INFORMATION SHEET

NOOSA MAIN BEACH ARTIFICIAL REEF PROPOSAL

1. BACKGROUND

Background information on the history of erosion at Noosa Main Beach is well documented in the technical paper prepared by P. Coughlin, Beach Protection Authority Queensland (BPA) in 1989.

Since that time Council has tended to rely on ongoing beach nourishment to repair the beach after erosion events.

However, there is doubt that this practice is sustainable due to:

- more stringent environmental requirements
- source, quantity and quality of sand supplies
- impact on local economy and tourist industry every time the beach is eroded.

Detailed studies were undertaken by the BPA over a period of three (3) years during the late 1980s/early 1990s to investigate sand and current movements in Laguna Bay. The cost of the studies was met on a 50/50 basis with Council.

This work helped identify the coastal processes occurring in Laguna Bay and provided a valuable foundation for investigations into a more permanent solution to the erosion problem. While the study identified possible permanent solutions, it did not pursue the options in any detail.

2. SEARCH FOR A MORE PERMANENT SOLUTION

In May 1999, through a public tender process, Council sought proposals from expert coastal engineering consultants to advise on the options identified as a result of the study, in addition to any other options that were currently considered world best practice in the field of erosion control in a coastal environment.

Consultants International Coastal Management (ICM) were engaged in June 1999 to undertake the investigations. The study team included Angus Jackson (ICM), Professor Kerry Black (University of Waikato, NZ) and Associate Professor Rodger Tomlinson (Griffith University, Queensland). Experts from USA and South Africa provided the peer review. The study evaluated the following options:

- Ongoing beach nourishment
- Extension of Noosa Woods groyne
- A submerged permanent near-shore breakwater
- A near-shore sand berm
- A submerged V-shaped artificial reef structure
- Realignment of the Noosa River mouth
- Energy absorbing sea wall

An important consideration during the evaluation process was that any works should:

- Stop or minimise loss of sand from the beach
- Be sustainable in the long term
- Preserve the amenity for the existing stakeholders
- If practical, improve the beach and surfing amenity

Council also obtained an independent peer review of the study by Dr Michael Gourlay, University of Queensland.

3. OVERVIEW OF COASTAL PROCESSES

Sand in this region is moved along the coast from south to north by the predominant SE winds and waves. Noosa Head acts as a barrier to the alongshore movement of sand, requiring high wave energy from the south to bypass sand around the headland into Laguna Bay. This results in a very spasmodic sand supply.

The regular impact of cyclones causes short-term erosion, which is often severe. But, cycles also provide the driving mechanism to move very large quantities of sand from the south around Noosa Head and into the Laguna Bay system. These conditions provide a long-term supply of sand to rebuild and maintain the beach.

When sand in Laguna Bay is plentiful, the shallow seabed ensures that the waves bend (refract). This results in reduction of the wave energy as it approaches the beach. When there is reduced sand supply into Laguna Bay, the deeper seabed results in larger waves which bend less as they approach the beach. These waves have higher energy and result in erosion of both the seabed and the beach.

The major storm wave events in 1967-1968 caused significant damage, which prompted property owners to dump rocks for protection along Noosa Main Beach. It should be noted that this, and previous severe erosion, occurred before the training wall, groyne and seawall construction and was the catalyst for the boulder wall construction.

Since construction of the trained entrance in 1978, a new system has been established and approximately 1 million cubic metres of sand have been pumped to the Main Beach. This sand has generally rapidly eroded, indicating that the supply of sediment around Noosa Head in this time has not been matching the sand transport westward along Main Beach. The groyne construction in 1982-83 was aimed at entrapping sand along Noosa Main Beach. The groyne has been effective in stabilising the NW end of Main Beach but it would need to be much longer to stabilise all of Main Beach.

4. RECOMMENDED SOLUTION – ARTIFICIAL REEF

4.1 THE CONCEPT

The ICM Report "Recommendations for Noosa Main Beach Restoration and Protection" dated October 1999, indicated that the modelling of each option found that there is no simple solution to the present erosion problem which is a result of the fact that the coastline is fundamentally misaligned in relation to wave approach directions.

The study found that while none of the recommended options would solve the problem, a solution merging the best components of the various options would modify the wave crests to match the existing seawall alignment and thereby optimise beach stability.

To achieve this, a nearshore berm (artificial reef) structure consisting of a curved submerged, low gradient berm, extending from the groyne and running offset from the shore, parallel to the east towards First Point, was recommended. Council accepted this option as the preferred approach.

4.2 TYPE OF CONSTRUCTION

Sand filled geo-textile bags are considered the most user-friendly and cost-effective solution for the reef structure. The reef structure would act much like a natural, submerged fringing reef with a shallow semi-protected area inshore of the reef. The bagged berm would have two functions:

- To reduce wave energy reaching the shoreline and thereby reduce sediment movement
- To realign the wave crests to reduce littoral drift to the west.

It is proposed that the structure be situated in about 5 metres of water and be approximately 4 metres high. The width is likely to range from approximately 50 metres wide on the bottom tapering to approximately 5 metres on top. The offshore gradient would be flat offshore to ensure that waves do not dump.

The sand-filled bags will have a weight range from 150 tonne to 300 tonne each.

Although the need for sand nourishment is not totally eliminated, the works will greatly reduce the maintenance volume required and will be sustainable with the sand reserves available (subject to necessary approvals).

4.3 ENVIRONMENTAL ISSUES

Environmental issues will be subject to assessment as part of the detailed design and modelling and approvals stage. The project requires approvals from the State Government through the BPA and Environmental Protection Agency (EPA) who will need to be satisfied that no environmental harm will be caused due to the reef construction.

Some of the benefits of the artificial reef (compared to other options) from an environmental point of view include:

- Potential for growth of marine plants on the bagged structure encouraging marine life (this is occurring at the artificial reef at Narrowneck on the Gold Coast using the same construction materials).
- Minimises the requirements for sand dredging (both volume and frequency) which is a source of concern in terms of impact on marine habitats in the river estuary. Studies into the impacts of a trial dredging scheme in the river estuary are as yet inconclusive.
- Avoids the impact of heavy haulage and major civil engineering works that impact on the environment and the amenity of the beach (eg construction/lengthening of rock groynes or relocation of the river mouth).

5. IMPLEMENTATION

The International Coastal Management (ICM) team has been commissioned to undertake the detailed modelling and design investigations for approvals to construct the artificial reef. They will be required to prepare a design report for presentation to Council. The report will require approval of Council, the BPA and the EPA to allow the project to proceed.

The exact alignment of the reef will be determined as part of these detailed investigations. The investigations also require the team to identify potential sources of sand supply essential for construction of the artificial reef and ongoing maintenance needs.

The approval process will involve obtaining approvals from the State Government, including Section 86 approval from the EPA, Section 47 approval from the BPA and Native Title clearance.

Provided that the necessary approvals can be obtained from the State Government, it is anticipated that the construction of the berm could be completed by December 2001. The estimated cost of the project is $2.5m.

NOOSA BEACH
COASTAL ENGINEERING WORKS TO MITIGATE
THE EROSION PROBLEM

1. INTRODUCTION

Noosa Heads, a rapidly expanding township located some 150 kilometres north of Brisbane, has long held a reputation as one of Australia's premier tourist destinations and residential havens. The main commercial area of the town is centred around Hastings Street which has been built on a narrow, vulnerable, natural sand spit on the southern bank of the Noosa River estuary.

The coastline in the region is embayed between the controlling rocky headlands of Noosa Headland to the south and Double Island Point to the north, a distance of some 50 kilometres. Noosa Beach is a 1.4 kilometre section of coastline which extends eastward from the mouth of the Noosa River. Noosa Headland is a large rocky headland which is predominantly National Park and contains the small pocket beaches of Granite Bay, Tea Tree Bay and Little Cove which have long been popular with surfboard riders. The surrounding hills and headland protect Noosa Beach from the prevailing southeasterly wave climate which allows for ideal swimming conditions for most of the year.

The recorded history of the area reveals that erosion has been a regular occurrence at Noosa Beach. Prior to the 1950s, high water mark at Noosa Beach was between 60 and 90 metres seaward from the boundary of private properties in Hastings Street. "The Noosa Story" by Nancy Cato (Ref 1) shows that the beach was not always this wide and suffered periodic major erosion. However, the frontal dunal system was maintained and this allowed the beach to recover from any erosion event.

During the 1950s, cyclones caused severe erosion of the beach. Erosion progressed gradually until 1968 when further cyclones caused major erosion resulting in loss of much of the esplanade reserve along Hastings Street and the encroachment of the erosion scarp into some private properties. Some property owners began dumping rocks along the beach edge to protect their land. This dumping of rock was a haphazard affair with no uniform alignment and the Noosa Shire Council felt compelled to undertake the construction of a rock wall at a cost of $210,000. This rock wall was constructed from the surf club to the camping ground at Noosa Woods which was close to the then position of the Noosa River mouth. The rock wall was located in the swash zone and this caused further lowering of beach levels seaward of the wall. The Council had intended to pump sand behind and over the wall onto the beach to create a sand dune which would mitigate the detrimental coastal effects of the wall but lack of money ensured that this planned beach restoration was never completed. For the first time, the cycle of erosion and accretion which had regularly occurred at Noosa and which had always ensured an all-tidal beach was interrupted by man's intervention. The beach, which was the catalyst that had attracted property development to Hastings Street, was suddenly denied its natural mechanism to recover and man has since tried to restore the beach to its former glory.

2. RIVER ENTRANCE RELOCATION

A canal estate was developed on Hays Island within the Noosa River estuary in the early 1970s. Movements of the main channel of the Noosa River began to cause undercutting and partial collapse of some of the revetments along Hays Island. Basically, the old channel on the northern side of the estuary which, for many years, had carried the main body of tidal flow was progressively abandoned through natural processes in favour of a southern channel which was close to Hays Island. The creation of the new dominant southern channel caused the river entrance to move south cutting into the camping reserve at Noosa Woods and at the same time reducing the length of the main surfing beach at Noosa.

By 1977, Noosa Beach was virtually non-existent seaward of the rock wall and within the combined threat to Hays Island from strong river currents in the dominant southern channel and possible wave penetration through the river mouth, immediate remedial works were required.

In 1978, a significant river mouth relocation and beach restoration scheme was implemented at a cost of $1.4 million which was jointly funded by the Queensland Government, the Noosa Shire Council and the receivers for Cambridge Credit, developers of Hays Island. The main aspects of the scheme involved:

(1) re-establishment of flow in the old northern channel by opening a new river entrance approximately 600 metres north of the existing entrance and closure of the old southern entrance;

(2) the construction of a new beach system and sand spit between Noosa Woods and the new river entrance, including its stabilisation and vegetation to prevent wind erosion damage;

(3) the construction of a rock groyne and revetment wall on the southern side of the new river entrance to retain sand on the newly developed beach and also to prevent further southward migration of the new entrance,

(4) beach nourishment of Noosa Beach seaward of the rock wall.

The scheme was completed in late 1978 and successfully gave protection to Hays Island, as well as providing a new 600-metre long beach complete with a dunal system south of the new river entrance. While Noosa Beach seaward of the rock wall was nourished as part of this scheme, it was recognised that the alignment of the whole beach system between the surf club and the new river entrance would depend on the natural action of the sea and the supply of sand around Noosa Head onto Noosa Beach. Additional sand nourishment was likely to be required for the section of beach in front of the rock wall during periods of minimal sand supply as the location of the wall was seaward of the expected equilibrium beach alignment.

2.1 Post River Entrance Relocation Beach Behaviour

Following the completion of the river relocation and beach restoration scheme, the eastern section of the nourished beach near the surf club quickly eroded. Surveys along the whole section of the beach between the surf club and the river mouth indicated that in excess of 100,000 cubic metres of sand was lost from the eastern section of the beach seaward of the rock wall in the 12 month period following completion of the river mouth relocation scheme. The surveys showed that the sand eroded from the eastern section of Noosa Beach was deposited on the beach and nearshore zone adjacent to the new river mouth; there was no observable major loss to offshore areas.

The net result was an overall change in the expected beach alignment with beach accretion near the river mouth and beach recession of the eastern section near the surf club.

This 12-month period following completion of the river mouth relocation scheme coincided with a period of below average longshore sand transport supply onto Noosa Beach from the south. The change in the expected beach alignment was considered to be due to this reduction in natural sand supply onto Noosa Beach rather than any major consequence of the river mouth relocation scheme.

While there was plenty of all-tidal beach available west of the Noosa Woods camping ground, the beach seaward of the rock wall was limited to low-tide use only. This was unacceptable to the commercial sector along Hastings Street who depended on the appeal of a useable beach to attract the thousands of tourists to the area. Consequently, the Noosa Shire Council in 1980 requested the Beach Protection Authority to undertake a study of the problem and to recommend on suitable options to rectify the situation.

3. INVESTIGATION OF THE EROSION PROBLEM

3.1 Previous Investigation

A number of previous investigations and studies of Noosa Beach had been undertaken. Among these were –

(i) The Harbours and Marine report of 1965 (Ref 2). This report examined the estuary and the beach and how the area could be reclaimed and developed and the consequences of such work on the navigability of the river bar and the erosion of Noosa Beach.

(ii) The University of Queensland study of the Noosa River and Estuary in 1975 (Ref 3). A movable bed physical model was constructed as part of this study.

(iii) The Beach Protection Authority report of 1977 (Ref 4) advised the Land Administration Commission of the causes and alternative solutions of the erosion problems which had occurred around Hays Island.

(iv) The Beach Protection Authority report of 1977 (Ref 5) commented on the chosen scheme for protecting Hays Island and creating a useable beach at Noosa.

Following the Council's request for the Beach Protection Authority to undertake another study of the erosion problem, the Authority commissioned further investigations.

3.2 Geological Investigation

The Authority commissioned the Geological Survey of Queensland to investigate sand transport patterns within and adjacent to Laguna Bay (Ref 6). This study found that surface sediments within Laguna Bay are predominantly sand with minor amounts of gravel, shell and mud. Based on texture, composition and colour, the sand could be further defined as inner nearshore sands, outer nearshore sands and inner shelf sediments. The inner shelf sediments do not appear to be involved in sand movements between the nearshore sands (inner and outer) and the beaches in the Noosa region. The nearshore sands are the dominant sediment factor influenced by local wave and current conditions. Of these sediments, the inner nearshore sands are predominantly involved in fair weather transport while both the inner and outer nearshore sands are involved in along-coast and shore-normal movement during storms and cyclones. The nearshore sands appear to move across this area without long-term accumulation. Although the inner shelf sands in some areas may be of a similar grain size to the nearshore sands, they do not provide a source of nearshore sand supply. The tidal delta at the mouth of the Noosa River is composed of former nearshore marine sands and the river does not act as a supply source for Noosa Beach.

The conclusion reached from the geological study was that nearshore sand moves around Noosa Head from the south into the nearshore zone of Laguna Bay during periods of above average wave activity with only low rates of sand movement during calmer periods. Losses of nearshore sand from the longshore transport system occur between Noosa Head and Noose Beach. Nearshore drift of sand caused by wave action is across but not around Laguna Bay during periods of fair weather, effectively removing nearshore sand from the local sand budget of Noosa Beach.

3.3 Sand Tracer Investigation

The authority also commissioned the Australian Atomic Energy Commission to undertake a nearshore sand tracer investigation at Noosa in November 1980 (Ref 7). The tracer investigation was carried out from November 10 to 21, 1980 and the wave climate during the test period was mild. Irradiated sand was placed at five sites at depths between 5 and 8 metres.

The investigation found that the ebb current from the Noosa estuary ran eastward and turned along the southern shore of Laguna Bay. A clockwise eddy can be generated by the ebb current in the southern extremity of Laguna Bay which results in a westward (upcoast) current parallel with Noosa Beach in the nearshore regions. Flood tide currents in Laguna Bay run parallel to the seabed contours and westward towards the river mouth.

The conclusion of this sand movement investigation was that sand is moved westward by ebb and flood tides and has little chance to accumulate in this current swept area. In addition, sand moved offshore from the beach by above average wave activity effectively will be dispersed and not

stored in nearshore bars where it could act as a sand source for beach accretion during non-storm conditions.

In addition to the sand study, broad patterns of current flow within Laguna Bay were measured using float poles, while nearshore sea bed currents adjacent to Noosa Headland were monitored using drogue type Woodhead drifters which follow the currents within about 0.3 metres of the bottom. The overall conclusion reached from the geological and current investigations is that the stability of Noosa Beach is dependant on the extent of fair and storm weather. During extended periods of fair weather, sand drifts across Laguna Bay from Noosa Head to Noosa North Shore and does not move into the nearshore zones of the pocket beaches in sufficient quantity to act as a feeder source for Noosa Beach. During storm periods, sand is moved off Noosa Beach and tidal currents generated by the Noosa estuary disperse this sand across the bay and prevent it being stored in nearshore sand bars. However, storm activity also has a beneficial effect by moving 'slugs' of sand around Noosa Head onto the pocket beaches and ultimately onto Noosa Beach. When the sand supply from the south (via the pocket beaches) is less than the longshore sand transport westward away from Noosa Beach, the beach recedes and realigns itself in an endeavour to balance the inwards and outwards longshore sand rate. The rock seawall along Hastings Street prevents the beach reaching its equilibrium alignment during low sand supply periods and consequently beach levels are lowered seaward of this rock wall limiting the recreational use of the beach to low tidy only.

3.4 Assessment of Longshore Sand Transport Rates

Waves are considered to be the dominant factor causing longshore sand transport at Noosa Beach, with the predominant deep-water wave direction in southeast Queensland being east to southeast. Waves from these directions are reduced in height by refraction around Noosa Headland but the less common northeast waves reach Noosa Beach virtually unaffected and are only marginally reduced in height. The Authority recorded deep-water waves at Double Island Point, 50 kilometres to the north, (for the period 1974 to 1977) and at Point Lookout, 125 kilometres to the south, (for the period 1976 to the present). Short-term wave recording also was undertaken at Noosa Nearshore (6 metres water depth, 250 metres offshore from Noosa Beach) for a six-month period in 1980/81, and 1.8 kilometres offshore from Noosa Head in 30 metres of water for a three-month period in 1980/81. In addition to these wave-recording buoys, the Authority also established coastal observation (COPE) stations at a number of sites along Noosa Beach and Noosa Headland. Volunteer observers undertook daily recordings of beach and coastal conditions which included wave heights and direction which assisted in correlating wave refraction coefficients.

Wave recording and COPE information indicated a highly variable longshore transport rate for Noosa Beach. Following completion of the river entrance relocation scheme and associated beach nourishment of Noosa Beach, annual net longshore sand transport rates of up to 160,000 cubic metres in 1979 and 93,000 cubic metres in 1980 were calculated for Noosa Beach. Sand supply rates onto Noosa Beach from around Noosa Head were assessed at about 110,000 cubic metres in 1979 and only about 40,000 cubic metres in 1980. Hence, a consistent annual deficit of at least 50,000 cubic metres of sand occurred between the sand supply onto Noosa Beach and the longshore sand transport away from Noosa Beach during the two-year period following completion of the river entrance relocation and beach nourishment scheme. The Authority advised the Council in its 1981 Noosa Beach Investigation Report (Ref 8) that further beach erosion could be expected between Noosa woods and the surf club if no further works were carried out.

4. CONSTRUCTION OF NOOSA WOODS GROYNE

The Authority's 1981 report discussed various options to overcome the erosion problem at the eastern end of Noosa Beach, which were:

(i) Regular beach nourishment between Noosa Woods and Noosa Headland at the rate of about 100,000 cubic metres per year at an estimated cost of $100,000 (1981) per nourishment.

(ii) Extension of the existing river mouth groyne by 200 metres to provide for a useable beach near the surf club. To prevent serious downdrift erosion, extension of the groyne would need to be accompanied by beach nourishment involving 1 million cubic metres of sand to fill the groyne. The estimated cost of this option was $1.5 million.

(iii) The construction of a new 160 metre long groyne at or near Noosa Woods to provide a stable alignment to the east of the groyne with a beach near the surf club. This option also needed to be accompanied by up to 300,000 cubic metres of beach nourishment east of the groyne and some dune strengthening immediately west of the groyne. The estimated cost of this option was some $650,000.

(iv) The construction of a new groyne at any location between Noosa Woods and the surf club to stabilise a nourished beach seaward of the clubhouse. Beach nourishment east of the groyne also would be needed. The cost of the groyne and beach nourishment would vary from $150,000 for a clubhouse groyne to $650,000 for the location at Noosa Woods (Option iii).

(v) Construction of a breakwater at First Point to provide a sheltered beach near the surf club in the lee of the breakwater. Unless other associated groyne works were constructed, such a breakwater would need to be 200 metres long to ensure a beach near the surf club. About 400 metres of rock wall south of Noosa Woods would remain without a useable beach, and 400,000 cubic metres of beach nourishment would be needed to fill the area in the lee of the breakwater. The estimated cost was $900,000.

In addition to the above, another option canvassed in the report was to accept the poor condition of the beach seaward of Hastings Street and relocate the main patrolled surfing area, including the surf clubhouse, to the area at or west of Noosa Woods where an excellent all-tidal beach

existed. However, this option would not be favoured by the tourist proprietors along Hastings Street who required a useable beach seaward of the expensive unit developments which are all located east of Noosa Woods.

In assessing the various options, it was clear that the rate of sand supply onto Noosa Beach from around Noosa Headland varies greatly. Before the river entrance was relocated, the river mouth moved in response to the varying rates of sand supply onto Noosa Beach. During periods of strong supply, the beach accreted and the mouth was forced to the north. When the supply was less than the longshore transport rate away from Noosa Beach, the river mouth moved southward and the "groyne" action of the entrance bar protected the beach from serious erosion by limiting the rate of output of sand to the north. As the river mouth was no longer able to move south during periods of low sand supply onto Noosa Beach, there was no chance for the formation of a natural sand bar to act as a groyne in the vicinity of Noosa Woods.

While beach nourishment seaward of the rock wall (Option i) was a viable solution to the problem, such work would be required on a regular basis to maintain a useable beach. Hence, the Authority recommended the construction of the 160 metre long groyne at Noosa Woods with associated sand nourishment of Noosa Beach to the east of the new groyne. This was expected to result in a reasonably stable beach east of the groyne requiring less maintenance and it would be less costly in the long term than regular beach nourishment. Following relocation of the river mouth, a large inactive sand reserve became available near Hays Island which was suitable for beach nourishment purposes. While the construction of a groyne at Noosa Woods had the disadvantage of dividing Noosa Beach into two distinct beaches, Noosa Beach was already effectively divided with limited useable beach seaward of the rock wall opposite Hastings Street and an all-tidal beach west of Noosa Woods. Noosa Shire Council accepted the Authority's recommendations and the construction of the Noosa Woods groyne and associated beach nourishment involving 220,000 cubic metres of sand was completed by January 1983.

5. POST GROYNE BEACH BEHAVIOUR

Following construction of the Noosa Woods groyne, the Authority monitored the condition of Noosa Beach by annual repetitive hydrographic surveys to the –10 metre contour and aerial photography. Noosa Shire Council also undertook regular beach surveys, while coastal observation (COPE) stations were established east and west of the Noosa Woods groyne. Survey profiles both pre and post groyne construction show that most sand movement in terms of accretion and erosion occurs above the –5 metre contour level, which agreed with the geological investigation results. Table 1 shows the sand volume changes at Noosa Beach following completion of the groyne.

Table 1 – Sand Volume Changes at Noosa Beach Since Noosa Woods Groune Construction

Date	Volume Changes to Beach	
	East of Groyne*	West of Groyne*
October 1982 (pre groyne) To July 1983 (post groyne)	Accretion 110,000m^3	Accretion 62,000m^3
July 1983 to July 1984	Accretion 20,000m^3	Erosion 23,000m^3
July 1984 to July 1985	Erosion 37,000m^3	Erosion 58,000m^3
July 1985 to July 1987	Erosion 13,000m^3	Surveys not undertaken
* Beach nourishment of 220,000m^3 undertaken east of groyne in January 1983.		

Between October 1982 and July 1987, there was a net gain of 80,000 cubic metres of sand east of the Noosa Woods groyne although 85 per cent of this sand accumulation occurred within 250 metres of the groyne. There was no long-term increase in beach levels seaward of the rock wall near the surf club during this period. Predominant weather conditions during this five-year period were mild which resulted in minimal sand transport around Noosa Head. Aerial photography undertaken on an annual basis showed a distinct lack of sand on any of the pocket beaches of Little Cove, Tea Tree Bay and Granite Bay during this period. Consequently, the nourished beach east of the groyne gradually eroded since the sand supply inwards was less than the longshore transport outwards. Noosa Beach realigned itself to balance the sand supply rate and this resulted in the rock wall becoming exposed again for a length of 350 metres at its eastern end by July 1987.

While the construction of the Noosa Woods groyne had successfully provided an all-tidal beach for some 250 metres east of the groyne during a prolonged period of minimal sand supply, it did not result in an all-tidal beach for the entire length of the rock wall as expected. The exposure of the rock wall caused further calls from the local community for remedial works. Consequently, the Noosa Shire Council asked the Beach Protection Authority for advice in 1987 on whether the Noosa Woods groyne should be extended. The Council's reasons for seeking the Authority's further advice were –

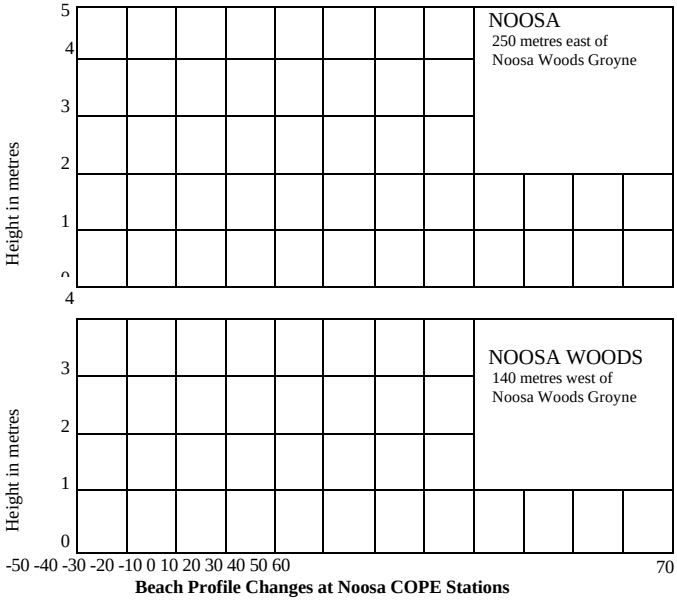
(i) the presence of an exposed rock wall and lack of useable beach seaward of the expensive unit developments along Hastings Street detracted from the overall tourist appeal of the area, and

(ii) the lack of beach allowed for wave breaking onto the rock wall causing concern about the structural adequacy of the wall and the degree of protection it afforded to esplanade property during a storm event. Wave overtopping already had occurred in 1976 during Cyclone 'David' causing flooding of esplanade property.

When the Authority assessed the possibility of extending the Noosa Woods groyne, it was noted that erosion had occurred to the beach west (downdrift) of the groyne. Most of the changes to this western beach were within 200 metres of the groyne and had happened since March 1986 when the natural sand-bypassing rate around the groyne had decreased following realignment of the eastern beach. This was cause for some concern as the entire beach system west of the groyne was man-made and consisted only of a primary frontal dune. The width of land between Hays Island and the sea was narrowest at the point of maximum erosion west of the groyne. Any cyclonic beach of this dune

could have caused major erosion of this reclaimed area and exposed Hays Island to wave attack.

The Council sought specific advice on the consequences of extending the Noosa Woods groyne by either 50 or 75 metres. The Beach Protection Authority submitted its report (Ref 9) to Council in May 1988. It was found that while both extensions would increase the length of useable beach east of the groyne under minimal sand supply rates,



Beach Profile Changes at Noosa COPE Stations

neither option would allow for an all-tidal beach for the entire length of the rock wall. At least a 100-metre extension of the groyne would be required to provide a reasonable useable beach near the surf club. Such an extension would need to be accompanied by 260,000 cubic metres of beach nourishment to fill the groyne and minimise any further downdrift erosion to the western beach. The estimated cost of such works was $1.2 million.

In lieu of groyne extension, beach nourishment of Noosa Beach east of the groyne during extended periods of fair weather was a viable and economical alternative. Beach nourishment of 100,000 cubic metres would be needed which would cost about $300,000 (1988). Bore hole tests undertaken in December 1987 of the inactive sand reserve used as the previous beach nourishment source indicated that this area still had in excess of 500,000 cubic metres of suitable sand. Regular beach nourishment also had the advantage over groyne extension of having no short or long term detrimental consequences on the beach west of the groyne. As it was pointed out to the Council, should Noosa Woods groyne be extended by 100 metres and subsequent storm/cyclonic activity erode the nourished eastern beach, tidal currents were likely to disperse this sand and it may not be held in nearshore bars to act as a supply source for the western beach . Under these circumstances, reinforcement of the dune system west of the groyne probably would be required until the eastern beach became full and sand bypassing around the groyne resumed, which could take a few years. Because of the vulnerability of this western beach and the likely need for repetitive beach nourishment even with a 100 metre groyne extension, the Authority recommended that regular sand nourishment of the beach east of the groyne be undertaken, with no groyne extension. While it was recognised that the inactive sand reserve near Hays Island would only provide a finite source of sand, there was a high probability of locating suitable offshore deposits seaward of Noosa Head which would be outside the active beach system. The Authority conducted a trial using the Port of Brisbane Authority dredger, 'Sir Thomas Hiley', which is equipped with a bow mounted pump-out which enables the dredge to jet sand 50 to 60 metres ahead of it. Sand was dredged from offshore of Noosa Head and jetted almost onto the beach at Granite Bay and Tea Tree Bay. This has potential long-term economic benefits as sand could be pumped into these feeder beaches at approximately half the cost of pumping directly into the nearshore zone of Noosa Beach where the offshore bathymetry prevents any suitable dredger being able to position itself close enough to the beach.

Noosa Shire Council accepted the Authority's recommendation and it undertook 116,000 cubic metres of beach nourishment of Noosa Beach in late 1988 at a cost of some $270,000. Storm activity in December 1988 caused some erosion to the beach towards the end of the nourishment contract, and an additional 28,000 cubic metres of sand was pumped onto the beach in January 1989 while the dredging plant was still in position. The nourished beach met with an enthusiastic response from locals and Hastings Street business proprietors and ensured a successful Christmas tourist season at Noosa.

In addition to beach nourishment, the Beach Protection Authority and the Noosa Shire Council agreed to a jointly funded monitoring program. This program, which will include measurement of waves in Laguna Bay, ocean currents at different locations in the bay, hydrographic surveys and aerial photography, will be undertaken over a three year period and will be used to assess the dynamic behaviour of Noosa Beach following beach nourishment.

Since completion of the beach nourishment, a number of storm events has caused large wave activity at Noosa Beach which has eroded the beach east of the Noosa Woods groyne and exposed a section of the rock wall. However, aerial photography captured by the Beach Protection Authority in May 1989 shows large volumes of sand in the nearshore zones between Noosa Head and Noosa Beach which should assist in some beach recovery.

6. SUMMARY

Noosa Beach is a coastal system which is constantly responding to changes in the sand supply rate around Noosa Head. Wave activity is the dominant factor in moving sand off and away from Noosa Beach. Tidal currents generated by the Noosa estuary ensure that any sand eroded off Noosa Beach during storm activity is not stored in nearshore sand bars to replenish the beach but is dispersed across Laguna Bay.

In the absence of any development on the sand spit on the southern bank of the Noosa River estuary, there was no need to interfere with the natural cycle of erosion and accretion which regularly occurred at Noosa Beach. However, development on the spit's frontal dune system ultimately resulted in the construction of a rock wall in 1968 to protect the esplanade property during an erosion cycle. This rock wall is seaward of the expected beach alignment when sand supply onto Noosa Beach is minimal

and as a result the beach seaward of the rock wall erodes, limiting its use to low tide only.

The relocation of the river mouth in 1978 was undertaken principally to protect Hays Island from undermining of revetment walls due to strong river currents as well as from possible wave attack. River mouth relocation also provided a new 600 metre long beach to the west of Noosa Woods which has always provided all-tidal recreational use and has become popular with both locals and tourists.

Relocation of the river mouth did not result in the retention of a useable beach seaward of the rock wall along Hastings Street and the Noosa Shire Council constructed a 160 metre long groyne at Noosa Woods in 1982 to provide some stability to Noosa Beach east of the groyne. While this groyne has resulted in a useable beach for some 250 metres east of the groyne, the rock wall in the vicinity of the surf club still becomes exposed during extended periods of low sand supply. During such periods, the Beach Protection Authority has recommended to the Council that it undertake beach nourishment to provide a useable beach, in preference to other works like groyne extension. Noose Shire Council accepted the Authority's recommendation and undertook beach nourishment in late 1988.

7. CONCLUSION

The erosion problem at Noosa Beach over the last twenty years unfortunately again shows that property development on frontal dunes and the maintenance of a useable beach seaward of the development are incompatible. The all-tidal amenity of the beach, which is the catalyst which attracts the tourist development, is so often sacrificed to protect the development during an erosion cycle, with a corresponding effect on the economic viability of the area through a reduction in the number of tourists. The provision of adequate dunal buffer zones which can accommodate both short term and long-term erosion events is the most practical and economical means of achieving the twin goals of tourist/property development and the maintenance of an all-tidal beach.

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