ADDENDUM TO COASTAL ZONE MANAGEMENT PLAN FOR OLD BAR

GREATER TAREE CITY COUNCIL
7 April 2014

8A0271-03A

Royal HaskoningDHV
Enhancing Society Together

HASKONING AUSTRALIA
MARITIME & WATERWAYS

Suite 5, Level 5
100 Walker Street
NORTH SYDNEY NSW 2060
+61 (0) 8854 5000
www.royalhaskoningdhv.com

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Drafted by	Gary Blumberg
Checked by	
Date/initials check	
Approved by	
Date/initials approval	

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1 INTRODUCTION

1.1 BACKGROUND

Greater Taree City Council (GTCC) has prepared a draft Coastal Zone Management Plan (CZMP) for the Greater Taree Local Government Area (LGA) (Worley Parsons WP, 2013). The plan covers the area from Black Head in the south, to Crowdy Head in the north, a shoreline distance of some 32 km.

The draft CZMP was written on the basis of a policy stance of "planned retreat" for the management of the entire Greater Taree coastline. Planned retreat involves the removal or relocation of structures when pre-determined (trigger) distances are activated, or when road access or services are no longer available. The draft CZMP recognises planned retreat as the best strategic approach to manage uncertainty associated with the impact of coastal hazards. The selection of planned retreat in the draft CZMP is a default position based on the non-affordability or availability of any other option. The draft CZMP has not been exhibited or formally adopted by GTCC nor has it been endorsed by the State Government. As such, the draft 2013 CZMP has no status.

However, at this time, the community at Old Bar has not been prepared to accept planned retreat which it views as detrimental to the future of the village. In acknowledgment of the community position, GTCC has investigated and proposed rock revetment coastal protection as a compromise solution option, one which balances the rights of property owners to protect their assets with beach access and amenity (RHDHV, 2013). The NSW Office of Environment and Heritage (OEH) has confidence in the long-term effectiveness of the proposed revetment.

Subsequent to the coastal hazard investigations (WP, 2010) that led to the draft CZMP for Greater Taree (WP, 2013), the beach at Old Bar has experienced substantially accelerated retreat. The reasons for this are not certain. GTCC now proposes to update the coastal hazard lines at Old Bar, and include the rock revetment as an option to planned retreat in the draft CZMP for Greater Taree. OEH will provide financial support to continue with the investigations. All available coastal management options have been considered in the context of the revetment proposal.

RHDHV has been retained by GTCC to undertake the follow-up investigations for coastal hazard redefinition and amendment to the draft CZMP for Greater Taree, in relation to Old Bar. Separate addendum reports to the Greater Taree Coastal Hazard Definition Study (WP, 2010a) and the draft CZMP for Greater Taree (WP, 2013) have been prepared. This report comprises the addendum to the existing draft CZMP.

1.2 STUDY AREA

The study area for the follow-up investigations relates to the township of Old Bar.

The study area covers 2.6 km of shoreline between the MidCoast Water exfiltration ponds in the south and the Old Bar Surf Lifesaving Club in the north. This is the same as the works area adopted for the Old Bar Beach Coastal Protection Structure Design Investigation (RHDHV, 2013). The study area is shown in **Figure 1**.

Figure 1: Study area at Old Bar Beach

1.3 SCOPE OF WORK

As agreed, the RHDHV reporting does not seek to reproduce relevant sections of the Greater Taree CZMP but rather cross-reference this material since the Greater Taree and Old Bar CZMPs would be read as companion documents.

Preparation of the Old Bar CZMP has regard to the Guidelines for Preparing Coastal Zone Management Plans (OEH, 2013) and 're-visits' management options for the Old Bar coastline. It addresses, based on the updated hazard definition, recent investigations, and recent community consultation, the following matters; singly and/or in combination:

- planned retreat;
- beach nourishment;
- staged seawall construction and associated potential environmental impacts and mitigating measures (to a preliminary level, not a formal EIA); and
- artificial offshore reefs.

The process was expected to involve:

- detailed discussions with GTCC officers to agree on the level of detail of the Old Bar CZMP and its interface with a (modified) Greater Taree CZMP. It is understood GTCC officers would undertake the necessary modification of the current draft Greater Taree CZMP;

- detailed review of the current draft Greater Taree CZMP, in particular in relation to the Old Bar coastline;

- preparation of a draft Old Bar CZMP based on the above activities, the updated hazard definition assessment, the recent investigations and the recent and further community consultation to be conducted as part of this project;

- finalisation of the Old Bar CZMP based on consolidated comments on the draft received from GTCC.

1.4 LEVEL DATUM

All reference to Reduced Level (RL) in this report is given in metres above Australian Height Datum (AHD). AHD is approximately Mean Sea Level along the Australian coast.

1.5 CURRENCY OF GUIDELINES FOR PREPARING COASTAL ZONE MANAGEMENT PLANS

The draft CZMP for Greater Taree (WP, 2013) was prepared in accordance with Guidelines for Preparing Coastal Zone Management Plans (DECC, 2010). These guidelines were updated by OEH (2013) essentially in relation to removal of references to the NSW Sea Level Rise (SLR) Policy Statement and related guides. Cross referencing across DECC (2010) and OEH (2013) for the purpose of this addendum is reasonable since while the State Government has retracted its former SLR benchmarks, GTCC still adheres to the technical studies underpinning the benchmarks to the extent that these are not superseded by more up to date information, in particular that reported by the IPCC.

1.6 ACKNOWLEDGEMENTS

RHDHV acknowledges the assistance provided by GTCC in steering this project. We also acknowledge the assistance of OEH.

2 DRAFT COASTAL ZONE MANAGEMENT PLAN (CZMP) FOR GREATER TAREE

In its draft CZMP for GTCC has adopted a policy stance of planned retreat for the management of its entire LGA coastline (WP, 2013). GTCCOld Bar Beach recognised by adopting the planned retreat policy stance that a coastal strategy which favours the retreat of public and private assets from coastal hazards represents the best strategic approach to the management of the uncertainty associated with the impact of coastal hazards particularly as GTCC is not in a position to fund costly active management options. Planned retreat involves the removal or relocation of development or structures when the erosion escarpment reaches a pre-determined (trigger) distance from the seaward edge of the structure, or when road access and/or services (water, sewage and electricity) are no longer available to the property.

GTCC expects public and private assets along the coastline would continue to become vulnerable to coastal hazards both now and into the future. It is likely that the intensity of coastal hazards along the coastline would increase over time, as would the risks to public and private assets as the effects of climate change are realised. Even with the current best available information, the true impacts/risks resulting from climate change and coastal hazards on the Greater Taree coastline still remains uncertain, although some of these risks have been modelled and used to produce coastal hazard lines. The plan does not advocate the sterilisation of all property seaward of the 2100 hazard line. It seeks to permit the beneficial occupation of land subject to coastal hazards for as long as reasonably possible.

The CZMP contains actions to assist in the implementation of the plan and associated actions in relation to beach access and amenities.

Issues which are addressed include community uses of the coastal zone, pressures on coastal ecosystems, and managing risks of public safety and built assets. This CZMP refers to the Greater Taree Coast Emergency Action Plan (EAP) in the event that a major storm occurs before development and structures at immediate risk can be removed or relocated. While GTCC's policy stance is planned retreat, the *State Environmental Planning Policy (Infrastructure) 2007* makes provision for landowners to lodge a development application (DA) for the purposes of a sea wall or beach nourishment. In June 2012, landowners in Lewis Street, Old Bar, lodged a DA for erosion protection works although this was refused on the grounds of likely adverse impacts on adjacent properties, limitation on public access, public safety, and inadequate arrangements for restoration and maintenance.

The draft CZMP for Greater Taree was prepared by GTCC in partnership with WorleyParsons with financial assistance from the NSW Government through OEH. The draft CZMP for Greater Taree does not necessarily represent the opinions of the NSW Government or OEH.

3 COASTLINE ZONE HAZARD DEFINITION UPDATE FOR OLD BAR

3.1 General

Coastal development setbacks have been traditionally defined through delineation of coastline hazard lines, using a variety of planning periods and hazard zones. However, until recently there has been no known rigorous assessment of the validity of traditional hazard lines to gauge an acceptable risk to property if used as setbacks for new development.

Borrowing a methodology developed by the Australian Geomechanics Society (AGS) for assessing landslide risk, RHDHV has developed acceptable risk lines for Old Bar (RHDHV, 2014), summarised below under the following main headings:

- Introduction
- Design Life
- Likelihood of Coastline Hazard
- Consequences of Coastline Hazard
- Likelihood and Acceptable Risk Lines

3.2 Introduction

The study area coastline zone hazard definition (CZHD) update was intended to be the same as that considered in the Old Bar Beach Coastal Protection Structure Design Investigation (RHDHV, 2013), that is from the Taree Old Bar Surf Life Saving Club (SLSC) in the north, to the MidCoast Water exfiltration ponds in the south. Southern end of this area, in the vicinity of the exfiltration ponds, was omitted since the 2013 photogrammetric data did not include this section of the beach. Importantly, the study area still extended well south of the Lewis Street properties (by some 400 m), and fully covered the remainder of the site up to and beyond the SLSC.

It is assumed that the 'acceptable risk' setbacks developed are caused by coastal storms and recession due to net sediment loss and sea level rise, and that the entire study area was sandy and erodible. Possible future protective works were excluded.

The framework for the methodology was developed by the Australian Geomechanics Society (AGS) of Engineers Australia for landslide risk management. The AGS procedures are well recognised and peer reviewed, attributed to the AGS Landslide Taskeforce with 23 members. The modification here for a "sandy beach" was implemented in consultation with AGS personnel.

However, the rigour of the methodology should not mask the intrinsic variability of the parameters being modelled, in particular wave behaviour, future climate cycles and sea level rise, and their consequences for coastline erosion and recession. Therefore, any development sited landward of a particular "acceptable risk" line is not at zero risk but at acceptably low risk, and damage may be possible both during and beyond the design life. Nevertheless, the acceptable risk approach is considered to be reasonable and an improvement on traditional methods of hazard definition.

Only risk to property is evaluated. In a coastal beach context, risk to life is considered to be acceptably low for various reasons including good foreknowledge with tides and coastal storms, high visibility of advancing erosion risk, and role of the State Emergency Service (SES) to warn and evacuate residents.

3.3 Design Life

The design life governs the planning period over which the risks are assessed. That is, the risks to structures will be determined as being acceptable or not acceptable on the basis of the risk of damage to the structure at the end of the design life.

Having regard to design life adopted for landslide risk assessment (AGS, 2007), design life adopted for structures and structural components in various Australian Standards, and amortization of residential development used in the Income

Tax Assessment Act 1997, it is considered that a reasonable design life for devising setbacks and controls for beachfront development is between 40 and 60 years. Since future climate is uncertain, an upper end design life of 60 years has been adopted.

It is appropriate that trigger conditions would also apply to again allow for uncertainty and to take account of the fact that development consents by default do not have a time limit.

3.4 Likelihood of Coastline Hazard

3.4.1 Terminology

For the purposes of the CZHD update for Old Bar, coastline hazard is taken to be erosion and/or recession hazard. All other coastline hazards for Old Bar are as described in WP (2010a).

The assessment borrows the AGS terminology. Likelihood descriptors and associated probabilities used by AGS are shown in **Table 1**. The assessment adopted the values in Column 5, which is conservative.

Table 1: Likelihood descriptors and associated probabilities used by AGS (2007a, b)

1 Descriptor	2 Annual Exceedance Probability (indicative value)	3 Annual Exceedance Probability (AEP)	4 Cumulative probability of event occurring over design life (range) (1)	5 Designated cumulative probability of event occurring over design life (1)
Almost Certain	10%	> 5%	> 95.4%	95.4%
Likely	1%	0.5 to 5%	26.0 to 95.4%	26%
Possible	0.1%	0.05 to 0.5%	3.0 to 26.0%	3%
Unlikely	0.01%	0.005 to 0.05%	0.3 to 3.0%	0.3%
Rare	0.001%	0.0005 to 0.005%	0.03 to 0.3%	0.03%
Barely Credible	0.0001%	< 0.0005%	< 0.03%	not used
Notes (1) Based on a standard formulation relating annual exceedance probability (AEP) and life to probability of a an event (RHDHV, 2014)				

3.4.2 Recession Likelihood

For sea level rise (SLR) and long term recession, three scenarios are considered:

- a "mild case" estimate, taken to have a 95% probability of exceedance (leading to lower recession);
- a "best" estimate, taken to have a 50% probability of exceedance;
- a "severe case" estimate, taken to have a 5% probability of exceedance (leading to a higher recession)

The long term recession quantified in WP (2010a) has been updated to account for the additional 7 years of aerial photography to 2013. Refined updated assessments are also brought to the description of SLR (IPCC,2013), slope of active coastal profile for application of Bruun Rule (Appendix A in RHDHV, 2014).

The key parameters developed for the likelihood of coastline hazard are summarised in **Table 2**.

Table 2: Recession Likelihood Summary

Descriptor	Scenario		
	95% exceedance "mild case"	50% exceedance "best estimate"	5% exceedance "severe case"
South from SLSC			
Long term recession rate due to net sediment loss	0.4 m/yr	0.8 m/yr	2.5 m/yr
Long term recession due to net sediment loss at 2074	24 m	49 m	153 m
Adopted SLR to 2074	0.25 m	0.38 m	0.52 m
Long term recession due to SLR	4 m	16 m	44 m
Future uncertainty allowance	0 m	5 m	20 m
Combined recession and rotation allowance at 2074	28 m	70 m	216 m
North from SLSC			
Long term recession rate due to net sediment loss	0.4 m/yr	0.8 m/yr	2.5 m/yr
Long term recession due to net sediment loss at 2074	0 m	6 m	43 m
Adopted sea level rise to 2074	0.25 m	0.38 m	0.52 m
Long term recession due to SLR	4 m	16 m	44 m
Future uncertainty allowance	0 m	5 m	20 m
Combined recession and rotation allowance at 2074	4 m	27 m	106 m

3.4.3 Storm Demand Likelihood

1% AEP storm demand (or erosion) is quantified as in volumetric terms from WP (2010a) as follows:

- 220 m^3/m south of SLSC
- 180 m^3/m north of the SLSC

The relationship between storm demand and recurrence is assumed to follow that described in Gordon (1987) for "high demand" (rip head) beaches. The likelihood of storm demand occurring over the adopted 60 year design life is described using the AGS terminology in **Table 1**, and statistically associated with the three "mild case", "best estimate" and "severe case" recession scenarios for storms occurring:

- at any time over the design life, ignoring recession as per **Table 3** (Type 1 storm); and
- in the last year of the design life, after full recession as per **Table 4** (Type 2 storm).

Table 3: Storm demand likelihood at Old Bar Beach (Type 1)

Likelihood (1)	Cumulative probability over design life (1)	AEP (%) (1)	ARI (years) (2)	Storm demand (m^3/m) (3)	
				North from SLSC	South from SLSC
Almost Certain	95.4%	5	20	130	160
Likely	26%	0.5	200	200	250
Possible	3%	0.05	2,000	280	350
Unlikely	0.3%	0.005	20,000	360	440
Rare	0.03%	0.0005	200,000	430	540

Notes (1) From Table 1.
(2) Statistical relationship between AEP and ARI.
(3) From Gordon (1987)

Table 4: Storm demand likelihood at Old Bar Beach for areas south from SLSC (Type 2)

Likelihood (1)	Cumulative probability of event occurring over design life (1)	Storm demand volume (m^3/m)		
		95% exceedance	50% exceedance	5% exceedance
Likely	26%	80	50	N/A
Possible	3%	180	150	40
Unlikely	0.3%	270	240	150
Rare	0.03%	370	340	240
Notes (1) From Table 1. (2) From Gordon (1987)				

For example, it follows from the above tables that for Type 1 erosion, when a storm could occur at any time over the 60 year design life, it is "likely" that over a period of 60 years that more than 251 m^3/m of sand would be removed in a single storm from the beach and dune south from the SLSC.

For a Type 2 assessment, when the storm erosion is taken to occur in the 60 th year after full recession, then the likelihood of a storm demand volume would depend on the recession scenario that the storm is being linked to. When particular cumulative probabilities are being sought, then it is found that the contribution of recession overwhelms the description (or likelihood) of the hazard, and the storm demand contribution is relatively small. Thus, for beach areas south of the SLSC, an "unlikely" coastline hazard line would be realized with a very severe 270 m^3/m storm in combination with a "mild" (95% exceedance) recession scenario, or alternatively with a more moderate 150 m^3/m storm in combination with a "severe" (5% exceedance) recession scenario.

Other bases and assumptions adopted with respect to storm demand included:

- The schematic representation of the coastline hazard zones after Nielsen et al (1992) is applied to describe how storm demand affects beach profiles and foundation capacity (**Figure 2**).
- Pre-storm profiles for the photogrammetric assessment were 2013, 7 years later than those adopted in WP (2010a).
- An angle of friction of 30 degrees was adopted for all sand comprising the coastline profile.
- The erosion assessment conservatively assumes that all locations in the study area are equally likely to be eroded in a particular storm (ie, rips could form at any location on the beach).

3.5 Consequences of Coastline Hazard

The consequence descriptors from AGS (2007a, b) are applied, namely "catastrophic", "major", "medium", "minor" and "insignificant". For example, a "major" consequence is associated with a cost of damage between 40 and 100% of the cost of the structure, whereas a "minor" consequence ranges between 1 and 10%. "Catastrophic" (>100%) has the structure completely destroyed and/or large scale damage requiring major engineering works for stabilisation which may exceed the cost of the structure.

A slumped erosion escarpment immediately seaward of the structure was considered to result in "minor" damage due to reduced foundation capacity in that zone. If on engineered piles, then the consequences for the same structure would be "insignificant".

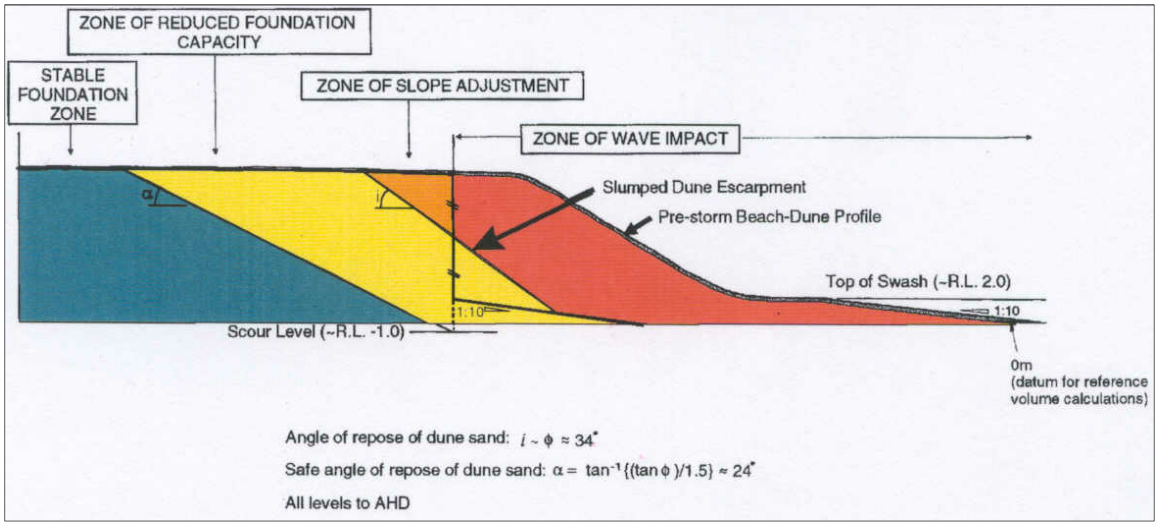

Figure 2: Schematic representation of coastline hazard zones (after Nielsen et al , 1992)

However, Old Bar is a developed area and not a greenfield site. The opportunity to pile is minimal, so other mechanisms must be explored to reduce the risk of coastline hazard for any development that occurs to existing residential property or vacant lots that are likely to be impacted by continued erosion and recession in the event no coastal protection of property is implemented.

3.6 Likelihood and Acceptable Risk Lines

RHDHV (2014) develops different likelihood lines for coastline hazard. These comprise likelihood lines for Type 1 storms only (no recession), and likelihood lines for the Type 2 storms occurring following in combination with the three adopted recession scenarios. A comparison of the likelihood hazard lines with the traditional hazard lines reported in WP (2010a) is included. It finds that the traditional Immediate Zone of Slope Adjustment is similar to (or slightly seaward of) the "almost certain" line. The traditional 2058 ZSA Reduced Foundation Capacity is generally similar to the "likely" line, particularly in the impacted developed areas of Lewis Street and Pacific Parade.

To gauge acceptable risk lines for new development, the risk matrix from AGS (2007a, b) is applied, reproduced below in **Table 5**.

Table 5: Risk matrix

Likelihood	Consequence				
	Catastrophic	Major	Medium	Minor	Insignificant
Almost certain	Very high	Very high	Very high	High	Medium
Likely	Very high	Very high	High	Medium	Low
Possible	Very high	High	Medium	Medium	Very low
Unlikely	High	Medium	Low	Low	Very low
Rare	Medium	Low	Low	Very low	Very low
Barely credible	Low	Very low	Very low	Very low	Very low

Based on a review of available literature (which was limited), extensive discussion amongst the Working Group, and a consideration of annualized cost of damage to property, AGS (2007a, b) concluded that

> "most informed home owners are likely to be risk averse as a result of appreciation of the consequences at a family or personal level, almost regardless of the likelihood of the event. This risk aversion suggests that "low" risk to property is an appropriate recommendation for acceptable risk to the regulator for domestic dwellings".

The acceptable risk level was also considered to be "low" for buildings and facilities where no more than 300 people can congregate in one area (eg schools). For buildings and structures designated as essential facilities or with special post disaster functions etc, the designated acceptable risk was "very low".

An "acceptable risk" threshold for new development at Old Bar is assessed to be "low" as shown by the bold outline in **Table 5**. On this basis, it follows that an acceptable risk would apply for (**Section 3.5**):

- an "unlikely" coastline hazard resulting in a "minor" consequence – new development constructed on conventional foundations;

- a "likely" coastline hazard resulting in an "insignificant" consequence – new development constructed on piled foundations.

RHDHV (2014) develops different likelihood lines for coastline hazard. These comprise likelihood lines for Type 1 storms only (no recession), and likelihood lines for the Type 2 storms occurring in combination with the three adopted recession scenarios (**Section 3.4.2**). A comparison of the likelihood hazard lines with the traditional hazard lines reported in WP (2010a) is included. It finds that the traditional Immediate Zone of Slope Adjustment (ZSA, **Figure 2**) is similar to (or slightly seaward of) the "almost certain" line. The traditional 2058 Zone Reduced Foundation Capacity line is generally similar to the "likely" line, particularly in the impacted developed areas of Lewis Street and Pacific Parade.

Two relevant plots for the Old Bar CZMP update are reproduced from RHDHV (2014) in **Figure 3** and **Figure 4**.

Figure 3 shows likelihood lines for the 50% exceedance ("best estimate") recession scenario combined with 50% exceedance Type 2 storm (excluding the "Almost certain" line which is due to a Type 1 storm and no recession), overlaid on the ZSA hazard lines reported in the Coastline Hazard Definition Study (WP, 2010). It is evident that the Immediate ZSA line from WP (2010) is similar to (or slightly seaward of) the "Almost certain" likelihood line. This simply points to the imminent threat up to this set of lines.

When recession is included, the probability of impacts increases markedly at Old Bar. Based on the adopted 60 year planning period and applying the "best estimate" assessment of recession, it is shown to be "likely" (26% chance over the 60 year period) that the ZSA would pass through the centre of the Meridian Resort, and severely impact all of the remaining coastal properties along Lewis Street and Pacific Parade. Other likelihood lines for 50% recession and a 50% Type 2 storm, and hazard lines from WP (2010), are included in **Figure 3**.

Figure 4 distills the Old Bar CZHD update to two key "acceptable" risk lines for GTCC planning purposes:

- an "acceptable" (unlikely) risk line for new development on conventional foundations based on a 60 year design life with a 5% Type 2 storm applied with combined "severe case" 95% long-term recession; and

- an "acceptable" (likely) risk line for new development on piled foundations based on a 60 year design life with 50% Type 2 storm applied with combined "best" estimate 50% long-term recession.

It should be noted that we are in no way advocating the use of piled foundations in the intervening space. To do so would be to ignore the engineering, aesthetic and economic considerations that make such a strategy impractical on a receding coast. It is merely an indication that conventionally founded buildings cannot expect to have a normal life expectancy in this zone.

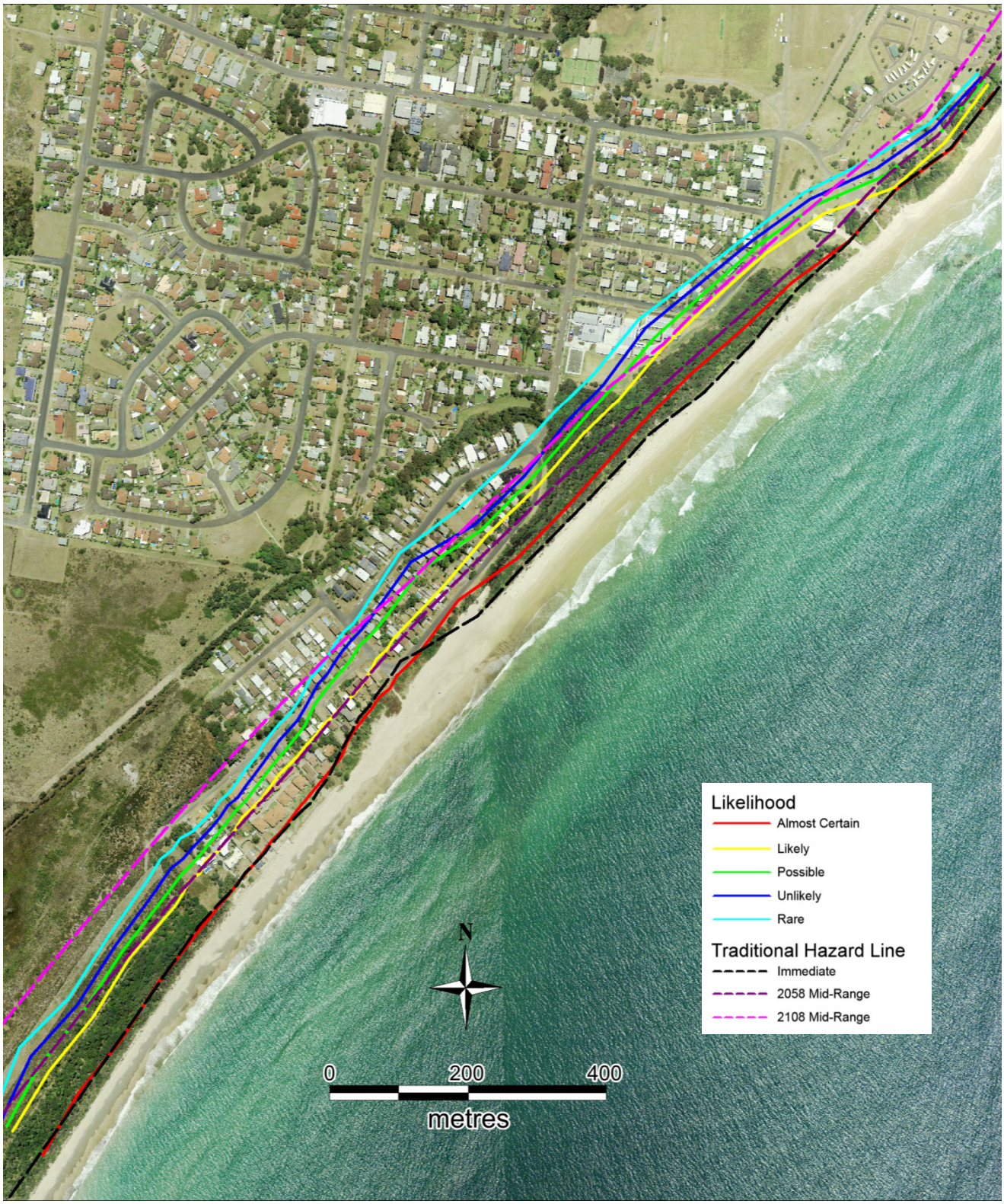

Figure 3: 50% exceedance recession scenario Type 2 likelihood lines, and no recession Type 1 "almost certain" likelihood line, compared to traditional hazard lines from WP (2010)

Figure 4: Acceptable risk setback lines determined at Old Bar Beach for 60 year planning period (Blue "unlikely" line – 5% Type 2 storm, 95% recession) (Yellow "likely" line – 50% Type 2 storm, 50% recession)

4 NEW INFORMATION TO INFORM A REVIEW OF THE COASTAL ZONE MANAGEMENT STRATEGY FOR OLD BAR

4.1 INTRODUCTION

New information is available to inform a review of the draft CZM strategy for Old Bar. This includes the updated hazard definition for Old Bar investigated by RHDHV in parallel with this study, and other technical deliberations.

4.2 UPDATED HAZARD DEFINITION FOR OLD BAR

The updated hazard definition based on the likelihood of coastline hazards provides GTCC with further information regarding the probability and consequences of coastline hazards. The acceptable risk setback lines reiterate the significant threat applicable to development along Lewis Street and Pacific Parade, and it highlights the magnitude of the risk over the adopted 60 year design life.

4.3 OTHER TECHNICAL DELIBERATIONS

4.3.1 Introduction

The Old Bar Coastal Protection Structure Design provides GTCC and OEH with a sufficient level of surety that the option represents a bona-fide alternative coastal management strategy for Old Bar. The artificial offshore reef option continues to be supported by members of the community and remarks on the technical validity of the scheme are warranted in the context of management alternatives for Old Bar. Finally, GTCC has mooted the possibility of a nourishment offset at the main section of Old Bar Beach in front of the SLSC which also warrants discussion.

These three matters are addressed in the following subsections.

4.3.2 Old Bar Beach Coastal Protection Structure Design

As GTCC recognises that planned retreat is a difficult option for the community to accept, with the support of OEH, an alternative CZM strategy was investigated late in 2013. RHDHV was engaged by GTCC to undertake a coastal engineering investigation to recommend a viable long-term coastal protection option (RHDHV, 2013) that would provide protection to property, infrastructure and assets.

Eight guiding principles to be achieved were identified in the brief prepared by GTCC and OEH, namely:

- proven performance and cost-effective;
- minimise impact on beach amenity and public access;
- resilient and adaptable design;
- public safety;
- management of end effects;
- racecourse Creek entrance stability;
- management of shoreline recession impacts;
- feasible structural life.

These were addressed in good measure, reflecting on the Greater Taree Coastline Management Study (WP, 2010) and bringing RHDHV's expertise and experience to an appraisal of all available options including do nothing, planned retreat, revetment, beach nourishment, groyne field and offshore reef. Benefits and limitations of each were canvassed, with a revetment identified as the preferred coastal protection option for Old Bar Beach (RHDHV, 2013).

A preliminary design for the rock revetment option was developed involving a consideration of design life (50 years adopted), foreshore protection principles and staging (triggers), public access and safety principles (a 'shareway' proposed along the structure), ground conditions, construction footprint with respect to private/public property boundaries, design

water levels (including effects of sea level rise), scour, breaking wave heights, wave runup and overtopping, acceptable damage in storms, maintenance regime and responsibility, rock sources, construction access, stormwater drainage and privacy of adjoining landowners.

A staged revetment preliminary design has been proposed. With the high threat to the Lewis Street properties, it was clear that construction would need to commence opposite these properties. As an improvement on the Lewis Street DA seawall proposal, the Stage 1 rock revetment would be taken to the roadhead at Rose Street, a further 150 m. This would assist to contain flanking erosion impacts with the north end of the structure set further landward (by approximately 10 m), and, importantly, removed from private properties. It is also expected that by placing the end of the Stage 1 structure in this location it would derive some level of protection from the head of the existing gabion training wall at Racecourse Creek (refer Dwg MA-1000 in RHDHV, 2013). Furthermore, when required, the rock revetment would retain the optimum alignment to ensure a ready progression to Stage 2 to protect Pacific Parade.

The threat to this part of Old Bar Beach is at such a level today that immediate treatment is warranted covering Stage 1, and probably also Stage 2. The remainder of the site is denoted as Stage 3, Old Bar Public School to the SLSC to the north (3N) and the MidCoast Water assets to the south (3S).

Old Bar Beach is exposed to some of the highest recession rates currently experienced on the NSW coast (Peter Evans, OEH pers comm). WorleyParsons (2010) in the Greater Taree Coastal Hazard Definition Study adopted 0.6 m/yr for the developed foreshore at Old Bar (photogrammetry to 2006), plus a further 0.2 m/yr for mid-range sea level rise over 50 years. This was reviewed as part of the revetment design investigation (photogrammetry and beach survey to 2013), with 0.8 m/yr adopted for Stages 1 and 2 "as representative of a likely estimate of long term sediment budget recession over the next 50 years, increased to say 2.5 m/yr to reflect a possible extreme recessional trend based on more recent observations" (RHDHV, 2013). Sea level rise recession formed an additional component, incorporated into the review of back-beach breaking wave height undertaken by WRL to support the RHDHV study (see Appendix E in RHDHV, 2013).

The key design parameters adopted for the Old Bar preliminary design are:

Coastal Loading

- Design life — 50 years (planning date 2063)
- Breaking wave height (1% AEP H_{10}) — 3.2 m (predicted midlife 2038)
- Wave period (Tp) — 13 s
- Shoreline (budget) recession — 0.8 m/yr
- Storm erosion (1% AEP) — 220 m^3/m
- SLR recession — 10 m (2030), 20 m (2050)
- Wave runup level (R2%) — RL 6.2 (assessed at midlife 2038)

Revetment

- Revetment slope — 1:1.5
- Rock armour (M50) — 5.2 T, 1.4m ϕ (dry density 2.65T/m^3), 2 layers
- Rock underlayer (M50) — 520 kg (dry density 2.65T/m^3), 2 layers
- Rock armour berm — 4.3 m wide (3 rocks), RL 1.4
- Armour toe level — RL-1.0 (self launch level at 2063 RL-2.9)
- Armour crest level — RL 6.2
- Average storm damage — 0-0.5% (2013-2038), <30% (2063 for H_{10}=3.9 m)

Management and Amenity

- Shareway details — 2.2 m wide, RL 5.0
- Maintenance regime (% capital cost) — 0.5% pa (2013-2038), 2% pa (2038-2063)
- Sand placement to manage end effects — 500-1,000 m^3/yr

The design principle involves developing a rock revetment structure which experiences "routine" 0-0.5% storm damage through to midlife (2038), but then experiences higher levels of damage as the coast at Old Bar continues to recede until end-of-life at 2063 when any design storm in that year would severely damage the revetment, but not to the point of full failure (ie damage <30% as described in CERC, 1984).

The preliminary design general arrangement for the Old Bar Beach coastal protection structure is depicted in summary in **Figure 5**. A zoom in on the Stage 1 and 2 layout in shown in **Figure 6**, and a preliminary design detail section for Stage 1 is shown in **Figure 7**.

Two optional revetment locations were examined for Stage 1, a location that aligned the structure crest with the crest of the existing erosion escarpment (Option 1), and a location that set the structure as far landward as possible without compromising foundation stability at existing dwellings and to provide for maintenance access behind the structure (Option 2). GTCC has indicated its preference for Option 1 and OEH for Option 2. The two options for Stage 1 are shown in plan in **Figure 5** and **Figure 6**, with a typical section opposite Meridian Resort shown in **Figure 8**.

Excluding maintenance, sand placement to manage end effects, and any costs associated with property acquisition, the preliminary capital cost estimates developed for the various stages of the project ranged between $15,200/m (Stage 3S) and $18,500/m (Stage 1, Option 2).

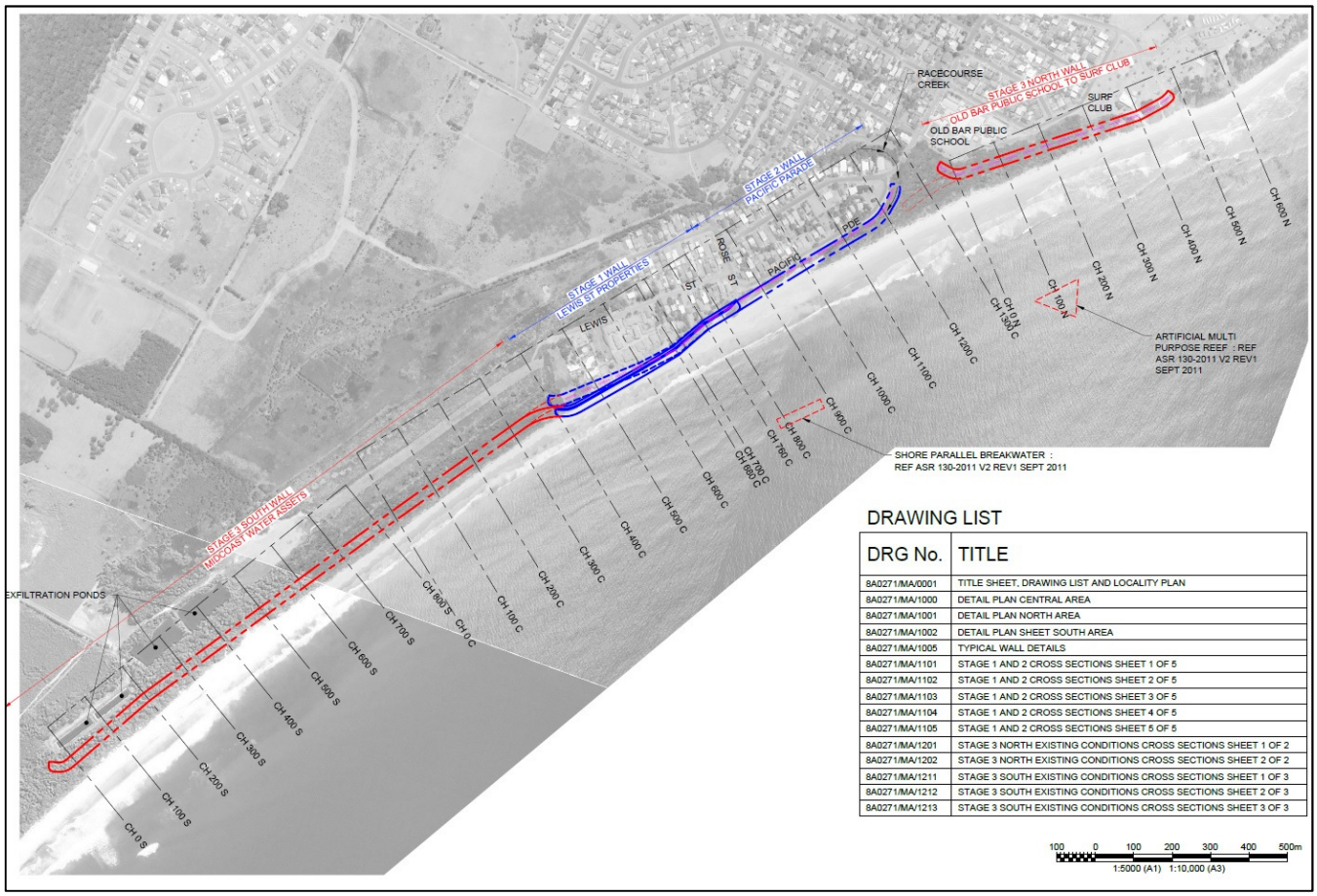

Figure 5: Preliminary design layout for rock revetment constructed in three stages (Extract Dwg 8A0271-MA-0001 C, Appendix D; RHDHV, 2013)

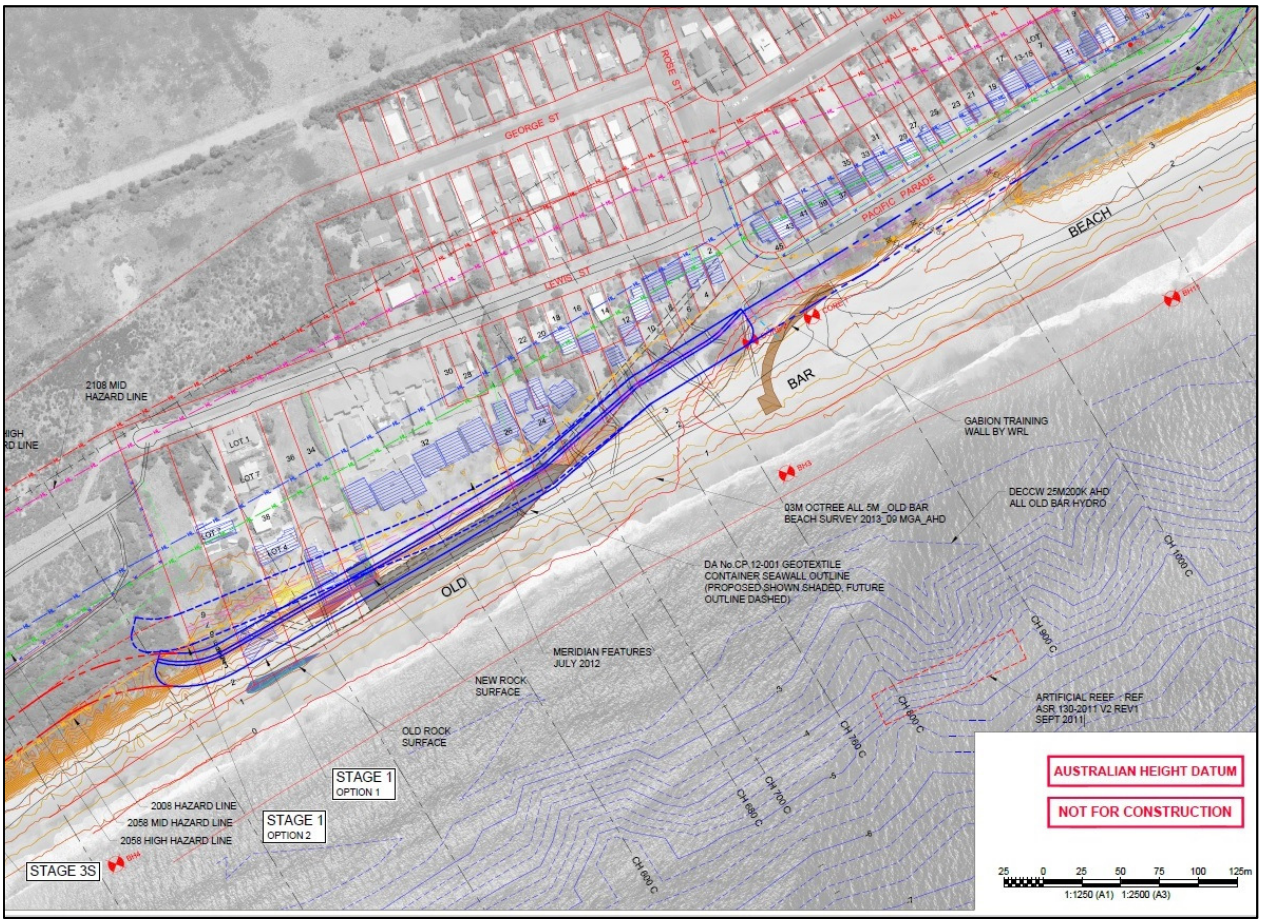

Figure 6: Preliminary design layout for Stages 1 and 2. See Figure 10 for north end of Stage 2 (Extract Dwg 8A0271-MA-1000 C, Appendix D; RHDHV, 2013)

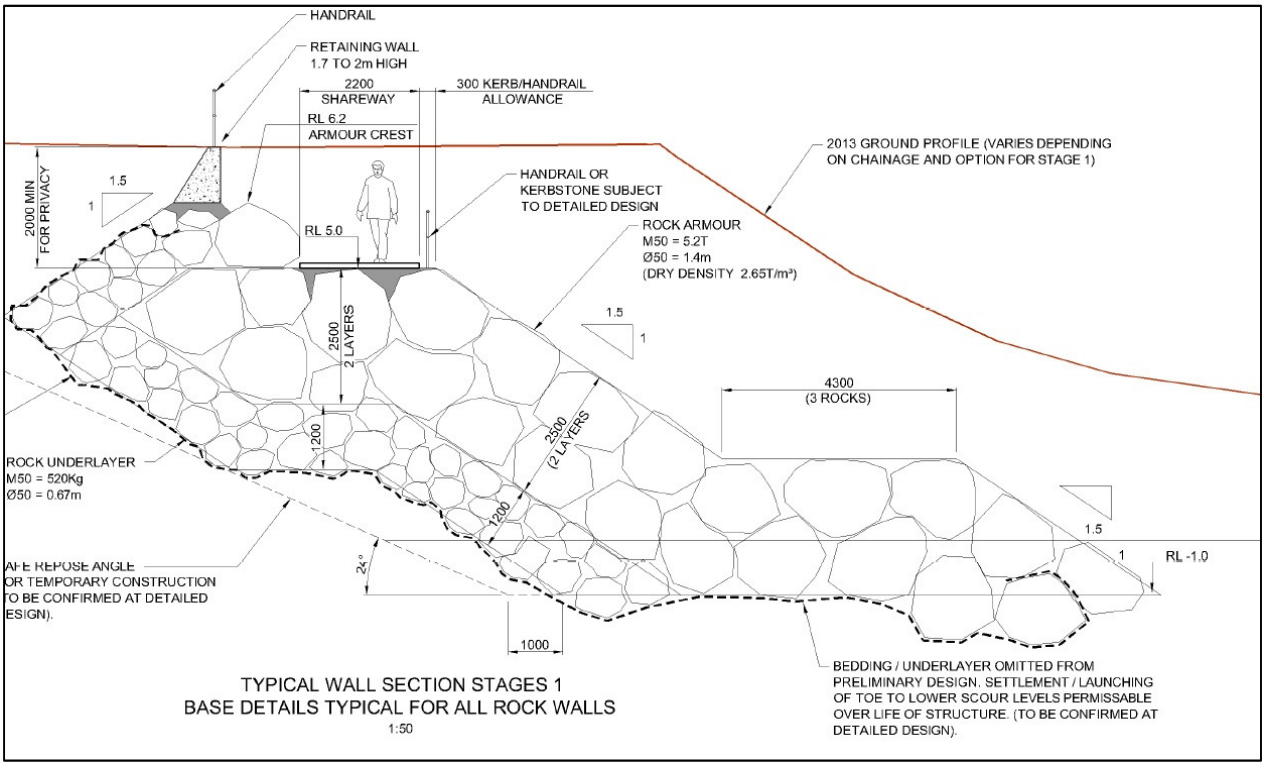

Figure 7: Preliminary design detail section for Stage 1 (Extract Dwg 8A0271-MA-1005 C, Appendix D; RHDHV, 2013)

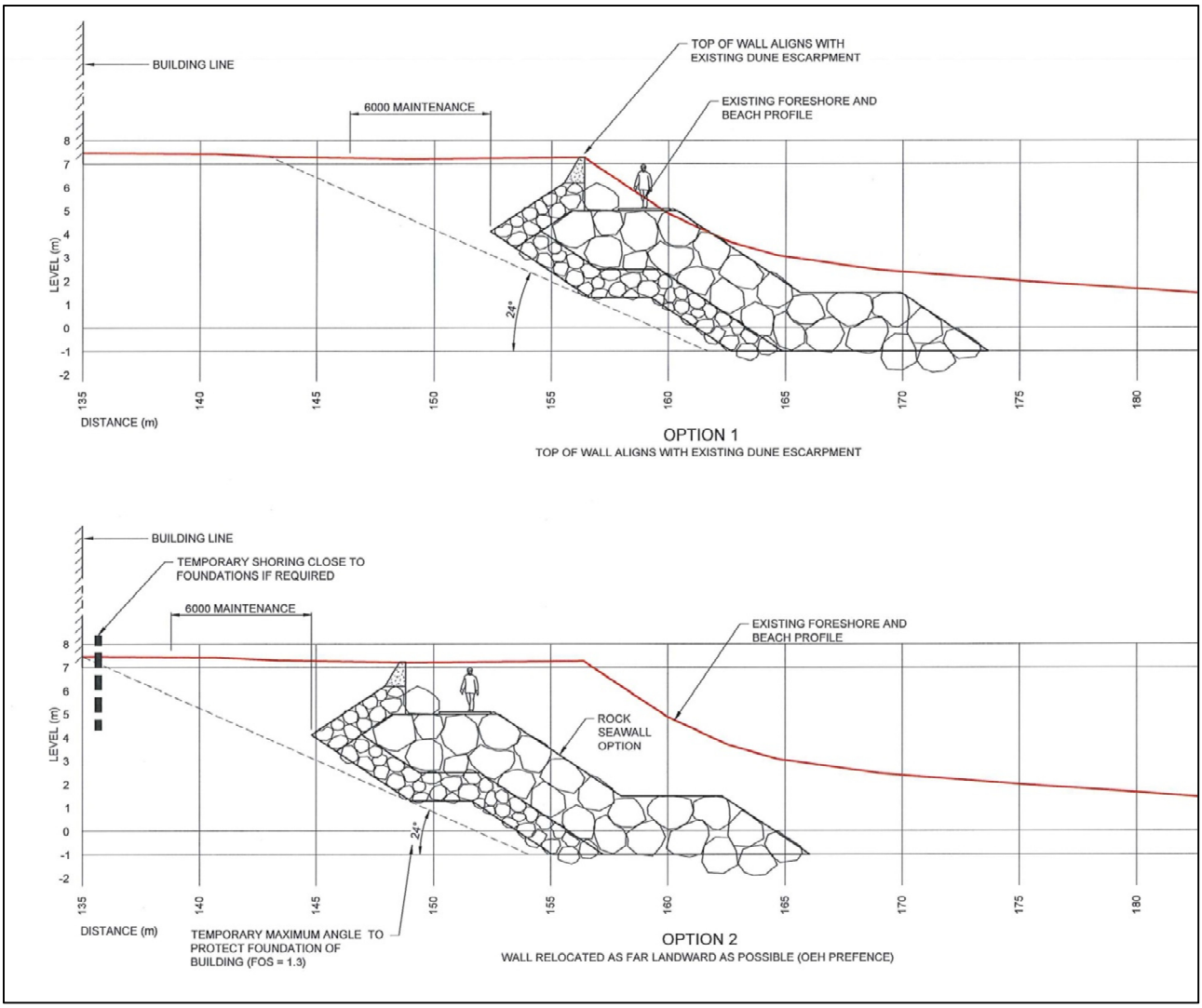

Figure 8: Typical sections showing Options 1 and 2 for Stage 1 revetment opposite Meridian Resort. Section at Ch 600C in Figure 6 (RHDHV, 2013)

4.3.3 Comments on Proposed Artificial Offshore Reef at Old Bar

The artificial offshore reef proposal developed by ASR Ltd (ASR, 2011) is summarised in Section 6.2.1 of RHDHV (2013). A peer review of the artificial offshore reef investigation by ASR, made by the Water Research Laboratory of the University of New South Wales, is summarised in Section 6.2.2 of RHDHV (2013).

Comments are provided here on construction aspects and likely costings. We also summarise performance of constructed reefs for which suitable costing data is available, and conclude with an opinion on the application of an artificial offshore reef at Old Bar. Specific comparisons are drawn with the Narrowneck Reef on the Gold Coast.

Placement Volume and Costs

The two reefs as conceptually described by ASR comprise placements of some 28,800 m^3 of structure suitable to withstand the coastal loadings. To provide spatial context, the reef locations interpreted from Figure 8.3 in ASR (2011) are overlaid in **Figure 5**. Our check of the total placement volume assuming 1:1.5 side batters and the bed contours shown in Appendix F of RHDHV (2013) indicates a slightly larger total volume of 32,500 m^3. These two reefs are predicted by ASR to develop beach salients which would extend from the southern end of Lewis Street to the SLSC, a shoreline distance of 1.35 km.

ASR have proposed sand-filled geotextile containers to construct the two reefs costed at between $6.9 and 7.9 million. The proposed staged rock revetment options to protect the same length of shoreline are estimated by RHDHV to cost a total $23.8 million (RHDHV, 2013), over three times the cost estimate by ASR for the reefs.

The $6.9 to 7.9 million construction costs estimated by ASR translates to a volumetric cost of $210/m^3 to $240/m^3 (based on RHDHV volume estimates). This compares to typical volumetric cost rates for all submerged constructed offshore reefs worldwide, where suitable information was available as reported in WRL (2013), ranging between $50 and $550/m^3, with an average of $370/m^3 (seven projects costed with average capital cost $2.3 million).

The key data worldwide on all costed reefs where suitable information is available as reported in WRL(2013) is summarised below in **Table 6**.

Table 6 – Summary of Key Design Parameters and Performance Measures for Costed Reefs Worldwide (WRL, 2013)

Site and Construction Date	Typ. H (m)	Type and Material [1]		Depth (m)	Cost ($M)	Vol Cost ($/m^3)	Objective and Performance (as reported in WRL, 2013) [2]			
							Primary		Secondary	
Actual Projects										
Aust, Cable Station WA, 1999	1-2	ASR	R	4-6	$2.5	$457	S	Partially		
Aust, Narrowneck, 2000	1	MPR	GC	3-6	$3.9	$56	P	Minor	S	Minor
NZ, Mount Maunganui, 2010	1.5	MPR	GC	3-4.5	$1.5	$545	S	No [3]	P	Negligible [3]
NZ, Opunake, 2006	NR	ASR	GC	1.8-3	$0.93	$274	S	No [3]		
USA, El Segundo California, 2000	0.9-1.5	ASR	GC	3	$0.68	$504	S	No		
UK, Boscombe England, 2008/9	0.5	MPR	GC	3-5	$4.9	$384	S	Partially	P	Minor
India, Kovalam Kerala, 2010	1-2.5	MPR	GC	1.3-3.7	$1.4	$351	P	Yes	S	Yes
Proposal										
Aust, Old Bar [3]	1-1.5	MPR	GC	4-6	$4.3-$4.9	$240-$270 [4]	P	?	S	?
	1-1.5	SB	GC	4-5	$2.6-$3.0	$240-270 [4]	P	?		
Notes										
(1)	ASR=artificial surfing reef; MPR=multipurpose reef; R=rock; GC=geotextile containers; SB=submerged breakwater									
(2)	Primary and secondary objectives and performance as reported by WRL. S=surfing enhancement. P = coastal protection									
(3)	Incomplete construction									
(4)	"Rough order" baseline costs adopted in ASR (2011)									

The projects in the table involved large expenditures with mixed reported performance at best. The "rough order" cost estimated by ASR for the Old Bar project ($240-$270/m^3) would seem to be low compared to other completed geotextile container reef projects (average $352/m^3). This is in spite of the completed container reef project costs being skewed by Narrowneck which had a significantly lower cost. This was probably due to the construction method involving an offshore dredge with split hopper used to fill and deploy large geotextile tubes. Note that sourcing sand from the seabed for the Narrowneck project was permissible in Queensland, but is currently not permissible in NSW.

The performance of a reef to modify wave action and sediment transport behaviour to encourage beach development depends on its size (volume of the reef) and crest height. It is instructive to compare the proposed Old Bar reefs with that installed at Narrowneck. The Narrowneck Reef has involved the placement of between 400 (by year 2000) and 450 (top up total at 2007) "mega" geotextile containers, each measuring 20 m in length, and 3-4.5 m in diameter. Assuming these were say 80% filled with sand (probably low but conservative for this assessment), the total "volume" of the Narrowneck Reef would range between 45,200 m^3 (conservative minimum in year 2000) to 69,300 m^3 (conservative maximum in 2007). An average conservative best-estimate "volume" over say the last decade would be approximately 57,000 m^3 (average of 45,200 and 69,300). This compares with 28,800 m^3 proposed and costed for Old Bar (or 32,500 m^3, RHDHV volume estimate of ASR design). Thus, the two proposed Old Bar reefs combined are very close to half the volume (size) of Narrowneck.

Performance and Durability

Based on updated Argus photography covering the beach in the vicinity of the Narrowneck Reef, analysed over the period 2000 to 2008, engineers from the Water Research Laboratory of the University of New South Wales advise that, "on a year on year basis, there has been no real sustained widening of the beach in the vicinity of the reef" (Matt Blacka in presentation to NSW Coastal Ocean and Port Engineering Panel of Engineers Australia, 17/3/14). This opinion is broadly consistent with a plot of monthly shorelines over 5 km of beach centred about Narrowneck Reef shown in **Figure 9** which suggests a minor planform widening to the south of the reef in the order of say 10 m (WRL, 2013). This may or may not be due to the reef.

It is understood that the reef construction method proposed by ASR for Old Bar is comparable to that used at Mount Maunganui NZ (**Table 6**), involving anchored webbing and pump in place containers.

The design life of geotextile containers is an important consideration where long-term structures are being considered. While particular heavy-duty geotextile materials are highly regarded and are predicted to exhibit up to a 100 year life in conventional buried applications (eg Port Botany Expansion Project), exposed containers that may be susceptible to rock projectiles in storms or possibly vandalism would not. A fair life for a vandal-deterrent heavy duty geotextile on an artificial offshore reef is about 20 to 40 years (as discussed in WRL, 2013). Because the geotextile would be located on a rock reef at Old Bar, it is possible that this may be lower. End-life removal of a geotextile reef should be a costed item.

If the reef scheme is to be compared with GTCC's rock revetment option proposal for its protective function, investigations would need to demonstrate protection of the shoreline for storm events which, in the absence of a reef, are predicted to remove up to 220 m^3/m of sand from the beach and dune measured above Mean Sea Level (WP, 2010). Also, given the expected life of the reef, the costing of a geotextile container structure should incorporate up to one rebuild and removal over the 50 year design life adopted for the revetment (RHDHV, 2013; Section 9.1.1). The cost of maintenance is a separate matter.

Materials and Construction

Based on the Cable Station experience in WA (Table 6) the construction cost for a rock reef would be higher than a geotextile container reef. To construct any rock reef at Old Bar to the ASR design configuration would probably require a jack-up barge sited beside the reef with a large crane (say 100T), with barge transportation of rock from Crowdy Head Boatharbour. The armour rock size to be stable in a storm would be approximately 30T. This is not feasible, and would need to be replaced with say 10T concrete armour units.

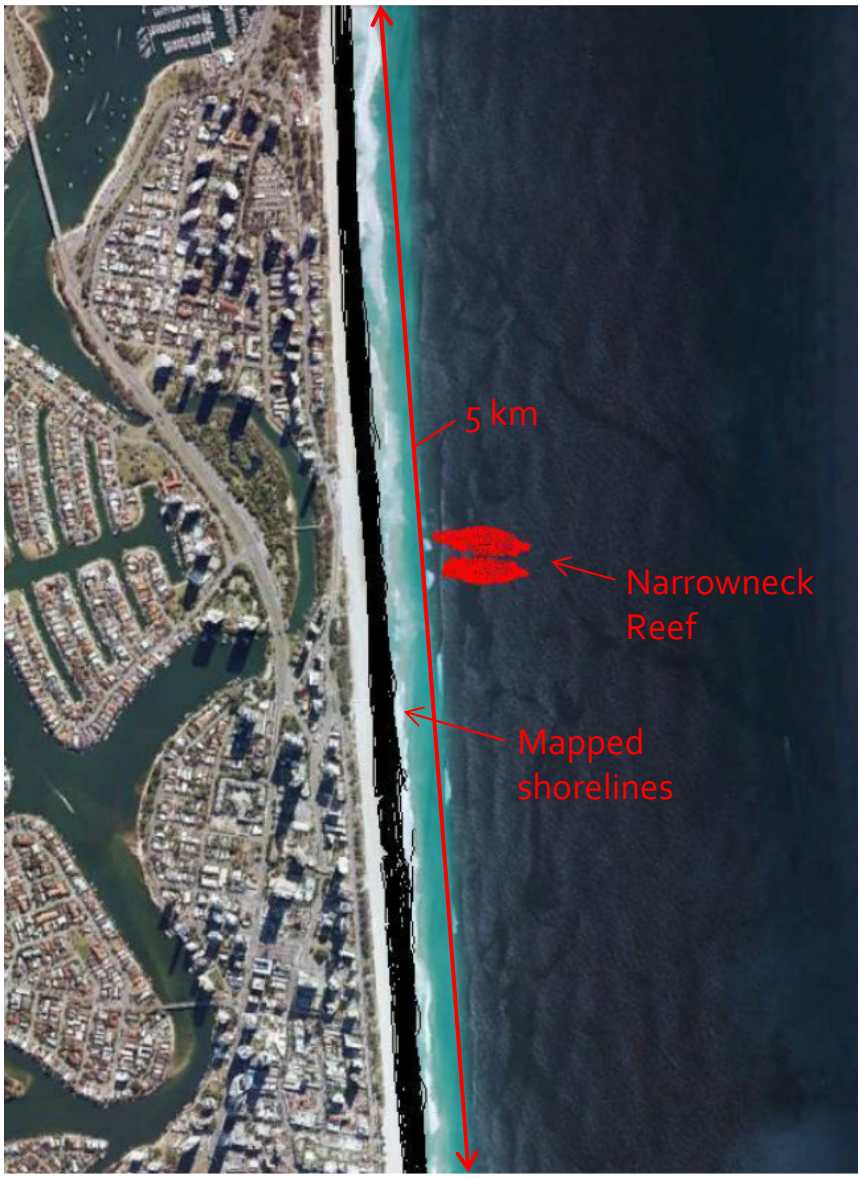

Figure 9: Monthly shoreline positions for years 1999 – 2007 (Source: WRL, 2013)

Issues during construction have beset most of the completed artificial offshore reef projects listed in **Table 6**. A cursory review of the listed projects to broadly gauge the weight of public opinion would lead an impartial observer to a view that public money should not be committed to projects of this type and design. In general, the projects have not delivered what was intended. Many have costed very much more than was expected. Although both the NZ ASR projects were not completed, their performance by measure, and possibly more so by public comment, points to a significantly lower than expected performance.

Application and Efficacy of Artificial Offshore Reef at Old Bar

RHDHV shares the concerns enunciated in WRL(2013) regarding the poor efficacy of actual constructed artificial offshore reefs of the type and design listed in **Table 6** to manage beach erosion. There is little prospect in our opinion that a cost-effective artificial offshore reef system would solve the erosion problem at Old Bar unless the reefs are emergent under most conditions, are longer (or more reefs of a similar size to those proposed are provided), and fundamentally, that there is a known sufficient supply of sand to develop the salients to achieve the required level of protection. The latter alone is

not established and would require substantial investigation to demonstrate, to a sufficient level of confidence, a prefeasibility platform for further consideration of an artificial offshore reef project for Old Bar.

It is telling that the "studies and planning" investigations undertaken to deliver the largest artificial offshore reef project in the world at Narrowneck cost in the order of $0.93 million (Ranasinghe, 2001), or around $1.3 million in today's dollars, a structure with a primary objective to enhance beach protection. Yet, by recent rigorous measure, this has not been achieved. If Narrowneck is to be used as a model for Old Bar, then the investigative effort, scale and ultimately level of performance observed at Narrowneck cannot give confidence to a similar scheme solving the erosion problem at Old Bar.

Conclusion

An emergent structure (one visible above the water level most of the time) of substantially larger scale and significantly greater cost than Narrowneck (or indeed any of the other 32 existing artificial offshore reefs world-wide investigated and reported on in WRL, 2013) would be required to potentially benefit coastal protection of Old Bar ("potentially", because at present there is no assurance as to the sufficient natural longshore delivery of sand to sustain such a project. The considerable complexities surrounding regional coastal processes at Old Bar Beach mean that the ability to predict shoreline response to an artificial reef structure(s) at this location would be highly uncertain. Unlike coastal revetments, which can be designed with a high degree of certainty, artificial offshore reefs cannot.

This Addendum to CZMP for Old Bar does not recommend further investigation of an artificial offshore reef.

4.3.4 Possible Localised Nourishment at the Main Section of Old Bar Beach in front of the SLSC

The proposed rock revetment option is designed to hold the position of the shoreline, protecting property behind it. As the beach is receding, it must be expected that the beach, which initially may separate the revetment from the ocean, would be lost over time. The prospect of a natural return of sand to form a stable beach in front of the revetment is small. There could be periods when sufficient sand is moving along the shore to form a beach, however any longer-term persistence of the beach would not be expected.

Seeking to artificially re-establish a beach in front of the revetment is not feasible. The sand would be removed by coastal processes. The destination of this eroded sand is not certain. Based on the existing understanding of sediment transport described in the CHDS, it is expected that the sand would move to the north under ambient coastal conditions, and probably be swept offshore and possibly also to the south in storms (WP, 2010).

Massive nourishment of the whole compartment to protect Old Bar Beach is theoretically achievable, but would require enormous amounts of sand initially plus ongoing maintenance. The total cost to implement such a scheme is estimated at $147 million (WP, 2010). Note that with massive nourishment, a revetment would not be required.

Destination NSW recognises that Old Bar is well known as a surfing beach, kite boarding and fishing spot for locals and visitors. Anecdotal feedback verified during community consultation (November 2013) indicates the more likely site for these activities being at the main section of Old Bar Beach, in front of the littoral rainforest and toward the northern end of Old Bar Beach, close to the SLSC. A long established annual sand modelling competition is hosted in front of the SLSC on the main section of Old Bar Beach. Anecdote from Lewis Street residents supported by results from the Pedestrian Traffic Study (GTCC, 2014, in prep) indicates that relatively little usage occurs further south, particularly in the vicinity of Lewis Street and Racecourse Creek.

GTCC has requested that consideration be given to the possibility of localised nourishment at the main section of Old Bar Beach in front of the SLSC to compensate for the eventual long-term loss of the beach in front of a seawall. In broad terms, this sand could extend over a distance of up to say 400 m, centred at the SLSC creating an appealing beach amenity for locals and visitors and an area that would greatly enhance SLSC activities provided for Nippers, which are often relocated due to adverse beach conditions.

The design storm erosion demand in the vicinity of the SLSC is 180 m^3/m of beach, less than the 220 m^3/m which is described for the remainder of Old Bar beach. This reduced exposure of the beach to storms at the northern end is attributed to the Urana Bombora, a natural rock reef which extends broadly seaward and to the south-east from in front of the caravan park. In addition to relative storm protection, the long term recession rate at the main section of Old Bar Beach in front of the SLSC is lower than the beach to the south. The long term rate over say 400 m of beach centred at the SLSC is zero (1940 – 2013), although this has increased to as much as 1 m/yr since 2006. If the southern portion of this 400 m zone is excluded, then the recent recession is much more muted. The data shows a recession "null point" about 200 m north of the SLSC, so any proposal to consider localised nourishment should focus on the beach directly out in front of the Club, extending to the north.

The cost and sustainability of any localised sand placement at the main section of Old Bar Beach in front of the SLSC would need to be investigated. As often occurs with such a project, initially the placement may experience relatively high erosion rates as wave energy is focused on the salient and processes respond to smooth out the perturbation. An ambient beach shape is a response to existing waves and currents. If this shape is artificially changed as would be the case with nourishment, then there would be an intensification of the interaction at the reshaped zone.

As well as a stable alignment, a stable beach also requires a stable profile. Placing sand on the drying beach (above say mean tide), would result in a rapid transfer of sand offshore. Nature acts to re-establish a regime profile. In broad terms, for every 1 m^3 of sand that is placed on a beach above mean tide, approximately 2/3 of that would eventually be taken offshore, out through the surf zone, to develop a stable sectional profile.

The consequence of the alignment and sectional reshaping is that more sand must be placed on the beach, each nourishment campaign, to provide for a stable amenity even in the short term.

However, sand losses northern end of the main section of Old Bar Beach in front of the SLSC are potentially mitigated by the prominence of the foreshore in the vicinity of the caravan park. This would appear to be the southern side of the salient formed by the Urana Bombora.

GTCC could not commit to any nourishment scheme for the main section of Old Bar Beach in front of the SLSC without a good understanding of the costs involved and associated environmental impacts. This would require an understanding of where the sand would come from to nourish the beach, and where it would eventually be transported to. The most environmentally sustainable model would be for the eroded sand to be replaced back on the beach each nourishment round. This could only be economically feasible at Old Bar if the eroded sand tracked alongshore, rather than offshore. Alternatively, Farquhar Inlet some 2-3 km to the north is potentially a source of sand however the feasibility of such a source would need to be examined. GTCC has recently submitted a grant application to the Office of Environment and Heritage for assistance with a sediment tracer study to address the core question of sediment transport routes.

Other issues associated with nourishment would include potential smothering of habitat on the reef from eroded sand, potential destruction of ecology and habitat at the sand source, noise issues during the project, sediment and water quality impacts, and traffic and beach use impacts. Heritage should not be an issue where mobile source and destination sites are involved.

Smaller sand placements (say a few thousand cubic metres) could involve mechanical plant to excavate and transport material. Larger placements (say 10,000 to 15,000 m^3 minimum) typically involve dredging and hydraulic pumping. There are other methods mainly associated with much larger quantities of material that are not relevant for the scheme envisaged at the main section of Old Bar Beach in front of the SLSC.

Sand renourishment projects are not usual on the open coast. They occur in estuaries in NSW at Jimmys Beach, Port Stephens (50,000 m^3 placed every 3-5 years) and Ettalong Beach, Brisbane Water (30,000 m^3 placed every 10-15 years). The placement intervals are driven by amenity pressures, need for protection and mobilisation costs for dredge plant. All up sand nourishment rates at these two sites, inclusive of design and other preliminaries, range between approximately $15 and $20/$m^3$.

A prospective nourishment project at the main section of Old Bar Beach in front of the SLSC would seek to address amenity considerations only. It could therefore involve relatively small placement quantities, around say 100-150 m^3/m making some allowance for profile losses. If this was placed over say 200-250 m of beach centred on the carpark (a reduction from the 400 m suggested above to avoid the higher recession rates south of SLSC), a total placement of some 30,000 m^3 per campaign could be envisaged. Assuming say a 5-10 year nourishment interval and an upper bound dollar rate for working on the open coast, a project of this type could cost in the order of $100,000 per year in annual average terms.

In closing, it must be recognised that any beach nourishment project would have clear performance objectives and be monitored against those objectives. The first campaign must be considered a feasibility trial.

4.4 RECENT COMMUNITY CONSULTATIONS

RHDHV, assisted by GTCC and OEH, convened a community drop-in session at Club Old Bar on Thursday 21 November 2013.

Copies of drawings showing the revetment preliminary design were displayed, together with photos showing typical seawalls and seawall construction projects. The intention with these photos was to convey the type of structure that was being considered for Old Bar and the likely scale of the construction project. Summary sheets were also displayed on the various shoreline protection options canvassed in the draft CZMP for Greater Taree and discussed in the RHDHV revetment design report. The drop-in session provided GTCC, OEH and RHDHV the opportunity to explain the coastal protection project, and canvas with members of the community the selected protection options and impacts. The opportunity for involvement was positively received by the community.

Between 80 and 95 people attended the drop-in session. This was considered to be a positive response, indicating high level of community interest. A survey form was available for completion on the day, completed by 42 attendees. A summary of the survey responses is provided below in **Table 7**.

Table 7 – Summary of Key Responses from Surveys at the Community Drop-In Session

Key Response	Number	Percentage
Opposed to a wall	10	24
Support for a wall	13	31
Wall but not rock	1	2
Concern and questions but neither opposition nor support for seawall	7	17
Neither opposition nor support	1	2
Reef support	9	21
Supports all measures	1	2
Total	**42**	**99**

Feedback received at the November 2013 forum, through both face to face conversations and on feedback forms left by attendees, and in the submissions received since the forum advise of a divided community. Views range from agreement that protection of property, infrastructure and assets is paramount to the future of Old Bar to those that maintain a sand beach is an essential element of Old Bar.

5 GTCC POSITION IN RELATION TO COASTAL MANAGEMENT AT OLD BAR

5.1 Background

The community at Old Bar is not supportive of planned retreat as a workable strategy, GTCC's default policy stance given the non-affordability or availability of any other option. There is a broad concern that it would lead to a reduction in visitors impacting on business activity and property values. Also, these impacts would not be limited to the affected coastal strip, but would be felt more broadly within the village.

At the same time when the draft CZMP for Greater Taree was being prepared, very high recession rates were being experienced at Old Bar Beach. This severe response post-dated the latest (2006) photogrammetry in the Hazard Definition Study (WP, 2010), resulting in a significant increase in longer term recession rates. Averaging between Lewis Street and the school at 2.5 to 3 m/yr over the past decade, these are currently the highest rates being experienced on the NSW coast. Private property and sensitive rainforest is being directly impacted. The aggressive recession and direct and immediate impacts on coastal property have focused community interest and concern at Old Bar, placing more urgency on the development and finalisation of the CZMP.

At about the same time, a resident group along Lewis Street submitted a development application (DA) for a seawall to protect their private properties, however this was refused by the NSW Coastal Panel for amenity, safety and economic reasons. A separate group investigated artificial offshore reefs as a possible alternative public project, but these too are not supported as being cost-effective by the NSW Office of Environment and Heritage (OEH) and GTCC.

Given the substantial implications of planned retreat for the Old Bar community, refusal by the NSW Coastal Panel of the Lewis Street DA and limited scientific support for an artificial offshore reef, GTCC, with the support of OEH, commenced a review for an alternative CZM strategy involving coastal protection of property

In late 2013, independent coastal engineering expert RHDHV was engaged to undertake a coastal engineering investigation to develop a viable long-term coastal protection option that would provide protection to property, infrastructure and assets. A revetment was identified as the preferred coastal protection option for Old Bar Beach and a preliminary design was prepared (RHDHV, 2013).

In the meantime, GTCC's draft CZMP remains on hold pending the Stage 2 Coastal Reforms, which are currently being considered by the State Government. It is expected by GTCC that the Old Bar revetment option will provide valuable input to the Coastal Reforms review. The draft CZMP for Old Bar, prepared as an addendum to the draft CZMP for Greater Taree, supports the technical confidence of a revetment for protection, but challenges the social and economic feasibility of the legislation.

5.2 Guiding Principles and GTCC Objectives

The brief for the Investigation and *Preliminary Design of a Coastal Protection Structure for Old Bar Beach* was issued in September 2013. Eight design principles were provided to guide the investigation for a rock revetment at Old Bar (GTCC, 2013):

(i) Design to be cost effective and capable of providing a demonstrated level of protection to development at risk.

(ii) To greatest extent possible, design to minimise the impact of the works on beach amenity and on public access to and along the beach. Any hard structures to be as far landward as possible.

(iii) To the extent possible, design to be resilient to further shoreline recession and sea level rise. The design to be stageable and if possible adaptable. Suggested triggers for extension of the works to be provided.

(iv) Design not to compromise public safety.

(v) Provision to be made for management of end effects for the life of the structure.

(vi) Design to include detail on the future entrance configuration of Racecourse Creek.

(vii) Impacts from any structure to be documented and understood upfront. For example, it is recognised that ongoing shoreline recession will result in progressively less sand in front of any protection structure. This will eventually lead to a likely loss of beach amenity and possible undermining of the structure toe.

(viii) On the basis of historical recession rates and the likely effect of sea level rise, an estimate of the feasible life of any protection structure to made.

It is accepted by GTCC that a rock revetment structure provides the most certainty in terms of design outcomes that meet those predicted for protection and that the current preliminary design (RHDHV, 2013) provides for continued access with installation of a pedestrian/cycleway on the structure. The alternative to coastal protection is in effect to allow continued erosion and recession and this would require adopting the option of planned retreat. The mechanisms for planned retreat are adequately detailed in the draft CZMP for Greater Taree (WP, 2013).

In the light of the recent investigations and discussions, it is instructive to reflect on the Coastal Management principles from the *Guidelines for Preparing Coastal Zone Management Plans* (DECCW 2010) and GTCC's objectives as reported in the draft CZMP for Greater Taree. Fresh comments are included in Table 4.3 from the draft CZMP, reproduced and expanded below in **Table 8**.

The draft CZMP for Greater Taree describes GTCC's multi-criteria analysis for selecting planned retreat, presented in the Coastline Management Study (WP, 2010b). In arriving at the revetment alternative, GTCC has reconsidered the governance, environmental, social, economic and technical aspects. As with the draft CZMP for Greater Taree, GTCC is committed to ensuring the responsible and sustainable management of the GTCC coastline for the benefit of the whole community.

Table 8 – Guiding Principles and GTCC Objectives

Principle		GTCC's Objective as reported in draft CZMP for Greater Taree	Comments and Review of GTCC's Policy Position
1	Consider the objectives of the *Coastal Protection Act 1979* and the goals, objectives and principles of the NSW Coastal Policy 1997 and the NSW Sea Level Rise Policy Statement 2009.	To meet all legal responsibilities	To meet all legal responsibilities, recognising that implementation of the revetment option may require Government policy and legislative change
2	Optimise links between plans relating to the management of the coastal zone.		No change. GTCC would retain links between coastal and floodplain management as reported in draft CZMP for Greater Taree
3	Involve the community in decision-making and make coastal information publicly available.	GTCC will inform and consult with residents, landholders and the community about coastal zone management issues that have the potential to affect their utilisation of the coast.	No change.

Principle		GTCC's Objective as reported in draft CZMP for Greater Taree	Comments and Review of GTCC's Policy Position
4	Base decisions on the best available information and reasonable practice; acknowledge the interrelationship between catchment, estuarine and coastal processes; adopt a continuous improvement management approach.	This plan is underpinned by best practice hazard definition techniques including comprehensive examination of the historical record and conceptual models of coastal processes supported by numerical modelling.	In addition, the Addendum plan draws on the updated Hazard Definition for Old Bar (**Section 4.2**). The preliminary design for the rock revetment offers an improved alternative management approach (**Section 4.3.2**)
5	The priority for public expenditure is public benefit; public expenditure should cost effectively achieve the best practice long-term outcomes.	In the management of risks associated with coastal hazards, GTCC will give priority to actions that can be implemented within its current resourcing capacity and are effective in addressing immediate and long term threats. Planning controls for new developments and triggers for retreating existing public and private assets that come under threat from coastal hazards is seen as a priority. The *Coastal Protection Act 1979* provides private landowners with the ability to implement and maintain protection works that benefit them.	Planned retreat was adopted in the draft CZMP for Greater Taree as a "default" position that was affordable. The recent revetment investigation identifies costs which remain unaffordable without private, corporate and/or other government assistance. Subject to the impacts of a revetment being acceptable and unless funding is available, GTCC would be forced to continue with planned retreat as enunciated in the draft CZMP for Greater Taree. The refusal of the Lewis Street DA and the decision by the landowners not to pursue an appeal (made March 2014) highlights the difficulties in private landowners implementing their own protection works. The key issue distils to affordable life-cycle cost to be met by the landowners themselves to implement and manage a viable project.

Principle		GTCC's Objective as reported in draft CZMP for Greater Taree	Comments and Review of GTCC's Policy Position
6	Adopt a risk management approach to managing risks to public safety and assets; adopt a risk management hierarchy involving avoiding risks where feasible and mitigation where risks cannot be reasonably avoided; adopt interim actions to manage high risks while long-term options are implemented.	GTCC will apply retreat strategies for coastal assets and infrastructure that will require the relocation or abandonment of assets and infrastructure to outside the coastal hazard lines. GTCC will use planning tools (LEP and DCP clauses, design guidelines) to ensure that new development does not result in an increased risk to life and property on land that is likely to be impacted by coastal hazards. GTCC will develop additional planning controls for land at risk from coastal hazards, which will apply to new residential development, major infrastructure, new subdivisions and strategic studies on appropriately zoned land.	The magnitude of the coastline risk at Old Bar is indicated in **Figure 4**. This reinforces the findings from the CHDS, described in the context of "acceptable risk". If a revetment scheme is implemented, planned retreat would not apply over the life of the scheme. The coastline hazard lines effectively move to the revetment and all property behind the revetment is removed from the hazard.
7	Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions.	GTCC will seek to avoid unnecessarily sterilising land within the coastal zone unless such land poses a risk to human life or property as a result of coastal hazards. GTCC will look at implementing flexible options to manage hazards and risks in the coastal zone that will allow ongoing use of land affected by coastal hazards until the risks to human life and public and private assets become unacceptable.	The proposed staging of the revetment provides an adaptive framework for implementation. A rock structure is flexible and, through top up and upgrade, is intrinsically adaptive to any unforseen increases in coastal risks.

Principle		GTCC's Objective as reported in draft CZMP for Greater Taree	Comments and Review of GTCC's Policy Position
8	Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded ecosystems.	GTCC accepts that to maintain coastal biodiversity, coastal ecological communities must have room to migrate and adjust to sea level rise and coastal recession.	Stage 3N of the proposed revetment will assist to protect remaining hind dune elements of SEPP26 Littoral Rainforest areas. However, as part of the detailed design it would be appropriate for the SEPP 26 areas to be remapped to achieve the most environmentally sympathetic revetment alignment for this location.
9	Maintain and improve public safe access to beaches and headlands consistent with goals of the NSW Coastal Policy.	GTCC will not approve property protection works for existing public and private assets where the works are likely to increase coastal hazard risks/impacts on adjoining land, the environment or impact on the community's access and use of the beach.	To greatest extent possible, the revetment is designed to minimise impact on beach amenity and public access to and along the beach. The revetments would be constructed as far landward as possible. The revetments allow for a longshore shareway on the structure (Stage 1) or immediately behind the structure (Stages 2 and 3).
10	Support recreational activities consistent with the goals of the NSW Coastal Policy.		The Stage 3N revetment protects the SLSC.

6 ROCK REVETMENT OPTION: ALTERNATIVE APPROACH TO MANAGE LONG TERM COASTAL HAZARDS AT OLD BAR

6.1 INTRODUCTION

The draft CZMP for Greater Taree and its supporting CZMS report on findings regarding the decision to set aside a revetment as a possible strategy to manage the coastline hazard at Old Bar. In this section the various considerations are revisited in the light of updated information and a reviewed policy stance on the part of GTCC and prospective Stage 2 reforms to the Coastal Protection Act 1979.

6.2 CONSIDERATION ON GOVERNANCE

The draft CZMP for Greater Taree rejects a revetment at Old Bar on legislative grounds since it does not include beach nourishment and therefore would be contrary to s55M of the Coastal Protection Act 1979. The inference is that beach nourishment would address amenity and access.

Due to the size of the beach compartment and the enormous volume and cost of sand that would be required to sustainably nourish the beach in front of a revetment ($147,000,000 reported in WP, 2013), linking nourishment with a revetment is not feasible. While longshore access would therefore be lost in time as beach width diminished with coastline recession in front of a revetment, the proposed revetment design incorporates shareway access along the structure for Stage 1, and immediately behind the structure for Stages 2 and 3. It would be feasible for interim pedestrian access to be provided across the face of the wall onto the beach at high use locations (such as Rose Street after the completion of Stage 2), however as beach width diminishes the need for such access is removed.

The high use beach area at Old Bar is in front of the SLSC. It is envisaged that this area of the beach would remain unprotected until approximately 2021 when the school or SLSC would become threatened and the Stage 3N revetment would be constructed (RHDHV, 2013). In the interim it is possible that the beach width fronting the Club may reduce as the coast continues to recede up against the elevated bluff and dune features in the area. GTCC is seeking to examine the sustainability of maintaining a suitable beach in this area with nourishment (**Section 4.3.4**).

GTCC requests that any legislative breach to the Coastal Protection Act associated with the proposed rock revetment, coupled with nourishment at the main section of Old Bar Beach in front of the SLSC if feasible and sustainable, be addressed by the State Government as part of the Stage 2 reforms. The State Government, through its agency OEH, understands the predicament of GTCC and the community as evidenced by the assistance that it has given to develop a suitably engineered and staged rock revetment for Old Bar Beach (RHDHV, 2013).

It is considered reasonable for GTCC to accept a rock revetment alternative for managing coastline hazard at Old Bar on governance grounds.

6.3 SOCIAL ASPECTS

The draft CZMP for Greater Taree rejects a revetment at Old Bar on social grounds, stating that a revetment does not maintain beach access and amenity for continued enjoyment by the wider community, and leads to the loss of a beach. However, beneficial protection to individual property owners is recognised.

The proposed revetment design incorporates a shareway to provide longshore access to pedestrians and cyclists. This feature replaces the access along the shore that would eventually be lost through recession and the fixed position of the revetment. The shareway would likely change the use of the foreshore. Promenading would replace beach walks, passive beach use and sunbaking, with increased access expected to those with mobility restrictions, prams and bicycles. Also the deeper water that would eventually be available along the toe of the revetments may benefit recreational fishing.

It is also understood that there is general community support for leash free dog zones in the Old Bar-Wallabi area. At present these are not feasible because of the levels of visitation to those parts of the beach close to Old Bar village and

safety concerns with leash free access. At a future date when Old Bar Beach is physically separated from the beach to the south of Lewis Street, it has been suggested that the large beach area between Lewis Street and Wallabi could be dedicated as a leash free zone.

It is considered reasonable for GTCC to accept a rock revetment alternative for managing coastline hazard at Old Bar on social grounds.

6.4 ECONOMIC CONSIDERATIONS

The draft CZMP for Greater Taree rejects a revetment at Old Bar on economic grounds, stating that a revetment has a high capital and ongoing maintenance cost, beyond GTCC's capacity to resource. It also maintains that capital and maintenance costs could be borne by the benefiting landholders, and that a revetment would lead to the potential impact on tourist trade due to the loss of beach and amenity.

The proposed revetment is costed at between $8.0 and $8.3 million for Stage 1 depending on its cross-shore location, a further $7.0 million for Stage 2 and $8.8 million and $24.2 million respectively for Stages 3N and 3S (all 2013 Australian dollars). Stage 1 and 2 are required in the short term, although there may be scope to accept a delay to Stage 2 on the basis that risk is lower to the private property assets and the probability of persons being affected by a slope failure in Stage 2 may also be lower. There may also be scope to split the works in Stage 2 related to the reduction in erosion risk behind the dune beside the entrance of Racecourse Creek (RHDHV, 2013). In any event, at least $8 million is required in the short term to initiate the revetment project at Old Bar.

The position stated in the draft CZMP for Greater Taree regarding GTCC's inability to resource the project on its own has not changed. A question mark must also remain on the general acceptance of ratepayers across Greater Taree to make what may need to be a substantial contribution to the cost of the revetment. OEH is presently investigating the cost-benefits of planned retreat and a rock revetment for Old Bar, and further consideration must be given by GTCC as to how it might fund any contribution from its rating base more broadly and levies from Old Bar residents which could be progressively applied, attached to their degree of direct coastal risk.

As opportunities arose through the NSW Coastline Management Program administered by OEH for 2013/2014 funding, GTCC made an application for $8,018,000 to fund the construction of the 450 m long Stage 1 Option 1 wall. This funding application in no way pre-empts a GTCC recommendation and Minister approval for construction of a rock revetment coastal management option, but rather ensures that in the event such a recommendation is made, the immediacy of the situation is acknowledged and realised. If funding is not available for a revetment, then GTCC would have no other option but to finalise the CZMP using planned retreat.

Since there remains the prospect of a model to fund the revetment, it is considered reasonable for GTCC to accept a rock revetment alternative for managing coastline hazard at Old Bar on economic grounds.

6.5 ENVIRONMENTAL CONSIDERATIONS

The draft CZMP for Greater Taree rejects a revetment at Old Bar on eight environmental grounds, as follows:

(i) Potential modification (training) of Racecourse Creek
(ii) Eventual loss of beach in front of revetment
(iii) Potential exposure of revetment
(iv) Potential end effects of revetment wall would cause increased recession at either end of structure, including the SEPP 26 littoral rainforest and on adjacent unprotected parts of the beach
(v) Potential change to natural sand movement
(vi) Potential environmental effects if structure fails or not properly maintained
(vii) Disruption to sand dunes and vegetation during construction phase

Further information on a number of these issues is now available having being considered in RHDHV (2013). These actual and potential impacts and suggested mitigation measures are canvassed individually below.

6.5.1 Potential Modification (training) of Racecourse Creek

The vegetated spit opposite the entrance to Racecourse Creek has retreated 140 m in past 8 years including 100 m in the past 4 years. The entrance to the creek has effectively retreated at the same rate. The creek entrance is being modified rapidly and naturally.

The Stage 2 revetment would extend along the creek to protect Pacific Parade. However, any decision to extend the Stage 2 revetment beyond the existing mouth of Racecourse Creek would be taken with due caution and only if it was determined that the spit which is currently protecting the entrance was to be lost. There is no point in constructing the revetment if the spit itself is to naturally provide the required protection (**Figure 10**).

The natural retreat of the spit and entrance, if it continues, could be expected to eventually steepen the creek gradients upstream of the culverts at David Street, potentially leading to undercutting at the outsides of bends further up the creek.

Thus it is not the revetment that stands to modify the entrance to Racecourse Creek, but rather the very aggressive erosive processes. The Stage 2 revetment would follow the retreating entrance in order to protect the road and the private properties.

The southern end of the Stage 3 N revetment can be treated in two ways, either with a return around the south eastern corner of the school, or by extending the structure to overlap the northern end of the Stage 2 revetment. The selected arrangement has no bearing on the end detail for the Stage 2 revetment (**Figure 10**).

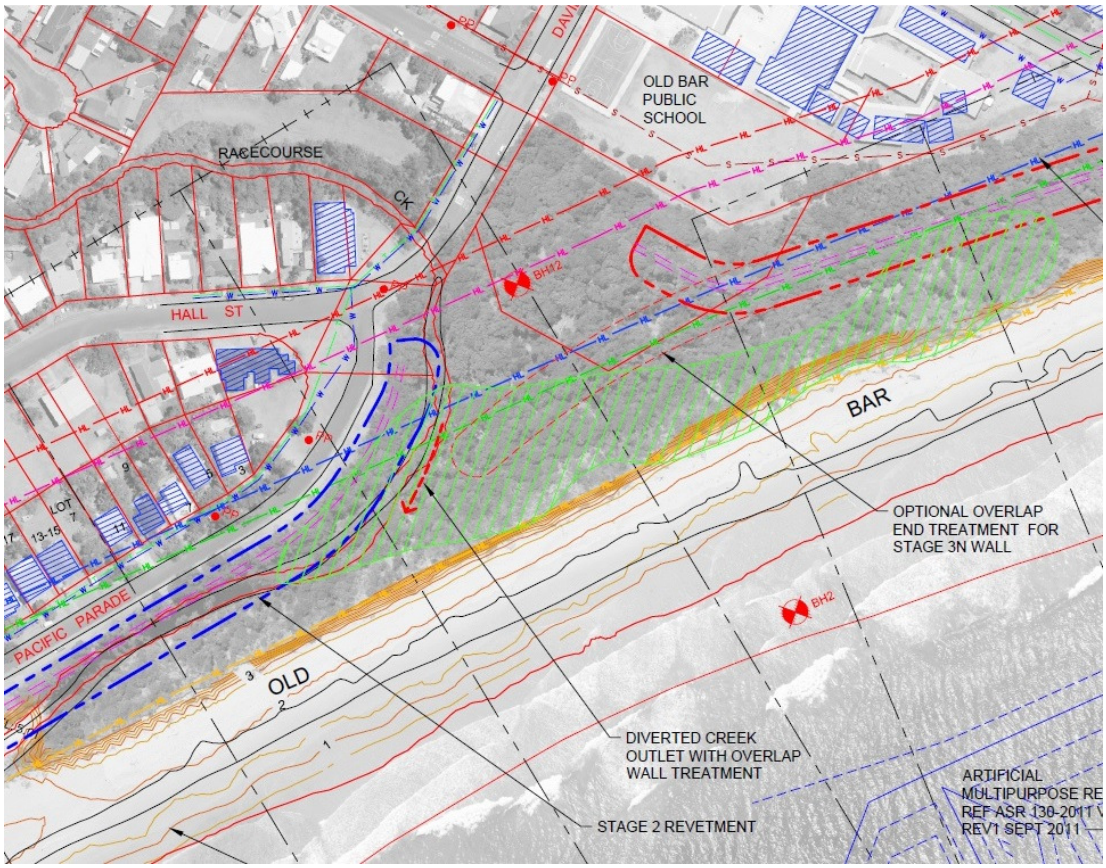

Figure 10: Proposed staged arrangements about the entrance to Racecourse Creek with preliminary revetment design (Extract from Dwg 8A0271-MA-1001B, Appendix F, RDHDV, 2013)

6.5.2 Eventual Loss of Beach in Front of Revetment

Based on the current understanding of the coastline at Old Bar there is every likelihood that the beach in front of a revetment would in time be lost.

It is important to understand that it is not the revetment that is causing the loss of the beach, but the recession process. Manly Beach has had a seawall for over 100 years, but it also had a beach because there is no long term recession.

GTCC is examining the possibility of nourishing the beach in the vicinity of the Old Bar Taree SLSC to provide an amenity for the community going forward, but it could only commit to supporting such a scheme if it was shown to be feasible and sustainable.

6.5.3 Potential Exposure of Revetment

The preliminary design for the revetment allows for long term recession due to sediment loss, SLR recession, storm erosion, scour and wave runp. The structure is designed for a 50 year life after which is would probably need to be substantially upgraded to continue to provide its design function.

Over its 50 year design life, the structure is designed to be exposed but not fail.

6.5.4 Potential End Effects of Revetment Wall would cause Increased Recession at either End of Structure, including the SEPP 26 Littoral Rainforest and on Adjacent Unprotected parts of the Beach

"End effects" of revetments are an issue. There are two principal causes:

Cause 1 Turbulence (primarily due to localised wave reflections and diffraction) leading to increased erosion from behind the ends of the structure. This impact is accentuated at times of storms;

Cause 2 Reduction in longshore sediment transport due to the "locking up" of sand from the active profile behind the structure, leading to a reduced downdrift delivery and net sand loss

Ordinarily the localised turbulence erosive impacts (Cause 1) are largely addressed by natural processes, with the sand returning to restore the erosion in time. However, if the coastline has receded beyond the line of the revetment, then natural accretion would not occur and a stable zeta-shaped beach would form in the lee of the structure end. The structure end is now acting as a headland and the diffraction process operates all the time, not just during storms.

End effects from Cause 2 potentially extend up to 70% of the length of the wall or 500 m whichever is the lesser (DECCW, 2010). This impact is primarily attributed to additional erosion due to the presence of the structure, and is likely to be greater on a receding beach, especially one with a net littoral drift.

End effects from Cause 1 are reduced by returning the ends of the structure as far landward as possible, keeping them out of the wave zone. It can be seen from **Figure 5** that accentuated returns are proposed with the preliminary revetment design stages at Old Bar. Nevertheless, on a receding shoreline the structure ends will eventually be exposed to wave action with accompanying end effects.

The Stage 1 revetment design has its ends purposefully located far away from private property. Cause 1 end effects, when they occur, are expected not to encroach into private property. In addition, the north end of Stage 1 is terminated in the lee of the existing gabion training wall. The gabion wall should act to attenuate (break) incoming waves in storms so reduce the wave action at the north end of the revetment and reduce the localised end effect. The alignment of the north end of the Stage 1 structure is selected to follow the projected alignment of Stage 2 which is always preferred. Wave action will focus on changes in alignment increasing locally the wave height, runup and scour.

It is possible that the Stage 1 revetment would bring forward the construction of Stage 2 as a consequence of its Cause 2 end effect given that the dominant ambient net sediment transport direction is south to north (RHDHV, 2013). However, the Stage 2 revetment is likely to be needed in the short-term anyway so the material consequence of this is arguably minor.

The SEPP 26 area is potentially impacted by end effects from Stage 2. However, the northern and landward extent of Stage 2 would depend on the proximity of the erosive threat. The greater the erosion the further north and landward Stage 2 works would be extended, but the more threatened would be the SEPP 26 area in any event not due to the end effect but the natural erosion process. This might then spur the introduction of the Stage 3N project which will assist to protect remaining hind dune elements of SEPP26 Littoral Rainforest areas.

The message here is that "end effects" are real and problematic with walls, but since the natural erosion is so aggressive at Old Bar the impact of the end effects are likely to be muted in bringing forward the next stage of the revetment project. The preliminary design for the rock revetment responds to the issue including landward returns, continuous alignments and careful attention to staging to manage the impact.

6.5.5 Potential Change to Natural Sand Movement

Sand movement on a beach due is characterised as being alongshore and/or onshore-offshore. The best assessment of the sediment transport processes at Old Bar suggests that the ambient transport direction is alongshore to the north, but that this can switch to the south in storms. Rips also can develop at any location along the beach in storms and will be responsible for erosion of sand offshore. Much of the eroded sand would normally return to the beach in subsequent fairweather periods under the action of low swell waves. It has been postulated that the largely rocky seabed out from Old Bar means that relatively little sand is mobilised in the inshore zone, that that this results in storm processes more aggressively "hunting" sand on the drying beach and dune hence leading to the large observed erosion (interpretation from Gordon, 2013).

Based on RHDHV's understanding of beach processes and the effects of shore structures it is expected that a revetment would not modify the longshore sand transport behaviour at Old Bar. However, higher wave reflections from the rock structure may temporarily lower the beach immediately directly in front of the structure during and for a short period following storms, although the net long term beach condition is unlikely to be affected. It is not feasible, nor is it warranted given the expected longer term outcome, for sand to be placed in front of the revetment to restore beach levels immediately following storms.

The "end effects" discussed in **Section 0** also describe a potential change to natural sand movement, however this is shown to be managed with the proposed design.

6.5.6 Potential Environmental Effects if Structure Fails or Not Properly Maintained

The preliminary design applies a conservative regime of water level, wave and scour conditions. The design is based on conditions that would be expected at the half-life point of the structure (2038) assuming 0.8 m/yr long-term recession, and a 1 in 100 year storm event at the time to cause 0-5% damage, checked against extreme recession of 2.5 m/yr over the 50 year life not leading to a full failure at full life (2063). Furthermore, as a rock mound structure the design is intrinsically flexible and adaptable. If it transpires that the coastline hazards are actually more severe than was assumed, additional rock could be added to bolster the revetment.

Nevertheless, functional performance over the life of the structure requires due attention to maintenance. Given the design assumptions and criteria applied, RHDHV (2013) recommends a cost allowance of 0.5% per annum over the first 25 years of the structure, followed by 2% per annum over the second 25 years. Assuming say a 3% long-term discount rate, this amounts to a Net Present Value for maintenance of the structure of $2.0 million (Option 1, Stage 1).

Moneys are not ordinarily committed by government for long-term future spend. While allocation depends on priorities at the time, there is currently provision in the Coastal Protection Act for councils to levy benefiting landholders to fund the maintenance of coastal protection works. Although the combined risk of insufficient maintenance spend and structural failure are likely to be minimal, the potential environmental effects could include mobilisation of the large armour and underlayer rocks in severe storms and ultimately their location in the surf zone. If the structure is not adequately maintained, then the continued safe use of the shareway along the structure would be compromised.

To confirm an acceptable design regime, it is recommended that the rock structure be physically model tested as part of its detailed design. The possible interchange maintenance effort for a stronger and more resilient capital work could be explored as part of the modelling investigation.

The risks associated with potential environmental effects associated with structural failure or inadequate maintenance would appear to be small and manageable, and should not be an impediment to pursuing this type of project.

6.5.7 Disruption to Sand Dunes and Vegetation during Construction Phase

Construction of the revetment would be highly disruptive. Some 50 to 60 m^2 of clearing of vegetation and between approximately 100 and 150 m^3 of excavation of the beach and dune would need to occur to construct each one metre of revetment length. Top soil would be returned to disturbed areas behind the structure and plantings re-established, as would be required under the Construction Environmental Management Plan (CEMP). It would not be possible to re-establish mature trees but saplings of the most desirable species would be specified. It is assumed that all of the excavated material is sand which would be stockpiled and recycled as backfill and beach replenishment.

A coastal revetment project at Old Bar would be disruptive to the sand dune and vegetation during the construction phase, but the disruption and impacts would be manageable with due attention paid to the CEMP and site restoration.

The disruption to the sand dunes and vegetation must be viewed in relation to the ongoing loss of these features attributed to the very high natural long-term recession rates being experienced at Old Bar Beach (**Photo 1**).

Photo 1 – Loss of dunes and vegetation between the school and entrance to Racecourse Creek

6.6 TECHNICAL CONFIDENCE

6.6.1 Technical Confidence in providing Protection

Seawalls and coastal revetments are used extensively and successfully to protect developed back-beach shorelines in NSW, and today it is estimated that there are in excess of 10 km of sea defences along the NSW coast (RHDHV, 2013).

The brief for the *Investigation and Preliminary Design of a Coastal Protection Structure for Old Bar Beach* issued in September 2013 had as one of its primary guiding principles that the design be capable of providing a demonstrated level of protection to the development at risk. This has been achieved.

The draft CZMP for Greater Taree endorses a rock revetment option as providing technical confidence for terminal protection for assets at risk from storm erosion and coastline recession. This addendum endorses and strengthens this assessment, finding a "high" level of technical confidence for terminal protection for assets at risk from storm erosion and coastline recession.

6.6.2 Technical Confidence in Predicting Impacts and Effectiveness

The draft CZMP for Greater Taree and this addendum both endorse as "high" the technical confidence in predicting the impacts and effectiveness of a rock revetment for Old Bar.

7 REVISED MANAGEMENT ACTION, IMPLEMENTATION AND RESPONSIBILITY FOR ROCK REVETMENT OPTION

7.1 Introduction

The draft CZMP for Greater Taree identifies property risk and response categories for public safety and built assets in accordance with the requirements of the *Guidelines for Preparing Coastal Zone Management Plans* (DECC, 2010). These are relevant for all possible management options including GTCC's existing draft management strategy of planned retreat, as well as a revetment option. The position described in the draft CZMP for Greater Taree is reviewed in the light of updated information.

Consideration is also given in this section to the implementation of a rock revetment option and the associated responsibilities.

7.2 Review of Risk and Response Category for a Revetment Option at Old Bar

The risk categories relate to the traditional coastal hazard area being defined as the current (or immediate), 2050 and 2100 hazard areas denoting the timeframe in which they are likely to be affected by erosion or recession. The response categories identify the intended response of a public authority to the feasibility and cost-effectiveness of coastal protection works.

For Old Bar, the draft CZMP for Greater Taree identifies roads, properties, infrastructure assets and community facilities as being exposed to variable risks over development planning timescales. The CHD Update described in **Section 3** underscores the level of hazard which applies to property and assets at Old Bar, describing this in "acceptable risk" terms.

The CHD Update accounts for the recent very aggressive coastline recession, updating the WP (2010) analysis. It also provides a more rigorous risk-based perspective on the coastal hazard. Like WP (2010), the CHD Update also finds a high level of threat to coastal property at Old Bar. In broad terms, without protection, it is assessed (as a "best estimate") to be "likely" (26% chance) that about 46 buildings will be undermined at Old Bar over the next 60 years, and "possible" (3% chance) that this will be increased to about 60 buildings. These 60 buildings (mainly private homes but also including most of Meridian Resort, parts of Old Bar Public School, and the entire SLSC) are at unacceptable risk.

A Response Category C as defined in DECC (2010) is allocated in the draft CZMP for Greater Taree to a revetment option for Old Bar, meaning that the coastal protection works are not considered technically feasible and implementation by a public authority is not intended. Response Category C was selected because it was assessed that a revetment was not legislatively feasible under the Coastal Protection Act 1979 as it did not maintain public access to the beach and include beach nourishment. These matters have been revisited and are addressed in this report. The governance aspects relating to a revetment are discussed in **Section 6.2**, and approaches to managing access and beach nourishment are discussed in **Sections 4.3.4** and **6.3**.

It is proposed that the Response Category for a revetment option at Old Bar be revised from C to A, meaning that the coastal protection works are considered technically feasible and cost-effective, and that funding is being sought for implementation. Note that GTCC has made an application for grant funding from the State Government under the NSW Coastline Management Program and a detailed cost benefit analysis of a rock revetment at Old Bar is the subject of a separate investigation being undertaken by OEH (**Section 6.4**). On the basis that the cost-benefit analysis demonstrates that a revetment is cost-effective, it follows that a switch in Response Category from C to A would be reasonable.

7.3 Implementation and Responsibilities for a Rock Revetment Option

The Stage 1 revetment project should be implemented as soon as possible. The two initial tasks would be the funding and land tenure arrangements which could be interrelated.

Coastal protection in NSW is usually funded by State and Local Government. There are instances in NSW where private landowners have contributed to extended coastal protection projects built by government. Funding models which draw a larger contribution from protected landowners and communities are more broadly canvassed nowadays.

The preliminary design has the revetment structure variously located on private and public land, depending on staging. In Stage 1, over 75% of the works would be located on private land. The remainder of the project, through Stages 2, 3N and 3S, the works are fully located on public land (RHDHV, 2013). The legalities surrounding occupation and tenure would be resolved in due course, however the expectation would be that the full structure would be constructed on public land.

As stated above, the expectation would be that the revetment is fully located on public land. For Stage 1, where part of the proposed structure currently occupies private land, it should be feasible for that footprint plus any private land further seaward, to be transferred to the Crown.

The local government funding source could cascade from the most affected landowners (properties which extend seaward of the yellow line, **Figure 4**), to other less affected landowners (properties between the yellow and blue lines, **Figure 4**), to all residents in Old Bar, or to all ratepayers in the LGA.

The Principal would also need to arrange a right of access across a maintenance corridor immediately behind the footprint of the structure. A maintenance corridor of 6 m is proposed in the preliminary design.

8 REVIEW OF OLD BAR CZMP ADDENDUM

It is proposed that the Old Bar CZMP addendum would be reviewed periodically. This should occur at no greater than 10 year intervals from its gazettal date, or at shorter intervals governed by any of the following trigger events:

- completion of construction of any particular stage of the Old Bar revetment;
- storm erosion exceeding 100 m^3/m above AHD measured at any location with the study area;
- within 25 years of the construction of any stage of the revetment, storm damage to the structure is assessed by a practicing Coastal Engineer to exceed 5% as measured in accordance with Coastal Engineering Manual (CERC, 2002);
- within 25 to 50 years of the construction of any stage of the revetment, storm damage to the structure is assessed by a practicing Coastal Engineer to exceed 15% as measured in accordance with Coastal Engineering Manual (CERC, 2002).

9 CONSULTATIONS FOR OLD BAR CZMP ADDENDUM

9.1 Consultation Plan and Delivery

An intensive single day Consultation Plan for presentation and discussion on the Old Bar CZMP addendum was developed by GTCC and implemented by GTCC, OEH, RHDHV and Water Research Laboratory (WRL) on 8 April 2014.

The proceedings commenced with a briefing of Councillors at Greater Taree Council Chambers between 11.30 am and 12.30 pm. The discussion explained the selection of the rock protection structure over other possible structural options. Briefing of Councillors was followed by two sessions of community consultations at Club Old Bar, the first running from 2.00 pm to 4.30 pm, and the second from 6.00 pm to 7.30 pm.

Both community sessions involved a 40 minute presentation made by GTCC staff, RHDHV and WRL. Meetings then followed involving 10 minute discussions, scheduled by prior appointment.

A board display was also prepared for information and to support general discussions involving GTCC, RHDHV and WRL.

A survey form prepared by GTCC was available for completion on the day. All attendees were encouraged to complete the survey.

9.2 Consultation Outcomes and Feedback

10 COMPLIANCE CHECKLIST AGAINST MINIMUM REQUIREMENTS FOR PREPARATION OF OLD BAR CZMP ADDENDUM

The Guidelines for Preparing Coastal Zone Management Plans (OEH, 2013) set out minimum requirements. A summary check list is set out below in **Table 9**.

Table 9 – Checklist against minimum requirements for preparation of Old Bar CZMP addendum

Section Heading in CZMP	Comment and Reference
CZMP planning process content and outcomes	
• Descriptions on how CM principles have been considered, community consultation process, and methodology to identify and evaluate management options	CM principles covered in draft CZMP for Greater Taree. Consultations undertaken by GTCC in parallel with design investigations for the rock revetment (**Section 4.3.2** and **Section 4.4**). Consultations also undertaken for Old Bar CZMP addendum (**Section 9**).
• Proposed and prioritised management actions, including private sector funding, monitoring and review	Revetment management action only covered in this addendum, largely based on design investigations (**Section 4.3.2**) and consultations (**Sections 4.4** and **9**). Funding models being investigated (**Section 6.4**).
• Evaluation across social, economic and environmental factors	Evaluations in draft CZMP for Greater Taree reviewed for revetment at **Sections 6.3, 6.4** and **0**.
• Consultation with local community, including consideration of submissions	Consultations undertaken by GTCC in parallel with design investigations for the rock revetment (**Section 4.4**). Consultations also undertaken for Old Bar CZMP addendum (**Section 9**).
Coastal risks	
• Describe coastal processes	Coastal processes described in CHDS (WP, 2010)
• Describe risks from coastal hazards	Risks from coastal hazards described in CHDS (WP, 2010) and CHD Update (**Section 3**).
• Describe climate change impacts	Climate change impacts described in CHDS (WP, 2010) and CHD Update (**Section 3**).
• Locations where landowners can build protective works	Discussed in draft CZMP for Greater Taree. Lewis Street DA for geotextile container seawall refused by NSW Coastal Panel for amenity, safety and economic reasons (RHDHV, 2013). Artificial reefs between Rose Street and the school also proposed, but considered technically deficient and not supported by GTCC and the State Government (RHDHV, 2013 and **Section 4.3.3**).
• Describe property risk and response categories	Covered in draft CZMP for Greater Taree and **Section 7.2**).
• Actions in implementation schedule to manage risks	Revetment designed and a flexible, adaptive structure with risk-averse selection of design parameters. Refer RHDHV (2013) and **Section 0**.
• Proposed arrangements for managing impacts and maintenance	Discussions taking place between GTCC, OEH and the State Government to develop acceptable funding arrangements for capital works and maintenance (see also **Sections 6.4** and **7.3**)
• Emergency Action Plan	Gazetted EAP currently in place.

Section Heading in CZMP	Comment and Reference
Coastal ecosystem health	
• Entrance management policy for Racecourse Creek	Not required as this minor creek has always breached the beach berm without intervention at times of heavy rain.
Community uses of the coastal zone	
• Actions that protect and preserve beach environments and access	The revetment includes a shareway in Stage 1, and provides for access immediately behind the structure in Stages 2 and 3. The beach fronting the revetment would eventually be lost as a consequence of natural coastline recession (**Section 6.5.2**). To help preserve beach amenity, GTCC is investigating beach nourishment for the main section of Old Bar Beach in front of the SLSC (**Section 4.3.4**).
• Potential impacts on access arrangements	Managed with a shareway. To help preserve beach amenity, Council is investigating beach nourishment for the main section of Old Bar Beach in front of the SLSC (**Section 4.3.4**).
• Cultural and heritage significance	Refer Section 2.3 of draft CZMP for Greater Taree
• Actions to manage environmental or safety impacts, and to protect/promote culture and heritage environment	Refer Section 2.3 of draft CZMP for Greater Taree

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