



Riverbank Erosion Assessment

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NORTHEAST BUSINESS PARK RIVERBANK EROSION ASSESSMENT

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EXECUTIVE SUMMARY

Cardno (Qld) Pty Ltd was commissioned by Northeast Business Park Pty Ltd to undertake an assessment of riverbank erosion within the lower reaches of the Caboolture River. This assessment has been undertaken to support an Environmental Impact Statement that has been prepared for a multi-use business park and marina development known as the Northeast Business Park (NEBP). The NEBP is situated on land fronting 9km of the Caboolture River, some 7.5km from the river mouth within the tidally influenced section of the river. This assessment addresses section 4.5.2 of the Terms of Reference, which was issued by the Coordinator-General in December 2006 in respect of the Environmental Impact Statement for the NEBP.

Riverbank erosion is an important issue for coastal development, particularly in essentially undeveloped waterways such as the Caboolture River. While rivers and estuaries are highly dynamic and erosion is a naturally occurring phenomenon, the process of erosion can change when human activities within river catchments interfere with normal environmental conditions, increasing rates of erosion beyond environmentally benign levels. A literature review was undertaken and anthropogenic activities which are identified in relevant literature sources as potential factors contributing to accelerated erosion include:

- clearing of fringing vegetation;
- grazing of stock, coastal development;
- alterations in stormwater runoff patterns;
- poor water quality;
- dredging; and
- boat wash.

This riverbank erosion assessment was undertaken on a study area extending from a location upstream of the NEBP project area to the lower reaches of the Caboolture River.

Characteristics considered in this assessment of erosion included channel geometry, adjacent land uses, depth and composition of fringing vegetation, and bank properties.

The aim of this study is two-fold. Initially this study is to provide baseline monitoring data on the extent of riverbank erosion on the Caboolture River (including estuary) and to identify some possible local causes of this erosion to determine any potential impacts from the proposed development and identify possible strategies for the management of erosion. Secondly this study aims to identify suitable permanent monitoring points to take repeated observations over time to enable meaningful monitoring of erosion which will inform the design and priority of future restoration projects to address potential impacts from the NEBP development.

An analysis of historical photography and bathymetric surveys was used to assess changes to riverbank alignment over time and identify reaches of the river with similar characteristics to inform sampling methodology and intensity. Historical photography and bathymetric surveys are provided in Appendix A and B respectively. Figure 1 illustrates the extent of the study area and the river reaches recognised for the assessment.

The assessment of historical aerial photography over a period of 50 years identified no significant change to river alignment. While erosion was evident this supports expert findings that a significant change to river alignment from erosion is a lengthy process. Minor downstream shift of river material has occurred in the last 10 years elevating the bed level at the river mouth and necessitating dredging of the Caboolture River estuary to maintain navigational depth.

The extent of fringing vegetation differed significantly along the length of the study area. Wide riparian zones were noted closer to the river mouth where existing protected areas are located (including the Moreton Bay Ramsar Wetland). Riparian buffers generally decreased in size travelling upstream, where land was increasingly modified. Modifications were generally for farming purposes and cattle were observed along large portions of riverbank where riparian vegetation had been cleared and replaced with pasture. Further upstream, tidal structures associated with residential development such as ramps, jetties, slipways and rock walls were common, particularly on the left riverbank (looking downstream).

The study area was divided into a number of reaches for the purposes of reporting. Each reach comprises a continuous section of river with broadly similar characteristics. Within each reach, data was recorded on the vegetation type and value, adjacent land uses, bank properties and artificial structures. Four classifications were derived to describe the level of actual and potential erosion status of riverbanks, and the length of each classification present in each reach has been recorded. Figure 2 illustrates erosion classes along the length of the study area with baseline data presented in Appendix C.

Erosion was predominantly present within the upper reaches of the study area. Scour affected all banks along the entire length of the study area, but had a more pronounced impact in the lower reaches of the study area. Wind and wave action in this area increases the potential for erosion.

Severe erosion was found in close proximity to the NEBP project area in reaches 6-9. This erosion corresponds to an increase in modified land uses, specifically grazing and forestry which are practised adjacent to the NEBP.

Both left and right river banks were assessed, comprising a total of approximately 34 km of riverbank. In total some 9km of the riverbank was classified as severely eroded, with approximately 12km of riverbank showing signs of some erosion. 12km of riverbank was classified as erosion class 3, defined as erosion was not evident but with potential for erosion. Approximately 1km of riverbank was classified as erosion class 4, defined as not currently eroded and unlikely to be eroded in the near future. Areas of erosion class 4 generally included developed land with, for example, a rock wall. However this class does not represent the total of riverbank that has been developed as in some areas tidal works have significantly increased erosion and erosion classes 1 or 2 were applied.

Erosion was clearly evident on both the left and right bank of the Caboolture River. However the scale of erosion varied significantly between banks. The left bank (looking downstream) is far more eroded compared to the right bank, as a result of the increased land management and use on the left bank. Severe riverbank erosion on both banks was particularly concentrated at points where the river meandered.

The assessment results suggest that in terms of general erosion, a steep slope combined with minimal vegetation cover (altered land uses) decrease stability and are significant attributes influencing erosion in the study area. Figures 3 and 4 illustrate the slope and shape respectively within the defined study area for both riverbanks.

A mixed riparian vegetation in the upper reaches of the study area significantly influenced erosion, compared to the mangrove dominated riparian vegetation closer to the river mouth. When mangroves (with pneumatophores) dominated the riverbank, they appeared to aid in anchoring sediment and increasing bank stability. Riparian vegetation has also been shown to absorb wave energy, reducing the potential for boat wash to undermine banks.

Based on results of the riverbank assessment, the existing pressures on the natural erosion processes within the Caboolture River in approximate order of importance are:

- riparian zone degradation caused by vegetation removal, weeds and stock (altered land uses);
- surface runoff;
- tidal flows;
- coastal development; and
- boat wash.

Riverbank erosion is not a local issue but a regional issue requiring long-term catchment focused management programs to address widespread causes of riverbank erosion within the Caboolture River. Such programs require the cooperation of local authorities, landowners and river users. No consistent principles for waterway protection have been developed at the regional level, however riverbank management strategies generally focus on improving riparian vegetation at a catchment level, in combination with planning and development controls imposed by Local Governments.

The NEBP development proposal will alter existing land parcels fronting Caboolture River from cleared former pine plantation use to urban development. As part of this proposal the Proponent has placed a great emphasis on the design, construction and operational of the NEBP development to determine and mitigate potential impacts through good environmental, social and economic planning.

The Proponent proposes the following initiatives to address existing and potential impacts on erosion arising from the NEBP development.

- revegetation and rehabilitation of 9km of the riparian zone on the right bank within the NEBP project area that is severely degraded;
- maintaining a 100m riparian buffer between the development and high water mark (with the exception of the marina lock allowing boat access to and from the Caboolture River by marina users);
- developing a funding model through a component of the marina berth and dry storage levy that will be allocated to a trust administered by local environmental catchment groups to restore eroded areas downstream of the NEBP project area;
- leading by example being a responsible developer and erosion conscious private land owner;
- investing \$18 million in managing stormwater runoff from a previously unmanaged 769 ha former pine plantation;
- committing to a mariner education program by the Marina Management about the Caboolture River ecosystem;
- adhering to Government objectives for protecting and preserving the environment;
- implementing an improved and managed (regulated) boat speed environment within the Caboolture River; and
- undertaking an erosion monitoring program to measure potential impacts on riverbanks from the Caboolture River estuary to upstream of the NEBP project area.

In conclusion, the combination of initiatives proposed by the Proponent for mitigating riverbank erosion will result in a significant improvement to the Caboolture River within the project area by stabilising bank properties thereby reducing the effects of boat wash and improving water quality in a degraded system. The result of these initiatives will benefit all those in the community that use the river and enjoy its environmental amenity and aspects whilst providing a development which advances the identity and prosperity of the Caboolture region and ecological health of the Caboolture River.

1. INTRODUCTION

Cardno (Qld) Pty Ltd (Cardno) has been commissioned by Northeast Business Park Pty Ltd ("Proponent") to undertake an assessment of existing riverbank erosion within the lower reaches of the Caboolture River to address section 4.5.2 of the Terms of Reference for an Environmental Impact Statement (EIS) for an integrated business park and marina concept.

This riverbank erosion assessment has been undertaken to inform the decision making regarding the proposed Northeast Business Park (NEBP), which is located on the Caboolture River approximately 7.5km from the estuary (or 4.8km in a direct line).

The NEBP development proposal involves a business park and a 911 wet berth marina (including 300 - 500 dry berths) concept that will integrate appropriate business, industry, commercial, marina facilities, residential, heritage and recreational greenspace precincts. The NEBP will provide a place to live, to work and to play in a master planned riverside precinct. This proposal also involves dredging the existing navigational channel within the Caboolture River from the estuary 6.5km upstream to provide an adequate navigation depth (3m at Lowest Astronomical Tide) for marina users.

The project area is bounded to the north by 9km of Caboolture River frontage. An increase in riverbank erosion has been identified as a potential impact from the development proposal because of land use changes associated with the proposed NEBP development from pine plantation to urban development and from the substantial predicted increase in boat traffic on the Caboolture River which is listed as an undeveloped waterway (EPA, 2006).

The NEBP development offers an opportunity for a private landowner to play a role in the protection and enhancement of the Caboolture River, by reducing existing pressures affecting riverbank erosion rates through improved stormwater management and riparian restoration, whilst providing the last viable opportunity for a substantial marina between Brisbane and Mooloolaba to meet regional and state demand for industry growth. In short, the NEBP development presents the opportunity to transform a heavily degraded former pine plantation into an integrated, holistic, landmark development thereby changing the face and advancing the identity, ecological health and prosperity of the Caboolture region.

The aim of this study is two-fold. Initially this study is to provide baseline monitoring data on the extent of riverbank erosion on the Caboolture River (including estuary) and to identify some possible local causes of this erosion, particularly those that result of past and present human activities to direct a discussion on riverbank management. This is to inform the design, construction and management of the NEBP development. Secondly this study aims to identify suitable permanent monitoring points to take repeated observations over time. This will enable meaningful monitoring of riverbank erosion over time and will inform the design of future restoration projects to address potential impacts from the NEBP development.

This report includes:

- a background to riverbank erosion, erosion mechanisms and erosion causes;
- a site description;
- comparison of aerial photography and bathymetric surveys;
- an assessment of baseline data from a riverbank erosion field investigation;
- proposed monitoring program;
- discussion of results which are relevant for the NEBP development proposal; and
- literature review on existing riverbank erosion management strategies to address identified pressures.

2. RIVERBANK EROSION – LITERATURE REVIEW

To fulfil the aims of this study it is important to understand erosion and factors affecting erosion. A number of national and international papers have focused on riverbank erosion against the backdrop of overall river health and management strategies however few local studies have been specifically concerned with issues of riverbank erosion and restoration on the Caboolture River.

Riverbank erosion processes can be simplified into three basic categories:

1. scour where sediments are gradually removed from the riverbank by water and wind;
2. collapse, sometimes referred to as mass-failure or slump, where larger sections of the bank fail and collapse in the river; and
3. sub-aerial erosion mechanisms, which include processes external to the water body, such as cattle trampling, rain splash or wind throw of river-side trees.

These erosion mechanisms often act in combination on riverbanks, with the relative importance of each largely dependent on which section of the catchment the riverbank is situated in.

Rates of erosion can increase beyond normal baseline levels as a result of natural occurrences such as floods, unusual waves, wind or tidal activity. However human activities, including clearing of vegetation, grazing of stock, introduction of tidal and non-tidal structures, dredging or the use of high-speed watercraft creating boat wash can all increase rates of erosion on riverbanks. It is not to be forgotten that rivers and estuaries are highly dynamic and erosion is a naturally occurring phenomenon. However it is broadly agreed upon by experts that the process of erosion changes when human activities within river catchments interfere with normal environmental conditions increasing rates of erosion beyond environmentally benign levels.

The *Riparian Land Management Technical Guidelines* reports (Lovett & Price, 1999) discusses principles of sound management within Australian river systems and reviews legislation relating to riparian management. Rutherford *et al.* (1999, 2000) studies on riverbank restoration have also aided in creating a knowledge bank on stream rehabilitation.

Numerous studies (Lovett & Price, 1999, MWH 2004, Gill & Blake 2002, Keown 1983, WSAHGP 2003) have found that the extent of erosion within river and estuary systems is inextricably intertwined with the nature of the banks themselves. Local differences in vegetation and vegetation density, the influence of faunal activities such as burrowing or trampling, the position of the site in relation to current flow and wave actions, the geometry of the bank, bank hydrology and banks' material composition are all vitally important factors which will help determine the erodability of a bank.

Consistently erosion has been found to increase with a reduction in riparian vegetation generally resulting in siltation and turbidity downstream (Lovett & Price, 1999) and increased surface water runoff of poorer quality. Alterations to the natural environment through erosion affect riverine, estuarine and sometimes marine organisms directly through smothering and indirectly through decreased light penetration for oxygen-producing plants. A reduction in photosynthetic productivity may lead to death of aquatic plants creating an environment with reduced oxygen levels elevating stress levels for fish. Riverbank erosion can also lead to a loss in scenic amenity and interfere with the navigability of the river changing existing alignment and bathymetry.

In accordance with these findings a number of technical studies have been undertaken to demonstrate the important role of riparian buffers in bank protection (for example

WSAHGP 2002, Rutherford *et al* 1999, Dixon *et al*. 2006). Riparian vegetation has been reported to assist in bank stability in a number of ways.

- Roots knit soil and sediment particles together into a matrix that resists erosion.
- Plant stems increase hydraulic roughness on channel banks and floodplains, slowing flow velocity and reducing scour.
- Large trees act as anchor points and buttress banks to resist failure.
- Inputs of large woody debris may roughen and stabilize the channel (in addition to providing improved fish and insect habitat).
- Riparian vegetation moderates the rate of lateral channel migration.

Human interference from boat wash has been identified as affecting erosion (Bonham 1980, 1983). A relationship between boat speed and course route (Macfarlane & Cox 2004), and wave height from boat wash and a vessels waterline length has been recently documented (Macfarlane and Renilson, 2000).

Pressures from recreational activities, including recreational boating, as well as public transport and marine tourism have been caused by:

1. continuing urbanisation of the environment and the premium placed on waterfront land;
2. the growth in leisure time, combined with low-cost, mass-produced, high-speed recreational craft; and
3. the growth in tourism.

Regionally, the Department of Natural Resources and Water (DNRW) (2001) assessed the ecological and physical condition of streams in the Pumicestone Region which included the Caboolture River. Subjective assessments of disturbance within reach environs revealed that the southern half of the Caboolture subcatchment was subject to high or extreme disturbance. Roads, bridges, culvert structures and forestry activity were the most common forms of disturbance recorded during the survey. The dominant process affecting bank stability was erosion or slumping, rather than aggradation. Erosion also occurred predominantly at points of seepage and runoff, while slumping often occurred at irregular locations. In general, factors commonly identified as affecting bank stability included runoff, seepage, and vegetation clearance.

Locally, in a study by The Ecology Lab (2007) as part of the NEBP development proposal, it was reported that parts of the Caboolture River are in areas prone to shoreline erosion and that erosion examples were evident along the river from the mouth of the estuary to the project area, particularly in places where the natural vegetation had been cleared to the edge of the river channel. In comparison, where erosion was not evident mangroves have provided stabilisation of banks, particularly by the growth of pneumatophores which hold the sediment together.

In short riverbank erosion is a not a local issue but a regional issue requiring long-term catchment focused management programs to reduce pressures including (in no particular order):

- loss of riparian vegetation and therefore poor quality stormwater runoff;
- stock grazing;
- coastal development; and
- boat wash.

3. CABOOLTURE RIVER AND MORETON BAY

The lower reaches of the Caboolture River discharge into the shallow marine waters of Moreton Bay.

Moreton Bay and its catchment has been the subject to extensive studies on water quality, hydrology, sedimentology and aquatic ecology. The Caboolture River is one of several major rivers that flow into Moreton Bay and has a total catchment area of 589 km².

The Caboolture River retains significant features such as fish habitat and remnant riparian vegetation, however there has been obvious alteration of the river by human activities. A key feature of the Caboolture River is the presence of a weir 19km upstream of the river mouth which affects the water quality, particularly salinity and prevents sediment transport from the upper Caboolture River catchment to Moreton Bay. In addition, there has been alteration of the river by several developments.

The health of the Caboolture River has been assessed from 1999 as part of the Ecosystem Health Monitoring Program (EHMP 2005-06). This program issued report cards grading the estuary of the Caboolture River as "D", which is essentially "poor" in terms of ecological health. The grades also show a gradual decline in health over the period of assessment with the poor grading attributed to both natural and anthropogenic processes.

Modelling of turbidity in Moreton Bay has also identified that the currently pristine waters of eastern Moreton Bay will face greater impacts from sedimentation in the year 2026 compared to 2004 data (Moreton Bay Waters and Catchment Partnership 2005-2006). It has been reported that this potential increase will be a result of substantial population growth, land clearing and disturbance of riparian vegetation based on historical trends in pressures since 1996 (Abal *et al.* 2002). Given that the Caboolture River is a significant catchment discharging into Moreton Bay, development within the catchment may have long-term adverse environmental impacts without management of pressures on riverbanks.

Natural processes contributing to poor health include impacts associated with flooding, storm surges, nutrients from oceanic upwelling and poor riparian cover and bank stability. Anthropogenic processes contributing to the poor health of Caboolture River includes the alteration of run-off patterns leading to diffuse pollution associated with discharges from agricultural land (for example increased sedimentation in stormwater), residential development (for example unmanaged stormwater runoff) and industry (for example sewage treatment plants).

The Caboolture River in the riverbank erosion study area has developed soil and vegetation types typical of an estuarine ecosystem. Alluvial sediments and mangroves dominate the surface profile in most cases, except where clearing of vegetation has occurred and terrestrial flora dominates. The cleared areas along the banks of the river were associated with boat ramp access facilities and private farm land uses.

The width of the Caboolture River varies with a wide river mouth gradually decreasing in size upstream. The lower reaches of the Caboolture River are shown on topographic map 9543-IV-NW (TOORBUL) with the upper reaches, including NEBP development site, on topographic map 9443-II (CABOOLTURE).

4. METHODOLOGY

4.1 Basis for Methodology

The type of riverbank erosion and ultimate causes can be determined in a number of ways. Based on review of literature and existing descriptions of the Caboolture River and Moreton Bay which are discussed in section 3, Cardno has developed the following methodology for assessing riverbank erosion, determining the primary causes of this erosion and for monitoring the potential impacts and/or benefits associated with the NEBP development

The assessment methodology has four main components.

1. Desktop study of the Caboolture River using aerial photographs, topographical maps and bathymetric surveys to map changes in position and depth over time, and a literature review of previous studies on riverbank erosion.
2. Field investigation to map and classify existing erosion on both river banks and bank properties from the Caboolture River estuary to upstream of the NEBP project area, in total approximately 30km of riverbank (taking into account both the right and left banks for a length of approximately 15km). Four erosion categories were identified.
3. Reporting of results and analysis in relation to land uses and potential development impacts.
4. Development of a riverbank erosion monitoring program.

This methodology is founded on existing approved methodologies used by DNRM (2001) in the state of the rivers assessments, the Rapid Assessment Protocol for riparian vegetation (Werren & Arthington 2002) developed for Queensland Waters and the Waterway Foreshore Assessment Tool for Pilbara and Kimberley (Department of Water, W.A.G. 2006).

The key components, being the desktop study and field investigation, were undertaken to ensure baseline data collected included, but was not limited to:

- documentation of aerial photography, summary of erosion history and any other geomorphic data pertinent to project location and design;
- documentation of pre project site and reach data pertaining to the riparian corridor, floodplain function and overall habitat condition;
- a summary of the study area;
- bank properties;
- vegetation characteristics; and
- local land uses.

Components 1 and 2 of the methodology are described in more detail below.

4.2 Desktop Study

A desktop study on the changes to the Caboolture River alignment and existing survey data was undertaken to support the general theory that riverbank erosion is a natural process occurring over time.

The desktop study was undertaken using the following steps.

1. Observe and compare river alignment from 1955 to the present using aerial photographs obtained from DNRW.
2. Compare bathymetric surveys of the river bed between 1998 and 2007.
3. Divide river into 'reaches' for the purposes of the river audit.

4.3 Field Methodology

The following parameters were recorded on purpose-designed data sheets for each riverbank.

- Reach description.
- Latitude and Longitude.
- Local land use.
- Vegetation and value.
- Bank condition including bank, slope, shape.
- Erosion Class.
- Factors affecting stability.
- Artificial bank protection measures.
- Permanent Monitoring Points.

Field investigations were carried out by an Environmental Scientist and Ecologist. Photographs of each sampling point were taken to support results, and the river bank condition was assessed at each sampling point.

Each recording parameter is discussed hereafter.

4.3.1 Reach Description

The Caboolture River was divided into reaches using aerial photography. Each reach is a section of the river within which river characteristics are similar. Characteristics considered include slope, channel geometry, fringing vegetation, adjacent land uses and tidal influences. Reach environs making up the study area are presented in Figure 1.

In general, the determination of reach boundaries was qualitative, based on existing data from field investigations (sediment sampling and aquatic species distributions), aerial inspections, aerial photography and maps.

The use of distinct river reaches is intended to aid description of the river systems and development of appropriate monitoring intensity and methodology. The use of reaches is not meant to imply that the characteristics of the channel change decisively at particular locations. Often river channel characteristics will change progressively over long distances.

4.3.2 Latitude and Longitude

The latitude and longitude were recorded at each sampling point using a hand-held global positioning system where the riverbank substantially changed, using bank properties and erosion class.

4.3.3 Local Land Use

Land use changes over time have been identified as a major contributor to increasing rates of erosion and land use has therefore been assessed as part of this study.

The land use beyond the river bank was assessed and described in the following way.

- Natural Land Use - represents areas of relatively natural vegetation fringing the riverbank.
- Altered Land Use - represents areas of altered land, which may be occupied by houses, industry or other anthropogenic structures.

In some instances local land use is made up of natural and altered land uses when natural riparian vegetation remains but altered land uses are clearly evident beyond the riparian buffer.

4.3.4 Vegetation Type and Value

The importance of riparian vegetation in bank stability has been widely acknowledged (Dixon *et al.* 2006). This riverbank erosion assessment identified the type of vegetation and valued vegetation on both the right and left banks of the Caboolture River to facilitate a focused approved to bank erosion monitoring and ecological restoration.

Vegetation type descriptions were classified using the following categories.

1. Mangrove forest/shrubland and saltmarsh complex.
2. Mangroves fringing altered land use (i.e. grazing paddocks and slash pine regrowth).
3. Mixed riparian vegetation fringing altered land use.
4. Cleared vegetation with maritime infrastructure and/or private gardens.
5. Cleared Land.

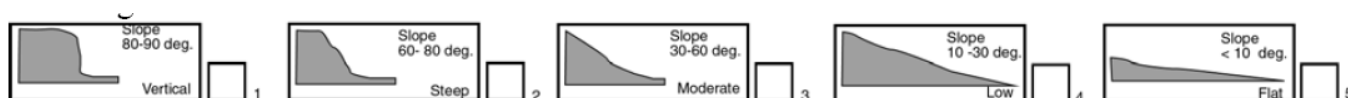
Vegetation was valued using the following classes.

1. Value 1 indicates areas of riverbank of high importance, which requires protection from erosion, and may include such areas as patches of high conservation value vegetation.
2. Value 2 indicates areas of moderate importance, such as intact patches of native vegetation in good condition.
3. Value 3 indicates areas of low importance such as degraded common land of low preservation value.
4. Value 4 indicates areas of insignificant preservation value, such as hopelessly weed-infested riparian land.

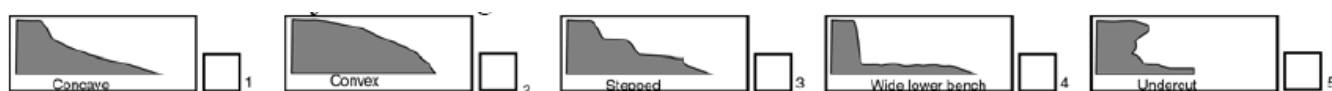
4.3.5 Bank Properties

Bank slope and bank shape were recorded using the following guides, with bank stability assessed based on slope and shape combined.

For each bank within each reach a bank profile category was assigned, identified using the illustrations below as a guide.



For each bank within each reach, the bank shape present was identified using the illustrations below as a guide.



For each riverbank the proportion of the bank length that is Stable, Eroding (loss of material), Aggrading (deposition of material), or Slumping (material slip/slides down bank) was recorded. These four figures add up to 100%.

4.3.6 Erosion Class

For each bank within each river reach, erosion severity was classified.

The intention of erosion classification is to create a framework of subjective assessment, which will allow some degree of meaningful analysis, and to have a baseline assessment for future quantitative studies.

- Class 1 includes areas where erosion is highly evident, as is demonstrated by mass failure of slabs of material, and significant stress lines visible on the bank itself.
- Class 2 areas are in the process of being eroded, but where erosion is not as severe as Class 1. Physical indicators include loose aggregates at the foot of the bank and/or the exposure of tree roots.
- Class 3 sections of the riverbank are not presently being visibly eroded, however, they remain vulnerable to future erosion (i.e. lack vegetation);
- Class 4 sections of the riverbank are not being eroded, and are unlikely to be eroded in the near future. This may include areas of the riverbank which have been completely subsumed by development.

4.3.7 Factors Affecting Stability

The factors affecting stability and therefore erosion class were noted along both lengths of the riverbank using the following factors as a guide. If a factor which appeared to be influencing erosion was not listed, then the 'Other' box was marked and a description given.

- Flow and Waves.
- Seepage.
- Runoff.
- Floodplain Scours.
- Stock.
- People/tracks.
- Ford, road, culvert, bridge, weir.
- Clearing of vegetation.
- Other.

4.3.8 Artificial Bank Protection Measures

Artificial bank protection measures, if any, were classified based on the following that are generally used as riverbank erosion protection structures (WSAHGP 2002). If a protection measure observed was not listed, then the 'Other' box was marked and a description given.

- Trees & other plants.
- Rock wall or layer.
- Fence structures.
- Logs strapped to bank.
- Concrete wall.
- Breakwater.
- Other.

4.3.9 Permanent Monitoring Points

Permanent monitoring points for erosion pins were considered during the erosion assessment which would allow long-term monitoring of erosion patterns. Permanent monitoring points were selected having a mixture of banks with and without vegetation, straight and bend sites and roughly measure 1km apart.

Erosion pins are individually numbered lengths 5mm diameter stainless steel rods located on the riverbank. Changes in exposed length of pins between measurements indicate the net amount of erosion or deposition that occurred during the monitoring period.

5. RESULTS

5.1 Assessment of Aerial Photography and Bathymetric Surveys

The mouth of Caboolture River is characterised by a wide shallow area with significant sand deposits in addition to fine silts. Upstream, the river is deeper with the width significantly decreased and coarser sediments. The river adjacent to the NEBP project area is characterised by large meanders.

Aerial photography was obtained from the DNRW from 1950 to the present (1955, 1965, 1971, 1981, 1991, 2002 and 2007) and is presented in Appendix A. Over this time the alignment of the river has slightly varied, particularly at the mouth where natural coastal processes tend to alter the landscape including littoral drift, currents and wave action. Upstream, but still within the confines of the marine environment, no significant changes are evident in the river alignment.

Minor loss of land has occurred due to erosion, particularly along banks of the river where vegetation has been cleared for agricultural (farming and grazing) and recreational (picnic area) purposes. However large scale land clearing and development within the Caboolture Shire since 1955 has increased surface runoff and flood levels appear to have influenced bank properties and erosion class more than coastal processes (eg. tidal flows).

A bathymetric survey of the Caboolture River in 1998 was compared with a survey undertaken in 2007 as part of the proposal to dredge the existing navigational channel to provide access to the proposed NEBP marina destination. Slight movement in sediment was recorded downstream elevating the bed level in the lower reaches of the Caboolture River (refer to Appendix B).

Comparisons of the Caboolture River alignment and bed depth using aerial photography and bathymetric survey indicate that erosion, while a concern to land managers, has not caused a significant change in the river alignment since 1955 or depth since 1998.

5.2 Field Investigations

5.2.1 Reach Environs

Erosion within the study area was generally characterised by scour and collapse (mass failure) and in some isolated cases, sub-aerial erosion.

Mass failure and sub-aerial erosion predominantly occurred with the upper reaches of the study area. Scour affected all banks along the entire length of the study area, but had a more pronounced impact in the lower reaches of the study area. Wind and wave action in this area increased the potential for erosion.

The erosion class was recorded within each reach is presented in Table 1.

Severe erosion was found in close proximity to the NEBP site in reaches 6-9 in the upstream portion of the Caboolture River study area. Downstream of the NEBP project area erosion was less severe. This corresponds to an increase in altered land uses in the upstream portion of the study area, specifically grazing and forestry practices.

In total some 9km of riverbank was classified as severely eroded, with approximately 12km of riverbank showing signs of some erosion. 12km of riverbank was classified as erosion class 3 with approximately 1km of riverbank classified as erosion class 4.

Areas classified as erosion class 4 however did not have 100% bank stability because in some areas existing tidal works had significantly increased erosion.

Table 1 Baseline Data from Riverbank Erosion Assessment of the Caboolture River – Reach Environs

Reach Number	Reach Length (Right + Left Banks)	Distance (in metres)			
		Class 1 – Severe Erosion	Class 2 – Moderate Erosion	Class 3 – Potential to Erode	Class 4 – Not eroding and unlikely to erode
1	2620		845	1775	
2	2290	610	1565	725	
3	2700	785	360	1140	415
4	3230	90	455	2585	100
5	3230	990	1575	490	175
6	2405	1320	345	740	
7	2405	1540	865		
8	3390	1880	550	840	120
9	2520	1025	260	910	325
10	7040	880	4200	1960	
11	1325	215	770	340	
12	350			350	

5.2.2 Erosion and Bank Properties

The results of the riverbank erosion assessment are presented in Appendix C for the right and left banks with relevant site photos given in Appendix D. Graphical presentation of data is attached as Appendix E.

Erosion was clearly evident on both the left and right bank of the Caboolture River however the scale of erosion varied significantly between banks. The left bank is far more eroded compared to the right bank as a result of the increased change in land management and use on the left bank. The increase in development includes clearing land for residential and farming uses which has increased the effect of flows and stormwater runoff. Stock were observed grazing close to the riverbank and local government roads were at some instances, in close proximity to the current riverbank. Severe riverbank erosion on both banks was particularly concentrated at points where the river meandered.

A significant difference in tidal development was observed between the banks. The left bank had a greater intensity of boat moorings, private jetties and bank stabilisation structures.

Results suggest that in terms of general erosion, a steep slope combined with minimal vegetation cover decreasing stability are significant attributes influencing erosion in the lower catchment of the Caboolture River. Figures 2-4 map bank erosion, slope and shape respectively within the defined study area.

On the right bank, a relationship between erosion class and bank slope is evident with severe erosion often observed on banks with a steep to vertical slope and less severe erosion observed on banks with moderate to low slope.

The shape of the right riverbank is clearly related to the erosion class with severe erosion generally distinguished by a wide lower bench or undercut bank shape and less severe erosion generally related to a convex/concave bank shape.

A clearer relationship between erosion class and stability was observed on the left bank with a decrease in erosion severity correlating with an increase in bank stability. However on the right bank there is no clear distinction between a decrease in erosion severity and

an increase in bank stability. It is assumed that this exception to an agreed upon relationship in literature was due to a recorded decrease in bank stability within some areas classified as erosion class 4. Parts of the Caboolture River that are developed had the potential for accelerated erosion as a result of poorly designed, constructed and maintained tidal works.

On the left bank similar relationships were observed between erosion class and bank slope and shape. A decrease in erosion class was found to correspond to a decrease in slope. The shape of the riverbank was closely related to erosion class with undercut the dominant bank shape when erosion class 1 and vertical/steep slopes were observed.

The general description of vegetation suggests that the dominant plants within riparian vegetation were mangroves of high conservation significance. Mangroves were primarily the species which influenced bank stability when present on both riverbanks. However it was evident that vegetation will not stop all erosion. A decrease in erosion severity was observed as correlating with a wider and denser riparian buffer. The term "riparian" refers to that area adjacent to a river that is physically linked to the moisture regime of the streamside environment (Dixon *et al.* 2006).

Riparian buffers provide essential functions for river and stream ecosystems, including cover and shade, a source of fine or coarse woody material, nutrients, and organic and inorganic debris that maintain stream ecosystem function. Riparian corridors also provide habitat for wildlife, especially migrating and breeding birds. Unfortunately riparian zones are generally the focus for much activity related to development, including grazing, agriculture and tourism, and they are vulnerable to disturbances such as weed invasion, feral animals, fire, overgrazing and erosion.

The riparian buffer ideally extends from the river's ordinary high water line to the outer edge of the floodplain.

Mixed riparian vegetation in the upper reaches of the study area was associated with greater erosion compared to the mangrove dominant riparian vegetation closer to the river mouth. Mangroves (with pneumatophores) dominating the riverbank near the estuary aided in anchoring sediment and increasing bank stability. As shown an increase in bank stability is related to lower erosion severity.

5.2.3 Erosion Causes and Pressures

The main cause of erosion within the defined study area was identified as historical and current land uses and human interference. Historical land use and human interference appeared to significantly impact on the type and width of the riparian buffer which has been shown above to affect bank stability and was inversely related to the number of breaks in the riparian corridor.

Based on results of the riverbank assessment, the existing key pressures to the natural erosion processes within the Caboolture River in approximate order of importance are:

- a weir 19km upstream preventing sediment flow downstream recharging banks;
- riparian zone degradation caused by vegetation removal, weeds and stock (altered land uses);
- unmanaged surface runoff;
- tidal flows;
- coastal development including wastewater discharges from sewage treatment plants; and
- boat wash.

6. STRATEGIES FOR THE MANAGEMENT OF BANK EROSION

In this section management strategies to reduce the potential for erosion of the Caboolture River are discussed to provide direction for restoration projects and to inform NEBP design, construction and operation.

6.1 Existing Management Strategies for the Caboolture River

Planning and development control mechanisms imposed by the Council for improving aquatic and riparian systems include:

- setbacks from waterways and wetlands;
- compensatory habitat provisions; and
- stormwater quality management (including retention of natural waterways and water sensitive urban design).

These mechanisms are consistent with the findings of this assessment which are that by retaining and restoring riparian vegetation and managing stormwater runoff, the overall health of an ecosystem can be improved. It was clear in this assessment that riparian buffers play an important role in bank stability and stormwater runoff.

At present there is no catchment-wide strategy for the management or improvement of the Caboolture River.

6.2 Existing Management Strategies for Other River Systems

No consistent principles for waterway protection have been developed however there is an obvious need for a set of principles be developed for the protection of biodiversity, ecosystems and processes in addition to an overarching framework for river management which acknowledges both community expectations for protection of a range of river values, and the government's own commitments to protection of biodiversity.

Doolan (2000) discussed the management framework for waterways (from the national to local level) in the context of the development of a Victorian River Health Strategy. Consideration of the roles at different levels of management was deemed important in the context of the scale of planning for waterway protection and achieving the right 'mix' of planning for waterway protection. Doolan (2000) outlined the following roles at different levels of waterway management:

National role:

- funding to States, groups and individuals to achieve national objectives;
- facilitation of interstate coordination;
- investment in development of national principles, best management practices, tools, research and development to facilitate improved management; and
- ensuring that Australia meets its international obligations.

State role:

- section of Statewide policy and strategic directions;
- establishment of legislative and regulatory frameworks;
- establishment of institutional arrangements;
- investment in provision of advice, research and monitoring, planning, extension, on-ground works and enforcement functions;
- implements State responsibilities under nationally agreed strategies; and
- provision of funding to groups and individuals to achieve State and regional priorities.

Regional role:

- development of regional strategies and action plans;
- provision of advice to State on regional resourcing priorities;
- coordination and implementation of work programs;
- provision of incentives and support for groups and individuals; and
- provision of mechanisms for community involvement in natural resource management.

Local government role:

- incorporation of waterway management objectives, priorities and actions into statutory planning processes; and
- provision of local support for local action groups.

Landcare (community) groups' role:

- smaller scale waterway and catchment management projects.

Landholders' role:

- land stewardship.

It is relevant to note that while it has been generally accepted that increased urbanisation leads to a decrease in the overall health of a waterway, there are examples of rivers in southeast Queensland that are highly urbanised, such as the Noosa River and Coomera River, which have been managed effectively and are achieving improved ecosystem health (Noosa Shire Council 2007, Gold Coast City Council 2007). Development within the Caboolture River catchment, by comparison, is mainly rural in nature with little urban development, yet the overall health of the river is poor (Ecosystem Health Monitoring Program 2005-06). Management strategies within the Coomera and Noosa Rivers have focused on sustainable coastal development, riparian restoration and control of stormwater runoff, and it is suggested that similar strategies should be considered for the Caboolture River.

6.3 Future Management of the Caboolture River

6.3.1 Riparian Vegetation

Management strategies for riverbank erosion are most commonly site specific and are generally focused on improving riparian vegetation. This assessment identifies the quality and extent of riparian vegetation to be very closely related to the level of erosion observed, and thus a future strategy which focuses on the reinstatement of riparian vegetation corridors on a catchment wide scale can be expected to bring a significant improvement to the quality of the riparian ecosystem.

6.3.2 Boat Wash

With regard to the increase in knowledge of impacts from boat wash and in response to increasing concerns expressed by local governments and the community over the impact of boats on waterways, in Queensland a number of management plans are being prepared to control impacts from marine traffic (eg. Noosa River), including proposals for marine zones. A marine zone is a specific area where certain types of vessels or certain types of activities can be restricted or excluded.

The role of riparian vegetation in reducing potential impacts from boat wash is still being understood however preliminary results indicate that sedges and fringing vegetation can absorb wave energy and assist in stabilising bank properties.

To address the specific issue of boat wash, it has been generally identified that a reduction of effects of boat wash on riverbanks and planted areas can be partially achieved by:

- introduction of recreational and commercial boat operator's Code of Practice;
- introduction of low wash zones;
- planting reeds and returning large woody debris to parts of the bank that are undercut;
- installing wash control structures around planted areas;
- preventing overflow parking at ramps on rivers;
- an intensive information and education campaign in the context of substantial environmental remediation programs; and/or
- soft engineering bank stabilisation works such as tow rock or revegetated finger groynes etc..).

7. NORTHEAST BUSINESS PARK INITIATIVES

The assessment has identified that the Caboolture River is severely eroding in some places. Disturbance to riparian vegetation associated with altered land uses and unmanaged surface water runoff are the existing causes of bank erosion along the Caboolture River.

The NEBP involves development of land fronting the Caboolture River altering the current land use (cleared pine plantation and grazing) to create an urban development which will result in a significant net benefit to the community and State in the absence of current regional and state planning. The Proponent has invested substantially in addressing existing and potential factors that affect riverbank erosion in the Caboolture River.

The NEBP development will address disturbance to riparian vegetation associated with altered land uses and unmanaged surface water runoff in the following ways.

- Revegetation and rehabilitation of 9km of the riparian zone within the NEBP project area that is severely degraded (refer to Table 1, page 14).
- Maintaining a 100m riparian buffer between the development and high water mark (with the exception of the marina lock allowing boat access to and from the Caboolture River by marina users).
- Leading by example being a responsible developer and erosion conscious private land owner.
- Investing \$18 million in managing stormwater runoff from a previously unmanaged 763 ha former pine plantation.
- Committing to a mariner education program by the Marina Management about the Caboolture River ecosystem.
- Adhering to Government objectives for protecting and preserving the environment.

It is expected that an improved riparian buffer within the NEBP project area and best practice control of stormwater runoff will provide important habitat connection, will improve water quality of a currently degraded system, decrease erosion severity and create a pleasant backdrop to the development.

The Landscape Master Plan Report (LMPR) prepared for NEBP by PLACE Planning and Design (2007) and the Aquatic Ecology assessment prepared by The Ecology Lab (2007) have also recognised the importance of the riparian zone and the necessity to conduct rehabilitation works to improve the ecological values and functions of the existing riparian vegetation.

As a result the Proponent is, in addition to the measures described above, providing a funding model through a component of the marina berth and dry storage levy that will be allocated to a trust administered by local environmental catchment groups to restore eroded areas downstream of the NEBP project area. The Proponent has already lodged an "Enviro Fund" application for \$50,000 to trial restoration of a severely eroded area.

A riparian restoration plan for works is recommended in consultation with a number of relevant stakeholders including the Department of Primary Industries and Fisheries, DNRW, Caboolture Shire Council, consultants, land owners and local catchment/environment groups (e.g. Caboolture Regional Environmental Education Centre) for restoration works.

A significant increase in marine traffic is expected to occur as a result of the NEBP development, which will provide a destination to boaters by providing:

- fish attracting devices;
- restaurants;
- quiet, safe and sheltered waters; and
- otherwise attractive locations.

Boat wash has been shown to affect erosion with a positive correlation to boat speed, changes to speed, curve of route and vessel length. The Caboolture River is in places speed restricted to 6km/hr (limited to where development exists) however the current alignment of the Caboolture River which significantly meanders, will result in boaters constantly accelerating and decelerating, generating a larger wash that is focussed on the inside of a curved course and diffracted on the outside.

The Proponent proposes the following strategies for addressing potential erosion impacts arising from an increase in maritime transport on the Caboolture River.

- An improved and managed (regulated) boat speed environment within the Caboolture River.
- An erosion monitoring program to measure potential impacts on riverbanks from the Caboolture River estuary to upstream of the NEBP project area.

The proposed erosion monitoring program is discussed further in section 8 of this assessment.

It is evident from the commitments listed above that the Proponent proposes to contribute to investigation and management of riverbank erosion beyond the expected role of a landowner, and is prepared to go beyond the rehabilitation of the development site itself, in order to provide a net benefit.

8. MONITORING PROGRAM

A monitoring program is proposed by the Proponent to inform stakeholders on changes to riverbank erosion in the future, and in particular the potential impact from the predicted increase in marine traffic within the Caboolture River. This will enable focused ecological restoration projects to protect the riverbanks.

Changes to the existing condition of the riverbank as a result of the NEBP development can be determined in a number of ways but the methodology will largely be dependent on the timescale within which erosion is occurring, and the time allowed to conduct such research. Mechanisms that have been considered useful in the past in establishing causes, processes and mechanisms of bank retreat over relatively short time periods include the use of erosion pins at fixed points installed perpendicular to the bank facing the river.

Erosion pins are individually numbered lengths of 5mm diameter stainless steel rods, secured to the riverbank. Changes in the exposed length of pins between measurements indicate the net amount of erosion or deposition that occurred during the monitoring period. Erosion is generally reported as a rate in mm/year, thus allowing comparison of monitoring periods of varying lengths (Saynor *et al.* 2003).

The Proponent has agreed to the recommendation to monitor riverbank condition yearly at permanent monitoring points. The duration of the monitoring program has not yet been confirmed, but it is anticipated that repeated measurements and reporting will continue during the construction period for the development and for at least 5 years thereafter.

Potential permanent monitoring points have been identified in Figure 5 of this assessment.

Monitoring methodology shall be consistent with that used in this assessment of existing riverbank conditions of the Caboolture River to enable comparison of results.

Repeated observations of riverbank erosion shall be reported in an annual report to the relevant stakeholders.

9. CONCLUSION

The NEBP development proposal to develop land fronting the Caboolture River as a multi-use business park and marina concept design has been highlighted as an activity which could potentially increase the erodability of the banks of the Caboolture River from anthropogenic impacts including the loss of riparian vegetation, stormwater run-off and boat wash.

The Caboolture River was assessed to determine the extent of current erosion to provide a baseline for the determination of whether an increase in erosion will result from the development proposal.

The severity and mechanisms for erosion were found to vary along the length of the study area, which stretches from the estuary to upstream of the NEBP project area. Results suggest the Caboolture River is moderately eroded and in some places, severely eroded, particularly on bends of the riverbanks where riparian vegetation is lacking. This is the case particularly within the reaches where the development is proposed although the left bank is far more eroded than the right bank where the development is proposed.

In general, steep bank slopes combined with a decrease in stability associated with reduced vegetation cover are significant attributes influencing erosion in the lower catchment of the Caboolture River.

Based on results of the riverbank assessment, the existing key threats to natural erosion processes within the Caboolture River in approximate order of importance are:

- riparian zone degradation caused by vegetation removal, weeds and stock (altered land uses);
- surface runoff;
- tidal flows; and
- coastal development; and
- boat wash.

The Proponent has placed a great emphasis on the design, construction and operational phases of the NEBP development to mitigate potential anthropogenic impacts through good environmental, social and economic planning. In particular the NEBP will restore 9km of riverbank that is severely eroded with a suitable riparian buffer and invest substantially in improving stormwater runoff.

It is identified that NEBP could influence downstream erosion by introducing an increased number of marine vehicles to a relatively undeveloped waterway, consequently increasing boat wash affects. Development initiatives to mitigate this potential impact include funding for riverbank restoration offsite, managed boat use and a monitoring program.

Whilst management options have been generally discussed with the emphasis on the role riparian vegetation appears to play in bank stability, restoration techniques have not been specified as this study can not determine specific adverse impacts related to the NEBP development proposal. It is expected that ongoing monitoring using erosion pins will identify impacts and inform location specific management strategies.

In conclusion, the combination of initiatives proposed by the Proponent of the NEBP for mitigating riverbank erosion will result in a significant net improvement to the Caboolture River by stabilising bank properties, thereby reducing the effects of boat wash and improving water quality in a degraded system and in the sensitive system of Deception Bay. The result of these initiatives will benefit all those in the community that use the river and enjoy its environmental amenity and aspects whilst providing a development which

advances the identity and prosperity of the Caboolture region and ecological health of the Caboolture River.

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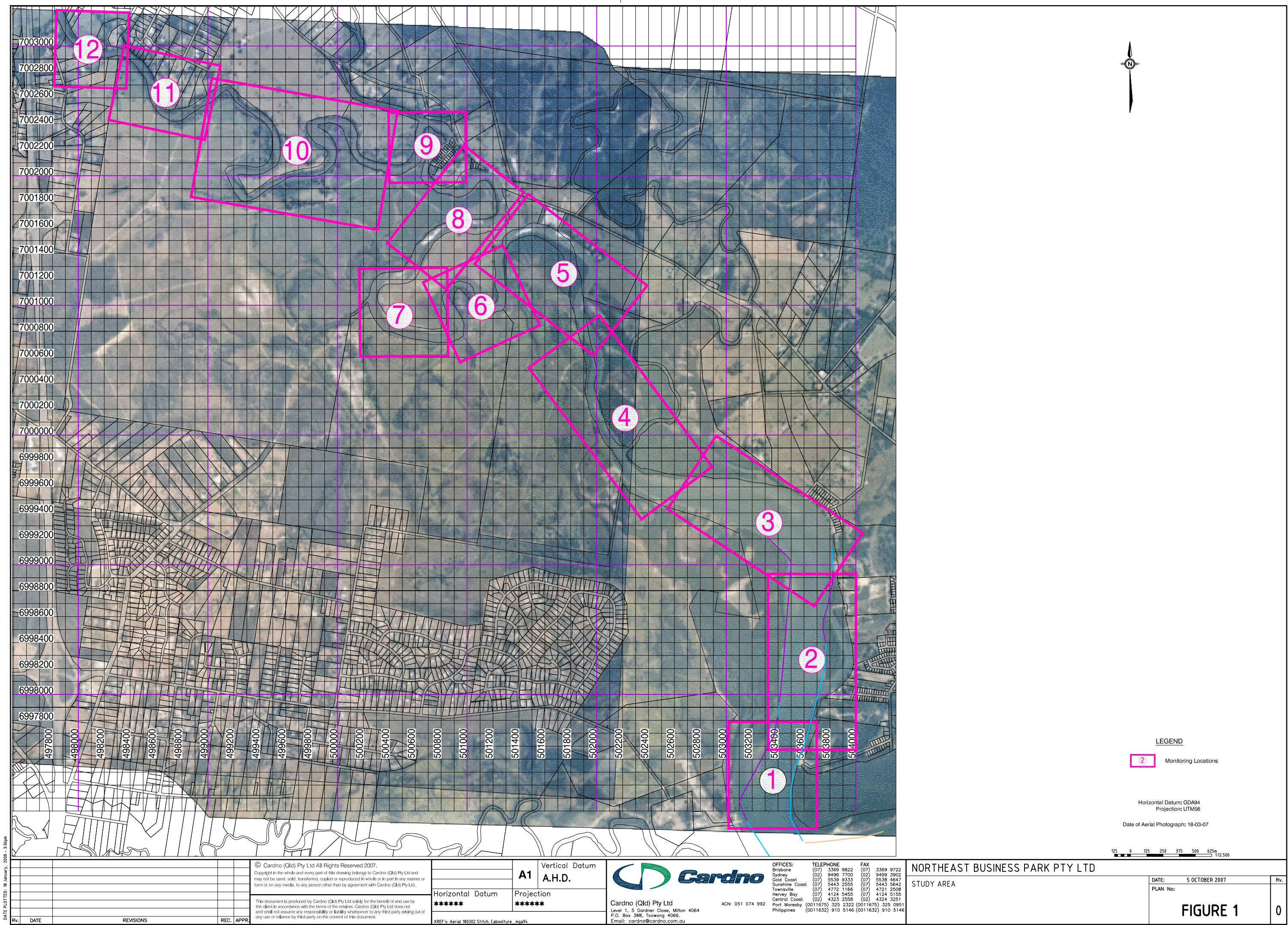
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FIGURES

- Figure 1 Study Area and Reach Environs**
- Figure 2 Riverbank Erosion Class and Local Land Use**
- Figure 3 Riverbank Slope and Local Land Use**
- Figure 4 Riverbank Shape and Local Land Use**
- Figure 5 Permanent Monitoring Locations**



DATE PLOTTED: 18 January, 2008 - 3:36pm

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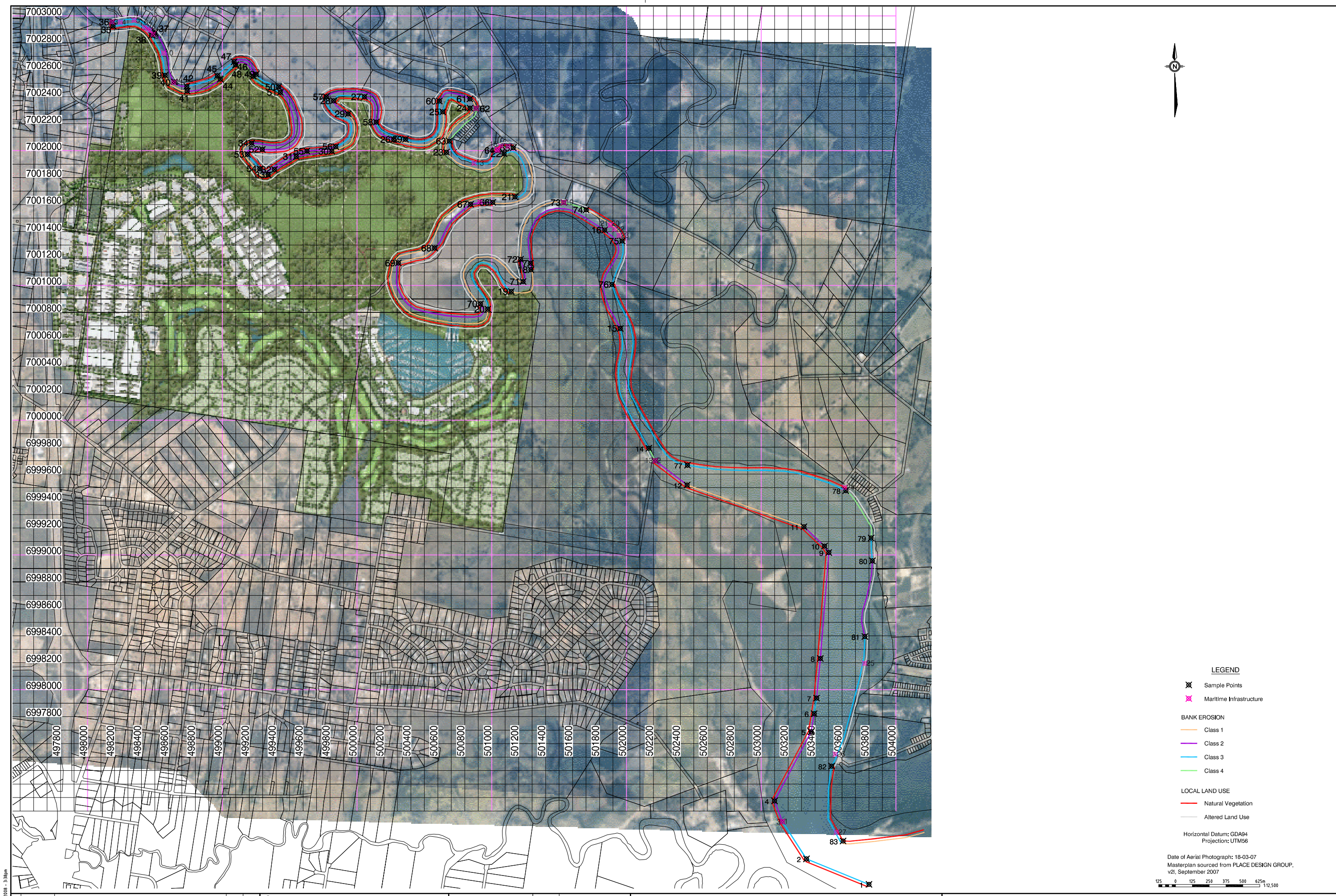
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NORTHEAST BUSINESS PARK PTY LTD
STUDY AREA

DATE:	5 OCTOBER 2007	Rv.
PLAN No:	FIGURE 1	0



LEGEND

Sample Points
Maritime Infrastructure

BANK EROSION

Class 1
Class 2
Class 3
Class 4

LOCAL LAND USE

Natural Vegetation
Altered Land Use

Horizontal Datum: GDA94
Projection: UTM56

Date of Aerial Photograph: 18-03-07
Masterplan sourced from PLACE DESIGN GROUP, v2, September 2007

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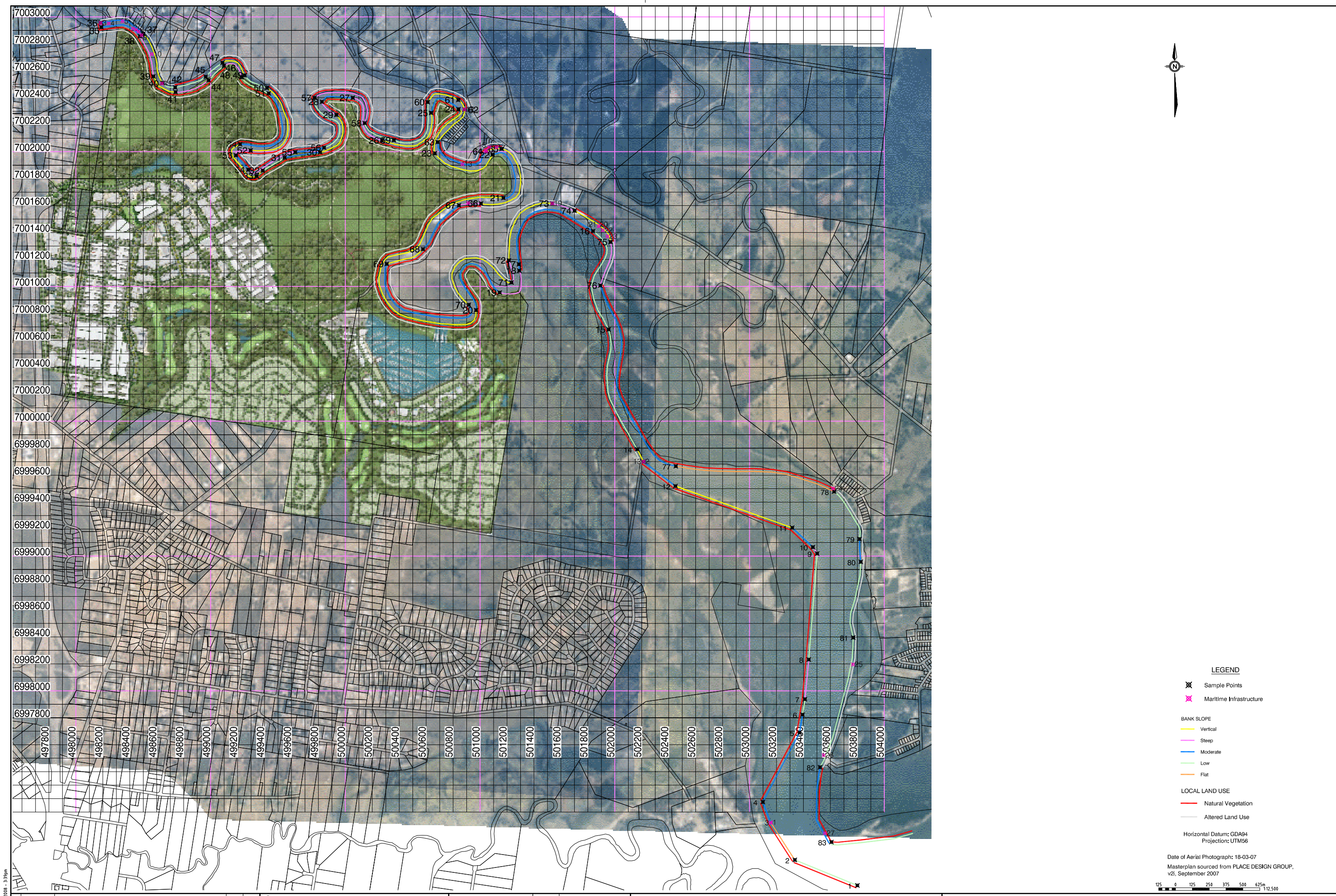
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Port Moresby	(0011675) 325 2322 (0011675) 325 0951		
Philippines	(0011632) 910 5146 (0011632) 910 5146		

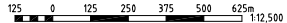
NORTHEAST BUSINESS PARK PTY LTD			
RIVERBANK EROSION CLASS AND LOCAL LAND USE	DATE:	5 OCTOBER 2007	Rv.
	PLAN No:		
	FIGURE 2		0

CAD FILE: L:\7800-40\ACAD\Assessment of Riverbank Erosion with the Lower Reaches of the Caboolture River\Figure 2 - Riverbank Erosion Class and Local Land Use.dwg
XREF: Caboolture_mga94; Aerial 180302 Shit; Bank Stability - Maritime Infrastructure; Bank Stability - Sample Points



- LEGEND**
- Sample Points
 - Maritime Infrastructure
- BANK SLOPE**
- Vertical
 - Steep
 - Moderate
 - Low
 - Flat
- LOCAL LAND USE**
- Natural Vegetation
 - Altered Land Use
- Horizontal Datum: GDA94
Projection: UTM56

Date of Aerial Photograph: 18-03-07
Masterplan sourced from PLACE DESIGN GROUP,
v2i, September 2007



DATE PLOTTED: 18 January, 2008 - 3:39pm

Rv.	DATE	REVISIONS	REC.	APPR.

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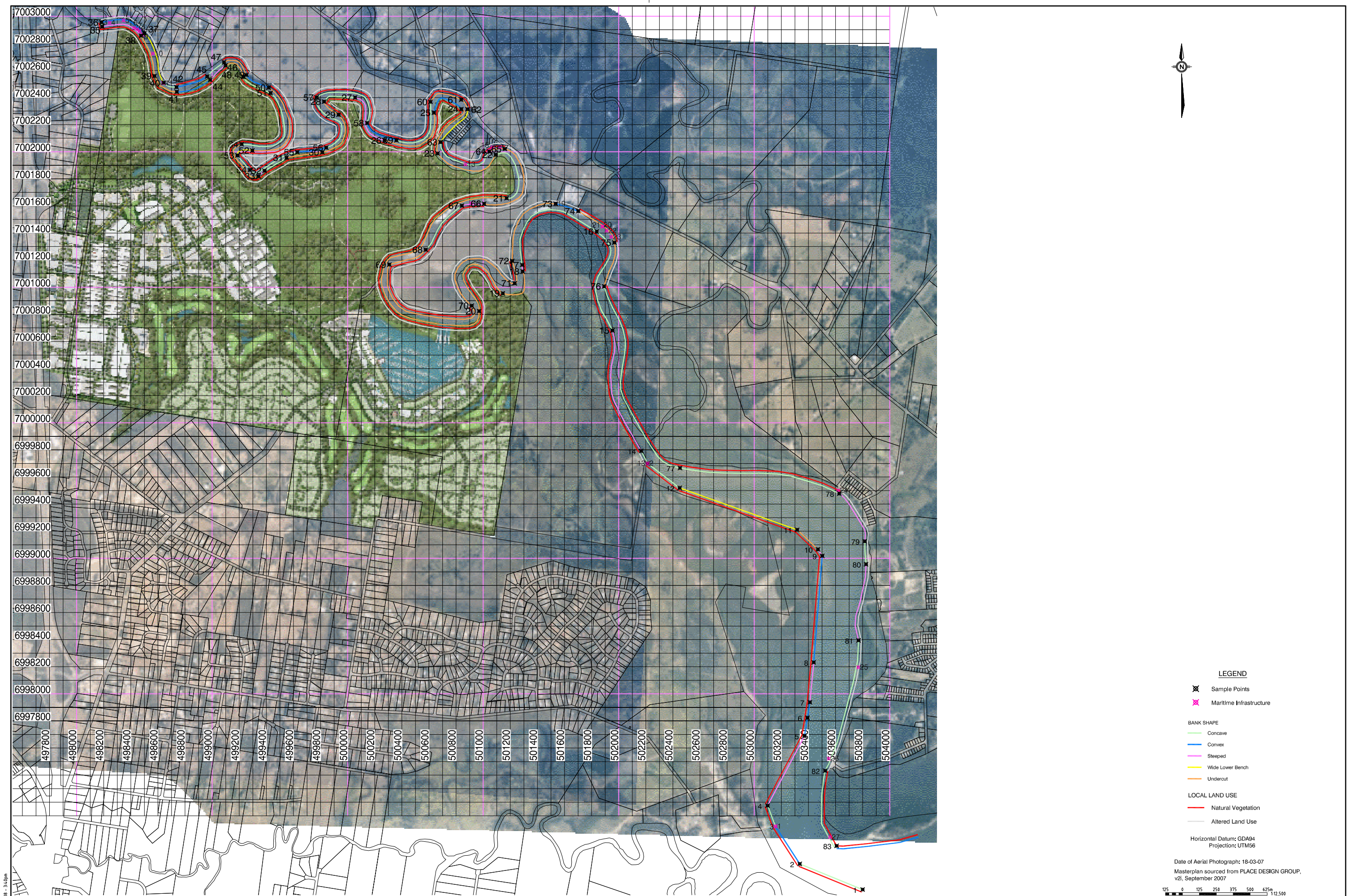
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Philippines	(0011632) 910 5146	(0011632)	910 5146

CAD FILE: I:\Y880-40\ACAD\Assessment of Riverbank Erosion with the Lower Reaches of the Caboolture River\Figure 3 - Riverbank Slope and Local Land Use.dwg
XREFs: Caboolture_mga94; Bank Stability - Sample Points; Bank Stability - Maritime Infrastructure; Aerial 18/03/07 Stitch

NORTHEAST BUSINESS PARK PTY LTD
RIVERBANK SLOPE AND LOCAL LAND USE

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FIGURE 3



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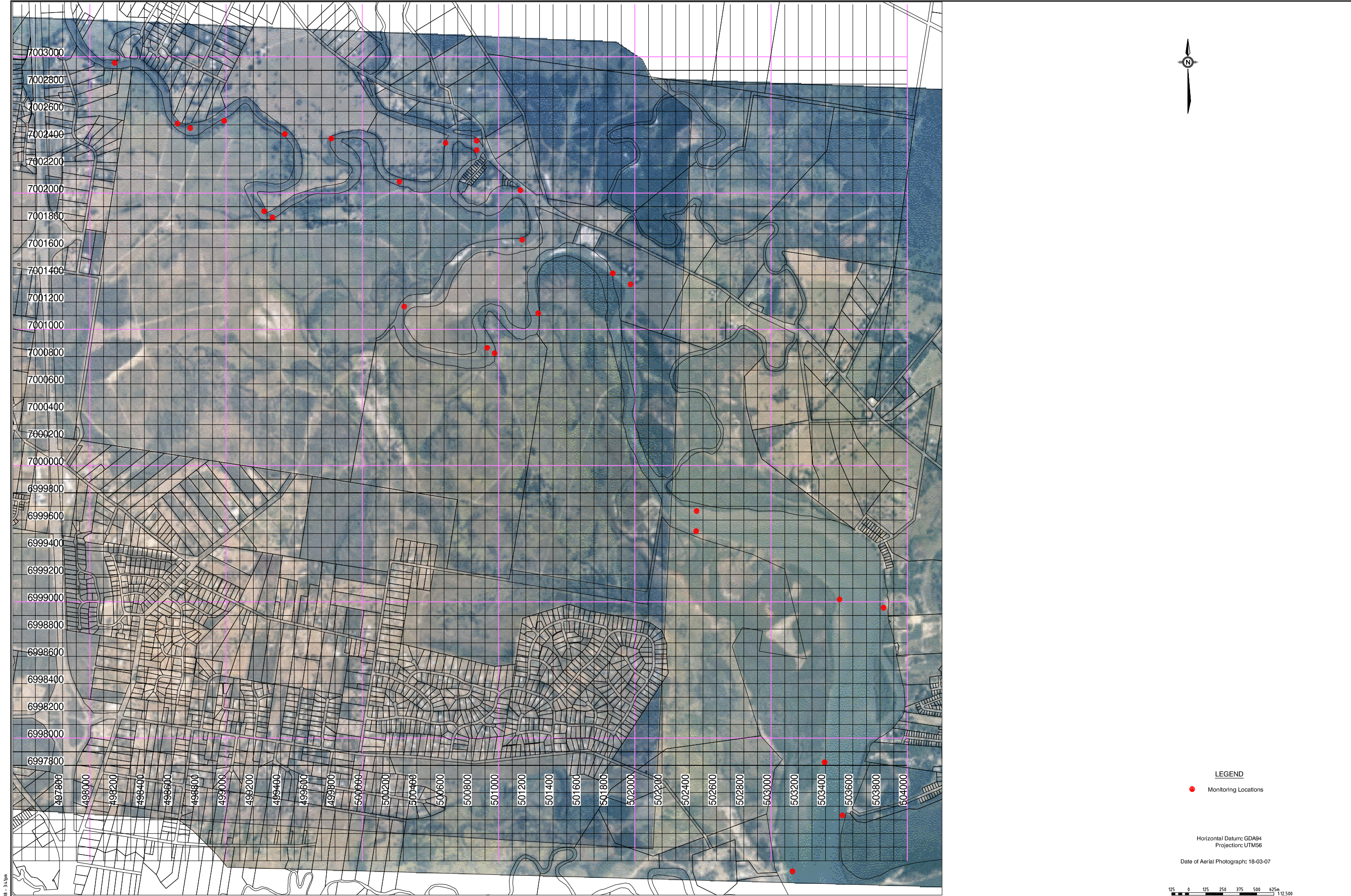
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Philippines	(0011632) 910 5146	(0011632) 910 5146	

LAD FILE: I:\1800-40\ACAD\Assessment of Riverbank Erosion with the Lower Reaches of the Caboolture River\Figure 4 - Riverbank Shape and Local Land Use.dwg
XREFs: Caboolture_mga94; Bank Stability - Maritime Infrastructure; Bank Stability - Sample Points; Aerial 180307.tif

NORTHEAST BUSINESS PARK PTY LTD		
RIVERBANK SHAPE AND LOCAL LAND USE		
DATE:	5 OCTOBER 2007	Rv.
PLAN No:		
FIGURE 4		0



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	A1	Vertical Datum A.H.D.
Horizontal Datum *****	Projection *****	

XREF's: Aerial 180302 511ch, Caboolture_mga94
CAD FILE: I:\1800-401\ACAD\Assessment of Riverbank Erosion with the Lower Reaches of the Caboolture River\Figure 5 - Permanent Monitoring Locations.dwg



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PERMANENT MONITORING LOCATIONS

DATE: 5 OCTOBER 2007

PLAN No:

FIGURE 5

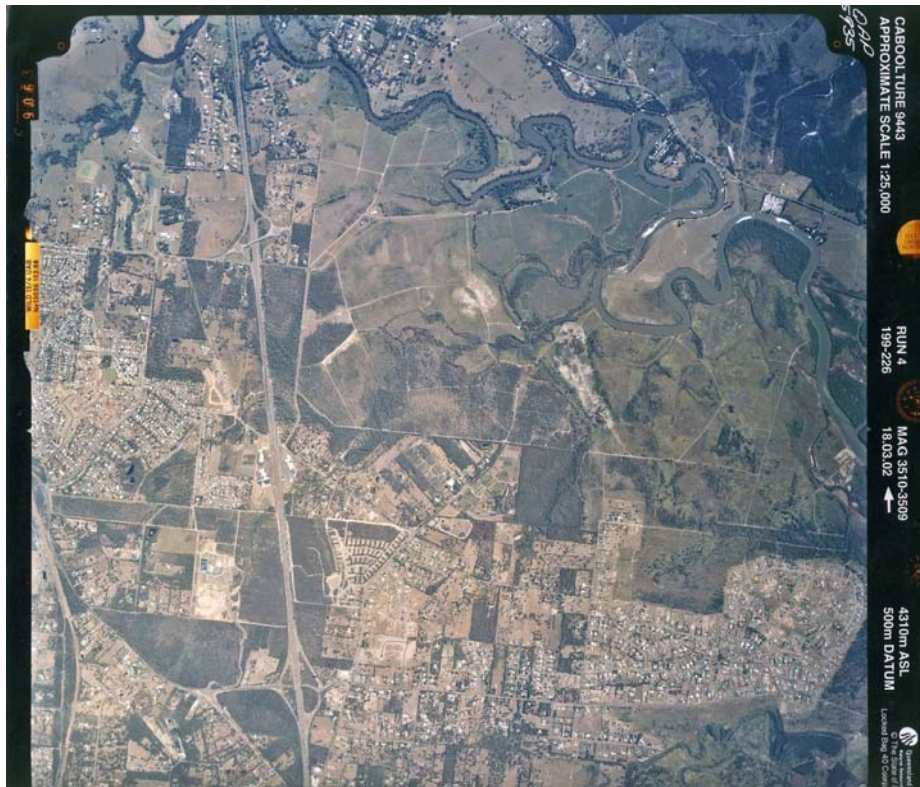
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APPENDIX A

Historical Aerial Photography



July 2007



March 2002



June 1991



May 1981



April 1971



July 1965



July 1955

APPENDIX B

Bathymetric Surveys

**1998 Survey**

Bed Level
(mAHD)

**2007 Survey**

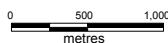
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Rev: 0 **Date: 22 October 2007**

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O:\Work\LAT\790033_3\Figures\mapinfo\workspaces\survey comparison.WOR



Scale: 1:50,000 (A4)

Appendix B Survey Comparison

Project No.: 790033/3

APPENDIX C

Riverbank Erosion Baseline Data

Baseline Data from Riverbank Erosion Assessment of the Caboolture River – Right Bank

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
1 Perm. Marker ☐	A wide river mouth with stable bank properties and mangrove fringing vegetation.	503800	6996556	Natural ☒ Artificial ☐	1	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	80% Stable 20% Slumping	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
2 Perm. Marker ☐	Tall closed mangrove forest of 8-10m in height.	503336	6996745	Natural ☒ Artificial ☐	2	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	100% Stable	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
3 Perm. Marker ☒	Concrete boat ramp. Boulder wall. Cleared Vegetation.	503157	6997022	Natural ☐ Artificial ☒	3	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒	1. ☐ 2. ☒ 3. ☐ 4. ☐	100% Stable	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☒ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
4 Perm. Marker ☐	Tall mangrove fringing river up to 8-10m in height with a moderately stable bank.	503099	6997175	Natural ☒ Artificial ☐	4	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	75% Stable 25% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
5 Perm. Marker ☐	Tall open mangrove forest. Bank slopes to a mangrove flat.	503371	6997689	Natural ☒ Artificial ☐	5	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	80% Stable 20% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
6 Perm. Marker ☐	Tall open mangrove forest. Flat bank. Edge of small tributary. Some natural die back of mangroves evident.	503393	6997823	Natural ☒ Artificial ☐	6	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	90% Stable 10% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
7	Stepped bank with			Natural ☒	7	1. ☒	1. ☐	1. ☐	70% Stable	1. ☐	1. ☐	1. ☒	1. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
Perm. Marker ☐	low open mangrove.	503411	6997938	Artificial ☐		2. ☐ 3. ☐ 4. ☐ 5. ☐	2. ☒ 3. ☐ 4. ☐	2. ☒ 3. ☐ 4. ☐	30% Eroding	2. ☒ 3. ☐ 4. ☐ 5. ☐	2. ☐ 3. ☒ 4. ☐ 5. ☐	2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
8 Perm. Marker ☐	Flat mangrove populated bank. Shrub land fringing mangroves.	503439	6998232	Natural ☒ Artificial ☐	8	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	90% Stable 10% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
9 Perm. Marker ☒	River meandering transitioning from low-flat bank to a steep bank.	503502	6999018	Natural ☒ Artificial ☐	9	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	60% Stable 40% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
10	Dense straggly closed mangrove	503470	6999066	Natural ☒ Artificial ☐	10	1. ☐ 2. ☐	1. ☐ 2. ☒	1. ☐ 2. ☒	50% Stable 5% Eroding	1. ☐ 2. ☐	1. ☐ 2. ☐	1. ☒ 2. ☐	1. ☐ 2. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
Perm. Marker ☐	forest. Sand deposition evident and undercut bank exposing mangrove roots.					3. ☒ 4. ☐ 5. ☐	3. ☐ 4. ☐	3. ☐ 4. ☐	45% Aggrading	3. ☒ 4. ☐ 5. ☐	3. ☐ 4. ☐ 5. ☒	3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
11 Perm. Marker ☐	Salt couch flat fringed with mangrove on a steep bank.	503317	6999210	Natural ☒ Artificial ☐	11	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	70% Eroding 30% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
12 Perm. Marker ☐		502450	6999519	Natural ☒ Artificial ☐	12	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	50% Stable 50% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
13 Perm.	Artificial retaining wall (wood) and cleared vegetation.	502213	6999700	Natural ☐ Artificial ☒	13	1. ☒ 2. ☐ 3. ☐	1. ☐ 2. ☐ 3. ☒	1. ☐ 2. ☐ 3. ☐	100% Eroding	1. ☒ 2. ☐ 3. ☐	1. ☒ 2. ☐ 3. ☐	1. ☒ 2. ☐ 3. ☐	1. ☐ 2. ☐ 3. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
Marker ☐						4. ☐ 5. ☐	4. ☐	4. ☒		4. ☐ 5. ☐	4. ☐ 5. ☐	4. ☐ 5. ☐ 6. ☒ 7. ☐ 8. ☐ 9. ☐	4. ☒ 5. ☐ 6. ☐ 7. ☐
14 Perm. Marker ☐	Mangrove on a flat bank.	502166	6999792	Natural ☒ Artificial ☐	14	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
15 Perm. Marker ☐	Dense grey mangrove vegetation, localised mangrove shrub land, taller mangroves fringing back on a low bank.	501954	7000681	Natural ☒ Artificial ☐	15	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	90% Stable 10% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
16 Perm. Marker ☐	Closed mangrove vegetation on moderate slope.	501838	7001411	Natural ☒ Artificial ☐	16	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
☐						5. ☐				5. ☐	5. ☐	5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	5. ☐ 6. ☐ 7. ☐
17 Perm. Marker ☒	Mangrove forest fringing riverbank with salt couch on flats behind.	501288	7001165	Natural ☒ Artificial ☐	17	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
18 Perm. Marker ☒	Mangrove fringe and salt couch plain. Vertical eroded bank.	501291	7001117	Natural ☐ Artificial ☒	18	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	20% Stable 60% Eroding 20% Slumping	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
19 Perm. Marker	Straggly mangrove fringing a steep riverbank.	501145	7000955	Natural ☒ Artificial ☒	19	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	50% Stable 30% Eroding 20% Slumping	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☒ 3. ☒ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
☐												6. ☐ 7. ☐ 8. ☐ 9. ☐	6. ☐ 7. ☐
20 Perm. Marker ☒	Weed infested riparian vegetation including swamp oak, acacia, river mangrove on a severely eroded bank.	500970	7000824	Natural ☒ Artificial ☐	20	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	90% Eroding 10% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
21 Perm. Marker ☒	Narrow mangrove fringe to riverbank, salt couch plain and paddock thereafter that is weed infested.	501173	7001657	Natural ☒ Artificial ☒	21	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	60% Stable 40% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☒ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
22 Perm. Marker ☐	Scattered terrestrial trees and mangroves on a vertical bank.	501092	7001977	Natural ☒ Artificial ☒	22	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	10% Stable 80% Eroding 10% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
												7. ☐ 8. ☒ 9. ☐	7. ☐
23 Perm. Marker ☐	Terrestrial vegetation fringing river with scattered mangroves on a vertical bank highly eroding.	500664	7001988	Natural ☒ Artificial ☒	23	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	25% Stable 75% Eroding	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
24 Perm. Marker ☒	Closed mangrove forest fringing river with cleared land behind.	500839	7002315	Natural ☒ Artificial ☒		1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	25% Stable 75% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
25 Perm. Marker ☐	Terrestrial vegetation (swamp oak and slash pine) with scattered mangroves and lantana infested riverbank that is	500636	7002288	Natural ☒ Artificial ☒	25	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	90% Eroding 10% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
	highly eroding.											8. ☐ 9. ☐	
26 Perm. Marker ☒	Mangrove and mixed terrestrial vegetation fronting riverbank that is steep with cleared vegetation behind.	500272	7002083	Natural ☒ Artificial ☒	26	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	30% Stable 79% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
27 Perm. Marker ☐	Narrow mangrove fringe with cleared paddock behind.	500055	7002400	Natural ☒ Artificial ☒	27	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
28 Perm. Marker ☐	Narrow fringing and marine and terrestrial vegetation with pasture behind that is slightly eroding with a steep bank.	499826	7002370	Natural ☒ Artificial ☒	28	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	30% Stable 70% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
												9. ☐	
29 Perm. Marker ☐	Scattered mangrove and terrestrial vegetation fringing riverbank with cleared vegetation beyond including pine.	499933	7002273	Natural ☒ Artificial ☒	29	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐	10% Stable 70% Eroding 20% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
30 Perm. Marker ☐	Terrestrial vegetation fringing riverbank on a steep bank.	499813	7001996	Natural ☒ Artificial ☒	30	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	40% Stable 60% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
31 Perm. Marker ☐	Mixed riparian and marine vegetation with cleared land behind on a flat plain.	499549	7001956	Natural ☒ Artificial ☒	31	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
32 Perm. Marker ☐	Mangrove and terrestrial riparian vegetation fringing bank with cleared land behind on a vertical slope.	499387	7001860	Natural ☒ Artificial ☒	32	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	50% Stable 50% Eroding	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
33 Perm. Marker ☒	Terrestrial open woodland fringing riverbank with cleared land behind on a vertical slope highly eroding.	499341	7001820	Natural ☒ Artificial ☒	33	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	20% Stable 90% Eroding	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
34 Perm. Marker ☐	Mangrove fringing river with paddocks behind.	499218	7002056	Natural ☒ Artificial ☒	34	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
35 Perm. Marker ☐	Mangrove fringing with cleared land behind.	498189	7002924	Natural ☒ Artificial ☒	35	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐	
38 Perm. Marker ☐	Mangrove fringe with cleared land behind on a moderate sloping riverbank.	498487	7002864	Natural ☒ Artificial ☒	36	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	40% Stable 60% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐	
39 Perm. Marker ☐	Mixed riparian vegetation with cleared land behind.	498575	7002559	Natural ☒ Artificial ☒	37	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	20% Stable 80% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐	

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
41 Perm. Marker ☐	Mixed native vegetation fringe with cleared land behind.	498740	7002449	Natural ☒ Artificial ☒	38	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	90% Eroding 10% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
44 Perm. Marker ☒	Mixed riparian vegetation with cleared land behind on a steep bank.	498972	7002548	Natural ☒ Artificial ☒	39	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	20% Stable 80% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
46 Perm. Marker ☐	Mangrove fringing riverbank with cleared land behind that is weed invested.	499095	7002645	Natural ☒ Artificial ☒	40	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	50% Stable 50% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
49 Perm. Marker ☐	Mangrove and riparian vegetation with cleared land behind on a steep bank.	499252	7002567	Natural ☒ Artificial ☒	41	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	10% Stable 90% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
51 Perm. Marker ☒	Mixed riparian vegetation and cleared pasture beyond with camphor incursion.	499431	7002433	Natural ☒ Artificial ☒	42	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	40% Stable 60% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Baseline Data from Riverbank Erosion Assessment of the Caboolture River – Left Bank

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
36 Perm. Marker ☒	Woody structure in poor condition, mangrove fringing with disturbed native vegetation.	498183	7002955	Natural ☐ Artificial ☒	43	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	50% Stable 50% Slumping	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☒ 7. ☐ 8. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☒ Wooden

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
												9. ☐	Jetty
37 Perm. Marker ☐	Private gardens fronting riverbank with cleared vegetation and structures for boat access.	498487	7002864	Natural ☐ Artificial ☒	44	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	20% Stable 80% Eroding	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☒ 7. ☐ 8. ☒ 9. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
40 Perm. Marker ☒	Cleared recreational area	498639	7002506	Natural ☐ Artificial ☒	45	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	20% Stable 80% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☒ 7. ☐ 8. ☒ 9. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
42 Perm. Marker ☒	Mangrove fringing bank with a low slope.	498740	7002449	Natural ☒ Artificial ☐	46	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
45 Perm. Marker ☐	Mangrove fringing with cleared land beyond.	498972	7002548	Natural ☒ Artificial ☒	48	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	40% Stable 60% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☒ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐	
47 Perm. Marker ☐	Mangrove riverbank fringing with cleared paddock beyond.	499095	7002645	Natural ☒ Artificial ☒	49	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	30% Stable 70% Eroding	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐	
48 Perm. Marker ☐	Mangrove riverbank fringing with cleared paddock beyond.	499252	7002567	Natural ☒ Artificial ☒	50	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	90% Stable 10% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐ 6. ☒ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐	

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
50 Perm. Marker ☐	Mixed riparian vegetation with cleared pastures beyond.	499418	7002473	Natural ☒ Artificial ☒	51	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	10% Stable 80% Eroding 10% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
52 Perm. Marker ☐	Mangrove fringing cleared land.	499297	7002009	Natural ☒ Artificial ☒	52	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	20% Stable 80% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
53 Perm. Marker ☐	Mangrove fringing cleared land.	499187	7001973	Natural ☒ Artificial ☒	-	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	80% Eroding 20% Slumping	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
54	Mangrove fringing	499279	7001866	Natural ☒	53	1. ☐	1. ☐	1. ☐	30% Stable	1. ☐	1. ☒	1. ☒	1. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
Perm. Marker ☒	cleared land.			Artificial ☒		2. ☐ 3. ☒ 4. ☐ 5. ☐	2. ☒ 3. ☐ 4. ☐	2. ☒ 3. ☐ 4. ☐	70% Eroding	2. ☒ 3. ☐ 4. ☐ 5. ☐	2. ☐ 3. ☐ 4. ☐ 5. ☐	2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
55 Perm. Marker ☐	Mixing riparian vegetation fringing pasture.	499628	7001997	Natural ☒ Artificial ☒	54	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	40% Stable 60% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☒ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
56 Perm. Marker ☐	Mangrove fringing cleared land.	499842	7002030	Natural ☒ Artificial ☒	55	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	80% Stable 20% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
57	Mixed riparian fringing cleared	499772	7002400	Natural ☒ Artificial ☒	56	1. ☐ 2. ☐	1. ☐ 2. ☒	1. ☐ 2. ☒	30% Stable 60%	1. ☐ 2. ☒	1. ☒ 2. ☐	1. ☒ 2. ☐	1. ☐ 2. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
Perm. Marker ☒	pasture.					3. ☒ 4. ☐ 5. ☐	3. ☐ 4. ☐	3. ☐ 4. ☐	Eroding 10% Slumping	3. ☐ 4. ☐ 5. ☐	3. ☐ 4. ☐ 5. ☐	3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
58 Perm. Marker ☐	Mixed riparian fringing cleared pasture.	500143	7002212	Natural ☒ Artificial ☒	57	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	75% Stable 25% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
59 Perm. Marker ☐	Thin disturbed mangrove fringing cleared land.	500360	7002085	Natural ☒ Artificial ☒	58	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	80% Stable 20% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
60 Perm.	Mixed riparian vegetation fringing cleared land on	500611	7002368	Natural ☒ Artificial ☒	59	1. ☐ 2. ☐ 3. ☒	1. ☐ 2. ☒ 3. ☐	1. ☐ 2. ☒ 3. ☐	10% Stable 80% Eroding	1. ☒ 2. ☐ 3. ☐	1. ☐ 2. ☐ 3. ☐	1. ☒ 2. ☐ 3. ☒	1. ☐ 2. ☐ 3. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
Marker ☒	bend of river.					4. ☐ 5. ☐	4. ☐	4. ☐	10% Slumping	4. ☐ 5. ☐	4. ☐ 5. ☒	4. ☐ 5. ☒ 6. ☒ 7. ☐ 8. ☒ 9. ☐	4. ☐ 5. ☐ 6. ☐ 7. ☐
61 Perm. Marker ☒	Recreational fishing area and parkland cleared of vegetation.	500838	7002384	Natural ☐ Artificial ☒	60	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	10% Eroding 90% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☒ 7. ☒ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
62 Perm. Marker ☐	Private jetties.	500884	7002314	Natural ☐ Artificial ☒	61	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒	100% Stable	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☒ 6. ☐ 7. ☐
63 Perm. Marker	Mangrove fringing cleared land.	500685	7002071	Natural ☒ Artificial ☒	62	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
☐						5. ☐				5. ☐	5. ☐	5. ☐ 6. ☐ 7. ☐ 8. ☒ 9. ☐	5. ☐ 6. ☐ 7. ☐
64 Perm. Marker ☐	Boat access and gardens.	501045	7002002	Natural ☒ Artificial ☒	63	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒	50% Stable 50% Eroding	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☒ Pontoons and boat ramps
65 Perm. Marker ☒	Cleared recreational area near road reserve.	501160	7002021	Natural ☐ Artificial ☒	64	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐	60% Eroding 40% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☒ 7. ☒ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
66 Perm. Marker	Mangroves lining lower bank with step up to cleared land.	501007	7001616	Natural ☒ Artificial ☒	65	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	40% Stable 60% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
☐												6. ☐ 7. ☐ 8. ☒ 9. ☐	6. ☐ 7. ☐
67 Perm. Marker ☐	Narrow mangrove fringe with cleared land behind	500843	7001602	Natural ☒ Artificial ☒	66	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	20% Stable 80% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
68 Perm. Marker ☐	Mixed riparian vegetation fringing cleared land.	500576	7001277	Natural ☒ Artificial ☒	67	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	90% Eroding 20% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
69 Perm. Marker ☒	Mangrove fringing pasture.	500307	7001167	Natural ☒ Artificial ☒	68	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	20% Stable 60% Eroding 20% Slumping	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
												7. ☐ 8. ☒ 9. ☐	7. ☐
70 Perm. Marker ☐	Cleared pasture land.	500916	7000864	Natural ☒ Artificial ☒	69, 70	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐	70% Stable 30% Eroding	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
71 Perm. Marker ☐	Mangrove fringing pasture.	501233	7001029	Natural ☒ Artificial ☒	71	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	30% Stable 70% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
72 Perm. Marker ☐	Cleared Land.	501214	7001194	Natural ☐ Artificial ☒	72	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐	60% Eroding 40% Slumping	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
												8. ☒ 9. ☐	
73 Perm. Marker ☐	Boat yard and ramp with scattered mangroves.	501535	7001616	Natural ☐ Artificial ☒	73	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☒	100% Eroding	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☒ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☒ 6. ☐ 7. ☐
74 Perm. Marker ☐	Vegetated banks downstream of boat yard.	501701	7001561	Natural ☒ Artificial ☐	74	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	10% Stable 70% Eroding 20% Slumping	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
75 Perm. Marker ☐	Scattered mangroves fringing cleared land.	501968	7001330	Natural ☐ Artificial ☒	75	1. ☐ 2. ☒ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	10% Stable 70% Eroding 20% Slumping	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
												9. ☐	
76 Perm. Marker ☐	Mangrove forest and low shrub land.	501892	7001007	Natural ☒ Artificial ☐	76	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
77 Perm. Marker ☐	Closed mangrove forest.	502436	6999625	Natural ☒ Artificial ☐	77	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	100% Stable	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
78 Perm. Marker ☐	Cleared land with private gardens and scattered mangroves.	503342	6999345	Natural ☐ Artificial ☒	78	1. ☒ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☒	1. ☐ 2. ☐ 3. ☐ 4. ☒	50% Stable 50% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☒	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☒ 7. ☐ 8. ☒	1. ☐ 2. ☒ 3. ☐ 4. ☒ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
												9. ☐	
79 Perm. Marker ☐	Mangrove forest and low shrub land.	503545	6999092	Natural ☒ Artificial ☐		1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	70% Stable 30% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
80 Perm. Marker ☒	Marine vegetation with salt marsh and good quality undergrowth on a low stepped bank.	503610	6998954	Natural ☒ Artificial ☐	79	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☒ 3. ☐ 4. ☐	40% Stable 60% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
81 Perm. Marker ☐	High closed mangrove forest on low slope.	503680	6998390	Natural ☒ Artificial ☐	80	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	20% Aggrading 80% Stable	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☒ 6. ☐ 7. ☐ 8. ☒ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

Sample and Bank	Description	MGA Easting	MGA Northing	Local Land Use	Photo No.	Vegetation Type	Vegetation Value	Bank Properties				Factors Affecting Stability	Artificial Measures
								Erosion Class	Bank Stability	Bank Slope	Bank Shape		
82 Perm. Marker ☐	Good quality mangrove forest and low shrub land and sand deposition zone.	503523	6997433	Natural ☒ Artificial ☐	81	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☐ 2. ☐ 3. ☒ 4. ☐	60% Stable 40% Eroding	1. ☐ 2. ☐ 3. ☒ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
83 Perm. Marker ☐	Sand flat with mangroves.	503482	6996828	Natural ☒ Artificial ☐	82	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐	100% Eroding	1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐	1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐	1. ☒ 2. ☐ 3. ☒ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐

APPENDIX D

Site Photos



Photo 1.



Photo 2.



Photo 3.



Photo 4.



Photo 5.



Photo 6.



Photo 7



Photo 8



Photo 9.



Photo 10.



Photo 11.



Photo 12.



Photo 13.



Photo 14.



Photo 15.



Photo 16.



Photo 17.



Photo 18.



Photo 19.



Photo 20.



Photo 21.



Photo 22.



Photo 23.



Photo 24.



Photo 25.



Photo 26.



Photo 27.



Photo 28.



Photo 29.



Photo 30.



Photo 31.

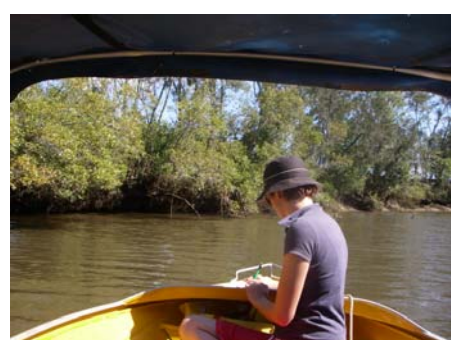


Photo 32.



Photo 33.



Photo 34.



Photo 35.



Photo 36.



Photo 37.



Photo 38.



Photo 39.



Photo 40.



Photo 41.



Photo 42.



Photo 43.



Photo 44.



Photo 45.



Photo 46.



Photo 47.



Photo 48.



Photo 49.



Photo 50.



Photo 51.



Photo 52.



Photo 53.



Photo 54.



Photo 55.



Photo 56.



Photo 57.



Photo 58.



Photo 59.



Photo 60.



Photo 61.



Photo 62.



Photo 63.



Photo 64.



Photo 65.



Photo 66.



Photo 67.



Photo 68.



Photo 69.



Photo 70.



Photo 71.



Photo 72.



Photo 73.



Photo 74.



Photo 75.



Photo 76.



Photo 77.



Photo 78.



Photo 79.



Photo 80.



Photo 81.



Photo 82.

APPENDIX E

Graphical Illustrations of Raw Data

