

Macleay River Arm
Bank Rehabilitation Plan
Stuarts Point Caravan Park Foreshore



Prepared by Kempsey Shire Council
April 2009

EXECUTIVE SUMMARY

The subject site is located on the NSW Mid North Coast 500km north of Sydney on the western bank of the Macleay River adjacent to the Stuarts Point Caravan Park. Kempsey Shire Council manages the site on behalf of the owners, the NSW Department of Lands.

Riverbank erosion along the foreshore of the subject site is presently occurring from both natural processes and human-induced factors. The erosion is currently threatening public assets, increasing sedimentation and impacting on native vegetation.

There can be a number of factors that contribute to river bank erosion. They include (but are not limited to) altered flow patterns due to natural and human activities, tidal currents, flood events, wind and boat wave action and saturated bank soils.

The *Macleay River Arm Rehabilitation Management Plan – Stuarts Point Caravan Park* was developed for the purpose of addressing and managing erosion issues within the foreshore area. The objective of the Rehabilitation Plan is to provide a program of works and measures that identify the underlying causes of bank erosion, instability and implement strategies to address and remediate.

The Rehabilitation Plan has identified four (4) zones that require site specific erosion control and bank stability strategies. In general there are three (3) broadly defined remediation options. These options include Hard Structural options, Soft Structural options and combined hard & soft options.

A Development Application for the proposed remediation works has been submitted and forwarded to relevant state agencies. Funding for the project/strategies will be derived from a number of sources including Local Council, Northern Rivers Catchment Management Authority and NSW Regional Government programs.

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1.0 INTRODUCTION

1.1 GENERAL

The Macleay River Arm is an important natural resource of the Macleay River Estuary. As with many other similar coastal estuarine systems on the east coast of NSW the Macleay River Estuary has undergone a series of natural morphological changes and human-made morphological changes since European settlement.

Bank erosion along the shores of the lower Macleay River is presently occurring from both natural processes and human-induced factors. Within the Macleay Arm riverbank erosion is occurring along the western bank adjacent to the Stuarts Point Caravan Park. This erosion activity is currently threatening public assets along the foreshore area.

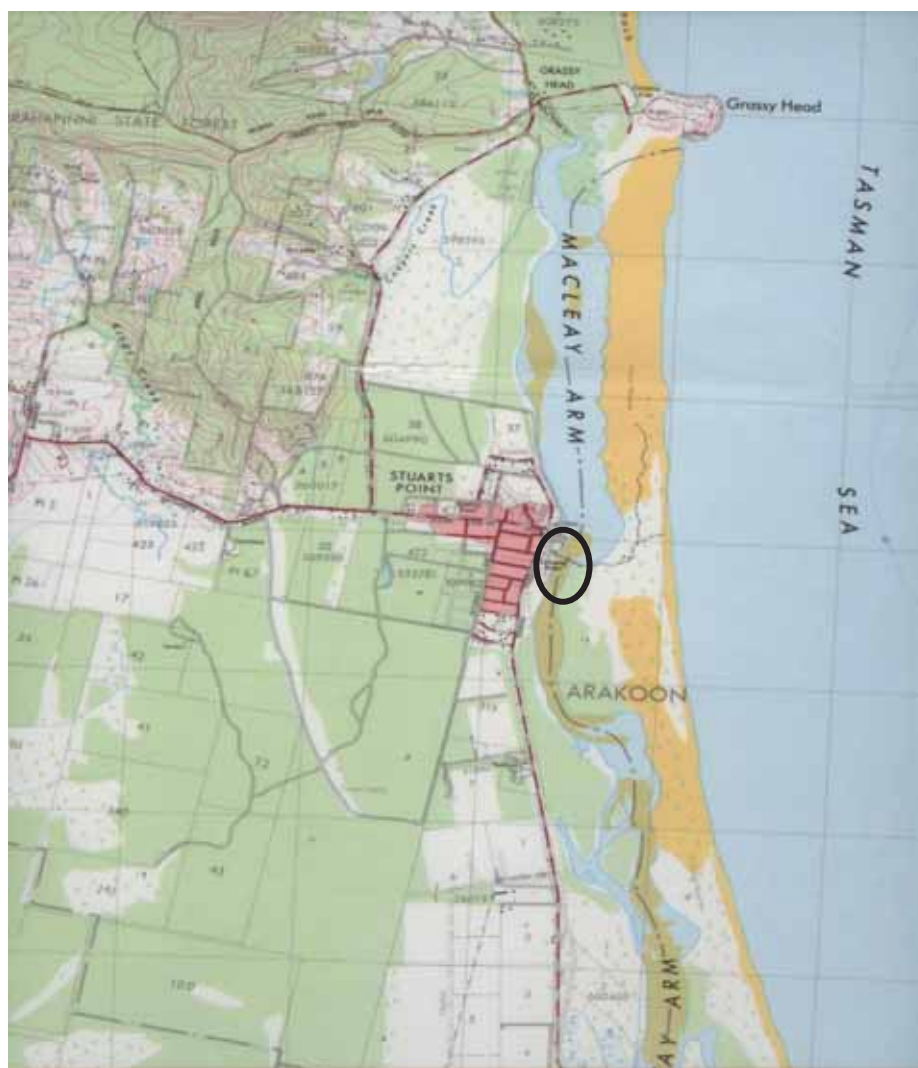


Figure 1 Location map showing Stuarts Point Caravan Park

1.2 ASSESSMENTS and REPORTS

In 1934 a report by the Department of Lands was commissioned into erosion of the Macleay River (Departmental Committee on Erosion – Macleay River Erosion 1934). In March 2004 GHD Consultants prepared a '*Design Report for River Bank Remediation*' Stuarts Point Caravan Park. In August 2005 GECO Environmental Consultants finalized the Macleay River Estuary Data Compilation Study to evaluate the adequacy of existing data and information to assist in the development of the Macleay River Estuary Management Plan (in progress). Supplementary to the Data Compilation a geomorphologic study of the Macleay River Estuary (Cohen 1995) was undertaken.

2.0 GEOMORPHOLOGICAL SETTING

The Macleay River estuary is a mature barrier-dominated system in a high-energy ocean wave setting (Cohen 2005). The Macleay River estuary is a filled (delta) system dominated by fluvial processes that can be broken in to three broad process zones that reflect differing degrees of fluvial and tidal interactions. They include; 1) the marine tidal delta, 2) fluvial marine transition zone and 3) fluvial zone. The Stuarts Point Caravan Park is located in the northern section of the Macleay Estuary Arm which is located in the marine tidal zone (Figure.2).

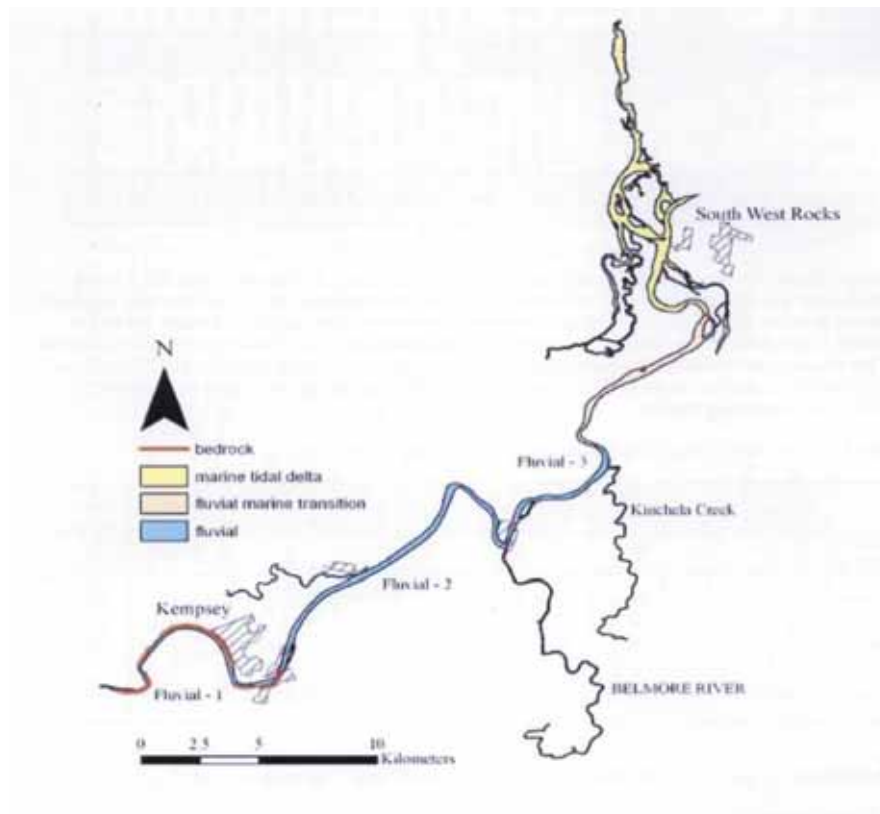


Figure 2 Distribution of process zones in the Macleay estuary (Cohen 2005)

The marine-flood tide process zone has been identified (Cohen 2005) as the most stable of the three process zones in regard to bank erosion, with 94% of the 70km assessed being stable and 6 % (3.8km) experiencing minor bank erosion.

3.0 EUROPEAN SETTLEMENT – Impact on Macleay Arm River Bank Erosion

The Macleay River Arm has undergone a number of changes since European settlement commence in 1835. Clement Hodgkinson when traveling by boat through the Macleay Valley documented when ascending the Macleay River in 1930's *'banks of extensive mangrove flats, thickets of myrtle palm and swamp oak which a few miles further were superseded by dense alluvial brushes rising like gigantic green walls on both sides of the river'*.

In 1827 timber cutters began to apply their trade in the area and by 1837 a ship building industry commenced at Stuarts point (GECO 2005). During this time the Macleay River entrance was at Grassy Head (see Fig). In 1888 Captain Howard when providing information to the report to Secretary of Public Works on options for fixing the Macleay Entrance described the river at Stuarts point as being *' 1400 ft wide and 8-12 feet deep over a clear sandy bottom '*.

Between 1863 and 1875 there were 18 flood events with eight being considered serious (GECO 2005). In 1886 a southerly gale opened a second entrance south of Stuarts Point and in 1893 a 1:100 year flood broke through the dunal system and in 1896 Public Works commenced work on a new entrance at South West Rocks.

In the Stuarts Point area the influence of European settlement has been significant and dramatic on both abiotic and biotic characteristics of the area. In the area immediate to the Stuarts Point Caravan Park riparian vegetation has been significantly cleared and the area and both the terrestrial and aquatic environments are extensively used by local and transient visitors.

The area is subject to relatively heavy boating and fishing activities. The boating activities are affecting the river banks contributing to erosion at the waterline interface. The banks of the river immediate to the Stuarts Point Caravan Park are mostly sand and as such are easily eroded by boat wave action.

4.0 METHOD ASSESSMENT

4.1 Erosion assessment

Cohen 2005, investigated the nature and extent of bank erosion at two partial scale (i.e. process zone and site specific scales).

The process-zone analysis reviewed existing information, developed maps from orthophotos, differentiated areas with similar characteristics, mapped major physical attributes and assessed relative contribution of fluvial and tidal processes.

The site specific analysis identified and mapped physical condition attributes focusing on the extent of bank erosion and supplemented that data with statistical information that quantified the relative extent of bank erosion classes, bank protection and riparian vegetation for each process zone.

<http://www.kempsey.nsw.gov.au/estuarymanagement.htm>

4.2 Visual Bank Assessment

Prior to finalising any specific approach to implementing remediation strategies based on the aforementioned assessment a site inspection and photographic documentation was undertaken.

4.3 Remediation assessment

The remediation assessment was undertaken using a combination of general riverbank erosion techniques (ie Rutherford *et.al* 2000) and a detailed site specific design report (GHD 2004)

5.0 OTHER MACLEAY RIVER ESTUARY MANAGEMENT PLANS

Other Plans of Management which address the long-term sustainability of the Macleay Estuary include;

- ***Macleay River Estuary Management Plan***

In 2004 Kempsey Shire Council in partnership with the Department of Natural Resources commenced the development of an Estuary Management Plan for the Macleay River Estuary. To date (Dec 07) a Data Compilation Study as been completed and the Estuary Processes Study is in the final stages.

- ***Yarrhapinni Wetlands Reserve Plan of Management 2001***

In 2001 the Yarrhapinni Plan of Management was developed as a working framework to guide the Reserve Trust's management of the wetlands.

- ***Mattys Flat and New Entrance Plan of Management 2006***

In 2006 the Mattys Flat Plan of Management was developed to assist Kempsey Shire Council and the Department of Lands in managing areas of public land within the immediate area.

6.0 STUARTS POINT CARAVAN PARK BANK EROSION

6.1 Site Description

The Stuarts Point Caravan Park (Figure 3) is located on the western bank of the Macleay River Arm approximately 7.5km north of New Entrance (outlet to the Pacific Ocean).

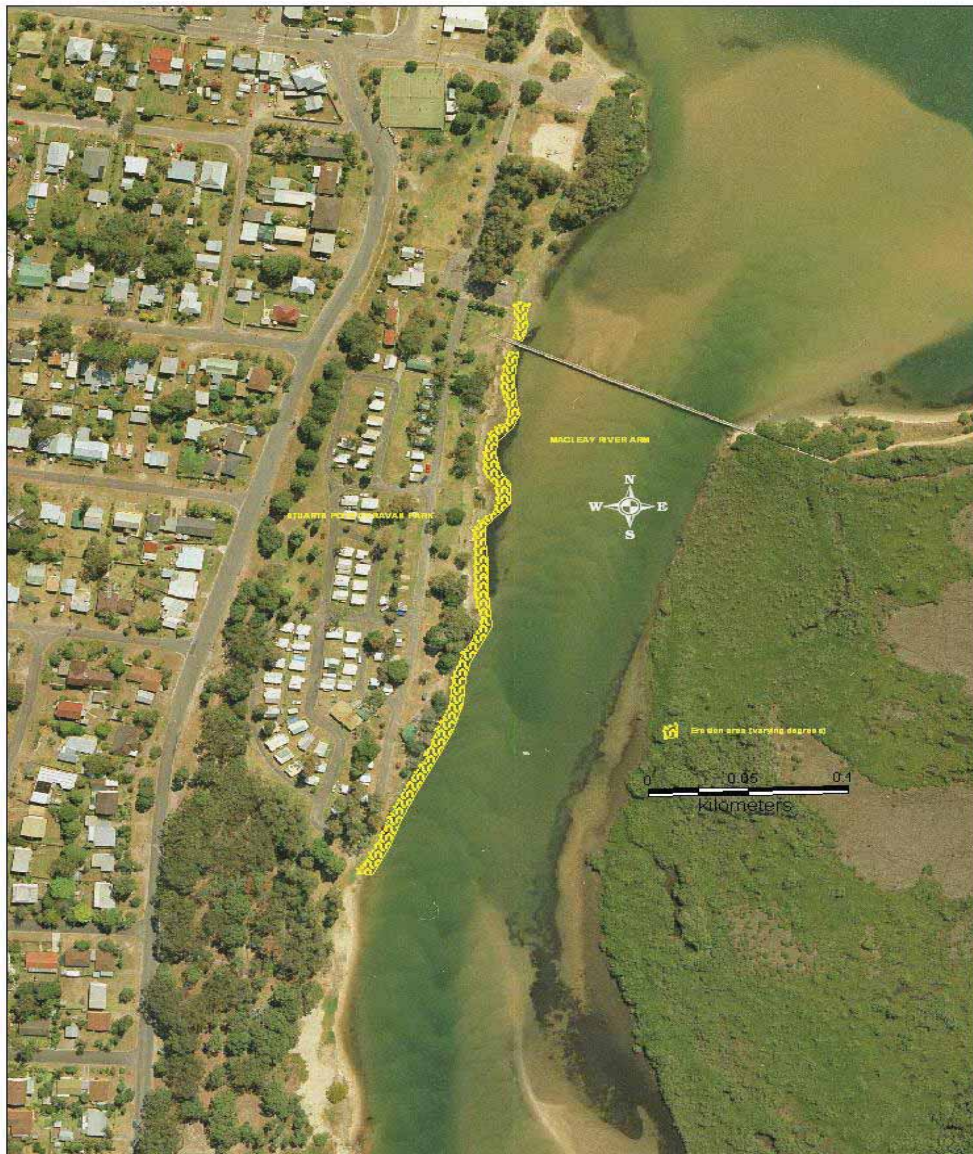


Figure 3 Image of Stuarts Point Caravan park and erosion areas

The Caravan Park is located on flood prone land (GHD 2004). A coastal dunal system separates the Macleay River Arm from the Pacific Ocean.

The Caravan Park has facilities for both permanent and transient users with public infrastructure such as public car park, boat ramp, playing ground and BBQ areas.



Figure 4 Public infrastructure under threat from bank erosion

6.2 Site Geology

The river bank area of the Stuarts Point Caravan Park are composed of an erodible alluvium that when exposed and unprotected erodes (GHD 2005). The river bank form varies from banks heights (at low tide) of around 0.3m, a flat beach gradient (Figure 5) to approx 1.8m (Figure 6)



Figure 5 Beach flat erosion



Figure 6 Steep bank erosion

7.0 FAILURE MECHANISM and REMEDIATION OPTIONS

7.1 Contributing Factors to Bank Erosion

In general there can be a number of factors that can result in or contribute to river bank erosion. They include (but are not limited to) altered flow patterns due to natural and human activities, tidal currents, flood events, wind and boat wave action and saturated bank soils.

The 2005 GHD report indicated that the section of the Macleay Arm adjacent to the Stuarts Point Caravan Park appears to be geologically stable (ie channel not moving closer to the river bank) and has reached an equilibrium. The report concluded the primary cause of river bank erosion, along the unprotected alluvium banks in the area appears to be as result of a process referred to as fretting (wave, tides and strong wind actions).

In addition, at some locations within the foreshore area there appears to be other factors contributing to the erosion, such as stormwater discharges.

7.2 Tidal Currents

The tidal range for the Macleay Arm at Stuarts Point are presented below
Table 1

Tide Levels		m AHD
Mean High Water Spring	MHWS	1.3
Mean High Water Neaps	MHWN	0.8
Mean Low Water Neaps	MLWN	0.6
Mean Low Water Spring	MLWS	0.1

Note: mean sea level in this vicinity is 0.7m (source GHD 2005)

7.3 Flood Velocities

During flood conditions, water can be discharged down river at high velocities, and can further increase outside (cut banks) of bends eroding and destabilising river banks. The rate of erodability and the stability of the bank is dependent on the characteristic of the bank material.

GHD (2005) made an assessment of peak flood levels within the area for the 1%, 2% and 5% Annual Exceedence Probability (AEP) events. These assessments were primarily based on the Macleay River Flood Study (PWD 1989). The AEP flood levels in the vicinity of Stuarts Point are presented below.

Table 2 Estimated Flood Levels (source GHD 2005)

Flood Levels		m AHD
5% AEP	2% AEP	1%AEP
2.1	2.52	3.1

The GDH (2005) report concluded that water depths for the 1% AEP close to the Macleay Arm (Stuarts Point) could reach a maximum of two (2) meters. The GHD (2005) report indicated that floodwaters in the area are essentially from backwater flooding with relatively low flood water velocities.

7.4 Wind & Boat Wave Action

Erosion of river banks due to wind action is largely dependent on the exposure of the site to significant wind fetches (TWEBMP 1998). The removal of riparian vegetation may impact on wind fetches increasing the effects of higher wind generated wave on exposed river banks.

The wake that is generated from navigating vessels (boats) can produce similar wave action to those generated by wind action. Many sites that are already affected by wind action can be compounded by the boat wave action. Areas of high vessel (boat) usage are at particular risk of boat wave erosion.

The Macleay Arm area at Stuarts Point and in particular the western bank of the Macleay Arm adjacent to the Stuarts Point Caravan Park is vulnerable to both high wind action and heavy boat usage. As a result of reduced/cleared riparian vegetation and the proximity to the coastal environment, the western bank is exposed to prevailing strong seasonal eastern winds.

8.0 MECHANISMS of BANK FAILURE

The contributing bank erosion factors result in various mechanisms of erosion such as surface scour of bank material, toe scour, loss internal strength (excessive pore pressure), and wave induced undercutting.

8.1 Surface Scour of Bank Material

Surface scour is usually the result of terrestrial activities, such as inciting gullies through exposing soils due to creating access tracks or disturbing riparian vegetation.

There are a number of surface scour locations within the Stuarts Point Caravan Park foreshore (Figure 7).



Figure 7 Showing surface scour resulting from pedestrian movement down the bank

8.2 Toe Scour of Bank

Toe bank scouring is the process where the toe or base of the river bank is undercut by the action of water movement. Banks with vertical faces and with little or no vegetation are the most common visible sign of river bank erosion caused by bank toe scouring.

Along the Stuarts Point Caravan park foreshore there are a number of locations showing the visible symptoms of bank toe scouring.



Figure 8 Image showing toe scour erosion along foreshore

8.3 Excessive Pore Water Pressure

When riverbanks are high, the seepage of ground water through the soil profile out through the exposed river bank may cause localized weakening of the bank structure. Excessive pore pressure associated with surface water runoff seeping through the bank may also result in the dislodgement of bank materials, resulting in a ‘piping failure’ of the bank (TWEBMP 1998).

As a result of geological characteristic of the Stuarts Point Caravan Park foreshores they are generally not exposed to erosion from such conditions.

8.4 Wave Induced Erosion

The symptoms associated with wave induced erosion caused by wind and/or boat action are generally only experienced to a lateral (generally narrow) zone immediately above and below the water line. However, given the variations in water levels from tidal influences the zone can vary in excess of 1.5 m up the bank face.

The GHD (2005) report indicated that this mechanism causing bank erosion is the primary cause of bank erosion along the Stuarts Point Caravan Park foreshore area.



Figure 9 Image showing wave induced erosion

10.0 REMEDIATION OPTIONS

Bank protection works that are installed solely in response to symptoms, (ie toe scouring), without addressing the underlying causes may result in limited or no successful outcomes and could possibly lead to new problems with the immediate area and/or down stream of the works. It is therefore imperative that the underlying causes of any erosion problems be understood.

The appropriate erosion management strategies selected will fundamentally be depend on any site specific considerations, the level existing development likely to be affected and any financial considerations. However, no matter whatever considerations are required to be assessed, all strategies undertaken to address river bank erosion need to be flexible and allow for changes to be made subject to monitoring.

10.1 Remediation Options

In general there are three (3) fundamental broadly defined option techniques;

1) Hard Structural Options

Hard structure options are primarily used on river banks that require significant immediate stabilisation and erosion protection. Generally, a physical barrier (ie rock wall, gabion baskets, sheet piling etc) is constructed and/or positioned along the river bank to abate any erosion mechanisms and physically hold back the toe or slope of river bank.

2) Soft Structural Options

Soft structure options employ erosion protection techniques using vegetation establishment to bind the river banks with roots of the vegetation. This type of strategy can be extremely useful in areas where erosion problems exist at the water line and can also have the ability to enhance the ecological integrity of the area.

3) Combined Hard & Soft Options

In some situations a combination of both hard and soft erosion strategies can be applied. A combination of hard and soft options can be effective in addressing erosion and bank stability and provide a more aesthetic approach. The hard and soft options approach can provide an immediate fix whilst facilitating the reestablishment of vegetation communities and integral to river health and function.

11.0 STUART POINT BANK EROSION ZONES and REMEDIATION OPTIONS

For the purpose of addressing erosion issues within foreshore area of the Stuarts Point Caravan Park, the river bank area has been divided into *zones* that will require site specific erosion control and bank stability strategies.

The area specific strategies identified to address specific area requirements have been determined given due consideration to the following factors;

- 1) bank profile
- 2) causes
- 3) evaluation of options
- 4) financial considerations
- 5) ecological benefits, and
- 6) social requirements

The following image shows the Stuarts Point Caravan Park foreshore erosion and remediation zones. The zones have been identified and determined via site inspections, geological characteristics and assessment of possible erosion remediation strategies.

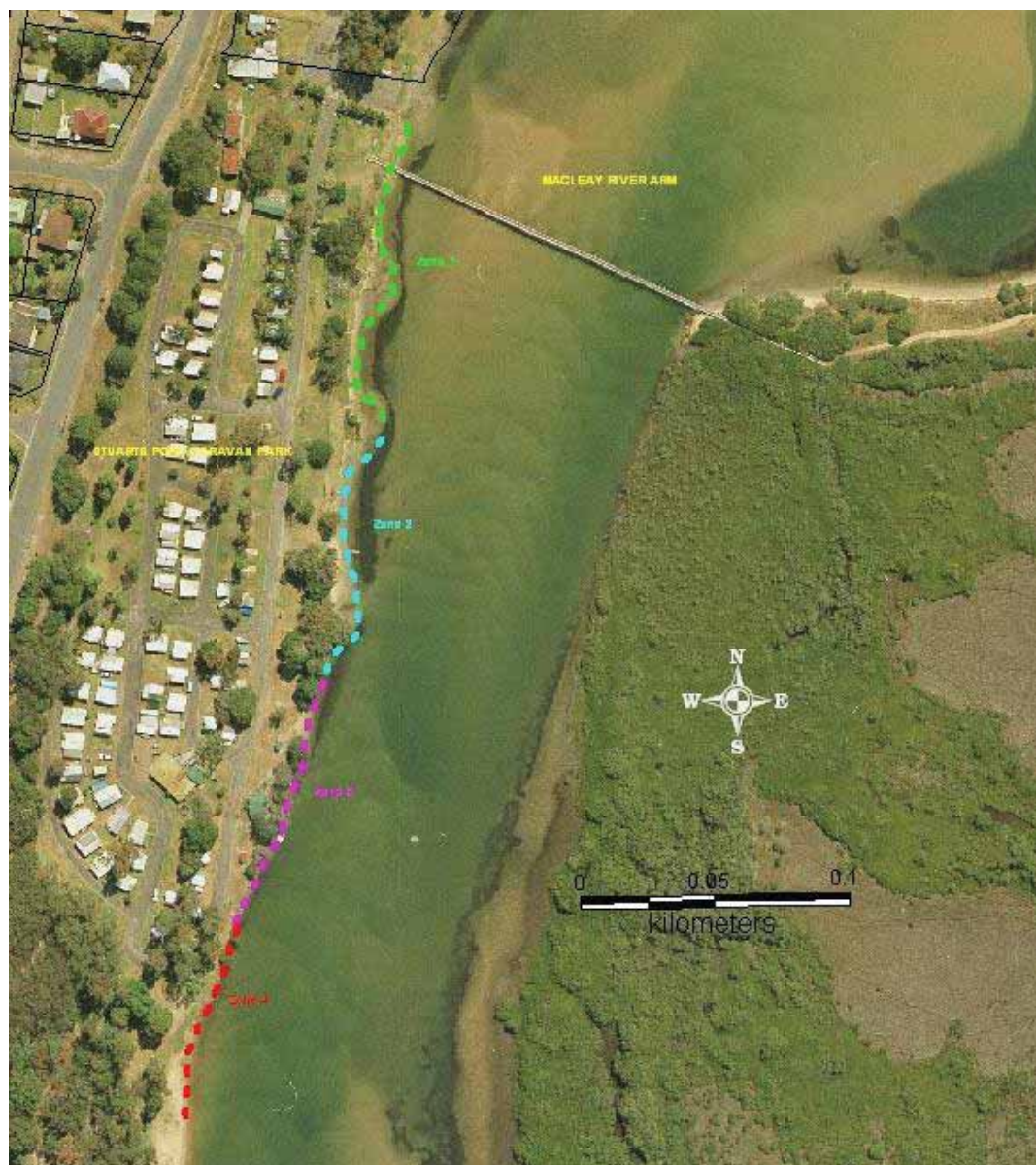


Figure 10. Erosion and remediation zones

12.0 OBJECTIVE OF REHABILITATION PLAN

The objective of the Macleay River Arm Bank Rehabilitation Management Plan – Stuarts Point Caravan Park is to provide an integrated program of works and measures that;

- a) Identify areas of current bank erosion and prioritise them in order of severity and degree of environmental, economic and social impacts
- b) Identify the underlying causes of bank erosion and instability, and
- c) Provide solutions to the problems

13.0 SUMMARY OF ISSUES

Bank erosion within the Stuarts Point Caravan Park foreshore area occurs as a result of different failure mechanisms which are both natural and man-made. They include surface scouring of bank material, toe scouring and bank failure, wave induced erosion.

Factors that result in the bank failure mechanism include tidal currents, river/flood velocities and boat and wind wave action.

Some of these mechanisms have been compounded by human activities including vegetation clearing and extensive use of the foreshore area for boating and recreational use.

A number of assessments of the foreshore area have been carried over the previous years. They include site assessment by relevant state agencies and government officials, reports prepared for Council, photo documentation.

From these assessments the foreshore condition was determined and areas of erosion prioritised based on the severity of erosion, observed rate of erosion, risk associated with on-going erosion.

The most common cause of river bank erosion along the Stuarts Point Caravan Park foreshore is wave induced erosion, generated by wave and/or boat wake wave action.

The erosion problems along the foreshore can be addressed by using a number of hard and soft structural and non-structural options.

14.0 MANAGEMENT PLAN ACTION

In excess of 90% of the Stuarts Point Caravan Park foreshore experiences bank erosion to some degree, ranging from minimal to severe.

The areas with the general geomorphic characteristic of beach flat gradient abutting banks with a bank height less than 0.4m (ie parts of Zone 1) were identified as minimal erosion activity areas, while areas of the foreshore with elevated bank height >0.4m (ie Zone 3) are experiencing more severe levels of erosion.

Although it is the intention to have all the eroded areas along Stuarts Point Caravan Park foreshore rehabilitated over time, a value judgment was made to address priority areas.

The priority classifications were underpinned by level and severity of erosion, risk to public safety, the threat to public infrastructure and indicative costs.

In addition to physical bank remediation works, a non-structural approach (ie information/awareness signage) will be included as part of the riverbank rehabilitation project in areas where existing vegetation is controlling erosion and where existing vegetation may be under threat.

The Stuarts Point Caravan Park foreshore is a very popular location and is extensively used by both local residents and holiday/tourist visitors. It is the intention of the Rehabilitation Plan to address the environmental needs (riverbank erosion) without impacting on the ability of the Caravan park foreshore to function as a social amenity.

In this regard, the Macleay Arm River Bank Rehabilitation Plan – Stuarts Point Caravan Park considers highly the communities expectations of the area when recommending riverbank erosion strategies.

Therefore, within a number of rehabilitation areas, public access and usage location (ie pedestrian steps, boat launching and mooring facilities) and environmental awareness infrastructure have been included.

15.0 REMEDIATION STRATEGIES

15.1 Zone 1



Figure 11 – Zone 1



Figure 12 – Zone 1

15.1.1 Description

Zone 1 consists of approximately 150 meters of low gradient beach flat sand bar with a general bank elevation < 0.3m. Vegetation cover on the top of the bank is primarily introduced grass species (kikuyu). Within Zone 1 there are some small isolated stands of intact mangrove, and a small number of large woody trees growing on the top of the bank.

15.1.2 Preferred Action

There are opportunities within Zone 1 to use hard structural, soft structural a combination of both and non-structural options. There are six (6) possible remediation options for zone 1. They include;

- Option A – Block Wall
- Option B – Rock Wall
- Option C – Timber Pole wall
- Option D – Physical Barriers
- Option E – Information/awareness strategy
- Option F – Gabion Wall

15.1.3 Erosion Areas

Given the bank geological characteristics and the high utilization of the area by both local and transient public, Options A & C have been identified as the two most preferred options to address and remediate the erosion areas of Zone 1 (refer Figures

13&14). Option A addresses the problem using a low level concrete block wall erected on a concrete footing. Option C requires the positioning of timber poles parallel to the bank. In regard to Option C, it is expected that in the near future the nearby pedestrian foot bridge will be replaced and as such timber from the old bridge could be utilised.



Figure 13. Proposed erosion remediation work – Zone 1



Figure 14. Proposed non-structural strategy for intact vegetation protection Zone 1.

15.1.4 Intact Vegetation Areas

It is a priority of this Rehabilitation Plan to ensure all intact native vegetation (Fig 15) remains and is protected from any possible future damage. To achieve this objective it is recommended that both Options D & E are implemented to ensure the integrity of the intact vegetation is sustained. They are;

Option D - Physical barriers

Physical barriers should be erected around the vegetated areas to restrict human access into the areas.

Option E - Information/awareness

To supplement the physical barriers, information/awareness signage is recommended to be erected, highlighting the importance of riparian vegetation.



Figure 15. Intact riparian vegetation to be protected



Figure 16. Intact riparian vegetation with signage and fencing

15.1.5 Performance Measures

Reduced bank fretting
 Increased vegetation growth with restricted area
 Controlled and improved pedestrian and boat management

15.1.6 Supplementary Works

Pedestrian step
 Boat mooring facilities
 Fish cleaning area.

14.1.7 Indicative costs

Erosion area

Option A -	=	\$64,560.00
Option C -	=	\$18,915.00

Intact Vegetation Zone

Option D -	=	\$2500.00
Option E -	=	\$1000.00

Supplementary Works

Steps	=	\$2700.00
Boat mooring	=	\$10,000.00

15.1.8 Priority

Medium

14.2 Zone 2



Figure 17 – Zone 2



Figure 18 – Zone 2

15.2.1 Description

Zone 2 consists of approximately 110 meters of low gradient beach flat sand bar with a general bank elevation $< 0.3\text{m}$ in the northern section to much steeper bank formation (ie $> 1.0\text{m}$) in the southern section. Vegetation cover on the top of the bank is primarily introduced grass species (kikuyu). Within Zone 2 there is an isolated stand of intact mangrove in the northern section, with a small number of large woody trees growing on the top of the bank. There are a number of large woody trees that are currently under threat of being toppled over due to toe scouring action.

15.2.2 Preferred Action

There are opportunities within Zone 2 to use hard structural, soft structural a combination of both and non-structural options. There are five (6) possible remediation options for zone 2. They include;

- Option A – Block Wall
- Option B – Rock Wall
- Option C – Timber Pole wall
- Option D – Physical Barriers
- Option E – Information/awareness strategy
- Option F – Gabion Wall

Given the bank geological characteristics and the high utilization of the area by both local and transient public, Options B, C & F have been identified as the three most preferred options to address and remediate the erosion areas of Zone 2 (refer Figures 17&18). Options C can be utilised to address the problem using timber poles in the northern section of the Zone 2. Given the geological characteristic of the riverbank in the southern section of Zone 2, Options B & F are the preferred remediation options.

Option F requires a gabion basket wall (refer to figure 19) to be erected to the height of the river bank and possible infilling of any exposed areas between the gabion wall and river bank.

Option B requires the positioning of large rocks adjacent to the erosion area which will require some infilling between the positioned rock and the bank. In regard to Option C, it is expected that in the near future the nearby pedestrian foot bridge will be replaced and as such timber from the old bridge could be utilized.

15.2.3 Erosion Areas

- Option B - Rock Wall
- Option F – Gabion Wall
- Option C – Timber Pole wall

15.2.4 Intact Vegetation Areas

Option D) Physical barriers

Physical barriers should be erected around the vegetated areas to restrict human access into the areas.

Option E) Information/awareness

To supplement the physical barriers, information/awareness signage is recommended to be erected, highlighting the importance of riparian vegetation.

15.2.5 Performance Measures

- Reduced bank fretting
- Increased vegetation growth with restricted area
- Controlled and improved pedestrian and boat management



Figure 19

15.2.6 Supplementary Works

Not required

15.2.7 Indicative costs

Erosion Areas	
Option C	=\$20,000.00
Option F	=\$15,000.00
Intact Vegetation Zone	
Option D -	=\$2,000.00
Option E –	=\$1,000.00
Supplementary Works	
Steps	=\$2,700.00
Boat mooring	=\$6,000.00
Fish clearing table	=\$5,000.00

15.2.8 Priority

High

15.3 Zone 3



Figure 20 – Zone 3



Figure 21 – Zone 3

15.3.1 Description

Zone 3 riverbank geomorphologic characteristic is of average bank height $> 1.2\text{m}$ where severe toe scouring of the bank is occurring. Within Zone a number of large woody trees have their roots exposed and are under threat of undermining and toppling over.

Zone 3 also includes the Caravan Parks ‘camp kitchen’ where a high level of human use of the area is concentrated. In addition, to the camp kitchen timber steps have been erected to allow access to two wooden fish cleaning tables that are located within the tidal zone.

15.3.2 Preferred Action

There are limited opportunities within Zone 3 when considering hard structural options. The two (2) most probable options are;

- Option A – Block Wall
- Option F – Gabion Wall

Due to the logistical issues Option C was not considered a feasible option within Zone 3.

15.3.3 Erosion Areas

Option F – Gabion Wall

Due to the steepness of the banks, level and severity of the current erosion condition of the bank, the immediate threat to park infrastructure and the high usage rate of the area for boating and fishing activates, it is recommended that a Gabion wall (Option F) be erected within area to abut the eroded bank.

Within Zone 3 there will be the requirement to remove and/or shape some of the exposed tree roots to accommodate the location and erection of the gabion wall.

15.3.4 Intact Vegetation

Sections of Zone 3 have large woody trees growing on the river bank edge, many have exposed root systems and are under threat of toppling over.

In the situation where the proposed gabion wall may be damage or under threat from existing unstable large woody trees, such trees should be cut at the base, making all efforts not to disturb the root system. Where large woody trees are required to be felled, new suitable native species should be planted.

15.3.5 Performance Measures

- Reduced foreshore recession and bank steepness
- Reduced slumping and bank undercutting
- Improved and safer facilities



Figure 22 – Block Wall



Figure 23 – Gabion Wall

15.3.6 Supplementary Works

- Pedestrian step
- Boat mooring facilities
- Fish cleaning area
- Tree/vegetation planting

15.3.7 Indicative costs

Erosion Areas	
Option A	= \$60,000.00
Option B	= \$20,000.00
Option F	= \$36,000.00
Intact Vegetation Areas	
Tree lopping and planting	= \$5,000.00
Supplementary Woks	
Steps	= \$2,000.00
Boat Mooring	= \$6,000.00
Fish Cleaning Table	= \$5,000.00

15.3.8 Priority

High

15.4. Zone 4



Figure 24 – Zone 4



Figure 25 – Zone 4

15.4.1 Description

Zone 4 consists of approximately 150 meters of low gradient beach flat sand bar with a general bank elevation < 0.5m. In the northern area of Zone 4 large rocks have been previously placed in some locations to abate erosion actions. This activity appears to have been successful where it has been used. Vegetation cover on the top of the bank is primarily introduced grass species (kikuyu). Within Zone 4 there are a small number of large woody trees growing on the top of the bank.

15.4.2 Preferred Action

There are opportunities within Zone 4 to use hard structural, soft structural a combination of both and non-structural options. There are five (5) possible remediation options for zone 4. They include;

- Option A – Block Wall
- Option B – Rock Wall
- Option C – Timber Pole wall
- Option D – Physical Barriers
- Option E – Information/awareness strategy
- Option F – Gabion Wall

Within the northern section of Zone 4 there have been previous efforts to address erosion at specific locations by positioning large rocks against the eroding bank. Where this activity has occurred it appears that the erosion within those areas has been controlled. In the southern section of Zone 4 no previous erosion control measures have been undertaken and subsequently erosion in this area is evident.

Based on the apparent successful outcomes from the previous erosion control measures, and the geological characteristic of the foreshore bank and the ability of heavy machinery to access the area, it is recommended that a low level (to bank height) rock wall (Option B) be considered for this area.

15.4.3 Erosion Areas

Option B – Rock Wall

15.4.4 Intact Vegetation Areas

There are limited areas of intact riparian vegetation within Zone 4. However, where intact vegetation exists the following options should be considered;

Option D) Physical barriers

Physical barriers should be erected around the vegetated areas to restrict human access into the areas.

Option E) Information/awareness

To supplement the physical barriers, information/awareness signage is recommended to be erected, highlighting the importance of riparian vegetation.

15.4.5 Preferred Action

Option B – Rock Wall

In some locations within the northern section of Zone 4 large rocks have been positioned in the past to address erosion. This activity appears to have been successful in controlling erosion where the rocks have been placed. It is recommended that a similar strategy be undertaken within the entire length of Zone 4.

It is also recommended that boat launching and mooring in this area be discouraged.

15.4.6 Performance Measures

Reduced bank fretting

Reduced bank undercutting



Figure 26



Figure 27

15.4.7 Supplementary Works

There may be opportunities within the southern section of Zone 4 to construct a rock fillet to assist in mangrove re-colonisation and to plant native riparian vegetation along sections of the foreshore bank.

15.4.8 Indicative costs

Erosion Areas	
Option B	= \$30,550.00
Supplementary Works	
Rock fillet	= \$15,000.00
Vegetation planting	= \$5,000.00

15.4.9 Priority

Medium

16.0 RESPONSILITIES FOR BANK EROSION

The entire foreshore area relevant to this erosion management plan is entirely within the Stuarts Point Caravan Park; hence it is ultimately the responsibility of the Caravan Park management to address the erosion which has manifested along the Caravan Park foreshore.

There is a need to make certain that any adopted bank protection activity is properly engineered and constructed to ensure;

- 1) effective and sustained erosion control, and
- 2) the health and safety of caravan park and foreshore users.

The Stuarts Point Caravan Park management needs to make a valued judgment on the net benefits of bank erosion protection and weigh them against alternative actions such as “do nothing” in regards to park asset management and caravan park user values.

In determining the level of commitment to arresting bank erosion the Stuarts Point Caravan Park management, may have to look at current foreshore usage and the associated impacts and give due consideration to possible alternatives. For example, selecting most appropriate locations for infrastructure positioning that will still provide for the needs and requirement of park users without resulting in continued and/or additional erosion management issues.

17.0 OTHER FUTURE ACTIONS

17.1 On-going Bank Monitoring

The Stuarts Point Caravan Park management and Kempsey Shire Council require the development of a monitoring program to determine if the benefits of the bank protection and any other associated works are successfully achieving their objectives.

It is recommended the monitoring program include;

- 1) photographic register
- 2) bank profile surveys
- 3) community responses

17.2 Community Awareness Program

In order to raise general community and caravan park users awareness regarding river bank management, consideration should be given to implementing a community awareness program on bank erosion processes. This program could include the following mechanisms;

- 1) Information brochures
- 2) News paper articles
- 3) Demonstration site
- 4) Educational material such as on site signage

18.0 REFERENCE

Cohen, T (2005) *The Geomorphology of the Macleay River Estuary, A Report prepared for Kempsey Shire Council.*

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Tweed River Estuary Bank Management Plan (1998), Produced for the Tweed River Management Plan Advisory Committee