PROCESSES TO DEVELOP AN INTEGRATED AND MULTI-FUNCTIONAL COASTAL MANAGEMENT STRATEGY FOR PALM BEACH, GOLD COAST

R. Tomlinson[1], J. McGrath[2], L. A. Jackson[3], G. Stuart[2], A. Robertson[1], M. DaGata[1], B. Corbett[3]
[1] Griffith Centre for Coastal Management, PMB 50 Gold Coast MC, Australia 9726
r.tomlinson@griffith.edu.au
[2] Gold Coast City Council, PO Box 5042, QLD 9729 Australia
JMCGRATH@goldcoast.qld.gov.au
[3] International Coastal Management, PO Box 7196 Gold Coast MC, Australia 9726
icm@onthenet.com.au

Abstract: Despite ongoing nourishment and groyne construction over 3 decades, the central section of Palm Beach is still very vulnerable to storm erosion. Palm Beach is in the central area of Gold Coast City and despite narrow beaches, these beaches and surf attract a large number of users and supports 3 surf clubs. The Palm Beach Beach Protection Strategy [PBBPS] has been developed for Gold Coast City Council using the IENCE philosophy [Infrastructure to Enhance the Natural Capacity of the Environment] to provide an integrated and multi-functional management strategy for these beaches. The strategy builds on the monitoring of the extensive works and nourishment since 1974.

An IENCE process has been developed based on the successful Northern Gold Coast Beach Protection Strategy [NGCBPS]. The process developed for Palm Beach relies heavily on the monitoring data and feedback received from NGCBPS. In particular, the reef design formulae developed using the monitoring data of beach width and storm cut from Narrowneck reef was used for the design of Palm Beach nourishment and reefs. Also, public consultation and information has been increased to ensure that expectations are realistic. The strategy includes nourishment from a number of sources plus construction of up to 3 reefs. A staged construction approach with ongoing monitoring is proposed to allow the strategy and design of structures and nourishment to be refined. The processes used in the development and design of the strategy is outlined. Implementation of the strategy is to commence in winter 2003.

Keywords: erosion, nourishment, reefs, coastal management plan, ecology

INTRODUCTION

The City of Gold Coast in Queensland, Australia is a popular tourist area with 52 km of recreational sandy beaches and many world class surfing sites. Storms, particularly tropical cyclones, can produce high-energy waves that can cause severe erosion events that adversely affect the tourism industry and in extreme events can threaten beachfront development. The suburb of Palm Beach has a 5km stretch of beach extending between Tallebudgera Creek [to the north] and Currumbin Creek [to the south] (Figure1) and the beaches and waterways are currently popular for a number of activities including swimming, surfing, fishing and diving [offshore bedrock reefs support diverse habitat in deeper waters].

As with all Gold Coast beaches, Palm Beach experiences high energy wave climate [average Hs = 1.2m, Hm = 13m], resulting in a very dynamic beach system. Severe storms in 1967, 1972 and 1974 caused severe structural damage to properties along the beachfront (Figure 2) and over the past three decades, a number of protection works have been implemented, including:

- Construction of an (almost) continuous seawall
- Two short groynes (at 11th and 21st Avenues)
- Beach nourishment in excess of 1M m^3
- Tallebugera Creek training wall / groyne
- Currumbin Creek Training Wall

Despite these works, the centre section of Palm Beach remains narrow and storms in May 1996 again emphasised the vulnerability of this section of Palm Beach to severe storm erosion. There has been continuing concern that, in the event of a moderate storm, the central section of Palm Beach does not have sufficient storm buffer to prevent loss of beach and, as much of the beachfront developments are in the active dunal system, provide adequate protection to beachfront properties.

As the coastal systems can no longer sustain the impacts from users such as tourism without infrastructure and management, Gold Coast City Council resolved to develop a pro-active IENCE [Infrastructure to Enhance the Natural Capacity of the Environment] type strategy for the protection of the beaches at Palm Beach (McGrath et. al, 1999).

METHODOLOGY

To ensure that this and other beach protection strategies for various sections of the Gold Coast are integrated and sustainable using the extensive database available to achieve "word best practice", Griffith Centre for Coastal Management (GCCM) based on the Griffith University's Gold Coast campus has been encouraged to work closely with Council's engineers. Continuous improvement of models and other design tools through monitoring and evaluation of implemented strategies or elements is a benefit achieved in this approach. GCCM is responsible for development and implementation of the Palm Beach Beach Protection Strategy (PBBPS) using a three-stage process (Figure 3) developed for the Northern Gold Coast Beach Protection Strategy (NGCBPS) (Jackson et. al, 2002).

The broad range of expertise and experience on the project team ensured that the strategy was formulated without previously held views to achieve specific detailed objectives developed in close consultation with Council and key stakeholders. In broad terms, the objectives are restoring beach conditions, increasing sand volume within the storm buffer to reduce the impact of storms and increasing the overall sustainability and stability of the beach system.

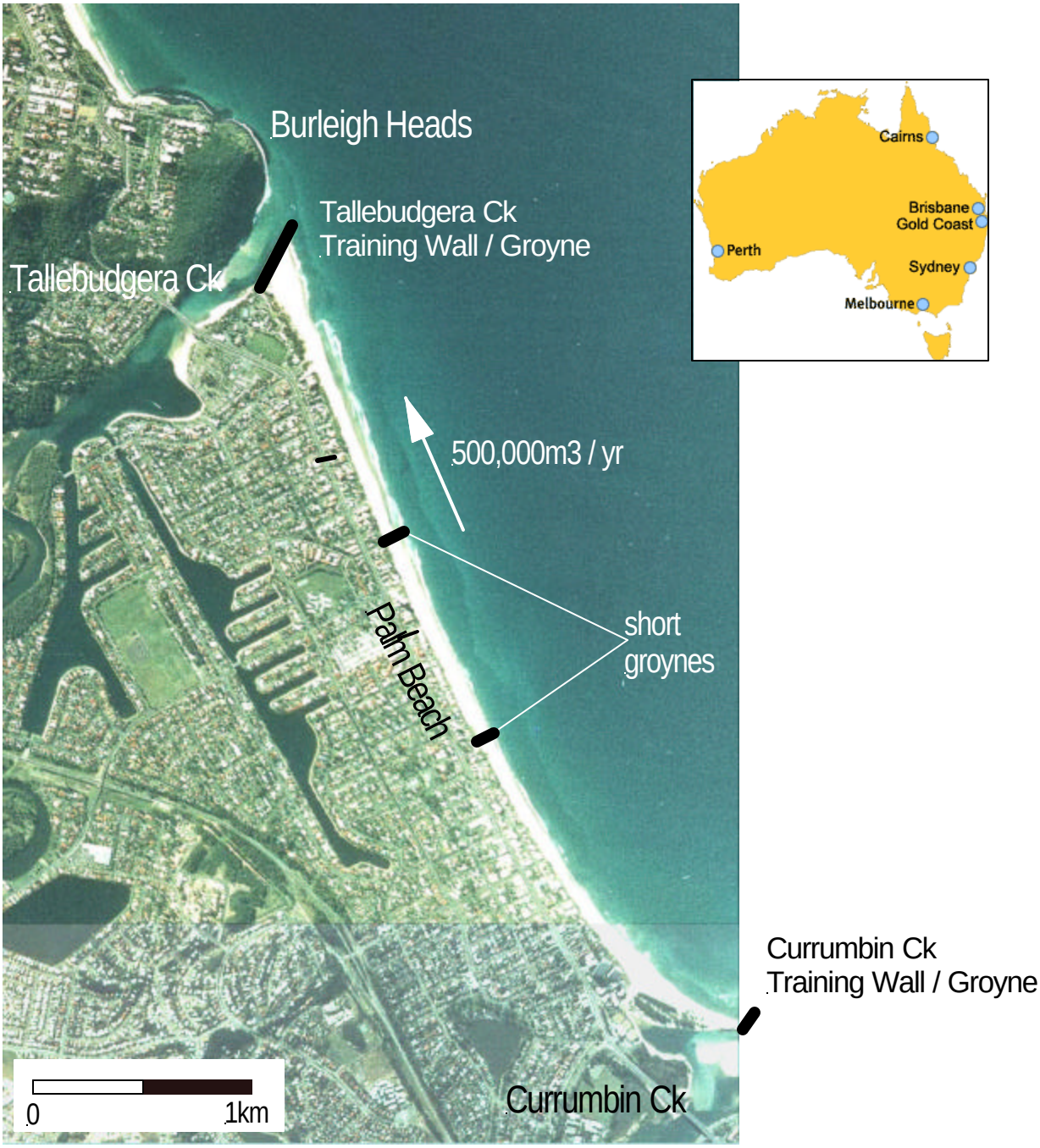

Figure 1. Aerial photo and location of Palm Beach

Figure 2. Erosion from 1967 storm

The process developed for Palm Beach relies heavily on the monitoring data and feedback received from the NGCBPS. In particular, the reef design formulae developed using the monitoring data of beach width and storm cut from Narrowneck reef and flume modelling of a proposed reef at Noosa were used for the design of Palm Beach nourishment and reefs. While surf quality is to be improved, safety is a key objective and development of an expert level and dangerous surf break is not suitable for this location. Public consultation and information has been increased to ensure that expectations, particularly regarding surf quality, are realistic.

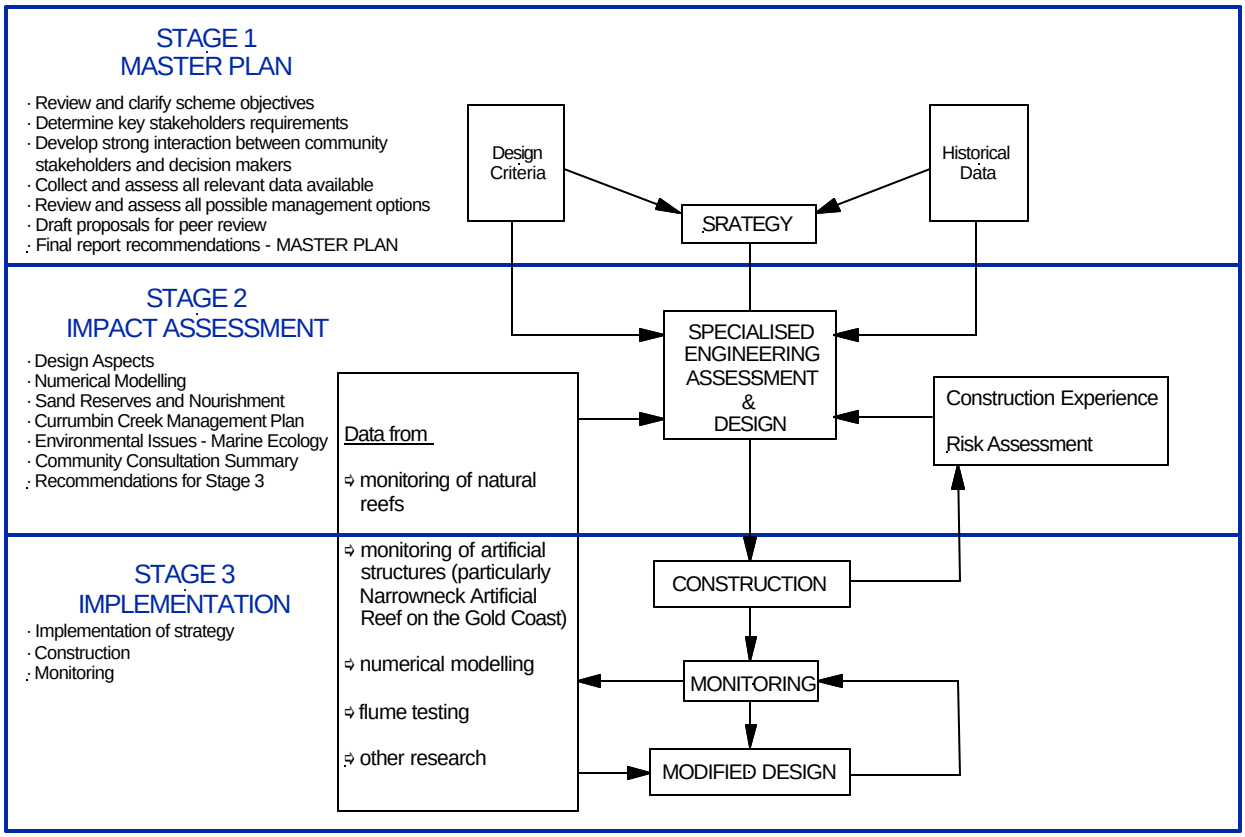

Figure 3. Staging and design methodology flow chart

PROPOSED STRATEGY

A staged construction approach with ongoing monitoring is proposed to allow the strategy and design of structures and nourishment to be refined. The staged construction also optimises initial benefits with limited funding. The proposed strategy is shown in Figure 4.

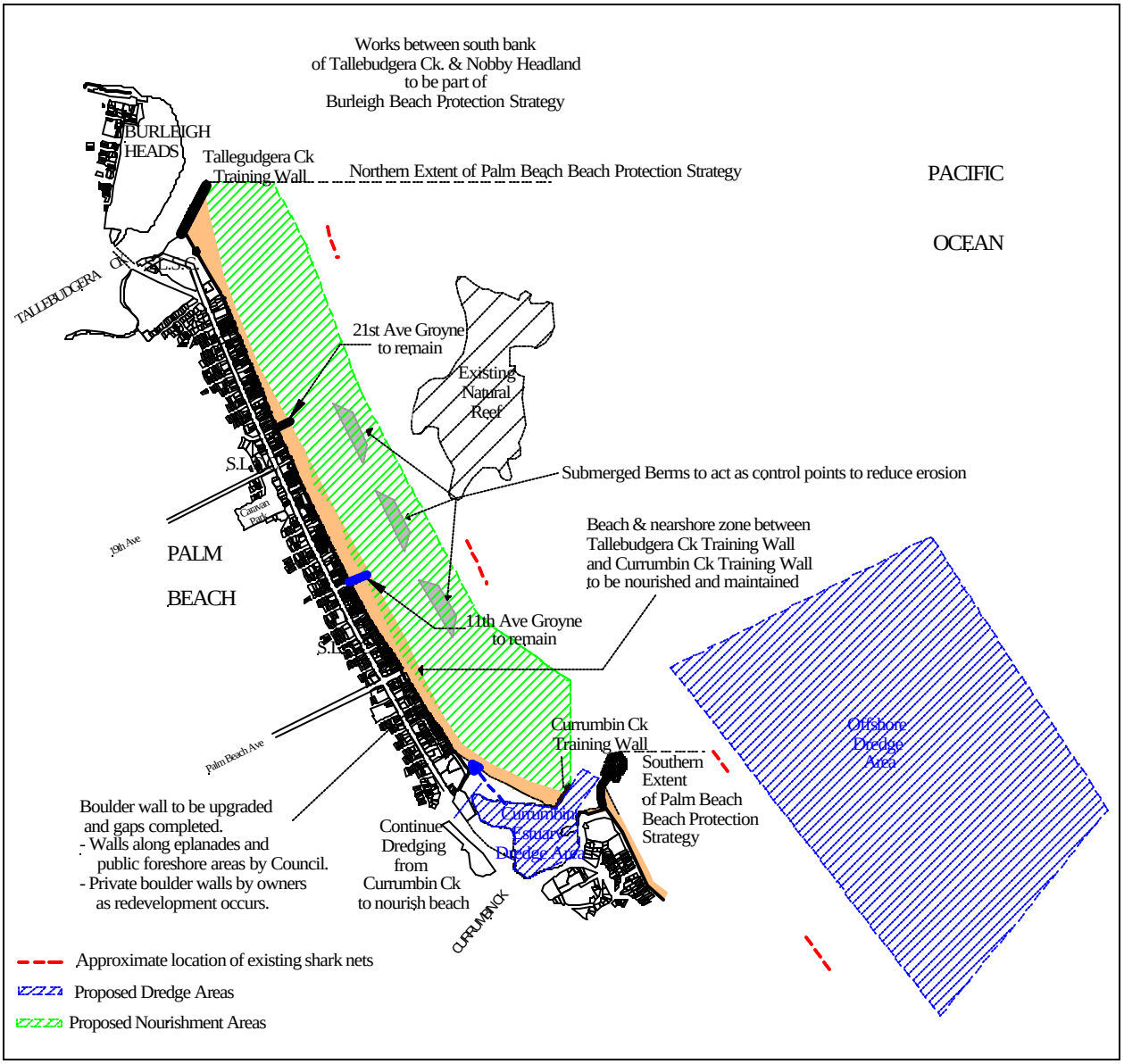

Figure 4. Scheme of Works for Palm Beach Beach Protection Strategy

Short Term (estimate = $2.4M)
The recommended short-term strategy involves the following key components:

A. Implement programs to upgrade sub-standard public and private boulder walls
B. Continue dredging from Currumbin and Tallebudgera creeks.
C. Increase regular hydrographic surveys of Palm Beach to provide data for detailed design.
D. Design the reef structure and associated nourishment
E. Construct the first of 3 reefs (with nourishment) in the vicinity of 19th Ave. to provide increased protection to the beach and properties in this area.
F. Additional Studies
    - Optimisation of the Currumbin and Tallebudgera dredging program
    - Identification of nourishment sand reserves (offshore and land-based)
    - Environmental impact studies

Long Term
The long-term strategy will evolve with monitoring of the initial works and the main components will be as follows.

A. Monitor the initial impacts of the Short Term Strategy.
B. Construct up to 2 more reefs.
C. Plan, design and construct a long-term foreshore improvement scheme.
D. Development of a socio-economic framework for the implementation of a long-term foreshore improvement scheme and associated coastal protection.

IMPLEMENTATION

Design

The design processes involved a number of elements, including the resolution of nourishment volumes to provide an adequate storm buffer, frequency of nourishment required, appropriate placement of material, identifying suitable sourcing locations, in addition to design of the reef structure, which serves to stabilise the nourished, widened beach and reduce erosion in storm conditions.

It is becoming increasingly common to utilise sophisticated and very expensive numerical models for the design of coastal protection / improvement works and it is not uncommon to see the cost of modelling approach the cost of the actual structure. Such models, despite their colourful results, in some cases do not fully predict with sufficient accuracy the impacts of the works, particularly with the wide variability inherent in the coastal system. For this project, the methodology relied on the integration of numerical and empirical modelling using data from a wide variety of sources. However, it was recognised that the impacts (sediment transport, shoreline re-alignment, rip currents etc) of reef structures, particularly when constructed of permeable sand filled geotextile containers, are difficult to model accurately using conventional numerical models.

The reef design was based on data which included monitoring of past works [particularly the Narrowneck reef], evaluation of natural reef salients along Australia's eastern coastline, numerical modelling and flume

testing, in addition to the results of research undertaken by others. The monitoring of the prototype Narrowneck artificial reef provided data on impacts and response of the coastal system to artificial reef structures. This monitoring included hydrographic and beach surveys, video imaging, dive inspections, aerial oblique photography, surf parameter observation and pressure measurements (Jackson et.al, 2002). It has significantly improved our understanding of the behaviour of these types of structures. This understanding has highlighted the fact that there is, in actual fact, less risk with reef structures involved than might initially be assumed provided an appropriate crest height is used. Research showed that a very shallow crest height was not required for good wave energy reduction and storm cut reduction and could increase scour in storm wave conditions as well as being a safety hazard to users.

This design methodology has aided in the development of a number of robust design principles and guidelines for a range of aspects of reef design, including salient size, likely storm cut, safety, surf quality, and diversity of marine habitat. This allowed us to optimise the proposed reef shape, locations and construction materials to best meet the design objectives at reasonable cost.

Approvals

The approval process required modification of the Coastal Management Plan (CMP) for the Gold Coast, as endorsed by the Queensland Beach Protection Authority, which included nourishment with the present structures. Also, the large number of existing dredge areas can be combined. As the present strategy has proved ineffectual to date, and as a reef has previously been approved at Narrowneck, modification of the CMP to include reefs has not been as difficult or time consuming as was the case at Narrowneck.

Funding

Approved coastal protection works in Queensland generally attract a 25% subsidy. Other sources of funding include a benefited area scheme or levy on local properties but these are not seen as equitable for this project that will have significant economic and environmental benefits to the community.

Construction

Tenders are to be advertised in mid-2003 for the construction of the first reef using sand filled geotextile containers. Non-conforming tenders are likely to be received and will be assessed alongside conforming ones. Sand for the initial nourishment and reef construction is to be dredged from the Tweed River entrance in late 2003 as part of the joint Queensland and New South Wales Governments' Tweed River Entrance Sand Bypassing Project.

Monitoring

Proposed monitoring is to include data collection and evaluation of:

- Beach width change and storm cut.
- Wave breaking characteristics and energy reduction.
- Beach and surf amenity improvement and usage.
- Rate and extent of new marine ecosystem development.
- Effect on property prices and rate income.
- Shape and stability of individual sand filled containers.

- Changes in reef shape due to seabed changes in storms.
- Durability of sand filled containers.

This data will allow the continued refinement and validation of existing design principles and guidelines.

CONCLUSIONS

The three stage process that has been utilised to develop both the Narrowneck and Palm Beach Beach Protection Strategies has resulted in not only an integrated, consistent approach to coastal problem solving on the Gold Coast but also acts as a driving force that has taken the project from the investigation stage through to the construction stage in a time- and cost-effective manner. The process resulted in a strategy that involves works that can be constructed at a reasonable cost utilising existing technology. It acknowledges that the system is highly variable and as a result recommends extensive monitoring and flexibility to facilitate ongoing improvements.

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KEYWORDS

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