Brunswick Heads Caravan Parks

Preliminary concept designs for shoreline remediation and small boat access and storage

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Preliminary concept designs for shoreline remediation and small boat access and storage

Prepared for: Byron Shire Holiday Parks Reserve Trust
Project Manager: Charlie Hewitt
Ref: 0910859
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PO Box 9
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

info@geolink.net.au

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1 Introduction

1.1 Background

The Byron Shire Holiday Parks Reserve Trust ('the Trust') manages three caravan parks at the town of Brunswick Heads on the north coast of NSW:

- Ferry Reserve Caravan Park;
- Massey Greene Caravan Park; and
- Terrace reserve Caravan Park.

The Trust has identified remediation of degraded foreshore areas by seawalls as a priority for the three parks. The Trust is not considering seawalls for shorelines that are currently well vegetated with mangroves. These stretches appear stable and are unlikely to present significant public liability risk, although encroachments by permanent residents in some of these areas may be of concern. Provision of storage and water access facilities for small boats (dinghies, canoes and kayaks) has been also identified as a priority for Terrace Reserve Caravan Park.

GeoLINK has been engaged to prepare preliminary concept designs for foreshore restoration and small boat facilities. All cost estimates have been prepared without detailed design consideration and are strictly approximations.

The Trust requested designs be developed in response to the existing state of the shorelines only. It is the intention of the Trust that these designs will be refined on the basis of more detailed site considerations such as land use and tenure, and consultation with the community, park users and key stakeholders such as Byron Shire Council and the Marine Parks Authority.

1.2 Study Area Description

The three caravan parks are on the shores of the Brunswick River estuary, in or near the town of Brunswick Heads on the north coast of NSW. Their locations are shown in Illustration 1.1, and more detailed descriptions of the respective shorelines are provided in Section 2.

Ferry Reserve and Massey Greene caravan parks are situated on the Brunswick River and Terrace Reserve Caravan Park is on Simpsons Creek, the major tributary to the south. All of the parks are within two kilometres of the mouth of the Brunswick River. Alluvial soils with very few rocky outcrops predominate on these lower reaches. Extensive mangroves are the main feature of shoreline areas, with some fragmented areas of saltmarsh.

A typical view of the natural shoreline on these reaches of the river system is shown in Plate 1.1, taken looking downstream at the 'Terrace Reserve Upstream' site (see Section 2.4). Note that the higher steeper bank on the left is on the outside of a bend – a normal characteristic of meandering rivers which generally follow a natural process of accretion on the inside of bends and erosion on the outside of bends. An elevated bank is a feature of the shoreline of Terrace Reserve Caravan Park in particular.

Source: Byron Shire Council Date: February 2007

North

0 200

GeoLINK environmental management and design

Brunswick Heads Caravan Parks
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Site Locations

Illustration 1.1

Plate 1.1 A typical view of relatively undisturbed shoreline areas on Simpsons Creek

In order to preserve biodiversity, foreshore management should aim to reflect natural shorelines as closely as possible. Appropriately designed seawalls are analogies of rocky shorelines. However, rocky shorelines are not a natural feature of the reaches on which the caravan parks are located. Despite this, seawalls remain the favoured management technique on the shorelines of the reserves that are already degraded with failed seawalls or are exhibiting erosion.

The Trust needs to provide stable shorelines as quickly as possible, while balancing the provision of natural habitat with the maintenance of public amenity, the limitation of public liability and the preservation of public land.

1.3 Shoreline Management, Seawalls, and Aquatic Habitat

It is the nature of development that natural habitats are replaced with artificial habitats. In the case of development on the shores of marine environments this replacement of habitat extends into the marine context. The naturally dynamic nature of shorelines is a feature that is often at odds with land managers, owners and users in developed areas who require stability of shorelines to provide surety of land availability and appropriate levels of public safety.

Seawalls, if designed well, generally offer shoreline stability over long periods of time and require very little maintenance. For these reasons, and the fact that many of the shoreline areas of concern in the current project are already degraded with poorly constructed seawalls that have failed, the Trust favours seawalls as a bank stabilisation option.

Seawalls are not the only option for shoreline stabilisation in developed areas. Other options, which can be used separately or in conjunction, include

- intensive intertidal and/or terrestrial revegetation;
- nourishment with sand, gravel or cobbles; and
- the installation of a sub-tidal toe (rock footing) to provide greater substrate stability for revegetation and/or nourishment.

Restoration of mangroves or some analogy, rather than seawalls, would be a truer reflection of the natural shoreline state of the study area. However, this approach would fail to eliminate shoreline erosion from heavy land-based use in the short term. Erosion from natural river processes would be a possibility in the

medium to long term resulting in the potential loss of public land. Additionally, public waterway access would be limited in locations where access is currently unconstrained.

In replacing natural shorelines, seawalls continue to provide habitat, that is, substrate for aquatic flora and epifauna (i.e. animals that live on the surface of rocks such as oysters) as well as shelter and feeding opportunities for aquatic fauna. The degree to which the habitat of artificial shorelines mirrors that of natural shorelines, and the effect that this has on the resulting flora and fauna assemblages compared to undisturbed assemblages, has not been studied in the same detail as the terrestrial context.

Important differences between seawalls and natural shorelines have been identified in terms of the habitat they provide, and the effect they have on flora and fauna assemblages:

- The rocky material of a seawall is entirely different to a sand/mud/soil shoreline and would dramatically alter the habitat and resultant assemblage.
- The surfaces of rocks in a seawall can be more uniform, as a result of quarrying, than surfaces of natural rocks. This can limit the suitability of the substrate for attachment by aquatic flora and epifauna.
- The intertidal sections of seawalls are often vertical, or near vertical, differing greatly from the gently sloping intertidal areas generally exhibited on natural shorelines. Slope and orientation have been shown to have a strong influence on intertidal and subtidal assemblages (Chapman and Bulleri, 2003).
- Vertical, or near vertical, seawalls offer a much smaller area of intertidal habitat than more gently sloping shorelines. In an area with a tidal range of around 1.5 m, such as the Brunswick River, a vertical seawall provides only 1.5 m^2/m of intertidal habitat, whereas a 1:5 natural shoreline, for example, would provide 7.5 m^2/m of intertidal habitat.
- There is often very little opportunity for the provision of shoreline vegetation, such as mangroves, in many seawall designs.
- Seawalls often show very little diversity in the types of habitats provided, i.e. rock pools, overhangs, and crevices of varying dimensions. There is much evidence to show that increasing the diversity of habitats increases the diversity of species found on a shoreline.

Research undertaken by Sydney councils and the Centre for Research on Ecological Impacts of Coastal Cities (a recognised leader in this field) on seawall design and construction projects has identified simple and cost-effective features that can significantly increase the habitat quality of seawalls. They include:

- use of materials that are naturally occurring in the surrounding area;
- varying grades between 1.5:1 and 3:1 (H:V) along sections of a single seawall – flatter grades may be more appropriate from an ecological perspective but are likely to be prohibitive in terms of material costs and/or plan area of seawall; and
- use of roughly quarried blocks of rock of varying sizes randomly but securely placed to provide a variety of crevices and hollows.

(Gee Chapman, pers. comm., 9/1/07. Edwin Ho, pers. comm., 17/1/07)

Limitations of these features include a failure of the seawalls to look tidy (a subjective evaluation), and a loss of terrestrial land and/or reclamation of the waterway, the extent of which depends on the height and grade of the seawall.

Further, if rocky foreshores are not a natural feature of a waterway, as is the case in the subject study area, then seawalls of any design will not reflect the natural habitat. However, as noted above, the Trust must balance this with the provision of shoreline stability, land surety, public safety and recreational amenity.

These considerations have informed the development of the preliminary concept designs described in Section 2.

2 Preliminary Concept Designs

2.1 Introduction

This section provides an assessment of the shorelines of the three caravan parks as well as a discrete site close to the upstream extent of the parcel of land occupied by the Terrace Reserve Caravan Park, referred to here as 'Terrace Upstream'.

Particular terms are used to describe the existing state of the shorelines or the possible remediation techniques. These are clarified below.

Rock revetment seawall: a sloping sea wall (generally between 1:1 to 3:1, H:V) formed by the random but secure placement of large angular rocks (the sizes of which are determined by expected wave energy).

Plate 2.1 Example of a rock revetment seawall at Ferry Reserve Caravan Park

Block seawall: a vertical or near vertical wall formed by the regular placement of semi-regular to regular rectangular blocks, sometimes grout injected or connected with steel reinforcement for increased stability.

Plate 2.2 Example of a block seawall north of Terrace Reserve Caravan Park

Gabion wall: 'Gabions' are blocks made of wire mesh and filled with rocks at the site of construction allowing flexibility in the size of the blocks and laying of the mesh on uneven slopes. They are often supported on a 'reno mattress' which is a series of interlinked flatter gabions less than 0.5 m thick.

Plate 2.3 Example of a gabion wall (CEES, 2007)

Washaway: the result of entrainment of sand and fines through a seawall caused by tidal energy, wave energy, or stormwater runoff which can lead to eventual failure of the seawall.

Plate 2.4 The initial stages of a washaway at Massey Greene Caravan Park

Plate 2.5 An advanced washaway at Massey Greene Caravan Park

2.2 Ferry Reserve Caravan Park

Ferry Reserve Caravan Park is situated on southern shore of the Brunswick River immediately west of the Pacific Highway, as shown in Illustration 2.2.

The condition of the shoreline of the park, and possible remediation actions, are summarised in Table 2.1. Note that the chainages are measured from east to west and are approximate as detailed surveys were not available.

Table 2.1 Summary of the condition of the shoreline of Ferry Reserve Caravan Park and possible remediation actions

Chainage	*Apparent shoreline stability and features*	*Possible remediation options*
Ch 0 to 20	Well vegetated with established mangroves to a width of approximately 5 m. Appears stable.	None necessary
Ch 20 to 25	Bitumen boat ramp.	None necessary
Ch 25 to 175	Recently installed rock revetment seawall, with a recessed 15 m section of block seawall that provides for a small beach. The frontage of the caravan park ends at Ch 175, although the block continues in the form of a small public park.	None necessary, however some washaways in very early stages noted. These are much less advanced than that shown in Plate 2.3 however they should be monitored for any development
Ch 175 to 215	Severe erosion, possibly exacerbated by boat wash. Informal small scale attempts at stabilising with construction waste, and possibly placement of two large logs. At Ch 215 the shoreline around a stormwater outlet has been severely eroded and stormwater is flowing in an uncontrolled channel.	Continuation of rock revetment seawall, Illustration 2.1 option (a) (approximate cost $80,000). Reinstatement of stormwater outlet and possibly armouring of stormwater channel (approximate cost $15,000)
Ch 215 to 315	Severe erosion, possibly exacerbated by boat wash. Extensive dumping of construction waste – very unsightly. Erosion is not as severe as that exhibited between Ch 175 and 215. This may be due to increased stability from the extensive construction waste and/or the aspect of the shoreline in relation to boat wash.	Continuation of rock revetment seawall, Illustration 2.1 option (b) (approximate cost $190,000)

2.3 Massey Greene Caravan Park

As shown in Illustration 2.4, Massey Greene Caravan Park is situated on the southern shore of the Brunswick River at the northern end of the town and immediately east of the small boat harbour.

The condition of the shoreline of the park, and possible remediation actions, are summarised in Table 2.2. Note that the chainages are measured from east to west and are approximate as detailed surveys were not available.

Table 2.2 Summary of the condition of the shoreline of Massey Greene Caravan Park and possible remediation actions

Chainage	*Apparent shoreline stability and features*	*Possible remediation options*
Ch 0 to 70	A stable beach formed by the artificial groin at Ch 0. Width between 2 m and 6 m at high water.	None necessary
Ch 70 to 105	Severe erosion, with isolated rocks likely to be from previous low scale armouring. A number of trees are under threat of collapse. Under high tide conditions, water is undercutting the bank in some places.	Small scale rock revetment seawall, Illustration 2.3 Option (c) (approximate cost $35,000)
Ch 105 to 205	Small scale rock revetment seawall with numerous washaways in varying stages of progression, some very severe. Erosion of areas landward of seawall is reducing the width of the walkway from 3 m to around 1 m.	Small scale rock revetment seawall, Illustration 2.3 Option (d) (approximate cost $90,000)

2.4 Terrace Reserve Caravan Park

As shown in Illustration 2.6, Terrace Reserve Caravan Park is situated east of the town of Brunswick Heads on western shore of Simpsons Creek, less than 500 m from its confluence with the Brunswick River.

The condition of the shoreline of the park, and possible remediation actions, are summarised in Table 2.3. Note that the chainages are measured from north to south and are approximate as detailed surveys were not available.

Table 2.3 Summary of the condition of the shoreline of Terrace Reserve Caravan Park and possible remediation actions

Chainage	*Apparent shoreline stability and features*	*Possible remediation options*
Ch 0 to 100	Recently completed 2.5 m high grout injected block seawall with small boulder field at its base for increased toe stability. Includes some provision of intertidal habitat.	None necessary
Ch 100 to 145	Severe erosion of bank approximately 1.5 m high above MHWL with some remaining rubble from what was probably an insufficient and poorly built seawall. Some isolated mangroves. Stormwater outlets at chainage 100 and 125. High public liability risk due to the heavy use of the area, which is also possibly exacerbating erosion. It is likely that any boat storage and access facilities will be situated on this stretch of shoreline should they proceed. See Section 2.5	Extension of block seawall, Illustration 2.5 Option (e) (approximate cost $115,000) Or Rock revetment seawall, Illustration 2.5 Option (f) (approximate cost $60,000). Design and installation will need to accommodate stormwater outlets.
Ch 145 to 295	Vegetated banks of varying heights (around 1.5 m to 2.5 m above MHWL) with some environmental weeds (e.g. banana trees and coral trees) and increasing steepness after chainage 210. A mangrove stand of around 10 m width exists along much of this section. However, mangroves have been cleared in a number of locations with encroachments of permanent residences onto the shoreline. Removal of mangroves is illegal under the Fisheries Management Act 1994 and Marine Parks Act 1997. Some of these encroachments may be on unstable sections of the shoreline. Permanent residences begin at chainage 185.	Minimal shoreline erosion primarily as a result of mangroves dissipating wave energy. No formal remediation necessary. Weeds can be addressed by active regeneration of banks with native vegetation, Illustration 2.5 Option (g) (see Section 2.4 for species). This should be done in a progressive manner to minimise instantaneous disturbance.
Ch 295 to 310	An apparently stable block seawall approximately 2 m high in front of a permanent residence, incorporating a stormwater outlet.	None necessary. A formal assessment of the integrity of the seawall may be necessary.
Ch 310 to 505	Steep banks with features similar to the banks observed between chainages 145 and 295. Extensive outbreak of fishbone fern. The mangrove stand thins to a width of around 5m at some points, and clearances are still prevalent. Chainage 420 marks the end of the permanent residences, followed by a flat grassed camping area with an established fence at the top of the bank. The bank height appears to increase between chainages 310 and 420 to around 3 m.	Revegetation as per chainage 145 to 295.

Chainage	*Apparent shoreline stability and features*	*Possible remediation options*
Ch 505 to 515	A swimming and waterway access area for small boats accessed via a set of timber stairs. Some bank erosion possibly as a result of heavy use and inappropriate boat storage. Some weed infestation.	The safety of the stairs may need to be investigated, and could be easily remediated by addition of some traction material. Installation of a timber platform (and possibly some boat storage) would significantly add to amenity and reduce erosion.
Ch 515 to 600	Same as banks between chainages 310 and 505, with increasing width of mangrove stand to around 30 m. Chainage 600 represents the end of the caravan park.	Revegetation – see chainage 145 to 295.

2.5 Terrace Reserve Upstream

'Terrace Reserve Upstream' is the name given in this report to the discrete site of severe bank erosion near the southern end of the land that Terrace Reserve Caravan Park is situated on. As shown in Illustration 2.6, the site is approximately 550 m south of the southern edge of the Terrace Reserve Caravan Park, and just north of the Brunswick Heads Bowling Club.

The bank is approximately 3.5 m high on a section of the shoreline that contains no mangrove stands. These features are typical of shorelines on the outside of a bend on this meandering stretch of the river where natural processes cause the banks to gradually recede.

Erosion is evident in this location in the form of a 'bite', about 4 m deep and 7 m across, out of a straight stretch of steep bank. It is locally defined and quite distinct from other nearby shoreline areas undergoing the same natural processes. Undercutting of the bank is also evident downstream of this location. This undercutting takes place at the interface between the overlying soil and a layer of coffee rock which is located above the low water mark.

A cycling/walking path is located immediately west of the localised erosion site, and is currently threatened by the gradually advancing erosion. At this location, a particularly wide section of road base material extends between the cycling/walking path and the sealed road formation of the Old Pacific highway. Field observations note that water ponds within this section of the road verge indicating that this particular area is relatively impervious (unlike the other adjacent sections of the road verge which appear to consist of pervious sandy soils and grass vegetation).

It appears that during more intense rainfall events, runoff from the road pavement and this extensive area of road base overflows at the western edge of the scour point and is exacerbating this localised failure of the bank.

Around 15 m to the south of this site is a rope swing on a sandy beach adjacent to a water hole. This feature is presumably used by local children swimming in the estuary and can be expected to attract reasonably heavy traffic up the bank at that location. However, the erosion here is not as pronounced at the point of localised erosion. It could be concluded therefore that the observed localised erosion of the bank is more likely to be caused by concentrated stormwater flows than by pedestrian traffic.

Stormwater Control and Revegetation

It is recommended that the likely causes of the erosion are removed and the bank stabilised by means of small-scale 'soft engineering' initially. The on-going stability of the bank should be carefully monitored, including the undercutting of the bank which is evident along this stretch of the estuary where the soil overlays the coffee rock.

The increased volumes of runoff and channelling of stormwater west of the erosion site can be substantially reduced by removing as much of the road base as possible and replacing it with well drained sand and turf. The restored area should include a slight depression to detain the runoff and allow infiltration into the sandy soil, thereby reducing the amount of stormwater runoff. This strategy would also provide water quality improvements.

The scarp area should be fenced off to discourage pedestrian access and the nearby access point could be provided with timber steps to improve accessibility. Complementary signage could also be installed indicating the importance of ensuring bank stability and its relation to maintaining the cycle/walking path.

If stormwater flows and pedestrian traffic are removed, is likely that the slope can be stabilised by means of revegetation. The lack of quality soil, exposure of tree roots, and instability of the slope will necessitate the provision of additional soil and an artificial biodegradable substrate to provide immediate stability and ensure that plants remain established.

A heavy grade jute fibre such as *Jutemaster* may be used to promote growth of tube stock for long term erosion control. It decomposes completely after 24-36 months. The fibre mat would be secured using retaining pins providing an immediate stabilising influence.

Plants suitable for the revegetation, recommended in Revegetating Streams in the Brunswick Catchment would include:

- creek sandpiper fig (*Ficus coronata*);
- cheese tree (*Glochidion ferdinandi*);
- spiny mat rush (*Lomandra hystrix*); and
- water gum (*Tristaniopsis laurina*).

A typical section is shown in Illustration 2.7 Option (h). This strategy is estimated to cost about $15,000 to implement.

Seawalls

If erosion continues despite the 'soft engineering' approach, the integrity of the cycle/walking path is likely to be threatened further and may need to be re-aligned. To ensure bank stability, it may therefore be necessary to adopt a more complex and costly approach as described below.

Rock revetment wall.

To ensure stability of rock revetment walls, their grade of is generally limited to 1:5:1 (H:V). Installation of a wall of this nature and height will require a significant volume of material, around 60m^3, to protect a relatively small length of shoreline. A revetment would preclude any revegetation of the shoreline. A typical section is shown in Illustration 2.7 Option (i). The approximate cost of this option would be $30,000.

Gabion wall on reno mattress toe

A gabion wall on a reno mattress toe (see Section 2.1) would be more efficient in terms of material than a rock revetment wall due to the steeper grades of gabion walls. A gabion wall on this site would require approximately 45m^3 of material. Additionally, gabion walls can be designed to incorporate revegetation which, once established, can provide habitat for fauna and 'soften' the visual impact of the wall. A probable species for revegetation on a gabion wall would be spiny mat rush (*Lomandra hystrix*). A typical section is shown in Illustration 2.7 Option (j). The approximate cost of this option would be $25,000.

End effects of rock revetment and gabion walls

Rock revetments and gabion walls may induce 'end effects' whereby hydrological changes resulting from the hard structure lead to erosion in other nearby areas, usually downstream, that have not been armoured. End effects are more pronounced in high energy environments, such as the open coast, but can still occur in estuaries as a result of tidal and river flow energy. Modelling for this inherent risk is generally not possible, necessitating regular monitoring of any changes to nearby bank morphology and planning for possible restoration works.

2.6 Boat Access and Storage

Along much of the shoreline of Terrace Reserve Caravan Park small boats such, particularly dinghies, are tied to mangroves or drawn over banks when gaining access to or from the waterway. The Trust has identified this as potentially damaging to mangroves and contributing to shoreline erosion.

Use of small boats and waterway access are highly valued attractions of the park which the Trust wants to maintain while minimising environmental damage.

To initiate discussions with park residents and those who use the park to access the waterway with small boats, the Trust requested a preliminary design of a small boat storage and access facility.

The design is based on a successful project conducted by Mosman Council (Edwin Ho, pers. comm., 17/1/07) and designs and advice provided by *Marine Dock Systems* a manufacturer of small and large scale marina facilities.

A preliminary design for the storage of up to 18 dinghies and the provision of safe and easy access to the waterway (maximum grade approximately 3.8:1) is shown in Illustration 2.8.

3 Recommendations

This report provides a basis for the development of detailed designs that will allow the Trust to tender for works to stabilise the shorelines of Ferry, Massey Greene and Terrace Reserve caravan parks, along with works to provide suitable boat access and storage facilities.

The following steps are recommended for the development of detailed designs for tender and construction of the shoreline remediation works:

- consultation with the community on the concept designs to inform any potential recreational amenity aspects that may be incorporated into the detailed designs, and minimise the risk of any community misunderstanding around the works;
- consultation with Marine Parks Authority NSW on the design and construction of shoreline structures within the park (the caravan park shorelines are all situated in areas classified as 'Habitat Protection Zone' in the Cape Byron Marine Park);
- preparation of detailed shoreline surveys showing all services, existing structures, and access points for plant and machinery; and
- preparation of detailed designs with thorough consideration of construction scheduling in relation to peak times, means of plant access, and requirements of the Marine Parks Authority NSW.

The following prioritisation of works is recommended.

Table 3.1 Recommended prioritisation of shoreline remediation works

Priority	*Description and justification*	*Approximate construction cost*
1	Rock revetment chainage 70 to 205 of Massey Greene Caravan Park shoreline – the walkway between the fence and water is severely threatened in a number of places	$125,000
2	Rock revetment chainage 175 to 215 of Ferry Reserve Caravan Park – severe erosion, unsightly construction waste, poor stormwater management	$95,000
3	Revegetation or rock revetment at Terrace Reserve Upstream site – the cycle path is threatened	$15,000 (revegetation) to $30,000 (rock revetment)
4	Rock revetment or block seawall chainage 100 to 145 of Terrace Reserve Caravan Park – heavy public use and prime camping/caravan sites threatened	$60,000 (rock revetment) or $115,000 (block seawall)
5	Rock revetment chainage 215 to 315 of Ferry reserve Caravan Park – unsightly and possibly dangerous construction waste	$190,000
6	Upgrade safety of stairs and install timber platform waterway access area between chainages 505 and 515 at Terrace Reserve Caravan Park	Not determined
7	Revegetation chainages 145 to 295, 310 to 505, and 515 to 600 of Terrace Reserve Caravan Park – intentional damage to mangroves, severe weed infestation, illegal encroachments by residents	Not determined
	APPROXIMATE TOTAL CONSTRUCTION COST	$485,000 to $555,000 (not incl. priority items 6 or 7)

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