation, eg workshops	2009	$10,000	Council	No. of residents receiving educational material	
Encourage uptake of on-site management options by offering incentives	2010 + ongoing	$20,000, but depends on incentives	Council	No. of residents who take up on-site stormwater management.	

See Section 6.3.3.7 for further details of this strategy.

7.6 Program for Implementation

Table 7.1 presents an indicative program for implementation of all the suggested management strategies. The table also distinguishes between one-off and on-going components of each strategy (where appropriate). This table can be used as reference to identify which strategies should be being carried out at any point in time over the next six years or so. Note that the periodic review process for the Management Plan may change this table somewhat in the future.

As outlined in Section 7.7, significant funds will be required to implement all of the strategies identified in this Estuary Management Plan. Council considers it highly unlikely that all strategies will be able to be implemented given limitations associated with funding and grant conditions (e.g. 1 to 1 funding, based on matching Council contributions). Therefore, the strategies in this Plan, and the indicative implementation program shown in Table 7.1, have been provided mostly for reference. Strategies should be implemented if and when appropriate funding becomes available, approximately in the implementation order presented in Table 7.1 and discussed previously in Section 7.4. Opportunities for seeking external funding are discussed in Section 7.7.

Table 7.1 Implementation Program for All Strategies

Strategy		2006	2007	2008	2009	2010	2011+
A	Entr. Policy						
B	Flood. Policy						
C	Meander corr.						
D	Leaky pits						
E	Bacteria monit.						
F	Cont. SWMP						
G	Entr. Signage						
H	Dredge shoals						
I	Upgrade flood.						
J	Develop. DCP						
K	Agric. Educ.						
L	Ag/econ assess						
M	WQ monit.						
N	Restore wall						
O	Riparian reveg						
P	Environ. flows						
Q	Swamp model						
R	Drain block						
S	Habitats & EEC						
T	Rezone water.						
U	F&F study						
V	On-site stmwtr						

One-off task *On-going task*

7.7 Funding Requirements and Opportunities

While a number of strategies can be implemented primarily by Council and other stakeholders as part of normal day-to-day duties, most strategies require some financial contribution, particularly for on-ground works, monitoring and further investigations. A breakdown of expenditure across all strategies over the first 6 year period is provided in Table 7.2.

Table 7.2 Financial Requirements for Implementation of Strategies

Strategy		2006	2007	2008	2009	2010	2011+	TOTAL
A	Entr. Policy	$10,000 maint	$10,000 maint	$10,000 maint	$10,000 maint	$10,000 maint	$10,000 maint	*$60,000*
B	Flood. Policy	$60,000 cap $40,000 maint	$40,000 maint	$40,000 maint	$40,000 maint	$40,000 maint	$40,000 maint	*$300,000*
C	Meander corr.	$35,000 cap	$15,000 cap					*$50,000*
D	Leaky pits	$28,000 cap						*$28,000*
E	Bacteria monit.	$1,000 cap $2,500 maint	$300 cap $2,500 maint	$2,500 maint	$2,500 maint	$2,500 maint	$2,500 maint	*$16,300*
F	Cont. SWMP	$5,000 cap	Costed as part of SWMP					*$5,000*
G	Entr. Signage	$1,000 cap $200 maint	$200 maint	$200 maint	$200 maint	$200 maint	$200 maint	*$2,200*
H	Dredge shoals	$10,000 cap	$60,000 cap	$200,000 cap	$5,000 maint	$5,000 maint	$5,000 maint	*$285,000*
I	Upgrade flood.	$5,000 cap	$40,000 cap					*$45,000*
J	Develop. DCP			$5,000 cap				*$5,000*
K	Agric. Educ.			$40,000 cap	$10,000 cap			*$50,000*
L	Ag/econ assess		$25,000 cap	$70,000 cap				*$95,000*
M	WQ monit.	$5,000 cap	$50,000 cap	$10,000 cap $30,000 maint	$30,000 maint	$30,000 maint	$30,000 maint	*$185,000*
N	Restore wall		$8,000 cap	$30,000 cap	$200,000 cap			*$238,000*
O	Riparian reveg		$5,000 cap	$10,000 cap $2,000 maint	$10,000 cap $2,000 maint	$10,000 cap $2,000 maint	$10,000 cap $2,000 maint	*$53,000*
P	Environ. flows				$50,000 cap	$10,000 cap		*$60,000*
Q	Swamp model				$50,000 cap	$110,000 cap		*$160,000*
R	Drain block						$100,000 cap	*$100,000*
S	Habitats & EEC					$40,000 cap		*$40,000*
T	Rezone water.					Staff time only costs		*$nil*
U	F&F study						$70,000 cap	*$70,000*
V	On-site stmwtr				$30,000 cap	$10,000 cap	$10,000 cap	*$50,000*
Capital Total		**$150,000**	**$203,300**	**$365,000**	**$350,000**	**$180,000**	**$190,000**	
Mainten. Total		**$52,700**	**$52,700**	**$84,700**	**$89,700**	**$89,700**	**$89,700**	

Approximately $1.85 million will be required to fully implement the Killick Creek Estuary Management Plan. A general breakdown of the key areas of expenditure for the next 6 years is as follows:

- $60,000 for entrance opening and management,
- $445,000 for agricultural drainage works, of which $180,000 (or ~$30,000 p.a.) is attributed to maintenance of the Killick drain automatic water quality probe,
- $365,000 for further investigations and studies (including meander correction assessment),
- $33,000 for stormwater works,
- $200,000 for water quality monitoring (~$30,000 p.a.),
- $285,000 for dredging works,
- $107,000 for community and landholder education, rebates etc,
- $240,000 for restoration of the entrance rock training wall,
- $110,000 for flora, fauna and habitat mapping, and
- $53,000 for revegetation works.

Council is expected to fund some of the works detailed in the Estuary Management Plan through environmental budget allocations of general revenue (particularly as an environmental levy is applied to landowners within the LGA). Given the high costs for overall implementation, however, the Plan will be reliant upon receiving external grants and funding to be successful, some of which will require matching funding from Council.

The **Northern Rivers Catchment Management Authority** (NRCMA) has recently prepared a draft Catchment Action Plan, which specifically targets implementation of natural resource management (NRM) activities identified in Estuary Management Plans (refer Section 1.4.19.2). NRM activities identified by this Estuary Management Plan include:

- Strategy D: installation of leaky pits to reduce pollutant inputs ($28,000);
- Strategy K: education of agricultural landholders regarding improved land management ($50,000);
- Strategy O: revegetation of riparian lands ($53,000);
- Strategy R: construction of a drain block for improved agricultural land management and rehabilitation ($100,000);
- Strategy S: Assessment of wetlands and EEC areas and protection of such areas ($40,000); and
- Strategy U: Flora and fauna surveys to identify assets and risks to habitats and communities ($70,000).

In addition to funding from the NRCMA, there are other state and federal government grant programs that should be explored for potential funding of various strategies outlined within this Estuary Management Plan. These grant programs include:

- Department of Natural Resources (DNR) Estuary Management grants (**note that works outlined in this Estuary Management Plan are eligible for part funding under the State Government's Estuary Management Program**);
- DNR Coastline Management grants;
- DNR Floodplain Management grants (noting that **almost $1.2 million** would be spent on works and further investigations associated with improving and rationalising drainage of the Lower Macleay River floodplain);
- DEC's Environment Trust Grants for:
  - Restoration and Rehabilitation;
  - Research; and
  - Education.
- NSW Maritime Authority's Infrastructure Grants Program (previously known as WADAMP grants); and
- DPI (Fisheries) Saltwater Recreational Fishing Trust.

In-kind contributions for completion of some of the elements of this Estuary Management Plan could also come from various educational institutions (such as universities), who could use the estuary for specific data collection or research projects. In-kind contributions could also come from volunteer community groups, such as Landcare, Creekcare, and schools.

Opportunities should also be explored to utilise environmentally-oriented volunteer teams, such as Greening Australia, Green Corps and Work for the Dole, to assist with physically demanding elements of the Plan, such as revegetation works.

Despite the above opportunities for funding, it is possible that financing the proposed strategies and works would be restricted by Council's ability to provide matching funding. Therefore, it is imperative that the highest priority strategies, particularly those strategies that have direct positive benefits for the local communities and economy, are carried out first to maintain community support for the Plan. In this regard, emphasis should be placed on securing funding for implementation of **Strategies A to I**, as a minimum 5 year target for the Plan (with a commensurate budget of $790,000, of which $240,000 is for maintaining the Killick Drain water quality probe, and $285,000 is for dredging of the entrance shoals). Significant community support would also be generated for **Strategies N and O** (restore entrance training wall and riparian revegetation: $290,000), which may also be fast-tracked if finances for undertaking all of the works are limited.

7.8 Performance Measures, Targets and Contingencies

The success of the Estuary Management Plan should be gauged through its ability to achieve the designated targets. The overarching targets are the Management Objectives, as described in Section 5. However, the timeframe for achieving some of these objectives is long (given the slow rate of vegetation establishment and growth, for example). To gain a better appreciation for the relative success of the Plan, a series of performance measures can be assessed on a periodic basis. Different types of performance measures are discussed in more detail below.

7.8.1 Primary Performance Measures

The first set of performance measures should ascertain whether the strategies are being implemented within the timeframe designated in the Plan. As such, the primary performance measures are simply a *measure of implementation*. Assuming that the Plan can be adopted by Council by early 2006, there are eleven (11) strategies that need to commence implementation within the 2006 calendar year, with a further four (4) strategies that need to commence before 2008 (refer Table 7.1).

The implementation of 15 separate strategies within 3 years means that many strategies will actually be carried out concurrently. Organisations responsible for implementation will need to review the Plan carefully and ensure that adequate resources are allocated to the various strategies to ensure that the timeframe for implementation is achieved.

Clearly, a high degree of co-ordination will be required to manage the successful implementation of all the strategies within the designated timeframe. This co-ordination should be facilitated by the Estuary Management Committee, who would be required to meet regularly to discuss and manage the implementation of the estuary management strategies.

If it is determined that the strategies are not being implemented to the nominated timeframe then one or both of the following *contingencies* should be adopted:

- Determine the cause for the delay in implementation. If delays are funding based, then seek alternative sources of funding, including a formal request to Council to increase contributions to the Plan. If delays are resource-based, seek additional assistance from stakeholder agencies and/or consider using an external consultancy to coordinate implementation of the Plan;
- Modify and update the Estuary Management Plan to reflect a timeframe for implementation that is more achievable. The revised Plan would need to be endorsed by all relevant stakeholders and agencies responsible for implementation.

7.8.2 Secondary Performance Measures

The second set of performance measures relate to *measuring specific outputs* from the individual strategies, as appropriate. The specific outputs from each action, or step, of each strategy, are provided within the Implementation Schedules (refer Section 7.5) under the 'measurables' column. These measurables define what the specific outcome from each action should be. If these outputs are delivered as defined, then the action (or strategy) is considered to have been successful.

In some cases, the nominated 'measurable' also identifies a specific tool for gauging the rate of implementation of specific actions. For example, the rate of implementation of riparian rehabilitation works can be 'measured' by determining the "length of foreshore revegetated" (refer Strategy M). In other cases, a one-off output is identified as the 'measurable', such as a specific report.

If specific outputs, as defined by the 'measurables', are not generated from implementation of the Plan then the following *contingencies* need to be adopted:

- Determine the reason for not producing the specified output. If the reason involves a lack of funding or resources, then similar contingency measures to those described for the primary performance measures (refer Section 7.8.1) should be adopted. If the reason is of a technical nature, then expertise in the area should be consulted to overcome the technical problem. DNR

and other government agencies should have the necessary in-house expertise to assist in most cases.

- Review the appropriateness of the specific output of the management strategy, and if necessary, modify the output described in the Plan to define a more achievable product.

7.8.3 Tertiary Performance Measures

The third set of performance measures are aimed at *measuring the outcomes of the Plan*, and as such relate to the specific management objectives of the Plan (as described in Section 5), and how implementation of the Plan has made a difference to the biophysical and social environments of Killick Creek (eg reduction in pollutant loads, improvement in swimming conditions, increase in biodiversity etc). The main mechanism for gauging whether these objectives have been achieved, or not, is monitoring. Therefore, monitoring of various elements of the physical, biological and social environment is an essential component of assessing the overall success of the Estuary Management Plan.

If, after a reasonable period of time, the specific objectives of the Plan are not being achieved by the strategies being implemented, then the following contingencies should be adopted:

- Carry out a formal review of the implemented management strategies, identifying possible avenues for increasing the effectiveness of the strategy in meeting the Plan objectives;
- Commence implementation of additional management strategies that may assist in meeting Plan objectives (possibly 'fast-track' some longer term strategies as necessary);
- Reconsider the objectives of the Plan to determine if they set impossible targets for future estuary conditions, and adjust the Plan, as necessary. Any such changes to the Plan would need to be endorsed by the stakeholders and relevant government agencies, as well as the public.

7.9 Factors for Success

The success of the Killick Creek Estuary Management Plan is dependent on the following factors:

- Agreement on the objectives, strategies and implementation schedules by all state and local government agencies, stakeholders and the general community;
- Understanding and acceptance of responsibilities for the implementation of the various aspects of the Plan;
- Commitment by those involved to dedicate appropriate time and resources to achieve the objectives and timeframe of the Plan;
- Sourcing of appropriate funds, through grants, user contributions, and in-kind commitments from community.

Possibly the most important of these is acceptance and agreement by the local community. Without significant support by the local community, Council and the other agencies will not receive the pressure to ensure that the long-term sustainable management of Killick Creek remains a high priority.

7.10 Future Reviews and Modifications or Amendments to the Plan

It is proposed that the Killick Creek Estuary Management Plan is reviewed on a regular basis, and completely updated within a period of about 5 years (all but two strategies within the Plan should commence implementation within a 5 year timeframe). The regular review of the Plan (which may occur annually, for example) is necessary to allow modifications / alterations to the management of the estuaries, on an as-needed basis, within the context of an adaptive management framework.

The periodic Estuary Management Plan reviews should cover the topics described in Table 7.3. This table also outlines who is responsible for conducting the periodic reviews.

Table 7.3 Framework for Future Estuary Management Plan Review

Review Period	Review tasks	Responsibility
Annual	• Assess primary, secondary and tertiary performance measures, and determine appropriate contingencies if performance measures do not meet targets • Review funding arrangements and allocations for current and future management strategies • Review resourcing and staffing allocations for current and future management strategies • Provide report on progress of Estuary Management Plan implementation, results of annual review, and any modifications required to the Plan coming out of the review	Estuary Management Committee or appointed external consultant* To be coordinated through Council and reported to Council, relevant stakeholders and government agencies
5 Yearly *(first review to be completed by end 2011)*	• Assess the overall effectiveness of each management strategy implemented to date • For strategies requiring on-going commitment, assess the value in maintaining implementation of those strategies • Reconsider the management options that were not short-listed and included in the original Plan (refer Section 6 for full list of previously identified options) • Provide implementation details of additional strategies that are to be included in the subsequent 5 year Plan • Update the Estuary Management Plan document to reflect proposed strategies for implementation over the next 5 year period, and seek endorsement by stakeholders, government agencies and the community.	Estuary Management Committee or appointed external consultant* To be coordinated through Council and reported to Council, relevant stakeholders government agencies and the general community

** It would be advantageous for the same consultant responsible for initially preparing the Estuary Management Plan to be involved in the annual review and 5-yearly update, given their appreciation of the study area and the details of the Plan and associated strategies.*

It is possible that the NSW Government's Estuary Management Program, under which this Plan has been prepared and will be implemented, may change in the future. A new Coastal Zone Management Manual is currently in preparation, and will combine and replace the existing Estuary Management Manual (1992) and the Coastline Management Manual (1990). Also, the role of the Northern Rivers Catchment Management Authority (NRCMA) in managing the coastal zone, including estuaries, is not yet clear. Therefore, on-going liaison between Council, NRCMA and DNR is necessary to ensure that the aims and objectives of the Killick Creek Estuary Management Plan continue to be achieved in the future.