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INITIAL ADVICE
MAROOCHY RIVER ENTRANCE
BREAKTHROUGH STUDY

RTI DL RELEASE - ENP

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1 INTRODUCTION

It has been well documented that, since the 1974 flood, the main ocean entrance channel of the Maroochy River has slowly migrated southwards causing the southern river channel to move southwards and eastwards towards the caravan park and become more dominant. Recent high tides and waves breached the dune immediately south of Pincushion Island for the second time in the last year and a breakthrough at this location appears imminent. Historical aerial photography during the 1940's and 1950's show the dramatic changes which take place when a breakthrough occurs. The Maroochy Shire Council (MSC) is concerned that a break-through may occur and result in a loss of property and infrastructure as well as generating a safety issue near the caravan park.

This report outlines the present level of understanding of the processes involved and gives initial impressions and advice on likely scenarios if a breakthrough south of Pincushion occurs. Also presented is a conceptual discussion about dredging a minimal channel through the spit to the north and sediment catching devices as alternatives to reduce the velocities and erosive capacity of the southern channel. At this stage all knowledge of the processes and likely scenarios are based on the work done for previous reports. It is envisaged that further assessments of processes and impacts will be carried out as a second phase to this study.

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2 METHODOLOGY

The scope of the study as determined by the Maroochy Shire Council Working Party includes the following:

- Recent rates of change, control points for current beach and river shape, extent of exposed coffee rock and its spatial distribution in the area of interest (based on Council surveys);
- Investigation of events (natural or man-made) which might facilitate a return of the entrance to the north of Pincushion (including excavation of a minimal channel across the northern spit);
- Modification of the existing 1D model to predict the impact on water levels and flows inside the entrance if a breakthrough just south of Pincushion occurs, and extreme movement to the south;
- Comment on Palisade Piers, the Sedlar proposal and other sediment catching options and their possible benefits and impacts;
- Reporting and liaison which is common to all components.

As a result of recent high tides and storm wave conditions, a minor breakthrough occurred to the south of Pincushion. This was repaired by Council and is now holding under more moderate tide and wave conditions. In view of these recent events and to provide Council with some urgent advice for consideration, the study is to be carried out in two stages.

Initial Advice

Preliminary advice on the urgent issues are detailed in this report and are based on a recent inspection of the existing situation during high tide and wave conditions and knowledge of the local coastal processes gained through previous studies and experience.

Ongoing Study

Hydrodynamic modelling of the impacts of entrance configurations south of Pincushion will be carried out subsequently, using the model established in the previous study, as well as consideration and assessment of sediment trapping options and man-made interventions in the natural processes.

Liaison will be maintained with Council and the relevant Government Departments throughout the study and a joint meeting is proposed later part of the study to present the main findings and get feedback on any recommendations. The requirements for permits for the proposed works will also be discussed at this meeting.

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3 RECENT RATES OF CHANGE

One of the primary long-term mechanisms for ongoing changes at the Maroochy River entrance is the incessant growth of a sand spit from the north shore towards the south. All of the historical photography (1940 to present) shows this growth. The southward growth is consistent and occurs when the spit is to the north (1974) or to the south as at present. It is not possible at this stage to determine the rate of spit growth and this will vary from year to year depending on the wave climate. However there is some indication from the aerial photography that the rate of growth increases as the spit progresses southwards behind Pincushion and this could be related to shoreline alignment, wave refraction and channel depth. This irreversible trend of spit growth is due to the dominant wave processes in the area of the entrance and has two main impacts:

- a cycle of spit growth to the south and eventual breakthrough to the north is established which means that the entrance is constantly changing, however the cycling nature indicates that the overall system is in dynamic equilibrium; and
- when the spit has grown significantly to the south as at present then the southern channel is narrowed, velocities increase and the southern bank begins to erode sometimes leading to a breakthrough south of Pincushion.

Another impact of the current arrangement where the southern channel is quite close behind Pincushion is that waves are refracting around the island and are attacking the rear of the frontal dunes. This is potentially a damaging scenario as eroded sand from the dunes by this process will not stay in the local system to be returned at a later date (as happens on the beach) but is carried away by the tidal currents. Therefore, with the channel in its current location, there is no natural mechanism for the return of sand eroded from behind the dunes and hence this erosion is irreversible.

Inspection of aerial photography also shows that the northern channel near Goat Island is now almost twice as wide as it was in 1940. Depending on the relative balance of flows between the north and south channels this may mean a reduction in velocities (and hence sand transport potential) in this channel. There is some indication that nature is making changes commensurate with this theory in that a shoal is forming at the eastern end of the channel and a backwater is being created ultimately resulting in a reduction of the effective channel size.

As the channels though the entrance become longer and more braided then their hydraulic efficiency decreases. Therefore, when large flood flows occur there is a necessity for the channels to become as efficient as possible either by becoming deeper and wider, requiring a large volume of sand has to be moved out of the system, or by becoming straighter, by breakthrough to the north near Twin Waters or to the south near Pincushion.

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Therefore it is concluded that, under the present situation with the northern spit wide, stable and progressing incessantly southward and the southern spit south of Pincushion becoming narrower through erosion, a breakthrough of the dunal system south of Pincushion is inevitable and becoming more likely with time.

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4 CONTROL POINTS FOR CURRENT BEACH AND RIVER SHAPE

The regional shape of the beaches is influenced by the major control points of Alexandra Headland and the tombolo formed in the lee of Mudjimba Island and the crescent shaped shoreline which would naturally form between these points has an alignment which is landward of Pincushion. Because Pincushion Island is seaward of this general alignment, beaches connecting to Pincushion (from the south or the north) will have an alignment seaward of the regionally stable alignment. This is particularly important when a breakthrough occurs south of Pincushion, as the beach to the south will naturally recede to its regionally stable alignment which is landward of the previous location and as a result beach recession will occur. The location of the river entrance bar can similarly effect the local beach alignment.

With regard to the development which occurs adjacent to the southern bank of the Maroochy River the following points can be made:

- while the beach to the south connects with Pincushion the beach alignment is relatively stable with only the normal seasonal variations occurring;
- if a breakthrough occurs south of Pincushion the beach to the south may recede to an alignment relative to the river entrance bar and Alexandra Headland - this is most likely to be behind the Pincushion alignment and shoreline recession will occur; and
- aerial photography shows that reclamation has occurred west of the caravan park where the existing pool and park are now located indicating that the channel has eroded southwards up to or past this location in the past.

Coffee rock exists extensively in the area and is often exposed at the beach face. Also, Council surveys have defined the spatial extent of coffee rock which underlies the area to the east of the caravan park. The following comments can be made about this coffee rock:

- it is encountered at about -2 to -4m AHD;
- it may limit the depth of channel scour and affect channel velocities;
- it has not restricted channel movement in past; and
- it is too low for economic revetment foundation.

5 MINIMUM CHANNEL TO THE NORTH

Considerable attention has recently been given to the option of constructing a channel across the northern end of the spit to effectively restart the spit growth cycle. This would establish a time buffer against channel erosion to the south and possible breakthrough south of Pincushion.

A recent study was commissioned to assess the options likely to prevent a breakthrough without using 'hard' structures such as rock training walls (WBM 1997). The study was aimed at determining the optimum size, location and impacts of a constructed northern channel entrance. This report concluded that the optimum channel would be directly east of the northern channel as it flows past Goat Island, have a cross sectional area of 460 square metres and require the relocation of about 500,000 cubic metres of sand from the spit to close off the existing entrance. This option was considered to be technically feasible, provide the longest design life and produce impacts within the normal range of natural conditions.

Part of the brief for this current study is to conceptually investigate the option of constructing a much smaller channel across the northern spit and let the new entrance scour naturally to its required size thereby letting nature do much of the work. This option has advantages and disadvantages as discussed below.

Advantages:

- less cost in constructing the channel and less sand to relocate;
- if an adequate initial channel is provided and conditions are right nature will create the size and location of the entrance required; and
- able to be implemented quickly reducing the risk of a breakthrough south of Pincushion.

Disadvantages:

- initial flows may not be sufficient to keep the entrance clear or enlarge it - the southern entrance may still dominate;
- sediment transport from the north (spit growth) may continue to block the constructed entrance particularly in high wave conditions;
- ebb and flood tide deltas will be large (while the entrance is enlarging) and the surrounding currents may not be large enough to quickly redistribute this material;
- if the entrance does not enlarge sufficiently, it will be more difficult and costly to get a dredge back to complete the works in because of waves and currents;

- there is no existing mechanism to close off the existing entrance or provide a stable dune in this area;
- the southern channel may continue to erode and a breakthrough south of Pincushion may still occur.

If this option is pursued it is considered that there is a high risk that the channel will not scour or become dominant and that a breakthrough may still occur in the weakened dunal area just south of Pincushion.

There are two major equipment options in constructing the new entrance;

- dredging a channel using a floating dredge and discharging onshore; or
- constructing a channel using land based machinery such as dozers and excavators.

In both cases the natural repose angle of dry sand will need to be taken into account when determining the minimum channel size and because of dune heights land based machinery may require benching for stability and to provide access. Also, it may be more efficient for hydraulic dredging plant to relocate the material sufficiently away from the entrance channel. In particular this material could be placed south of Pincushion to reinforce the dune and provide some short term protection. For long term protection it would be necessary to close off the southern entrance and build a dune as a buffer as has been done in the past.

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6 EVENTS WHICH MAY INDUCE THE ENTRANCE TO MOVE NORTH OF PINCUSHION

Investigation of aerial photography indicates that the following mechanisms take place after a breakthrough south of Pincushion has occurred to allow the entrance to move to the north.

- breakthrough occurs and Pincushion is no longer the controlling point for the beach shape;
- shoreline rotation occurs to the northwest-southeast;
- sediment transport increases on this rotated shoreline and sand is eroded from the main north-south beach;
- the north-south beach recedes as sand is transported into the river entrance;
- the southern bank of the south channel now has a mechanism to accrete and this continues as the south channel continues to infill;
- the distribution of flows changes with the northern channel scouring and becoming dominant as the southern channel fills in;
- the northern channel is now able to breakthrough if the right combination of flow and possibly tide and waves occurs.

This process is natural and therefore may partially or fully occur at any time depending on circumstances. Duplication of the process by man is risky with the chance of failure because of unforeseen circumstances and the unpredictability of the combination of natural events such as wind, wave, tide and flood. However, it is possible to design a channel opening regime which has a high possibility of success and it is likely that the closer the man-made channel is to the natural channel then the higher will be the chance of success.

7 SEDIMENT CATCHING OPTIONS

The following initial comments can be made on Palisade Jetty System, the Sedlar proposal and other sediment catching options and their possible benefits and impacts:

- sediment catching devices (usually achieved by locally reducing velocity) must satisfy the basic law of conservation which for sediment transport means sediment accumulation in one location will result in sediment reduction in another;
- only if there is an excess of sediment in the system can sediment be accumulated in one location without detriment to another;
- it is possible to collect sediment at one location at the expense of another location which may be less important point or expendable;
- at present velocities near the southern channel bank can reach 2 metres per second producing large forces on structures located in this area and potential for scour around these structures;
- there is significant wave action as well as high currents;
- sediment catching options will not prevent the movement of the spit southwards and if they do retard erosion then the channel area will reduce and velocities get higher;
- sediment catching options will not prevent erosion of the beach which is also likely to contribute to a breakthrough during a major storm event.

8 APPROVALS

it is expected that approvals will be necessary under Section 86 of the Harbours Act which should include advice from DPI regarding fish breeding times, and a Permit to Disturb Marine Vegetation.

9 CONCLUSIONS

Under the present situation with the northern spit wide, stable and progressing incessantly southward and the southern spit south of Pincushion becoming narrower through erosion, a breakthrough of the dunal system south of Pincushion is inevitable and becoming more likely with time.

With regard to the development which occurs adjacent to the southern bank of the Maroochy River the following points can be made:

- while the beach to the south connects with Pincushion the beach alignment is relatively stable with only the normal seasonal variations occurring;
- if a breakthrough occurs south of Pincushion the beach to the south may recede to an alignment relative to the river entrance bar and Alexandra Headland - this is most likely to be behind the Pincushion alignment and shoreline recession will occur; and
- aerial photography shows that reclamation has occurred west of the caravan park where the existing pool and park are now located indicating that the channel has eroded southwards up to or past this location in the past.

Coffee rock exists extensively in the area and is often exposed at the beach face. Council surveys have defined the spatial extent of coffee rock which underlies the area to the east of the caravan park. The following comments can be made about this coffee rock:

- it is encountered at about -2 to -4m AHD;
- it may limit the depth of channel scour and affect channel velocities;
- it has not restricted channel movement in past; and
- it is too low for economic revetment foundation.

Sediment catching devices can only collect sediment at one location by taking sediment from another location. At the moment there is no excess of sediment on the southern bank of the river where erosion is occurring. Conditions at the site are severe with high currents and waves propagating in from the ocean. Significant structures which may exacerbate local velocities and cause turbulence would be required. Also, any action on the southern bank will do nothing to reduce the southward migration of the spit and this will mean continued pressure on the bank.

The cyclic process of the entrance progressing southwards and then breaking though to the north is natural and therefore may partially or fully occur at any time depending on circumstances. Simulation of the process by man is risky with the chance of failure because of unforeseen circumstances and the unpredictability of the combination of natural events such as wind, wave, tide and flood. However, it is possible to design a channel opening regime which has a high possibility of success. It is likely that the closer the man-made channel is to the natural channel in area, combined with blockage of the southern channel, then the higher will be the chance of success.

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**Shire Services****FACSIMILE**

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From: Council Chambers
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ACTION: ☐FOR INFO: ☒

TO: BPA DATE: 16.10.2000
FAX NO: 3221 0768 Attn: Paul O'Keeffe
FROM: Roger Chalmer

Paul, attached is draft documentation for the meeting on Thursday. Are there other options you would like to add or additional matters that should be included on the Options Checklist?

Would you mind doing an informal background presentation on the third dot point on Item 6 of the Agenda. I thought Nikki Moore & JP1 could be co-presenters and will approach them with the same request. Ten minutes or so + questions should do.

Regards, Roger

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Maroochy River Entrance Working Party

Thursday 19 October 2000

Time 1.00pm

Large Committee Room

AGENDA AGENDA

The desired outcome from this meeting is to identify and "workshop" the options available to increase the flow in the northern channel through the estuary and reduce the flow in the southern channel to minimise erosion along the southern shore.

1. Introduction
2. Apologies
3. Confirmation of previous minutes (meeting of 17 March 2000)
4. Report on Council Meeting of 27 June 2000
 - Report submitted to Council
 - Resolutions from meeting
5. Current status of resolution actions
 - Meeting with Hon. Rod Welford MLA
 - Design & Approvals for Entrance Relocation
 - Protection of existing river banks
6. Promote Flow in Northern Channel (Workshop Forum)
 - Historical background
 - Engineering background and constraints
 - Environmental background and constraints
 - Identify and list options
 - Discuss each option in turn and complete options checklist.
 - Rank options in order of preference.
7. Recommendations
8. Next meeting

- cost/benefit study
- subsidy guidelines

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MAROOCHY RIVER ENTRANCE

Options for Promoting Flow in the Northern Channel

(for presentation and discussion)

1. Dredge a northern channel past Channel Island
2. Re-open a channel between Goat and Channel Islands
3. Williams Sedlar's proposal for sediment trapping
4. Submerged sausage groyne in southern channel
5. Diversion sausage groyne at Picnic Point
6. Dredge shoals west of Goat Island

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MAROOCHY RIVER ENTRANCE

Promoting Flow in the Northern Channel

Options Checklist

Option No.

Details:

Discussion & Comment:-

Engineering Behaviour

- Hydrological/Flooding
- Coastal/tidal influences
- Cyclonic conditions
- Safety issues
- Stability of location
- Construction method
- Ongoing maintenance

Environmental Considerations

- Dredging operations
- Fish habitat
- Marine plants
- Water quality
- Shoreline issues

Recreational Considerations

- Boating
- Swimming
- Shoreline issues

• Fishing

Governmental Approvals

- EPA
- BPA
- DPI

Estimated Costs

- Construction cost
- Maintenance costs

SUMMARY:-

- Advantages
- Limitations



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see p. 50
for minutes

Thank

sch4p4(6) Personal information

ROGER
SPECIAL PROJECTS ENGINEER

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Maroochy River Mouth - Recommended Options File No: 1-9357

Moved Cr Taylor seconded Cr Cansdell that Council:

1. Receive the Minutes of the Maroochy River Entrance Working Party dated 17 March 2000.
2. Arrange a meeting with the Hon Rod Welford, MLA, Minister for Environment and Heritage and Minister for Natural Resources and representatives of Department of Primary Industries (DPI), Environmental Protection Agency (EPA) and the Beach Protection Agency (BPA), to discuss:
 - the options available to Council, including a "less intrusive" channel through the northern spit;
 - the approval processes;
 - a commitment for funding assistance;
 - a possible increase in the normal level of funding assistance.
3. Adopt the entrance relocation option
4. Engage consultants to prepare a detailed design of the selected option and obtain all the government approvals required to permit construction to proceed

Cr. Cansdell called for a Division on the motion by Cr. Taylor which was put to the vote.

Those for the Motion - Crs. Tatton, Middlebrook, Dunne, Thompson, Dickson, Cansdell and Taylor

Those against the Motion - Crs. Rowan, Schwabe and Johnston

THE MOTION WAS CARRIED.

Possible Protection Measures to Maintain Existing River Bank Alignment in the Area of the Pincushion Caravan Park

Moved Cr Thompson seconded Cr Dickson that as a matter of urgency Council approach the appropriate authorities to investigate possible protection measures to maintain the existing river bank alignment in the area of the Pincushion Caravan Park

Carried.

Investigation of Options to Maximise Flow in the Northern Channel of the Maroochy River

Moved Cr Middlebrook seconded Cr Schwabe that the Chief Executive Officer investigate options to increase the flow in the northern channel and reduce the flow in the southern channel to minimise erosion

Cr Tatton left the meeting

Carried.

ENVIRONMENTAL PROTECTION AGENCY
DEPUTATION BRIEFING NOTE

TO THE HONOURABLE THE MINISTER
SUBJECT MAROOCHY RIVER ENTRANCE

E/00/04300

ot Approved

[Signature]
8.11.02

RECOMMENDATION

It is recommended that the Minister **note** the information provided for the meeting with the representatives from the Maroochy Shire Council Working Party regarding the erosion problems associated with the movement of the Maroochy River entrance.

Minister's comments

- Government agencies to assist Council develop feasible alternative at least cost to environment & budget to ensure protection of caravan park.*
- As discussed. Letter from to Council confirming our willingness to assist.*

BACKGROUND

The Maroochy Shire Council, with the assistance and advice of the Environmental Protection Agency (EPA), and Department of Primary Industry (DPI) officers, have been investigating the options to contain the erosion on the southern bank of the Maroochy River entrance and estuary for a number of years.

The options considered are:

- Determine a last line of defence and construct a seawall to protect existing infrastructure and development. The most seaward line of defence would be the seaward boundary of the Pincushion Caravan Park.
- Construction of a series of groynes at the southern entrance to the river. This option was model tested at the Queensland Government Hydraulics Laboratory.
- Relocate the entrance of the river to the north by dredging through the northern spit, blocking off the existing entrance, and dredging a number of channels in the estuary to ensure tidal flushing.

The Maroochy Shire Council at its meeting on 27 June 2000 resolved to adopt the entrance relocation option (3) to solve the erosion problems at the southern entrance of the Maroochy River and engage consultants to prepare a detailed design of the selected option and obtain all government approvals required to permit construction to proceed.

In November 1998, following on from a previous investigation, the Council made application under section 86 of the *Harbours Act 1955* to relocate the Maroochy River entrance to the north of the existing entrance. The Council was advised that further detailed information was required before the application could be processed. At the same time, the Council applied for an environmental authority to undertake the dredging under the *Environmental Protection Act 1994*. The application was deemed invalid as insufficient information was provided to enable

Approved: Olwyn Crimp
Director Environmental Planning

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Date: 3 November 2000

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File No: 802630/STH684

maroochy river bne2000-7548.doc

the application to be decided. To date, no additional information has been received to allow the processing of the section 86 application, and no dredging application has been received.

KEY ISSUES

- The Maroochy River entrance is a natural river entrance and over the last several decades the entrance channel has moved from a northern location to south of Pincushion Island. The current location of the entrance channel is still within the historical limits of entrance movement.
- Further southerly movement of the channel and subsequent realignment of Maroochy beach has the potential to threaten the Maroochy Surf Life Saving Clubhouse and the established Pincushion and Cotton Tree Caravan Parks (as opposed to the relatively undeveloped adjacent camping area of which less than 50% of the original area established in 1985 remains).
- The majority of the Maroochy River estuary is in a declared Fish Habitat Area (FHA) and DPI has advised that the FHA would need to be revoked before works associated with the relocation of the mouth could be approved. The FHA is an important tool for maintaining the estuary as a viable aquatic ecosystem.
- It is considered that the proposed channel relocation will not have any adverse effects on coastal processes for this section of the coast. The relocation of the river mouth by dredging a new channel through the northern spit and closing off the existing southern channel is a replication of the natural processes and avoids the need for hard engineering works such as rock walls and groynes. Nevertheless, from a coastal processes viewpoint, the model tested option of a series of groynes at the southern entrance of the river would be an acceptable alternative.
- However, the dredging works required for relocation of the river mouth have the potential to have significant impact on the environment of the Maroochy River estuary. Existing information indicates that dredging in the estuary would compromise the management of water quality and could threaten the ability of the estuary to continue as a viable aquatic ecosystem. This aspect of the proposal needs further detailed investigation to quantify the impacts and determine acceptable means of mitigating the detrimental impacts.
- Since 1996, the local conservation community have expressed strong opposition to the proposal to "interfere" with the natural processes of the Maroochy River estuary by dredging. In particular, the Sunshine Coast Environment Council can be expected to strongly oppose revocation of the FHA to allow dredging of the estuary.
- Given the relatively high cost of the dredging option, a cost/benefit analysis of the project would appear to be warranted and would be beneficial in determining the ecological sustainability of the proposal. The need for such an analysis has been discussed informally with Maroochy Shire Council officers.
- The Maroochy Shire Council have approached the State government for assistance with funding for this project on several occasions and to date have been advised that the only avenue to obtain State funding would be through the Local Governing Bodies' Annual Capital Works Program administered by the Department of Communication, Information, Local Government, Planning and Sport (DCILGPS). A 25% subsidy is available to Council for approved works and the Beach Protection Authority provides a recommendation to DCILGPS with respect to whether the works satisfy the guidelines.

Briefing Officer: Paul O'Keeffe
Senior Principal Engineer

Approved: Olwyn Crimp
Director Environmental Planning

Telephone: 07-3227 8496
Correspondence No: BNE2000/7548
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Date: 3 November 2000
File No: 802630/STH684

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Date Prepared:	30 November 2000	Prepared by:	Paul O'Keeffe
Approved by:	Olwyn Crimp	Title:	Senior Principal Engineer
Position:	Director, Environmental Planning	Division/Region:	Environmental Planning EPA
Date Approved:	4 December 2000	Telephone:	3227 8496
		Track No:	M/00/01771, E/00/04300

Ref: BNE1791-1
BNE2000/7548

Mr N Cooney
Manager Business Services
Maroochy Shire Council
PO Box 76
NAMBOUR QLD 4560

Dear Mr Cooney

Thank you for the opportunity to meet with representatives of the Maroochy Shire Council's Working Party examining the erosion problems at the Maroochy River entrance, on 8 November 2000.

At the meeting, various options designed to alleviate the erosion threat to the southern shoreline were discussed. During the meeting, I undertook to ensure that the Council would be provided with advice regarding the measures that would be likely to receive approval from Government, the information requirements for approval and the timeframe.

The Government recognises that the problems facing the Council, as a result of the movements of the Maroochy River mouth, are significant. In recognition of the magnitude of the problem and the environmental importance of the Maroochy River entrance, the Environmental Protection Agency (EPA) will continue to assist the Council to develop a feasible solution for the protection of the caravan park within the parameters of least cost to the environment and a realistic budget.

By way of confirmation of our discussions, I am not unsympathetic to the option of dredging a new entrance through the northern spit and closing off the existing entrance, but only as a last resort. Given that the dredging option requires the disturbance of the Fish Habitat Area, it is the least favourable option and should only be pursued after all other options are proven ineffective. Officers from the EPA will provide further advice with respect to options that could be approved and pursued in the short to medium term.

The Council's responsibility to protect public assets is recognised but actions to achieve this need to be designed to have as little intervention with the environment as possible. With respect to cost, the Council needs to examine the cost/benefits of any proposal to ensure that it is economically and ecologically justified.

Thank you for bringing this matter to my attention and I trust this information is of assistance. Should you have any further inquiries, please contact Mr Paul O'Keeffe of the Environmental Protection Agency on telephone 3227 8496.

Yours sincerely

ROD WELFORD MP

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Trevor Carter, Beach Protection Agency
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11/12/13

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- 3.2 He also reported that, as requested by Council, a meeting was being sought with the Hon Rod Welford, MLA, Minister for Environment and Heritage and Minister for Natural Resources, but as yet no date had been allocated.
- 3.3 Malcolm Andrews of WBM Oceanics stated that the motion for consultants to prepare a detailed design of the selected option and obtain all the government approvals required for construction could be actioned once options were agreed. Roger Chalmers said that the design would then be shown to the Minister and WBM Oceanics would prepare budget cost estimates and a construction schedule. He said that timing of the work would be important so that dredgings were not washed out to sea or into the estuary.
- 3.4 Another motion carried by Council was for the investigation of possible protection measures to maintain the existing river bank alignment in the area of Pincushion Caravan Park. Roger Chalmers reported that he and Nikki Moore had met with Councillors to inspect the area and a list had been prepared of possible measures. Council was also developing a masterplan for the management of the Cotton Tree and Esplanade area and it was hoped that protective measures might be included in that.

4. BACKGROUND & HISTORICAL SUMMARY

- 4.1 It was emphasised that the focus of the current meeting was to look at options to promote flow within the northern channel. To assist delegates, Roger Chalmers provided a Powerpoint presentation with historical and recent photographs of the river mouth. This was to explain the impact of climatic, flood and other conditions, the way the river mouth behaves, etc, so that options could be considered which would be effective over a longer term.
- 4.2 Councillor Schwabe asked whether a watch was being kept on changes in the northern spit and Roger confirmed this. Photographs were shown as recently as the previous week. Mark West advised that it was now possible to walk from the northern spit to Pincushion at low tide.

5. GENERAL DISCUSSION

- 5.1 A composite shot was shown to illustrate a plan by WBM for opening the north channel and dredging in the south to keep Cornmeal Creek refreshed.
- 5.2 Malcolm Andrews said it would not take much sand to block off the southern entrance but the proposed northern exit was quite wide and had a lot more material than would be required for the work in the south.

Minutes – Maroochy River Entrance Working Party

- 5.3 John Jolly referred to the 1985 and 1992 floods and said his concern was that one should know the depth of the coffee rock before putting a northern channel through. In the event of a flood, the channel could widen dramatically or, if this was not possible, it could erode the built area. He recommended a flood study with associated studies on sedimentation and scouring.
- 5.4 John also said that, if it was intended to make the northern channel the major egress, significant dredging would be required further west to force the river to use the northern exit and to slow the flow to the south and that it would be necessary to get that system up quickly. Malcolm agreed, saying it was necessary to give the river "a big push in the direction you want it to go".
- 5.5 Kerry Taylor queried the position of the suggested northern passage. Malcolm stated that the further north, the better, as the river would come south again in time and fixing the most northerly passage might buy a year or two. He confirmed that once an entrance was established, dredging would have to continue or Council would have to accept the work as having an approximate 25-year lifespan.
- 5.6 Jim Cash said that the meeting was hearing a lot about dredging but nothing about river ecology and this was not a single issue situation. He said there were considerations re the effects of dredging on the river and the flow-on effects on recreation activities.
- 5.7 Trevor Carter said he had concerns about dredging. He could not see the point of dredging the northern channel by itself unless a new entrance was made through the spit. Dredging alone would only exacerbate the effect on Pincushion as water flow headed straight towards the Pincushion/Cotton Tree area. If the only action was the increase of the flow in the northern channel, the situation could be made worse, not better. Roger advised that dredging was never thought of in isolation but always in conjunction with a break through the spit. Malcolm Andrews added that in his opinion the channel through the northern spit alone, without dredging to the west, would be sufficient to alter the course of the river with only a small degree of risk to entrance closure.
- 5.8 Trevor said he wondered whether cutting through in the north would be sufficient without additional dredging as this was a much shorter path for the river. He assumed studies using the model could assist in judging this. There were a lot of hurdles to go through to get State Government approvals and cost/benefit analyses would be required. He said Council should be looking at how long would it last and should weigh up the benefits of protection as was done before the groynes were constructed and the BPA would encourage Council to do that.
- 5.9 Nikki Moore said they would require cost/benefit analysis of dredging. Council would have to apply for a dredging licence. The EPA would require considerable ecological information and she recommended cost/benefit studies as the first stage.

- 5.10 Ross Quinn said Council should look at the implications of any new system in terms of access and safety.
- 5.11 Ross also distributed copies of studies of fisheries within the Maroochy River system. There were important areas for juvenile feeding and nursery areas. Boundaries of fish habitat areas were indicated. He pointed out that the only areas excluded from fish habitat were the marked navigation channels and therefore Council would need approvals from Fisheries to do the kind of work that was being proposed. The impact on the environment would be quite significant and fish habitat areas would have to be revoked. He said that in general his Department did not support revocation of fish habitat areas; very good reasons would be required and studies would have to be undertaken including comment from commercial and recreational fishers. The northern area was extremely important to juvenile fish and to the spawning of a number of commercial fish species, as were all estuarine areas.
- 5.12 In answer to questions, Ross described wetland reserve areas - B areas and fish habitat reserves - A areas. The Maroochy River mouth was an A area. Revocation of fish habitat areas had occurred twice in B areas and once in an A area although the latter case did not involve work directly in the A area. He said the new mouth of the River in the south was not a fish habitat area.

6. PROTECTION OF PINCUSHION CARAVAN PARK

- 6.1 Mark West and Gary Ehsman reported on their concerns for immediate action to protect the Park with king tides expected in November, December and January. A January 11 tide of 2.73 metres was expected and this was the Park's busiest time of year. Mark asked what Council would do when the tides came and for the permanent residents who were mostly older people. Gary said the Park was an important part of the tourism industry for the Sunshine Coast and if word gets around about problems at the Park, the whole economy can be affected.
- 6.2 Roger said there was a contingency plan for a cyclonic event but that a plan was needed for the immediate problem. It was agreed that he would get a group of the relevant people together, including a BPA representative, to walk through the Park and develop a plan. Councillor Taylor said this could be a major publicity and public relations issue for Council and the Coast if action was not taken. Councillor Schwabe pointed out that Council had already made a decision that the Park was a sacrificial area. However, Mark referred to Council's June motion to investigate possible protection measures to maintain existing river bank alignment in the area of the Park and Gary stated that action was needed before the end of November.

7. OPTIONS FOR PROMOTING FLOW IN THE NORTHERN CHANNEL

7.1 Six options were listed for discussion:

- (a) Dredge a northern channel past Channel Island
- (b) Re-open a channel between Goat and Channel Islands
- (c) Williams Sedlar's proposal for sediment trapping
- (d) Submerged sausage groyne in southern channel
- (e) Diversion sausage groyne at Picnic Point
- (f) Dredge shoals west of Goat Island

7.2 Option (a):

Ross stated that the marked navigation channel finished some way before the spit so it was unlikely it would be available as a suitable dredging area. Nikki said the area was a wildlife conservation park and also contained threatened species. She further said that a dredging licence would be required and that her agency would be looking at the effects on water quality and aquatic eco systems, and the likelihood of acid sulphate/chemicals/organochlorides in sediments being released by dredging. Trevor said the option would require approval under the Beach Protection Act and Harbour Protection Act. His agency would liaise closely with the DPI re fish habitat and whether dredging was a one-off or ongoing and its effect on water quality. Malcolm said it was possible that 400,000-500,000 m³. of material would be required to be moved in opening up the spit. Construction cost was estimated at \$1.5 million to \$2 million including licences, with maintenance costs of \$100,00-\$200,000 p.a.

7.3 Option (b)

The meeting felt that, in view of the fact that the channel had been closed for at least 20 years, Option (b) did not merit further consideration.

7.4 Option (c)

The option was presented by Kerry and Bard, having been suggested to them by retired river hydrologist William Sedlar. It was suggested as an alternative and possibly speedier solution to dredging options which might take years for approvals to come through and would be far more costly. The basis of the idea was the construction of a stone ramp below the water stretching out from Pincushion. A length of 10 - 20 metres would be sufficient for a trial. The difference between high and low tide levels would be filled with trees, tyres etc which would gradually trap sediment. The width would be a minimum of 4 metres to permit access for trucks with dumping material. Bard suggested that the ramp would have no effect on fish habitat.

7.5 Councillor Schwabe said the concept was logical but required careful consideration of position, dimensions and angle. He also stated a concern re the lack of protection for the structure from the ocean. Roger said it might be possible for WBM to appraise using a desktop study. Trevor voiced concerns that the proposal would still not prevent

erosion of the coast towards the caravan park. Jim said he could see no major problems with the option from an environmental point of view provided it was investigated properly.

- 7.6 Bard put forward a figure of \$40,000 as a guesstimate for a ramp 40 metres x 4 metres wide x 2-3 metres in height.
- 7.7 Option (d)
Roger presented the option of a submerged groyne from the end of Wharf Street about 1 metre in height to begin with, additional material being added or subtracted to achieve the right level. John said this was an option that could be examined on the model.
- 7.8 Discussion focussed on the existing percentage of flow which Malcolm said the model showed as 80 per cent north. Kerry said a more likely percentage was now 60/40 in favour of the north. Trevor suggested measurements of current flow be carried out.
- 7.9 Option (e)
There was limited discussion of Option (e) but it was felt unlikely to achieve the objectives.
- 7.10 Option (f)
Option (f) was ruled out without discussion.

8. RECOMMENDATIONS

- 8.1 Councillor Schwabe asked whether the Working Party had given up on the option in the model, i.e the southern groynes. He felt it was the only solution which delivered security and beaches. Councillor Taylor pointed out that Council had not approved this option at its June meeting.
- 8.2 The recommendation of the Working Party was to:
 - (a) request the consultants be asked to verify the flow dominance of both channels.
 - (b) request the consultants to undertake a desktop study of Option (c) and provide costings.

The meeting closed at 5.00 pm.

Maroochy
Shire Council



A.B.N. 60 983 072 606

Your reference:
Our reference:
Enquiries:
Direct Telephone:
Direct Fax No:

Office of the Minister
Environment and Heritage and
Minister for Natural Resources

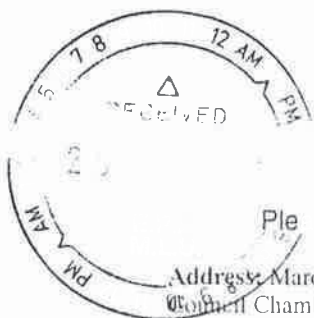
Date Rec'd. 24 NOV 2000

No. E/06/04620

To: DE-ENR Response

BNE2000/19208

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JOHN WARM
GENERAL MANAGER, SHIRE

ON

[REDACTED]
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Original version signed
by T. Cantor A/SPE 15/12/00.

sch4p4(6) Personal information
20/12/00.

Dear Mr Warmington

folw 81
Thank you for your letter of 20 November 2000 concerning the Maroochy River mouth and for the opportunity to meet with representatives of the Maroochy Shire Council's Working Party examining the erosion problems at the Maroochy River entrance, on 8 November 2000.

RTI DL RELEASE - EHP

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structural elements. It should be noted that because the recent sand bagging undertaken as an emergency measure is well seaward of the caravan park boundary, it should not be considered as part of any permanent wall construction. Upon receipt of suitable plans, an application could be processed within two months.

Option 2 would be likely to be approved by the Agency. It may also be possible to construct this option in stages. Council's consultants who were involved with model testing of the original concept should be in a position to advise on the possibility of stage construction. Similarly, there are choices with respect to the construction materials and other design details. Approval could be facilitated within two months of receipt of a suitable application.

Substantial additional work would need to be done before option 3 could be approved. An environmental dredging licence would need to be obtained and part of the Maroochy River Fish Habitat Area would need to be revoked. I understand that your Council has been provided with details of the information required by the relevant agencies to consider these issues. While I am not unsympathetic to the option of dredging a new entrance through the northern spit and closing off the existing entrance, such action should only be considered as a last resort. Given that this option requires disturbance of the Fish Habitat Area, it is the least favourable and should only be pursued after all other options are proven ineffective.

A number of other options involving structures in the river estuary have also been discussed but have been discarded on technical grounds or lack of definitive data. There would be further options that could be considered in the future but before they can be considered seriously, they would need to be properly investigated. At the present time, subject to design details being determined, there is sufficient information about the first two options to consider them for approval.

Your reference to the management of rivers being a State Government matter is noted. However, the responsibility for undertaking any works in this regard lies with the relevant Local Government. The role of the State Government is to provide advice and act as an approving authority to ensure that any works that are undertaken do not cause environmental harm.

Regarding the matter of increased rates of subsidy for beach protection works, I advise that officers of the Agency have held discussions with officers of the Department of Communication and Information, Local Government and Planning and Sport. I support an increase in the level of subsidy and have advised the Honourable Terry Mackenroth MP, Minister for Communication and Information, Local Government and Planning and Minister for Sport, accordingly.

Thank you for bringing this matter to my attention and I trust this information is of assistance. Should you have any further inquiries, please contact Mr Paul O'Keeffe of the Environmental Protection Agency on telephone 3227 8496.

Yours sincerely

ROD WELFORD MP

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Enquiries Paul O'Keeffe
Telephone 3227 8496
Your reference
Our reference BNE1791

20 December 2000

Chief Executive Officer
Maroochy Shire Council
PO Box 76
NAMBOUR Q 4560
Attention: Mr Roger Chalmers

Dear Sir

I refer to the matter of the erosion problems at the Maroochy River entrance and the various proposals put forward to alleviate the problems caused by the erosion.

As you would be aware the Maroochy River mouth has been moving in a southerly direction for some time. It has now reached a point where the entrance has re-established itself on the southerly side of Pincushion Island and further movement is posing a threat to the development on the southern shoreline. As a result of this threat, your Council, in consultation with this Agency, the Department of Primary Industries, and various community groups, has put forward a number of options to alleviate the erosion problem.

The principal options that have been under consideration recently are:

1. Determine a last line of defence and construct a seawall to protect existing infrastructure and development. The most seaward line of defence would be the seaward boundary of the Pincushion Caravan Park.
2. Construction of a series of groynes at the southern entrance to the river. This option was model tested at the Queensland Government Hydraulics Laboratory.
3. Relocate the entrance of the river to the north by dredging through the northern spit, blocking off the existing entrance, and dredging a number of channels in the estuary to ensure tidal flushing.

With regard to option 1, the Agency would be likely to grant the necessary approvals. The wall could be constructed in stages with the first stage comprising protection of the caravan park and a second stage providing protection for the car park to the south. Such a wall could be designed as a rock revetment or with sandbags as the main structural elements. It should be noted that because the recent sand bagging undertaken as an emergency measure is well seaward of the caravan park boundary, it should not

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be considered as part of any permanent wall construction. Upon receipt of suitable plans, an application could be processed within two months.

Option 2 would be likely to be approved by the Agency. It may be possible to construct this option in stages. Council's consultants who were involved with the model testing of the original concept should be in a position to advise on the possibility of stage construction. Similarly, there are choices with respect to the construction materials and other design details. While this option has been designed primarily to provide protection to the caravan park at the southern entrance to the river, it could also provide a fixed control point for the northern end of Maroochy Beach. Before the river broke through south of Pincushion Island, the control point for the beach was provided by the island. Since the break-through, the beach has undergone realignment in response to the new conditions and erosion of the northern end of Maroochy Beach has resulted. While not reinstating the beach to its previous condition, a new fixed structure such as the groynes in option 2 could provide much needed stability to the alignment of Maroochy Beach. This would then allow other future measures to improve the beach, such as beach nourishment, to have a greater chance of success in the long term. Approval of a project for which the model test results can be applied, could be facilitated within two months of receipt of a suitable application.

Substantial additional work would need to be done before option 3 could be approved. An environmental dredging licence would need to be obtained and part of the Maroochy River Fish Habitat Area would need to be revoked. I understand that your Council has been provided with details of the information required by the relevant agencies to consider these issues. In view of the number of problematic issues that would need to be investigated and addressed, dredging a new entrance through the northern spit and closing off the existing entrance should only be considered as a last resort. Given that this option requires disturbance of the Fish Habitat Area, it is the least favourable and should only be pursued after all other options are proven ineffective.

A number of other options involving structures in the river estuary have also been discussed but have been discarded on technical grounds or lack of definitive data. There may be further options that could be considered in the future but before they can be considered seriously, they would need to be properly investigated. At the present time, subject to design details being determined, there is sufficient information about the first two options to consider them for approval.

Officers of this Agency will continue to assist Council where possible, in its efforts to overcome the river mouth problems.

Yours sincerely

sch4p4(6) Personal information

Paul O'Keeffe

A/Manager Coasts Wetlands and Waterways

*Original faxed to Roger Chalmers
12 45 pm 21/12/00*

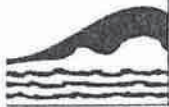
*PO'Keeffe
21/12/00*

File Note: This letter generated as a result of the Council deputation to the Minister on 8/11/00. Refer folio 79A.

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20/12/00

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REPORT

from: Team Leader, Special Projects

(65)

29 NOVEMBER 1999

MAROOCHY RIVER MOUTH

File No: 1-9357

INTRODUCTION

1. This report provides a brief history of the Maroochy River Mouth in recent times, and will discuss the various studies and construction works which have been undertaken during this period to identify, mitigate and control erosion problems in the estuary. It also provides details of the current model study (November 1999) being conducted by WBM Oceanics on behalf of Council, to identify and test possible means by which to protect the Caravan Park and other infrastructure at Cotton Tree on the southern shores of the estuary.
2. A locality plan which identifies specific features in the area is attached to the rear of this report.

BACKGROUND

3. The lower reaches of the Maroochy River are a complex and highly dynamic system of channels, islands, intertidal shoals and coastal bars. The entrance is currently dominated by a large sandpit, which extends southwards from the north shore, and by a rocky outcrop known as Pincushion Island.
4. Within the estuary, Goat and Channel Islands divide the river into two main channels; the north and south channels. Prior to the early 1980's a natural channel between these two islands provided a third flow path at high tide. The deposition of sand subsequently closed this channel and the area is currently covered in vegetation.
5. The river mouth is subject to change under the influences of the prevailing coastal and tidal processes, and by cyclonic and flood conditions. Historical records suggest the main channel to the ocean undergoes a cyclic process where it drifts south from its most northerly location adjacent to Twin Waters to a position south of Pincushion Island, before breaking through in the north again. The natural migrations of the entrance which are inherent in such a dynamic estuarine system have dominated the history of the lower estuary. These migrations can be illustrated by a brief history of the entrance configuration between 1940 and 1998:

1940 & 1958: Main entrance south of Pincushion Island

1961 to 1979: Main entrance north of Pincushion Island, near the north shore

1982 to 1996: Main entrance to the north of Pincushion Island but moving progressively south as the sand spit extended south from the north shore.

1998: Main entrance immediately north of Pincushion Island. The river broke through south of Pincushion briefly on three occasions early in 1998 and indications at that time were that it was about to do so on a more permanent basis.

6. The events in 1998 sharpened a growing concern within Council and the Community about the threat of erosion on the southern shore and Maroochydore Beach. This is well illustrated by the following record:-

"At a public meeting (organised by Council) on 26 February 1997 it was stated that the last time the entrance was south of Pincushion Island, in the mid 1950's, the river flowed along the beach causing a loss of sand and a need to provide sandbag protection to the surf club building."

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7. The records indicate the main channel to the sea had been located north of Pincushion Island for some decades prior to December 1998, and the island formed part of the southern shore. However, with storm activity during the early months of 1999, the channel broke through south of the island taking a substantial portion of the southern foreshore and camping ground with it. At the time of writing this report the channel remains south of the island and is in excess of 250m wide.
8. The Maroochy River is not subject to any significant flow control works such as breakwaters or revetment walls and, as such, is considered to be one of the few remaining 'natural' river entrances on the East Coast of Australia.
9. A mix of urban development and open space occurs adjacent to the southern bank of the river. This includes residential and commercial development upstream between Picnic Point and the mouth of Cornmeal Creek, a caravan park and camping ground in the Cotton Tree/Pincushion area, an area of park between Cornmeal Creek and the Cotton Tree Caravan Park, and public beach areas near Pincushion Island and on Maroochydhore Beach.

The northern shore of the river adjoins public open space, and the Twin Waters Resort.

Over the years the river mouth and estuary have become increasingly popular for leisure activities including swimming, camping, surfing, fishing and boating. Further, with the development of infrastructure along the southern margin of the river mouth, it is now one of the key elements of the Sunshine Coast's tourist industry.

STUDIES AND CONSTRUCTION WORKS 1980-1996

10. An outdoor model of the Maroochy River flood plain was constructed for Maroochy Shire Council by the Queensland Government Hydraulics Laboratory early in the 1980's. This was used to determine flow criteria and estimate flood levels in the river system at that time.
11. Erosion of the southern shoreline adjacent to the Caravan Park and boatshed occurred during the late 1980's and early 1990's, particularly during the floods in February and March 1992. Council undertook channel dredging and foreshore replenishment at various times during this period.
12. In July 1992, Council and the Beach Protection Authority (BPA) agreed to jointly undertake an investigation into what engineering work would be required to halt this erosion. Council undertook the survey work including stream flow velocity measurements, while the BPA provided instrumentation and one officer to assist. In order to avoid any possible delays in constructing what work the investigation might recommend, Council lodged a preliminary application with the Department of Environment and Heritage (Marine Board of Queensland) for approval to construct rock protection in the area.
13. In December 1992, the BPA proposed a physical model be constructed by the Queensland Government Hydraulics Laboratory in order to test the use of river groynes to mitigate the erosion problem. Council accepted the proposal and agreed to share in its funding. To determine appropriate boundary conditions, the existing model of the Maroochy River flood plain was modified in accordance with the more recent survey information, and run with 50 year and 100 year ARI flood events.

The BPA then constructed and tested the second model, using data from the first, and released their Interim Report in December 1993. Council agreed with the recommendations contained in the report and in February 1994 applied to the Marine Board of Queensland for approval to construct a river groyne system. Approval was promptly given and during March and April tenders were invited by Council for the construction of two groynes, revetment mattress protection and the dredging of sand from the channel.

The works were constructed during mid-1994 at a total cost of \$290,000 as detailed below:

Design, survey and contract administration by Council	\$21,000
Supply and installation of groynes and revetment works	\$70,000
Dredging Works	\$195,000
Supply and installation of beacons on groynes	\$4,000
	<u>\$290,000</u>

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14. Further erosion continued along the southern shore during 1995 and 1996.

During 1995 discussions were held between Council, the BPA and the Department of Primary Industries (DPI) as to whether a third groyne should be installed to the east of the first two, and whether other options should be explored. These options included the re-opening of the channel between Goat and Channel Islands, and the excavation of a new channel to the sea at the north end of the northern spit.

The situation prompted considerable community interest and concern from both individuals and bodies such as the Maroochydore Surf Lifesaving Club. Early in 1996, it became evident that should the erosion continue, Pincushion Island might well be isolated from the southern shore and become an island once again.

15. Discussions and negotiations as to appropriate solutions continued between Council and various Government Departments and by the end of 1996, Council was being urged by the community to undertake something positive to address the situation. A significant milestone was reached in January 1997 when the following occurred:

- (a) Council received a letter from the Minister for the Environment which set out the DPI and BPA criteria to be addressed in any detailed study of the situation.
- (b) Council received a letter from the Department of Environment supporting the relocation of the river mouth to the north, and endorsing the need for a technical study.
- (c) Council resolved to engage a consultant to consider the re-establishment of a northern channel.
- (d) Discussions were held with a firm of coastal engineering consultants, WBM Oceanics, regarding the terms of reference for such a study. On 29 January 1997 WBM submitted a detailed proposal and offered to undertake the study for a maximum fee of \$50,000.
- (e) WBM were engaged for the Relocation Study on 3 February 1997.

RELOCATION STUDY - 1997

16. The aim of the study was to determine the most appropriate configuration for a new northern entrance to the Maroochy River and to assess potential impacts associated with this entrance change. Consideration was to be given to the need for associated closure or alteration of existing channels in the area as part of these works to minimise impacts and/or improve their effectiveness. The scope of the study was not to assess and recommend the most appropriate option for dealing with the erosion problem at Cotton Tree, but to assess the specific option of re-establishing a northern entrance channel.

The study included a process of community consultation and addressed the following considerations:

- (a) coastal and river hydraulic processes;
 - (b) water quality and flushing of the lower estuary; and
 - (c) the natural values of the lower estuary, particularly related to fisheries
17. Community consultation was undertaken via a public meeting on 26 February 1997 and by correspondence with various individuals who provided historical details about the river mouth and offered suggestions as to possible solutions.
18. WBM lodged their report with Council on 4 June 1997. It concluded that "relocating the entrance channel of the Maroochy River to the north is within the range of natural (historical) migrations." The total value of this consultancy was \$68,000.

A Council meeting on 16 July 1997 received the report from WBM and resolved to invite relevant Government Departments to discuss its recommendations.

19. Council and the Department of Environment heard a presentation of the study by WBM on 19 August 1997 and resolved that a Working Group should be formed with a brief to consider the study and report back to Council with its recommendations. The Group was called the Maroochy River Entrance Working Party and comprised the following representatives:-
 - Maroochy Shire Councillors and Staff
 - Representatives from the Department of Environment and BPA
 - Local interest groups
20. The Working Party recommended that Council negotiate with WBM to further assess the options discussed, together with a "do nothing" option.
21. Council accepted this recommendation and on 26 November 1997 invited WBM to submit a fee proposal to undertake the additional work. Following discussion on the detail of the further investigations, WBM submitted a fee proposal of \$60-\$80,000 on 18 February 1998. A meeting of the Working Party was held on 6 March 1998 to consider this proposal and resolved to further extend the study to include the following:
 - (a) Determine recent rates of change, control points for current beach and river shape, the extent of exposed coffee rock and its spatial distribution in the area of interest (based on Council surveys)
 - (b) Investigate the events, (natural or man-made) which might facilitate a return of the entrance to the north of Pincushion Island
 - (c) Modify the existing 1D model to predict the impact on water levels and flows inside the entrance if a breakthrough just south of Pincushion should occur
 - (d) Comment on Palisade Piers, a proposal by Mr Sedlar and other sediment catching options, and their possible benefits and impacts
 - (e) Report on the above

INITIAL ADVICE - 1998

22. On 26th March 1998, WBM submitted a report to Council which provided initial advice and comment on the various matters being discussed at that time. Their report concluded:
 - (a) Under the present situation a breakthrough of the dunal system south of Pincushion Island was inevitable and becoming more likely with time.
 - (b) While the beach to the south connects with Pincushion Island, the beach alignment is relatively stable. However, should a breakthrough occur south of Pincushion, the beach to the south may recede to a new alignment.
 - (c) The cyclic process of the entrance progressing southwards and then breaking through to the north is natural. Simulation of this process by man is risky. However, it would be possible to design a channel opening regime which had a high possibility of success.
23. During the following months numerous meetings were held within Council, and with WBM, the Working Party, Government Agencies and local interest groups to review the details for any further study and to establish suitable terms of reference.
24. Council considered it likely they would extend the scope of the study to include the option to relocate the river entrance to the north and close the southern channel, and in August 1998 engaged WBM to obtain all the approvals necessary to construct this later option should it be adopted. The approvals required were extensive and included the following:

- (a) Approval under Section 86 of the Harbours Act (works on tidal lands or waters). Need detailed plans of the works, letters of support from Fisheries, Beach Protection Authority, Harbour Master and Regional Office of the Department of Environment;
 - (b) Approval under Section 47 of the Beach Protection Act (disturbance of sand in an EPA). Need detailed plans of the works including dune vegetation;
 - (c) Licence under Section 41 of the Environment Protection Act (dredging and spoil disposal). Need detailed drawings of the works, equipment to be used (dredging and land based), hours of work and anticipated noise levels, fuel storage details, discharge water quality and latent water quality, turbidity and erosion management;
 - (d) Permit to Disturb Marine Vegetation under the Fisheries Act (disturbance of mangroves). Need details of mangrove populations and significance and impact of disturbance/removal;
 - (e) Permit to carry out works in a Fish Habitat Area OR Revocation of that portion of the Fish Habitat Area involved in the works. Detailed plans of the works and impacts on the management of the Fish Habitat Area.
25. In addition, WBM were engaged to investigate the appropriate location for a "last line of defence" to be adopted in the event of the river breaking through south of Pincushion Island. These works would provide permanent protection to the caravan parks and other infrastructure on the southern shore.

LAST LINE OF DEFENCE - 1998

26. In December 1998 Council received the "Last Line of Defence" study from WBM. It concluded the following:
- (a) Under the present situation with the northern spit wide, stable and progressing incessantly southward and the southern spit south of Pincushion becoming narrower through erosion, a breakthrough of the dunal system south of Pincushion was inevitable and becoming more likely with time.
 - (b) Various options existed to develop a last line of defence in the case of a breakthrough. These were summarised as:
 - Seawalls costing about \$2,500/m (\$750,000 to \$2,500,000 total) to protect infrastructure with a loss of beach amenity when in use;
 - Groynes costing about \$5,000/m (\$2,000,000 total) to protect infrastructure and maintain a reduced beach amenity while preventing sand drift northwards into the southern channel; and
 - A combination of lower cost groynes and ongoing maintenance at an initial cost of \$600,000 and an annual maintenance cost of \$120,000. These works would protect infrastructure and maintain a reduced beach amenity but included a degree of operational risk in being able to maintain the variable nourishment requirement.

The options of seawalls or rock groynes were more likely to provide the level of protection required for the infrastructure for the longest time with the least amount of maintenance. However, it was noted that the seawall would result in the greatest loss of beach amenity and the groynes would lock up sand which would naturally flow north to close off the southern channel and help the entrance move northwards.

In comparison, the cost of relocating the entrance to the north was estimated at \$2,000,000 with an immediate removal of the threat to infrastructure and an increase in river and beach amenity.

- (c) It was recommended that the seawall option be considered as the immediate last line of defence in combination with relocation of the entrance to the north as the long term objective.

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- (d) It also concluded that there might be some benefit in using innovative techniques for the erosion and accretion of sand at various locations throughout the river entrance. However, it was expected that the overall size of the system and the energy driving the natural forces were such that a larger concentrated effort would be required to change the momentum of the system and forge the change required.
27. The report noted there could be some opposition from environmental groups to the option to relocate the entrance to the north. WBM confirmed that applications for a possible relocation had been submitted to the following agencies:
- the Beach Protection Authority
 - the Marine and Ports Division of the Department of Transport
 - the Department of Environment under Section 86 of the Harbours Act, and under Section 41 of the Environment Protection Act
 - the Department of Primary Industries under Section 51 of the Fisheries Act 1994 for work in the Fish Habitat Area

They also advised that the cost in additional consulting work required to obtain all the necessary approvals could be considerable, and suggested a sum in excess of \$100,000.

28. Ongoing storm conditions during December 1998 and January 1999 continued to threaten a more established breakthrough of the entrance south of Pincushion Island.
29. A meeting of the Working Party was held on 18 January 1999 to discuss the report from WBM, and to consider a proposal to construct a physical model of the entrance to better determine a course of action.

The meeting agreed the following recommendations be put to Council:

- a physical model of the Pincushion area be undertaken
 - State Government be approached for funding support
 - no further action be taken on seeking approvals for dredging the northern channel
30. A full meeting of Council accepted these recommendations on 20 January 1999, and approved an estimate of \$150,000 to carry out physical modelling and to provide a report. There were further discussions within Council about Government support to fund the model, and of a proposal to commission a further model to test the northern channel option.
31. Discussions were held with WBM and the Queensland Government Hydraulics Laboratory to confirm details of a commission to undertake a model study, and on 30 April 1999 WBM were formally advised to commence work immediately. The agreed fee structure was as follows:

WBM Project Management Costs	\$ 27,750
QGHM Modelling Costs	\$124,212
Survey Works by Council (estimated)	\$ 2,500
Total Costs	<u>\$154,462</u>

MODEL STUDY COSTS

32. The formal proposal submitted by WBM described the detail and function of the proposed model as follows:

The test model would be constructed at a scale of 1:50 and would use a system of pumps and wave generators, to simulate such conditions as wave action, tidal flows and sediment transport. A total of four scenarios as detailed below, would be tested to determine the likely outcome of various natural conditions.

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a) Model Test 1 - Post Breakthrough Mechanisms under existing conditions:

The model would be constructed with a post-breakthrough geometry and the dominant wave, tide and sediment transport mechanisms would be calibrated. Primarily these would include a wave climate which would include day to day conditions as well as a representative proportion of storm conditions, a mean spring tide range with no flood surcharge and simulation of sediment transport northwards from near the Surf Club and southwards along the northern spit. It was expected that this process would include recession of the shoreline past the eastern boundary of the Pincushion Caravan park. It was not proposed to run the model to an equilibrium condition as this would be likely to take a significant amount of time and it would not be possible to represent the cyclones, storms and floods which might occur during this period.

The primary outcome from this model run would be to assess whether the model conditions were sufficiently representative of the natural conditions to simulate sediment movement after a breakthrough. If this were the case then the model could confidently be used to simulate the effect of protection works around the caravan park.

b) Model Test 2 - Impact of Defence Works on Post Breakthrough Mechanisms:

In this test, the calibrated boundary conditions developed in Model Test 1 would be used on a model which had been rebuilt with the caravan park defence structures in place. The defence structures would be three rock groynes around the boundary of the caravan park similar to the arrangement indicated in Figure 4 of the last Line of Defence Report (WBM 1998). The final arrangement of the groynes would be determined after consultation with Council officers and after the results of the first model test had been interpreted.

The primary outcome from this model would be to assess whether the defence structures around the caravan park would cause significant change to the processes after breakthrough and if so, whether it was still likely that the southern channel would be blocked and the northern channel become dominant.

The test would also indicate the stability of the groynes under south easterly conditions and provide information about the capability of the groynes to retain a beach and foreshore in front of the Caravan Park and as far south as the model could reliably predict, along Alexandra Parade.

c) Model Test 3 - Optimisation of Defence Works:

This test would incorporate any improvements to the rock groyne arrangement which became apparent during the previous test. Alternatively, if the rock groynes did not allow blockage of the southern channel, then an alternative defence arrangement (i.e. a rock seawall) could be constructed and tested.

d) Model Test 4 - Stability Test of Defence Structure in NE Storm Conditions:

This final test would use typical cyclonic conditions to test the structural stability of the selected final defence works.

The test would also provide information about the capability of the groynes to retain a beach and foreshore in these conditions, in front of and to the north of the caravan park and as far south as the model extends along Alexandra Parade.

33. Seas finally broke through between Pincushion Island and the southern shore in March 1999 and established a significant channel within a few weeks.
34. Weather conditions delayed the collection of survey data and as a result model construction did not commence until August 1999. By this time, the breakthrough of the entrance south of Pincushion Island was well established.
35. By mid-November 1999, the model had been constructed and calibrated in accordance with Model Test 1 to reasonably simulate the measured characteristics at the river mouth.
36. At the time of writing this report (November 1999), WBM and QGHL had commenced to run Model Test 2 on a configuration of seawalls and groynes.

FUNDING OF CONSTRUCTION WORKS & ENGINEERING STUDIES

37. The estimated costs to Council in undertaking previous studies and approved construction work, and in commissioning the current Model Study are detailed below:

(a) Model of the Maroochy River flood plain constructed by QGHL early in the 1980's	\$500,000
(b) Combined study with BPA in 1992/93	\$ 20, 000
(c) Construction of groynes and revetment works, and dredging in 1994	\$400,000
(d) Relocation Study by WBM in 1997	\$ 68, 000
(e) Initial Advice and Last Line of Defence Study by WBM in 1998	\$ 47, 000
(f) Current Model Study by WBM (estimated)	
(i) Project Management by WBM	\$ 27,750
(ii) QGHL Modelling costs	\$124,212
(iii) Survey Work by Council (to date)	\$ 10,000
	<u>\$ 161,962</u>
	<u>\$1,196,962</u>

38. WBM has previously suggested a budget of between \$750,000 and \$2,500,000 to construct the works which may result from the current study. The details are provided in section 26(b) of this report.

39. During 1998 and 1999, enquiries were made of various Government Agencies regarding the possible provision of support funding for the studies being undertaken by Council. The Beach Protection Authority advised funding was unlikely to be available through their agency and suggested Council contact the Department of Communication and Information, Local Government and Planning (DCILGP).

DCILGP indicated funding might be available through the Local Government Bodies' Capital Works Subsidy Scheme. Part 14 of this scheme provides for 25% subsidy for the prevention of sea and river erosion, providing the works are approved by BPA and the Coastal Management Branch of DOE (now the EPA).

40. A deputation meeting was held with Minister Rod Welford at Landsborough on 30 August 1999 to discuss the project and to request assistance in funding the following:

- (a) The current Model Study
- (b) Any capital works that might result from the Model Study
- (c) A possible Model Study of the option to open a new channel through the northern end of the spit.

The Minister expressed his interest in, and support for the current Model Study and suggested that Council make a formal submission to his Department for assistance in funding both of the model studies, and any future construction work.

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Date Prepared:	30 November 2000	Prepared by:	Paul O'Keeffe ✓
Approved by:	Olwyn Crimp	Title:	Senior Principal Engineer
Position:	Director, Environmental Planning	Division/Region:	Environmental Planning EPA
Date Approved:	4 December 2000	Telephone:	3227 8496
		Track No:	M/00/01771, E/00/04300

Ref: BNE1791-1
BNE2000/7548

Mr N Cooney
Manager Business Services
Maroochy Shire Council
PO Box 76
NAMBOUR QLD 4560

19 DEC 2000

CARMS MODIFIED

Dear Mr Cooney

Thank you for the opportunity to meet with representatives of the Maroochy Shire Council's Working Party examining the erosion problems at the Maroochy River entrance, on 8 November 2000.

At the meeting, various options designed to alleviate the erosion threat to the southern shoreline were discussed. During the meeting, I undertook to ensure that the Council would be provided with advice regarding the measures that would be likely to receive approval from Government, the information requirements for approval and the timeframe.

The Government recognises that the problems facing the Council, as a result of the movements of the Maroochy River mouth, are significant. In recognition of the magnitude of the problem and the environmental importance of the Maroochy River entrance, the Environmental Protection Agency (EPA) will continue to assist the Council to develop a feasible solution for the protection of the caravan park within the parameters of least cost to the environment and a realistic budget.

By way of confirmation of our discussions, I am not unsympathetic to the option of dredging a new entrance through the northern spit and closing off the existing entrance, but only as a last resort. Given that the dredging option requires the disturbance of the Fish Habitat Area, it is the least favourable option and should only be pursued after all other options are proven ineffective. Officers from the EPA will provide further advice with respect to options that could be approved and pursued in the short to medium term.

The Council's responsibility to protect public assets is recognised but actions to achieve this need to be designed to have as little intervention with the environment as possible. With respect to cost, the Council needs to examine the cost/benefits of any proposal to ensure that it is economically and ecologically justified.

Thank you for bringing this matter to my attention and I trust this information is of assistance. Should you have any further inquiries, please contact Mr Paul O'Keeffe of the Environmental Protection Agency on telephone 3227 8496.

Yours sincerely



ROD WELFORD MP

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Date Prepared: 18 December 2000	Prepared by: Trevor Carter ✓
Approved by: Olwyn Crimp	Title: Principal Engineer
Position: Director, Environmental Planning	Telephone: 3227 7618
	AND: Paul O'Keeffe ✓
	Title: Senior Principal Engineer
	Telephone: 3227 8496
	Division/Region: Environmental Planning EPA
Date Approved: 18 December 2000	Track No: E/00/04620

Ref: BNE1791-1
BNE2000/9208
Your Ref: RJC\pml

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Mr J Warmington
General Manager, Shire Services Division
Maroochy Shire Council
PO Box 76
NAMBOUR QLD 4560

16 JAN 2001

CARMS MODIFIED

Dear Mr Warmington

for

Thank you for your letter of 20 November 2000 concerning the Maroochy River mouth and for the opportunity to meet with representatives of the Maroochy Shire Council's Working Party examining the erosion problems at the Maroochy River entrance on 8 November 2000.

At the meeting, various options designed to alleviate the erosion threat to the southern shoreline were discussed. During the meeting, I undertook to ensure that the Council would be provided with advice regarding the measures that would be likely to receive approval from Government, the information requirements for approval and the timeframe.

The principal options that have been under consideration recently are:

1. Determine a last line of defence and construct a seawall to protect existing infrastructure and development. The most seaward line of defence would be the seaward boundary of the Pincushion Caravan Park.
2. Construction of a series of groynes at the southern entrance to the River. This option was model tested at the Queensland Government Hydraulics Laboratory.
3. Relocate the entrance of the River to the north by dredging through the northern spit, blocking off the existing entrance and dredging a number of channels in the estuary to ensure tidal flushing.

With regard to option 1, the Environmental Protection Agency (EPA) would be likely to grant the necessary approvals. The wall could be constructed in stages with the first stage comprising protection of the caravan park and a second stage providing protection for the carpark to the south. Such a wall could be designed as a rock revetment or with sandbags as the main structural elements. It should be noted that because the recent sand bagging undertaken as an emergency measure is well seaward of the caravan park boundary, it should not be considered as part of any permanent wall construction. Upon receipt of suitable plans, an application could be processed within two months.

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Option 2 would be likely to be approved by the EPA. It may also be possible to construct this option in stages. The Council's consultants who were involved with model testing of the original concept should be in a position to advise on the possibility of stage construction. Similarly, there are choices with respect to the construction materials and other design details. Approval could be facilitated within two months of receipt of a suitable application.

Substantial additional work would need to be done before option 3 could be approved. An environmental dredging licence would need to be obtained and part of the Maroochy River Fish Habitat Area would need to be revoked. I understand that your Council has been provided with details of the information required by the relevant agencies to consider these issues. While I am not unsympathetic to the option of dredging a new entrance through the northern spit and closing off the existing entrance, such action should only be considered as a last resort. Given that this option requires disturbance of the Fish Habitat Area, it is the least favourable and should only be pursued after all other options are proven ineffective.

A number of other options involving structures in the river estuary have also been discussed but have been discarded on technical grounds or lack of definitive data. There would be further options that could be considered in the future but before they can be considered seriously, they would need to be properly investigated. At the present time, subject to design details being determined, there is sufficient information about the first two options to consider them for approval.

Your reference to the management of rivers being a State Government matter is noted. However, the responsibility for undertaking any works in this regard lies with the relevant local government. The role of the State Government is to provide advice and act as an approving authority to ensure that any works that are undertaken do not cause environmental harm.

Regarding the matter of increased rates of subsidy for beach protection works, EPA officers have held discussions with officers of the Department of Communication and Information, Local Government, Planning and Sport. I support an increase in the level of subsidy and wrote to the Honourable Terry Mackenroth MP, when he was Minister for Communication and Information, Local Government and Planning and Minister for Sport, accordingly.

Thank you for bringing this matter to my attention and I trust this information is of assistance. Should you have any further inquiries, please contact Mr Paul O'Keeffe of the Environmental Protection Agency on telephone 3227 8496.

Yours sincerely



ROD WELFORD MP

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Beach Protection Authority Queensland

(1)

FACSIMILE MESSAGE

Date: 20-1-97 Number of Pages: (including facsimile cover sheet)

Please deliver the following pages to:

Name: PAUL COUGHLIN Fax Number: 07 3225 8723Department/Company: ENVIRONMENTContact Officer: TREVOR CARTER Phone Number: 76718Branch: COASTAL MANAGEMENT☐ UrgentOriginal to Follow: NO

Notes/Comments:

Paul

Briefing notes on Maroochy River
as requested

Trevor

sch4p4(6) Personal information

Authorisation: _____

IF TRANSMISSION IS INCOMPLETE OR ILLEGIBLE PLEASE CONTACT US ON (07) 3227 8494 OR 617-3227 8494 (INTERNATIONAL)



Department of Environment

5th Floor,
160 Ann Street, Brisbane
PO Box 155
Brisbane, Albert Street, Qld 4002
AUSTRALIA

Telephone: (07) 3227 8495

Facsimile: (07) 3221 0768

Received Time

20. Jan. 10:08

Print Time

20. Jan. 10:10

000005

(139)
BRIEFING NOTE

BRIEFING FOR THE HONOURABLE BRIAN LITTLEPROUD
MINISTER FOR ENVIRONMENT

Subject: Maroochy River Mouth

Prepared by: George Mootoo, Senior Engineer, Coastal Planning

Date Prepared: 13 January 1997

Requirement: Request from Director Coastal Management

BACKGROUND:

- There have been extensive movements of the Maroochy River mouth for many years. In 1958, the mouth of the river flowed south of Pincushion Island. Subsequent photos taken in 1974 and 1995 indicate the magnitude of natural changes which have occurred. Copies of these photographs are attached with the original of this briefing note.
- The construction of two groynes along the southern bank of the Maroochy River was carried out by the Maroochy Shire Council in 1994 to protect the Council's substantial investment in the caravan park at Cotton Tree. The groynes, which were subject to physical model testing, have been in place for two years and are considered to have been very successful in mitigating the erosion in front of the caravan park.
- Recently, there has been erosion of the area between the downstream groyne and Pincushion Island. This erosion is within the bounds of natural changes that have occurred in the past.
- The erosion has also resulted in the loss of part of the park used for camping. However, it has been previously acknowledged by the Council that the camping area currently under threat is not permanent. In this respect, the Council is investigating acquisition of a more stable area to the east of the current camping area to replace the threatened land, thereby maintaining the current camping capacity of the park.
- Recently, the growth of a spit from the northern bank is affecting the flow capacity of the northern channel of the river by pushing the river mouth to the south. One of the best options for addressing the above problem is to breach the northern spit somewhere near the 1974 location of the river mouth and hence "shortcut" the natural entrance migration process.
- However the northern channel of the Maroochy River estuary is contained within a Fish Habitat Reserve under the jurisdiction of the Department of Primary Industries, Fisheries and Forestry which severely restricts any dredging options.

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ISSUES:

- The Maroochy Shire Council has expressed concern over the current situation at the river mouth. The Council's concerns are focused on the effect that the state of the river mouth could have on flooding and on the long term implications should erosion of the southern bank continue unabated.
- In response to the Maroochy Council's concerns, the erosion was inspected by Council and Departmental officers on 13 January 1997. That inspection revealed that:
 - Erosion was mainly on the river side of the southern bank of the river adjacent to Pincushion Island.
 - The area near the groynes had suffered little erosion.
 - No Council infrastructure is currently under threat.
 - There are some small mangroves in the area where it would be most logical to breach the spit.
- The Department is not aware of any conservation reasons not to breach the spit. However, Regional staff indicate that there may be some local issues which will need to be addressed in the entrance relocation study to accommodate concerns of local residents and that there may be some people who will oppose any works at the mouth of the river.
- Without detailed design it is not possible to estimate the cost of breaching the spit. However, initial estimates suggest the cost should of the order \$250 000 to \$500,000.
- The Council officer present on the inspection indicated that this was within Council resources for this work. Council officers had previously agreed that the Council would undertake the necessary design work with some technical advice from the Department.

RECOMMENDATION:

- It is recommended that subject to a favourable response from the Department of Primary Industries, the Council be advised to commission a study to look at the feasibility of relocating the mouth of the Maroochy River to a position similar to that which existed in 1974.

CONTACT OFFICER:

- George Mootoo Phone (07) 3227 6884

ACTION PLAN TO COMBAT EROSION AT MOUTH OF MAROOCHY RIVER

Background

The southern bank of the Maroochy River near its mouth is eroding. The erosion has resulted in the loss of part of the Pincushion camping ground. The Council is also concerned that the river channel could migrate to the south of Pincushion Island, leading to beach erosion problems at Maroochydore.

The current erosion is within the bounds of natural changes in the mouth that have occurred in the past. It has previously been acknowledged by the Council that the area currently under threat would be vulnerable to erosion and its use for camping purposes should be accepted as being temporary only.

The Beach Protection Authority has advised the Council previously that one of the best means of dealing with the erosion problem at the river entrance was to relocate the present river entrance to the north by dredging through the sandspit which extends southward into the river entrance from the northern bank.

In response to the Maroochy Council's concerns, the erosion was inspected by Council and Departmental officers on 13 January 1997. That inspection indicated that no private property or Council infrastructure is currently under threat and that it should be feasible to cut a new entrance by dredging through the northern sandspit in the approximate location of the entrance in 1974. However this new entrance would require careful design to ensure that it provided the desired solution to the erosion problem.

The Department is not aware of any conservation reasons not to breach the spit. However, Regional staff indicate that there may be some local issues which will need to be addressed in the entrance relocation study to accommodate concerns of local residents and that there may be some people who will oppose any works at the mouth of the river.

Relocation of the river entrance by breaching the spit would involve dredging within a fish habitat reserve. The Department of Primary Industries has verbally acknowledged that works to overcome the erosion need to be undertaken but has indicated that advice should be given from the Department of Environment that the proposed solution will provide a reasonable time before further works are required.

Actions

Departmental officers have discussed future action with the Maroochy Shire Mayor and Director of Engineering. It was agreed that engineering design work was required to ensure that the proposed new entrance would function as required and that the Council would commission the required design work.

To facilitate the resolution of this erosion problem the following actions are proposed.

- Council initiate surveys of the river in the vicinity of the proposed entrance (this work has commenced)

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1 The Department provide the Council with a list of the main issues to be considered in the design brief (letter prepared jointly with SE Region on this).

- The Council commission a consultant to provide design advice (expected to occur week starting 20/1/97).
- Departmental officers assist Council in its interpretation of the design parameters.
- The Council submit applications for approvals under the Harbours Act, Beach Protection Act and Fisheries Act.
- The Council call tenders and implement works.

Conclusion

Provided the proposed works are well designed this process should provide an effective solution to the immediate erosion problem.

The Mayor was happy with this proposed program.

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RTI DL RELEASE - EHP

sch4p4(6) Personal information

an
A / Senior Principal Engineer



Queensland Department of Environment
Marine Parks
Coastal Management Branch

180 Ann Street • Brisbane Queensland • PO Box 155 • BRISBANE ALBERT STREET QLD 4002
Telephone (07) 3225 1808 • Facsimile (07) 3225 1909

FACSIMILE TRANSMISSION

DEH Southeastern Region - FILE DETAILS		
Ref:	Part:	Folio:
Correspondence #	197/660	
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Related Items	42570	

Pages: 6 (including cover page) Date: 2-1-97
To: PAUL COUGHLAN Fax No:
Sender:
Subject: Phone No:

MESSAGE:

MAROOCHY INFO AS DISCUSSED

URGENT REGIONAL INPUT
NEEDED

sch4p4(6) Personal information

000013

Mr. T. Carter

(07) 3227 6718

750186

The Chief Executive Officer
Maroochy Shire Council
PO Box 76
NAMBOUR QLD 4560
Attention: Mr. Noel Ludwig

17 January 1997

EROSION AT MOUTH OF MAROOCHY RIVER

Dear Sir

I refer to a recent inspection of the Maroochy River mouth undertaken with Mr. Noel Ludwig of your Council and officers from this Department. It is understood that your Council wishes to prevent further erosion of the Pincushion camping area.

As advised at the inspection, this Department endorses the recommendation of the Beach Protection Authority that one of the best means of overcoming the erosion problem is to relocate the entrance of the river to the north. Such action would relieve the pressure currently being placed by the southern channel on the camping area, while also maintaining the river mouth in a relatively natural state.

Prior to undertaking such works, it is important that an adequate design study is undertaken. Such a study is necessary in order to determine an appropriate location and cross-section for the new entrance and to determine the need for any changes to other parts of the existing estuary. An adequate design investigation will give the project the best chance of success thereby providing a reasonable time before further works are required.

For your information, I have attached ^{suitably qualified} guidelines which set out recommended design study requirements. Council is advised to engage a ~~coastal engineering~~ consultant to undertake the project design. Officers of this Department would be willing to assist council by reviewing the consultant's report.

The works would be subject to statutory requirements under Section 86 of the *Harbours Act 1955* and Section 471A of the *Beach Protection Act 1968*.

Yours faithfully

C. C. Pattearson
Director Coastal Management

[blj-050]

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GUIDELINES FOR DESIGN STUDY FOR RELOCATION OF MAROOCHY RIVER ENTRANCE

PREAMBLE:

The southern bank of the Maroochy River near its mouth is eroding. The erosion has resulted in the loss of part of the Pincushion camping ground. It is proposed to prevent further erosion in the area by relocating the entrance of the river to approximately a position which existed naturally in 1974. The project would involve dredging a new channel through the large spit protruding from the northern bank and blocking either totally or partially the existing southern entrance. There may be other areas within the estuary where the channel topography needs to be altered to provide the new entrance with a good chance of remaining open, and to ensure that the Pincushion caravan park is not threatened by river channel movements for at least several years.

STUDY REQUIREMENTS

1. Determine an appropriate location and cross-section for a new northern entrance channel across the existing spit growing from the northern bank of the river. (It is expected that the location of the new entrance would be similar to that which existed in 1974).
2. Determine the need for either total or partial closure of the existing entrance channel. Such determination should include the relevant quantities and locations for dredging and deposition of sand.
3. Determine the need for the alteration of any areas within the estuary in order to ensure that the new entrance becomes dominant. Such determination should include the relevant quantities and location for dredging and deposition of sand.
4. Determine the relevant dredging quantities involved in all phases of the project.
5. Describe the dredging procedure which should be adopted in order to effect the project. The description should include timing of dredging works with respect to the tide and the required sand pumping rates.
6. Determine the impact on the tidal and flooding regime of the river and of Cornmeal Creek both during the period of the works and after completion of the works. Such assessment should also include any potential effects on water quality in Cornmeal Creek as a result of any changes.
7. Should any potential problems be identified, describe means of overcoming such problems.

[bdj-015]

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ACTION PLAN TO COMBAT EROSION AT MOUTH OF MAROOCHY RIVER

Background

The southern bank of the Maroochy River near its mouth is eroding. The erosion has resulted in the loss of part of the Pincushion camping ground. The Council is also concerned that the river channel could migrate to the south of Pincushion Island, leading to beach erosion problems at Maroochydore.

The current erosion is within the bounds of natural changes in the mouth that have occurred in the past. It has previously been acknowledged by the Council that the area currently under threat would be vulnerable to erosion and its use for camping purposes should be accepted as being temporary only.

The Beach Protection Authority has advised the Council previously that one of the best means of dealing with the erosion problem at the river entrance was to relocate the present river entrance to the north by dredging through the sandspit which extends southward into the river entrance from the northern bank.

In response to the Maroochy Council's concerns, the erosion was inspected by Council and Departmental officers on 13 January 1997. That inspection indicated that no private property or Council infrastructure is currently under threat and that it should be feasible to cut a new entrance by dredging through the northern sandspit in the approximate location of the entrance in 1974. However this new entrance would require careful design to ensure that it provided the desired solution to the erosion problem.

The Department is not aware of any conservation reasons not to breach the spit. However, Regional staff indicate that there may be some local issues which will need to be addressed in the entrance relocation study to accommodate concerns of local residents and that there may be some people who will oppose any works at the mouth of the river.

Relocation of the river entrance by breaching the spit would involve dredging within a fish habitat reserve. The Department of Primary Industries has verbally acknowledged that works to overcome the erosion need to be undertaken but has indicated that advice should be given from the Department of Environment that the proposed solution will provide a reasonable time before further works are required.

Actions

Departmental officers have discussed future action with the Maroochy Shire Mayor and Director of Engineering. It was agreed that engineering design work was required to ensure that the proposed new entrance would function as required and that the Council would commission the required design work.

To facilitate the resolution of this erosion problem the following actions are proposed.

- Council initiate surveys of the river in the vicinity of the proposed entrance (this work has commenced)

000010

- The Department provide the Council with a list of the main issues to be considered in the design brief (letter prepared jointly with SE Region on this).
- The Council commission a consultant to provide design advice (expected to occur week starting 20/1/97).
- Departmental officers assist Council in its interpretation of the design parameters.
- The Council submit applications for approvals under the Harbours Act, Beach Protection Act and Fisheries Act.
- The Council call tenders and implement works.

Conclusion

Provided the proposed works are well designed this process should provide an effective solution to the immediate erosion problem.

The Mayor was happy with this proposed program.

RTI DL RELEASE - EHP

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MIN97/000024

Minister for Environment

Hon. Brian Littleproud, MLA

160 Ann Street • Brisbane Queensland • PO Box 155 • BRISBANE ALBERT STREET QLD 4002

Telephone (07) 3227 8819 • Facsimile (07) 3221 7082

07 January 1997

MEMORANDUM

TO: TOM TOLHURST
DIRECTOR-GENERAL

FROM: THE HON BRIAN LITTLEPROUD MLA
MINISTER FOR ENVIRONMENT

SUBJECT: EROSION AT MOUTH OF MAROOCHY RIVER

Rec'd 13/1
Could I please have an action program by noon Friday to table at next meeting with the Minister

sch4p4(6) Personal information

Yesterday I inspected serious erosion of the south bank of the Maroochy River near its mouth.

If the erosion continues it will cause considerable financial losses to many people.

For some time Council has been negotiating with DoE and DPI.

A proposal to dredge a new channel to the north through a newly created sand spit may solve the problem.

I understand DPI are concerned the water behind the spit is a fish habitat and wants to carry out a two year study.

I doubt we have that long!

I'll be talking to Chris Pattearson today and also writing to the Hon Trevor Perrett MLA on this issue.

Executive Director (Conservation)

For early advice on the action plan please.

Tom Tolhurst

Director-General - 14/1/97

Brian Littleproud
Brian Littleproud
Minister for Environment

100% recycled paper

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Queensland
Department of Environment

(4)

Facsimile Cover Sheet

North Coast District Office
Ground Floor, 9 Golf Street MAROOCHYDORE
PO Box 168 COTTON TREE QLD 4001

Telephone No. 0754 438944
Facsimile No. (074) 438 942

From: John Williams

Date: 20/1/97 10:50 AM

To: Paul Coughlan

Fax No.

Business/Unit: Coastal Development Section

Number of Pages (including facsimile cover sheet) 2

Priority ☐ Urgent ☐ Routine

Confidential

☐ Yes ☐ No

Messages: Further to your fax re design study for relocation of Maroochy River entrance, please find attached handwritten comments on the draft. It would be remiss of the department, and viewed in a very negative light by the community if the study didn't address impacts on the natural values of the Maroochy River system.

It may well prove that environmental impacts of the proposed dredging are negligible, however I believe an objective evaluation is required in the first instance.

Kate Guard is absent from this office today at a course in Brisbane. I understand that she can be contacted on 07 32251062.

regards

sch4p4(6) Personal information

1997 9:44

DoE SOUTHEASTERN 8:04 ; M.O. - MARINE PARKS-

No. 9524 322P, 4/7# 3/ 6

From: COASTAL

GUIDELINES FOR DESIGN STUDY FOR RELOCATION OF MAROOCHY RIVER ENTRANCE

PREAMBLE:

The southern bank of the Maroochy River near its mouth is eroding. The erosion has resulted in the loss of part of the Pincushion camping ground. It is proposed to prevent further erosion in the area by relocating the entrance of the river to approximately a position which existed naturally in 1974. The project would involve dredging a new channel through the large spit protruding from the northern bank and blocking either totally or partially the existing southern entrance. There may be other areas within the estuary where the channel topography needs to be altered to provide the new entrance with a good chance of remaining open, and to ensure that the Pincushion caravan park is not threatened by river channel movements for at least several years.

STUDY REQUIREMENTS

1. Determine an appropriate location and cross-section for a new northern entrance channel across the existing spit growing from the northern bank of the river. (It is expected that the location of the new entrance would be similar to that which existed in 1974).
2. Determine the need for either total or partial closure of the existing entrance channel. Such determination should include the relevant quantities and locations for dredging and deposition of sand.
3. Determine the need for the alteration of any areas within the estuary in order to ensure that the new entrance becomes dominant. Such determination should include the relevant quantities and location for dredging and deposition of sand.
4. Determine the relevant dredging quantities involved in all phases of the project.
5. Describe the dredging procedure which should be adopted in order to effect the project. The description should include timing of dredging works with respect to the tide and the required sand pumping rates.
6. Determine the impact on the tidal and flooding regime of the river and of Cornmeal Creek both during the period of the works and after completion of the works. Such assessment should also include any potential effects on water quality in Cornmeal Creek as a result of any changes.
7. Should any potential problems be identified, describe means of overcoming such problems.

[bdj-015]

8. Determine potential impacts on the natural values of the adjacent fish habitat reserve through relocation of the entrance channel.

9. Where change to upstream tidal / flooding regime are determined, evaluate impacts on natural values of the river and instream islands, including river banks, riparian vegetation, flora and fauna, habitat and connectivity.

Received Time 20, Jan, 8:12

Print Time 20, Jan, 8:18

Received Time

20, Jan, 10:46

Print Time

20, Jan, 10:47

Im/ 7793

(5)

Director Coastal Management

Maroochy River Mouth Dredging Study

20 January 1997

Reference is made to your facsimile of today's date requesting the comments of the Southeastern Region on the "Guidelines for Design Study for Relocation of Maroochy River Entrance".

Comments of SERO on the Guidelines are as follows.

(i) Preamble

Reference to the Fish Habitat Reserve status of the estuary should be included.

(ii) Study Requirements

- Add new requirements:
 - "8. Determine potential impacts on the natural values of the Fish Habitat Reserve through relocation of the entrance channel."
 - "9. Liaise with the Department of Primary Industries, Fisheries and Forestry to mitigate any detrimental impacts from the dredging works on the Fish Habitat Reserve, particularly with respect to key fish spawning areas and the timing of the dredging works."
 - "10. Where changes to upstream tidal/flooding regimes are determined, evaluate impacts on the natural values of the river and instream islands, including river banks, riparian vegetation, and flora and fauna habitat and connectivity."
- Item 6. The reference to "...potential effects on water quality in Cornmeal Creek..." should include the Maroochy River as well. Blocking of the southern channel could lead to water stagnation problems around the groyne area if this area started to silt up as shown in the 1974 photograph. Noel Ludwig indicated at the site inspection on the 13/1/97 that this was a problem prior to the northern entrance being breached in 1974. Baseline water quality data

should be obtained prior to dredging works commencing to enable a comparison with the post-dredging status of the estuary.

It is noted that no consultation with the local community is proposed. Consultation is considered desirable and may limit any adverse local reaction to the dredging works.

I would appreciate if you would keep this office informed of the progress of the study. In this regard, the Region's contact officer will be Paul Coughlan.

sch4p4(6) Personal information

20 Jan - 97
R.A. (Bob) Speirs
Regional Director
(Southeastern)

sch4p4(6) Personal information

20/1/97

RTI DL RELEASE - EHP

1m/5004

(8)

Paul Coughlan
(07) 3225 8425

29 January 1997

971AP1713

sch4p4(6) Personal information

Dear Madam,

Re: Erosion at the Mouth of the Maroochy River

I refer to your letters of 20 and 23 January 1997 concerning the dredging works proposed for the mouth of the Maroochy River.

There has been recent discussions between officers of the Maroochy Shire Council, the Department of Primary Industries, Fisheries and Forestry, the Beach Protection Authority of Queensland, and the Department of Environment concerning the recent erosion which has occurred near Pinfishion Island at the mouth of the Maroochy River.

Following these discussions, I understand that the Council has commissioned consultants to carry out a study to investigate the option of dredging as a means to mitigate the erosion problem. This study is being funded by the Council and any concerns you have should be directed to the Council for its consideration and possible referral to their consultants.

Yours sincerely

ORIGINAL SIGNED
P. COUGHLAN

Paul Coughlan
A/Regional Manager
Coastal Management

000024

B/c Manager Coastal Planning
Department of Environment
PO Box 155
BRISBANE Q 4002

Letter is forwarded for your information. I have
enclosed copies of (6) Personal information correspondence for
your records.

A/Regional Manager
Coastal Management

B/c Chief Executive officer
Maroochy Shire Council
PO Box 76
NAMBOUR Q 4568
Attention: Noel Ludwig

Letter is forwarded for your information.

A/Regional Manager
Coastal Management

RTI DL RELEASE - EHP

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2 of 2

23rd January 1997

sch4p4(6) Personal information

Phone:

Mr Paul Coughlan
Coastal Management Branch
Qld Dept of Environment
BRISBANE Q

Dear Mr Coughlan,

DEH Southeastern Region - FILE DETAILS		
Ref:	Part:	Folio: 9
Correspondence #	197/881	
Action Officer	Paul Coughlan	
Related Items		

RE: Erosion of Pincushion - Maroochy River

42804

Further to my letter 20/1/97, Mayor Bob King's solution to Pincushion - Cotton Tree erosion is to dredge a channel through the Northern Sand Spit to the Ocean and upstream to the "Cod Hole".

Employing a Consultant as to where the channel should be made is the only consideration our impulsive Mayor believes he has to consider. Where is he getting his advice from? Has this decision come from your Department? I don't believe your Dept. would be so naive as to suggest this as a remedy as this would adversely effect the beaches on North Shore and increase tidal velocity to the river. Surely there are other options available which would have a less damaging effect to river-side dwellers and adjacent beaches.

I am concerned that the tidal and storm surge will unnaturally increase within the North Channel and Lend Lease Lake and Canal System of North Shore, adding even a greater flood threat to the already flood prone district of Mudjimba and Pacific Paradise.

This concern is magnified by Council decision to allow Lend Lease to install a weir to greatly inhibit ebb tide flow from the Lake and Canal System. The fate of future residents of Twin Waters Residential Development will also be effected by the increased tidal effect. River-side dwellers at Bradman Ave. on the South Bank as well as Maroochy Waters Canal residents will have to deal with the effects this man made mouth to the Ocean will create.

If creating an artificial mouth to our River would remedy Cotton Tree erosion problems there would be some consolation. Unfortunately this move will only increase the tidal velocity of the river waters creating even more estuary/beach erosion and flooding.

Working with nature and not against her should be first priority if a practical workable solution is to be found. One would think we were talking management of connecting swimming pools not the Ocean, Tides and River Mouth.

To respect the safety of property and life of all effected by the Maroochy River and adjacent beaches will entail a delicate balance. With adequate money, careful study, and genuine respect for all people and the environment, I believe this can be achieved.

If the decision to dredge a Northern Mouth is to satisfy the needs of Maroochy Beach and Cotton Tree dwellers, the problem is then shifted to North Shore dwellers. "Shifting the problem won't solve it."

Yours sincerely,

sch4p4(6) Personal information

000025

For "The Concerned Residents of North Shore"

Received Time

24. Jan. 9:52

Print Time

24. Jan. 9:55



Department of Environment

Southeastern Regional Office

Level 15, Jetset Centre, 288 Edward Street • Brisbane, Queensland
GPO Box 2771 • BRISBANE QLD 4001
Telephone (07) 3224 5641 • Facsimile (07) 3225 8723

File reference 971AP1713
Your reference

10

Memorandum

To File Note

Subject Meeting to Discuss Study of Dredging Option-Maroochy River Mouth

Date 5 February 1997

A meeting was held on the 23 January 1997 to discuss the Maroochy Shire Council's (MSC) proposal to commission consultants to undertake an investigation of the proposed dredging of a channel through the northern spit to alleviate the erosion problem at Pincushion Island. The meeting was held at the offices of WBM Oceanics, consulting engineers, who were being considered for the commission.

Notes

sch4p4(6) Personal in

Present at this meeting were:

- Ross Quinn and Dan Curry (DPI)
- John Warmington and Noel Ludwig (MSC)
- Trevor Carter and Paul Coughlan (DoE)
- Malcolm Andrews and Craig Witt (WBM)

The main points of discussion were as follows.

- (i) Council has passed a motion to commission consultants to undertake an investigation of the dredging option. WBM Oceanics are the preferred consultant.
- (ii) Any new channel will not be viewed by the Council as a navigation channel.
- (iii) Council has concerns if the southern channel was to break through south of Pincushion Island; particularly from a safety viewpoint at the Maroochydoore Surf Club if it caused unsafe surf conditions.
- (iv) DPI would be very concerned if water levels significantly dropped upstream in the estuary as well as having concerns as to where dredge spoil from any dredging would be dumped. Tidal ranges after any dredging should be kept close to the existing.
- (v) DPI could probably issue a permit under the Fisheries Act for the dredging works if it was a long term solution, say dredging required every 10 years or greater. If dredging to maintain the channel was

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sch4p4(6) Personal information

an
A/Regional Manager

RELOCATION OF MAROOCHY RIVER ENTRANCE DESIGN STUDY REQUIREMENTS

1. Determine an appropriate location and cross section for a new northern entrance channel across the existing spit growing from the northern bank of the river. (It is expected that the location of the new entrance would be similar to that which existed in 1974).
2. Determine the need for either total or partial closure of the existing entrance channel. Such determination should include the relevant quantities and locations for dredging and deposition of sand.
3. Determine the need for the alteration of any areas within the estuary in order to ensure that the new entrance becomes dominant. Such determination should include the relevant quantities and location for dredging and deposition of sand.
4. Determine the relevant dredging quantities involved in all phases of the project.
5. Describe the dredging procedure which should be adopted in order to effect the project. The description should include timing of dredging works with respect to the tide and the required sand pumping rates.
6. Determine the impact on the tidal and flooding regime of the river and of Cornmeal Creek both during the period of the works and after completion of the works. Such assessment should also include any potential effects on water quality in Cornmeal Creek and the Maroochy River as a result of any changes. Baseline water quality data should be obtained prior to dredging works commencing to enable a comparison with the post dredging status of the estuary.
7. Determine potential impacts on the natural values of the fish Habitat Reserve through relocation of the entrance channel.
8. Liaise with the Department Primary Industries, Fisheries and Forestry to mitigate any detrimental impacts from the dredging works on the Fish Habitat Reserve, particularly with respect to key fish spawning areas and the timing of the dredging works.
9. Where changes to upstream tidal/flooding regimes are determined, evaluate impacts on the natural values of the river and instream islands, including river banks, riparian vegetation and flora and fauna habitat and connectivity.
10. Ensure that appropriate consultation with the local community is undertaken.
11. Should any potential problems be identified, describe means of overcoming such problems.

Correspondence No. 97/44872

16

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Rec'd on Email from
Justin Overton

sch4p4(6) Personal information

Mandi, pls file on 971AP1713

sch4p4(6) Personal information

sch4p4(6) Personal information

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Di. 10/93

Y. V. Morrison
BE MEngSc PhD MIEAust CPEng
RPEQ AMASME

W W Barlow
BE FEAust CPEng RPEQ MRINA Cong AMSNAME

D C Patterson
BE BSc DipHE(DelR) MEngSc MIEAust CPEng

Associates

D M Borgeaud
BE MIEAust MAAS CPEng NPER3

W D Drake
BE MIEAust CPEng RPEQ MAIRAH

P R Fry
BScEng MScEng MIEAust CPEng

Associates

D M Jenkins
BE PhD MIEAust CPEng

P A Lugg
BE MIEAust CPEng RPEQ

A B McAlister
BE (Hons) MEngSc MIEAust CPEng

B L Manser
BE MEngSc MIEAust CPEng MAAS

R M Morton
BSc MSc PhD

D J Proud
BE MIEAust CPEng RPEQ MASME

P A Smith
BE MEng(McGill) PhD(McGill) MIEAust CPEng MRAES
CEng

C L Witt
BE Dip HE(DelR)

WBM Pty Ltd
99 Leichhardt Street, Brisbane
Queensland, Australia 4000

PO Box 203, Spring Hill 4004

Facsimile (07) 3832 3627
Telephone (07) 3831 6744

ACN 010 881 601		Southeastern Region - FILE DETAILS	
NSW Office Newcastle Sydney	Ref: 971AP1713	Part:	File: 18
Victoria Office Melbourne Morwell	Correspondence #	197/216	
USA Office Denver	Action Officer	sch4p4(6) Personal information	

WBM
OCEANICS AUSTRALIA

FACSIMILE TRANSMISSION

TO: Department of Environment - (Cultural Heritage Branch - SE Region)

ATTN: Rob Neal **DATE:** 21 February 1997

FAX NO: 3225 8723 **PROJECT NO:** 10374

FROM: Craig Witt **PAGES:** 1
(including header)

Dear Rob

RE: MAROOCHY RIVER ENTRANCE RELOCATION DESIGN STUDY

Reference is made to our recent discussions concerning the above study which we are presently undertaking for the Maroochy Shire Council. As discussed, we are investigating the most appropriate configuration and associated impacts of re-establishing a northern entrance channel to the Maroochy River.

At this stage it is envisaged that such works would involve dredging a new entrance channel across the existing sand spit which extends from the northern foreshore. The entrance was located in this area some 20-30 years ago. It is probable that the sand will be used to infill the existing entrance channel adjacent to Pincushion Island. As such, all works will most likely be in areas which have been previously disturbed by natural river and beach processes.

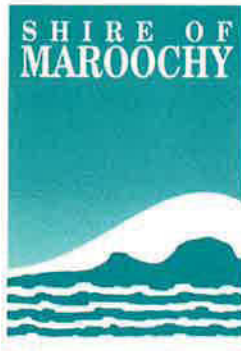
We would appreciate if you can confirm that on the above basis, there are not any specific matters or concerns which need to be addressed with respect to cultural heritage considerations. The works will be subject to the normal approvals process including Section 86 of the Harbours Act administered by the Department of Environment.

Please do not hesitate to call if you have any queries.

Yours faithfully
WBM OCEANICS AUSTRALIA

sch4p4(6) Personal information

Craig Witt



25

Maroochy Shire Council
Council Chambers
Cnr Bury and Currie Sts. Nambour
Tel (07) 5441 8211

DEN Southeastern Region - FILE DETAILS		
713	Part:	Folio:
Correspondence #	97/970	
Action Officer	Paul Coughlan	
Related Items		

Your reference:
Our reference:
Enquiries:
Direct Telephone:
Direct Fax No:

Meeting attended

sch4p4(6) Personal information

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CHIEF EXECUTIVE OFFICER

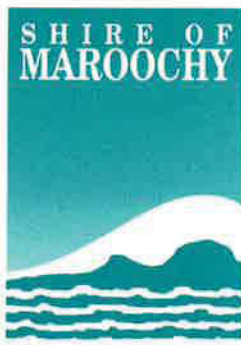
Encl.

*Joadie C,
pls file.*

sch4p4(6) Personal information



Address all communications to: The Chief Executive Officer, P.O. Box 76, Nambour, Qld., 4560.
DX 41900 Facsimile (07) 5441 8338



Maroochy Shire Council
Council Chambers
Cnr Bury and Currie Sts. Nambour
Tel (07) 5441 8211

24

Your reference:
Our reference:
Enquiries:
Direct Telephone:
Direct Fax No:

Miss
Coughlan
I Engineer, SE

DoE Southeastern Region - FILE DETAILS		
Ref: <i>971AP1725</i>	Part: <i>i</i>	Folio:
Correspondance #	<i>197/11744</i>	
Action Officer	<i>Paul Coughlan</i>	
Related Items		
Barcode #	<i>56167</i>	

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sch4p4(6) Personal information

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*Noted. I have
arranged to attend
this meeting.*

sch4p4(6) Personal information

15/9/97



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Address all communications to: The Chief Executive Officer, P.O. Box 76, Nambour, Qld., 4560.
DX 41900 Facsimile (07) 5441 8338

Pages 75 through 76 redacted for the following reasons:

sch3(1) Cabinet matter - brought into existence before commencement

DEH Southeastern Region - FILE DETAILS	
Part:	File: 28
Correspondence #	1291
Action Officer	
Related Items	

d

This is a
S.E. Regional Issue.
Please send to RD (SE) for

Ministerial Request

(Please complete and fax to the Office of Director-General F No. 3227 6485)

direct response please.

2 9

sch4p4(6) Personal information

21/7/98

bj

DIRECTOR OF MINISTRY

f (any specific req)

PROPOSED RESPONSE

Dep

Officer:

Phone:

(2) Advised Rhonda Murray that Mr O'Keefe was preparing a briefing note on this matter.

sch4p4(6) Personal information

Name

sch4p4(6) Personal information

Telephone Number

3880



(1) File Note: I telephoned Mr Paul O'Keefe, A/MCO, Central Office, 28/7/98 regarding this briefing. He advised that his section was preparing a briefing and that we need for SE Region to give use.



FIONA SIMPSON M.A.

WORKING FOR MAROOCHYDORE

Member for Maroochydore
Minister for Health and Women's Policy
Minister for Maroochydore
Minister for the Environment and Heritage and
Minister for Natural Resources



SHADOW MINISTER FOR HEALTH AND WOMEN'S POLICY

19 May 1995

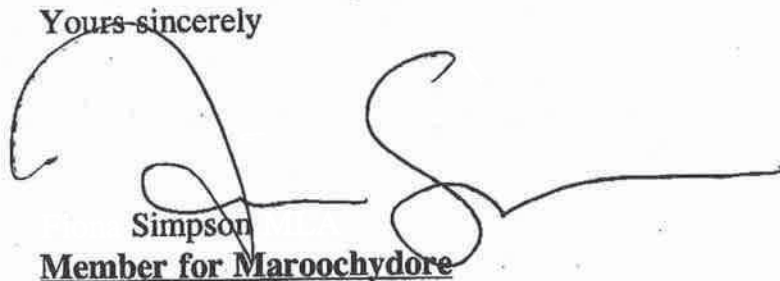
Hon. K. J. Walker M.L.A.
Minister for Environment and Heritage and
Minister for Natural Resources
19 May 1995
100-100 ALBERT STREET

Dear Mr Walker

Thank you for the letter of 14 May 1995.

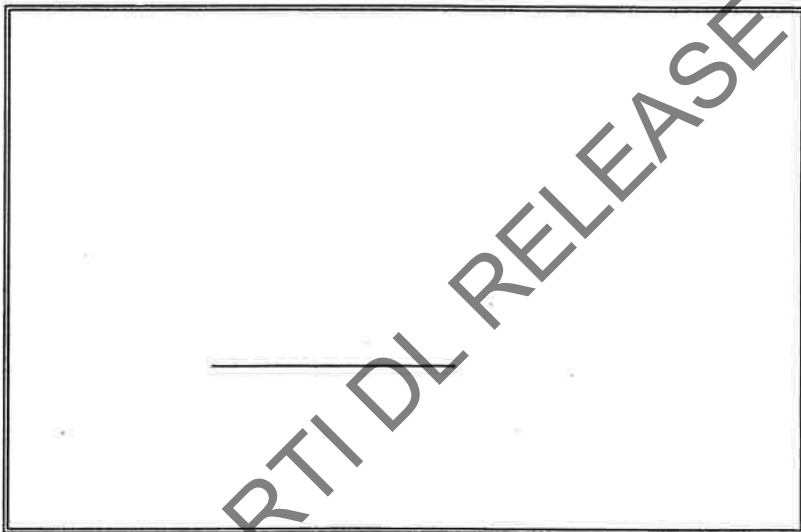
I am pleased to hear that you are interested in the work of the Shadow Minister for the Environment and Heritage and the Shadow Minister for Natural Resources. I am also pleased to hear that you are interested in the work of the Shadow Minister for Health and Women's Policy.

Yours sincerely


Simpson
Member for Maroochydore

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sch4p4(6) Personal information

Jeff, per response

sch4p4(6) Personal information

please

sch4p4(6) Personal information

Note: The due date above is when a response to the requesting office is required, please ensure briefing notes are sent for the Regional Director's approval in time to meet this deadline.

You are required to record all movements through CARMS.

Regional

Action

6

Records: The original of this correspondence is held by Mr Paul O'Keefe of Wastel Management Brand Central Office. He is preparing a ministerial briefing on the matter. No further action is required by SE Region

sch4p4(6) Personal information

remain

SPE 28/2

		TAILS
971AP1713		Ro of 29
	198/15837	
AISPCA Action Officer	JULIAN BROOKS	



RTI DL RELEASE - EHP

proposed work within
assess the application



You should be aware that as from 1 October 1998, all applications for approvals under the *Fisheries Act 1994* must consider native title issues. Relevant indigenous groups are notified of each proposal and comments requested before finalising any assessment. Provision of a 28 day period is mandatory for indigenous groups to comment.

If you have any queries regarding this matter please contact the Southern Fisheries Centre on 3817 9554.

Yours sincerely

sch4p4(6) Personal information

RH Quinn
ACTING INDUSTRY MANAGER
FISHERIES RESOURCE MANAGEMENT

CC: Mr Dan Currey, General Manager (Fisheries Resource Protection), Department of Primary Industries, Forestry House, PO Box 3129, BRISBANE Q 4001

Southeastern Regional Office, Department of Environment, PO Box 2771, BRISBANE Q 4001

RTI DL RELEASE - EHP



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Correspondence No. 198/17336	Barcode No.
File No. 951RF332	PART (30)
Action Officer John Horden	Related to



RTI DL RELEASE - EHP

sch4p4(6) Personal information



Department of Primary Industries,

Southeastern Regional Office, Department of Environment, PO Box 2771, BRISBANE Q 4001



Department of E
michelle.walker
bill.kerwin

(31)
Bruce,
could we please
meet to discuss this
Michelle
29/11

Michelle, in capacity as acting Bill. I have been approached by Maroochy Shire Council for some "TOR" for information that should be provided in support of an application to relocate the Maroochy River mouth by dredging. This matter was previously dealt with by Paul Coughlan in your section, and I believe Sel Sultmann is also involved. I would appreciate your input on any coastal matters that you would like to see addressed by information supporting such an application for environmental authority. Given the concerns that the applicant is raising (that Maroochydhore may be swept into the sea any day now - please throw us a bouy), they want these "TOR" ASAP. Could you please facilitate a response for coastal. I am producing TOR from Env Prog perspective that will look at sediment quality, ASS, water quality, so no need to double up. Probably engineering issues and coastal processes are the things I might need help with if Paul has not previously addressed them. A response within the next 7 days would be greatly appreciated. Cheers Nikki

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15/11

RTI DL RELEASE - EHP

sch4p4(6) Personal information

**Draft Terms of Reference for proposal to relocate the Maroochy River Mouth -
Maroochy Shire Council**

Description of Proposal

Further detail is required with respect to the specific manner in which the proposed works are to be undertaken. The Department of Environment and Heritage (DEH) is of the understanding that Council are still considering a number of different options (all involving some form of dredging and relocation of dredged material) but that a final decision is yet to be arrived at. Please clarify precisely which 'option' Council intends to pursue.

Therefore, subject to the above, the following information is required:

- a complete description of the operations/activities to be carried out including details relating to plant/equipment proposed to be utilised during the project and the scope of the proposed works;
- a description of the processes proposed to be used including the names and locations of all equipment to be utilised;
- the proposed location of a site office;
- proposed hours of operation;
- the expected duration of the proposal;
- the proposed location for after-hours storage of plant and equipment;
- the proposed location of fuel/oil storage facilities (including any associated safeguards proposed eg. bunding);
- locations of associated infrastructure including pipelines associated with dredging works;
- details relating to public access restrictions to the site;
- a site plan;
- a large scale drawing which indicates the boundaries of the proposed works and which indicates the location of all proposed discharge and emission points to the environment (including discharges to water and land, air and noise emissions);
- details of contingency/emergency response procedures;

The DEH also requests details of any financial assurance arrangement proposed between the Council and the contractor with respect to actions which may or may not be required to rehabilitate or restore the environment as a result of environmental harm being caused by the activity.

Site-Based Management Plan

A Site-Based Management Plan must be developed which provides for the following functions:

- (i) The monitoring of releases of contaminants into the environment;
- (ii) The assessment of the environmental impacts of any releases of contaminants into the environment, for example any ambient environmental quality monitoring or noise monitoring; and
- (iii) The training of all relevant staff, agents and contractors ("staff") to competent levels in at least the following:

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- (a) The environmental management plan developed specifically for the proposal so that staff are aware of any relevant commitments to environmental management; and
 - (b) Any relevant environmental objectives and targets so that all staff are aware of the relevant performance objectives and can work towards these; and
 - (c) Control procedures for routine operations for day to day operational activities to prevent or minimise environmental harm, however occasioned or caused; and
 - (d) Contingency plans and emergency procedures for non-routine situations to deal with foreseeable risks and hazards including corrective responses to prevent and mitigate environmental harm (including any necessary site rehabilitation, contingencies in case of fuel spillages etc); and
 - (e) Organisational structure and responsibility to ensure that roles, responsibilities and authorities are appropriately defined to manage environmental issues effectively; and
 - (f) Effective communication to ensure two-way communication on environmental matters between operational staff and Council as well as communications with the administering authority; and
 - (g) Documentation systems so that appropriate records of environmental matters are kept to satisfy the relevant Governmental agencies and the community to demonstrate that the applicant is meeting environmental commitments; and
 - (h) Responsibilities of the Council and staff according to the *Environmental Protection Act 1994* so that these can be met; and
- (iv) The conduct of environmental and energy audits to review periodically:
- (a) the level of environmental performance; and
 - (b) the effectiveness of environmental management procedures adopted; and
 - (c) efficiency in using energy and resources and opportunities for more efficient usage; and
- (v) The implementation of an effective and appropriate waste management plan.

Acid Sulfate Soils

An Acid Sulfate Soil (ASS) Investigation is required for any coastal area at or below 5 metres AHD which will be exposed, drained or otherwise disturbed by the proposal. ASS investigations should be performed in accordance with the Queensland Acid Sulfate Soil Investigation Team (QASSIT) draft "*Sampling and Analysis Procedure for Lowland Acid Sulfate Soils (ASS) in Queensland*" dated 15 October 1997, or later versions thereof if the investigation is postponed for any reason. Full soil profiles should be described according to McDonald et al., 1990 "*Australian Soil and Land Survey Field Handbook*" second edition, Inkata Press, Melbourne, and must include horizon differentiation and depths, field texture, colour, mottles, soil structure, erosion hazard rating and pH, and appropriate action levels of oxidisable sulfur selected from the QASSIT Guideline with respect to these soil

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descriptions. The location of each borehole and its existing surface height (Australian Height Datum) should be accurately surveyed, recorded and presented.

Possible investigation strategies (including staged testing) should be discussed with QASSIT and/or Land Resource Officers of the Department of Natural Resources (Nambour), and/or the Department of Environment (North Coast District Office).

An Environmental Management Plan (EMPlan) should be prepared prior to any soil disturbance and should include:

- a three (3) dimensional map of the potential acid sulfate soils to the depth of disturbance;
- details that reflect potential on-site and off-site impacts of the disturbance of the soil and/or the groundwater levels;
- the methods that will be used to avoid, treat or otherwise manage ASS including the contained on-site management and treatment of potential and actual ASS;
- details of management of the height of the groundwater table on and off the site both during and post-construction;
- details of all soil and water monitoring to be performed during and after treatment, and including verification testing of soils;
- details of the handling and storage of neutralising agents;
- details of the contained on-site treatment and management of potentially contaminated stormwater run-off, surface waters and leachate (including details of groundwater management) associated with the works both in the short- and long-term; and
- a description of contingency procedures to be implemented on and off the site if the management procedures prove to be unsuccessful and acid is generated and/or leachate problems occur.

This plan should provide for ongoing management and monitoring of the impacts of acid soil material through the construction and operation of the project and describe the construction schedules and environmental management procedures. The development should be staged so that the potential impact of any area disturbed at any one time is limited and easily managed. Consideration should also be given to protecting any engineered structures from the corrosive properties of ASS and associated waters.

Water Resources

Describe the existing surface and groundwater resources. Establish a baseline of ground water and surface water quality and quantity taking into account seasonal changes. The following parameters (as a minimum) should be assessed: pH, dissolved oxygen, salinity, total nitrogen, nitrate, nitrite, ammonia, total phosphate, orthophosphate, chlorophyll a, iron, aluminium, manganese, suspended solids, turbidity, sulfate and chloride. Predict any changes that may occur as a result of this proposal.

000094

Sediment Sampling

Develop a sediment sampling and analysis program to determine contaminant levels in the material proposed to be dredged, for the purpose of determining appropriate disposal methods for dredged spoil.

The sediment sampling and analysis program must be carried out in accordance with the *"Environmental Assessment of the Sea Disposal of Dredged and Excavated Material Draft Guidelines"*, December 1996, produced by the Australian and New Zealand Environmental and Conservation Council, or more recent editions of that document as such become available.

The sediment sampling and analysis program must include at least the following:

1. an appropriate number of sediment sampling locations;
2. analysis of at least the following parameters/elements:
 - total organic carbon;
 - particle size;
 - moisture content;
 - settling characteristics in salt water;
 - organochlorine and organophosphorus pesticides;
 - total poly chlorinated biphenyls (PCB's);
 - polynuclear aromatic hydrocarbons (PAH's);
 - total petroleum hydrocarbons;
 - copper;
 - lead;
 - zinc;
 - chromium;
 - cadmium;
 - mercury;
 - arsenic; and
 - tributyltin.
3. in the event of analysis results of any elements/parameters listed above which indicates an exceedance of the screening levels stated in Table 7, of the *Australian and New Zealand Environment and Conservation Council Environmental Assessment of the Sea Disposal of Dredged and Excavated Material Draft Guideline*, appropriate toxicity testing will be required and 'follow-up' strategies developed, to demonstrate to the Department of Environment and Heritage that disposal of such material to waters will not cause environmental harm.

Flora and Fauna

Provide a detailed assessment of the vegetation in the area of the proposed operations and the adjacent protected areas (ie. Maroochy River Conservation Park). A vegetation map at site specific scale with particular attention paid to populations of regional significance should be provided. Include an assessment of the tidal areas within the site and adjacent tidal areas likely to be affected by the proposal, particularly any potential impact the proposal may have on freshwater wetlands,

000093

saltmarsh, mangrove and seagrass beds. Include a discussion of the significance of the vegetation of the site to native fauna including intertidal invertebrates and shorebirds. Particular attention should be given to any potential impacts on the avifauna that utilise the site and adjacent areas.

Provide a detailed assessment of terrestrial and marine fauna present in the area of operation and in the adjacent protected areas, including the existence at any time of the year of rare or threatened species, protected or listed under international agreements (eg. RAMSAR, CAMBA and JAMBA), wildlife corridors and the impact of the proposal on these.

Provide a statement of the potential impacts of the proposal on the terrestrial and aquatic fauna. Quantitative data for existing fauna populations should be collected where possible (specific reference should be made to the False Water Rat - *Xeromys myoides*, and its habitat). Of particular concern is the potential impact the proposal may have on the avifauna that utilise the area. A thorough description of the species and the habitat utilised should be included. Temporal, spatial and climatic variations should also be considered in the assessment.

Make an assessment of the impact of the proposal on flora/fauna and identify and quantify the areas of different types of existing tidal habitat which will be lost and any habitat areas which will be created and the immediate and long-term effects of any loss or modification of tidal, inter-tidal and sub-tidal lands. Discuss the impact of noise and light associated with the construction and operational stages of the proposal on any wildlife likely to be present and management measures to mitigate any impact. Any potential impacts on avifauna must be discussed in full. Provide details of revegetation/rehabilitation proposed for disturbed areas.

Data on field observations is to be accompanied by information on sampling methods and substantiation of the efficiency of these methods.

Benthic Organisms

For the purposes of determining the on-going efficacy of strategies proposed to be implemented to protect water quality, details of the extent and nature of benthic invertebrates potentially affected by the proposal are requested. Information required includes:

- a survey and assessment of the benthic invertebrates potentially affected by the proposal;
- details of appropriate points at which regular benthic invertebrate monitoring is to be undertaken including details of the nature and frequency of parameters proposed to be tested; and
- any strategies proposed to minimise impacts on benthic invertebrates.

Aquatic Ecosystems

The proposal is considered by the Department of Primary Industries (Fisheries Management) to have the potential for major impact on fisheries resources. Therefore, it must be demonstrated that all potential impacts are correctly identified and appropriate mitigation strategies are developed to minimise any such impacts. This includes indirect as well as direct impacts to fish habitat. The high level of

5
000092

protection afforded to the declared Fish Habitat Areas potentially affected by the proposal, further increases concern for the integrity and sustainability of this important area. Furthermore, the DEH has the responsibility of ensuring that species biodiversity is protected and that the appropriate water quality values as identified in the ANZECC guidelines are maintained with respect to aquatic ecosystems.

Any application must address all of the above issues and any mitigation measures that Council will undertake to retain or create aquatic ecosystems. In particular, the following issues must be addressed.

- identify and describe the habitats or natural processes that are being restored;
- identify and discuss the benefits to public health and safety that will result from the relocation of the river mouth;
- discuss the nature of impacts that will occur to shallow water and intertidal areas in the estuary, especially those close to the new channel;
- provide information as to the mitigation measures Council propose to undertake to retain or create aquatic ecosystems, that currently exist in the mouth area;
- following sediment analysis, information should be provided on the anticipated size, location and duration of any turbidity plume.

RTI DL RELEASE - EHP

000091

Subject: Mississippi River mouth dredging
Date: 10-25-1957
From: [illegible]
Organization: Department of Commerce
Location: [illegible]
Classification: [illegible]

term because there is no ne
they are just picking up the
o the current channel).

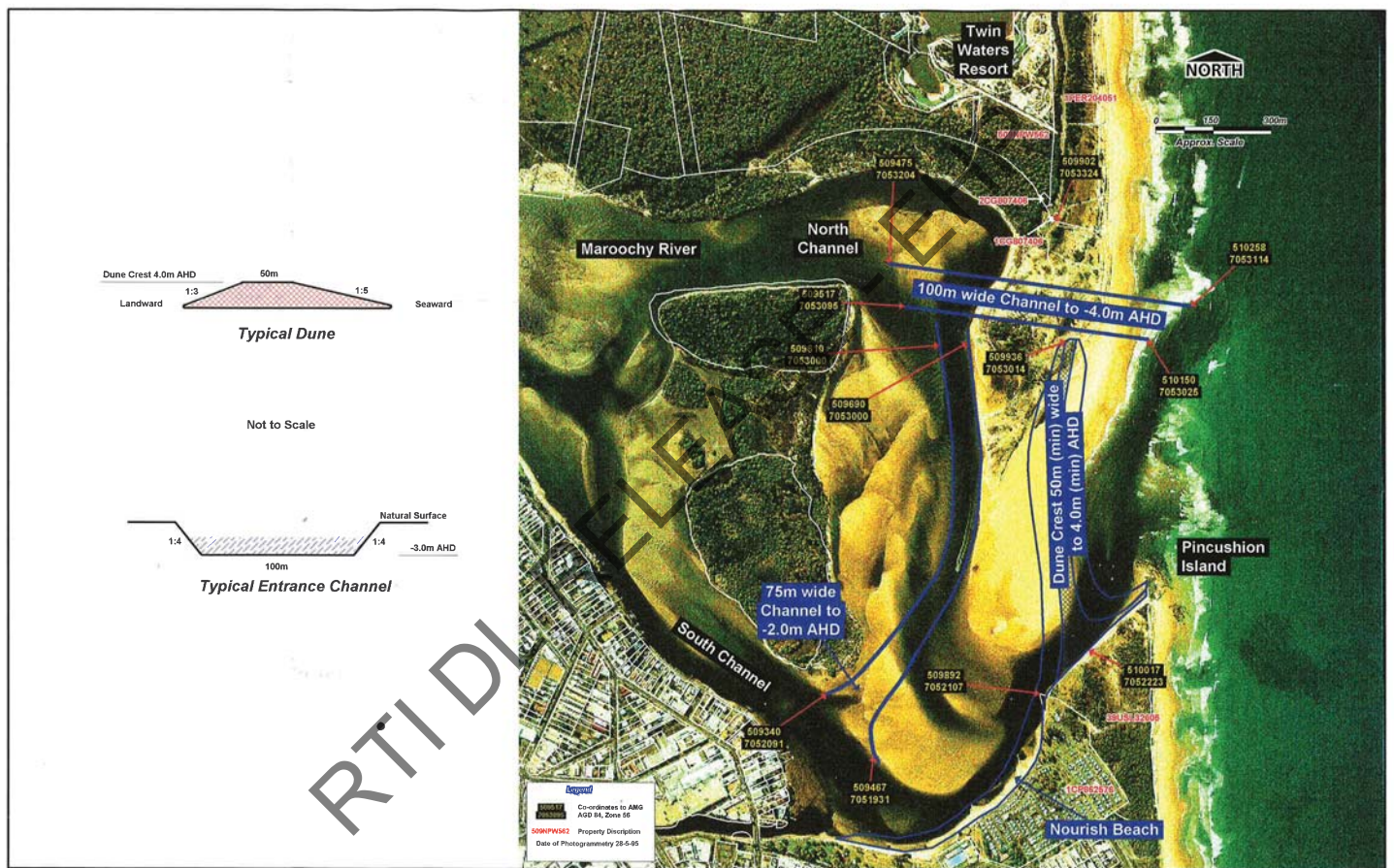
RTI DL RELEASE - EHP

proposed channel
processes will see
depends on storm

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Release



Maroochy River Entrance Relocation - Plan of Works

Figure 1

011128.dhbwengrivers_06.wor



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Coastal Development Section

South Eastern Region

15th Floor, Jetset Centre, 288 Edward Street, Brisbane, Qld. 4000

(G.P.O. Box 2771, Brisbane, Qld. 4001)

APPLICATION FOR SANCTION PURSUANT TO SECTION 86 OF THE HARBOURS ACT
TO CONSTRUCT WORKS ON TIDAL LANDS OR WATERS
FOR OTHER THAN PRIVATE USE

1. APPLICANT Name MAROOCHY SHIRE COUNCIL Address CNR BURY AND CURRIE STREETS, NAMBOUR		Phone No. (07) 54 418 608 Fax No. (07) 54 418 626 Post Code 4560
2. ENGINEER/CONTRACTOR/AGENT Name WBM OCEANICS AUSTRALIA Address 99 LEICHHARDT STREET, SPRING HILL		Phone No. (07) 3831 6744 Fax No. (07) 3832 3627 Post Code 4004
3. DESCRIPTION OF WORKS RELOCATION OF MAROOCHY RIVER ENTRANCE APPROXIMATELY 600m TO THE NORTH AND ASSOCIATED WORKS.		
4. LOCATION OF WORKS/DESCRIPTION OF LAND MOUTH OF MAROOCHY RIVER Street No. Street Name Suburb/Town Lot No. R.P. No.		
5. TENURE OF LAND (☐ Where applicable) ☐ Freehold ☐ Leasehold ☒ Vacant Crown Land ☐ Crown		
6. DRAWING NOS. ATTACHED: Figures 1 and 2		
7. ESTIMATED VALUE OF COMPLETED WORKS: \$1,500,000		
8. PRESCRIBED FEE (See Schedule) \$5,083.00 (Cheque/money order/cash enclosed. Cheques to be made payable to the Department of Environment) Fees are not refundable		
9. I/We as the owner/lessee hereby nominate the above engineer/contractor/agent to act on my/our behalf and make any amendments required by the Department of Environment. Correspondence is to be forwarded to owner/engineer/contractor/agent. (Strike out where not required)		
Signature of Applicant sch4p4(6) Personal information		Date: 27/11/98
OFFICE USE ONLY		
Receipt No. 2917258	Amount \$ 5,083.00	Date Received 7/12/98

DEPARTMENT OF ENVIRONMENT

APPLICATION FOR SANCTION PURSUANT TO SECTION 86 OF THE HARBOURS ACT TO CONSTRUCT WORKS ON TIDAL LANDS OR WATERS FOR OTHER THAN PRIVATE USE

Coastal Development Section, Department of Environment,
15th Floor, Jetset Centre, 288 Edward Street, Brisbane, Qld. 4000
G.P.O. Box 2771, Brisbane, Qld. 4001

PLEASE NOTE

- . Use block letters throughout.
- . Where the applicant is a body corporate or company, then the space provided for "Signature of owner/lessee" must be signed under the company seal or by a person who has authority to sign on behalf of the body corporate or company. Proof of such authority should accompany the application.
- . Read and retain the "Information to Applicants" and the "Guidelines for Construction of Works on Tidal Lands or Waters for Other than Private Use".
- . Call or write to the above address if you have any queries.
Phone: (07) 3225 8422 or (07) 3225 8425.

INFORMATION TO BE INCLUDED WITH YOUR APPLICATION

1. The applicant should be the owner or lessee of the site of the works or of the land abutting or adjoining the works, or a body authorised by the owner or lessee. In the latter case a copy of the authorisation should be included.
2. The prescribed application fee. The scale of fees (if not attached) is available from the above address. Cheques are to be made payable to the Department of Environment and marked "NOT NEGOTIABLE". Please note that fees are not refundable.
3. Three copies of drawings, folded to A4 size, showing the location of the works dimensioned in relation to the real property boundaries of the land at the works, the location of adjacent works (if any), and the real property description of the land.
4. Three copies of drawings of the works, folded to A4 size, showing dimensions, full constructional details, the locations and levels of high and low water marks on spring tides, design parameters including live loading, wind load, flood levels, maximum size of vessels to use the structure, etc. These drawings are to be signed as approved by a Registered Professional Engineer of Queensland.
5. A letter from the Local Authority expressing its views on the proposed works.
6. A letter from the following as applicable expressing its views on the proposed works:
 - (a) the relevant Port Authority where the proposed works will be situated within the Port Authority boundaries of Brisbane.
 - (b) the Marine and Ports Division, Department of Transport at the Gold Coast for works situated on the Gold Coast Waterways and in the boat harbour at Mooloolaba.
 - (c) the Marine and Ports Division, Department of Transport at Brisbane for works situated in the boat harbour at Mooloolaba.
7. A letter of comment from the Department of Transport, Marine and Ports Division, Regional Harbour Master in Brisbane or Manager Marine Services in Southport.
8. A copy of a document giving tenure over the land where the works are to be constructed or the land abutting or adjoining the works as follows:-
 - (a) For freehold land: title deed or confirmation of ownership from Department of Natural Resources
 - (b) For leasehold land: lease document
 - (c) For other tenure: document and plan giving tenure.
- or
9. A Real Property plan of the land referred to in item (8) above.
10. A letter of comment from relevant authorities as detailed in Item 3 of the attached Information to Applicants.

WHERE TO SUBMIT YOUR APPLICATION

The application should be submitted to the Department of Environment, G P.O. Box 2771, Brisbane, Qld. 4001.



*Maroochy aspires to be the most environmentally responsible,
caring, enterprising and dynamic community in Australia.*

Your reference:
Our reference:
Enquiries:
Direct Telephone:
Direct Fax No:

071101713		010: 34
		RC/18850
sch4p4(6) Personal information		

RTI DL RELEASE - EHP

sch4p4(6) Personal information

CHIEF EXECUTIVE OFFIC R

7/12/98 2917258 45083-00



Please quote our file reference number on your reply for fast tracking within Council.

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Address: Maroochy Shire Council
Council Chambers
Cnr Bury and Currie Sts, Nambour, Qld. Aust.
Telephone: (07) 5441 8211

Postal: The Chief Executive Officer
Maroochy Shire Council
PO Box 76, Nambour, Qld. Aust. 4560
DX 41900 Fax: (07) 5441 8338

Printed on recycled paper

Michelle Walker, Acting Regional Ma
Southeastern Regional Office

sch4p4(6) Personal information

14/12/98
Nella

RTI DL RELEASE - EHP



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QUEENSLAND GOVERNMENT

Department of Environment

Southeastern Region

DEH Southeastern Region - FILE DETAILS		
9711 AP 1713	Part:	Folio:
Correspondence #	198/19223	
Action Officer	MICHAEL WALKER	
Related Items		

7 December 1998

Enquiries to
Telephone
Your reference
Our reference

Tony Crozier
(07) 5443 8944
SRW:jhl
972EN123

The Chief Executive Officer
Maroochy Shire Council
Attention: Mr Steve Wood/Mr Noel Ludwig
PO Box 76
NAMBOUR QLD 4560

Dear Sir

APPLICATION FOR ENVIRONMENTAL AUTHORITY (SECTION 41 OF THE ENVIRONMENT PROTECTION ACT 1994) - FOR ENVIRONMENTALLY RELEVANT ACTIVITY 19 (C) DREDGING MATERIAL - FOR PROPOSAL TO RELOCATE THE MAROOCHY RIVER MOUTH

I refer to the abovementioned application for environmental authority dated 27 November 1998.

According to Section 41(1) of the *Environmental Protection Act 1994*, an application for environmental authority must -

- (a) be made to the administering authority in the approved form; and
- (b) be supported by enough information to enable the authority to decide the application, including, for example, relevant information about the likely risks to the environment, details of wastes to be generated and any waste minimisation strategy; and
- (c) be accompanied by the appropriate application fee.

Following a preliminary assessment of your submission, it is considered that insufficient information has been provided to enable the authority to decide the application. As the amount of information outstanding is considerable, your submission has been deemed an invalid application.

As you may recall, during our meeting of 17 November 1998, officers the Department indicated that there were a number of outstanding issues that had not been adequately addressed by the WBM Oceanics report 'Maroochy River Entrance Relocation Study'. You were advised that information in relation to these outstanding issues would be required in support of a licence application. Attached is a summary of the information that was identified as outstanding during our meeting, and on

review of the existing report and your recent submission. The information is
provided in the report and is available to the public. The information is
the Ministry of Health and a copy of the report is available to the public.
Attachment: Please note that the information is available to the public.
Information is available to the public and is available to the public.
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The information is available to the public and is available to the public.

Yours sincere

[Redacted Signature]
sch4p4(6) Personal information

Principal Environment Officer

FOR YOUR INFORMATION

The following information is available to the public:

Ministry of Health and a copy of the report is available to the public.

Attachment: Please note that the information is available to the public.

Information is available to the public and is available to the public.

The information is available to the public and is available to the public.

The information is available to the public and is available to the public.

RTI DL RELEASE - EHP

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ATTACHMENT ONE

Description of Proposal

Further detail is required with respect to the specific manner in which the proposed works are to be undertaken. The Department of Environment and Heritage (DEH) is of the understanding that Council are still considering a number of different options (all involving some form of dredging and relocation of dredged material) but that a final decision is yet to be arrived at. Please clarify precisely which 'option' Council intends to pursue under an application for environmental authority.

Therefore, subject to the above, the following information is required:

- a complete description of the operations/activities to be carried out including details relating to plant/equipment proposed to be utilised during the project and the scope of the proposed works;
- a description of the processes proposed to be used including the name and proposed location of all equipment to be utilised;
- the proposed location of a site office;
- proposed hours of operation;
- the expected duration of the proposal;
- the proposed location for after-hours storage of plant and equipment;
- the proposed location of fuel/oil storage facilities (including any associated safeguards proposed e.g. bunding);
- locations of associated infrastructure including pipelines associated with dredging works;
- details relating to public access restrictions to the site;
- a site plan;
- a large scale drawing which indicates the boundaries of the proposed works and which indicates the location of all proposed discharge and emission points to the environment (including discharges to water and land, air and noise emissions);
- details of contingency/emergency response procedures;

The DEH also requests details of any financial assurance arrangement that may be proposed between the Council and the prospective contractor with respect to actions which may or may not be required to rehabilitate or restore the environment as a result of environmental harm being caused by the activity.

Site-Based Management Plan

A Site-Based Management Plan must be developed which provides for the following:

- (i) The monitoring of releases of contaminants into the environment;
- (ii) The assessment of the environmental impacts of any releases of contaminants into the environment, for example any ambient environmental quality monitoring or noise monitoring; and
- (iii) The training of all relevant staff, agents and contractors ("staff") to competent levels in at least the following:
 - (a) The environmental management plan developed specifically for the proposal so that staff are aware of any relevant commitments to environmental management; and
 - (b) Any relevant environmental objectives and targets so that all staff are aware of the relevant performance objectives and can work towards these; and

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- (c) Control procedures for routine operations for day to day operational activities to prevent or minimise environmental harm, however occasioned or caused; and
 - (d) Contingency plans and emergency procedures for non-routine situations to deal with foreseeable risks and hazards including corrective responses to prevent and mitigate environmental harm (including any necessary site rehabilitation, contingencies in case of fuel spillages etc.); and
 - (e) Organisational structure and responsibility to ensure that roles, responsibilities and authorities are appropriately defined to manage environmental issues effectively; and
 - (f) Effective communication to ensure two-way communication on environmental matters between operational staff and Council as well as communications with the administering authority; and
 - (g) Documentation systems so that appropriate records of environmental matters are kept to demonstrate that the applicant is meeting environmental commitments; and
 - (h) Responsibilities of the Council and staff according to the *Environmental Protection Act 1994* so that these can be met; and
- (iv) The conduct of environmental and energy audits to review periodically:
- (a) the level of environmental performance; and
 - (b) the effectiveness of environmental management procedures adopted; and
 - (c) efficiency in using energy and resources and opportunities for more efficient usage; and
- (v) The implementation of an effective and appropriate waste management plan.

Acid Sulfate Soils

An Acid Sulfate Soil (ASS) Investigation is required for any coastal area at or below 5 metres AHD which will be exposed, drained or otherwise disturbed by the proposal. ASS investigations should be performed in accordance with the Queensland Acid Sulfate Soil Investigation Team (QASSIT) "*Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998*" dated October 1998 (Revision 4.0), or later versions thereof. Full soil profiles should be described according to McDonald et al., 1990 "*Australian Soil and Land Survey Field Handbook*" second edition, Inkata Press, Melbourne, and must include horizon differentiation and depths, field texture, colour, mottles, soil structure, erosion hazard rating and pH, and appropriate action levels of oxidisable sulfur selected from the QASSIT Guideline with respect to these soil descriptions. The location of each borehole and its existing surface height (Australian Height Datum) should be accurately surveyed, recorded and presented.

Possible investigation strategies (including staged testing) should be discussed with QASSIT and/or Land Resource Officers of the Department of Natural Resources (Nambour), and/or the Department of Environment (North Coast District Office).

An Environmental Management Plan (EMPlan) should be prepared prior to any soil disturbance and should include:

- a three (3) dimensional map of the potential acid sulfate soils to the depth of disturbance;

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- details that reflect potential on-site and off-site impacts of the disturbance of the soil and/or the groundwater levels;
- the methods that will be used to avoid, treat or otherwise manage ASS including the contained on-site management and treatment of potential and actual ASS;
- details of management of the height of the groundwater table on and off the site both during and post-construction;
- details of all soil and water monitoring to be performed during and after treatment, and including verification testing of soils;
- details of the handling and storage of neutralising agents;
- details of the contained on-site treatment and management of potentially contaminated stormwater run-off, surface waters and leachate (including details of groundwater management) associated with the works both in the short- and long-term; and
- a description of contingency procedures to be implemented on and off the site if the management procedures prove to be unsuccessful and acid is generated and/or leachate problems occur.

This plan should provide for ongoing management and monitoring of the impacts of acid soil material through the construction and operation of the project and describe the construction schedules and environmental management procedures. The development should be staged so that the potential impact of any area disturbed at any one time is limited and easily managed. Consideration should also be given to protecting any engineered structures from the corrosive properties of ASS and associated waters.

Water Resources

Describe the existing surface and groundwater resources. Establish a baseline of ground water and surface water quality and quantity taking into account seasonal changes. The following parameters should be considered: pH, dissolved oxygen, salinity, total nitrogen, nitrate, nitrite, ammonia, total phosphate, orthophosphate, chlorophyll a, iron, aluminium, manganese, suspended solids, turbidity, sulfate and chloride. Predict any changes that may occur as a result of this proposal.

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Develop a sediment sampling and analysis program to determine contaminant levels in the material proposed to be dredged, for the purpose of determining appropriate disposal methods for dredged spoil.

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 - total poly chlorinated biphenyls (PCB's);

- polynuclear aromatic hydrocarbons (PAH's);
- total petroleum hydrocarbons;
- copper;
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- zinc;
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Provide a detailed assessment of terrestrial and marine fauna present in the area of operation and in the adjacent protected areas, including the existence at any time of the year of rare or threatened species, protected or listed under international agreements (eg. RAMSAR, CAMBA and JAMBA), wildlife corridors and the impact of the proposal on these.

Provide a statement of the potential impacts of the proposal on the terrestrial and aquatic fauna. Quantitative data for existing fauna populations should be collected where possible (specific reference should be made to the False Water Rat - *Xeromys myoides*, and its habitat). Of particular concern is the potential impact the proposal may have on the avifauna that utilise the area. A thorough description of the species and the habitat utilised should be included. Temporal, spatial and climatic variations should also be considered in the assessment.

Make an assessment of the impact of the proposal on flora/fauna and identify and quantify the areas of different types of existing tidal habitat which will be lost and any habitat areas which will be created and the immediate and long-term effects of any loss or modification of tidal, inter-tidal and sub-tidal lands. Discuss the impact of noise and light associated with the construction and operational stages of the proposal on any wildlife likely to be present and management measures to mitigate

any impact. Any potential impacts on avifauna must be discussed in full. Provide details of revegetation/rehabilitation proposed for disturbed areas.

Data on field observations is to be accompanied by information on sampling methods and substantiation of the efficiency of these methods.

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For the purposes of determining the on-going efficacy of strategies proposed to be implemented to protect water quality, details of the extent and nature of benthic invertebrates potentially affected by the proposal are requested. Information required includes:

- a survey and assessment of the benthic invertebrates which will be potentially affected by the proposal;
- details of appropriate points at which regular benthic invertebrate monitoring is to be undertaken including details of the nature and frequency of parameters proposed to be tested; and
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The proposal is considered by the Department of Primary Industries (Fisheries Management) to have the potential for major impact on fisheries resources. Therefore, it must be demonstrated that all potential impacts are correctly identified and appropriate mitigation strategies are developed to minimise any such impacts. This includes indirect as well as direct impacts to fish habitat. The high level of protection afforded to the declared Fish Habitat Areas potentially affected by the proposal, further increases concern for the integrity and sustainability of this important area. Furthermore, the DEH has the responsibility of ensuring that species biodiversity is protected and that the appropriate water quality values as identified in the ANZECC guidelines are maintained with respect to aquatic ecosystems.

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- identify and discuss the benefits to public health and safety that will result from the relocation of the river mouth;
- discuss the nature of impacts that will occur to shallow water and intertidal areas in the estuary, especially those close to the new channel;
- provide information as to the mitigation measures Council propose to undertake to retain or create aquatic ecosystems, that currently exist in the mouth area;
- following sediment analysis, information should be provided on the anticipated size, location and duration of any turbidity plume.

Impacts on Coastal/River Processes

The main potential impacts associated with the proposed works which relate directly to coastal/river processes are: potential for changes to the tidal prism (low water and high water levels); potential change in the maximum velocity; and potential changes to flood hydraulics. These issues have been identified and addressed by the WBM report, *'Maroochy River Entrance Relocation Study'*. However, during the proposed dredging operations when there will be two channels open to the ocean (for an unknown period), the hydraulic efficiency will be increased, which is likely to result in

000104

lower low waters upstream in the Maroochy River (and in tributaries such as Cornmeal Creek) and therefore potential impacts on the intertidal communities and acid sulfate soils. An investigation of these issues should be provided.

Furthermore, it would appear that from the outset, no alternatives to dredging a channel opening across the northern spit have been considered. As the aforementioned WBM report notes, once the proposed channel is dredged and the existing channel closed, natural processes will again ensure that the channel moves south over time (at a rate dependent on factors such as the frequency of storm events). Therefore, an investigation of possible alternatives to the current proposal is requested.

RTI DL RELEASE - EHP

000103

NOTIFICATION UNDER THE NATIVE TITLE ACT 1993

Date of Issue: 7 January 1999

1m/22803

Foundation for Aboriginal and Islander Research
Action Aboriginal Corporation
c/- Mr Doug Fergusson
Senior Land Officer
Department of Natural Resources
GPO Box 1401
BRISBANE QLD 4001

Undumbi People
c/- Mr Stephen Nall
Nall Payne Solicitors
Level 19
141 Queen Street
BRISBANE QLD 4000

NATIVE TITLE CLAIM REFERENCE NO.	QC97/44
---	----------------

An application has been received by the Department from Maroochy Shire Council for the following approval :

TYPE OF APPROVAL	Sanction to carry out works in, on, over, through or across tidal lands or waters
UNDER WHAT STATE ACT	section 86 of the <i>Harbours Act 1955</i> - (as continued by section 236 of the <i>Transport Infrastructure Act 1994</i>)

The approval, if granted, will permit the following activity to happen :

NATURE OF ACTIVITY	Relocation of Maroochy River Entrance.
LOCATION OF ACTIVITY	Mouth of Maroochy River
REFER TO MAP	See attached map (map no

Some further details about the activity:

IT WILL COMMENCE ON	upon granting of sanction under section 86 of the <i>Harbours Act</i> .
IT WILL CONTINUE UNTIL	will remain in place (permanent works)
LIKELY DISTURBANCE TO THE LAND OR WATERS	Relocation of Maroochy River Entrance (approx 600m to the North and associated works.

You are invited to comment upon the grant of the approval.

Any comments :
must be **IN WRITING**; and
must be received no later than **12 FEBRUARY 1999**.
(in reply please quote: 971AP1713)

YOU CAN SEND YOUR COMMENTS TO :

Regional Manager Coastal Management
Department of Environment and Heritage
Southeastern Region
GPO Box 2771
BRISBANE QLD 4001

Signature of Issuing Officer
(Luke Zambelli - A/Technical Officer)

000112

*Application Received for Construction
of Works on Tidal Lands or Waters*

SECTION 86 HARBOURS ACT

Coastal Management Floor 23

TO: *Manager, Coastal Planning*

FILE NUMBER: 971AP1713

(section 86 file)

APPLICANT: Maroochy Shire Council

WORKS: Construction of:-

- (a) bunding to block the existing entrance; and
- (b) dredging of new channels

LOCATION: Maroochy River

Attached is a copy of the above application.

Where works proposed might have effects in regard to coastal management, the Beach Protection Authority's views as to the effects the works are likely to have in regard to coastal management are required, in accordance with the provisions of section 86(3)(id) of the *Harbours Act*.

Accordingly it is recommended that the Beach Protection Authority be requested to advise of its views on the proposed works, and to refer a copy of these views to this Section. Where the Beach Protection Authority requires additional information to give its views, it is requested that the Authority obtain such information directly from the applicant.

Signed

sch4p4(6) Personal information

Date

3 February 1999

John Harden

sch4p4(6) Personal information

000113

Application Received for Construction
of Works on Tidal Lands or Waters

SECTION 86 HARBOURS ACT

Coastal Management Floor 23

39

TO: Regional Manager, Cultural Heritage (Attention: Ms Jo-Anne Bain - 15th Floor)

FILE NUMBER: 971AP1713

(section 86 file)

APPLICANT: Maroochy Shire Council

WORKS: Construction of:-

- (a) bunding to block the existing entrance; and
- (b) dredging of new channels

LOCATION: Maroochy River

Attached is a copy of the above application. So that a response to the above can address all Regional concerns, please complete and return as soon as possible (ie within 7 working days).

Signed

sch4p4(6) Personal information

Date:

3 February 1999

John Harden

☒ (whichever is appropriate)

☐ Any objection to proposed works.

YES

☐ Detail on attached sheet

NO

☐ No objection to proposed works, subject to the following:-

☐ No conditions.

☐ Standard conditions.

☐ Other Conditions (detail on attached sheet).

TO BE DETERMINED

☐ (Detail on attached sheet)

☐ Additional information required before comments can be finalised (detail on attached sheet).

Applicant advised:

YES

☐

NO

☐

☐ Additional comments on proposed works (detailed on attached sheet).

☐ Any Departmental or Public issues known to be relevant to the works.

YES

☐

(Detail on attached sheet)

NO

☐

Action Officer

Name:

Telephone Number:

(Please note that section 86 of the Harbours Act 1955 pertains to sanctions for the construction of works in the area below the level of mean high water spring tides. Any conditions or comments should relate to the construction of the works, not the associated operations following construction.)

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Mr J Harden
(07) 3225 8422
SRW:jhl
971AP1713

5 February 1999

Chief Executive Officer
Maroochy Shire Council
PO Box 76
NAMBOUR QLD 4560

Attention: Mr Steve Wood

Dear Sir

RE: MAROOCHY RIVER ENTRANCE RELOCATION

I refer to your application dated 27 November 1998 for sanction under section 86 of the *Harbours Act 1955* to re-alignment of the river mouth, including

- construction of dunal bund across the river entrance,
- beach nourishment along The Esplanade and Cotton Tree Parade, Maroochydore; and
- dredging of 100 and 75 metre wide channels.

Officers of this Department have examined your proposal and the following matters require attention:-

1. The drawing, Figure 1, does not provide sufficient information on the proposed works.

Would you please provide two (2) copies of:-

- (a) Figure 1, signed as approved by a Registered Professional Engineer of Queensland, and including the following:-

- (i) Detail a "Typical Section" through the 75 metre wide channel.
- (ii) On each of the sections, detail the levels of mean high water spring tide and mean low water spring tide.
- (iii) Include additional AMG co-ordinates for:-
 - the outer limits of the dune crest;
 - the 75 metre wide dredged channel; and
 - the limits of the beach nourishment area.

- (iv) Detail the approximate volume of material to be dredged from each channel.

000117

- (v) The proposed disposal methods and area for the dredge spoil (Where the dredge spoil material is to be placed on tidal lands and not in the dunal bund and the beach nourishment, the AMG co-ordinates of the location will be required).
- (b) A drawing, signed as approved by a Registered Professional Engineer of Queensland, showing full construction details of the proposed beach nourishment works along The Esplanade and Cotton Tree Parade, Maroochydore.

This plan should include dimensions, batter slopes and details of the level of mean high water spring tide and mean low water spring tide.

2. Would you please provide the following:-

- (a) Letters of comment on the proposed works from the Regional Harbour Master Brisbane and the Department of Primary Industries.

Your advice that you are seeking these letters, is noted.

- (b) A letter from the Department of Natural Resources providing:-

- (i) advice on land tenure that may exist over the area of the works; and
(ii) comments on the proposed works.

- (c) Copies of documents giving tenure information for the subject waterfront properties along The Esplanade and Cotton Tree Parade, Maroochydore; including lot 39 USL 32605 and lot 1 on CP 862576

- (d) A copy of the registered real property plans USL 32605 and CP 862576.

You are also advised that:-

- (i) As required under section 86 (3)(id) of the *Harbours Act*, your proposal will be referred to the Beach Protection Authority for its views.
- (ii) Your proposal has been referred to other sections of this Department for consideration and comment.

Any concerns raised may need to be resolved before a s86 sanction is granted.

- (iii) The Commonwealth's *Native Title Amendment Act 1998* which took effect on 30 September 1998, has required the Queensland Government to change its operating procedures with respect to the assessment of the impact on native title of any proposed action prior to the authorisation of this action by the Government.

In certain circumstances, the Commonwealth *Native Title Act 1993* now requires that registered native title holders, registered native title claimants and Aboriginal and Torres Strait Islander Representative Bodies be notified and given an opportunity to comment on any proposal, and that these comments, if any, be taken into account in the assessment of applications for any authorisations, approvals, licenses or permits required under Queensland statutes.

"Notification" in accordance with the requirements of the Native Title Act has been sent to relevant registered native title holders and/or registered native title claimants, and Aboriginal and Torres Strait Islander Representative Bodies, inviting comments on your proposal.

Yours sincerely

B/c as per the attached sheet

sch4p4(6) Personal information

Bruce Brooks

Acting Senior Principal Engineer
Coastal Management

000116

B/c Environmental Protection Agency
North Coast District Office
PO Box 168
COTTON TREE QLD 4558

Attention: Mr Tony Crozier

Your Ref: 972EN123

Your letter dated 7 December 1998 to the Maroochy Shire Council refers.

A copy of the above application is attached.

Would you please advise when your office's concerns relating to the issuing of the EPA licence have been resolved and the s86 sanction could be processed.

Acting Senior Principal Engineer
Coastal Management

RTI DL RELEASE EMP

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SECTION 86 HARBOURS ACT

sch4p4(6) Personal information

John

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☐

RTI DL RELEASE - EHP

JBAIN

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sch4p4(6) Personal information

12/2/99



Memorandum

To

Subject **Relocation of the mouth of the Maroochy River**

Date

Notes

RTI DL RELEASE - EHP

Regional Manager
Southeastern

sch4p4(6) Personal information

~~o Anne Bain~~
Senior
Southeastern

sch4p4(6) Personal information

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rm/23596

Mr J Harden
(07) 3225 8422
SRW:jhl
971AP1713

15 February 1999

Chief Executive Officer
Maroochy Shire Council
PO Box 76
NAMBOUR QLD 4560

Attention: Mr Steve Wood

Dear Sir

RE: MAROOCHY RIVER ENTRANCE RELOCATION

I refer to this Department's letter dated 5 February 1999 concerning Council's application for sanction under section 86 of the *Harbours Act 1955* for the re-alignment of the river mouth.

Further to this Department's letter dated 5 February 1999, you are advised that:-

It is considered that the proposed works have the potential to have a severely negative impact on indigenous cultural heritage places and archaeological material within the old dunal system to the north of the current river mouth.

It is therefore appropriate that you be required to undertake a professional cultural heritage investigation and assessment of the development proposal.

This study should be undertaken by a professional heritage consultant holding a permit under the *Cultural Record (Landscapes Queensland and Queensland Estate) Act 1987*. The study should account for Aboriginal, archaeological and historic sites, items and places.

Following completion of the study, a management plan should be developed in consultation with the relevant indigenous people and the Regional Manager Cultural Heritage, to address the identified and potential cultural heritage values in the affected area.

Should you require any further information in relation this matter, the Regional Manager (Cultural Heritage) of this Department's Southeastern Region can be contacted on (07) 3225 8426).

Yours sincerely

sch4p4(6) Personal information

B/H Brooks
Acting Senior Principal Engineer
Coastal Management

000120

LEVEL 19, 141 QUEEN STREET, BRISBANE
GPO BOX 3114, BRISBANE, QLD 4001



TELEPHONE: (07) 3221 2044
FACSIMILE: (07) 3229 9842
DX: 40095
nallpayne@mailbox.uq.edu.au

27 January, 1999

OUR REF: SEN.PC.96443
YOUR REF: 971AP1713

Regional Manager Coastal Management
Department of Environment & Heritage
Southeastern Region
GPO Box 2771
BRISBANE QLD 4001

DEH Southeastern Region - FILE DETAILS		
971AP1713	Part:	Folio: 13
Correspondence #	199/1435	
Action Officer	ALISA Brewer Brooks	
Related Items		

Dear Sir

**Re: NATIVE TITLE CLAIM REF NO QC97 / 44
RELOCATION OF MAROOCHY RIVER ENTRANCE
SANCTION TO CARRY OUT WORKS IN, ON, OVER, THROUGH
OR ACROSS TIDAL LANDS OR WATERS**

We act on behalf of the Undumbi people.

We have consulted with our clients' representative, Mr K Dalton, about the above notification. He has advised us that:-

1. Because of our clients' knowledge of the Undumbi landscape, they are aware that archaeological material may be present on the ground in the area you wish to disturb. Such material, if it exists, will have been produced by their ancestors and will be of great significance to the Undumbi people. Our clients have instructed us they will contact you directly to arrange a suitable time to inspect the site and determine the basis upon which, if it is appropriate, they would be prepared to consent to works proceeding.
2. In the area you wish to disturb it is possible that archaeological material (or burials of Undumbi people) may exist underground. Such material (Undumbi ancestors) would be of historical and cultural significance to our clients. Our clients have instructed that they will contact you direct to make arrangements for the inspection of the site to determine the basis on which, if appropriate, works may proceed.
3. Our clients' knowledge of the Undumbi landscape indicates that your proposed development is close to or over known places of cultural heritage significance. Archaeological material produced by Undumbi ancestors may be present around or over the

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Partners:	Associates:	Associate Firms:			
Stephen Nall John Payne	Cameron Hall Cameron McCracken	SYDNEY R L Whyburn & Associates	ADELAIDE Duncan and Hannan	MELBOURNE Ryan Carlisle Thomas	PERTH Dwyer Durack

000122

Yours faithfully
NALL PAYNE

sch4p4(6) Personal information

sch4p4(6) Personal information

RTI DL RELEASE - EHP



18 February 1999

DEH Southeastern Region - FILE DETAILS		
971AP1713	Part:	Folio: 44
Correspondence #	199/2753	
Action Officer	A/SEA Brett Brooks	
Related Items		

Our Ref: N4020 FUA 99.0018

Regional Manager Coastal Management
Department of Environment and Heritage
Southeastern Region
GPO Box 2771
BRISBANE QLD 4001

Dear Sir/Madam

I write regarding the following Notification received by FAIRA Aboriginal Corporation pursuant to provisions of the *Native Title Act 1993* (Cth):

DNR Ref: 99.0018

Your Ref: 971AP1713

Date Received 18 January 1999

Nature of proposed activity Works in or over tidal lands and waters

State Legislation s.86 Harbours Act 1955

Details of proposed activity Relocation of Maroochy River Entrance
(approx 600m to the North)

Provision of NTA None provided



Foundation for Aboriginal and Islander Research Action

37 Balaclava Street
WOOLLOONGABBA

Telephone (07) 3391 4677
Facsimile (07) 3391 4551

PO Box 8402
WOOLLOONGABBA Q 4102 000121

RTI DL RELEASE - EHP

sch4p4(6) Personal information

sch4p4(6) Personal information

25 February 1999

Dr R Morton
WBM Pty Ltd
PO Box 203
SPRING HILL Q 4004



DEH Southeastern Region - FILE DETAILS		
97/AP/171.3	Part:	Folio: 48
Correspondence #	199/3130	
Action Officer	B. Kerwin	
Related Items		

Dear Dr Morton

MAROOCHY RIVER ENTRANCE RELOCATION WORKS

I refer to your letter and accompanying report of 11 December 1998 addressing issues raised by the Department of Primary Industries (DPI) concerning the proposal to relocate the mouth of the Maroochy River.

Fisheries Group, DPI have assessed the report and considers the proposed works within the lower reaches of the Maroochy River to have impacts upon fisheries resources not to be in keeping with the Fisheries legislation and the intent of the declaration of the Fish Habitat Area (FHA). Fisheries Group advises that Maroochy Shire Council must seek revocation of the FHA, before works associated with the relocation of the Maroochy River mouth may be approved.

In this particular case, the steps to be completed are listed below. The onus for initiating the revocation process lies with Council. This needs to be supported by a single document (the **Revocation Support Study (RSS)**).

I realise that much of the material being requested in the **RSS** has already been prepared and exists in other reports.

1. Maroochy Shire Council prepares **RSS** document and forwards same to DPI. The **RSS** needs to address the following issues:

- nominate the specific area/s within a declared FHA to be revoked;
- document/justify the need for the revocation;
- document all site options for proposed works;
- identify impacts on declared FHA and on fisheries;
- outline mitigation measures (see below) to reduce impacts from any proposed works;
- summarise community support for proposal (this would include the comments of Queensland Commercial Fishermen's Organisation and SUNFISH); and,
- summarise Whole-of-Government and community support.

CC: Mr M Dredge, Industry Manager, Fisheries Resource Management, Southern Fisheries Centre, PO Box 76, DECEPTION BAY QLD 4508

Mr B Kerwin, Acting Regional Manager, Coastal Management, Department of Environment and Heritage, GPO Box 2771, BRISBANE QLD 4001

District Officer, Queensland Boating and Fisheries Patrol, PO Box 199 MOOLOOLABA QLD 4557

sch pp4 (6) Personal Information

FISHERIES GROUP

Enquiries to: Mathew Johnston Your Ref: Our Ref: 210/12
13 Beach Road, PO Box 76, Deception Bay, QLD 4508
Telephone: (07) 3817 9554 Facsimile: (07) 3817 9555
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RTI is the RSS act passed in 2005. It is the right to know. It is the right to know the government's activities and the right to know the government's policies. It is the right to know the government's actions and the right to know the government's decisions.

The government is the one who is responsible for the RTI. It is the government's duty to provide the information to the citizens. It is the government's duty to provide the information to the citizens in a timely and accurate manner.

RTI is a right to know. It is the right to know the government's activities and the right to know the government's policies. It is the right to know the government's actions and the right to know the government's decisions. It is the right to know the government's information.

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sch4p4(6) Personal information

RTI DL RELEASE - EHP

000123



Department of Environment

Southeastern Regional Office

Level 15, Jetset Centre, 288 Edward Street • Brisbane, Queensland

GPO Box 2771 • BRISBANE QLD 4001

Telephone (07) 3224 5641 • Facsimile (07) 3225 8723

File reference 971AP1713
Your reference

Memorandum

To

anager (C)

25/2

Subject

Response to Undumbi's Native Title Claims (s86).
Proposed Relocation of the Maroochy River Entrance

Date

Notes

RTI DL RELEASE - EHP

sch4p4(6) Personal information

B Brooks
Acting Senior Principal Engineer
Coastal Management

LEVEL 19, 141 QUEEN STREET, BRISBANE
GPO BOX 3114, BRISBANE, QLD 4001



TELEPHONE: (07) 3221 2044

FACSIMILE: (07) 3229 9842

DX: 40095

nallpayne@mailbox.uq.edu.au

COPY

27 January, 1999

OUR REF: SEN.PC.96443

YOUR REF: 971AP1713

Regional Manager Coastal Management
Department of Environment & Heritage
Southeastern Region
GPO Box 2771
BRISBANE QLD 4001

DEH Southeastern Region - FILE DETAILS		
971AP1713	Part:	Folio: 143
Correspondence #	199/1435	
Action Officer	N. SPENCE	
Related Items	Barron Brierley	

Dear Sir

**Re: NATIVE TITLE CLAIM REF NO QC97 / 44
RELOCATION OF MAROOCHY RIVER ENTRANCE
SANCTION TO CARRY OUT WORKS IN, ON, OVER, THROUGH
OR ACROSS TIDAL LANDS OR WATERS**

We act on behalf of the Undumbi people

We have consulted with our clients' representative, Mr K Dalton, about the above notification. He has advised us that:-

1. Because of our clients' knowledge of the Undumbi landscape, they are aware that archaeological material may be present on the ground in the area you wish to disturb. Such material, if it exists, will have been produced by their ancestors and will be of great significance to the Undumbi people. Our clients have instructed us they will contact you directly to arrange a suitable time to inspect the site and determine the basis upon which, if it is appropriate, they would be prepared to consent to works proceeding.
2. In the area you wish to disturb it is possible that archaeological material (or burials of Undumbi people) may exist underground. Such material (Undumbi ancestors) would be of historical and cultural significance to our clients. Our clients have instructed that they will contact you direct to make arrangements for the inspection of the site to determine the basis on which, if appropriate, works may proceed.
3. Our clients' knowledge of the Undumbi landscape indicates that your proposed development is close to or over known places of cultural heritage significance. Archaeological material produced by Undumbi ancestors may be present around or over the

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Partners:	Associates:	Associate Firms:			
Stephen Nall	Cameron Hall	SYDNEY	ADELAIDE	MELBOURNE	PERTH
John Payne	Cameron McCracken	R L Whyburn & Associates	Duncan and Hannan	Ryan Carlisle Thomas	Dwyer Durack

000136

...and we have discussed the proposed changes to the proposed rule with the
Department. The proposed rule is being revised to reflect the comments and
concerns of the public and to ensure that the rule is appropriate and
effective.

For the reasons stated above, the proposed rule is being revised to reflect the
comments and concerns of the public and to ensure that the rule is appropriate and
effective. The proposed rule is being revised to reflect the comments and
concerns of the public and to ensure that the rule is appropriate and
effective.

Yours faithfully
NALL PAYNE

[Redacted]
sch4p4(6) Personal information

[Redacted]
sch4p4(6) Personal information

RTI DL RELEASE - EHP

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if granted,

RTI DL RELEASE - EHP

RTI DL RELEASE - EHP

sch4p4(6) Personal information

OFFICE USE ONLY

Receipt No. 2917258

Amount \$ 5,083-00

Date Received 7/12/18



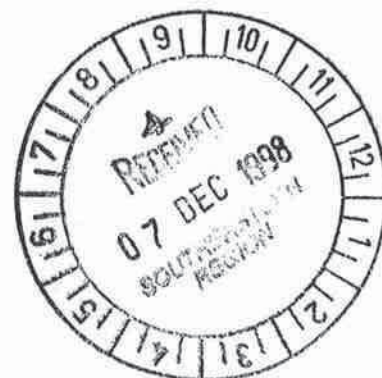
Maroochy Shire Council
PO Box 76, Nambour, Qld. 4560
Tel: (07) 5441 4333 Fax: (07) 5441 4333

RTI DL RELEASE - EHP

sch4p4(6) Personal information

CHIEF EXECUTIVE OFFICER

7/12/98 2917256 85063-00



Postal: The Chief Executive Officer
Maroochy Shire Council
PO Box 76, Nambour, Qld. Aust. 4560
DX 41900 Fax: (07) 5441 4333

000132



100682

1AP1713		ETAILS FILE
Region		J HARDEN

sch4p4(6) Personal information



000140

Contact officer:

Your ref:

160 Ann Street, Brisbane
PO Box 155
BRISBANE ALBERT STREET
QUEENSLAND 4002
Telephone (07) 3227 8494
Facsimile (07) 3221 0768

Telephone:

Our ref:

(Please quote)

File No.: 750186

CHAIRPERSON

BEACH PROTECTION AUTHORITY

SECTION 86 - HARBOURS ACT 1955
CONSTRUCTION OF BUNDING TO BLOCK THE EXISTING CHANNEL
AND DREDGING A NEW CHANNEL SITUATED AT THE
MAROOCHY RIVER MOUTH, MAROOCHYDORE

Section 86 of the *Harbours Act 1955* provides that where works proposed to be constructed or placed on the coast consist of a groyne, seawall or river training wall or other works of a type which might have effects in regard to coastal management, a copy of the plan of the proposed works shall be referred to the Beach Protection Authority and the Authority shall advise in writing its views as to the effects the construction or placement of the works is likely to have in regard to coastal management.

In accordance with section 86 of the said Act the views of the Authority have been sought concerning an application by Maroochy Shire Council proposing to construct bunding to block the existing channel and dredging a new channel situated at the Maroochy River mouth, Maroochydore.

The proposal has been examined and it is considered that the Authority advise as follows.

The Maroochy Shire Council has proposed to realign the mouth of the Maroochy River to reduce erosion on the southern bank of the river. The works comprise dredging a new entrance channel to the north and blocking the existing channel with the sand obtained from the dredging.

A report on the entrance of the Maroochy River has been prepared by WBM Oceanics on behalf of Maroochy Shire Council. The report considered the impacts of a new entrance channel on the tidal and flooding dynamics of the estuary and demonstrated that any detrimental effects would not be significant. The report also indicated that the proposed position of the new channel is within the historic range of natural migration of the river entrance. Therefore, the proposed works are not expected to have any adverse impacts on coastal processes for this section of coast.

Power to provide the views of the Authority concerning proposals for works under section 86 of the *Harbours Act 1955* has been delegated by the Authority.

Accordingly, in the exercise of that delegated power, your approval is requested to provide the aforementioned views of the Authority in relation to the proposed works.

Approved

sch4p4(6) Personal information

R. Martin

ACTING SECRETARY

BEACH PROTECTION AUTHORITY

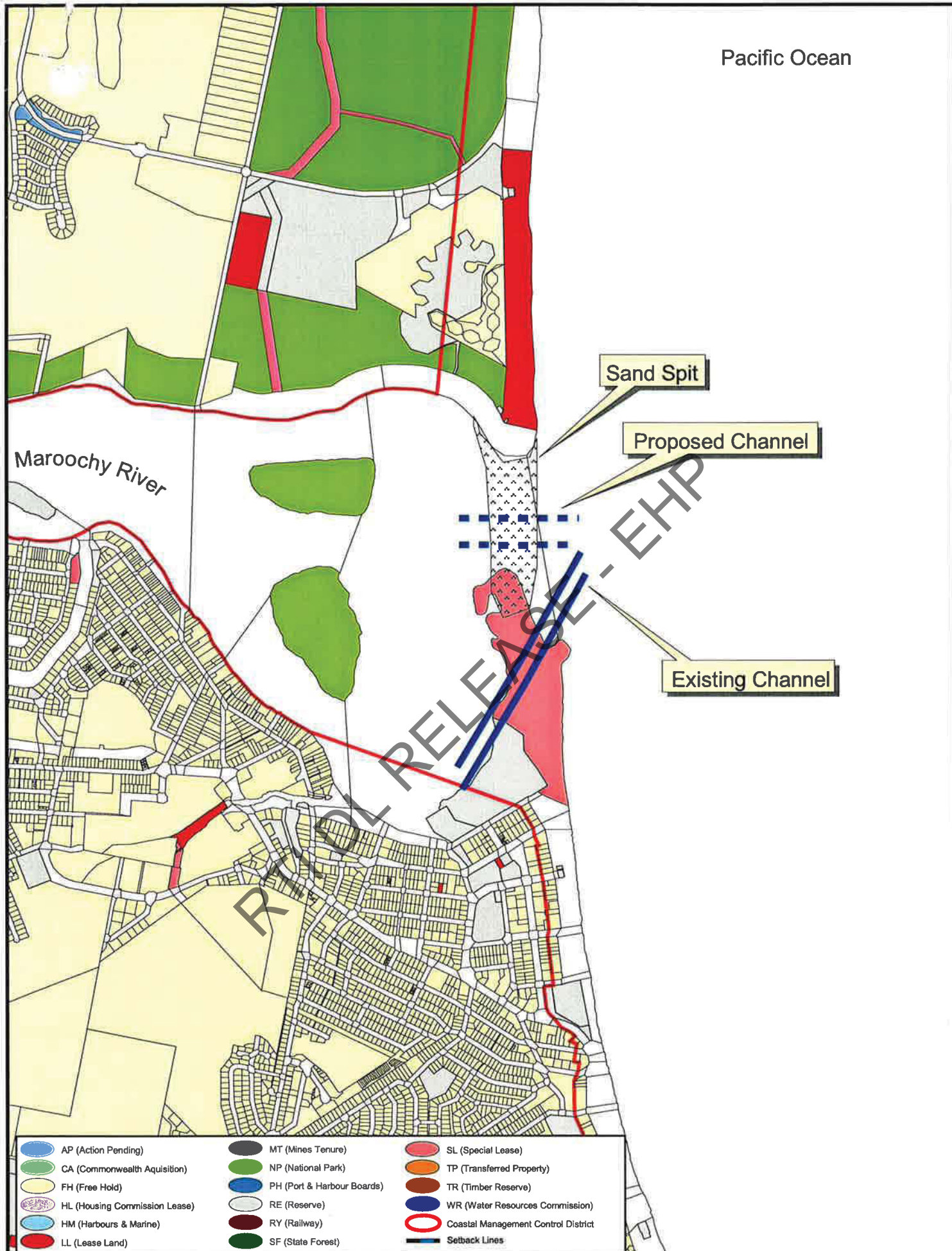
Date: 7 September 1999

sch4p4(6) Personal information

Delegate/Chairperson
Beach Protection Authority

sch4p4(6) Personal information

sch4p4(6) Personal information



**ENVIRONMENTAL PROTECTION AGENCY
DEPUTATION BRIEFING NOTE**

TO THE HONOURABLE THE MINISTER
SUBJECT DREDGING MAROOCHY RIVER MOUTH
DEPUTATION BY QCC FOR MEETING
ON 24 August 2000

Noted/ Approved/ Not Approved	
Minister	
Date	/...../.....

RECOMMENDATION

It is recommended that the Minister **note** the information provided for the meeting with the representatives from the Queensland Conservation Council regarding the proposal by the Maroochy Shire Council to relocate the Maroochy River mouth to the north by dredging a new channel through the northern spit and closing off the existing southern channel.

Minister's comments

BACKGROUND

By letter dated 3 August 2000, the Maroochy Shire advised the EPA that at its meeting on 27 June 2000 it was resolved to arrange a meeting with the Minister and representatives of the Department of Primary Industries (DPI), the EPA and the Beach Protection Authority (BPA) to discuss, among other things, the options available to Council with respect to dredging through the northern spit of the Maroochy River entrance, and the approval processes for those options. This meeting is still to be arranged.

Council further resolved to adopt the entrance relocation option and engage consultants to prepare a detailed design of the selected option and obtain all government approvals required to permit construction to proceed.

The Maroochy Shire Council, with the assistance and advice of the EPA (BPA officers, Central office and regional staff), and DPI officers, have been investigating their options to contain the erosion on the southern bank of the Maroochy River entrance and estuary for a number of years. This investigation included model testing at the Queensland Government Hydraulics Laboratory, of a number of proposals at the southern entrance. The model testing was commissioned and the testing program specified by the Maroochy Shire Council.

In November 1998, following on from a previous investigation, the Council made application under section 86 of the *Harbours Act 1955* to relocate the Maroochy River entrance to the north of the existing entrance. The Council was advised that further detailed information was required before the application could be processed. At the same time, the Council applied for environmental authority to undertake the dredging under the *Environmental Protection Act 1994*. The application was deemed invalid as insufficient information was provided to enable the application to be decided. To date, no additional information has been received to allow the processing of the section 86 application, and no dredging applications have been received.

Briefing Officer: Paul O'Keeffe
Senior Principal Engineer

Approved: Olwyn Crimp
Director Environmental Planning

Telephone: 07-3227 8496
Correspondence No: BNE2000/4150

Date: 23 August 2000
File No: STH684

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KEY ISSUES

- The Maroochy River entrance is a natural river entrance and over the last several decades the entrance channel has moved from a northern location to south of Pincushion Island. The current location of the entrance channel is still within the historical limits of entrance movement.
- Further southerly movement of the channel has the potential to threaten the Maroochy Surf Life Saving Clubhouse and the established Pincushion and Cotton Tree Caravan Parks (as opposed to the relatively undeveloped adjacent camping area of which less than 50% of the original area established in 1985 remains).
- The majority of the Maroochy River estuary is in a declared Fish Habitat Area (FHA) and DPI has advised that the FHA would need to be revoked before works associated with the relocation of the mouth could be approved.
- The BPA is of the view that the proposed channel relocation will not have any adverse effects on coastal processes for this section of the coast. The Authority considers that the relocation of the river mouth by dredging a new channel through the northern spit and closing off the existing southern channel is a replication of the natural processes and avoids the need for hard engineering works such as rock walls and groynes.
- However, the dredging works required for such a project have the potential to have significant impact on the environment of the Maroochy River estuary. This aspect of the proposal needs further detailed investigation to quantify the impacts and determine, if possible, acceptable means of mitigating the detrimental impacts.
- Since 1996, the local conservation community have expressed strong opposition to the proposal to "interfere" with the natural processes of the Maroochy River estuary by dredging.
- Given the relatively high cost of the project, a cost/benefit analysis of the project would appear to be warranted and would be beneficial in determining the ecological sustainability of the proposal.
- The Maroochy Shire Council have approached the state government for assistance with funding for this project on several occasions and to date have been advised that the only avenue to obtain State funding would be through the Local Governing Bodies' Annual Capital Works Program administered by the Department of Communication, Information, Local Government, Planning and Sport.

Briefing Officer: *Paul O'Keeffe*
Senior Principal Engineer

Telephone: 07-3227 8496
Correspondence No: BNE2000/4150

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Approved: *Olwyn Crimp*
Director Environmental Planning

Date: 23 August 2000
File No: STH684

000165

SUNSHINE COAST ENVIRONMENT COUNCIL Inc.

23 Howard Street PO Box 269 Nambour Qld 4560 Phone (07) 5441 5747 Fax (07) 5441 7478



00197

The Minister for Environment
Hon. Brian George Littleproud, MLA
Level 17
160 Ann St.
Brisbane, 4000

OFFICE OF THE MINISTER FOR ENVIRONMENT		
RECEIVED 16 JAN 1997		
GO TO	NAME	NOTED
	MINISTER	
	SNR MIN ADVSR	
	MIN ADVISOR	
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	SNR MEDIA ADVISOR	
	MEDIA ADVISOR	
✓	DIRECTOR-GENERAL	
	MINISTERIAL FILE	

17/1/97

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97/00023

Dear Mr. Littleproud,

Re: Maroochy River Mouth dredging

The Sunshine Coast Environment Council was alarmed to read in the Sunshine Coast Daily of January 14 (p. 5) that the Maroochy Shire Mayor is "pressuring him (the Minister for Environment) to talk to the Natural Resources people" (Mr King's words; words in brackets added by the author) to give support to a plan to dredge a new northern channel for the Maroochy River as a proposed solution to the erosion at Pincushion.

SCEC feels compelled to urge you, as Minister for the Environment, to give serious consideration to the environmental consequences such an operation would have. A number of recreational fishers are also concerned about moves to dredge the river mouth. Therefore, SCEC requests that a meeting between a delegation of community, environment and recreational fishery representatives and the Minister be arranged as a matter of urgency to discuss this important matter.

The training of the river mouth has been a recurring issue for a number of years now, because of potential implications on the Pincushion Caravan Park and perceived risks to a number of structures. For this reason a submission on this very issue has been prepared on behalf of SCEC some time ago and is enclosed with this letter for your information.

A certain natural and land use induced instability of the river mouth is to be expected and cannot be effectively addressed by simply redirecting the channel. To the contrary, if the river mouth is changed, dredging will have to be conducted continuously and this will mean a considerable strain on Council funds as well as on environmental resources. Inevitably permanent training would be suggested.

- ~~B/C Exec Dir Cons~~ ① COASTAL M'MENT.
- ☒ For Ministerial reply
- ☐ For Appropriate Action
- ☐ For information & any necessary action

sch4p4(6) Personal information

Director-General

M.C.U.

21 JAN 1997

Seeking to Preserve the Quality of Life

Some of the environmental concerns with the proposed dredging of a northern channel are as follows:

- 1. Dredging will interfere with the fish breeding grounds at the river mouth and could have catastrophic results on fishstocks, especially with ongoing dredging.**
- 2. As the Maroochy River mouth would effectively be widened, it would mean that the level of brackish water upstream would be raised during high tide, with serious potential salinity related impacts on littoral, riparian and other associated ecosystems as well as certain land uses (e.g. cane farming).**
- 3. The currents at the river mouth would be increased resulting in higher turbidities with associated effects on estuarine and marine ecology as well as visual amenity, not to mention the dangers to surfers and swimmers.**

The Maroochy River is the last river in south-east Queensland which has a natural river mouth. The dredging of a northern channel could have serious side effects on the tourism industry as its visual amenity and safety aspects would be seriously affected.

All assets in the vicinity of the river mouth (e.g. Caravan Park) were approved on the condition that they may have to be removed as a result of natural changes of the river near the mouth. For this reason, State Government has never allowed any permanent fixtures at Pincushion Caravan Park.

Rather than dredging an alternative channel to the north, a better solution, from the environmental point-of-view, would be to provide weirs on all existing canal ends in order to reduce the volume of the tidal exchange water. A further mitigating measure could be to build bund walls to protect properties and any structures at Cotton Tree. Terminating the Maroochy Shire Council lease on Pincushion Caravan Park and establishing a foreshore reserve would also have, both public and environmental, benefits.

SCEC urges the Minister to refrain from making a quick decision, but instead to conduct a full environmental impact assessment, including detailed hydrological studies to gauge upstream flooding effects of opening up the river mouth.

Yours sincerely

sch4p4(6) Personal information

**Barbara Schwabe
Project Officer**

003028

**THE ARGUMENTS AGAINST
SUBMISSION ON
MAROOCHY RIVER MOUTH
STABILIZATION/RECLAMATION
SCHEME**

*Prepared by Jim Cash
for Sunshine Coast Environment
Council and the Australian
Littoral Society*

SUMMARY

This report demonstrates

1. The Maroochy River has no major siltation problem at the Maroochy River mouth.

Historical and photographic records show it has always had a restricted river entrance with sand banks extending up to Chambers Island.

2. The Maroochy River has a history of movement of its mouth - movement either side of Pin Cushion. The present situation mirrors this history. The State Beach Protection Agency has an adequate and logical plan to cope with this movement.

The proposal to open the mouth is based on wrong information attempting to give the impression that the river mouth is behaving abnormally different to times past.

This report demonstrates that opening the river mouth has the following consequences for the community.

(i) EROSION OF NORTH SHORE BEACHES

Reclamation of sand from the mouth will rob the Northern lateral drift of sand of some 3 to 4 million cubic metres. Sand destined for northern Sunshine Coast beaches. **EROSION OF NORTH SHORE BEACHES IS INEVITABLE.**

(ii) LOSS OF FISHERIES

The Maroochy River Fisheries will be severely damaged due to -

- Loss of the sand bar zone (considered to be of regional significance for fish breeding)
- damage to the biology of the river due to dredging activities.

(iii) FLOODING PROBLEMS

The Sand bar reduces tidal heights within the Maroochy River system. By removing it, average tidal heights will be higher in the Maroochy River potentially increasing the flooding problems. This scheme fails as a flood mitigation scheme as it makes no account of tidal influence.

(iv) **LOSS OF AESTHETICS** - the low key passive recreation provided by the Maroochy River mouth will be replaced by a build up of urban environment/

(v) **LOSS OF RECREATIONAL RESOURCE**

Recreational Fisheries will be depleted and a low key natural river mouth will be lost to the community.

(vi) **LOSS TO TOURIST INDUSTRY**

Hundreds of thousands of people visit/use the Maroochy River each year. The majority use it for recreational fishing and its other natural values. The tourist industry will suffer by the loss of this resource.

(vii) **Huge COSTS IN CONSTRUCTION and MAINTENANCE** - some of which will inevitably be met by government funding - our taxes and rates.

CONCLUSION

This report suggests alternative ways of managing pollution and flood mitigation associated with the Maroochy River System.

It concludes the points against the proposal far outweigh the points for.

**THE STABILIZATION SCHEME SHOULD
BE REJECTED**

Original and full report
will be sent by mail.

sch4p4(6) Personal information

RTI DL RELEASE - EHP

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RTI DL RELEASE - EHP

Environment Council

sch4p4(6) Personal information

6/2/97

5/2/97

5/2/97

030022

Ref: 750186
97/00825

14 FEB 1997

Ms B Schwabe
Project Officer
Sunshine Coast Environment Council Inc
PO Box 269
NAMBOUR QLD 4560

Dear Ms Schwabe

I refer to your letter dated 17 January 1997 with regard to dredging at the mouth of the Maroochy River.

I am sure your members would know that the ongoing erosion to the south bank of the Maroochy River at its mouth and the possibility that the river will break through the dunes to the south of Pincushion Island are issues about which the Maroochy Shire Council has genuine concern.

If there were no development to the south, the obvious coastal management strategy would be to 'do nothing'. However, there is infrastructure in proximity to a possible southerly migration of the Maroochy River and the 'do nothing' option is not realistic, given that building development is established in Alexandra Parade and at the surf life saving club.

For most of its observed history, the Maroochy River has flowed to the ocean through a single dominant channel. Over time, the position of the dominant channel has varied between the north shore at Mudjimba to south of Pincushion Island, covering the whole width of the entrance.

The reinstatement of the river mouth to its 1974 location would artificially simulate the natural processes of river mouth fluctuation and meander. Following relocation, the mouth would again move naturally thus creating minimum impact on the whole ecology of the river.

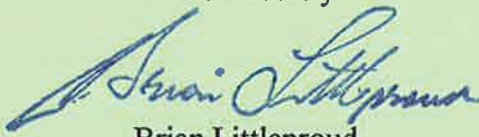
..../2

000031

The mouth of the Maroochy River has migrated naturally over a long term cyclical basis. The dredging option simply shortens the period between the times when the mouth is in a northern location.

The Maroochy Shire Council has commissioned a design study of the coastal process and river dynamic aspects of the dredging option. The Council will also liaise with the Department of Primary Industries, Fisheries and Forestry to mitigate any impacts the dredging may have on the Fish Habitat Reserve. The study will also require consultation with the local community and the issues which you have raised will be addressed through that study.

Yours sincerely



Brian Littleproud
Minister for Environment

RTI DL RELEASE - EHP

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HON. N. TURNER MLA
MINISTER FOR NATURAL RESOURCES



sch4p4(6) Personal information

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Turner

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080043

RTI DL RELEASE - EHP

sch4p4(6) Personal information

26 MAR 1997

CARING OFFICER

information

letter dated 4 March 1997 in which you advise of your request to the Maroochy Shire Council to dredge the mouth of the Maroochy River to the south bank of the Maroochy River at its mouth. The proposed dredge break through to the south of Pincushion Island are issued. The Maroochy Shire Council has genuine concern.

re, for most of its observed history, the Maroochy River has been a single dominant channel. Over time, the position of the channel has moved from the north shore at Mudjimba to south of Pincushion Island. The natural cycle and the reinstatement of the river mouth to its original position would allow the natural process of river mouth fluctuation and movement. The river mouth would again move naturally thus creating minimum river

The ongoing erosion to the south bank of the Maroochy River at its mouth and the possibility that the river will break through to the south of Lincushion Island are issues about which the Maroochy Shire Council has genuine concern.

As you are aware, for most of its observed history, the Maroochy River has flowed to the ocean through a single dominant channel. Over time, the position of the dominant channel has varied between the north shore at Mudjimba to south of Pincushion Island. This migration is part of a long term cycle and the reinstatement of the river mouth to its 1974 location would artificially simulate the natural process of river mouth fluctuation and meander. Following relocation, the mouth would again move naturally thus creating minimum impact on the whole ecology of the river.

Yours sincerely

Yours sincerely


000056



MINISTÈRE DU DÉVELOPPEMENT ÉCONOMIQUE

FRONT

DIRECTORATE GENERAL OF ECONOMIC DEVELOPMENT

MINISTÈRE DU DÉVELOPPEMENT ÉCONOMIQUE

WORK

sch4p4(6) Personal information

ST 0111 : The Government of Canada is pleased to provide this information and documents to the public.

Subject: The Government of Canada is pleased to provide this information and documents to the public.

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RTI DL RELEASE - EHP

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.....sch4p4(6) Personal information.....

: 21 / 3 / 97

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: 20 / 3 / 97

.....A T BUTLER.....

: 20 / 3 / 97

.....78496.....

RTI DL RELEASE - EHP

000054

Ref: 750186
97/03061

11 March, 1997

sch4p4(6) Personal information

sch4p4(6) Personal information

The Honourable Brian Littleproud, MLA, Minister for Environment, has asked me to acknowledge receipt of your letter dated 4 March 1997 concerning a proposal to dredge the Maroochy River.

Mr Littleproud will write to you as soon as possible.

Yours sincerely

sch4p4(6) Personal information

Gary Gilbert
Senior Ministerial Advisor

RTI DL RELEASE - EHP

000053

97/03061

Hon. B. Littleproud
Minister for the Environment
P.O. Box 155
Albert Street
Brisbane 4002

Dear Mr Littleproud,

I am writing to you regarding the Maroochy S

OFFICE OF THE MINISTER FOR ENVIRONMENT		
RECEIVED - 5 MAR 1997		
GO TO	NAME	NOTED
	MINISTER	
	SNR MIN ADVSR	
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✓	DIRECTOR-GENERAL	
	MINISTERIAL FILE	

sch4p4(6) Personal information

*For preparation of a
Ministerial reply please
1/3/97*

RTI DL RELEASE - EHP

B/C: Exec Dir Cons

☒ For Ministerial reply

☐ For Appropriate Action

☐ For information & any necessary action

sch4p4(6) Personal information

for
Director-General

sch4p4(6) Personal information

Ref: 750186
97/03352

- 8 APR 1997

CARMS MOD

sch4p4(6) Personal information

Dsch4p4(6) Personal information

I refer to your letter dated 4 March 1997 in which you express opposition to the decision of the Maroochy Shire Council to dredge a northern channel at the mouth of the Maroochy River.

The ongoing erosion to the south bank of the Maroochy River at its mouth and the possibility that the river will break through to the south of Pincushion Island are issues about which the Maroochy Shire Council has genuine concern.

As you are aware, for most of its observed history, the Maroochy River has flowed to the ocean through a single dominant channel. Over time, the position of the dominant channel has varied between the north shore at Mudjimba to south of Pincushion Island. This migration is part of a long term cycle and the reinstatement of the river mouth to its 1974 location would artificially simulate the natural process of river mouth fluctuation and meander. Following relocation, the mouth would again move naturally thus creating minimum impact on the whole ecology of the river.

The design study which has been commissioned by the Maroochy Shire Council will examine the option of dredging and reinstating the mouth of the river to its 1974 location. The brief for the consultants does not include any requirement to study mechanisms to stop the movement of the mouth to the south. The consultants will examine the following components: coastal/hydraulic process model; water quality model; and surveys and mapping of ecological and fisheries resources. The study includes community consultation.

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The advice that I have received on the current design study indicates that the list of issues set out in your letter is included in the study.

I appreciate your interest in this matter and thank you for providing me with your views on the proposal.

Yours sincerely

A handwritten signature in blue ink, appearing to read "Brian Littleproud".

Brian Littleproud
Minister for Environment

RTI DL RELEASE - EHP

000061



MINISTERIAL CORRESPONDENCE UNIT

FROM: DIRECTOR, CAPITAL MANAGEMENT

2

MINISTERIAL CORRESPONDENCE UNIT - APPROVED

WRITER:

sch4p4(6) Personal information

SUBJECT: Financial Institutions Ministry Order From The Director, Capital Management
Date: March 14, 2018

Notes: The above subject should be placed in the following manner:

The original document is the subject of the Ministry Order. The subject is the
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sch4p4(6) Personal information

Date: 26/3/97

Date: 25/3/97

AT BUTLER

Date: 25/3/97

Contact Officer's Telephone No.: 78496

RTI DL RELEASE - EHP

000050

Ref: 750186
97/03352

18 March, 1997

sch4p4(6) Personal information

Dear Ms Marriott

The Honourable Brian Littleproud, MLA, Minister for Environment, has asked me to acknowledge receipt of your letter dated 4 March 1997 concerning a proposal to dredge a northern channel through the sandbar zone of the Maroochy River.

Mr Littleproud will write to you as soon as possible.

Yours sincerely

sch4p4(6) Personal information

Gary Gilbert
Senior Ministerial Advisor

000058

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MINISTER	
SRM MIN ADVSR	
MIN ADVSR	
PTNS SCS	
ADVISOR	
MEDIA ADVISOR	
☒ DIRECTOR-GENERAL	

sch4p4(6) Personal information

97/0182

For preparation of a suitable reply for Ministers signature please

RTI DL RELEASE - EHP

M.C.U.

13 MAR 1997

sch4p4(6) Personal information

① COASTAL MIMENT

030037

B/C Exec Dir Cons

- ☒ For Ministerial reply
- ☐ For Appropriate Action
- ☐ For information & any necessary action

sch4p4(6) Personal information

S H
MA

Hydraulics Lab.

Please file on 750186 PB
Our records show the
file is with you.
Thank you, Rezeers

Maroochy Shire Council
Council Chambers
nr Bury and Currie Sts. Nambour
Tel (07) 5441 8211

Your reference:
Our reference:
Inquiries:
Direct Telephone:
Direct Fax No:

75018

PT2.

25A

Authority Queensland

97/
RTI DL RELEASE - EHP

sch4p4(6) Personal information

CHIEF EXECUTIVE FF

Pod,
file and
attend
behalf

Confirmed attendance
of meeting on 24 Sept.

sch4p4(6) Personal information

sch4p4(6) Personal information

Address all communications to: The Chief Executive Officer, P.O. Box 76, Nambour, Qld., 4560.
DX 41900 Facsimile (07) 5441 8338



Maroochy aspires to be the most environmentally responsible,
caring, enterprising and dynamic community in Australia.

750186
PT2
(28)

Your reference:
Our reference:
Enquiries:
Direct Telephone:
Direct Fax No:

of Environment,



sch4p4(6) Personal information

CHIEF CUTIVE

Noted
700K
25/5

A. Butler
T. Carter
T. Mooney

For your information

sch4p4(6) Personal information

Please quote our file reference number on your reply for fast tracking within Council.

Address: Maroochy Shire Council
Council Chambers
Cnr Bury and Currie Sts, Nambour, Qld, Aust.
Telephone: (07) 5441 8211

Postal: The Chief Executive Officer
Maroochy Shire Council
PO Box 76, Nambour, Qld, Aust. 4560
DX 41900 Fax: (07) 5441 8338

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NOTES

Compiled by
Secretary to Director Engineering Services

MAROOCHY RIVER ENTRANCE WORKING PARTY

Large Committee Room

8 May 1998

ATTENDEES:

Cr H Schwabe (Deputy Mayor)

Cr B Cansdell

Cr A Kerlin

N Ludwig

J Kleinschmidt

J Jolly

Cr J Natoli

Cr G Gordon

J Warmington

L Willis

I Hamilton

C Witt

M Andrews

P O'Keefe

R Quinn

WBM Oceanics

WBM Oceanics

Beach Protection Authority

Department of Fisheries

Meeting opened at 1.15 p.m.

J Warmington opened the meeting and advised that WBM Oceanics had been commissioned to undertake a further assessment of the options put forward at the meeting of the Working Party on 24 September 1997 including the "do nothing" option. After the recent breakthrough south of Pincushion the Consultants had been invited to provide information back to Council fairly quickly.

WBM OCEANICS PRESENTATION

C Witt gave a presentation on the studies they have prepared.

PREVIOUS STUDY

WBM had been commissioned in early 1997 to undertake a study to look at establishing a new entrance to the Maroochy River to the north. The findings of that study determined that the southern channel continued to migrate south and was threatening to breakthrough south of Pincushion.

The objectives of the previous study were to:-

- Determine appropriate location and cross-section of northern entrance
- Look at associated works and the potential impact of these works
- Look at options for a new entrance to the north coupled with the closure of the existing entrance

Summary of findings from previous study:-

- The northern entrance option was preferred
- The relocation of the entrance would be unlikely to affect flooding or water quality
- Small loss of salt marsh, mangroves and sea grass
- Preferred time to do works September/October (because of fish spawning cycles)
- Major earthworks would be required - up to 500,000 cubic metres of sand
- Large capacity dredge would be required
- New dunes would need to be stabilised and vegetated.
- This would involve major works and would require major funding.

PRESENT STUDY

The scope of the present study ^{is} are to look at:-

- Recent rates of change
- Control points for the beach and river and what the effect would be if it breaks through
- Constructing a minimum channel to the north
- Certain sediment catching options

This study has shown that the river is continuing to migrate to the south and a breakthrough is inevitable if nothing is done,

A Council survey to determine the occurrence of coffee rock found it was encountered at about -2 to -4m AHD. This may limit the depth of scour but it is not considered that it will stop the river from migrating south.

This study looked at constructing a minimum channel to the north and let nature create the size and location.

The advantages of a minimum channel are

- Less quantities of sand to be moved, therefore less cost
- A floating dredge and land based machinery could be used
- The sand could be pumped to the best location for beneficial use
- There is a fairly large dredge currently set up in Twin Waters. If this was moved to the site it would save on fairly high relocation expenses.

The disadvantages are that the southern entrance could still dominate if the new entrance is not big enough and the potential for it to close with sediment deposits.

The study had also looked at sediment trapping options however it was pointed out that any sediment trapped is lost from somewhere else. There is significant wave action in the area and large river flows with scouring potential.

Conclusions of this study and options for consideration:-

- Do nothing and accept a breakthrough and its consequences
- Construct a minimum channel (with the risk that it may not work)
- Construct the maximum northern channel which will cost more but will have a higher probability of success
- It is not considered that sediment catching devices would have much probability of assisting in this situation
- Construction of hard devices (rock walls, breakwater) to prevent southern migration
- Regular ongoing programme of maintenance dredging

000004

DEPARTMENT OF FISHERIES

R Quinn advised

- The Department would require that the timing for any works in the river to take into account fish spawning and migration (September/October and March/April).
- The Department would be unlikely to object to dredging if infrastructure is being threatened however they would require assurance that the works would have a high probability of success.
- The Department would require sediment plumes to be minimised. In this area the sand should precipitate fairly quickly

BEACH PROTECTION AUTHORITY

P O'Keefe advised

- That he concurred with the analysis undertaken by WBM
- He did not anticipate any problems with getting necessary approvals from the Authority providing no sand was removed from site
- He could not recommend construction of a third groyne as the area was too exposed to wave action and the channel is deep. It is marginal that any groyne constructed there would remain in place.
- If a minimum channel is constructed to the north, the southern channel will probably still dominate unless the flows are reduced in the southern channel
- He would recommend to the Authority at 25% subsidy should the maximum channel be constructed.
- If the minimum channel was constructed it would be necessary to be assessed to ensure it would contribute to beach protection, it would solve the problem and would stay in place for a reasonable period of time.

Messrs Witt, Andrews, O'Keefe and Quinn were thanked for their presentation and advice and left the meeting.

COUNCILLORS'/STAFF COMMENTS

- The loss of Pincushion caravan park is a minor consequence in the overall picture of the river breakthrough south of the island. The major concern was safety at Maroochydoore Beach. The Surf Club have expressed concern for the safety of the lifesavers and the beach-going public. The likelihood of losing the clubhouse is minimal.
- For a minimum channel to be successful it would be necessary for the majority of the water flow to be redirected to the north of Goat Island. This would require the opening up of the northern channel. Parts of these shoals are fish habitat areas and may not receive approval for dredging
- Council need to consider resourcing any proposed works in the upcoming budget.
- Construction of the maximum channel would cost of the order of \$1.5-\$2 million but does carry less risk of failure

CONCLUSIONS

- Council wants the cheapest option that will ensure closure of the southern entrance. Constructing a minimum channel to the north, closure of the southern channel and possible dredging of the shoals west of Goat Island to shift the main flow of water from the southern to the northern channel are to be assessed.
- These works are to be costed and provision of \$400,000 made in the 1998/99 budget
- J Warmington to have discussions with the Consultants to determine whether modelling is required for the minimum channel.
- Department of Fisheries to be contacted to discuss possible dredging upstream of Goat Island.
- Further meeting to be held in approximately 3 weeks time

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Meeting closed at 3.50 p.m.

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RTI DL RELEASE - EHP

sch4p4(6) Personal information

Director: ..

Date: 29/1/98

sch4p4(6) Personal information

29/1/98

020111

Minister for Environment and Heritage

COPY

Faxed
21/7/98

Ministerial Request

(Please complete and fax to the Office of the Director-General Fax. No. 3227 6485)

Date

21 / 7 / 98

Priority

standard ☐urgent ☐

Please provide

☒

Briefing Note

☐

Speech Note

☐

Report

☐Deputation
Briefing Note☐Draft Media
Release☐Other (Described
Below)

Date

Time

Required by

28 / 7 / 98

:

am
pm

Subject

DRAFTING OF PROPOSAL RIVER

Brief to include (any specific Ministerial requirements to be detailed here)

PROPOSED RESPONSE

For Departmental Use

Briefing Officer:

Phone:

Ministerial Office Contact

Name

sch4p4(6) Personal information

Telephone Number

3896 7674



FIONA SIMPSON MLA

WORKING FOR MAROOCHYDORE

Suite 1 AMP House
Cnr First and Memorial Avenues
MAROOCHYDORE QLD 4558
Phone: (07) 5443 7995
Fax: (07) 5443 7242



SHADOW MINISTER FOR HEALTH AND WOMEN'S POLICY

July 9, 1998

Hon R J Welford MLA
Minister for Environment and Heritage and
Minister for Natural Resources
PO Box 456
BRISBANE ALBERT STREET QLD 4002

Dear Mr Minister

Re: Dredging of the mouth of the Maroochy River

I write to request the Government's advice as to its position on the dredging of a northern channel into the mouth of the Maroochy River in an effort to halt severe erosion at Cotton Tree and Pincushion Island.

Your advice in this matter would be appreciated.

Yours sincerely


Fiona Simpson MLA
Member for Maroochydore
Shadow Minister for Health & Women's Policy



Personnel Management
sch4p4(6) Personal information
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Briefing Note
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B/C Exec Dir Cons
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☐ For Appropriate Action
☐ For information & any necessary action

2/7/98
Director-General

Helen G. Gagnier
Atty Gen 3/27/98

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4/26

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RTI DL RELEASE - EHP

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RTI DL RELEASE - EHP

sch4p4(6) Personal information

Approved

sch4p4(6) Personal information

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Prepared by:	Paul O'Keeffe
Title:	Senior Principal Engineer
Division/Region:	Conservation
Telephone:	3225 1911
Track No.:	

Ref: 750186 PT2
98/08069

13 AUG 1998

Ms F Simpson MLA
Member for Maroochydore
Suite 1 AMP House
Cnr First and Memorial Avenues
MAROOCHYDORE QLD 4558

Dear Ms Simpson

Thank you for your letter of 9 July 1998 concerning the dredging of the mouth of the Maroochy River.

The Maroochy Shire Council commissioned a study to report on the coastal and river processes at the mouth of the Maroochy River. The Council received the completed study earlier this year and is currently considering its options.

The study recommends the relocation of the mouth of the river to the north by dredging a new channel through the northern spit and closing off the existing southern channel. Such a solution is a replication of the natural processes and avoids the need for hard engineering works in this sensitive natural river mouth.

The implementing of any dredging works at the mouth of the Maroochy River is the responsibility of the Maroochy Shire Council.

Any works of this nature would be subject to normal statutory approvals administered by both my Department and the Department of Primary Industries. To date, the Council has not formally sought any approvals from my Department for dredging works at the mouth of the river.

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I trust this information clarifies the situation.

Yours sincerely

A handwritten signature in dark ink, appearing to read 'Rod Welford', with a stylized flourish at the end.

Rod Welford MLA

**Minister for Environment and Heritage
and Minister for Natural Resources**

RTI DL RELEASE - EHP

000114

Pages 168 through 169 redacted for the following reasons:

sch3(1) Cabinet matter - brought into existence before commencement



Your reference:
Our reference:
Enquiries:
Direct Telephone:
Direct Fax No:



98/14762

**REQUEST FOR COMMENTS ON WORKS
IN THE MAROOCHY RIVER ENTRANCE**

RTI DL RELEASE - EHP

provide further information regard

*ref to f39
for advice to Council
9.12.98
Please advise that
BPA supports the
proposal.*

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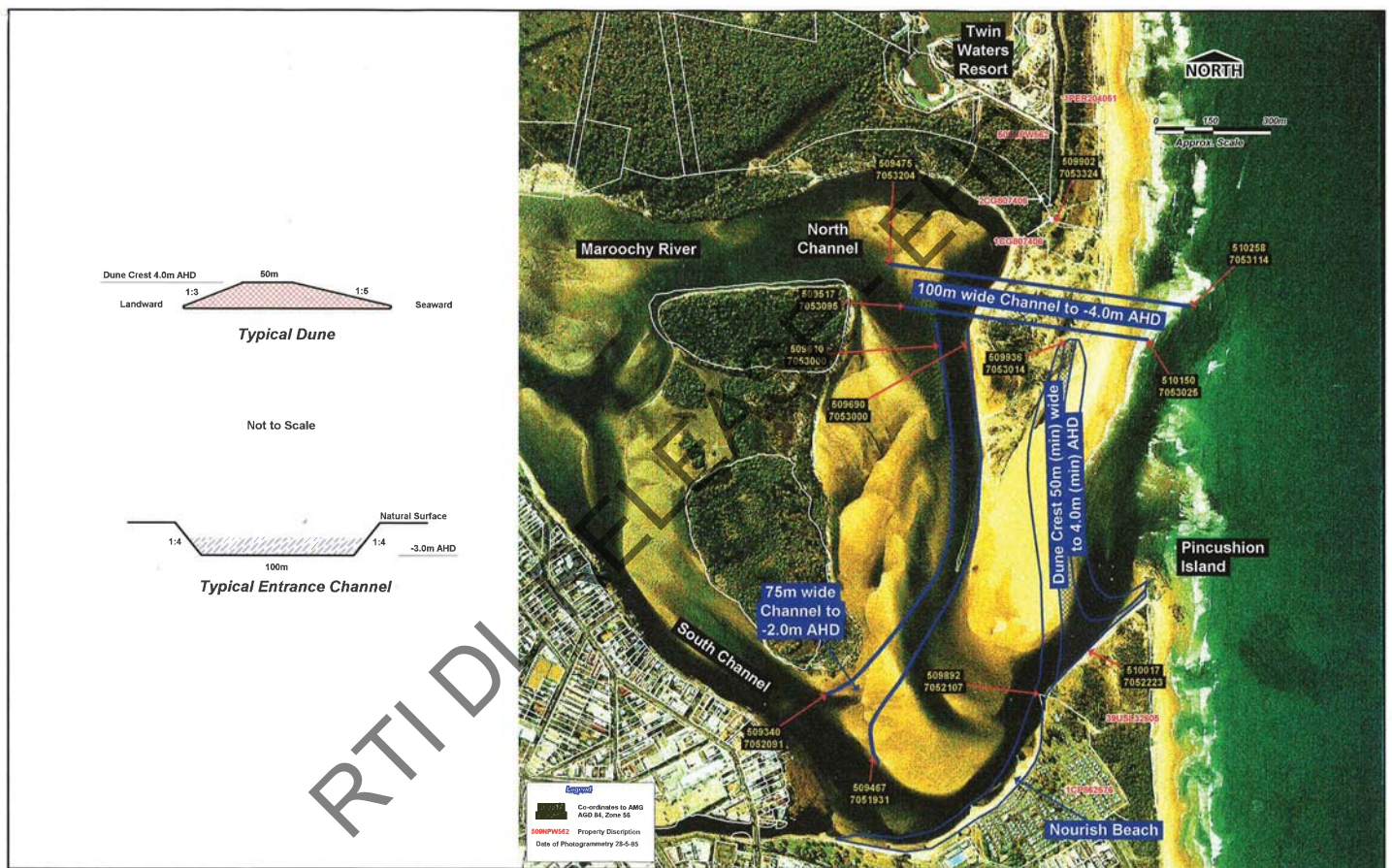
T. Carter

Please quote our file reference number on your reply for fast tracking within Council.

Address: Maroochy Shire Council
Council Chambers
Cnr Bury and Currie Sts, Nambour, Qld. Aust.
Telephone: (07) 5441 8211

Postal: The Chief Executive Officer
Maroochy Shire Council
PO Box 76, Nambour, Qld. Aust. 4560
DX 41900 Fax: (07) 5441 8338

Printed on recycled paper



Maroochy River Entrance Relocation - Plan of Works

Figure 1

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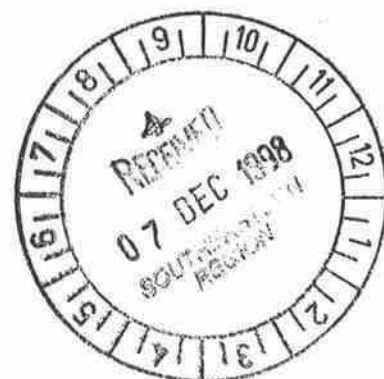




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SECTION 86 HARBOURS ACT



99 / 01672

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(y)

first seen 15/2/99.

Refer F42.
for Response.

P.P.

2-9-99.

Mr. Henrich:

Please process. We will
also need a Sect. 47

sch4p4(6) Personal information

000127

15/09

T. Carter

RTI DL RELEASE - EHP

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OFFICE USE ONLY

Receipt No. 2917258

Amount \$ 5,083-00

Date Received 7/12/18

**MAROOCHY RIVER ENTRANCE
BREAKTHROUGH STUDY
LAST LINE OF DEFENCE**

RTI DL RELEASE - EHP

Prepared for: Maroochy Shire Council
Prepared by: WBM Oceanics Australia
99 Leichhardt Street
SPRING HILL QLD 4004
Telephone: (07) 3831 6744
Fax: (07) 3832 3627
Document: 11128.1.0

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Market Researches: Marketing 171 Entrepreneur's View SPRING 1991, Q1D and Abstracts 172		Documentary 173-174 Articles/Documentary 174-175 Original Patent Issues 175-176 Product Managers 176-177
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INTRODUCTION

Since the 1974 flood, the main ocean entrance channel of the Maroochy River has slowly migrated southwards causing the southern river channel to become more dominant and move southwards and eastwards towards the caravan park. Occasionally over the last 2 years high tides and waves have breached the dune immediately south of Pincushion Island and a breakthrough at this location appears imminent. Historical aerial photography during the 1940's and 1950's show the dramatic changes which take place when a breakthrough occurs. The Maroochy Shire Council (MSC) is concerned that a break-through may occur and result in a loss of property and infrastructure as well as generating a safety issue at the river bank and loss of beach amenity.

This report outlines the options which are available to the Council for a last line of defence to protect infrastructure based on the current level of understanding of the coastal and estuarine processes involved if a breakthrough south of Pincushion occurs. Previous reports (WBM 1997 and WBM 1998) have detailed the results of studies into the relocation of the entrance to the north to a position similar to that which existed in 1974 and initial comments on sediment catching devices as alternatives to reduce the velocities and erosive capacity of the southern channel. At this stage all knowledge of the processes and likely scenarios are based on the work done for these previous reports.

RTI DL RELEASE END



METHODOLOGY

The scope of the study as determined by the Maroochy Shire Council Working Party includes the following:

- Undertake a more detailed study of the southern movement of the river entrance to determine the location of a suitable last line of defence; and
- Investigate ways of causing breakthrough of the northern channel when the river mouth is south of Pincushion Island by use of palisade piers, groynes etc to catch sand on the southern bank in combination with piers, groynes etc around the black banks to promote erosion at that location.

To achieve these outcomes the following steps will have been out:

- an estimation of the likely southern extent of the entrance if a breakthrough occurs based on existing historical information and coastal and estuarine processes knowledge;
- an investigation of the options available for a last line of defence;
- assessment of these options with regard to type, location, cost and resulting beach amenity;
- investigation of the options likely to cause accretion of sand in the southern channel and erosion at the northern channel; and
- assessment of these options with regard to cost and likelihood of success.

Liaison with Council and the appropriate Government departments has been maintained during the studies.

RIVER ENTRANCE MOVEMENT AFTER BREAKTHROUGH

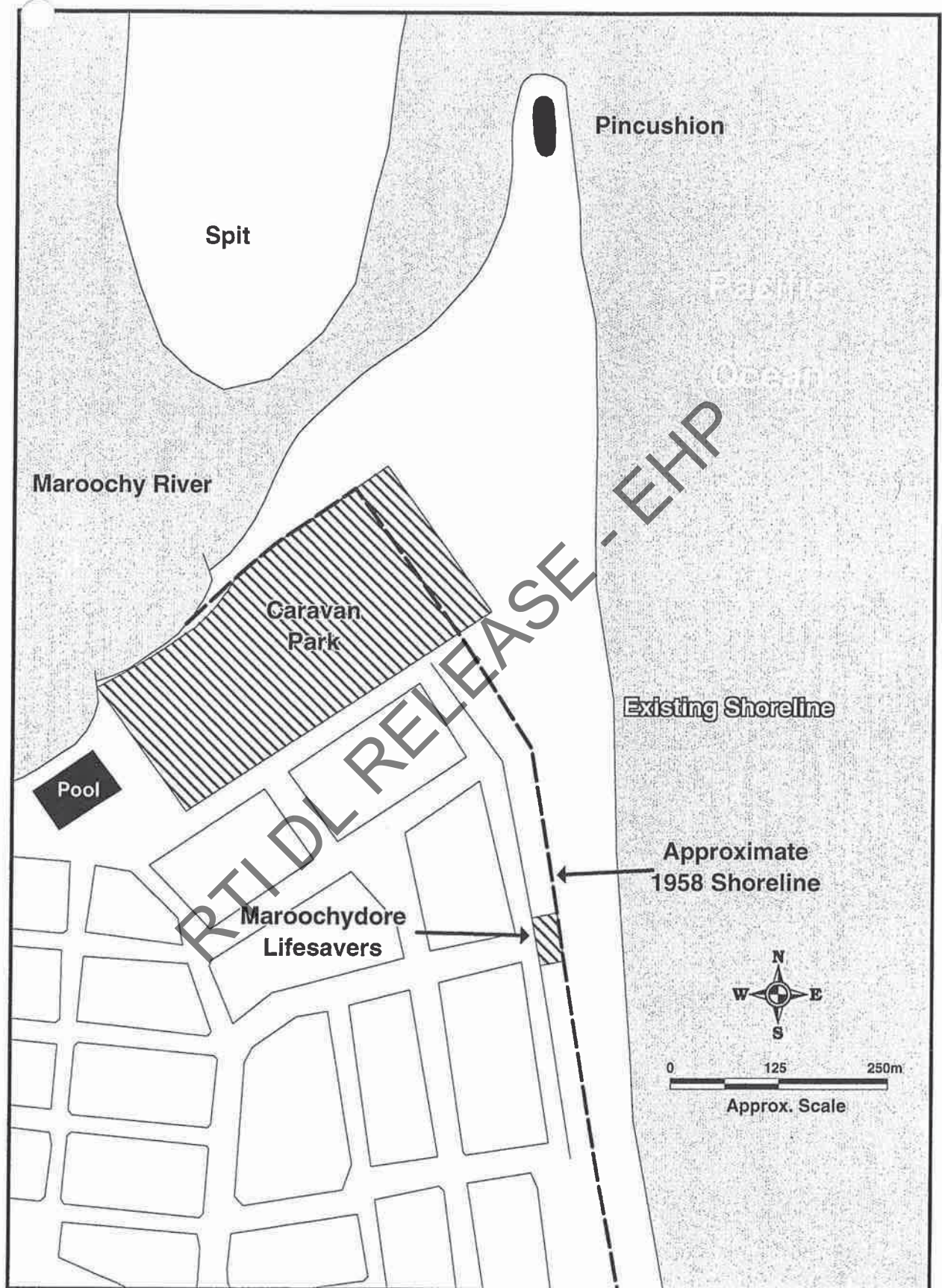
Historical aerial photography since 1940 exists for the Maroochy River entrance area and shows that in this relatively short time, in geomorphological terms, the entrance has moved from south of Pincushion north to near Twin Waters and south again to a position where a breakthrough is again likely. During the period from 1940 to 1958, the entrance was located south of Pincushion Island and there is evidence which indicates that the shoreline receded westwards to a position within the existing caravan park as shown in Figure 1.

It is possible that, during previous cycles, the entrance has migrated further south and north than the locations shown in the aerial photography.

At this stage it is reasonable to assume that if the entrance breaks through south of Pincushion Island that it will recede to the location shown in the 1958 photography. A previous report (WBM 1998) indicated that this beach recession was part of the mechanism which allowed the southern entrance to close and the northern entrance to again become dominant and start the cycle again. There are many factors which could cause the beach recession to be more or less than in the past and some of these are:

- the weather conditions may be significantly different;
- there may be short term geological changes particularly relating to the supply of sand from offshore sources;
- the volume and distribution of sand south of Pincushion Island may be different (there is evidence of sand mining and the large scale movement of sand in the dune areas in photography);
- the reclamation and infrastructure carried out along the southern shoreline since 1940 may result in a different response from the natural environment.

However, the main concern at this stage is the caravan park and associated infrastructure and there is sufficient evidence to suggest that a breakthrough south of Pincushion Island will threaten these developments. Also, a breakthrough south of Pincushion Island is likely to result in a landward recession of the shoreline south of the Island (WBM 1998) and loss of the frontal dune which will significantly reduce the buffer against wave attack which currently exists for all the development north of the Maroochy Lifeline building.



Existing and Historical Coastlines

Figure 1

OPTIONS FOR A LAST LINE OF DEFENCE

4.1 Method of Assessment

The options for a last line of defence can be grouped into two main categories as follows:

- soft options such as do nothing or ongoing maintenance by nourishment of a set alignment;
- hard structures such as revetments, seawalls and groynes on a set alignment.

However, before the options themselves can be assessed, the following important components of the assessment need to be discussed:

- the level of defence offered;
- timing of construction;
- cost;
- the level of beach amenity retained; and
- the level of public acceptance.

The level of defence refers to the protection provided to infrastructure and includes an assessment of the probability of the defence being breached. In this case nominating a planning timeframe of 50 or 100 years would allow the design conditions of wind, wave and storm tide levels to be assessed and any structures designed according to those conditions. In the case of revetments, seawalls and groynes this level of design can be readily incorporated. However, for ongoing maintenance programs there is still the problem of the design event happening quickly or at a time when preventative works cannot be instigated ie cyclonic or flood conditions.

As well as the type and location of the defence it is also necessary to consider the timing of construction. This is a complex issue as there is no possibility of predicting the future weather (cyclones or floods) and therefore there is no way of predicting when the breakthrough will occur and how long it will take from the point of breakthrough until the caravan park is threatened. There is evidence from the historical photography that once the entrance is south of Pincushion Island it may stay there for 20 years and that the process of moving back to the north may naturally take a similar period. However, there is no indication of how long it will take from initial breakthrough until the caravan park is threatened. Also, it is likely to be more efficient and cost effective to carry out the works in a reasonable timeframe and in stable physical conditions rather than in an emergency under difficult physical conditions such as a flood or a cyclone.

The cost of the defence option will need to take into account the actual cost of completion, any ongoing maintenance costs and the likelihood of use. For example a seawall located at

the boundary of the caravan park may have a high capital cost, low maintenance cost and only be needed for a short time every 20 years whereas ongoing nourishment may have a low capital cost, a high maintenance cost and be needed regularly for 20 years.

The resulting beach amenity is important in an area which derives substantial income from tourist activities. Some of the available options such as seawalls may leave very little beach amenity at times whereas options such as ongoing nourishment will maintain amenity. The value of this amenity is very subjective and will need to be considered carefully by Council.

The level of public acceptance of each of the options will also be subjective and will be dependent on the community attitude to the maintenance of natural values and the protection of infrastructure. There has previously been community resistance to training walls for the river entrance and an education program may be needed to convince the community that some of the defence options will not result in a similar fate for the river entrance.

4.2 Methods of Providing a Last Line of Defence

The major options for a last line of defence are:

- seawall to varying extents around the caravan park and associated infrastructure;
- various arrangements of groynes around the caravan park to maintain a stable beach and channel alignment; and
- ongoing maintenance of the beach and river bank around the caravan park by dredging the southern channel and relocating the spoil to eroded areas in conjunction with groynes.

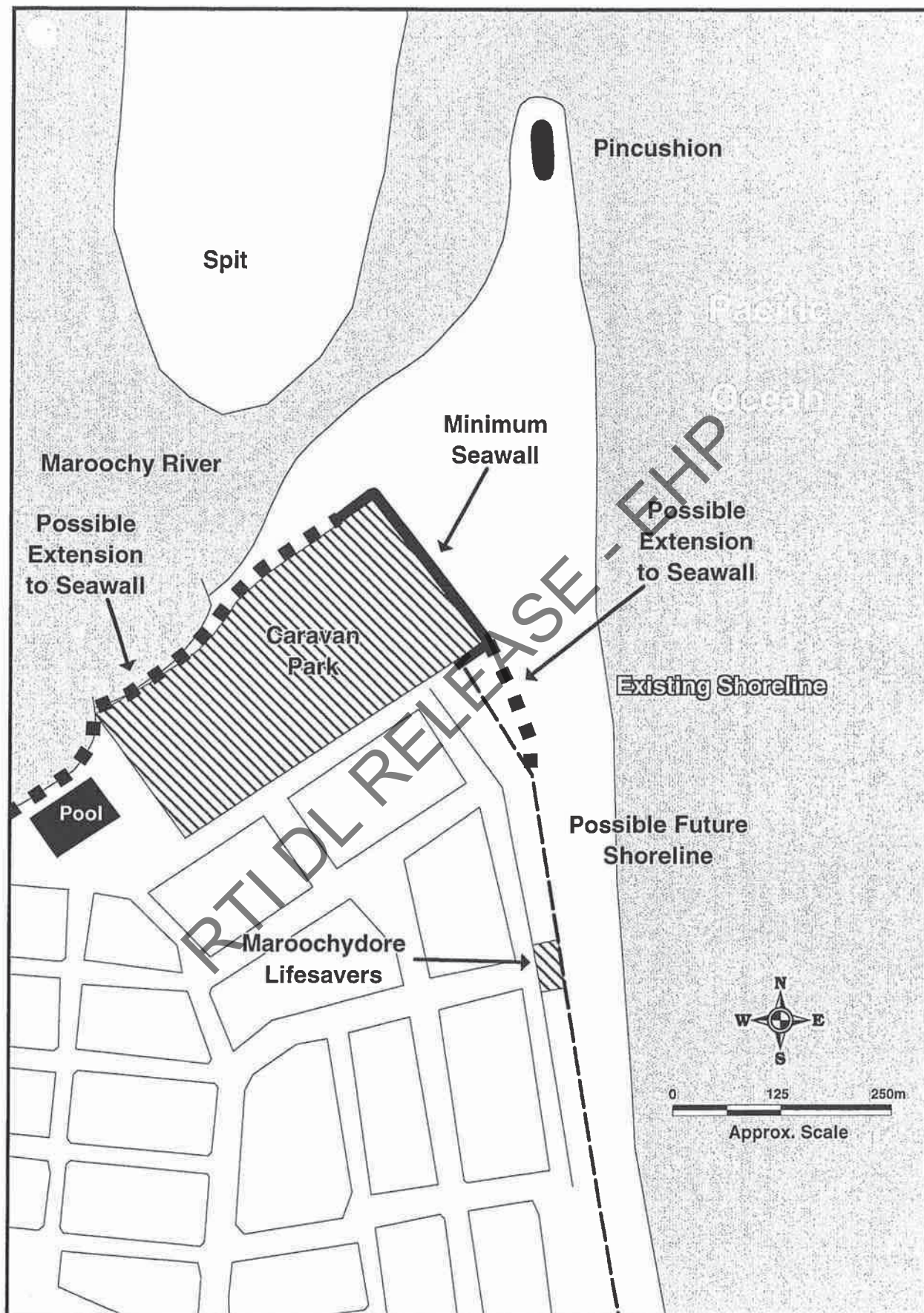
These options are discussed and assessed below based on the criteria described above.

4.2.1 Seawalls

Seawalls have been a standard method of defence against encroachment of the ocean for many years. Rock seawalls have proven to be the most effective and cost efficient and are the most widely used. In areas where aesthetics are important or the cost of rock is prohibitively high, concrete units of various shapes and sizes have been used instead of rock.

The advantages of rock seawalls are:

- they can be constructed from locally sourced natural materials
- they are relatively inexpensive;
- they require little maintenance;
- they are easily designed and built; and
- they can usually be located in the dune and hidden until required.



Existing and Historical Coastlines

Figure 2

The disadvantages of rock seawalls are:

- there is usually a loss of visual and beach amenity when the wall is exposed;
- the wall may rarely or never be used.

It is possible to design rock seawalls to provide a range of levels of defence with the primary points of consideration being the armour (rock) size and the height of the wall. The construction of rock walls is most efficiently carried out in dry conditions as bunds do not then have to be constructed and access to the site is unrestricted.

Construction of the walls could be carried out in emergency or stormy conditions however extra care would need to be taken regarding the foundation and filter placements. Also, it is likely that costs would significantly increase in these cases.

The rock seawalls on the Gold Coast, which are exposed to similar design conditions, cost about \$2,500 per metre length. The following scenarios, as shown in Figure 2, will act as an indication of the cost of this option:

- protect seaward end of caravan park only (300m) \$750,000;
- protect caravan park and car park to south (450m) \$1,125,000; and
- protect caravan park, car park and pool (1000m) \$2,500,000.

Rock seawalls at Cotton Tree could be located in the dunes and be hidden during normal conditions. However, when the walls are exposed it is likely that the beach in front of the walls will be lost resulting in a reduction of public amenity and possible decrease in safety. Also, there is often an increase in beach recession at each end of the wall and this will need to be taken into account in the design and the proposed use for the adjacent beach in these locations.

Therefore, it can be concluded that rock seawalls can provide a high level of defence with the major constraints being the choice of the time of construction and the loss of beach amenity when exposed.

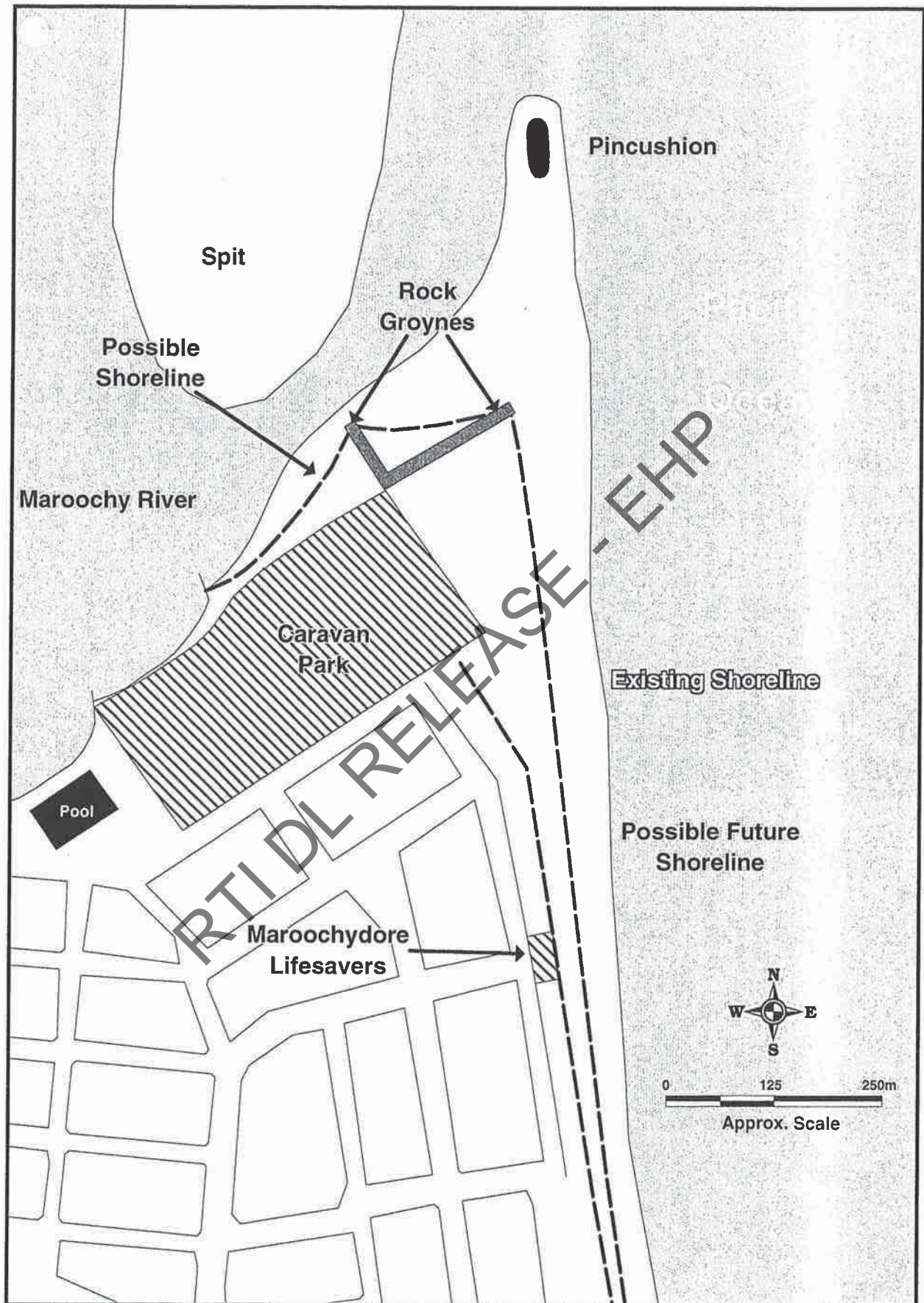
4.2.2 Groynes

Groynes, and training walls, are also a standard method of shoreline stabilisation and are a more pro-active form of defence than seawalls because they can be located in positions to maintain the alignment of the beach or river channel.

The advantages of groynes are:

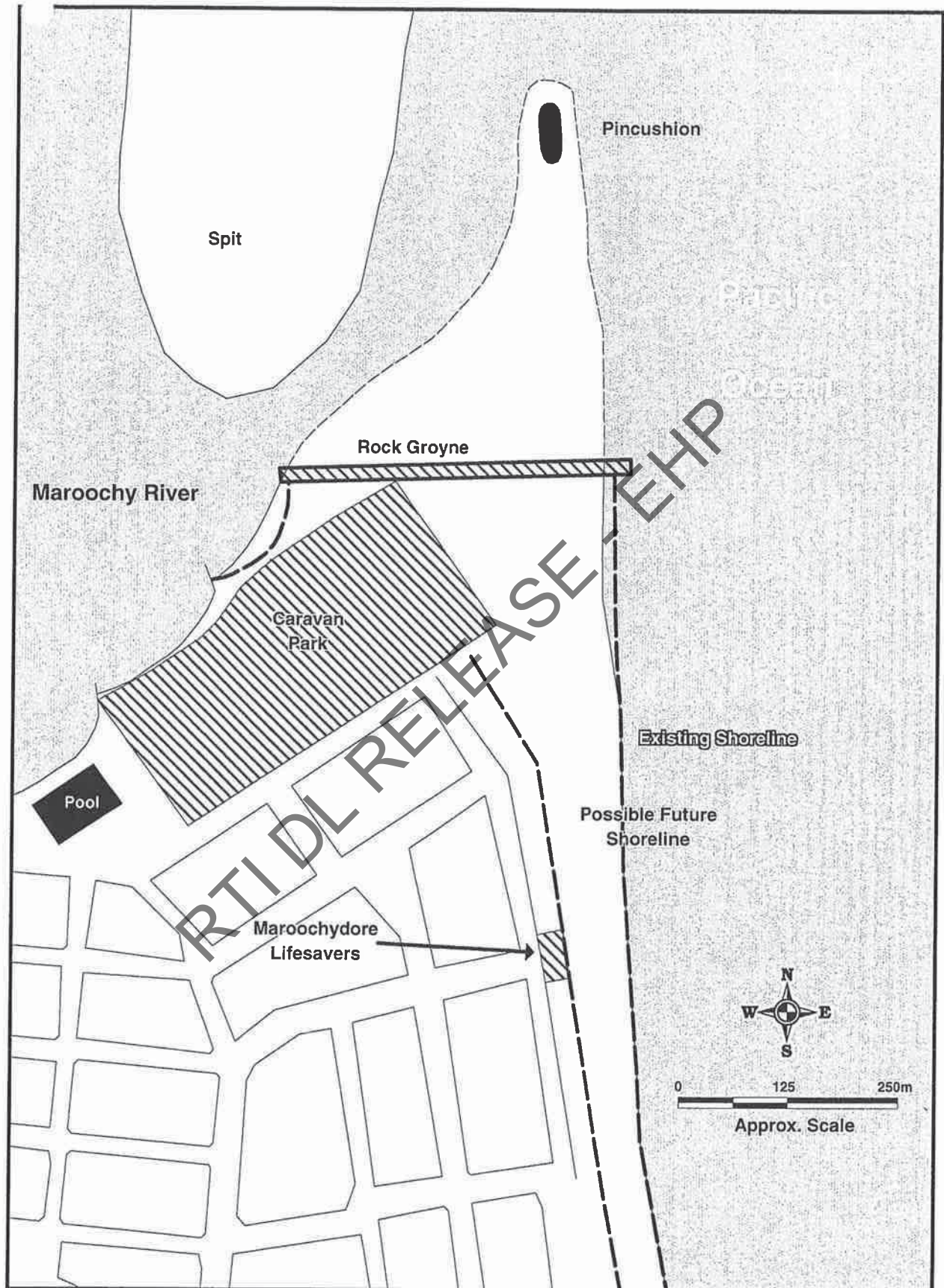
- they are readily designed and built; and
- they can be constructed from locally sourced natural materials.

The disadvantages of groynes are:



Existing and Historical Coastlines

Figure 3a



Possible Location of Groyne

Figure 3b

- they are more expensive per metre length than seawalls;
- they are usually located across the beach or along the river channel and are often exposed most of the time;
- groynes on a beach can lead to erosion shadows and may lock up sand which would naturally move elsewhere; and
- often deep water and high current velocities are experienced near groynes when they are exposed (this may be an advantage to fishermen).

It is possible to design groynes to provide a range of levels of defence with the primary points of consideration being the depth to which the groyne extends (ie how far into the ocean); armour size and the height of the wall. The construction of groynes is most efficiently carried out in dry conditions as bunds do not then have to be constructed and access to the site is unrestricted.

It is unlikely that construction could be carried out in emergency or stormy conditions as the ends of the groynes would be fully exposed to wave action and there may not be enough time to source materials and transport them to site..

Based on the cost of seawalls it is expected that groynes would cost about \$5,000 per metre length. The following scenarios, as shown in Figure 3, will act as an indication of the cost of this option:

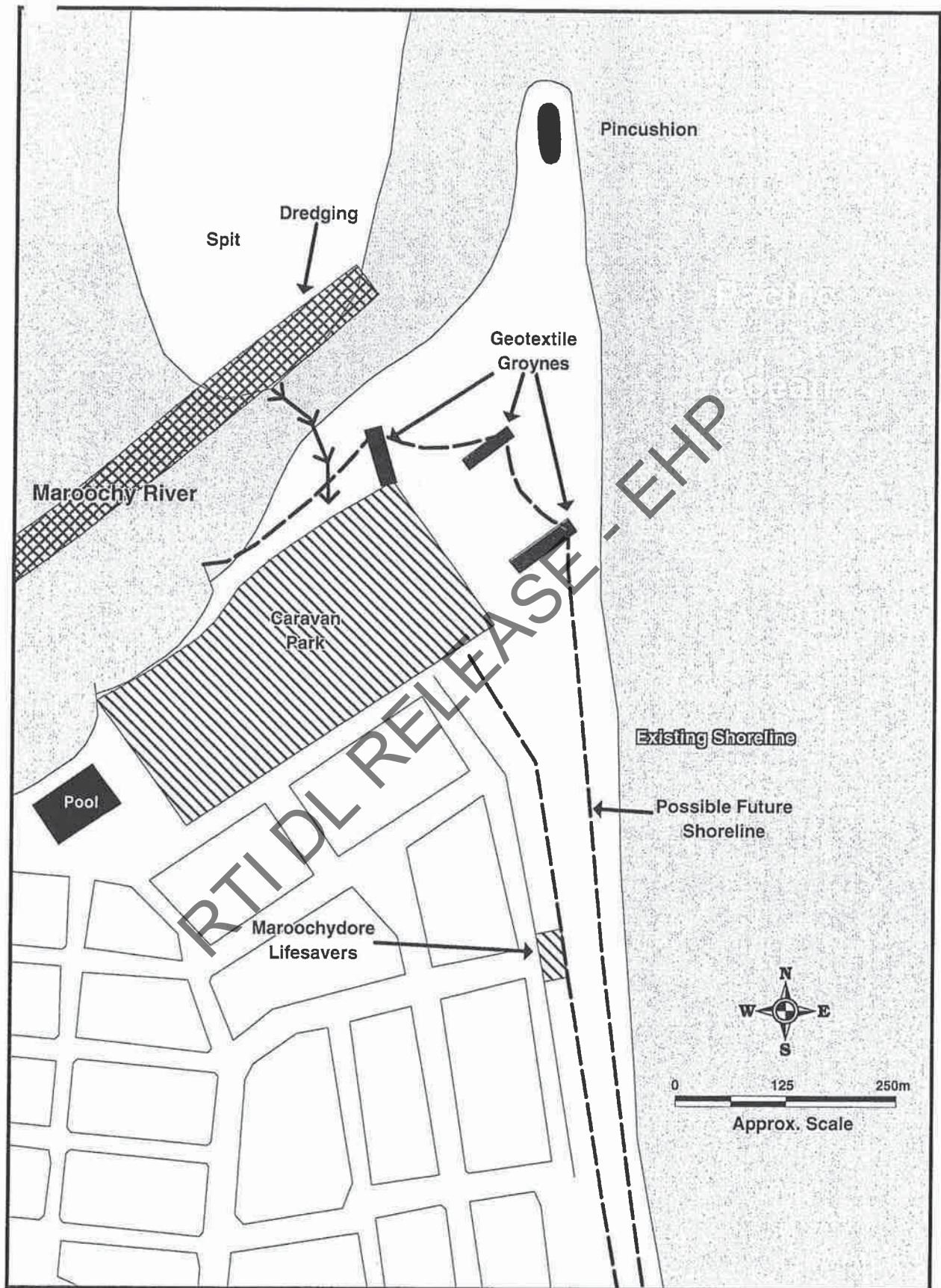
- two finger groynes around the caravan park (1x150m and 1x250m) \$2,000,000; and
- one groyne perpendicular to the beach (400m) \$2,000,000.

Groynes around the Cotton Tree caravan park would be exposed soon after breakthrough. However, the beaches around the caravan park could be retained with possibly a decrease in safety due to the reflected waves and current activity associated with hard structures.

Therefore, it can be concluded that groynes can provide a high level of defence with the major constraints being a possible restriction on the time of available for construction.

4.2.3 *Nourishment in Conjunction with Groynes*

The seawalls and groynes described above are intended to be designed and built to withstand fully exposed conditions, without further reinforcement, for the life of the structure. Another option is to use groynes with a limited life expectancy (such as the goetextile groynes at Cotton Tree) and reduce the exposure of these groynes with continued nourishment by sand dredged from the river as shown in Figure 4. The dredging may be able to be arranged so that the southward migration of the spit is stopped and this would relieve the pressure on the southern bank of the river near the caravan park.



Possible Location of Geotextile Groynes

Figure 4

The advantages of this system would be:

- the initial capital cost would be reduced;
- there would be some flexibility in the dredging and nourishment program could aid in the management of beach amenity; and
- the technology to build geotextile groynes has been developed locally.

The disadvantages would be:

- funding of an initial and ongoing dredging maintenance program is required;
- the system could be subject to rapid changes during storms and may require a flexible maintenance plan which can be initiated quickly;
- the life of the groynes is limited and planned replacement would be required;
- environmental effects of continued dredging.

The geotextile groynes would cost about \$600,000 (\$200,000 each) based on the cost of the existing groynes and an approximate dredging program of \$120,000 annually (30,000 cubic metres of sand) would be required to hold the growth of the northern spit to its current location. The nourishment program may be reduced in years with little storm activity and may need to be increased in years of high storm activity.

4.2.4 Relocation of Main Channel to the North

This section is included to briefly review the recommendation of previous studies (WBM 1997 and WBM 1998) in relation to the relocation of the entrance to the north and inclusion of an assessment of this option with regard to the above criteria to provide more information for the decision making process. It is recognised that the relocation of the entrance and the last line of defence can be two discreet activities and it may be that either one or both can be carried out at any time.

The advantages of entrance relocation are:

- it will immediately remove erosion threat at Cotton Tree;
- it can be carried out at any time (subject to environmental issues);
- it requires an initial capital cost with little maintenance;
- it has an expected life of about 20 years based on historical information
- hydraulic and environmental studies have been carried out.

The disadvantages of entrance relocation are:

- initial capital cost;
- the size and complexity of the work; and
- public perception of the impacts of the project.

The estimated cost of the relocation and associated works is \$2,000,000 which is mostly related to dredging and relocation of about 400,000 cubic metres of sand.

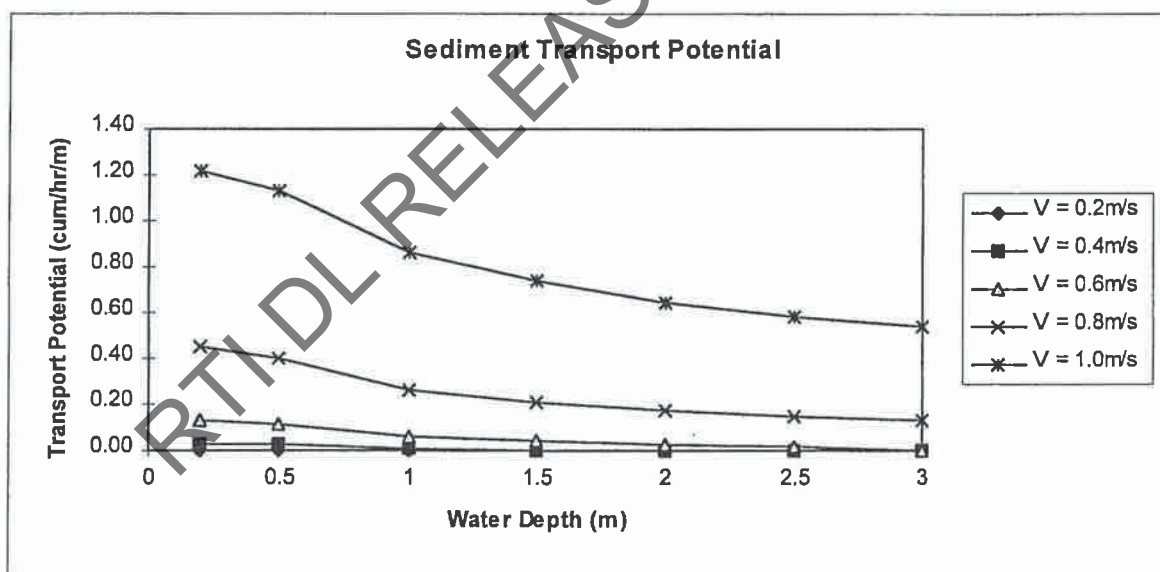
RTI DL RELEASE - EHP

5 OPTIONS FOR MODIFYING SAND MOVEMENT

Initial comments have been made on the sediment catching options and their possible benefits and impacts (WBM 1998). These comments generally related to the principles that sand trapped in one location would be at the expense of sand erosion at another location and that accretion of sand is achieved by reducing water velocities and erosion is achieved by increasing velocities.

The current study has looked at the possibility of accreting sand at Cotton Tree and eroding sand from behind the northern spit to induce a channel breakthrough of the spit at that point. However, it should be noted that these areas are over 1000m apart and it is not hydraulically feasible to consider these two process as acting together ie it is not possible to erode sand from the northern spit and directly deposit it at Cotton Tree. Therefore these processes have been considered separately.

Numerical models have been used to determine the sand transport in a combination of water depth and velocity scenarios as shown in the figure below. Generally it can be concluded that once the current velocity exceeds 0.2 - 0.4m/s (excluding wave action) sand transport is initiated.



Therefore, it is necessary to reduce velocities to below this value to cause sand deposition and keep them above this value to erode sand.

In the area around the caravan park it will be necessary to reduce the peak tidal velocities of around 2m/s to around 0.2m/s to cause long term deposition. This has not been achieved by the existing geotextile groynes as they need regular nourishment nor is it achieved by the many trees which are falling into the channel near Pincushion Island.

Added complications are that:

- the existing entrance allows significant wave penetration into the channel which induces sand suspension and allows the sand to be carried by the tidal current;
- the caravan park is located on the outside of a bend where velocities are highest and three dimensional effects occur; and
- the continual southward push of the northern spit continues to reduce the channel size and hence increase velocities.

Therefore, it is unlikely that the velocities in the caravan park area can be reduced sufficiently to cause sand accretion without extensive engineering works which would need to be designed to withstand high currents and wave activity and be flexible enough to accommodate changing sand levels.

With regard to erosion of sand at the northern end of the spit near Twin Waters it must be noted that the spit is now 300m wide and has accreted to an average level of +2mAHD. Also, the channel which passes to the east near the spit has become hydraulically inefficient and is not carrying a high flow. Therefore, the situation now exists where the spit is very wide and little hydraulic energy is available to move the sand. However a series of groynes could be used to direct sufficient flow to the spit initially to erosion. The groynes would need to be continually extended seawards either by leapfrogging the landward units or building a continual unit. The groyne would also need to be removed at the end of the process.

It is expected that this or similar processes would be very inefficient (especially compared to hydraulic dredging) and expensive because of the need to continually move the structure.

Therefore it is concluded that there may be some benefit in using innovative techniques for the erosion and accretion of sand at various locations throughout the river entrance. However, it is expected that the overall size of the system and energy driving the natural forces is such that a larger concentrated effort is required to change the momentum of the system and forge the change required.

F CONCLUSIONS

Under the present situation with the northern spit wide, stable and progressing incessantly southward and the southern spit south of Pincushion becoming narrower through erosion, a breakthrough of the dunal system south of Pincushion is inevitable and becoming more likely with time.

Various options exist to develop a last line of defence in the case of a breakthrough. These can be summarised as:

- seawalls costing about \$2,500/m (\$750,000 to \$2,500,000 total) to protect infrastructure with a loss of beach amenity when in use;
- groynes costing about \$5,000/m (\$2,000,000 total) to protect infrastructure and maintain a reduced beach amenity while preventing sand drift northwards into the southern channel; and
- a combination of lower cost groynes and ongoing maintenance at an initial cost of \$600,000 and an annual maintenance cost of \$120,000 to protect infrastructure and maintain a reduced beach amenity but with a degree of operational risk in being able to maintain the variable nourishment requirement.

Therefore, the last line of defence options of seawalls or rock groynes are more likely to provide the level of protection required for the infrastructure for the longest time with the least amount of maintenance. However, it should be noted that the seawall will result in the greatest loss of beach amenity and the groynes will lock up sand which would naturally flow north to close off the southern channel and help the entrance move northwards.

In comparison the cost of relocating the entrance is estimated at \$2,000,000 with an immediate removal of the threat to infrastructure and an increase in river and beach amenity.

It is the recommendation of this report that the seawall be considered as the immediate last line of defence in combination with relocation of the entrance to the north as the long term objective.

It is also concluded that there may be some benefit in using innovative techniques for the erosion and accretion of sand at various locations throughout the river entrance. However, it is expected that the overall size of the system and energy driving the natural forces is such that a larger concentrated effort is required to change the momentum of the system and forge the change required.

R Martin
3227 8495

971AP1713
750186



20 September 1999

MEMORANDUM

TO: Regional Service Director, Southeastern Region

FROM: Rae Martin
Acting Secretary

99/13228

SUBJECT: Construction of Bunding to Block the existing Channel and Dredging
a New Channel situated at the Maroochy River Mouth
Maroochydore

I refer to the memorandum dated 3 February 1999 (971AP1713) received from Mr John Harden requesting the views of the Authority on the above mentioned application pursuant to section 86 of the *Harbours Act 1955*.

The views of the Authority are attached.

While these are the views of the Beach Protection Authority from a coastal processes perspective there may be other environmental factors to be considered in the decision on the Section 86 Application.

sch4p4(6) Personal information

R Martin
Acting Secretary

[bms-047]

000133



Contact officer:

Your ref:

160 Ann Street, Brisbane
PO Box 155
BRISBANE ALBERT STREET
QUEENSLAND 4002
Telephone (07) 3227 8494
Facsimile (07) 3221 0768

Telephone:

Our ref:

(Please quote)

File No.: 750186

CHAIRPERSON

BEACH PROTECTION AUTHORITY

SECTION 86 - HARBOURS ACT 1955

CONSTRUCTION OF BUNDING TO BLOCK THE EXISTING CHANNEL
AND DREDGING A NEW CHANNEL SITUATED AT THE
MAROOCHY RIVER MOUTH, MAROOCHYDORE

Section 86 of the *Harbours Act 1955* provides that where works proposed to be constructed or placed on the coast consist of a groyne, seawall or river training wall or other works of a type which might have effects in regard to coastal management, a copy of the plan of the proposed works shall be referred to the Beach Protection Authority and the Authority shall advise in writing its views as to the effects the construction or placement of the works is likely to have in regard to coastal management.

In accordance with section 86 of the said Act the views of the Authority have been sought concerning an application by Maroochy Shire Council proposing to construct bunding to block the existing channel and dredging a new channel situated at the Maroochy River mouth, Maroochydore.

The proposal has been examined and it is considered that the Authority advise as follows.

The Maroochy Shire Council has proposed to realign the mouth of the Maroochy River to reduce erosion on the southern bank of the river. The works comprise dredging a new entrance channel to the north and blocking the existing channel with the sand obtained from the dredging.

A report on the entrance of the Maroochy River has been prepared by WBM Oceanics on behalf of Maroochy Shire Council. The report considered the impacts of a new entrance channel on the tidal and flooding dynamics of the estuary and demonstrated that any detrimental effects would not be significant. The report also indicated that the proposed position of the new channel is within the historic range of natural migration of the river entrance. Therefore, the proposed works are not expected to have any adverse impacts on coastal processes for this section of coast.

Power to provide the views of the Authority concerning proposals for works under section 86 of the *Harbours Act 1955* has been delegated by the Authority.

Accordingly, in the exercise of that delegated power, your approval is requested to provide the aforementioned views of the Authority in relation to the proposed works.

Approved

SITE No. 3816

sch4p4(6) Personal information

R. Martin

ACTING SECRETARY

BEACH PROTECTION AUTHORITY

Date: 7 September 1999

sch4p4(6) Personal information

Delegate/Chairperson

Beach Protection Authority

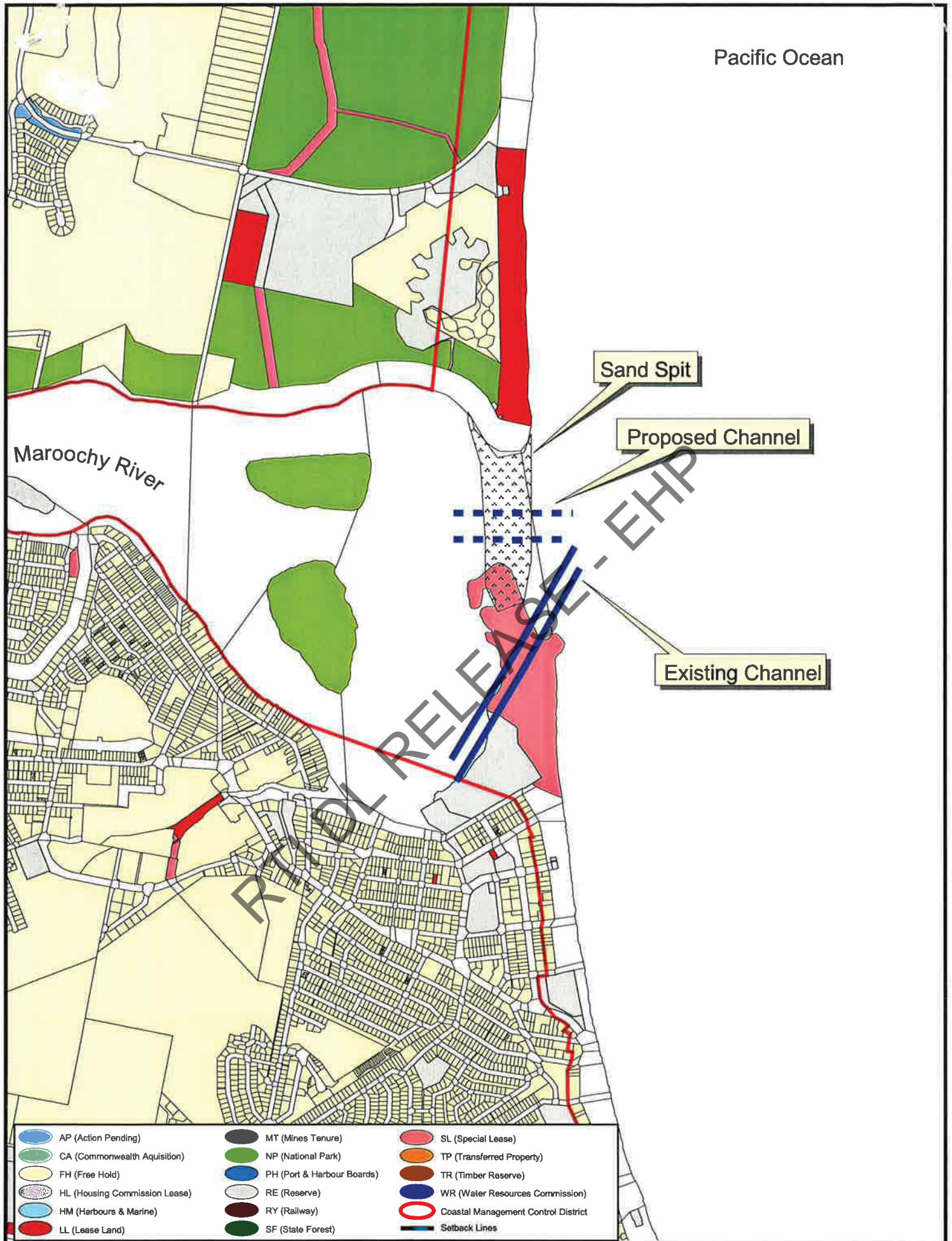
sch4p4(6) Personal information

*Endorsed
Please ensure
the views are
supported from
coastal processes
perspective (which
move in the channel
of the Bilt). I
am aware that
the Maroochy
Office do have
concerns with
works at the
Maroochy River
mouth. These views
should be sent to
RSD noting that
there may be
other environmental
factors to be
considered in
the S86
100% recycled paper*

15/9/99

000133

*Please note on
register*





*Maroochy aspires to be the most environmentally responsible,
caring, enterprising and dynamic community in Australia.*

Your reference:

Our reference:

Enquiries:

Direct Telephone:

Direct Fax No:

RC: av

Mr Roger Chalmers

5441 8070

5441 8111

29 December 1999

The Honourable Rod Welford MLA
Minister for Environment & Heritage and
Minister for Natural Resources
PO Box 2454
BRISBANE QLD 4001

Dear Minister,

MAROOCHY RIVER MOUTH

I refer to our previous correspondence of 2 September 1999 regarding the Maroochy River Mouth, and now submit this formal request for government assistance in funding our current Model Study and any future construction work which may result.

In support of this request I include a Council report which provides an historical background to the current situation at the river mouth, and which details the various studies and construction work undertaken to date. It describes the current model constructed at the Queensland Government Hydraulics Laboratory in Quinlan Street, Deagon and the various options being tested to protect the Cotton Tree/Pincushion area on the southern shore.

In addition to this report, are included copies of two earlier reports from Council's consultants, WBM; the Relocation Study of 1997 and the Initial Advice report given in 1998. These complement the technical report included with our letter of 2 September and now provide you with a copy of all the reports issued to date by WBM.

Being untrained, the Maroochy River is considered to be one of the few remaining "natural" river mouths on the East Coast of Australia. The river and the adjacent coastline is a significant element in the Sunshine Coast's tourist industry and the area of Maroochydore is a key regional centre. Having significance therefore to a wider community than Maroochy Shire alone, Council has elected to adopt a consultative approach when considering issues which relate to the long term management of the river mouth. The current study results from such a philosophy and Council expects the findings from the model should provide a basis for making a properly informed decision on suitable protection for the southern shores.

You will see from section 37 of our report that Council's commitment over the years to both engineering studies and the construction of protective works, has been considerable. We anticipate the cost to construct whatever works may be recommended by the current Model Study to be in the order of \$1.0 to \$2.5 million.

.../ page 2

Please quote our file reference number on your reply for fast tracking within Council.

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REPORT

from: Team Leader, Special Projects

29 NOVEMBER 1999

MAROOCHY RIVER MOUTH

File No: 1-9357

INTRODUCTION

1. This report provides a brief history of the Maroochy River Mouth in recent times, and will discuss the various studies and construction works which have been undertaken during this period to identify, mitigate and control erosion problems in the estuary. It also provides details of the current model study (November 1999) being conducted by WBM Oceanics on behalf of Council, to identify and test possible means by which to protect the Caravan Park and other infrastructure at Cotton Tree on the southern shores of the estuary.
2. A locality plan which identifies specific features in the area is attached to the rear of this report.

BACKGROUND

3. The lower reaches of the Maroochy River are a complex and highly dynamic system of channels, islands, intertidal shoals and coastal bars. The entrance is currently dominated by a large sandpit, which extends southwards from the north shore, and by a rocky outcrop known as Pincushion Island.
4. Within the estuary, Goat and Channel Islands divide the river into two main channels; the north and south channels. Prior to the early 1980's a natural channel between these two islands provided a third flow path at high tide. The deposition of sand subsequently closed this channel and the area is currently covered in vegetation.
5. The river mouth is subject to change under the influences of the prevailing coastal and tidal processes, and by cyclonic and flood conditions. Historical records suggest the main channel to the ocean undergoes a cyclic process where it drifts south from its most northerly location adjacent to Twin Waters to a position south of Pincushion Island, before breaking through in the north again. The natural migrations of the entrance which are inherent in such a dynamic estuarine system have dominated the history of the lower estuary. These migrations can be illustrated by a brief history of the entrance configuration between 1940 and 1998:

1940 & 1958: Main entrance south of Pincushion Island
1961 to 1979: Main entrance north of Pincushion Island, near the north shore
1982 to 1996: Main entrance to the north of Pincushion Island but moving progressively south as the sand spit extended south from the north shore.
1998: Main entrance immediately north of Pincushion Island. The river broke through south of Pincushion briefly on three occasions early in 1998 and indications at that time were that it was about to do so on a more permanent basis.
6. The events in 1998 sharpened a growing concern within Council and the Community about the threat of erosion on the southern shore and Maroochydoore Beach. This is well illustrated by the following record:-

"At a public meeting (organised by Council) on 26 February 1997 it was stated that the last time the entrance was south of Pincushion Island, in the mid 1950's, the river flowed along the beach causing a loss of sand and a need to provide sandbag protection to the surf club building."

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7. The records indicate the main channel to the sea had been located north of Pincushion Island for some decades prior to December 1998, and the island formed part of the southern shore. However, with storm activity during the early months of 1999, the channel broke through south of the island taking a substantial portion of the southern foreshore and camping ground with it. At the time of writing this report the channel remains south of the island and is in excess of 250m wide.
8. The Maroochy River is not subject to any significant flow control works such as breakwaters or revetment walls and, as such, is considered to be one of the few remaining 'natural' river entrances on the East Coast of Australia.
9. A mix of urban development and open space occurs adjacent to the southern bank of the river. This includes residential and commercial development upstream between Picnic Point and the mouth of Cornmeal Creek, a caravan park and camping ground in the Cotton Tree/Pincushion area, an area of park between Cornmeal Creek and the Cotton Tree Caravan Park, and public beach areas near Pincushion Island and on Maroochydoore Beach.

The northern shore of the river adjoins public open space, and the Twin Waters Resort.

Over the years the river mouth and estuary have become increasingly popular for leisure activities including swimming, camping, surfing, fishing and boating. Further, with the development of infrastructure along the southern margin of the river mouth, it is now one of the key elements of the Sunshine Coast's tourist industry.

STUDIES AND CONSTRUCTION WORKS 1980 – 1996

10. An outdoor model of the Maroochy River flood plain was constructed for Maroochy Shire Council by the Queensland Government Hydraulics Laboratory early in the 1980's. This was used to determine flow criteria and estimate flood levels in the river system at that time.
11. Erosion of the southern shoreline adjacent to the Caravan Park and boatshed occurred during the late 1980's and early 1990's, particularly during the floods in February and March 1992. Council undertook channel dredging and foreshore replenishment at various times during this period.
12. In July 1992, Council and the Beach Protection Authority (BPA) agreed to jointly undertake an investigation into what engineering work would be required to halt this erosion. Council undertook the survey work including stream flow velocity measurements, while the BPA provided instrumentation and one officer to assist. In order to avoid any possible delays in constructing what work the investigation might recommend, Council lodged a preliminary application with the Department of Environment and Heritage (Marine Board of Queensland) for approval to construct rock protection in the area.
13. In December 1992, the BPA proposed a physical model be constructed by the Queensland Government Hydraulics Laboratory in order to test the use of river groynes to mitigate the erosion problem. Council accepted the proposal and agreed to share in its funding. To determine appropriate boundary conditions, the existing model of the Maroochy River flood plain was modified in accordance with the more recent survey information, and run with 50 year and 100 year ARI flood events.

The BPA then constructed and tested the second model, using data from the first, and released their Interim Report in December 1993. Council agreed with the recommendations contained in the report and in February 1994 applied to the Marine Board of Queensland for approval to construct a river groyne system. Approval was promptly given and during March and April tenders were invited by Council for the construction of two groynes, revetment mattress protection and the dredging of sand from the channel.

The works were constructed during mid-1994 at a total cost of \$290,000 as detailed below:

Design, survey and contract administration by Council	\$21,000
Supply and installation of groynes and revetment works	\$70,000
Dredging Works	\$195,000
Supply and installation of beacons on groynes	\$4,000
	<u>\$290,000</u>

14. Further erosion continued along the southern shore during 1995 and 1996.

During 1995 discussions were held between Council, the BPA and the Department of Primary Industries (DPI) as to whether a third groyne should be installed to the east of the first two, and whether other options should be explored. These options included the re-opening of the channel between Goat and Channel Islands, and the excavation of a new channel to the sea at the north end of the northern spit.

The situation prompted considerable community interest and concern from both individuals and bodies such as the Maroochy Surf Lifesaving Club. Early in 1996, it became evident that should the erosion continue, Pincushion Island might well be isolated from the southern shore and become an island once again.

15. Discussions and negotiations as to appropriate solutions continued between Council and various Government Departments and by the end of 1996, Council was being urged by the community to undertake something positive to address the situation. A significant milestone was reached in January 1997 when the following occurred:

- (a) Council received a letter from the Minister for the Environment which set out the DPI and BPA criteria to be addressed in any detailed study of the situation.
- (b) Council received a letter from the Department of Environment supporting the relocation of the river mouth to the north, and endorsing the need for a technical study.
- (c) Council resolved to engage a consultant to consider the re-establishment of a northern channel.
- (d) Discussions were held with a firm of coastal engineering consultants, WBM Oceanics, regarding the terms of reference for such a study. On 29 January 1997 WBM submitted a detailed proposal and offered to undertake the study for a maximum fee of \$50,000.
- (e) WBM were engaged for the Relocation Study on 3 February 1997.

RELOCATION STUDY - 1997

16. The aim of the study was to determine the most appropriate configuration for a new northern entrance to the Maroochy River and to assess potential impacts associated with this entrance change. Consideration was to be given to the need for associated closure or alteration of existing channels in the area as part of these works to minimise impacts and/or improve their effectiveness. The scope of the study was not to assess and recommend the most appropriate option for dealing with the erosion problem at Cotton Tree, but to assess the specific option of re-establishing a northern entrance channel.

The study included a process of community consultation and addressed the following considerations:

- (a) coastal and river hydraulic processes;
 - (b) water quality and flushing of the lower estuary; and
 - (c) the natural values of the lower estuary, particularly related to fisheries
17. Community consultation was undertaken via a public meeting on 26 February 1997 and by correspondence with various individuals who provided historical details about the river mouth and offered suggestions as to possible solutions.
18. WBM lodged their report with Council on 4 June 1997. It concluded that "relocating the entrance channel of the Maroochy River to the north is within the range of natural (historical) migrations." The total value of this consultancy was \$68,000.

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A Council meeting on 16 July 1997 received the report from WBM and resolved to invite relevant Government Departments to discuss its recommendations.

19. Council and the Department of Environment heard a presentation of the study by WBM on 19 August 1997 and resolved that a Working Group should be formed with a brief to consider the study and report back to Council with its recommendations. The Group was called the Maroochy River Entrance Working Party and comprised the following representatives:-
 - Maroochy Shire Councillors and Staff
 - Representatives from the Department of Environment and BPA
 - Local interest groups
20. The Working Party recommended that Council negotiate with WBM to further assess the options discussed, together with a "do nothing" option.
21. Council accepted this recommendation and on 26 November 1997 invited WBM to submit a fee proposal to undertake the additional work. Following discussion on the detail of the further investigations, WBM submitted a fee proposal of \$60-\$80,000 on 18 February 1998. A meeting of the Working Party was held on 6 March 1998 to consider this proposal and resolved to further extend the study to include the following:
 - (a) Determine recent rates of change, control points for current beach and river shape, the extent of exposed coffee rock and its spatial distribution in the area of interest (based on Council surveys)
 - (b) Investigate the events, (natural or man-made) which might facilitate a return of the entrance to the north of Pincushion Island
 - (c) Modify the existing 1D model to predict the impact on water levels and flows inside the entrance if a breakthrough just south of Pincushion should occur
 - (d) Comment on Palisade Piers, a proposal by Mr Sedlar and other sediment catching options, and their possible benefits and impacts
 - (e) Report on the above

INITIAL ADVICE – 1998

22. On 26th March 1998, WBM submitted a report to Council which provided initial advice and comment on the various matters being discussed at that time. Their report concluded:
 - (a) Under the present situation a breakthrough of the dunal system south of Pincushion Island was inevitable and becoming more likely with time.
 - (b) While the beach to the south connects with Pincushion Island, the beach alignment is relatively stable. However, should a breakthrough occur south of Pincushion, the beach to the south may recede to a new alignment.
 - (c) The cyclic process of the entrance progressing southwards and then breaking through to the north is natural. Simulation of this process by man is risky. However, it would be possible to design a channel opening regime which had a high possibility of success.
23. During the following months numerous meetings were held within Council, and with WBM, the Working Party, Government Agencies and local interest groups to review the details for any further study and to establish suitable terms of reference.
24. Council considered it likely they would extend the scope of the study to include the option to relocate the river entrance to the north and close the southern channel, and in August 1998 engaged WBM to obtain all the approvals necessary to construct this later option should it be adopted. The approvals required were extensive and included the following:

- (a) Approval under Section 86 of the Harbours Act (works on tidal lands or waters). Need detailed plans of the works, letters of support from Fisheries, Beach Protection Authority, Harbour Master and Regional Office of the Department of Environment;
 - (b) Approval under Section 47 of the Beach Protection Act (disturbance of sand in an EPA). Need detailed plans of the works including dune vegetation;
 - (c) Licence under Section 41 of the Environment Protection Act (dredging and spoil disposal). Need detailed drawings of the works, equipment to be used (dredging and land based), hours of work and anticipated noise levels, fuel storage details, discharge water quality and latent water quality, turbidity and erosion management;
 - (d) Permit to Disturb Marine Vegetation under the Fisheries Act (disturbance of mangroves). Need details of mangrove populations and significance and impact of disturbance/removal;
 - (e) Permit to carry out works in a Fish Habitat Area OR Revocation of that portion of the Fish Habitat Area involved in the works. Detailed plans of the works and impacts on the management of the Fish Habitat Area.
25. In addition, WBM were engaged to investigate the appropriate location for a "last line of defence" to be adopted in the event of the river breaking through south of Pincushion Island. These works would provide permanent protection to the caravan parks and other infrastructure on the southern shore.

LAST LINE OF DEFENCE - 1998:

26. In December 1998 Council received the "Last Line of Defence" study from WBM. It concluded the following:
- (a) Under the present situation with the northern spit wide, stable and progressing incessantly southward and the southern spit south of Pincushion becoming narrower through erosion, a breakthrough of the dunal system south of Pincushion was inevitable and becoming more likely with time.
 - (b) Various options existed to develop a last line of defence in the case of a breakthrough. These were summarised as:
 - Seawalls costing about \$2,500/m (\$750,000 to \$2,500,000 total) to protect infrastructure with a loss of beach amenity when in use;
 - Groynes costing about \$5,000/m (\$2,000,000 total) to protect infrastructure and maintain a reduced beach amenity while preventing sand drift northwards into the southern channel; and
 - A combination of lower cost groynes and ongoing maintenance at an initial cost of \$600,000 and an annual maintenance cost of \$120,000. These works would protect infrastructure and maintain a reduced beach amenity but included a degree of operational risk in being able to maintain the variable nourishment requirement.

The options of seawalls or rock groynes were more likely to provide the level of protection required for the infrastructure for the longest time with the least amount of maintenance. However, it was noted that the seawall would result in the greatest loss of beach amenity and the groynes would lock up sand which would naturally flow north to close off the southern channel and help the entrance move northwards.

In comparison, the cost of relocating the entrance to the north was estimated at \$2,000,000 with an immediate removal of the threat to infrastructure and an increase in river and beach amenity.

- (c) It was recommended that the seawall option be considered as the immediate last line of defence in combination with relocation of the entrance to the north as the long term objective.

- (d) It also concluded that there might be some benefit in using innovative techniques for the erosion and accretion of sand at various locations throughout the river entrance. However, it was expected that the overall size of the system and the energy driving the natural forces were such that a larger concentrated effort would be required to change the momentum of the system and forge the change required.
27. The report noted there could be some opposition from environmental groups to the option to relocate the entrance to the north. WBM confirmed that applications for a possible relocation had been submitted to the following agencies:
- the Beach Protection Authority
 - the Marine and Ports Division of the Department of Transport
 - the Department of Environment under Section 86 of the Harbours Act, and under Section 41 of the Environment Protection Act
 - the Department of Primary Industries under Section 51 of the Fisheries Act 1994 for work in the Fish Habitat Area
- They also advised that the cost in additional consulting work required to obtain all the necessary approvals could be considerable, and suggested a sum in excess of \$100,000.
28. Ongoing storm conditions during December 1998 and January 1999 continued to threaten a more established breakthrough of the entrance south of Pincushion Island.
29. A meeting of the Working Party was held on 18 January 1999 to discuss the report from WBM, and to consider a proposal to construct a physical model of the entrance to better determine a course of action.
- The meeting agreed the following recommendations be put to Council:
- a physical model of the Pincushion area be undertaken
 - State Government be approached for funding support
 - no further action be taken on seeking approvals for dredging the northern channel
30. A full meeting of Council accepted these recommendations on 20 January 1999, and approved an estimate of \$150,000 to carry out physical modelling and to provide a report. There were further discussions within Council about Government support to fund the model, and of a proposal to commission a further model to test the northern channel option.
31. Discussions were held with WBM and the Queensland Government Hydraulics Laboratory to confirm details of a commission to undertake a model study, and on 30 April 1999 WBM were formally advised to commence work immediately. The agreed fee structure was as follows:

WBM Project Management Costs	\$ 27,750
QGHL Modelling Costs	\$124,212
Survey Works by Council (estimated)	\$ 2,500
Total Costs	<u>\$154,462</u>

MODEL STUDY - 1999

32. The formal proposal submitted by WBM described the detail and function of the proposed model as follows:

The test model would be constructed at a scale of 1:50 and would use a system of pumps and wave generators, to simulate such conditions as wave action, tidal flows and sediment transport. A total of four scenarios as detailed below, would be tested to determine the likely outcome of various natural conditions.

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a) Model Test 1 - Post Breakthrough Mechanisms under existing conditions:

The model would be constructed with a post-breakthrough geometry and the dominant wave, tide and sediment transport mechanisms would be calibrated. Primarily these would include a wave climate which would include day to day conditions as well as a representative proportion of storm conditions, a mean spring tide range with no flood surcharge and simulation of sediment transport northwards from near the Surf Club and southwards along the northern spit. It was expected that this process would include recession of the shoreline past the eastern boundary of the Pincushion Caravan park. It was not proposed to run the model to an equilibrium condition as this would be likely to take a significant amount of time and it would not be possible to represent the cyclones, storms and floods which might occur during this period.

The primary outcome from this model run would be to assess whether the model conditions were sufficiently representative of the natural conditions to simulate sediment movement after a breakthrough. If this were the case then the model could confidently be used to simulate the effect of protection works around the caravan park.

b) Model Test 2 - Impact of Defence Works on Post Breakthrough Mechanisms:

In this test, the calibrated boundary conditions developed in Model Test 1 would be used on a model which had been rebuilt with the caravan park defence structures in place. The defence structures would be three rock groynes around the boundary of the caravan park similar to the arrangement indicated in Figure 4 of the last Line of Defence Report (WBM 1998). The final arrangement of the groynes would be determined after consultation with Council officers and after the results of the first model test had been interpreted.

The primary outcome from this model would be to assess whether the defence structures around the caravan park would cause significant change to the processes after breakthrough and if so, whether it was still likely that the southern channel would be blocked and the northern channel become dominant.

The test would also indicate the stability of the groynes under south easterly conditions and provide information about the capability of the groynes to retain a beach and foreshore in front of the Caravan Park and as far south as the model could reliably predict, along Alexandra Parade.

c) Model Test 3 - Optimisation of Defence Works:

This test would incorporate any improvements to the rock groyne arrangement which became apparent during the previous test. Alternatively, if the rock groynes did not allow blockage of the southern channel, then an alternative defence arrangement (i.e. a rock seawall) could be constructed and tested.

d) Model Test 4 - Stability Test of Defence Structure in NE Storm Conditions:

This final test would use typical cyclonic conditions to test the structural stability of the selected final defence works.

The test would also provide information about the capability of the groynes to retain a beach and foreshore in these conditions, in front of and to the north of the caravan park and as far south as the model extends along Alexandra Parade.

33. Seas finally broke through between Pincushion Island and the southern shore in March 1999 and established a significant channel within a few weeks.
34. Weather conditions delayed the collection of survey data and as a result model construction did not commence until August 1999. By this time, the breakthrough of the entrance south of Pincushion Island was well established.
35. By mid-November 1999, the model had been constructed and calibrated in accordance with Model Test 1 to reasonably simulate the measured characteristics at the river mouth.
36. At the time of writing this report (November 1999), WBM and QGHL had commenced to run Model Test 2 on a configuration of seawalls and groynes.

FUNDING OF CONSTRUCTION WORKS & ENGINEERING STUDIES

37. The estimated costs to Council in undertaking previous studies and approved construction work, and in commissioning the current Model Study are detailed below:

(a) Model of the Maroochy River flood plain constructed by QGHL early in the 1980's	\$500,000
(b) Combined study with BPA in 1992/93	\$ 20, 000
(c) Construction of groynes and revetment works, and dredging in 1994	\$400,000
(d) Relocation Study by WBM in 1997	\$ 68, 000
(e) Initial Advice and Last Line of Defence Study by WBM in 1998	\$ 47, 000
(f) Current Model Study by WBM (estimated)	
(i) Project Management by WBM	\$ 27,750
(ii) QGHL Modelling costs	\$124,212
(iii) Survey Work by Council (to date)	\$ 10,000
	<u>\$ 161,962</u>
	<u>\$1,196,962</u>

38. WBM has previously suggested a budget of between \$750,000 and \$2,500,000 to construct the works which may result from the current study. The details are provided in section 26(b) of this report.

39. During 1998 and 1999, enquiries were made of various Government Agencies regarding the possible provision of support funding for the studies being undertaken by Council. The Beach Protection Authority advised funding was unlikely to be available through their agency and suggested Council contact the Department of Communication and Information, Local Government and Planning (DCILGP).

DCILGP indicated funding might be available through the Local Government Bodies' Capital Works Subsidy Scheme. Part 14 of this scheme provides for 25% subsidy for the prevention of sea and river erosion, providing the works are approved by BPA and the Coastal Management Branch of DOE (now the EPA).

40. A deputation meeting was held with Minister Rod Welford at Landsborough on 30 August 1999 to discuss the project and to request assistance in funding the following:

- (a) The current Model Study
- (b) Any capital works that might result from the Model Study
- (c) A possible Model Study of the option to open a new channel through the northern end of the spit.

The Minister expressed his interest in, and support for the current Model Study and suggested that Council make a formal submission to his Department for assistance in funding both of the model studies, and any future construction work.



LOCALITY PLAN

000203

Maroochy River Estuary

Breakthrough South of Pinetree Island

Modelling of Impact on Northern Spit



1.0 Introduction

In late morning on 14 January 1998 the Maroochy River Estuary was closed to commercial shipping and a major spill of oil into the river was reported. The spill was contained within the river and did not reach the ocean. The spill was contained within the river and did not reach the ocean.

A preliminary model has been developed to assess the impact of the spill on the river and the ocean. The model has been developed to assess the impact of the spill on the river and the ocean. The model has been developed to assess the impact of the spill on the river and the ocean.

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2.0 Methodology

2.1 Physical Model

The physical model was developed to assess the impact of the spill on the river and the ocean. The physical model was developed to assess the impact of the spill on the river and the ocean.

2.2 Numerical Physical Model

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be taken back into the physical model and the process repeated until the changes in each cycle are small. A significant amount of interpretation and experience will be involved in assessing the results which will at best be able to indicate trends and not rates or volumes.

It should be noted that the events such as storms, floods and cyclones which may induce significant changes in a short period are not intended to be modelled in this exercise. These events and their impacts can occur randomly in time and intensity and are not able to be predicted. The modelling will only give an indication of the likely changes near the northern spit under typical conditions. It should also be noted that there are indications that the last cycle took at least 30 - 40 years for the entrance to move from south of Pin Cushion to the northern end of the northern spit.

3.0 Indicative Costs

3.1 Physical Model

Model Construction and Testing	\$125,000
Project Management and Reporting	\$ 12,500

TOTAL COST	\$137,500 approx
Timing 12 weeks	

3.2 Combined Models

Physical Model

Model Runs (expected 5 @ \$3,500/day)	\$17,500
Communications and Administration	\$ 2,500

Numerical Model

Establishment of Numerical Model	\$10,000
Model Runs (expected 5 @ \$1,000)	\$ 5,000
Project Management and Reporting	\$10,000

COST	\$45,000 approx
Timing 4 weeks	

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NUMERICAL MODEL BOUNDARY



PHYSICAL MODEL
BOUNDARY

INITIAL ADVICE
MAROOCHY RIVER ENTRANCE
BREAKTHROUGH STUDY

RTI DL RELEASE - EHP

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1 INTRODUCTION

It has been well documented that, since the 1974 flood, the main ocean entrance channel of the Maroochy River has slowly migrated southwards causing the southern river channel to move southwards and eastwards towards the caravan park and become more dominant. Recent high tides and waves breached the dune immediately south of Pincushion Island for the second time in the last year and a breakthrough at this location appears imminent. Historical aerial photography during the 1940's and 1950's show the dramatic changes which take place when a breakthrough occurs. The Maroochy Shire Council (MSC) is concerned that a break-through may occur and result in a loss of property and infrastructure as well as generating a safety issue near the caravan park.

This report outlines the present level of understanding of the processes involved and gives initial impressions and advice on likely scenarios if a breakthrough south of Pincushion occurs. Also presented is a conceptual discussion about dredging a minimal channel through the spit to the north and sediment catching devices as alternatives to reduce the velocities and erosive capacity of the southern channel. At this stage all knowledge of the processes and likely scenarios are based on the work done for previous reports. It is envisaged that further assessments of processes and impacts will be carried out as a second phase to this study.

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2 METHODOLOGY

The scope of the study as determined by the Maroochy Shire Council Working Party includes the following:

- Recent rates of change, control points for current beach and river shape, extent of exposed coffee rock and its spatial distribution in the area of interest (based on Council surveys);
- Investigation of events (natural or man-made) which might facilitate a return of the entrance to the north of Pincushion (including excavation of a minimal channel across the northern spit);
- Modification of the existing 1D model to predict the impact on water levels and flows inside the entrance if a breakthrough just south of Pincushion occurs, and extreme movement to the south;
- Comment on Palisade Piers, the Sedlar proposal and other sediment catching options and their possible benefits and impacts;
- Reporting and liaison which is common to all components.

As a result of recent high tides and storm wave conditions, a minor breakthrough occurred to the south of Pincushion. This was repaired by Council and is now holding under more moderate tide and wave conditions. In view of these recent events and to provide Council with some urgent advice for consideration, the study is to be carried out in two stages.

Initial Advice

Preliminary advice on the urgent issues are detailed in this report and are based on a recent inspection of the existing situation during high tide and wave conditions and knowledge of the local coastal processes gained through previous studies and experience.

Ongoing Study

Hydrodynamic modelling of the impacts of entrance configurations south of Pincushion will be carried out subsequently, using the model established in the previous study, as well as consideration and assessment of sediment trapping options and man-made interventions in the natural processes.

Liaison will be maintained with Council and the relevant Government Departments throughout the study and a joint meeting is proposed later part of the study to present the main findings and get feedback on any recommendations. The requirements for permits for the proposed works will also be discussed at this meeting.

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3 RECENT RATES OF CHANGE

One of the primary long-term mechanisms for ongoing changes at the Maroochy River entrance is the incessant growth of a sand spit from the north shore towards the south. All of the historical photography (1940 to present) shows this growth. The southward growth is consistent and occurs when the spit is to the north (1974) or to the south as at present. It is not possible at this stage to determine the rate of spit growth and this will vary from year to year depending on the wave climate. However there is some indication from the aerial photography that the rate of growth increases as the spit progresses southwards behind Pincushion and this could be related to shoreline alignment, wave refraction and channel depth. This irreversible trend of spit growth is due to the dominant wave processes in the area of the entrance and has two main impacts:

- a cycle of spit growth to the south and eventual breakthrough to the north is established which means that the entrance is constantly changing, however the cycling nature indicates that the overall system is in dynamic equilibrium; and
- when the spit has grown significantly to the south as at present then the southern channel is narrowed, velocities increase and the southern bank begins to erode sometimes leading to a breakthrough south of Pincushion.

Another impact of the current arrangement where the southern channel is quite close behind Pincushion is that waves are refracting around the island and are attacking the rear of the frontal dunes. This is potentially a damaging scenario as eroded sand from the dunes by this process will not stay in the local system to be returned at a later date (as happens on the beach) but is carried away by the tidal currents. Therefore, with the channel in its current location, there is no natural mechanism for the return of sand eroded from behind the dunes and hence this erosion is irreversible.

Inspection of aerial photography also shows that the northern channel near Goat Island is now almost twice as wide as it was in 1940. Depending on the relative balance of flows between the north and south channels this may mean a reduction in velocities (and hence sand transport potential) in this channel. There is some indication that nature is making changes commensurate with this theory in that a shoal is forming at the eastern end of the channel and a backwater is being created ultimately resulting in a reduction of the effective channel size.

As the channels though the entrance become longer and more braided then their hydraulic efficiency decreases. Therefore, when large flood flows occur there is a necessity for the channels to become as efficient as possible either by becoming deeper and wider, requiring a large volume of sand has to be moved out of the system, or by becoming straighter, by breakthrough to the north near Twin Waters or to the south near Pincushion.

Therefore it is concluded that, under the present situation with the northern spit wide, stable and progressing incessantly southward and the southern spit south of Pincushion becoming narrower through erosion, a breakthrough of the dunal system south of Pincushion is inevitable and becoming more likely with time.

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4 CONTROL POINTS FOR CURRENT BEACH AND RIVER SHAPE

The regional shape of the beaches is influenced by the major control points of Alexandra Headland and the tombolo formed in the lee of Mudjimba Island and the crescent shaped shoreline which would naturally form between these points has an alignment which is landward of Pincushion. Because Pincushion Island is seaward of this general alignment, beaches connecting to Pincushion (from the south or the north) will have an alignment seaward of the regionally stable alignment. This is particularly important when a breakthrough occurs south of Pincushion, as the beach to the south will naturally recede to its regionally stable alignment which is landward of the previous location and as a result beach recession will occur. The location of the river entrance bar can similarly effect the local beach alignment.

With regard to the development which occurs adjacent to the southern bank of the Maroochy River the following points can be made:

- while the beach to the south connects with Pincushion the beach alignment is relatively stable with only the normal seasonal variations occurring;
- if a breakthrough occurs south of Pincushion the beach to the south may recede to an alignment relative to the river entrance bar and Alexandra Headland - this is most likely to be behind the Pincushion alignment and shoreline recession will occur; and
- aerial photography shows that reclamation has occurred west of the caravan park where the existing pool and park are now located indicating that the channel has eroded southwards up to or past this location in the past.

Coffee rock exists extensively in the area and is often exposed at the beach face. Also, Council surveys have defined the spatial extent of coffee rock which underlies the area to the east of the caravan park. The following comments can be made about this coffee rock:

- it is encountered at about -2 to -4m AHD;
- it may limit the depth of channel scour and affect channel velocities;
- it has not restricted channel movement in past; and
- it is too low for economic revetment foundation.

5 MINIMUM CHANNEL TO THE NORTH

Considerable attention has recently been given to the option of constructing a channel across the northern end of the spit to effectively restart the spit growth cycle. This would establish a time buffer against channel erosion to the south and possible breakthrough south of Pincushion.

A recent study was commissioned to assess the options likely to prevent a breakthrough without using 'hard' structures such as rock training walls (WBM 1997). The study was aimed at determining the optimum size, location and impacts of a constructed northern channel entrance. This report concluded that the optimum channel would be directly east of the northern channel as it flows past Goat Island, have a cross sectional area of 460 square metres and require the relocation of about 500,000 cubic metres of sand from the spit to close off the existing entrance. This option was considered to be technically feasible, provide the longest design life and produce impacts within the normal range of natural conditions.

Part of the brief for this current study is to conceptually investigate the option of constructing a much smaller channel across the northern spit and let the new entrance scour naturally to its required size thereby letting nature do much of the work. This option has advantages and disadvantages as discussed below.

Advantages:

- less cost in constructing the channel and less sand to relocate;
- if an adequate initial channel is provided and conditions are right nature will create the size and location of the entrance required; and
- able to be implemented quickly reducing the risk of a breakthrough south of Pincushion.

Disadvantages:

- initial flows may not be sufficient to keep the entrance clear or enlarge it - the southern entrance may still dominate;
- sediment transport from the north (spit growth) may continue to block the constructed entrance particularly in high wave conditions;
- ebb and flood tide deltas will be large (while the entrance is enlarging) and the surrounding currents may not be large enough to quickly redistribute this material;
- if the entrance does not enlarge sufficiently, it will be more difficult and costly to get a dredge back to complete the works in because of waves and currents;

- there is no existing mechanism to close off the existing entrance or provide a stable dune in this area;
- the southern channel may continue to erode and a breakthrough south of Pincushion may still occur.

If this option is pursued it is considered that there is a high risk that the channel will not scour or become dominant and that a breakthrough may still occur in the weakened dunal area just south of Pincushion.

There are two major equipment options in constructing the new entrance;

- dredging a channel using a floating dredge and discharging onshore; or
- constructing a channel using land based machinery such as dozers and excavators.

In both cases the natural repose angle of dry sand will need to be taken into account when determining the minimum channel size and because of dune heights land based machinery may require benching for stability and to provide access. Also, it may be more efficient for hydraulic dredging plant to relocate the material sufficiently away from the entrance channel. In particular this material could be placed south of Pincushion to reinforce the dune and provide some short term protection. For long term protection it would be necessary to close off the southern entrance and build a dune as a buffer as has been done in the past.

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6 EVENTS WHICH MAY INDUCE THE ENTRANCE TO MOVE NORTH OF PINCUSHION

Investigation of aerial photography indicates that the following mechanisms take place after a breakthrough south of Pincushion has occurred to allow the entrance to move to the north.

- breakthrough occurs and Pincushion is no longer the controlling point for the beach shape;
- shoreline rotation occurs to the northwest-southeast;
- sediment transport increases on this rotated shoreline and sand is eroded from the main north-south beach;
- the north-south beach recedes as sand is transported into the river entrance;
- the southern bank of the south channel now has a mechanism to accrete and this continues as the south channel continues to infill;
- the distribution of flows changes with the northern channel scouring and becoming dominant as the southern channel fills in;
- the northern channel is now able to breakthrough if the right combination of flow and possibly tide and waves occurs.

This process is natural and therefore may partially or fully occur at any time depending on circumstances. Duplication of the process by man is risky with the chance of failure because of unforeseen circumstances and the unpredictability of the combination of natural events such as wind, wave, tide and flood. However, it is possible to design a channel opening regime which has a high possibility of success and it is likely that the closer the man-made channel is to the natural channel then the higher will be the chance of success.

7 SEDIMENT CATCHING OPTIONS

The following initial comments can be made on Palisade Jetty System, the Sedlar proposal and other sediment catching options and their possible benefits and impacts:

- sediment catching devices (usually achieved by locally reducing velocity) must satisfy the basic law of conservation which for sediment transport means sediment accumulation in one location will result in sediment reduction in another;
- only if there is an excess of sediment in the system can sediment be accumulated in one location without detriment to another;
- it is possible to collect sediment at one location at the expense of another location which may be less important point or expendable;
- at present velocities near the southern channel bank can reach 2 metres per second producing large forces on structures located in this area and potential for scour around these structures;
- there is significant wave action as well as high currents;
- sediment catching options will not prevent the movement of the spit southwards and if they do retard erosion then the channel area will reduce and velocities get higher;
- sediment catching options will not prevent erosion of the beach which is also likely to contribute to a breakthrough during a major storm event.

8 APPROVALS

it is expected that approvals will be necessary under Section 86 of the Harbours Act which should include advice from DPI regarding fish breeding times, and a Permit to Disturb Marine Vegetation.

9 CONCLUSIONS

- Under the present situation with the northern spit wide, stable and progressing incessantly southward and the southern spit south of Pincushion becoming narrower through erosion, a breakthrough of the dunal system south of Pincushion is inevitable and becoming more likely with time.

With regard to the development which occurs adjacent to the southern bank of the Maroochy River the following points can be made:

- while the beach to the south connects with Pincushion the beach alignment is relatively stable with only the normal seasonal variations occurring;
- if a breakthrough occurs south of Pincushion the beach to the south may recede to an alignment relative to the river entrance bar and Alexandra Headland - this is most likely to be behind the Pincushion alignment and shoreline recession will occur; and
- aerial photography shows that reclamation has occurred west of the caravan park where the existing pool and park are now located indicating that the channel has eroded southwards up to or past this location in the past.

Coffee rock exists extensively in the area and is often exposed at the beach face. Council surveys have defined the spatial extent of coffee rock which underlies the area to the east of the caravan park. The following comments can be made about this coffee rock:

- it is encountered at about -2 to -4mAHD;
- it may limit the depth of channel scour and affect channel velocities;
- it has not restricted channel movement in past; and
- it is too low for economic revetment foundation.

Sediment catching devices can only collect sediment at one location by taking sediment from another location. At the moment there is no excess of sediment on the southern bank of the river where erosion is occurring. Conditions at the site are severe with high currents and waves propagating in from the ocean. Significant structures which may exacerbate local velocities and cause turbulence would be required. Also, any action on the southern bank will do nothing to reduce the southward migration of the spit and this will mean continued pressure on the bank.

The cyclic process of the entrance progressing southwards and then breaking through to the north is natural and therefore may partially or fully occur at any time depending on circumstances. Simulation of the process by man is risky with the chance of failure because of unforeseen circumstances and the unpredictability of the combination of natural events such as wind, wave, tide and flood. However, it is possible to design a channel opening regime which has a high possibility of success. It is likely that the closer the man-made channel is to the natural channel in area, combined with blockage of the southern channel, then the higher will be the chance of success.

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QUEENSLAND GOVERNMENT
Department of Environment
 Southeastern Region

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DEH Southeastern Region - FILE DETAILS		
971AP1713	Var:	Folio:
Correspondence #	198/19223	
Action Officer	MICHAEL WOLFE	
Related Items		

Enquiries to
 Telephone
 Your reference
 Our reference

Tony Crozier
 (07) 5443 8944
 SRW:jhl
 972EN123

7 December 1998

The Chief Executive Officer
 Maroochy Shire Council
 Attention: Mr Steve Wood/Mr Noel Ludwig
 PO Box 76
 NAMBOUR QLD 4560

Dear Sir

APPLICATION FOR ENVIRONMENTAL AUTHORITY (SECTION 41 OF THE ENVIRONMENT PROTECTION ACT 1994) - FOR ENVIRONMENTALLY RELEVANT ACTIVITY 19 (C) DREDGING MATERIAL - FOR PROPOSAL TO RELOCATE THE MAROOCHY RIVER MOUTH

I refer to the abovementioned application for environmental authority dated 27 November 1998.

According to Section 41(1) of the *Environmental Protection Act 1994*, an application for environmental authority must -

- (a) be made to the administering authority in the approved form; and
- (b) be supported by enough information to enable the authority to decide the application, including, for example, relevant information about the likely risks to the environment, details of wastes to be generated and any waste minimisation strategy; and
- (c) be accompanied by the appropriate application fee.

Following a preliminary assessment of your submission, it is considered that insufficient information has been provided to enable the authority to decide the application. As the amount of information outstanding is considerable, your submission has been deemed an invalid application.

As you may recall, during our meeting of 17 November 1998, officers the Department indicated that there were a number of outstanding issues that had not been adequately addressed by the WBM Oceanics report 'Maroochy River Entrance Relocation Study'. You were advised that information in relation to these outstanding issues would be required in support of a licence application. Attached is a summary of the information that was identified as outstanding during our meeting, and on

review of the existing report and your recent submission. That information is considered important and relevant to decide an application for dredging to relocate the Maroochy River mouth and create a north flushing channel from Cornmeal Creek (Attachment One). Please note that Attachment One details some specific information required to process your application, however your application should also include information required in "Draft guidelines for completing an application for an environmental authority" and (if relevant) "Draft guidelines for preparing an integrated environmental management system (IEMS) to support a single application for an environmental authority" which you were provided with on 17 November 1998.

I look forward to receipt of an application with the abovementioned supporting information. Should you require further information or assistance in completing a valid application for environmental authority please contact Tony Crozier, Senior Environmental Officer or myself at the above number.

Yours sincerely

sch4p4(6) Personal information

Nikki Moore
Principal Environment Officer
North Coast District Office

CC/FOR YOUR INFORMATION
The Chief Executive Officer
Maroochy Shire Council
Attention: John Kleinsmidt
PO Box 76
NAMBOUR QLD 4560

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ATTACHMENT ONE**Description of Proposal**

Further detail is required with respect to the specific manner in which the proposed works are to be undertaken. The Department of Environment and Heritage (DEH) is of the understanding that Council are still considering a number of different options (all involving some form of dredging and relocation of dredged material) but that a final decision is yet to be arrived at. Please clarify precisely which 'option' Council intends to pursue under an application for environmental authority.

Therefore, subject to the above, the following information is required:

- a complete description of the operations/activities to be carried out including details relating to plant/equipment proposed to be utilised during the project and the scope of the proposed works;
- a description of the processes proposed to be used including the name and proposed location of all equipment to be utilised;
- the proposed location of a site office;
- proposed hours of operation;
- the expected duration of the proposal;
- the proposed location for after-hours storage of plant and equipment;
- the proposed location of fuel/oil storage facilities (including any associated safeguards proposed e.g. bunding);
- locations of associated infrastructure including pipelines associated with dredging works;
- details relating to public access restrictions to the site;
- a site plan;
- a large scale drawing which indicates the boundaries of the proposed works and which indicates the location of all proposed discharge and emission points to the environment (including discharges to water and land, air and noise emissions);
- details of contingency/emergency response procedures;

The DEH also requests details of any financial assurance arrangement that may be proposed between the Council and the prospective contractor with respect to actions which may or may not be required to rehabilitate or restore the environment as a result of environmental harm being caused by the activity.

Site-Based Management Plan

A Site-Based Management Plan must be developed which provides for the following:

- (i) The monitoring of releases of contaminants into the environment;
- (ii) The assessment of the environmental impacts of any releases of contaminants into the environment, for example any ambient environmental quality monitoring or noise monitoring; and
- (iii) The training of all relevant staff, agents and contractors ("staff") to competent levels in at least the following:
 - (a) The environmental management plan developed specifically for the proposal so that staff are aware of any relevant commitments to environmental management; and
 - (b) Any relevant environmental objectives and targets so that all staff are aware of the relevant performance objectives and can work towards these; and

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- (c) Control procedures for routine operations for day to day operational activities to prevent or minimise environmental harm, however occasioned or caused; and
 - (d) Contingency plans and emergency procedures for non-routine situations to deal with foreseeable risks and hazards including corrective responses to prevent and mitigate environmental harm (including any necessary site rehabilitation, contingencies in case of fuel spillages etc.); and
 - (e) Organisational structure and responsibility to ensure that roles, responsibilities and authorities are appropriately defined to manage environmental issues effectively; and
 - (f) Effective communication to ensure two-way communication on environmental matters between operational staff and Council as well as communications with the administering authority; and
 - (g) Documentation systems so that appropriate records of environmental matters are kept to demonstrate that the applicant is meeting environmental commitments; and
 - (h) Responsibilities of the Council and staff according to the *Environmental Protection Act 1994* so that these can be met; and
- (iv) The conduct of environmental and energy audits to review periodically:
- (a) the level of environmental performance; and
 - (b) the effectiveness of environmental management procedures adopted; and
 - (c) efficiency in using energy and resources and opportunities for more efficient usage; and
- (v) The implementation of an effective and appropriate waste management plan.

Acid Sulfate Soils

An Acid Sulfate Soil (ASS) Investigation is required for any coastal area at or below 5 metres AHD which will be exposed, drained or otherwise disturbed by the proposal. ASS investigations should be performed in accordance with the Queensland Acid Sulfate Soil Investigation Team (QASSIT) *"Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998"* dated October 1998 (Revision 4.0), or later versions thereof. Full soil profiles should be described according to McDonald et al., 1990 *"Australian Soil and Land Survey Field Handbook"* second edition, Inkata Press, Melbourne, and must include horizon differentiation and depths, field texture, colour, mottles, soil structure, erosion hazard rating and pH, and appropriate action levels of oxidisable sulfur selected from the QASSIT Guideline with respect to these soil descriptions. The location of each borehole and its existing surface height (Australian Height Datum) should be accurately surveyed, recorded and presented.

Possible investigation strategies (including staged testing) should be discussed with QASSIT and/or Land Resource Officers of the Department of Natural Resources (Nambour), and/or the Department of Environment (North Coast District Office).

An Environmental Management Plan (EMPlan) should be prepared prior to any soil disturbance and should include:

- a three (3) dimensional map of the potential acid sulfate soils to the depth of disturbance;

- details that reflect potential on-site and off-site impacts of the disturbance of the soil and/or the groundwater levels;
- the methods that will be used to avoid, treat or otherwise manage ASS including the contained on-site management and treatment of potential and actual ASS;
- details of management of the height of the groundwater table on and off the site both during and post-construction;
- details of all soil and water monitoring to be performed during and after treatment, and including verification testing of soils;
- details of the handling and storage of neutralising agents;
- details of the contained on-site treatment and management of potentially contaminated stormwater run-off, surface waters and leachate (including details of groundwater management) associated with the works both in the short- and long-term; and
- a description of contingency procedures to be implemented on and off the site if the management procedures prove to be unsuccessful and acid is generated and/or leachate problems occur.

This plan should provide for ongoing management and monitoring of the impacts of acid soil material through the construction and operation of the project and describe the construction schedules and environmental management procedures. The development should be staged so that the potential impact of any area disturbed at any one time is limited and easily managed. Consideration should also be given to protecting any engineered structures from the corrosive properties of ASS and associated waters.

Water Resources

Describe the existing surface and groundwater resources. Establish a baseline of ground water and surface water quality and quantity taking into account seasonal changes. The following parameters should be considered: pH, dissolved oxygen, salinity, total nitrogen, nitrate, nitrite, ammonia, total phosphate, orthophosphate, chlorophyll a, iron, aluminium, manganese, suspended solids, turbidity, sulfate and chloride. Predict any changes that may occur as a result of this proposal.

Sediment Sampling

Develop a sediment sampling and analysis program to determine contaminant levels in the material proposed to be dredged, for the purpose of determining appropriate disposal methods for dredged spoil.

The sediment sampling and analysis program must be carried out in accordance with the *"Environmental Assessment of the Sea Disposal of Dredged and Excavated Material Draft Guidelines"*, December 1996, produced by the Australian and New Zealand Environmental and Conservation Council, or more recent editions of that document as such become available.

The sediment sampling and analysis program must include at least the following:

1. an appropriate number of sediment sampling locations;
2. analysis of at least the following parameters/elements:
 - total organic carbon;
 - particle size;
 - moisture content;
 - settling characteristics in salt water;
 - organochlorine and organophosphorus pesticides;
 - total poly chlorinated biphenyls (PCB's);

- polynuclear aromatic hydrocarbons (PAH's);
- total petroleum hydrocarbons;
- copper;
- lead;
- zinc;
- chromium;
- cadmium;
- mercury;
- arsenic; and
- tributyltin.

3. In the event of analysis results of any elements/parameters listed above which indicates an exceedance of the screening levels stated in Table 7, of the *Australian and New Zealand Environment and Conservation Council Environmental Assessment of the Sea Disposal of Dredged and Excavated Material Draft Guideline*, appropriate toxicity testing will be required and 'follow-up' strategies developed, to demonstrate to the Department of Environment and Heritage that disposal of such material to waters will not cause environmental harm.

Flora and Fauna

Provide a detailed assessment of the vegetation in the area of the proposed operations and the adjacent protected areas (i.e. Maroochy River Conservation Park). A vegetation map at site specific scale with particular attention paid to populations of regional significance should be provided. Include an assessment of the tidal areas within the site and adjacent tidal areas likely to be affected by the proposal, particularly any potential impact the proposal may have on freshwater wetlands, saltmarsh, mangrove and seagrass beds. Include a discussion of the significance of the vegetation of the site to native fauna including intertidal invertebrates and shorebirds. Particular attention should be given to any potential impacts on the avifauna that utilise the site and adjacent areas.

Provide a detailed assessment of terrestrial and marine fauna present in the area of operation and in the adjacent protected areas, including the existence at any time of the year of rare or threatened species, protected or listed under international agreements (eg. RAMSAR, CAMBA and JAMBA), wildlife corridors and the impact of the proposal on these.

Provide a statement of the potential impacts of the proposal on the terrestrial and aquatic fauna. Quantitative data for existing fauna populations should be collected where possible (specific reference should be made to the False Water Rat - *Xeromys myoides*, and its habitat). Of particular concern is the potential impact the proposal may have on the avifauna that utilise the area. A thorough description of the species and the habitat utilised should be included. Temporal, spatial and climatic variations should also be considered in the assessment.

Make an assessment of the impact of the proposal on flora/fauna and identify and quantify the areas of different types of existing tidal habitat which will be lost and any habitat areas which will be created and the immediate and long-term effects of any loss or modification of tidal, inter-tidal and sub-tidal lands. Discuss the impact of noise and light associated with the construction and operational stages of the proposal on any wildlife likely to be present and management measures to mitigate

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any impact. Any potential impacts on avifauna must be discussed in full. Provide details of revegetation/rehabilitation proposed for disturbed areas.

Data on field observations is to be accompanied by information on sampling methods and substantiation of the efficiency of these methods.

Benthic Organisms

For the purposes of determining the on-going efficacy of strategies proposed to be implemented to protect water quality, details of the extent and nature of benthic invertebrates potentially affected by the proposal are requested. Information required includes:

- a survey and assessment of the benthic invertebrates which will be potentially affected by the proposal;
- details of appropriate points at which regular benthic invertebrate monitoring is to be undertaken including details of the nature and frequency of parameters proposed to be tested; and
- any strategies proposed to minimise impacts on benthic invertebrates.

Aquatic Ecosystems

The proposal is considered by the Department of Primary Industries (Fisheries Management) to have the potential for major impact on fisheries resources. Therefore, it must be demonstrated that all potential impacts are correctly identified and appropriate mitigation strategies are developed to minimise any such impacts. This includes indirect as well as direct impacts to fish habitat. The high level of protection afforded to the declared Fish Habitat Areas potentially affected by the proposal, further increases concern for the integrity and sustainability of this important area. Furthermore, the DEH has the responsibility of ensuring that species biodiversity is protected and that the appropriate water quality values as identified in the ANZECC guidelines are maintained with respect to aquatic ecosystems.

Any application must address all of the above issues and any mitigation measures that Council will undertake to retain or create aquatic ecosystems. In particular, the following issues must be addressed.

- identify and describe the habitats or natural processes that are being restored;
- identify and discuss the benefits to public health and safety that will result from the relocation of the river mouth;
- discuss the nature of impacts that will occur to shallow water and intertidal areas in the estuary, especially those close to the new channel;
- provide information as to the mitigation measures Council propose to undertake to retain or create aquatic ecosystems, that currently exist in the mouth area;
- following sediment analysis, information should be provided on the anticipated size, location and duration of any turbidity plume.

Impacts on Coastal/River Processes

The main potential impacts associated with the proposed works which relate directly to coastal/river processes are: potential for changes to the tidal prism (low water and high water levels); potential change in the maximum velocity; and potential changes to flood hydraulics. These issues have been identified and addressed by the WBM report, *'Maroochy River Entrance Relocation Study'*. However, during the proposed dredging operations when there will be two channels open to the ocean (for an unknown period), the hydraulic efficiency will be increased, which is likely to result in

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lower low waters upstream in the Maropchy River (and in tributaries such as Cornmeal Creek) and therefore potential impacts on the intertidal communities and acid sulfate soils. An investigation of these issues should be provided.

Furthermore, it would appear that from the outset, no alternatives to dredging a channel opening across the northern spit have been considered. As the aforementioned WBM report notes, once the proposed channel is dredged and the existing channel closed, natural processes will again ensure that the channel moves south over time (at a rate dependent on factors such as the frequency of storm events). Therefore, an investigation of possible alternatives to the current proposal is requested.

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*Maroochy aspires to be the most environmentally responsible,
caring, enterprising and dynamic community in Australia.*

Your reference:

Our reference:

Enquiries:

Direct Telephone:

Direct Fax No:

RC: av

Mr Roger Chalmers

5441 8070

5441 8111

29 December 1999

The Honourable Rod Welford MLA
Minister for Environment & Heritage and
Minister for Natural Resources
PO Box 2454
BRISBANE QLD 4001

Dear Minister,

MAROOCHY RIVER MOUTH

I refer to our previous correspondence of 2 September 1999 regarding the Maroochy River Mouth, and now submit this formal request for government assistance in funding our current Model Study and any future construction work which may result.

In support of this request I include a Council report which provides an historical background to the current situation at the river mouth, and which details the various studies and construction work undertaken to date. It describes the current model constructed at the Queensland Government Hydraulics Laboratory in Quinlan Street, Deagon and the various options being tested to protect the Cotton Tree/Pincushion area on the southern shore.

In addition to this report, are included copies of two earlier reports from Council's consultants, WBM; the Relocation Study of 1997 and the Initial Advice report given in 1998. These complement the technical report included with our letter of 2 September and now provide you with a copy of all the reports issued to date by WBM.

Being untrained, the Maroochy River is considered to be one of the few remaining "natural" river mouths on the East Coast of Australia. The river and the adjacent coastline is a significant element in the Sunshine Coast's tourist industry and the area of Maroochydore is a key regional centre. Having significance therefore to a wider community than Maroochy Shire alone, Council has elected to adopt a consultative approach when considering issues which relate to the long term management of the river mouth. The current study results from such a philosophy and Council expects the findings from the model should provide a basis for making a properly informed decision on suitable protection for the southern shores.

You will see from section 37 of our report that Council's commitment over the years to both engineering studies and the construction of protective works, has been considerable. We anticipate the cost to construct whatever works may be recommended by the current Model Study to be in the order of \$1.0 to \$2.5 million.

... / page 2

Please quote our file reference number on your reply for fast tracking within Council.

Address: Maroochy Shire Council
Council Chambers
Cnr Bury and Currie Sts, Nambour, Qld. Aust.
Telephone: (07) 5475 8501

Postal: The Chief Executive Officer
Maroochy Shire Council
PO Box 76, Nambour, Qld. Aust. 4560
Fax: (07) 5441 8338

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Date Prepared: 5 January 2000	Prepared by: Paul O'Keeffe ✓
Approved by: Helen Gregory	Title: Acting Manager, Coastal Planning
Position: A/Director, Environmental Planning	Division/Region: Environmental Planning (EPA)
	Telephone: 3227 8496
	Other Refs: 750002Pt2
Date Approved: 6 January 2000	Track No: E/99/06436

Ref: 750186 p12
99/20452

Your Ref: RC:av

13 JAN 2000

Mr N Cooney
A/Manager Facilities Services
Maroochy Shire Council
PO Box 76
NAMBOUR QLD 4560

Dear Mr Cooney

My Minister, the Honourable Rod Welford MLA, has received further advice following receipt of your letter of 29 December and report of 29 November 1999 concerning funding assistance in relation to the study and construction of works at the Maroochy River mouth. Mr Welford has asked me to respond on his behalf.

The Maroochy River mouth, the last natural major river mouth in south east Queensland and one of the last on the east coast of Australia, has significant environmental values. Therefore it is important that any works proposed for the river mouth are designed to have minimal impact on the natural values of the area. In this respect, the Maroochy Shire Council is commended on its initiative to use a physical model to study the effects of the various design options to protect the infrastructure under threat on the southern bank of the river. It will be particularly important to ensure that any proposed works, while restricting further southerly movement of the mouth, do not affect the ability of the mouth to move naturally between its current position and its previous most northerly location just south of Twin Waters. Equally important will be the need to ensure that any proposed works are ecologically sound in relation to the whole of the Maroochy River estuary and ecosystem.

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With respect to the funding of this study and the implementation of any works, none of the agencies under the Minister's control (including the Beach Protection Authority, Environmental Protection Agency, Queensland Parks and Wildlife Service, and the Department of Natural Resources) have any funding available for this purpose. However, the Council would be eligible to apply for subsidy for the works under the Local Governing Bodies' Annual Capital Works Program administered by the Department of Communication and Information, Local Government and Planning. Under this Program, beach restoration and shoreline protection works in tidal areas are eligible for consideration of 25% subsidy provided the works meet the guidelines (copy enclosed). In addition, the Beach Protection Authority, which provides recommendations on the eligibility for subsidy payment, is of the opinion that studies, surveys, investigations (including modelling) and reports associated with a scheme of works may be eligible for subsidy provided the works recommended are included in a Capital Works Program and are implemented with all applicable state approvals. Further information on the payment of subsidy under this Program should be sought from Mr Noel Tierney on telephone 3225 8694 in the Department of Communication and Information, Local Government and Planning.

The Minister thanks you for bringing this matter to his attention and trusts this information is of assistance. Should you wish to discuss this matter further, please contact Mr Paul O'Keeffe of the Environmental Protection Agency on telephone 3227 8496.

Yours sincerely

sch4p4(6) Personal information

Steve Moriarty
Senior Policy Advisor
(Environment and Heritage)

Encl.

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Maroochy
Shire Council



750 186 ~~750001~~ PTH
*Maroochy aspires to be the most environmentally responsible,
caring, enterprising and dynamic community in Australia.*

Your reference:

Our reference: NJC/mjf 1-9357

Enquiries: Mr Roger Chalmers

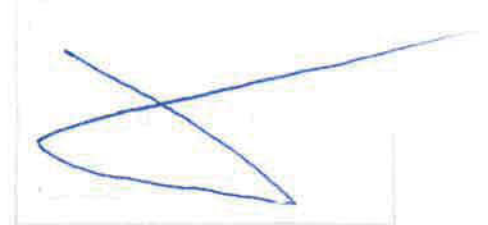
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Party on 17 March 2000

meeting of the Working

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NICK COONEY

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meeting

P. O'Keefe.

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MAROOCHY RIVER ENTRANCE WORKING PARTY

**Friday, 17 March 2000
11:00 am
Large Committee Room**

AGENDA

The desired outcome from this meeting is to obtain clear recommendations to Council on whether or not to implement the "Last Line of Defence", and whether to proceed with further investigations.

- 1. Introduction**
John Warmington, General Manager, Shire Services
- 2. Powerpoint Presentation of Historical Photographs**
Roger Chalmers, Special Projects
- 3. Presentation of Model Study**
Malcolm Andrews, WBM Oceanics
Robert Schwartz, Qld Government Hydraulics Laboratory
- 4. General Discussion**
 - (a) Last Line of Defence
 - (b) Entrance Relocation
 - (c) "Do Nothing" Option
 - (d) Seawall to Pincushion Island
 - (e) Other matters
- 5. Statutory Approvals**
Requirements, procedures and processing
- 6. Recommendations**
- 7. Next Meeting**

MAROOCHY RIVER ENTRANCE WORKING PARTY

Friday, 17 March 2000-03-06
11:00am

Large Committee Room

LIST OF DELEGATES INVITED TO ATTEND

Title	FirstName	LastName	JobTitle	Company
Cr	Don	Culley	Mayor	Maroochy Shire Council
Cr	Hermann	Schwabe	Division 1 Councillor	Maroochy Shire Council
Cr	Barbara	Cansdell	Division 10 Councillor	Maroochy Shire Council
Cr	Joe	Natoli	Division 10 Councillor	Maroochy Shire Council
Cr	Peter	Whale	Division 10 Councillor	Maroochy Shire Council
Cr	Alan	Kerlin	Division 4 Councillor	Maroochy Shire Council
Cr	Gerry	Gordon	Division 5 Councillor	Maroochy Shire Council
Mr	Roger	Chalmers	Team Leader Special Projects	Maroochy Shire Council
Mr	John	Warmington	General Manager Shire Services	Maroochy Shire Council
Mr	Nick	Cooney	Acting Manager Facilities Services	Maroochy Shire Council
Mr	Tim	O'Brien	Manager, Health & Local Laws	Maroochy Shire Council
Mr	John	Jolly	Team Leader Hydraulics & Hydrology	Maroochy Shire Council
Mr	Malcom	Andrews		WBM Oceanics
Mr	Robert	Schwartz		QGHL
Mr	Steve	Moriarty		Ministry for Environment & Heritage
Mr	Paul	O'Keeffe		Beach Protection Agency
Dr	Nikki	Moore		Environmental Protection Agency
Mr	Ross	Quinn	Department of Primary Industries	Fisheries Branch
Mr	Jim	Cash		S.C. Environment Council
Mr	Kerry	Taylor	Maroochy Shore Surf Lifesaving Club	
Mrs	Judy	Dawson		Cotton Tree Caravan Park
Mr	Mark	West		Pincushion Caravan Park
Mrs	Bennie	Alcorn		
Mrs	Helen	Birch		Birch & Hanson Pty Ltd

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WBM

OCEANICS AUSTRALIA

DRAFT

**MAROOCHY RIVER ENTRANCE
RELOCATION STUDY**

RTI DL RELEASE - EHP

Prepared for: Maroochy Shire Council

Prepared by: WBM Oceanics Australia
99 Leichhardt Street
SPRING HILL QLD 4004

Telephone: (07) 3831 6744
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Document: 10374.1.0

DOCUMENT CONTROL SHEET

What Changes Occurred	Reviewed By
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SPRINGFIELD, QLD 4050	
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10/11/2014	10/11/2014
10/11/2014	10/11/2014
10/11/2014	10/11/2014
10/11/2014	10/11/2014
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1 INTRODUCTION

1.1 Background

The Maroochy River is situated within the Shire of Maroochy on the Sunshine Coast in Queensland (see Figure 1.1). The lower river and entrance is comprised of an estuarine system and associated system of coastal bars as illustrated in Figure 1.2.

Historical records show that the river entrance naturally migrates up and down the coast due to prevailing coastal and estuarine processes. The entrance channel has been located both north and south of "Pincushion Island" which is a rocky outcrop on the coastline. Over the last two decades, the entrance channel has migrated southwards from a northern alignment and at present it is located immediately north of Pincushion Island. Erosion along the southern bank of the river near the entrance at Cotton Tree is continuing and there is now a threat of a break-through to the south of Pincushion Island.

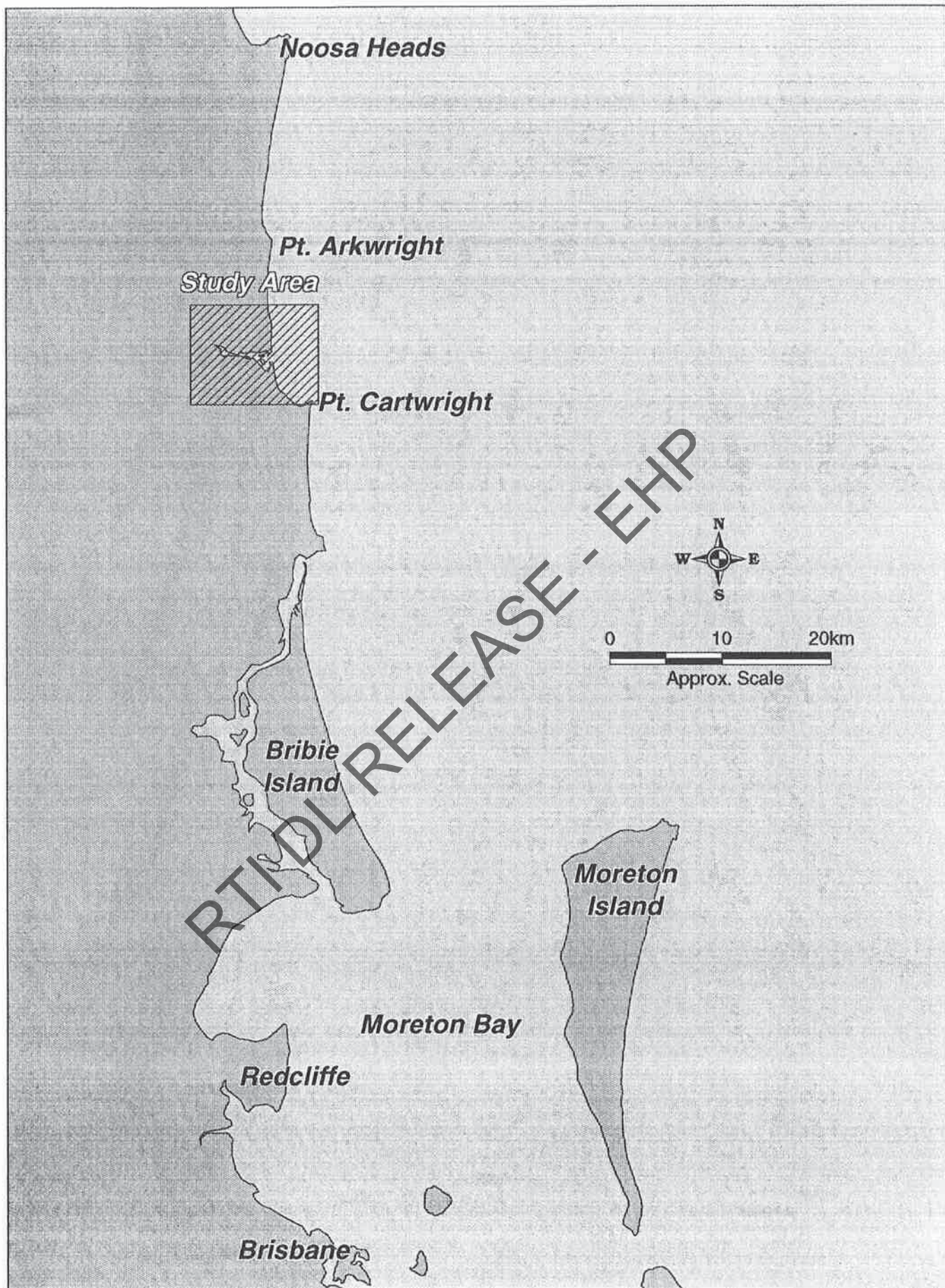
The Maroochy Shire Council has been concerned about the ongoing erosion and the consequences of the river entrance re-establishing to the south of Pincushion Island. Following consultation with the Department of Environment and the Department of Natural Resources, Council resolved that this study be undertaken to investigate the option of re-establishing a northern channel to relieve the erosion problem.

1.2 Scope of Study

The aim of this study was to determine the most appropriate configuration for a new northern entrance to the Maroochy River and to assess potential impacts associated with this entrance change. Consideration has also been given to the need for associated closure or alteration of existing channels in the area as part of these works to minimise impacts and/or improve their effectiveness. The scope of the study was not to assess and recommend the most appropriate option of dealing with the present erosion problem at Cotton Tree, but to assess the specific option of re-establishing a northern entrance channel. A copy of the study brief is attached in Appendix A.

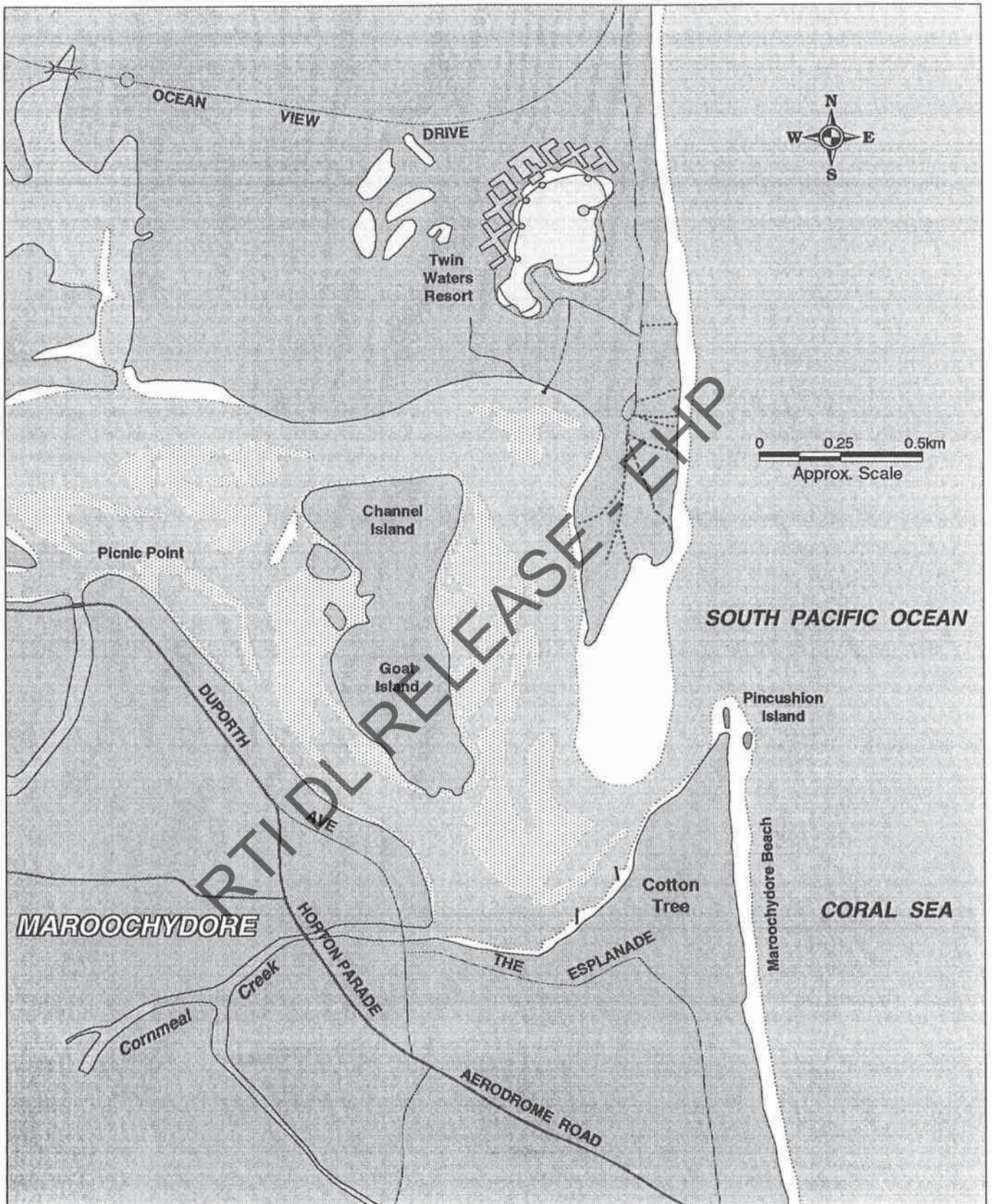
As part of the study, consideration has been given to:

- coastal and river hydraulic processes;
- water quality and flushing of the lower estuary; and
- the natural values of the lower estuary, particularly related to fisheries.



LOCALITY PLAN

FIGURE
1.1



STUDY AREA

FIGURE
1.2

The study also encompasses:

- community consultation;
- liaison with Government Departments;
- specific design and implementation details; and
- environmental management and monitoring recommendations

1.3 Description of Proposal

The specific option investigated in this study is the re-establishment of a northern entrance channel to the Maroochy River. The objective of this is to relieve the existing erosion problem at Cotton Tree and remove the immediate threat of a break-through of the river entrance to the south of Pincushion Island.

The channel would be excavated through the existing northern spit, most likely in a location similar to that which existed in 1974. This is towards the northern extremity of past migrations and is aimed at re-establishing the northern approach channel as the dominant flow path and easing the pressure on the southern approach channel. The specific location and configuration of the entrance are the subject of this investigation.

The existing entrance channel adjacent to Pincushion Island will also need to be closed off to ensure the effectiveness of the works. The southern approach channel will remain connected to the new entrance via the existing channel behind the spit.

The most appropriate method for excavation of the new entrance and closure of the existing entrance is with the use of conventional dredging equipment. Specific requirements in this regard are also discussed in the report.

The proposal does not include the construction of any training or revetment walls and therefore a natural river entrance will be retained. In this way, the new entrance will quickly evolve to a natural equilibrium status with the prevailing processes. It will also be subject to ongoing natural migration as has occurred in the past. Therefore, the proposed works should not be regarded as a permanent solution to the existing problems.

1.4 Outline of Study Methodology

The general approach adopted for this study was to gain an understanding of the processes and values of the lower estuary through a review existing information, further data collection and consultation with the public, fishing organisations and government agencies. From this, conceptual options for a new northern entrance channel were developed and assessed with the assistance of numerical models as predictive tools with respect to the physical processes.

The main components of the study were as follows:

- Collect and review existing information on all relevant aspects including coastal processes, tidal and flood hydraulics, water quality, morphological processes and fisheries and ecological values;
- Perform a field data collection exercise, to supplement this existing information;
- Carry out consultation with the public, fishing organisations and government agencies to obtain further information and identify specific constraints;
- Select a series of potential options for the configuration of the northern entrance based on the understanding of the processes and natural values gained from the above;
- Develop and calibrate a numerical model of the Maroochy River system, based upon the available information;
- Assess any potential impacts associated with each relocation option in relation to the following:
 - ⇒ coastal processes
 - ⇒ tidal hydraulics
 - ⇒ flood hydraulics
 - ⇒ water quality and flushing
 - ⇒ fisheries values
 - ⇒ ecological values
 - ⇒ economic and practical considerations
- Recommend an entrance relocation option according to the findings of the above criteria; and
- Determine design and implementation details, including:
 - ⇒ excavation/fill details
 - ⇒ construction procedures
 - ⇒ ancillary works
 - ⇒ environmental management and monitoring

This methodology is described in detail in this report, including a description of the work undertaken, presentation of results and measurements made, and detailed discussions of the implications of the proposed works.

2 CHARACTERISTICS OF THE LOWER ESTUARY

2.1 General Description

The lower estuary of the Maroochy River is a complex system of channels, intertidal shoals, islands and coastal bars. The entrance area is dominated by a large spit which extends southwards from the north shore. The river enters the ocean between the southern tip of this spit and a rocky outcrop known as Pincushion Island. The alignment of the northern spit is landward of the general coastal alignment to the south of Pincushion Island and as such, the entrance channel is oriented towards the north. (see Figure 1.2). A shallow bar extends across the river entrance out from Pincushion Island.

Within the estuary, Goat/Channel Island divides the river into two main channels; the north and south channels. The north channel traverses to the north of Channel Island, and then runs parallel to and between the seaward side of the island and the landward side of the spit before rejoining the southern channel at Cotton Tree. The south channel traverses to the south of Goat Island from Picnic Point to Cotton Tree.

A mix of urban development and open space occurs adjacent to the southern bank of the river. This includes residential and commercial properties between Picnic Point and the mouth of Cornmeal Creek, a caravan park and camping ground at Cotton Tree, an area of parkland used for public recreation between Cornmeal Creek and the Cotton Tree Caravan Park and public open space near Pincushion Island.

The northern bank of the river adjoins public open space, and the Twin Waters Resort.

The Maroochy River has not been subject to any significant flow control works such as breakwaters or revetment walls. As such, it is considered to be one of the few remaining 'natural' river entrances on the east coast of Australia. However, historical changes show that the river entrance has migrated over time from south of Pincushion Island north to the existing carpark area near Twin Waters Resort.

2.2 Historical Changes

As discussed above, the Maroochy River has not been artificially controlled or constrained to any appreciable extent. As such, the natural entrance migrations inherent in such a dynamic estuarine system have dominated the history of the lower estuary. These natural migrations have occurred under the influences of the prevailing coastal processes as well as the tidal and flood hydraulic regime of the river.

A history of the configuration of the Maroochy River entrance has been documented in a series of aerial photographs, taken at various times since 1940. The photographs, as displayed in Figures 2.1(a), (b) and (c), illustrate the variation in entrance configurations that has occurred in the period between 1940 and the present. A dot-point description of the condition of the lower estuary at each photograph time is given below.



1940



1958



1961



1967



1974



1979

Figure 2.1 Historical Aerial Photographs of Maroochy River Entrance 1940 to 1979

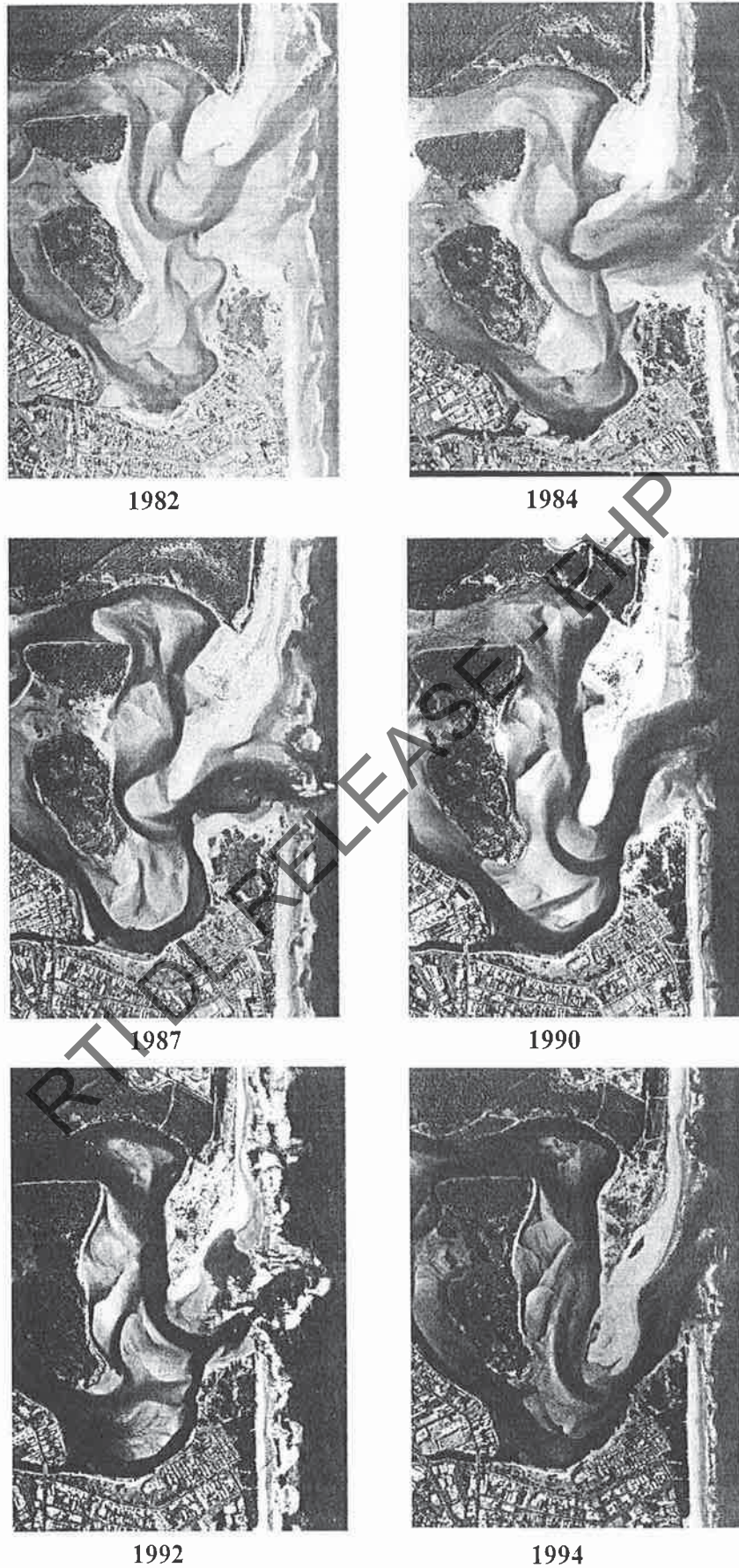
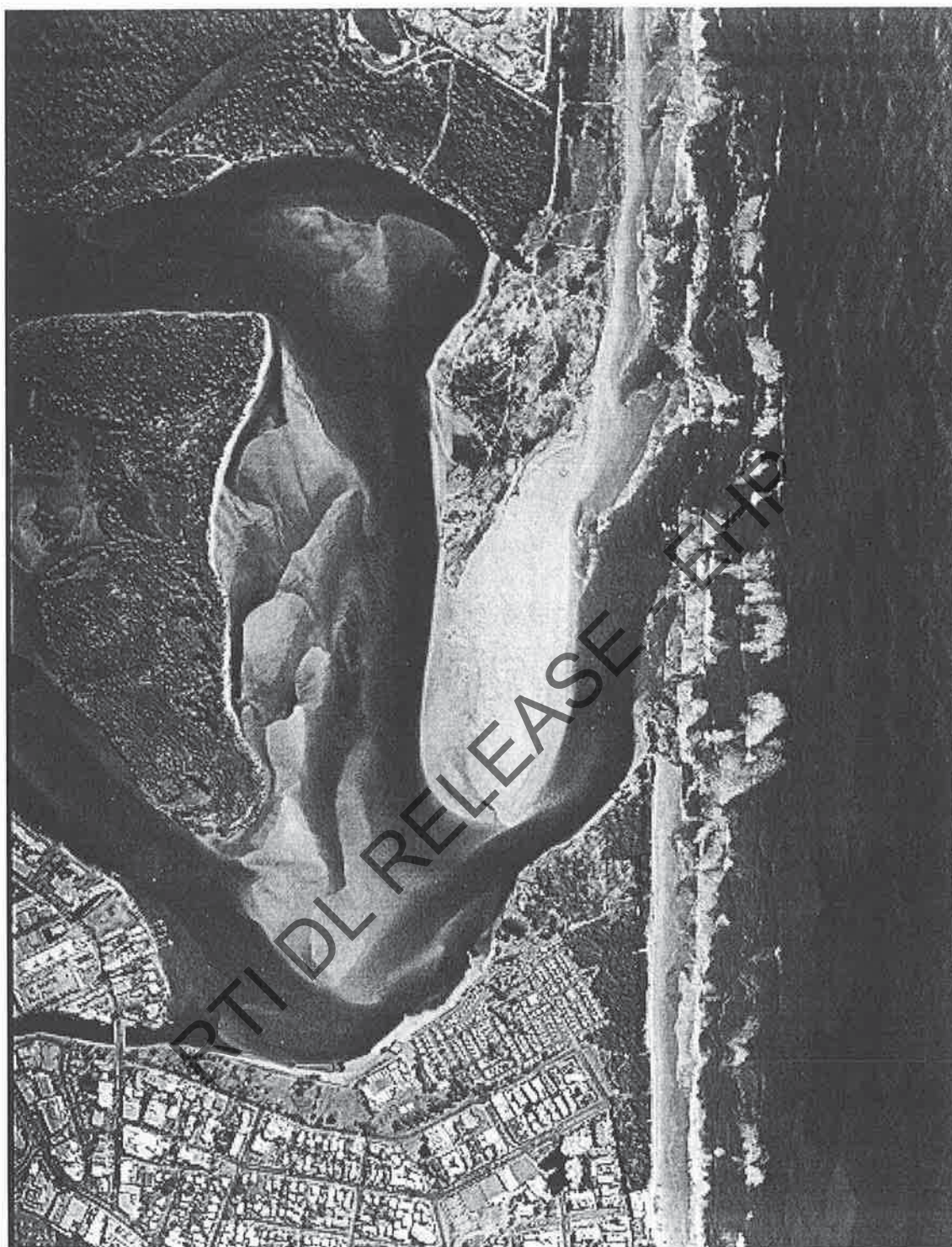


Figure 2.1(b) Historical Aerial Photographs of Maroochy River Entrance 1982 to 1994



1996

Figure 2.1 (c) Historical Aerial Photographs of Maroochy River Entrance 1996

JULY 1940 (1:18,900)

- main entrance south of Pincushion with small channel to north
- northern spit extended to south and relatively narrow with vegetation
- entrance symmetrical about centreline (approx 30 deg south of shore normal)
- sparse vegetation suggests entrance may have been much further to north and south
- high tide channel between Goat and Channel Islands

5 MAY 1958 (1:25,000)

- entrance south of Pincushion
- northern spit extended to south and connected to Pincushion but eroded by river and very narrow with little vegetation
- sand spit essentially closing south channel
- high tide channel between Goat and Channel Islands
- potential for reduced flushing at Cotton Tree

25 SEPTEMBER 1961 (1:12,700)

- entrance north of Pincushion
- northern spit very short with no revegetation, suggesting recent growth
- southern foreshore connected to Pincushion with no vegetation, suggesting recent deposition
- extensive sand bank from Channel Island to Cotton Tree caravan park effectively blocking southern channel
- high tide channel between Channel and Goat Islands but blocked by abovementioned bank
- potential for reduced flushing at Cotton Tree

16 JULY 1967 (1: 48,000)

- entrance north of Pincushion
- new northern spit extending south with no revegetation
- high tide channel between Channel and Goat Islands
- southern spit well developed extending from Pincushion toward Channel Island
- south channel effectively closed by abovementioned spit
- potential for reduced flushing at Cotton Tree

10 NOVEMBER 1974 (1:12,000) after Jan 1974 flood

- entrance north of Pincushion - slightly north of location in 1961
- northern spit beginning to extend south with no vegetation indicating recent growth

- southern spit well developed north of Pincushion towards Channel Island
- south channel effectively closed by above spit
- dredging in south channel
- high tide channel between Channel and Goat Islands but becoming more restricted
- potential for reduced flushing at Cotton Tree

23 MAY 1979 (1:12,000)

- entrance north of Pincushion but migrating southwards and angled towards northeast
- northern spit continuing to extend south with no vegetation
- southern spit extending northwards from Pincushion with no vegetation
- both north and south channels open
- high tide channel between Goat Islands almost closed naturally by sand bar

20 JULY 1982 (1:12,000)

- entrance north of Pincushion but continuing to migrate southwards and angled towards northeast
- northern spit extending south with no vegetation
- southern spit reduced but extensive intertidal shoals
- both north and south channels open although with extensive shoals
- high tide channel between Goat and Channel Islands naturally closed

20 JULY 1984 (1:12,000)

- entrance immediately north of Pincushion but angled almost straight out to the ocean
- northern spit extending south with no vegetation
- both north and south channels open but with extensive shoals
- high tide channel between Channel and Goat Islands closed and starting to be colonised by mangroves

23 JULY 1987 (1:12,000)

- entrance just north of Pincushion
- northern spit continuing to extend south - signs of vegetation
- both north and south channels open - south channel looks to becoming more dominant
- high tide channel between Channel and Goat Islands closed with vegetation increasing

11 AUGUST 1990 (1:12,000)

- entrance just north of Pincushion and becoming more aligned to the north east
- northern spit continuing to extend south past Pincushion with established vegetation

- both north and south channels open
- some erosion of the southern bank between Cotton Tree and Pincushion
- high tide channel between Channel and Goat Islands closed and vegetated

6 JUNE 1992 (1:12,000) AFTER FEBRUARY 1992 FLOOD

- entrance just north of Pincushion
- northern spit slightly shorter - presumably scoured during February 1992 flood
- both north and south channels open
- erosion of southern bank at Cotton Tree and downstream to Pincushion
- high tide channel between Channel and Goat Islands closed and vegetated

12 NOVEMBER 1994 (1:12,000)

- entrance just north of Pincushion with channel aligned towards north
- northern spit continuing to extend south past Pincushion
- both north and south channels open
- high tide channel between Channel and Goat Islands closed and vegetated
- south bank continuing to erode between Cotton Tree and Pincushion

27 MAY 1996 (1:12,000)

- entrance just north of Pincushion and aligned towards the north
- northern spit continuing to extend south past Pincushion
- both north and south channels open
- high tide channel between Channel and Goat Islands closed and vegetated
- south bank continuing to erode between Cotton Tree and Pincushion

The significant features identified from the historical photographs are as follows:

- the lower estuary is highly dynamic and subject to continuing change;
- the sediments are highly mobile with channels and shoals continually moving under the influences of tides, floods and waves;
- the entrance channel has been located from south of Pincushion Island to near the present car park area on the north shore;
- following a major switch or break-through, the entrance channel generally migrates slowly southwards;
- the northern spit generally recurves into the estuary with the entrance channel skewed towards the north;
- when the northern channel is dominant, the southern channel is substantially shoaled, potentially reducing flushing in the Cotton Tree area;

- when both north and south channels are open, they are generally both shallow; and
- the central channel between Channel and Goat Islands has become blocked and is now well vegetated.

At present, the northern spit is well developed and continuing to grow southwards. The spit extends the full length of Goat/Channel Islands and south of Pincushion Island. As the northern spit continues to grow, the flow resistance along the north channel will increase. It is likely that this will result in a corresponding increase in flow through the south channel with the potential for high velocities to continue or increase. As such, erosion along the south bank can be expected to continue with the potential for a break-through to the south of Pincushion Island as has occurred in the past.

2.3 Coastal Process

2.3.1 General Considerations

At river entrances, there is a strong inter-relationship between coastal and estuarine processes. Coastal longshore sand transport plays a significant role in the development of coastal spits and the migration of entrance channels. It is also an important factor in the overall dynamic behaviour of estuaries by supplying sand which is transported upstream under the influence of the prevailing tidal currents.

An understanding of these processes is necessary in considering entrance relocation options. The potential for beach erosion and wave overtopping in contributing to a break-through is also an important consideration in the design of any closure works.

2.3.2 Longshore Transport Considerations

When waves approach the shoreline at angle, they generate a current along the coast which transports sand stirred into suspension by the wave action. Transport occurs both up the coast and down the coast depending on the prevailing wave direction with the overall balance being called the net longshore transport rate.

No detailed studies of longshore transport have been undertaken for the Maroochydore area. Available information from earlier studies for the Mooloolah River entrance (Department of Harbours and Marine, 1987) indicate that regional net longshore transport rates are likely to be towards the north and relatively low, given the alignment of the coast and the influence of Point Cartwright. An overall net longshore transport rate towards the north is also supported by the build-up of sand to the south of Pincushion Island which acts as a groyne holding the shoreline in its present location.

While the overall net longshore transport is towards the north, historical evidence illustrates a southwards migration of the northern entrance spit and the river entrance. This is likely to be due to the influence of the entrance bar. North-easterly waves will naturally induce a southwards transport of sand. Waves from the east and east-south-east are likely to refract and diffract around the bar and approach the spit at an angle which generates a southerly

transport. Pincushion Island and the shoreline to the south effectively prevent any waves from reaching the spit which would generate a northerly transport of sand. Accordingly in the absence of other works, it is likely that the spit will continue to grow in a southwards direction.

2.3.3 Beach Erosion and Wave Run-up

During storm or cyclone events, large waves and elevated water levels can result in erosion of the beach. The sand is typically transported offshore to form an offshore bar. Following the event, normal wave action slowly transports the sand back to the foreshore. While detailed calculations for the specific site have not been carried out, it could be expected that erosion of the order of 400 to 500 cubic metres per metre length of beach could occur during severe storm conditions. This would result in recession of the foreshore by some 40m to 50m depending on the height of the dune.

Differentials in longshore sand transport both during storm events and in the long term can also lead to erosion of the foreshore.

The above processes and associated wave run-up and overtopping potential are important considerations in the design of any new dune system associated with the project.

2.4 Tidal Hydraulics

2.4.1 General Considerations

The river entrance is an important controlling factor on the tidal regime of the estuary. The shoals and shallow channels of the entrance region restrict the propagation of the tide from the ocean into the estuary with a corresponding reduction in tidal range.

Natural river entrances on sandy coastlines have been shown to exhibit a dynamic equilibrium wherein there is a relationship between the tidal prism and the cross-sectional area of the channel. If this equilibrium is upset due to either natural or man induced influences, the estuary will re-adjust until a new equilibrium is achieved.

Tidal hydraulics play a key role in the sediment transport processes and associated erosion/deposition trends. Flow patterns and distributions are also important with respect to the flushing of the lower estuary and the associated water quality.

For this study, an understanding of the tidal hydraulics, in particular the influence of the entrance channel and the distribution of flow between the north and south channels is important for consideration of entrance relocation options. This understanding has been gained through a review of existing information together with additional field data collection of present day conditions as outlined below. Numerical modelling of the tidal hydraulics has also been carried out as discussed in Section 4, with the recorded field data being used for model calibration purposes.

2.4.2 Existing Data

At the commencement of the study, all available data concerning the hydraulic nature of the Maroochy River, particularly the lower estuary and entrance, was collated and reviewed. Information retrieved included the following:

- recent aerial photos of the estuary;
- data from existing tide recorders;
- published tide level predictions;
- past investigations into tidal processes completed by the Beach Protection Authority (BPA); and
- bathymetry information collected by Maroochy Shire Council (MSC) and BPA.

This section details the collation of these data, and provides details of the content, quality and source of the various components.

2.4.2.1 Aerial Photography

As discussed in Section 2.2, vertical aerial photography of the lower estuary is available from 1940 to present and clearly shows the location of sand shoals, bars, and flow distribution channel and their changes over time.

2.4.2.2 Tide Data

Tidal planes for the estuary are available in the Tide Tables published by the Department of Transport (DoT, 1997). Also, tide recordings were made available from existing gauges in the estuary and from previous investigations.

The offshore tidal characteristics were described using tidal information for the Port of Mooloolaba (DoT, 1997). Previous investigations by the Tides Section of DoT have shown that the tide recorded at Mooloolaba is equivalent to the ocean tide.

The tidal planes at locations progressively upstream in the Maroochy River are presented in Table 2.1 below:

Table 2.1 Tidal Characteristics of the Maroochy River (DoT, 1997)

Location	Mean High Water Spring (m LAT)	Mean High Water Neap (m LAT)	Mean Low Water Neap (m LAT)	Mean Low Water Spring (m LAT)	AHD (m LAT)	Mean Spring Tidal Range (m)	Mean Neap Tidal Range (m)
Mooloolaba	1.60	1.28	0.56	0.24	0.99	1.36	0.72
Picnic Point	0.90	0.77	0.35	0.22	0.46	0.68	0.42
David Low Bridge	0.88	0.76	0.32	0.21	0.44	0.67	0.44
Dunethin Rock	0.96	0.80	0.32	0.17	0.44	0.79	0.48
Junction North Maroochy River	1.00	0.87	0.33	0.21	0.49	0.79	0.54

The table above shows that for a mean spring tide, the tidal range decreases from 1.36 m to 0.68 m between the ocean and Picnic Point. The lower estuary has a relatively shallow entrance with an extensive system of tidal flats and sand bars. This configuration is a constriction to tidal flows, and as such there is a significant reduction in the tidal range between the ocean and the estuary.

The tidal range does not change significantly between Picnic Point and the David Low Bridge. This suggests that upstream of the entrance channel there is little constriction to tidal flow into and out of the Maroochy River.

Beyond the David Low Bridge the geometry of the river system tends to amplify the tidal range.

2.4.2.3 Stream Gauging Exercises (BPA)

As part of an investigation into erosion processes at the mouth of the Maroochy River, the BPA undertook stream gauging exercises in 1992 and 1994 to define characteristics of water flow through the lower estuary and entrance channel. Stream gauging was undertaken at the following key sites (as shown in Figure 2.2):

- Station 5D, Cotton Tree
- Station 6, South Channel
- Station 13, North Channel



LOCATION OF BPA STREAM GAUGING SITES -
1992/1994

FIGURE
2.2

The stream gauging adopted the following methodology:

- At each of the three sites, regular velocity measurements were taken at 0.2, 0.6 and 0.8 of the total depth at selected points along the river cross-section. Measurements were taken throughout a tidal cycle (~13 hours).
- Accurate tidal water level data were obtained using tide board readings. In addition, the 1992 gauging used tide records measured by the DoT in the ocean and at Cotton Tree. The 1994 gauging used tide records measured in the ocean and at Cotton Tree, South Channel and North Channel.
- A hydrographic survey of the stream gauging cross-sections was completed by Pacific Hydrographic Survey. This, in combination with the water level recordings, provided accurate information on the water depth during the measurement period.

The 1992 stream gauging exercise was undertaken on 8 December 1992, coinciding with mean tidal conditions. The measured data were processed to give the average flow characteristics at the given cross sections. The results are presented as flow rates (m^3/s) over time in Figure 2.3, for the South and North Channels, respectively. The Cotton Tree results are not considered relevant to this project and therefore have not been presented.

Further analysis of the measurements was performed to determine the tidal prisms for the North and South Channels, and the distribution of flow between them. This is presented in Table 2.2 below:

Table 2.2 BPA Stream Gauging Exercise, 1992 Tidal Flow Characteristics

<i>Tidal Phase</i>	<i>Tidal Prism (m^3)</i>		<i>Prism Distribution</i>
	<i>South Channel</i>	<i>North Channel</i>	<i>North / South</i>
Ebb	1,828,000	3,296,000	1.80
Flood	1,048,000	1,377,000	1.31

The 1994 stream gauging exercise was undertaken on 27 April 1994, coinciding with spring tidal conditions. As above, the measured data were processed to give the average flow characteristics at the given cross sections. The results are presented as flow rates (m^3/s) over time in Figure 2.4, for the South and North Channels, respectively.

Further analysis of the measurements was performed to determine the tidal prisms for the North and South Channels, and the distribution of flow between them. This is presented in Table 2.3 below:

Table 2.3 BPA Stream Gauging Exercise, 1994 Tidal Flow Characteristics

<i>Tidal Phase</i>	<i>Tidal Prism (m³)</i>		<i>Prism Distribution</i>
	<i>South Channel</i>	<i>North Channel</i>	<i>North / South</i>
Ebb	2,936,000	2,677,000	0.91
Flood	6,176,000	3,864,000	0.63

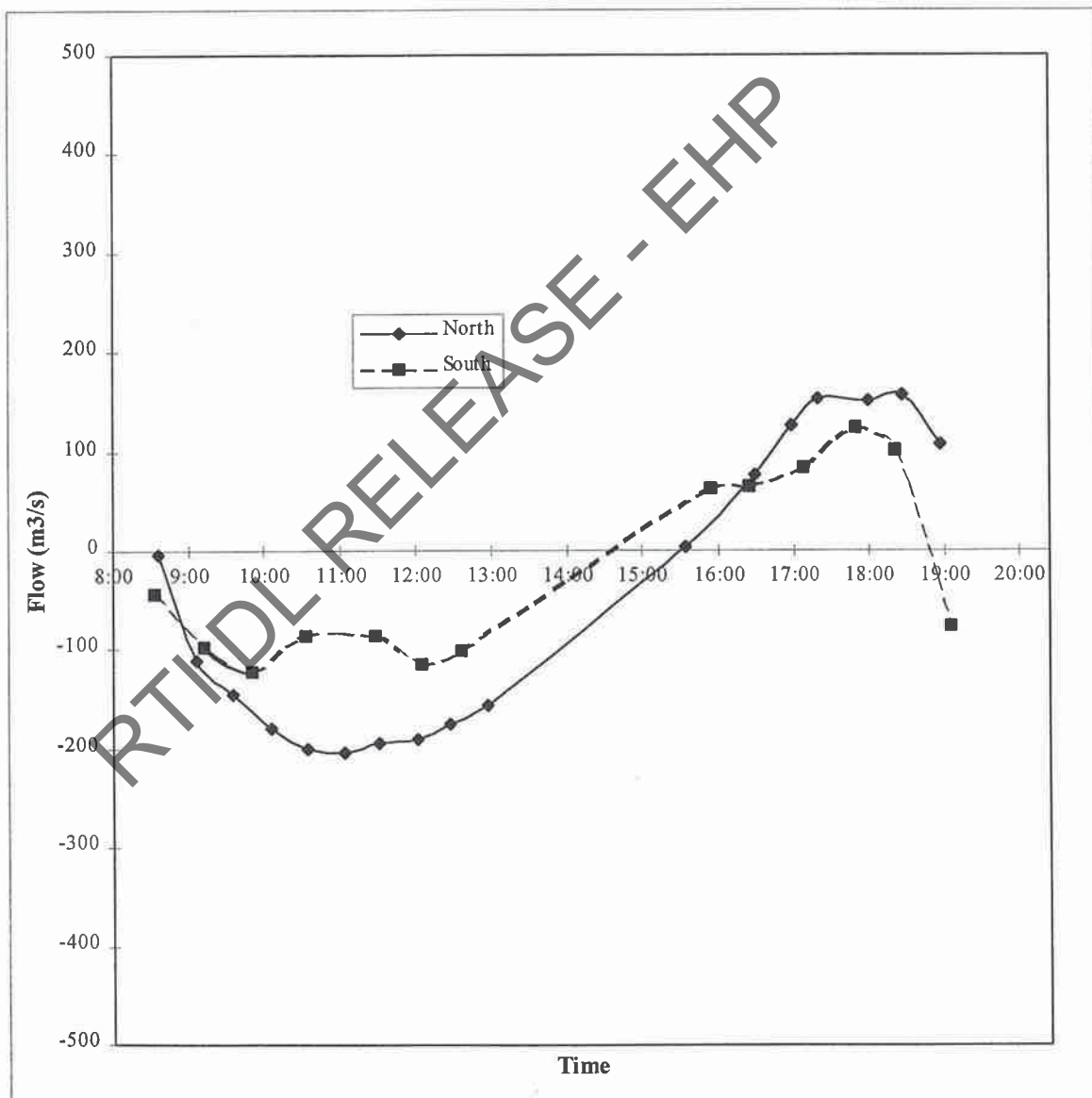


Figure 2.3 Maroochy River Flow Characteristics - 1992

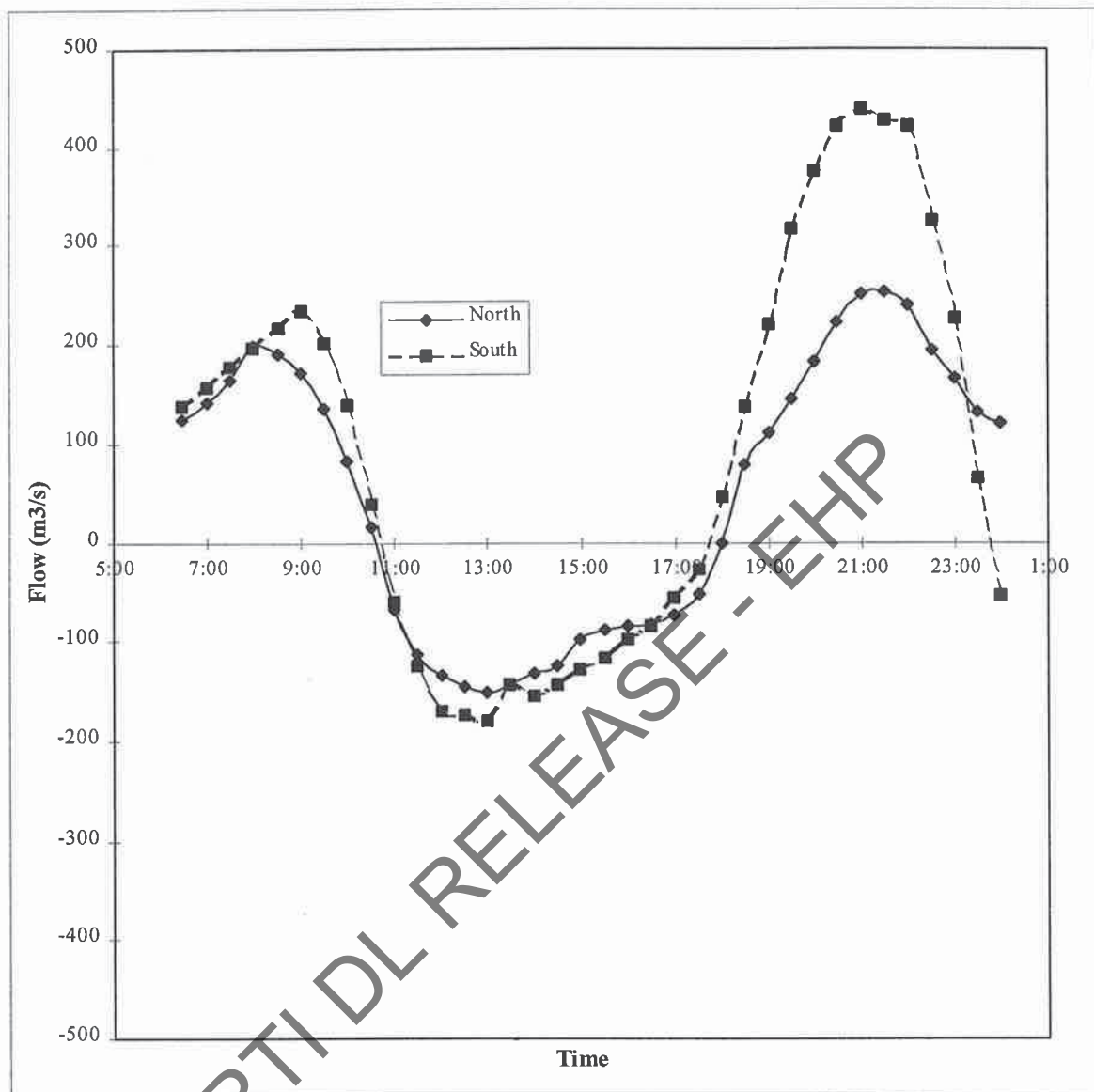


Figure 2.4 Maroochy River Flow Characteristics - 1994

2.4.2.4 Survey Data

Survey information from the 1980's to present have been made available from the Maroochy Shire Council (MSC) and the Beach Protection Authority (BPA). Primarily this data has consisted of cross sections of the estuary and river which have been used for previous erosion and flood studies. Broadly the data was collected at three times as listed below:

- 1982/3 cross sections used by MSC for numerical flood modelling;
- 1992 and 1994 BPA/MSC cross sections for the Cotton Tree erosion study; and
- 1997 MSC cross sections and spit survey for present study.

2.4.3 Additional Field Data Collection

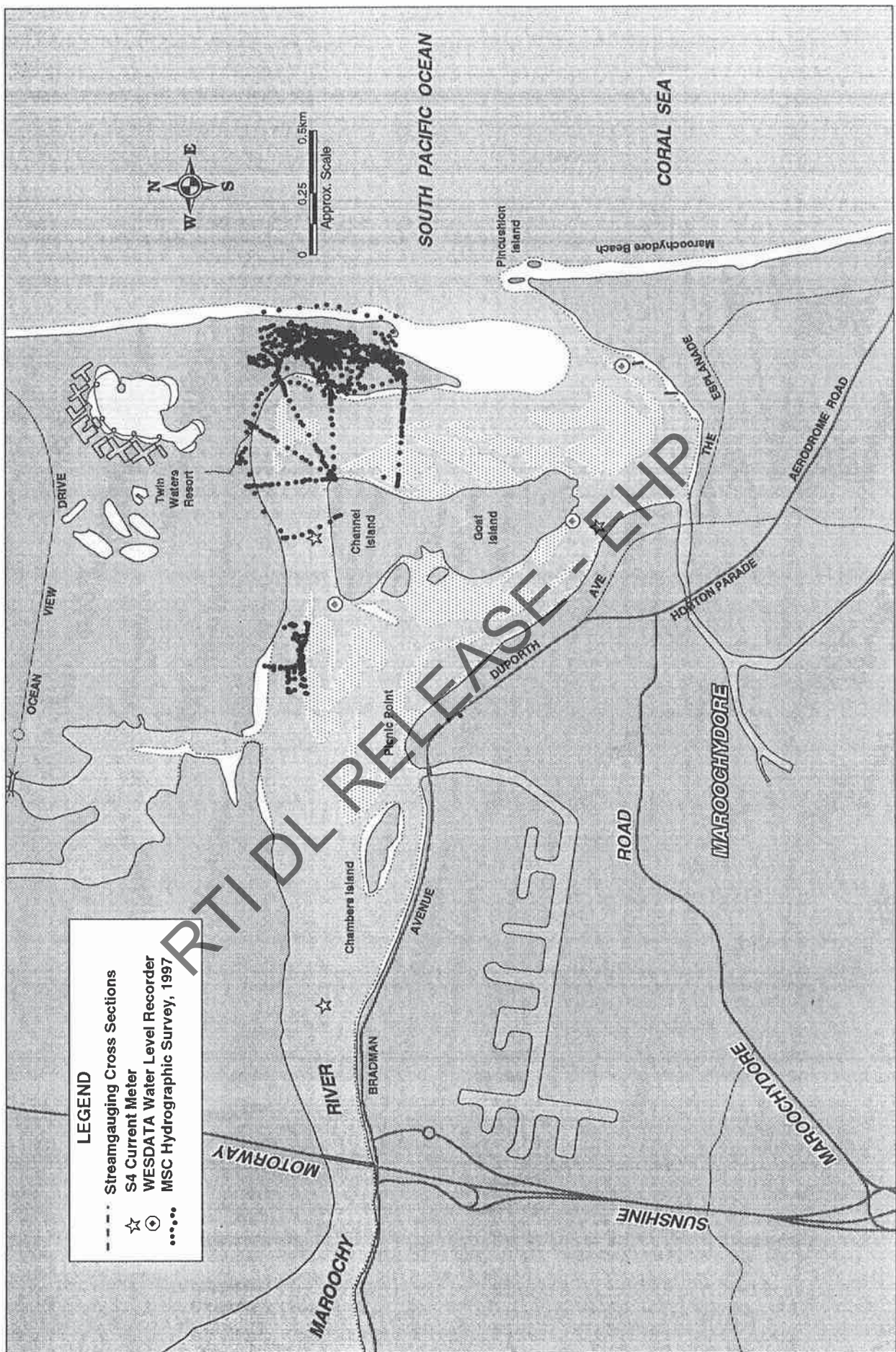
2.4.3.1 General

Information on the hydraulic nature of the river from previous studies was collated, as described above. Although this information provides some basis for this study, additional data collection was required given the continual changes. The aim of the field data collection exercise was to supplement the existing information, and to provide a more detailed description of the state of the lower estuary at the present time.

The field data collection exercise undertaken included the following:

- water level measurements at several locations along the Maroochy River;
- current measurements;
- stream gauging at sections previously gauged to allow comparisons; and
- cross-sectional surveys (WBM Oceanics Australia and MSC).

The field data collection exercise took place over a 3 day period between February 5 and 7, 1997, which coincided with spring tidal conditions. The locations of the monitoring instruments are displayed in Figure 2.5. Details of the instruments deployed and other data collection are provided below.



LOCATIONS OF INSTRUMENTS, FIELD DATA COLLECTION - 1997

FIGURE

2.5

2.4.3.2 S4 Current Meter Measurements

Three InterOcean S4 current meters, which recorded water level and current speed and direction were deployed. As shown in Figure 2.5, the deployment locations were:

- upstream of Chambers Island;
- South Channel; and
- North Channel.

The S4 current meters were deployed for a total of three days. The instruments were programmed to record water depth, flow velocity and flow direction every six minutes. Readings were taken at half second intervals for one minute, and a vector average of the 120 readings calculated and recorded. Reliable data was obtained from the Chambers Island and North Channel S4 current meters, with the South Channel S4 giving unreliable depth results.

Current speed and direction data are presented for all S4 current meters in Appendix B.

2.4.3.3 Tide Gauge Measurements

Three tide level recorders were deployed at Cotton Tree, South Channel and North Channel. The recorders were programmed to record instantaneous water levels every six minutes. In addition, data was obtained from the recorder at the Port of Mooloolaba (ocean) and the Maroochy Shire Council flood warning gauge operating at Picnic Point. The measurements are presented in Appendix B.

2.4.3.4 Survey Data

A hydrographic survey of the area, including the sand spit, was carried out by MSC. The survey included a series of cross-sections, most of which had been used previously for data collection exercises. The locations are shown in Figure 2.5.

2.4.3.5 Stream Gauging

Stream gauging was undertaken over a 13 hour period at two sites:

- Station 6, South Channel; and
- Station 13, North Channel.

These sites correspond to those adopted by the BPA during previous stream gauging exercises in 1992 and 1994 (see Section 2.4.2.3). The stream gauging adopted the following methodology:

- At each site, regular velocity measurements were taken at 0.2, 0.6 and 0.8 of the total depth at selected points along the river cross-section. Measurements were taken throughout the tidal cycle (~13 hours).
- Accurate tidal water level data was obtained from tide board readings, as described in Section 2.4.3.3.

- As discussed in Section 2.4.3.4, a hydrographic survey of the stream gauging cross-sections was completed. Measurements taken during the stream gauging exercise confirmed the survey results. This, in combination with the water level recordings, provided accurate information on the water depth during the measurement period.

The measured data were processed to give the average flow characteristics at the given cross section. The results are presented as flow rates (m^3/s) over time in Figure 2.6 for the South and North Channels. Further analysis of the measurements was performed to determine the tidal prisms for the North and South Channels, and the distribution of flow between them as shown in Table 2.4.

Table 2.4 Tidal Prism of North and South Channels, 1997

<i>Tidal Phase</i>	<i>Tidal Prism (m^3)</i>		<i>Prism Distribution</i>
	<i>South Channel</i>	<i>North Channel</i>	<i>North / South</i>
Ebb	3,205,000	2,414,000	0.75
Flood	3,125,000	2,114,000	0.68

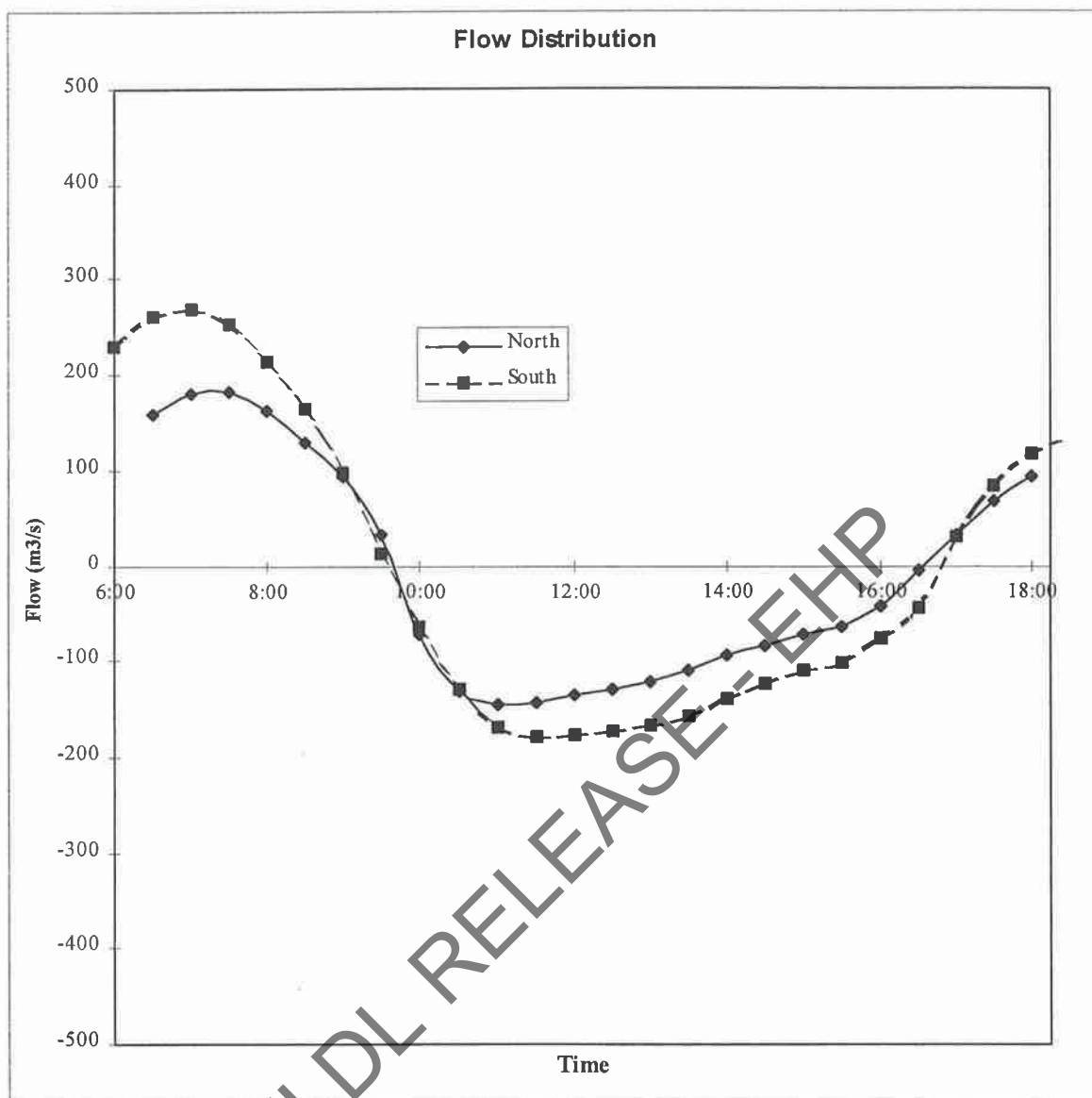


Figure 2.6 Flow Distribution North and South Channels, 1997

2.4.4 Cross-Sectional Area Considerations

The available tide data indicates that the entrance region has a significant effect on the tidal range in the river system. The entrance conditions are continually changing and so it can be expected that the tidal regime within the estuary is also subject to natural variations.

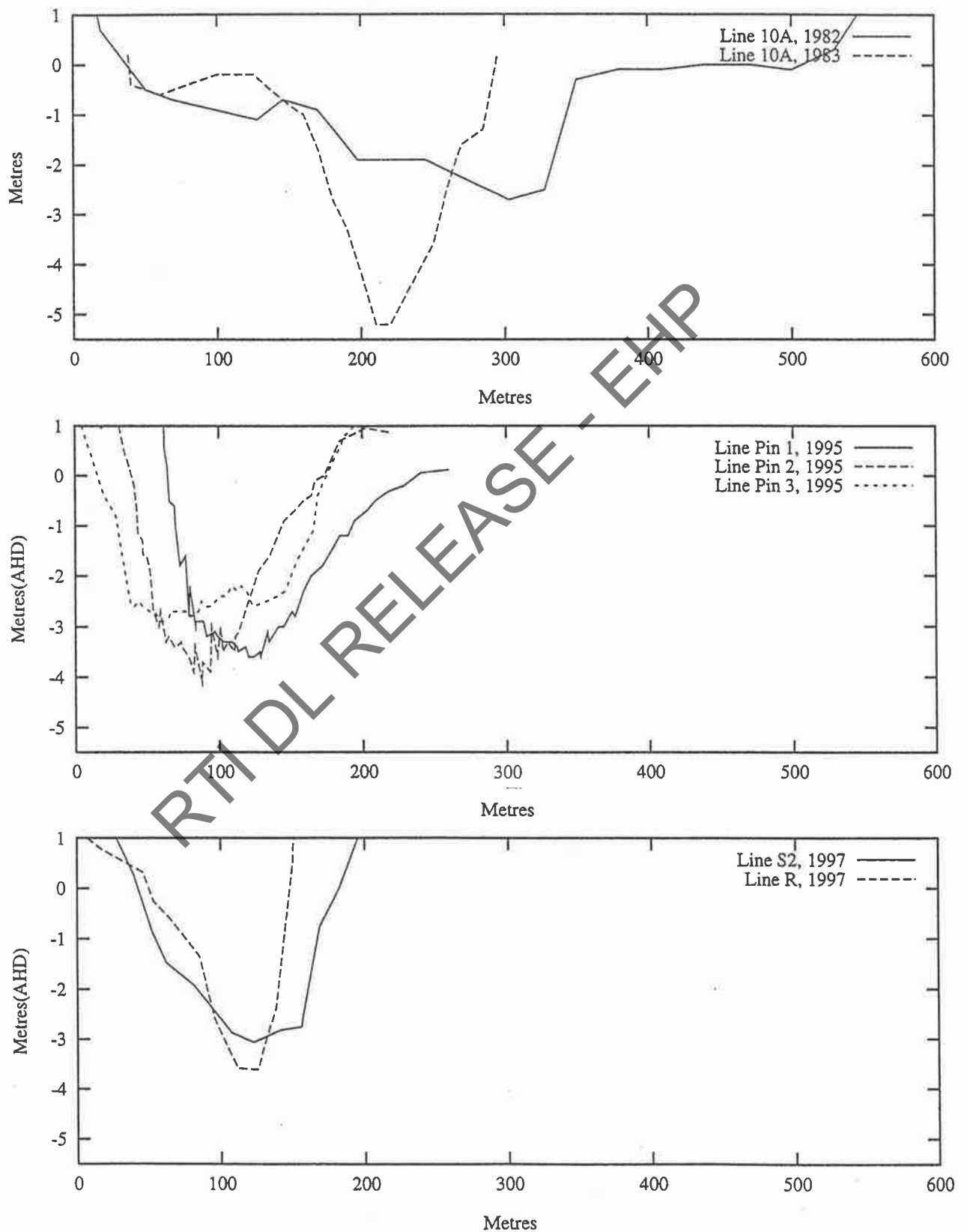
Figure 2.7 displays typical cross-sectional profiles of the entrance as existed in 1982, 1983 (post-flood), 1995 and 1997. The figure indicates that scour occurs during flood events and that the cross-sectional area of the entrance channel has reduced substantially from about 460m² below AHD in 1982 to about 250m² below AHD in 1997.

Following a flood event which induces significant scour, it can be expected that a deeper entrance will result in a higher tidal range in the estuary. The natural processes will gradually lead to infill of the channel once again, returning the estuary to an equilibrium between the tidal prism and the channel cross-sectional area.

As discussed above, the present entrance channel has a relatively small cross-sectional area compared to previous available surveys. This is reflected in very high tidal velocities through the channel. It would normally be expected that these high velocities would scour the channel to a deeper cross-sectional area (as in the past). However, observations indicate that coffee-rock is exposed along the bed of the channel which restricts the potential for it to scour deeper. Therefore it is possible that the presently constricted entrance is restricting tidal propagation into the estuary with corresponding smaller tidal ranges. Further analysis of historical tide levels data would be required to confirm this.

While the entrance channel itself has a significant influence on tidal propagation into the estuary, the channels and shoals inside the entrance also have a major effect. The historical photographs show that there have been substantial changes in the channels and shoals over time. There have been periods when the southern channel has been substantially blocked off and accordingly at these times, the flows and flushing through the south channel are likely to have been restricted.

The stream gauging data from 1992, 1996 and 1997 also shows a redistribution in flow from the north channel to the south channel with the south channel now taking more flow than the north.



River Entrance Cross-Sections

Figure
2.7

2.5 Flood Hydraulics

The Maroochy River system comprises the main river plus several tributaries. Major tributaries include the North and South Maroochy Rivers, Petrie, Paynter and Eudlo Creeks. Each tributary has a subcatchment from which runoff from a storm event collects and concentrates. As such, the distribution, intensity and duration of rainfall across the Maroochy River catchment is a major factor in determining the nature of a particular flood event.

Historically, flood events have dramatically altered the geometry of the lower estuary. Generally, flood events have tended to realign the channel entrance according to the path of least resistance for flow from the main river channel through to the ocean.

Flood events are generally associated with extreme weather conditions. In some cases this can result in an elevation in mean ocean water levels due to the effects of wind and wave setup and atmospheric pressure effects (or storm surge). When a flood event coincides with a high tide, the combination of tide and surge can have a significant impact upon flood levels in the river. If a flood event coincides with a low tide, flood levels can be lower in the river than would occur during a high tide. However, a lower ocean boundary condition can also increase the water surface gradient along the river, which may result in an increase in the velocity of the flood waters.

The entrance configuration of the river has an impact upon the hydraulics of the lower estuary during a flood event. If the entrance is constricted, flood waters flowing into the ocean will also be constricted. This may cause an increase in water levels landward of the entrance. If the entrance is wide and deep and presents a low resistance to flood flow, water levels in the lower estuary may be lower.

If velocities through the entrance channel are sufficiently high, scouring of the channel may occur during a flood event. This has been demonstrated during past flood events. Widening and deepening of the channel through scour reduces resistance to flood waters flowing into the ocean, and hence may reduce peak water levels in the lower estuary.

At present, the entrance channel has a relatively small cross-sectional area compared to previous available surveys, which is reflected in very high tidal velocities through the channel. Coffee rock exposed along the bed of the channel has been observed, which would suggest that the potential for the channel to scour deeper could be restricted. However, there is still potential for widening of the entrance channel during a flood event.

If the potential for scour in the entrance channel during a flood event is restricted, it is possible that flood water levels in the river will be higher than would normally be expected.

If the degree of entrance constriction and/or flood flows and/or ocean water levels are sufficiently high, there is potential for a breakthrough. However, the height, width and stability of the northern spit at present is such that it is unlikely that any breakthrough from the estuary to the ocean would occur across it, except during a very extreme storm event. As

has been demonstrated on occasions in the past year, potential exists for breakthrough to the south of Pincushion Island.

2.6 Water Quality

2.6.1 General

Estuarine water quality levels reflect the combined influence of catchment runoff, point source pollutant discharges and tidal flushing. This section of the report investigates existing water quality levels in the Maroochy River.

2.6.2 Existing Data

2.6.2.1 General

At the commencement of this study, all available data concerning the water quality of the Maroochy River, particularly the lower estuary and entrance, were collated and reviewed. Information obtained included the following:

- An extensive Department of Environment (DoE) water quality database, which consisted of water quality information collected as part of both the Basin 141 study and monthly ambient sampling (DoE, 1996).
- A past WBM Oceanics Australia water quality investigation within Cornmeal Creek (WBM Oceanics Australia, 1996).
- Recent physical water quality investigations undertaken by the Maroochy River Waterwatch group (Waterwatch, 1996).
- Investigations undertaken by the University of Queensland for Sinclair Knight Merz (University of Queensland, 1996).

2.6.2.2 Water Quality Data, Department of Environment

Since 1972, the Department of Environment has undertaken an extensive evaluation of the water quality in the Maroochy River. Periodic sampling for physical and chemical characteristics has occurred at chainages/distances of 0.0 km, 0.3 km, 2.6 km, 4.8 km, 7.1 km, 9.7 km, 12.3 km, 15.0 km, 17.1 km, 19.7 km, 21.4 km, 23.7 km, 25.3 km, and 27.6 km from the mouth. The data sets are presented in Appendix C. ANZECC (1992) criteria and typically accepted levels of total nitrogen and phosphorus are also provided in the Appendix as an indication of the current status of the river.

2.6.2.3 Cornmeal Creek Investigation (WBM Oceanics Australia)

As part of a development application, six water sampling locations were selected by WBM Oceanics Australia to gather information throughout Cornmeal Creek. At the locations, samples were taken during a period of neap tides at the mid stage of the flood. In addition to the water quality sampling exercise, in-situ physical water quality parameters were also

measured throughout the water column with a multiparameter water quality instrument at the sites.

The chemical and physical results of the water quality sampling exercise are summarised in Appendix C.

2.6.2.4 Water Quality Data, Waterwatch

The Maroochy River Catchment Needs Friends (MRCAN) Waterwatch group has undertaken a number of the water quality surveys at various locations in the Maroochy River since the start of 1996. Measurement of physical characteristics has occurred at 0.1 km, 0.8 km, 2.6 km, 3.5 km, 4.1 km, 7.1 km, 9.7 km and 13.0 km from the mouth. The data sets are presented in Appendix C.

2.6.2.5 Water Quality Data, University of Queensland/SKM

In 1996, the Marine Botany Group of the University of Queensland conducted three surveys of the Maroochy River for Sinclair Knight Merz (University of Queensland, 1996). The objective of the surveys was to evaluate the impact of discharge of treated sewage effluent upon marine flora. The surveys of the river were performed during the following periods:

- during standard conditions (April 1996);
- immediately after a period of heavy rainfall (May 1996); and
- after an extended period of minimal rainfall (October 1996).

Samples were taken at seven stations along the river and analysed for a series of parameters. The results of the surveys are presented in Appendix C. The results indicate that the river is productive in nature, becoming potentially eutrophic during times of high freshwater inflow.

2.6.3 *Additional Field Data Collection*

2.6.3.1 General

Information on the water quality of the river, particularly the lower estuary and entrance, was collated from the sources described above. Although this information provided a basis for subsequent study, additional data collection was required. The aim of the field data collection was to supplement the existing information, and to provide a more detailed description of the water quality of the lower estuary at the present date.

The field data collection exercise was undertaken in February 1997, and involved the collection of water samples and the measurement of physical water quality parameters along the Maroochy River at sites coinciding with DoE sites during neap and spring tides. The site specific data supplemented the existing Maroochy River data, such that the water quality characteristics in the area of interest were well understood.

2.6.3.2 Methodology

Eight water sampling locations, as illustrated in Figure 2.8, were selected for neap and spring tide water quality surveys. The location of these sites were selected to coincide with present DoE monitoring sites. Additional sites were also selected in areas of concern for the present study. At each location, water samples were collected at approximately high and low water, during spring (7/2/97) and neap (3/2/97) tides. Samples were collected at the surface due to the shallow, turbulent and hence well mixed nature of the river, then stored on ice and forwarded the next day for analysis. The samples were analysed for the following parameters:

- total kjeldahl nitrogen ($\text{NH}_4 + \text{org-N}$);
- oxidised nitrogen (nitrate and nitrite, NO_x);
- total nitrogen (Tot-N);
- orthophosphorus (PO_4);
- total phosphorus (Tot-P);
- total suspended solids (TSS); and
- chlorophyll-*a* (Chl*a*).

In addition to the sampling exercise, physical water quality parameters were measured throughout the water column with a Hydrolab water quality instrument at the eight stations. Physical water quality parameters were profiled at approximately one metre intervals from the water surface to the bed. Physical parameters recorded included:

- water temperature;
- conductivity;
- salinity;
- dissolved oxygen;
- pH; and
- turbidity.

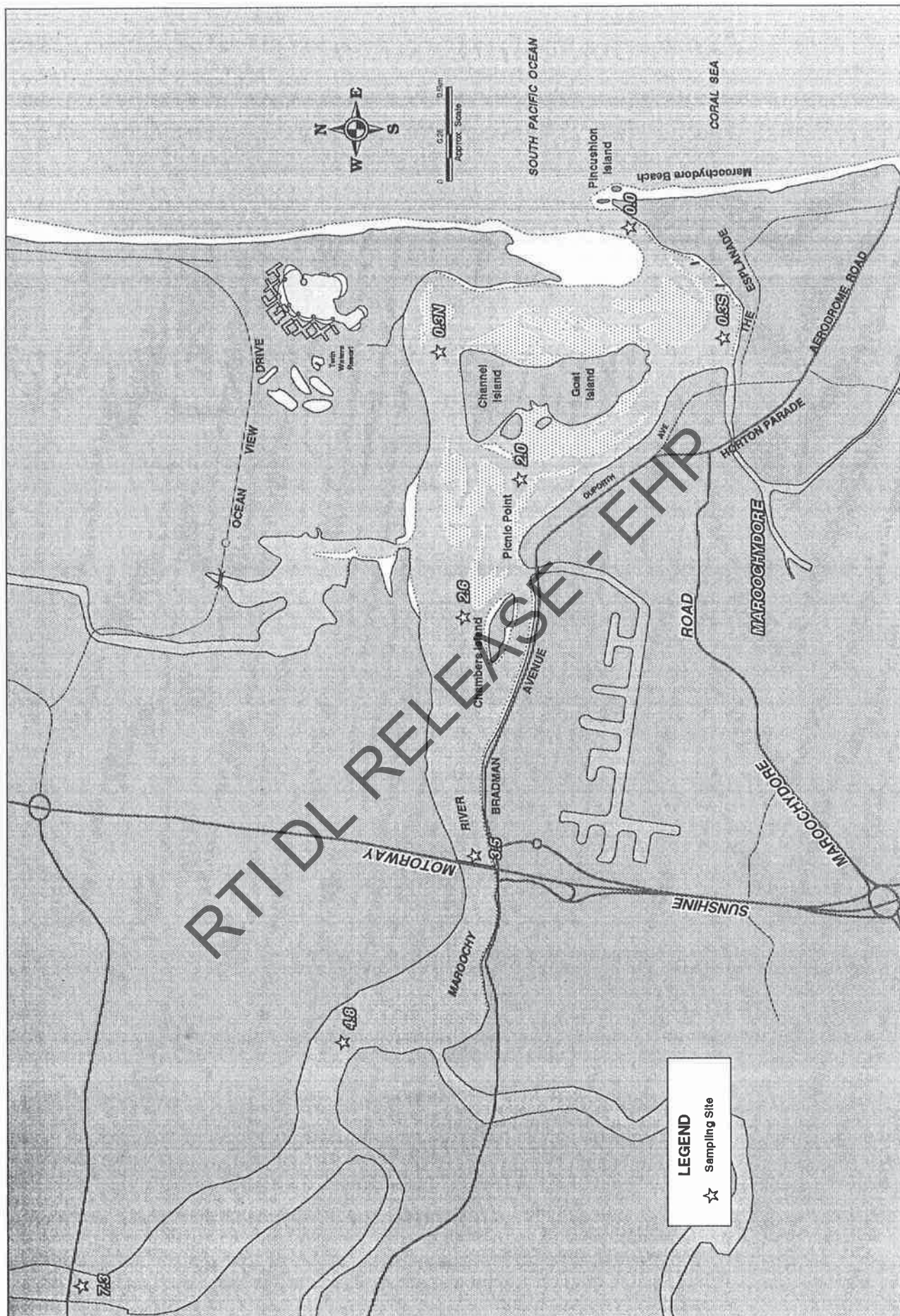
2.6.3.3 Presentation of Measurements

The physical water quality results, and the laboratory results of the water quality sampling exercise, are presented in Appendix D.

2.6.3.4 Discussion

The water quality measurements indicate the following:

- The temperature varied between 25°C and 30°C during the surveys, reflecting the warm conditions experienced in February.



WATER QUALITY SAMPLING SITES

**FIGURE
2.8**

- The observed salinity is similar to that of seawater at the mouth of the river, decreasing slightly with movement upstream. No significant vertical stratification was observed.
- The pH level was slightly alkaline.
- Dissolved oxygen levels appear to be high during all surveys.
- Water clarity, indicated through turbidity measurements, appeared to be acceptable at high tide and slightly degraded at low tide.
- Nutrient levels were at or above acceptable criteria for the protection of aquatic ecosystems. This indicates that the river has no capacity for additional nutrient loads, and may be sensitive to any change (reduction) in tidal flushing.
- Chlorophyll-*a* levels appear to be variable across the four surveys. Values found during the neap low tide survey well above the criteria set by ANZECC, with the remainder of the surveys indicating levels at and below the criteria.

2.6.4 Discussion

2.6.4.1 General

A summary of all relevant water quality data is presented in Tables D.3 and D.4 in Appendix D. The average values for the river were calculated by combining all DoE, University of Queensland, Waterwatch and WBM Oceanics Australia data for the length of the river between. For comparison, the ANZECC (1992) guidelines for the protection of aquatic ecosystems are also included.

A discussion of the various components of water quality that have been investigated is provided below:

2.6.4.2 Salinity/Conductivity

Table D.3 in Appendix D shows the spatial variation of salinity/conductivity over the water quality monitoring sites in Maroochy River. Salinity and conductivity decreases with passage upstream as a result of increasing freshwater influence. Values throughout the lower reaches of the river are similar to ocean levels as tidal flushing is large in these areas. Standard deviation values indicate that the salinity and conductivity in the middle to upper reaches of the river show greater variability, presumably due to stormwater and freshwater flow influences.

2.6.4.3 Temperature

Little variation is found when moving around the sites with mean temperatures varying between 21.4°C and 23.15°C. The variability in measured temperatures increases with movement upstream.

present. These results indicate that increased phosphorus levels may be unacceptable in the river.

2.6.4.10 Chlorophyll-a

Table D.4 shows the variation of mean chlorophyll-a levels throughout Maroochy River. Comparison of this data with the previous data for total phosphorus and total nitrogen indicates similar trends along the river. This could be expected as algal productivity and thus chlorophyll-a concentrations are mainly determined by nutrient levels. The table shows that all sites, except those at AMTD 12.9 km, 15km and 23.7 km, fall within the indicative concentrations recommended by ANZECC (1992) of between 1 and 10 µg/L.

2.6.4.11 Summary

The concentrations of all the water quality parameters assessed generally fall within the guidelines provided by ANZECC (1992).

2.7 Fisheries Value

2.7.1 Recreational Fishery

The Maroochy River is an important recreational fishery for both boat and shore based anglers. As in other locations throughout southern Queensland, the usage of these areas is increasing rapidly. WBM Oceanics Australia is unaware of any angler surveys conducted in the area, but an indication as to the increase can be gained from the 780% increase in private vessel registrations in the Sunshine Coast region from 1972 to 1992 (Hyland 1993).

Anglers target a variety of fish species throughout the estuarine portions of the Maroochy River. The major species sought include yellowfin bream (*Acanthopagrus australis*), summer whiting (*Sillago ciliata*) and dusky flathead (*Platycephalus fuscus*). All species are caught year round with catches (and corresponding angler numbers) of bream peaking in the winter months while catches of whiting and flathead peak in the summer months. Additionally a seasonal fishery for tailor (*Pomatomus saltatrix*) occurs in the winter months in the lower portions (generally downstream of the Cod Hole) of the river and on ocean beaches adjacent to the river mouth, (pers. comm D.Bateman, Sunfish). Other recreationally important species such as black bream (*Girella tricuspidata*), trevally (*Caranx* species) and mullet (*Argyrosomus hololepidotus*) are also caught in the Maroochy River. These are less prevalent than the above species.

Bait gathering by anglers is also an important activity in the lower Maroochy River. Anglers collect soldier crabs (*Mictyris longicarpus*) and yabbies (*Callinassa australiensis*) from intertidal sand shoals. Additionally, baitfish such as silver biddies (*Gerres oyon*) and hardyheads (*Atherinomorus ogilbyi*) are collected.

Numbers of recreational anglers in the Maroochy River peak in response to both fish migration patterns (see above) and school holiday periods. Fishers are subject to a number of restrictions under the Fisheries regulations. These include size limits and gear restrictions.

2.7.2 Commercial Fisheries

Commercial fishing operations in the Maroochy River involve two fisheries; the net fishery and the beam trawl fishery. Due to area closures under fisheries regulations (see below), no estuarine commercial fishing is undertaken in the immediate area of the proposed entrance relocation works.

The Maroochy River mouth is unsuitable for access to offshore fishing grounds, and therefore the river does not support a seagoing fishing fleet, as occurs in the nearby Mooloolah River.

The net fishery within the Maroochy River is based upon mesh netting operations targeting a range of estuarine species such as bream, whiting, flathead, and mullet (various *Mugil* species). The majority of the catch is comprised of mullet species, particularly sea mullet (*M. cephalus*). Some commercial fishers also hold endorsements to net the ocean beaches.

Net fishing is undertaken year round in the Maroochy River with whiting and flathead catches peaking in the summer months, whilst bream and sea mullet catches peak in the winter months.

Commercial netting operations are subject to a number of Fisheries regulations. These include weekend closures (no netting between 6pm Friday to 6pm Sunday), gear restrictions and areas of operation. The area downstream of the Cod Hole to the river mouth (including 400m north and south of the mouth) is closed to commercial fishing operations.

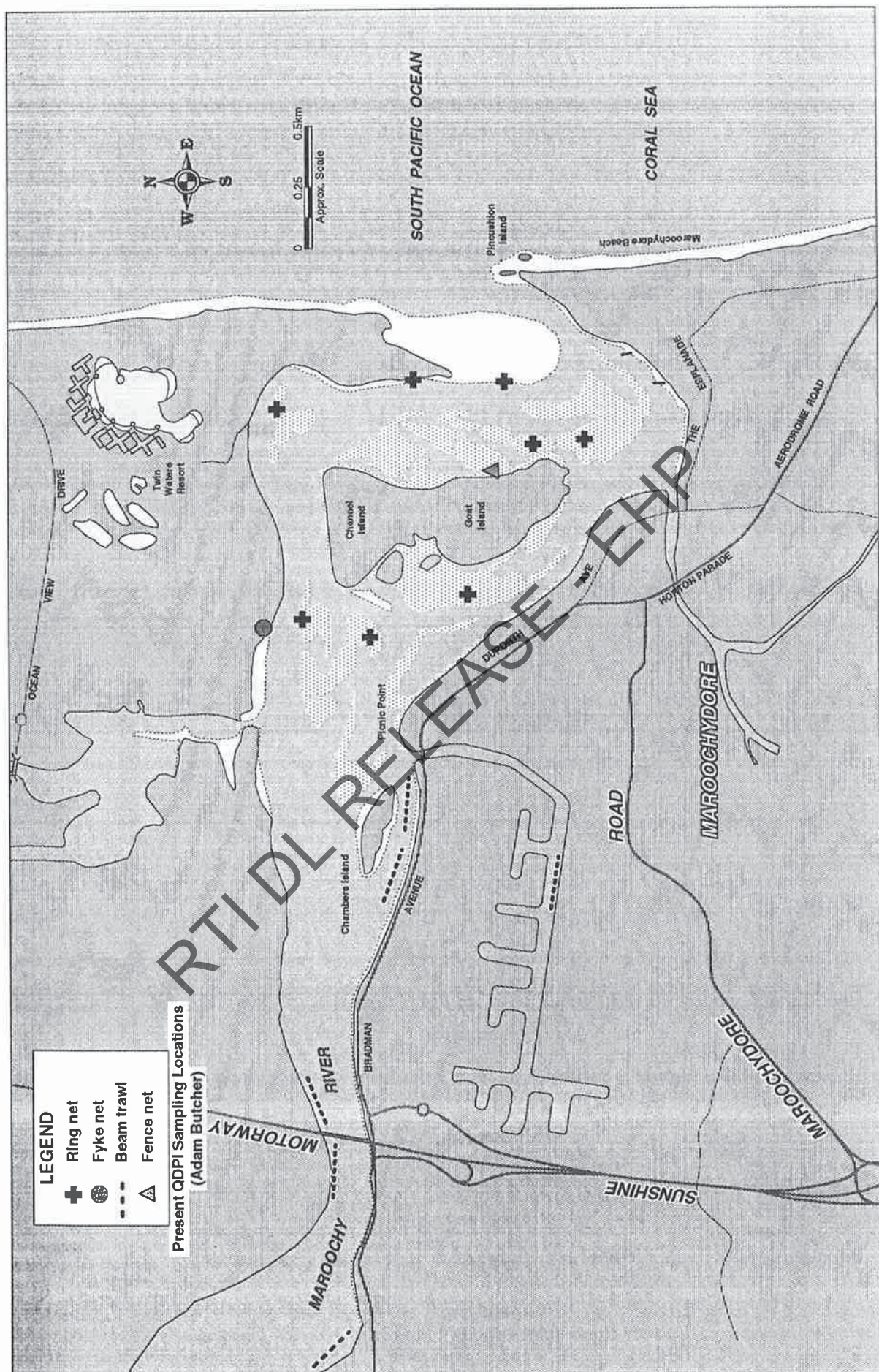
Beam trawling operations target commercial prawn species such as school (*Metapenaeus macleayi*), king (*Metapenaeus plebejus*) and Greentail (*Metapenaeus bennettiae*) prawns. Seasonal variations in abundance of each of the species influence the catch patterns with best catches generally occurring in the warmer months (Hyland 1993).

Beam trawling operations are also subject to a number of Fisheries regulations such as weekend closures, restrictions on netting gear (type, minimum mesh sizes and maximum vessel size) and areas of operation (operations are limited to areas between the Cod Hole and the junction of the North and South Maroochy Rivers).

2.7.3 Restocking Research Program

The Queensland Department of Primary Industries, Fisheries (QDPI) is currently undertaking a research program in the lower Maroochy River to assess the success of restocking estuarine areas with recreationally and commercially important fish species.

This study, initiated in December 1995, uses a variety of netting techniques at various locations (Figure 2.9). The first release of fingerlings (60,000 flathead fingerlings) occurred in December 1996. More intensive sampling is being undertaken to determine the success of this restocking. Further releases of flathead and sand whiting fingerlings are planned in 1997 (pers comm Adam Butcher QDPI, Southern Fisheries Centre).



QDPI RESTOCKING RESEARCH PROGRAM

FIGURE
2.9

2.8 Ecological Values

A survey of the estuarine communities in the lower Maroochy River was undertaken over the period 5/2/97 to 7/2/97. This was supplemented by available literature, discussions with local fishers and researchers working in the area.

2.8.1 Aquatic Fauna

The QDPI is currently undertaking a Restocking Research Program in the Maroochy River (see above). A preliminary species list has been supplied (pers comm A. Butcher, QDPI) as shown in Appendix E. It should be noted that this species list is preliminary as sampling is still underway. Additionally, larger predatory and/or pelagic fish (eg. sharks, mackerel) are unlikely to be sampled by netting techniques employed.

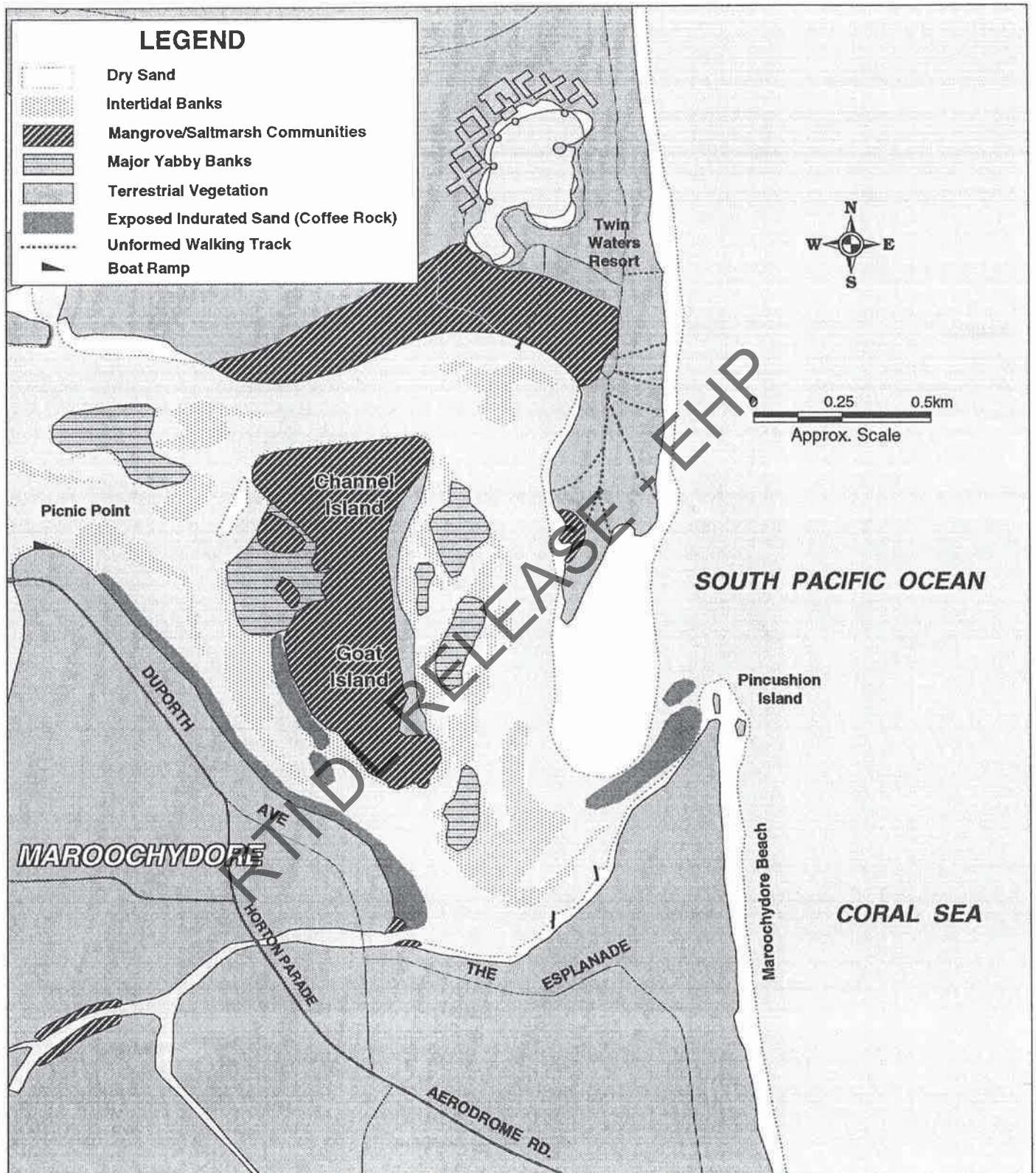
Numerically dominant species include bream, yellow perchlet, silver biddy, southern herring, gar, flat-tailed, sand, sea and flicker mullet, trumpeter, flathead, small-toothed flounder, whiting (sand and winter) and common toadfish.

These species are typical of those found in south Queensland estuarine systems. No rare or endangered species have been recorded.

River entrances, such as the mouth of the Maroochy River, are ecologically important. Many estuarine fish (such as bream, mullet and flathead) and prawn species actively migrate to river entrances to spawn. Eggs, larvae and juveniles resulting from spawning in and near the river mouth drift into estuaries where they grow and mature. To a large degree this movement is passive with eggs and larvae (as part of the plankton) being transported into the estuary by tidal and/or wind currents. Spawning is often timed to coincide with specific tides to ensure the best distribution of larvae. Studies by Pollock et al (1983) noted that larval bream occur at estuary mouths most frequently on flood tides during full moon phase.

The Maroochy River entrance area is comprised of mobile shoals of marine sands. These shoals continually change in shape and location in response to alterations in the wave/tidal and flow regime or more dramatic changes caused by flood and/or cyclonic events. The mobile nature of such sand banks generally prevents the development of diverse benthic communities. However, the more stable sand shoals adjacent to the existing river entrance have been colonised by yabbies and soldier crabs (Figure 2.10). No unique species or communities are anticipated.

The river bed at the entrance contains areas of indurated sands (coffee rock) exposed by the extreme current velocities (up to 1.5 m/s). Current action and sand movement inhibit the development of encrusting communities. Diver transects of the river mouth area conducted by WBM Oceanics Australia (7/2/97) failed to find any significant benthic communities in the present river entrance. Large numbers of fish (trevally, black bream, yellowfin bream) were observed in the area during the slack tide.



FAUNA/FLORA DISTRIBUTION IN THE LOWER ESTUARY

**FIGURE
2.10**

The ocean beach area adjacent the present river entrance is comprised of mobile sands. These areas would support a range of benthic fauna (such as pipis and beach worms) typical of southern Queensland ocean beaches. Fish species such as mullet, whiting, bream, tailor and dart (*Trachinotos velox*) would utilise these areas.

Approximately 3.5km north-east of the present river entrance is Mujimba Island. The island shores support a range of encrusting corals (hard and soft) and associated reef fish fauna. The island has important conservation and recreational (SCUBA diving, fishing and surfing) values.

2.8.2 Protected Marine Fauna

No dugongs (*Dugong dugon*) have been reported in the Maroochy River or are likely to be present given the lack of seagrass beds upon which they feed.

Infrequent sightings of small turtles have been reported in the river by commercial fishermen (pers. comm. K. Cannon, QCFO rep.). These are most likely to be juvenile green turtles (*Chelindoa midas*). Again, due to the lack of extensive seagrass areas, numbers are expected to be low (pers. comm. Col Limpis QDoE).

Infrequent sightings of dolphins (most likely bottle nose dolphins (*Tursopsis truncatus*)) have also been reported by commercial fishers. These are likely to enter the river, following migrations of fish (such as sea mullet) on which they feed.

2.8.3 Shorebirds

The southern portions of the northern spit and the intertidal banks south of Goat Island are utilised by shorebirds as roosting and feeding sites. Species abundant during field surveys (5 - 7/2/97) included pied oystercatcher (*Haematopus ostralegus*), eastern curlew (*Numenius madagascariensis*), silver gull (*Larus novaehollandiae*), crested tern (*Sterna bergii*) and lesser crested tern (*Sterna bengalensis*).

At present both areas are subject to moderate levels of disturbance. The northern spit area is popular for people walking dogs, which disturb birds, and the area south of Goat Island is disturbed by boat traffic and recreational anglers gathering bait. This area is also fully inundated by most tides and becomes unavailable for roosting at high tide.



Plate 1: Shorebirds on the northern spit¹

¹ Species shown include silver gulls, crested and lesser crested terns.

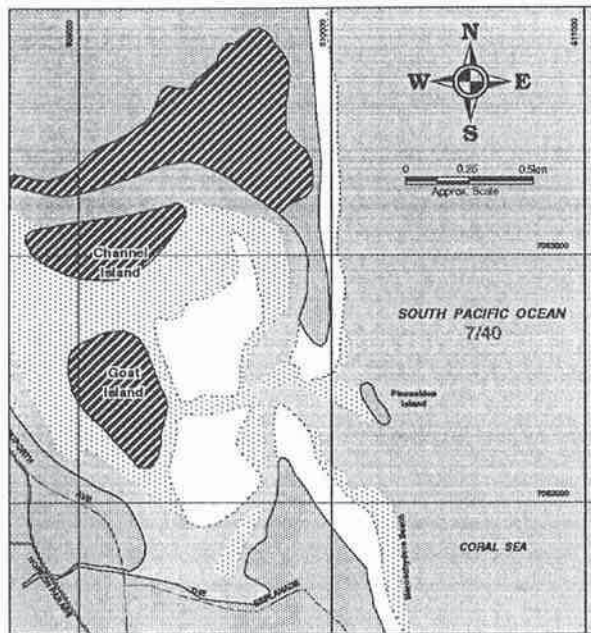
2.8.4 Mangroves

Mangroves are of substantial ecological value and contribute significantly to the fisheries productivity of aquatic ecosystems. They provide shelter and nursery grounds for a wide variety of fish and crustaceans, most of which are of direct fisheries value. Additionally, mangroves contribute significant amounts of plant litter (which forms the base of many estuarine food chains) and assist in the stabilisation of intertidal areas.

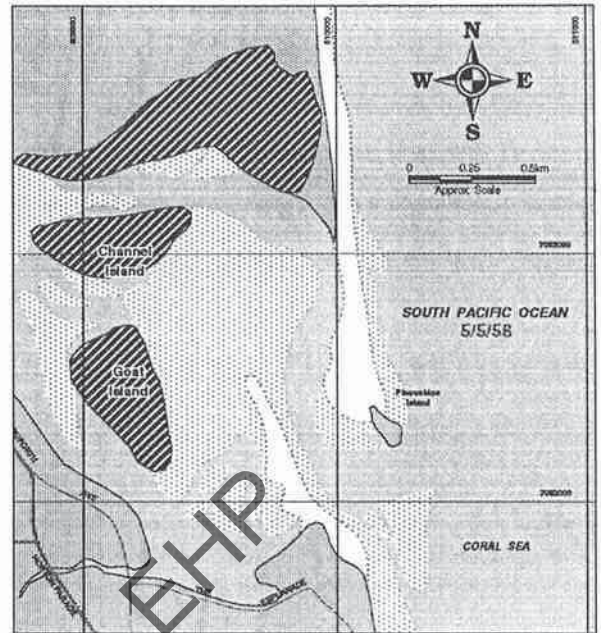
The present distribution of mangroves (Figure 2.10) does not necessarily reflect the historical distribution. Mangrove distribution has changed markedly in the lower Maroochy River as a result of shifting sand shoals, changes in the entrance location and associated changes to the tidal range within the estuary. Figure 2.11 indicates historical changes in mangrove distribution.

Of key note is the joining, over time, of Goat and Channel Islands, and the associated expansion of mangrove distribution in the area near the entrance.

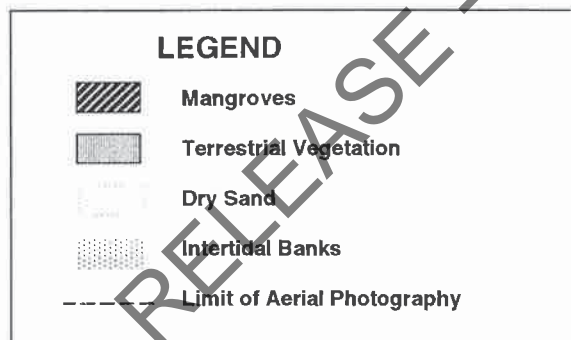
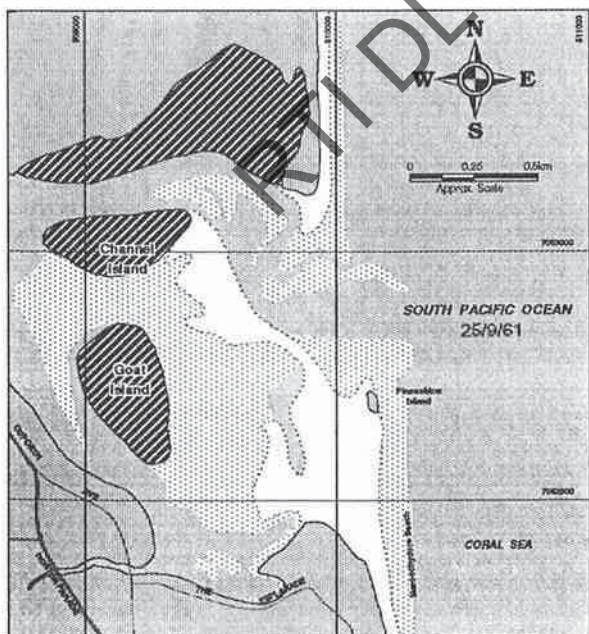
No mangroves occur near the existing river entrance. The largest areas of mangroves in the lower Maroochy River presently occur on Goat and Channel Islands and along the northern banks of the river.



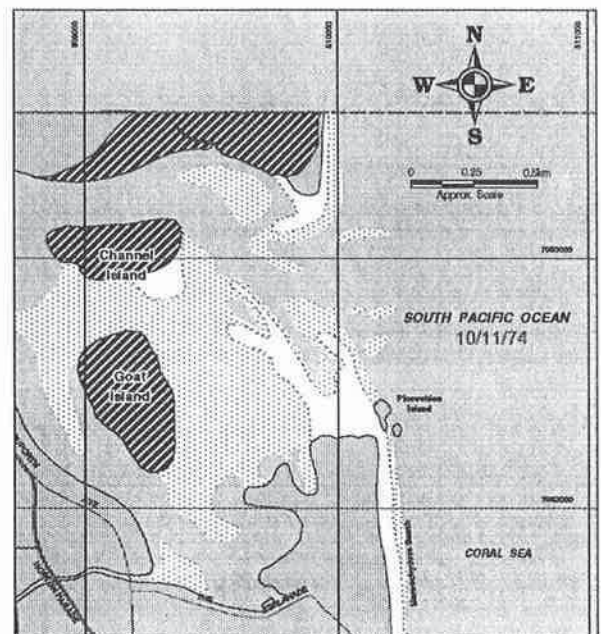
1940



1958

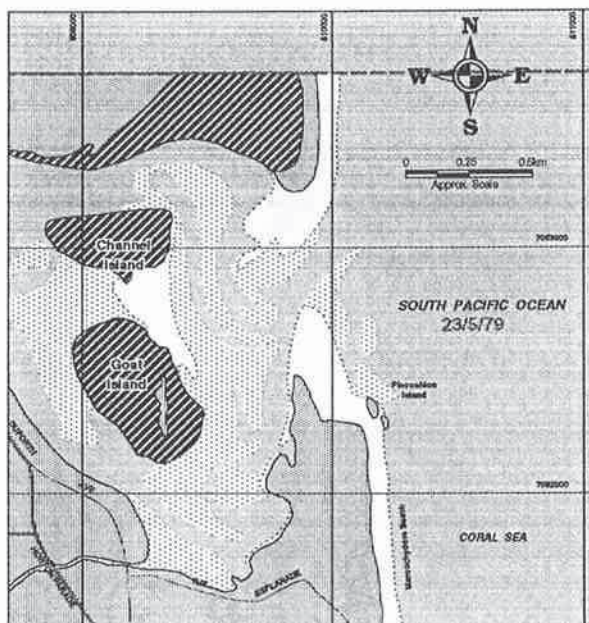


1961

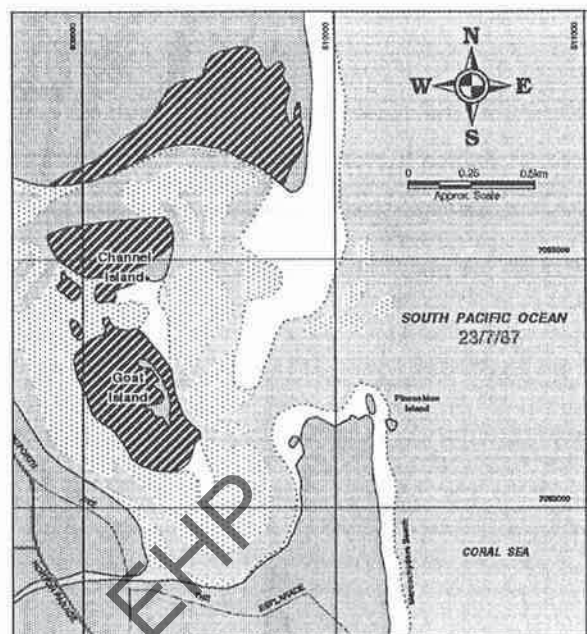


1974

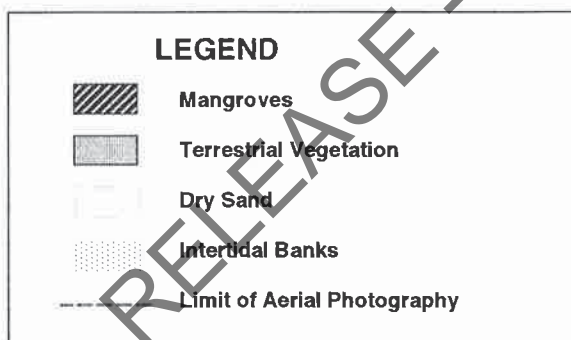
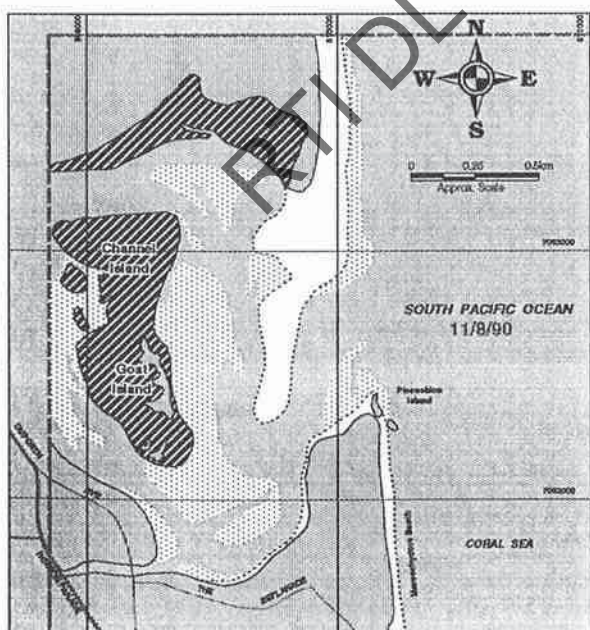
FIGURE
HISTORICAL CHANGES IN MANGROVE DISTRIBUTION - 1940 to 1974 2.11(a)



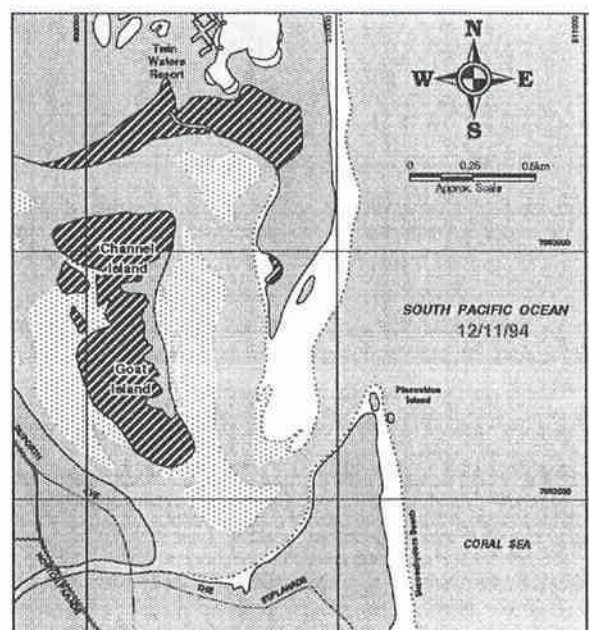
1979



1987



1990



1994

FIGURE
HISTORICAL CHANGES IN MANGROVE DISTRIBUTION - 1979 to 1994 2.11(b)

Mangrove communities are generally in good condition. However, erosion processes lead to the undercutting of many mangrove areas on the river frontage and some have died or fallen into the river as a result of this process (see Plate 2). Additionally, some die back (caused by a fungal disease, *Phytophthora*) is present throughout the mangroves in the lower entrance, although this is not at levels that significantly detracts from their high ecological values. Such processes and consequent changes to mangrove communities are typical of these in sub-tropical estuaries which do not have a trained river mouth.



Plate 2: Erosion causing undercutting and collapse of banks on the northern margin of Channel Island.

A small area of mangroves (exclusively grey mangroves - *Avicennia marina*) has recently established in a natural lagoon on the western margin of the northern spit of the entrance (see Plate 3). All appear to be in good condition. Aerial photography suggests that these have established in the last 6 years. Trees range in height from 2 - 5 metres tall with the majority of mangroves being approximately 3 metres tall. Large numbers of seedlings have established (apparently in the past year) and it is likely that this mangrove area will increase in the future.



Plate 3: Small area of mangroves which have established on the western margin of the northern spit¹

¹This photograph taken from rear of the mangroves facing west towards the Maroochy River. Note the fringe of saltmarsh communities at the rear of the mangroves.

All of the mangrove areas in the lower reaches of the Maroochy River would provide habitat for fishes and crustaceans. In this regard, their maintenance is essential to ensure the environmental "health" of the river.

2.8.5 Seagrasses

Anecdotal evidence has suggested that seagrasses occurred in the lower reaches of the Maroochy River in the 1950s. However, no seagrasses presently occur.

Previous surveys undertaken by the Queensland Department of Primary Industries (QDPI; Hyland 1993) indicated that the only seagrass present in the lower Maroochy River was a small patch of seagrass near Chambers Island.

More recent surveys undertaken as part of this and a QDPI study have shown that this seagrass area is no longer present. Additionally, commercial fishermen operating in the area

report that no large patches of seagrass have been sighted within the lower reaches over the past 10 to 15 years.

The only exception to this is one small area of seagrass (*Zostera capricorni*, less than 2 m²) observed in the lagoon where mangroves occur on the northern spit (see above) during field surveys. This seagrass was in relatively poor condition being heavily covered in epiphytic growth with a large amount of dead seagrass leaves evident in adjacent areas. It appears that flushing to this lagoon area has been restricted in recent time (due to natural sand accumulation at the lagoon entrance), leading to poor water quality in the area. The long term viability of the seagrass is highly uncertain.

2.8.6 Saltmarsh

Saltmarsh vegetation (eg. saltwater couch, succulents) grows in upper littoral areas generally landward of mangroves. Large continuous areas of saltmarsh in the lower Maroochy River are limited and most is restricted to relatively small clumps of vegetation, generally less than 100m² more extensive areas occur on Goat/Channel Island.

The mangroves associated with the lagoon on the northern spit are fringed by a band (10 to 15 m wide) of saltmarsh. The saltmarsh primarily consists of saltwater couch (*Sporobolus virginicus*), *Sarcocornia quinqueflora* and *Suaeda australis*. The majority of the succulent species are rather patchily distributed whereas the saltcouch grass has dense coverage.

2.8.7 Dune Vegetation

The northern spit has been colonised by a variety of dune species typical to those associated with the Sunshine Coast region.

Dominant species include Casuarinas (*Casuarina equisetifolia*), Sand Spinifex (*Spinifex hirsutus*), Snake vine (*Hibbertia scandens*), Vigna (*Vigna marina*), Ipomoea (*Ipomoea pes-caprae*), Oenothera (*Oenothera drummondii*) and Pig Face (*Cirpobrotus goaucescens*).

Casuarinas range in height from seedlings to large dominant trees up to 7 m tall, with most trees being 3-5 m tall. Trees are more prevalent in northern regions of the spit which is not unexpected considering the greater age of this region compared to areas recently developed as the river mouth has moved south. Spinifex cover is extensive, covering elevated portions of the spit. Southern regions of the spit are unvegetated (Figure 2.10). All vegetation appears to be in good condition and is colonising newly available areas associated with the southern movement of the river channel.

2.8.8 Reserves for Fisheries Purposes

There were two types of reserves prior to the release of the 1994 Fisheries Act; Wetland Reserves and Fish Habitat Reserves.

Fish Habitat and Wetland Reserves are declared by the Queensland Department of Primary Industries (QDPI) to protect the habitat in areas considered to be important to regional

fisheries. These areas include seagrass beds and mangrove forests which are essential for the maintenance of fish and prawn stocks. The destruction or disturbance of plant life, sedentary animals or substrate within these reserves is prohibited.

Wetland Reserves have the same function as Fish Habitat Reserves, but provide a lower level of protection and are declared over areas of lesser fisheries significance. Wetland Reserves are often located as buffer zones between development and preservation areas such as Fish Habitat Reserves. The policies relating to these was subsequently altered under the 1994 Fisheries Act and both have been renamed Fish Habitat Areas. There are, however, still essentially two levels of protection that follow the management guidelines described above for Fish Habitat and Wetland Reserves.

The majority of the lower Maroochy River is declared a Fish Habitat Area (formerly a Wetland Reserve). Any works within or adjacent to this area will require a permit issued by the QDPI.

RTI DL RELEASE - EHP

3 CHANNEL RELOCATION CONSIDERATIONS

3.1 General

To determine the optimum location and configuration of a new northern entrance channel, a number of options were considered. The criteria for assessment of options was based upon several factors including:

- coastal processes;
- tidal and flood hydraulic processes of the lower estuary;
- water quality considerations;
- environmental considerations; and
- economic considerations.

The options were chosen on the basis of our understanding of the processes and values of the lower estuary as well as the likely effectiveness of the works as discussed below.

3.2 Processes Contributing to Entrance Channel Location

Historical evidence suggests that the location of the entrance to the Maroochy River varies according to a natural cycle, dominated by the interaction between major flood events and coastal/tidal processes. These processes need to be considered in determining entrance relocation options.

- **Coastal Processes**

The influence of the predominant wind and wave action upon the river entrance causes the development and growth of a spit, which extends from the north of the estuary in a southerly direction. The growth of this spit southwards forces the southward migration of the entrance channel. At present, this northern spit is well developed. The southward migration of the entrance also increases the hydraulic resistance along the northern channel with a corresponding change in the balance of flow between the north and south channels. This has been observed with the south channel now being the dominant channel.

It is possible that the development of the northern spit would continue to force the entrance channel further south and eventually beyond Pincushion Island. Recent wave overtopping to the south of Pincushion Island during spring tides and heavy offshore wave conditions tends to support this.

The southward migration of the entrance channel could be expected to continue until a major flood event and/or beach erosion occurs which is sufficient to breach the northern spit, recreating the northern entrance configuration.

Accordingly, selecting a northern most location for the entrance channel will maximise the time frame before erosion once again threatens a breakthrough to the south of Pincushion

Island. However, the northern spit is now quite wide and consideration needs to be given to the quantities and associated costs of construction. In addition, the potential for northwards migration of the entrance channel and threat to existing improvements should also be considered.

- **Tidal Processes**

Both north and south channels convey tidal flow from the entrance and around Goat/Channel Island. On occasions there has been a third channel between Goat and Channel Islands. However, this is now effectively blocked.

Movement of water in and out of the estuary due to tidal influences alone would naturally tend to favour the northern channel, being the passage which presents the least resistance to flow. As such, the southern channel has undergone periods in which flows and velocities are reduced and siltation increases. If this continues over a period of time, the southern channel may become blocked and reduce the flushing capacity at Cotton Tree. Accordingly, while encouraging the northern channel to be dominant will ease the erosion threat at Cotton Tree, consideration needs to be given to maintaining flow and flushing of the south channel for water quality purposes.

- **Major Flood Events**

Major flood events result in high volumes of flood waters, which raise water levels in the lower estuary. When coincident with a raising of ocean water levels (through storm surge and/or wind and wave setup), the northern spit can be breached. As the channel created by the breached section of the spit provides a path of less resistance for flood waters, the northern channel would accommodate the majority of flood flow. Local scour would increase the size of the northern channel to such an extent that after the flood event the northern channel becomes the dominant entrance to the river once again.

3.3 Cross-Sectional Area Considerations

The cross-sectional area of the entrance channel has an impact upon the tidal compartment of the river system. A wider/deeper entrance channel allows more tidal flow in and out of the system, thus increasing the tidal range in the river system. Conversely, a narrower/shallower entrance channel reduces the tidal range in the river system.

Historical surveys of the entrance channel profile suggest that the entrance channel area has been larger than at present. This is possibly due to coffee-rock on the bed of the existing channel, which counters the natural deepening of the entrance channel. The constriction to flow results in an increase in velocity and probably a reduction in the tidal range in the estuary.

Figure 2.7 displays typical cross-sectional profile of the entrance channel as existed in 1982, 1983 (post-flood), 1995 and 1997. The figure indicates that the cross-sectional area of the entrance channel has reduced in area by almost 50% between 1982 and 1997 and associated natural changes in the hydraulic regime of the estuary are likely to have occurred. While the

cross-sectional area of the new entrance is important, it will quickly evolve to a natural dynamic equilibrium condition.

3.4 Configurations Considered

Taking the above process related considerations into account, two broad entrance configuration options were formulated, as displayed in Figure 3.1 for further consideration of potential impacts as discussed in Sections 4 and 5.

Option 1 proposes to position a new northern entrance channel directly across from the north channel. In this way, flow entering or leaving the entrance channel will smoothly follow into the north channel. Option 1 has an advantage in that it is located further north. If present trends in the movement of the northern spit continue, it is likely that any northern entrance will tend to migrate southwards. Thus, an entrance situated further north will take a longer time to return to present day conditions. The location for Option 1 still provides about a 150m buffer from existing improvements on the north shore to accommodate any northwards migration which may occur.

Option 2 proposes to position the entrance channel further south, at a location where the northern spit is narrower and lower. Again, the alignment and location of the entrance channel is such that flow entering or leaving the entrance channel will smoothly follow into the north channel. Option 2 is further south than Option 1. It is therefore likely that if present day trends continue, the northern entrance proposed in Option 2 would migrate southwards to present day conditions in a shorter period of time than for that proposed in Option 1. However, Option 1 has a greater quantity of material to be relocated and hence will probably be more expensive.

Both options propose to obstruct the existing entrance completely. Without this obstruction, the existing entrance could quickly redevelop as the dominant flow path making the works ineffective. In addition, two entrance channels would be likely to be more efficient than the existing entrance and change the tidal regime of the estuary. While the existing entrance would be blocked, the channel between Channel/Goat Island and the existing spit would be retained to maintain flow and flushing between the south channel and the new entrance.

As discussed in Section 3.3, the cross-sectional area of the entrance channel has varied in the past. The entrance configurations of Options 1 and 2 have been assessed with a large cross-sectional area similar to that which existed in the 1980's, when the entrance was located to the north and it was not constrained. To determine the sensitivity of the lower estuary hydraulic processes to a variation in cross-sectional area, two additional options were assessed using the existing channel cross-sectional area.

Options 3 and 4 have the location of the entrance channel identical to that of options 1 and 2, but with the entrance cross-sectional area reduced to the current value.

2.6.4.4 Dissolved Oxygen

Table D.3 in Appendix D present the results of dissolved oxygen (DO) data analyses. Investigation of these values indicates that Maroochy River is oxygen rich along its length. All sites show oxygen levels in excess of the lower DO limit recommended by ANZECC (1992) of 80% saturation.

2.6.4.5 pH

pH follows a similar trend to salinity, with Table D.3 showing a general decrease from typical pH levels of 8.3 at the mouth to 7.24 at AMTD 15 km, rising slightly to 7.4 at the upstream end. All values remain within the optimal range suggested by ANZECC (1992) which is between 6.5 and 9.

2.6.4.6 Turbidity

Table D.3 in Appendix D presents the results of turbidity data analysis. The values indicate that turbidity of the river is quite low (3.3 NTU) at the mouth, increasing to 15 NTU at the middle reaches of the river. At these middle reaches, turbidities vary significantly between 10-17NTU finally dropping to 10 NTU at the far upstream freshwater site. This turbidity variation occurs as a result of the significant interaction between saline tidal and freshwater influences in the middle reaches, keeping solids in suspension. This is typical of most northern Australian estuarine systems.

2.6.4.7 Suspended Solids

Suspended solids concentrations in the river show a similar trend as turbidity, being reasonably low at the mouth and increasing within the middle reaches of the river and finally decreasing at the upstream freshwater site.

2.6.4.8 Nitrogen

Nitrogen exists in three forms: Ammonia, Organic Nitrogen and Oxidised Nitrogen. These forms are interdependent. Analyses of the nitrogen levels are presented in Table D.4 of Appendix D.

- Ammonia

Ammonia occurs in coastal waters at low concentrations, with indicative values being less than 0.005 mg/L (no criteria has been set for marine waters). Within estuarine waters, higher levels, of the order of 0.05mg/L, are typically observed. The most common cause of high ammonia concentrations is industrial and sewage effluent. Table D.4 in Appendix D, which presents ammonia levels in Maroochy River, indicates that ammonia concentrations are reasonably elevated throughout most of the river, with peaks occurring near the confluences at Eudlo Creek and Coolum Creek. These peaks are thought to occur as a result of the sewage outfall in Eudlo Creek and stormwater influences in Coolum Creek.

- Organic Nitrogen

The measurements indicate that with movement upstream in the Maroochy River, organic nitrogen levels increase. This is probably a direct result of the increased stormwater influences with movement upstream and the sewage discharge in Eudlo Creek.

- Oxidised Nitrogen

Oxidised, or nitrite and nitrate, nitrogen seldom naturally appears in concentrations greater than 0.5mg/L. Concentrations in undisturbed surface and groundwater are normally below 0.1-0.2mg/L. Table D.4 indicates that this is true for the downstream reaches of Maroochy. However, values from AMTD 12.9 km to 25.3km are elevated and variable presumably as a result of increased stormwater influences which contains dissolved fertilisers utilised in farming practices.

- Total Nitrogen

Total Nitrogen values are obtained by summing the concentrations of ammonia, organic nitrogen and oxidised nitrogen. No indicative allowable marine or estuarine values for Total Nitrogen are provided by ANZECC (1992) however values of between 0.1 and 0.75 mg/L are given for rivers and streams, with a value of 0.5 mg/L being widely accepted for estuarine conditions. The results show that total nitrogen is elevated throughout the river with values at AMTD 4.8 km and upstream greater than accepted criteria. These values indicate that Maroochy River from Eudlo Creek upstream has no capacity to assimilate additional nitrogen loads which may result from increased stormwater (diffuse) and sewage (point) pollution.

2.6.4.9 Phosphorus

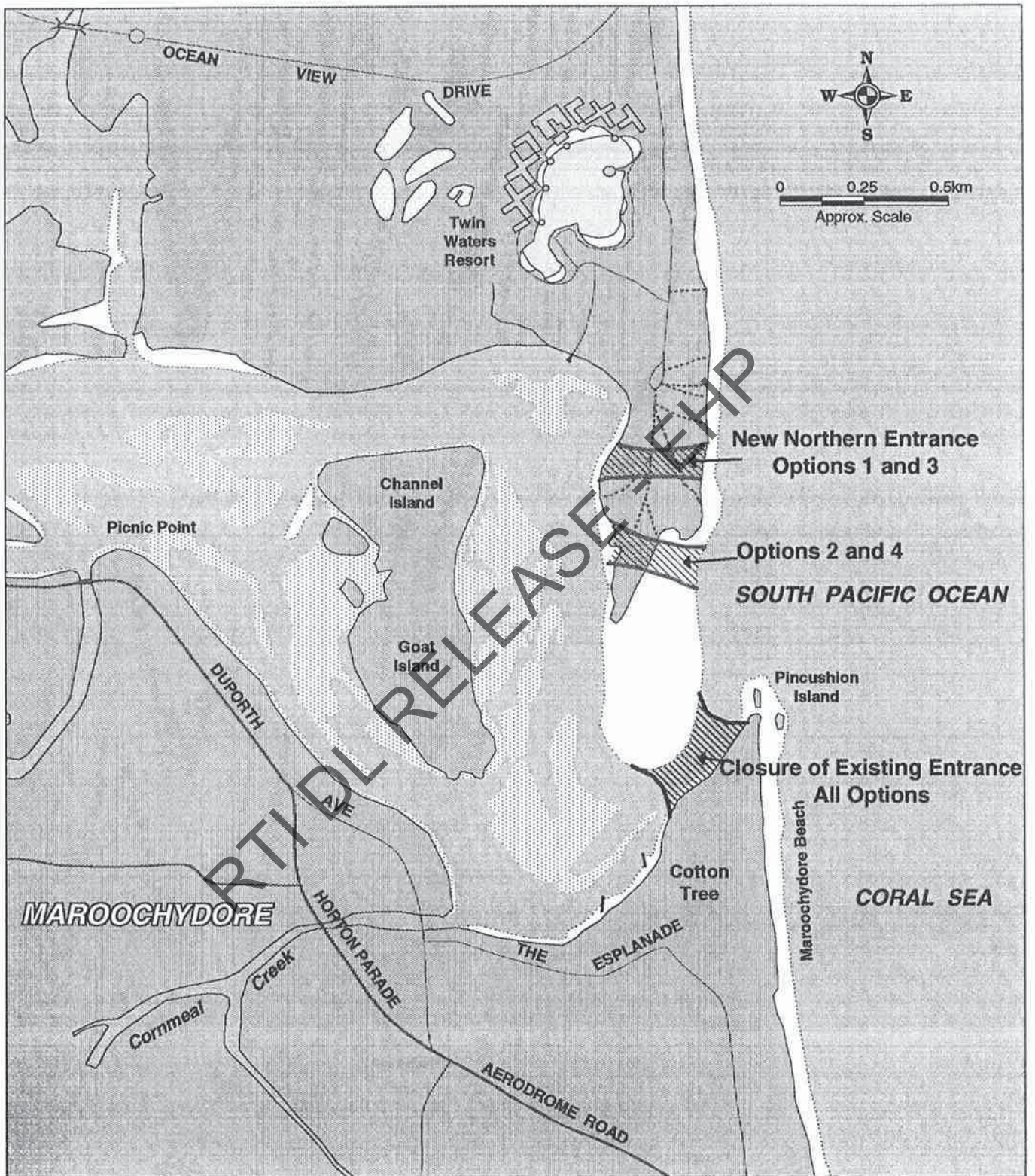
Phosphorus data were provided in two forms, dissolved (orthophosphate) and total, both of which are discussed below.

- Orthophosphorus (Dissolved) Phosphorus

Dissolved phosphorus occurs in low concentrations in natural marine waters. ANZECC (1992) provides indicative acceptable values of between 0.005 and 0.015 mg/L. Table D.4, which shows the trend for dissolved phosphorus in the Maroochy River, indicates that most sites remain within this range.

- Total Phosphorus

Total phosphorus is determined by summing dissolved and organic/particulate phosphorus, and has indicative acceptable values of between 0.01 and 0.1 mg/L for freshwater rivers (ANZECC, 1992). No values are available for marine environments, however 0.05 mg/L is widely accepted as being acceptable. Looking at Table D.4 it can be seen that the Maroochy River mean total phosphorus levels vary between 0.04 mg/L to 0.07 mg/L, with large variations observed globally. This range is a significant increase on dissolved phosphorus levels, which indicates that significant concentrations of organic or particulate phosphorus are



ALTERNATIVE ENTRANCE CONFIGURATIONS

FIGURE
3.1

4 NUMERICAL MODEL ASSESSMENTS OF ENTRANCE RELOCATION

4.1 General

To provide a better understanding of the physical processes and a tool to assess the impacts of relocation options, a numerical model of the Maroochy River was developed, based upon the modelling package MIKE11. A short description of MIKE11 is provided in Appendix F.

The model was calibrated with measured tidal data and was then used to predict potential impacts associated with proposed entrance changes. Potential hydraulic impacts include changes to water levels, flow patterns, velocities and tidal volumes which in turn impact on water quality and environmental issues. These were assessed initially using the hydrodynamic module of the model (HD). Potential impacts associated with water quality and tidal flushing were assessed using the advection-dispersion module (AD).

Using information from earlier studies combined with the numerical model, additional simulations were performed to predict potential impacts for a flood event. As for the tidal simulations, potential hydraulic impacts investigated included changes to water levels, flow patterns and peak velocities.

4.2 Tidal Hydraulics

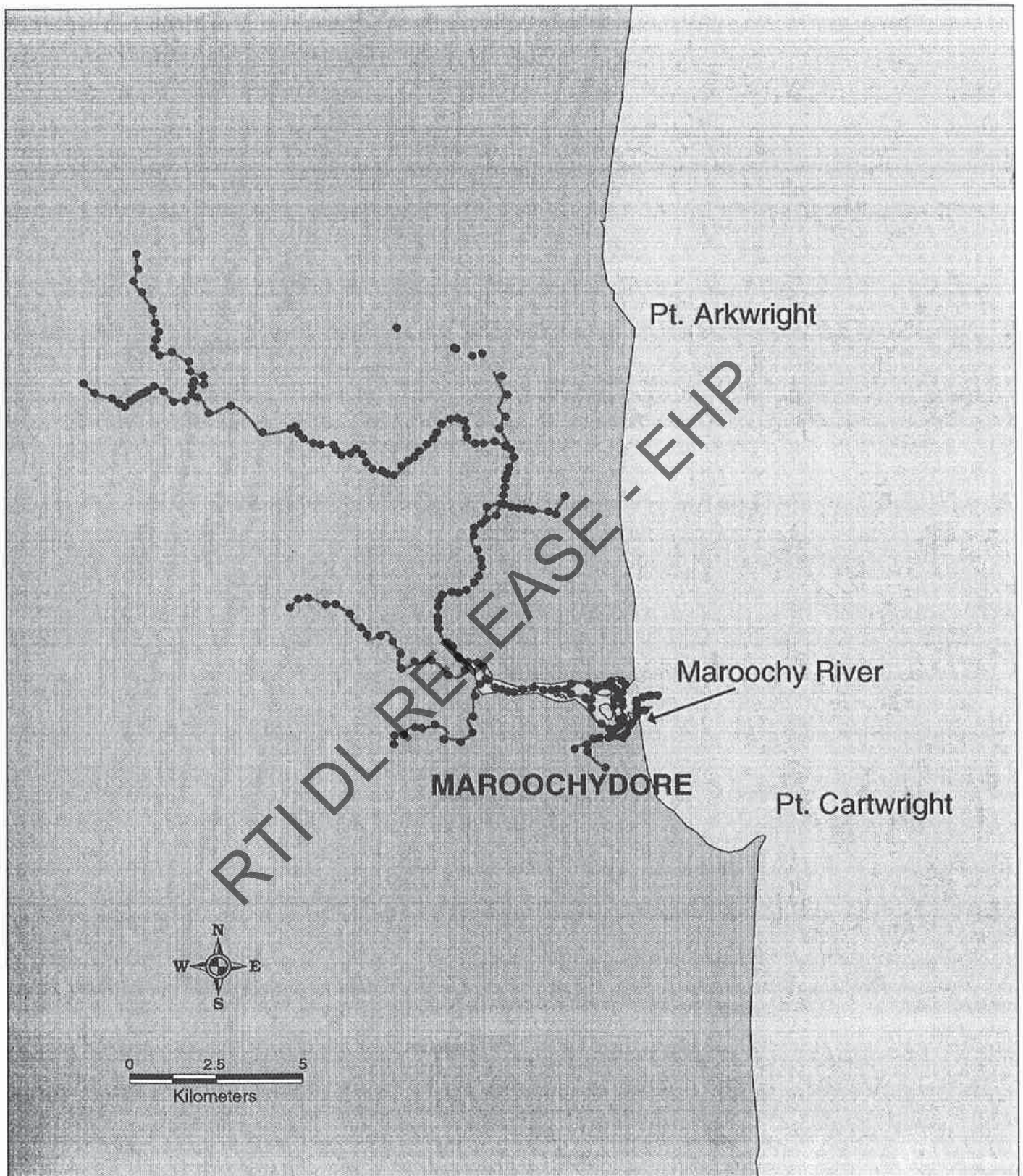
4.2.1 Model Setup

A model of the entire Maroochy River system was developed, as shown in Figure 4.1. Details of the model within the lower estuary are displayed in Figure 4.2. The geometry of the model was developed from a number of sources:

- data obtained from a field survey of the lower estuary and river entrance, commissioned by Maroochy Shire Council in January, 1997;
- data obtained from a field survey of the Maroochy River, extending from the lower estuary upstream to Yandina Creek, commissioned by Maroochy Shire Council in 1988;
- cross-sectional data of Petrie and Eudlo Creeks, and upper reaches of the Maroochy River, obtained from the Maroochy Shire Council RUBICON flood model; and
- width/elevation data of the North Maroochy and South Maroochy Rivers, obtained from the WBM Oceanics Australia ESTRY flood model.

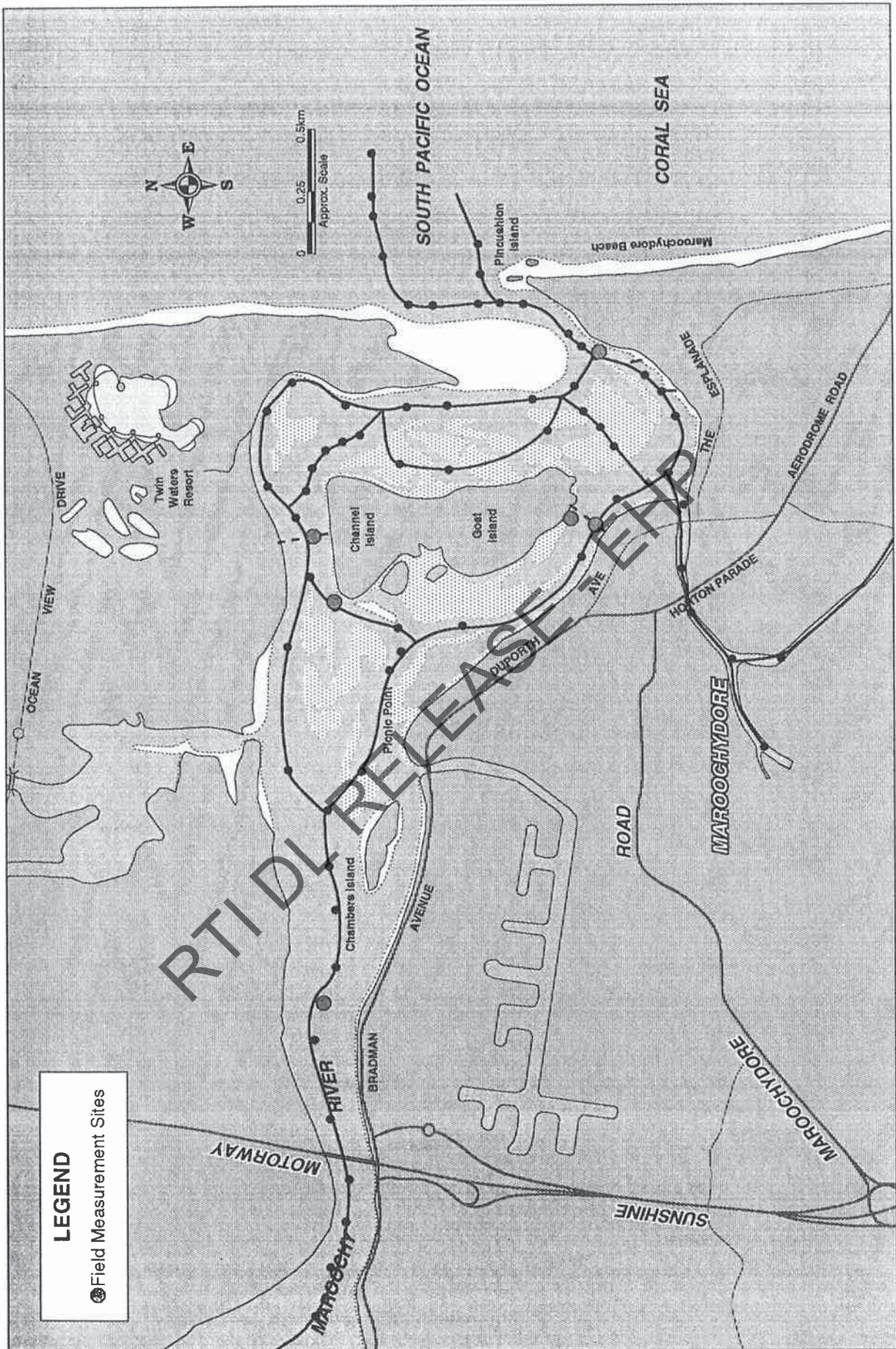
A field data collection exercise was undertaken in February, 1997 to obtain information regarding the present hydrodynamic behaviour within the lower estuary, including water level measurements and stream gauging exercises. Results from the field survey are described in Section 2.4.3.

The model geometry and associated inputs were reduced to Australian Height Datum (AHD).



MAROOCHY RIVER MODEL

**FIGURE
4.1**



**LOWER ESTUARY:
FIELD MEASUREMENT LOCATIONS AND MODEL NETWORK**

**FIGURE
4.2**

4.2.2 Model Calibration

Model calibration was performed using the data collected during the 1997 field data collection exercise, as detailed in Section 2.4. The calibration was performed by comparing model results to measured data at the following locations:

- Water level recorder, Cotton Tree
- Water level recorder, Picnic Point
- Water level recorder, North Channel
- Water level recorder, South Channel
- Water level recorder, Upstream
- Stream Gauge/Flow measurements, North Channel
- Stream Gauge/Flow measurements, South Channel

The locations of the measurements are displayed in Figure 2.5.

Water levels recordings at the Mooloolaba storm tide recorder (DoT, 1997) were used as the ocean boundary condition. No upstream flow conditions were specified.

The final calibration of the model is displayed in Figure 4.3. As shown in Figure 4.3, the model results accurately predict water level variations within the lower estuary. Comparisons to flow measurements indicate that the model is accurately representing the storage characteristics of the system, and the distribution of flow between the north and south channels.

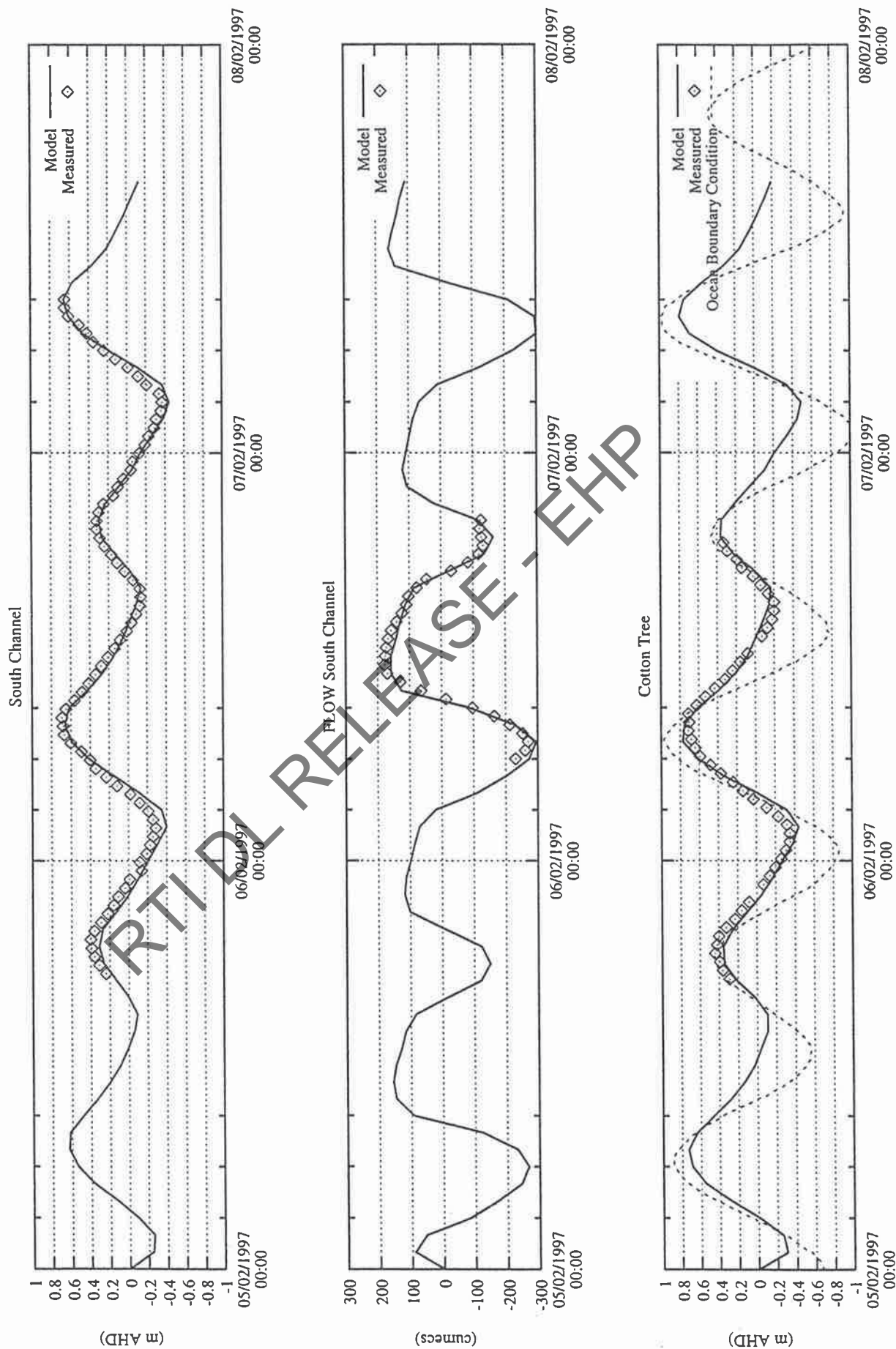
4.2.3 Design Simulations

Assessments of the entrance configuration options were made by simulating a mean spring tide and a mean neap tide and comparing the results to those for the existing case. Information on tidal planes were obtained from Mooloolaba Port (DoT, 1997), as displayed in Table 2.1. Mean spring tide was considered to vary sinusoidally between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS). Similarly, mean neap tide was considered to be between Mean High Water Neaps (MHWN) and Mean Low Water Neaps (MLWN).

4.2.4 Assessment of Proposed Channel Configurations

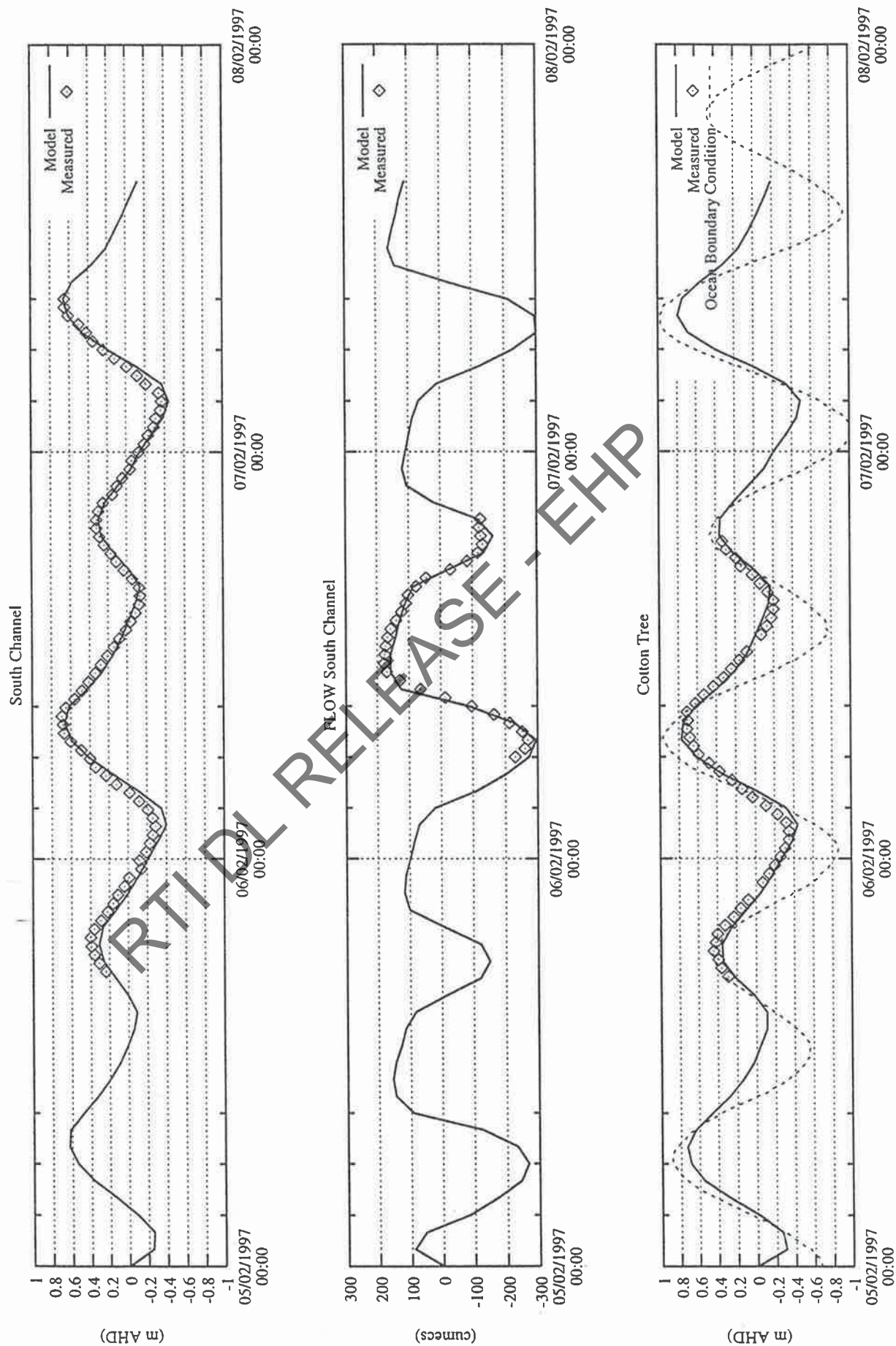
Following calibration, possible entrance configurations were assessed using the model. This involved modifying the existing model to incorporate the channel configuration options. By comparing the simulation results of the existing conditions to those with the channel configuration options, an assessment of the impacts could be made.

The results of the assessments are presented below while the implications of the various channel configurations is discussed in Section 5.



Model Calibration
South Channel and Cotton Tree Sites

Figure
4.3(b)



Model Calibration
South Channel and Cotton Tree Sites

Figure
4.3(b)

4.2.5 Model Results

Assessment of options 1 to 4, outlined in Section 3.4, were performed with the aid of the numerical model. Simulations of a mean spring and mean neap tide were performed for the existing conditions and for each of the options. The results of the simulations were compared to the existing conditions to identify and quantify any potential impacts upon the hydraulics of the river system.

A number of locations within the lower estuary were selected for comparison of the results of the various simulations. The locations, as displayed in Figure 4.4, include:

- the entrance channel;
- upstream of the lower estuary, adjacent to Chambers Island;
- the north channel, north of Channel Island; and
- the south channel, south of Goat Island.

Parameters used to describe the hydraulic nature of the estuary included:

- the tidal prism (the volume of water passing a given point over a tidal cycle);
- the maximum velocity recorded over a tidal cycle; and
- the maximum and minimum water level recorded over a tidal cycle.

These parameters provide an indication of the changes likely to occur as a result of a new entrance configuration. The tidal prism and peak water levels provide an indication of any change in the propagation of the tidal wave in and out of the river system, while the velocities provide an indication of potential areas of changing velocity which may result in accretion/erosion.

A summary of the results obtained from the simulations is displayed below in Table 4.1 and Table 4.2 for water levels and velocities, respectively. Discussion of the results is provided in Section 5.



IMPACT ASSESSMENT LOCATIONS

FIGURE
4.4

Table 4.1 Numerical Modelling Results, Tidal Hydraulics, Water Levels

Tidal Condition	Location	Entrance Configuration	Tidal Prism		High Water Level		Low Water Level	
			(m ³ × 10 ⁶)	Change ¹ (%)	(mAHD)	Impact ¹ (m)	(mAHD)	Impact ¹ (m)
Mean Spring	Entrance Channel	Existing	5.20		0.55		-0.30	
		Option 1	5.80	12	0.52	-0.03	-0.40	-0.10
		Option 2	5.79	11	0.52	-0.03	-0.40	-0.10
		Option 3	5.56	7	0.51	-0.04	-0.37	-0.07
		Option 4	5.53	6	0.51	-0.04	-0.37	-0.07
	Upstream	Existing	3.65		0.44		-0.20	
		Option 1	3.98	9	0.46	0.02	-0.29	-0.09
		Option 2	3.97	9	0.46	0.02	-0.29	-0.09
		Option 3	3.81	4	0.44	0.00	-0.28	-0.08
		Option 4	3.82	4	0.44	0.00	-0.28	-0.08
	North Channel	Existing	1.78		0.46		-0.21	
		Option 1	3.38	90	0.50	0.04	-0.37	-0.16
		Option 2	3.36	89	0.50	0.04	-0.37	-0.16
		Option 3	3.25	82	0.48	0.02	-0.34	-0.13
		Option 4	3.14	76	0.47	0.01	-0.33	-0.12
	South Channel	Existing	2.79		0.49		-0.24	
		Option 1	1.64	-41	0.47	-0.02	-0.34	-0.10
		Option 2	1.66	-40	0.47	-0.02	-0.34	-0.10
		Option 3	1.57	-44	0.46	-0.03	-0.32	-0.08
		Option 4	1.58	-43	0.45	-0.04	-0.32	-0.08
Mean Neap	Entrance Channel	Existing	3.34		0.30		-0.25	
		Option 1	3.67	10	0.30	0.00	-0.29	-0.04
		Option 2	3.67	10	0.30	0.00	-0.30	-0.05
		Option 3	3.66	9	0.29	-0.01	-0.28	-0.03
		Option 4	3.65	9	0.29	-0.01	-0.28	-0.03
	Upstream	Existing	2.28		0.27		-0.22	
		Option 1	2.49	9	0.28	0.01	-0.27	-0.05
		Option 2	2.49	9	0.28	0.01	-0.27	-0.05
		Option 3	2.40	5	0.27	0.00	-0.26	-0.04
		Option 4	2.40	5	0.27	0.00	-0.26	-0.04
	North Channel	Existing	1.08		0.27		-0.22	
		Option 1	2.23	106	0.29	0.02	-0.28	-0.06
		Option 2	2.21	104	0.29	0.02	-0.28	-0.06
		Option 3	2.31	113	0.28	0.01	-0.27	-0.05
		Option 4	2.11	95	0.28	0.01	-0.27	-0.05
	South Channel	Existing	1.82		0.28		-0.23	
		Option 1	1.02	-44	0.28	0.00	-0.28	-0.05
		Option 2	1.03	-43	0.28	0.00	-0.28	-0.05
		Option 3	0.98	-46	0.27	-0.01	-0.26	-0.03
		Option 4	0.99	-46	0.27	-0.01	-0.26	-0.03

¹ Change defined as value for Option compared to Existing Case. Positive value denotes an increase.

Table 4.2 Numerical Modelling Results, Tidal Hydraulics, Velocities

Tidal Condition	Location	Entrance Configuration	Tidal Prism		Maximum Velocity		
			(m ³ × 10 ⁶)	Change ¹ (%)	Ebb Tide (m/s)	Flood Tide (m/s)	Change ¹ (%)
Mean Spring	Entrance Channel	Existing	5.20		1.54	-1.09	
		Option 1	5.80	12	0.96	-0.96	-25
		Option 2	5.79	11	0.98	-0.96	-24
		Option 3	5.56	7	1.24	-1.20	-5
		Option 4	5.53	6	1.25	-1.19	-5
	Upstream	Existing	3.65		0.24	-0.26	
		Option 1	3.98	9	0.28	-0.27	12
		Option 2	3.97	9	0.28	-0.27	12
		Option 3	3.81	4	0.27	-0.26	6
		Option 4	3.82	4	0.27	-0.26	6
	North Channel	Existing	1.78		0.34	-0.24	
		Option 1	3.38	90	0.67	-0.43	89
		Option 2	3.36	89	0.66	-0.43	87
		Option 3	3.25	82	0.63	-0.42	79
		Option 4	3.14	76	0.62	-0.41	78
	South Channel	Existing	2.79		1.00	-0.44	
		Option 1	1.64	-41	0.65	-0.27	-37
		Option 2	1.66	-40	0.66	-0.38	-24
		Option 3	1.57	-44	0.61	-0.25	-40
		Option 4	1.58	-43	0.62	-0.36	-28
Mean Neap	Entrance Channel	Existing	3.34		1.10	-0.71	
		Option 1	3.67	10	0.66	-0.62	-26
		Option 2	3.67	10	0.67	-0.62	-26
		Option 3	3.66	9	0.86	-0.79	-5
		Option 4	3.65	9	0.86	-0.79	-6
	Upstream	Existing	2.28		0.17	-0.15	
		Option 1	2.49	9	0.20	-0.16	11
		Option 2	2.49	9	0.20	-0.16	11
		Option 3	2.40	5	0.19	-0.16	6
		Option 4	2.40	5	0.19	-0.15	6
	North Channel	Existing	1.08		0.24	-0.14	
		Option 1	2.23	106	0.47	-0.29	102
		Option 2	2.21	104	0.47	-0.29	100
		Option 3	2.31	113	0.45	-0.28	94
		Option 4	2.11	95	0.44	-0.28	92
	South Channel	Existing	1.82		0.74	-0.30	
		Option 1	1.02	-44	0.45	-0.16	-43
		Option 2	1.03	-43	0.46	-0.23	-30
		Option 3	0.98	-46	0.43	-0.15	-45
		Option 4	0.99	-46	0.44	-0.22	-33

¹ Change defined as value for Option compared to Existing Case. Positive value denotes an increase.

4.3 Flood Hydraulics

4.3.1 Overview

To predict any possible changes to the lower estuary during a flood, model simulations of a flood event were performed. The aim of the simulations was to determine any potential impacts associated with the entrance configuration options.

4.3.2 Model Setup

WBM Oceanics Australia has a comprehensive flood model of the Maroochy River system. This model, developed and upgraded over several years, provides a detailed representation of the flood dynamics in the system. Following initial calibration of the model, verification and recalibration has been performed several times in the past, most recently in 1996 (WBM Oceanics Australia, 1996).

As the MIKE11 model used for the tidal hydraulics and water quality simulations does not include floodplains in the geometry, it was not considered appropriate to use the entire model for flood simulations. Therefore the model was truncated upstream of the Sunshine Motorway Bridge. Information extracted from the earlier WBM flood model was used to provide the input flow boundary conditions at this location and at several other inflow points in the lower estuary.

In previous flood assessments provision has been made to account for the effect of scour upon the channel entrance during a flood event. This has been done by using an entrance channel cross-section wider and/or deeper than that which normally exists. It is difficult to determine the amount of scour that may potentially occur in the entrance channel. More importantly, the rate of scour that may occur in the relocated channels being assessed in this study may be different to the rate of scour that may occur in the existing channel. Therefore, for the purposes of this study, the model simulations made no account of any widening or deepening of the entrance channel that may occur during a major flood event. While the absolute values may not be appropriate, this provides a direct relative impact assessment.

4.3.3 Design Simulations

Assessment of the entrance configuration options were made by simulating a 100 year ARI (Annual Recurrence Interval) design flood event. Rainfall for the design flood was based upon information supplied in AR&R (IEAust, 1987) and temporal patterns provided in AR&R (IEAust, 1977). The 1977 temporal patterns were used as there is general concern within the industry that those provided in the 1987 edition tend to underestimate flows and resulting flood levels in this region. This is consistent with the Maroochy Shire Council's policy on determining design storms.

Previous work (WBM Oceanics Australia, 1996) found that a 36 hour duration storm event produced the highest flood flows in the Maroochy River.

Design ocean boundary conditions were synthesised by combining a mean spring tide with a storm surge of the type described by the Beach Protection Authority (BPA, 1985). The BPA recommends ocean levels for given annual exceedence probabilities plus additional allowance for wave setup. The peak of the storm was timed to coincide with the peak rainfall temporal pattern.

4.3.4 Assessment of Proposed Channel Configurations

As for the tidal hydraulics, model simulations were performed for the existing conditions and for each of the channel configurations. By comparing the simulation results of the existing conditions to those with the new channel configurations, potential impacts could be assessed.

4.3.5 Model Results

As for the tidal hydraulics, assessment of options 1 to 4 were performed with the aid of the flood model. The results from the simulations were compared to the existing conditions to identify and quantify any potential impacts upon peak water levels and peak velocities in the lower estuary.

As for the tidal hydraulics, a number of locations within the lower estuary were selected for comparison of the results of the various simulations. The locations are displayed in Figure 4.4. A summary of the results obtained from the simulations is displayed below in Table 4.3. Discussion of the results summarised in Table 4.3 is provided in Section 5.

Table 4.3 Numerical Modelling Results, Flood Hydraulics

Design Event	Location	Entrance Configuration	Peak Water Level		Maximum Velocity	
			(mAHD)	Impact (m)	(m/s)	Impact (m/s)
100 Year ARI Flood	Entrance Channel	Existing	2.74		3.7	
		Option 1	1.94	-0.80	5.3	1.6
		Option 2	1.95	-0.79	5.4	1.7
		Option 3	2.00	-0.74	6.3	2.6
		Option 4	1.93	-0.81	6.4	2.7
	Upstream	Existing	3.48		1.0	
		Option 1	2.83	-0.65	1.2	0.2
		Option 2	2.82	-0.66	1.2	0.2
		Option 3	3.00	-0.48	1.1	0.1
		Option 4	2.99	-0.49	1.1	0.1
	North Channel	Existing	3.46		1.6	
		Option 1	2.61	-0.85	2.2	0.6
		Option 2	2.61	-0.85	2.2	0.6
		Option 3	2.86	-0.60	2.1	0.5
		Option 4	2.85	-0.61	2.1	0.5
	South Channel	Existing	3.21		1.2	
		Option 1	2.41	-0.80	1.5	0.3
		Option 2	2.40	-0.81	1.5	0.3
		Option 3	2.65	-0.56	1.3	0.1
		Option 4	2.64	-0.57	1.3	0.1

4.4 Tidal Flushing and Water Quality

4.4.1 General

Following the development of the MIKE11 HD model, which predicts the hydraulic behaviour of the river, an AD (Advection/Dispersion) model of the river was developed to predict the water quality of the lower estuary.

AD simulations were performed to assess the flushing times at certain locations in the river system. To assess the flushing times, a simulation was performed using a series of mean spring tides. A second simulation was performed using a series of mean neap tides. For each simulation, an initial uniform concentration of material was specified. The simulations were performed until concentrations in the lower estuary had reduced to 37.5% of the initial concentration; the E-folding time.

There was no data available to calibrate the advection-dispersion model. Parameters adopted in the AD model were based upon values recommended in reference texts and found to be relevant in other AD model studies conducted by WBM Oceanics Australia.

4.4.2 Model Results

As for the tidal hydraulics, assessment of options 1 to 4 were performed with the aid of the AD model. Using the HD model results for a mean spring and mean neap tide, simulations were performed to determine the flushing times for the existing conditions and for each of the options. The results from the simulations were compared to the existing conditions to identify and quantify any potential impacts upon the water quality of the river system.

As for the tidal hydraulics, a number of locations within the lower estuary were selected for comparison of the results of the various simulations. The locations are displayed in Figure 4.4. A summary of the results obtained from the simulations is displayed below in Table 4.4. Discussion of the results summarised in Table 4.4 is provided in Section 5.

Table 4.4 Numerical Modelling Results, Water Quality

Tidal Condition	Location	Entrance Configuration	Tidal Prism		Flushing (E-folding) Time	
			(m ³ × 10 ⁶)	Change ¹ (%)	(hrs)	Change ¹ (%)
Mean Spring	Entrance Channel	Existing	5.20		32	
		Option 1	5.80	12	8	-75
		Option 2	5.79	11	8	-75
		Option 3	5.56	7	8	-75
		Option 4	5.53	6	8	-75
	Upstream	Existing	3.65		79	
		Option 1	3.98	9	78	-1
		Option 2	3.97	9	80	1
		Option 3	3.81	4	78	-1
		Option 4	3.82	4	81	3
	North Channel	Existing	1.78		57	
		Option 1	3.38	90	49	-14
		Option 2	3.36	89	51	-11
		Option 3	3.25	82	48	-16
		Option 4	3.14	76	50	-12
	South Channel	Existing	2.79		52	
		Option 1	1.64	-41	61	17
		Option 2	1.66	-40	62	19
		Option 3	1.57	-44	61	17
		Option 4	1.58	-43	62	19
Mean Neap	Entrance Channel	Existing	3.34		97	
		Option 1	3.67	10	60	-38
		Option 2	3.67	10	62	-36
		Option 3	3.66	9	90	-7
		Option 4	3.65	9	92	-5
	Upstream	Existing	2.28		162	
		Option 1	2.49	9	137	-15
		Option 2	2.49	9	140	-14
		Option 3	2.40	5	161	-1
		Option 4	2.40	5	164	1
	North Channel	Existing	1.08		137	
		Option 1	2.23	106	88	-36
		Option 2	2.21	104	93	-32
		Option 3	2.31	113	113	-18
		Option 4	2.11	95	117	-15
	South Channel	Existing	1.82		119	
		Option 1	1.02	-44	103	-13
		Option 2	1.03	-43	107	-10
		Option 3	0.98	-46	127	7
		Option 4	0.99	-46	130	9

¹ Change defined as value for Option compared to Existing Case. Positive value denotes an increase.

5 IMPACTS OF CHANNEL RELOCATION

5.1 General

A quantitative assessment of the hydraulic and water quality aspects of the options was performed using the Mike 11 numerical model developed for the Maroochy River system. The results from the model, as summarised in Section 4, are included in the overall assessment of the options. Other components of the study, including environmental and economic considerations, have also been considered in the selection of the optimum entrance channel as discussed below.

5.2 Coastal Processes

As discussed in Sections 2.2 and 2.3, the entrance channel is subject to continual change under the influence of the prevailing processes and generally migrates in a southern direction until a major events causes a breakthrough. Accordingly it can be expected that a new northern entrance channel will slowly migrate to the south.

Option 1 is the northern most location and will therefore provide the longest time frame before the entrance returns to its present day position. A buffer some 150m wide has been left between the proposed entrance location and the existing carpark on the north shore to accommodate any short term northwards migrations.

Some localised erosion of the foreshore to the north and south of the entrance can be expected as the new entrance evolves to a natural configuration with the adjoining areas. The area seaward of the carpark and esplanade road to the north has naturally accreted during the growth of the northern spit. It could be expected that the northern shoreline may recede to an alignment similar to when the entrance was previously at a northern location.

Option 2 provides a greater buffer distance to the northern development and would be likely to result in less change to the northern foreshore. However, it will not provide as much time as Option 1 for the entrance to reach its present location once again.

In summary, some changes can be expected to the shoreline alignment, particularly to the north. However, provided that no sand is removed from the active system, these changes should be within the limits of natural fluctuations where it has occurred in the past.

5.3 Tidal Hydraulics

As discussed in Section 4, hydrodynamic (HD) simulations were performed for mean spring and neap tides. Using the results the tidal volumes of the river system for the existing entrance and the four alternative entrance configurations were calculated. The results of the simulations, including the tidal prism calculations, maximum and minimum water levels and maximum velocities, are displayed in Table 4.1 and Table 4.2.

- *upstream tidal prism*

The results suggest that a northern entrance channel will increase tidal flow in the river. For the deeper entrance configuration (options 1 and 2) there is a 10% increase in tidal prism immediately upstream of the lower estuary. For the shallower entrance configurations (options 3 and 4) there is a 4% increase. Even though these options have the same cross-sectional area as the existing entrance, the location provides a more direct route to the ocean and improves the overall efficiency.

- *upstream tidal range*

This increase in tidal prism is associated with an increase the tidal range in the river. The results indicate that during a mean spring tide an increase in tidal range corresponds to a lowering of low water levels by approximately 0.10 m for the deeper entrance configuration, and 0.08 m for the shallower entrance configuration.

Similarly, high water levels are raised, although not to the same extent as for the low water levels. For a mean spring tide, high water levels are raised by 0.02 m immediately upstream of the lower estuary for the deeper entrance channel. For the shallower entrance channel there is no increase in high water levels. Further upstream from this location it is likely that the tidal influence will be less. As such, the high tide water level should not increase by more than 0.02 m (for a mean spring tide, deeper entrance channel) further up the river system.

- *upstream tidal velocities*

The increase in tidal flow also increases velocities in the lower estuary. For a mean spring tide, peak tidal velocities increase by 12 % for the deeper entrance channel, and 6 % for the shallower entrance channel. Similar percentage increases occur during a mean neap tide.

- *entrance channel*

At present, tidal velocities in the entrance channel are high (1.54 m/s and 1.09 m/s for the ebb and flood stages of a mean spring tide). For each option assessed, tidal velocities in the entrance channel were less. As expected, a deeper entrance channel will reduce velocities.

Note that at present there is evidence to suggest that exposed coffee rock on the bed of the entrance channel, plus the bank protection measures at Cotton Tree, is restricting the cross-sectional area of the entrance channel. This would account for high velocities that presently occur. A northern entrance channel would not be constrained to the same extent as presently exists, and as such would vary until a dynamic equilibrium is reached between the tidal prism and entrance cross-section.

- *north channel/south channel distribution*

A northern entrance channel alters the distribution of flow between the north and south channels. The tidal prism and velocities of the north channel increase by approximately 80 - 90 % for a mean spring tide and approximately 100 - 110 % for a mean neap tide. Conversely, the tidal prism and velocities of the south channel decreases by approximately 40 % for a mean spring tide and approximately 40 - 50 % for a mean neap tide. These results

indicate that a northern channel entrance will increase tidal flow in the north channel, which now presents the least resistant path for tidal flow between the main river channel and the ocean. This increase in flow in the north channel corresponds to a decrease in tidal flow in the south channel.

Associated with the change in flows and velocities will be changes to the sediment transport patterns. Detailed assessment of the impacts to sediment transport processes was beyond the scope of the present study. However, it is likely that the changes will result in scour of the northern channel as it becomes more dominant. This has occurred in the past and it is not likely to induce any significant new bank erosion problems.

While the velocities in the south channel reduce, they are still likely to be large enough to generate sediment transport. Nevertheless, it is possible that some shoaling of the southern channel may occur as has been observed in previous times when the northern channel was dominant.

5.4 Flood Hydraulics

As discussed in Section 4, model simulations were performed for a 100 year ARI design flood event. The results of the simulations, and impacts to peak water levels and velocities associated with the four entrance configuration options, are presented in Table 4.3.

Note that the flood simulations performed assume that no scouring occurs in the entrance channel. This will tend to constrict flood flows in the channel, increasing velocities and raising water levels in the lower estuary. As such, the absolute values of peak water level as displayed in Table 4.3 are considered to be conservative. However, the relative trends between the existing conditions and the four entrance options are still considered to be relevant.

Relocation of the channel entrance appears to reduce peak water levels in the river during a flood event. This is most likely due to the reduction in flow resistance between the main channel and the ocean that a northern entrance channel provides. The model results indicate that for the deeper entrance configuration (options 1 and 2), peak water levels in the lower estuary are reduced by approximately 0.65 to 0.85 m. For a shallower entrance configuration (options 3 and 4), peak water levels are reduced by approximately 0.50 to 0.80 m.

For all the alternative entrance configuration options there is an overall increase in peak flood velocity throughout the lower estuary. Results suggest that peak velocities in the river upstream of the lower estuary increase by 0.2 (options 1 and 2) and 0.1 m/s (options 3 and 4). The relocation of the entrance concentrates flood flow through the north channel, with peak velocities in the north channel increasing by 0.6 (options 1 and 2) and 0.5 m/s (options 3 and 4) over the existing case. In the south channel, peak flood velocities increase by 0.3 m/s (options 1 and 2) and 0.1 m/s (options 3 and 4).

Note that a deeper entrance configuration results in a greater increase in velocities in the lower estuary than for a shallower entrance configuration. This is due to a higher hydraulic

efficiency through the deeper entrance, which increases the rate of flow out of the river system.

For the deeper entrance configuration (options 1 and 2) peak velocities through the entrance channel are approximately 1.6 m/s greater than for the existing case. For a shallower entrance configuration (options 3 and 4) peak velocities are approximately 2.6 m/s greater. Note that high velocities through the entrance channel will induce scour, which will tend to increase the cross-sectional area of the channel and consequently reduce velocities. This effect has not been included in the assessment.

In summary, relocation of the entrance channel is likely to lower peak levels in the river system during a flood event provided that the cross sectional area is at least that of the existing entrance. Note that during a flood event it is likely that high velocities will tend to scour the entrance channel, resulting in a larger cross-sectional area.

5.5 Tidal Flushing and Water Quality

5.5.1 Tidal Flushing

As discussed in Section 4, hydrodynamic (HD) model simulations were performed for mean spring and mean neap tides. Using these results the tidal volumes of the river system for the existing entrance and the four alternative entrance configurations were calculated. Using the HD model results, advection/dispersion (AD) model simulations were also performed to determine the flushing characteristics of the river for the existing entrance configuration and for each of the four alternative entrance configurations. The results of the simulations, including the tidal prisms and flushing times associated with the four entrance configuration options, are presented in Table 4.4.

In general, relocation of the entrance channel appears to increase the tidal prism of the river. Upstream of the lower estuary, the tidal prism increases by 4 to 9 % over the existing entrance configuration. This general improvement in the tidal prism is evident in all areas of the lower estuary except for the south channel. As the entrance relocation options are to the north of the existing entrance, the south channel is now situated further away from the entrance. This results in a reduction in tidal flow propagating through the south channel. The reduction in tidal prism in the south channel is of the order of 40 to 45 % over the existing.

Changes to the tidal prism are reflected in the tidal flushing for each of the entrance configurations. In general, flushing in the lower estuary is improved by the relocation of the entrance, except for the south channel, particularly during a spring tide. During a mean spring tide the flushing time in the south channel increases by approximately 20%. For a neap tide, during which tidal flushing is considered to be more critical in terms of the water quality of the estuary, there is a decrease in flushing times for the deeper entrance configuration (options 1 and 2), and a small increase in flushing times for the shallower entrance configuration (options 3 and 4). Note that at present the flushing characteristics of the south channel are very good, due to the high velocities and corresponding tidal flows which pass through the south channel to/from the existing entrance. Regardless of the above,

even for the worsened spring tide case, absolute flushing times are still less than 3 days in the south channel, which will ensure no adverse water quality impacts.

An area of concern regarding water quality in the lower estuary is at the confluence of Cornmeal Creek, which provides runoff from a significantly urban catchment including the Maroochydore CBD. At present, tidal flow through the south channel is such that the receiving waters of the estuary at Cotton Tree are well flushed.

Historical records of the lower estuary and discussions with Council staff and long term residents have suggested that at times in the past the Cornmeal Creek and associated water bodies have not been directly connected to the ocean via the South Channel. This resulted in poor tidal flushing in the area, which resulted in poor water quality.

However, since all options being considered maintain a southern channel connection to the sea and provide an ancillary channel around the southern end of Goat Island, then it is unlikely that water quality will deteriorate due to lack of flushing. Model results, particularly for a mean neap tide, confirm to this. Nevertheless, should shoaling of the southern channel occur as discussed in Section 5.3, the flushing could reduce. This should be subject to ongoing monitoring.

In summary, relocation of the entrance appears to generally improve flushing in the lower estuary. The deeper entrance configurations (options 1 and 2) appear to improve flushing in the south channel during a neap tide, which is considered to be the more critical in terms of impacts to river water quality.

5.5.2 Water Quality During Dredging

Concerns have been raised, through public consultations and submissions (Section 6), that the entrance relocation works have the potential to generate plumes of turbid water with the associated impacts to both inshore and near-shore aquatic fauna.

While turbid plumes are likely to be generated, they are unlikely to be extensive in intensity and extent due to:

- *the nature of the sediments*

The sediments at the proposed entrance location (both options 1 and 2) are reworked marine sands. The coastal processes resulting in their deposition (ie. littoral drift) are unlikely to provide material with a high silt content. It is possible that isolated areas may contain higher silt content as a result of deposition during flood events but these are likely to be minor in proportion to the volume of material relocated.

- *the localised area of operation*

As outlined (Section 7) the proposed dredging procedure is to progressively cut a channel from west to east, with the final break through on an ebbing tide. This procedure will limit the exchange of dredge area waters and the wider Maroochy River. Placement will

occur primarily in the existing entrance area with the potential for plumes to travel offshore during the ebb tide and upstream during the flood tide. Given the nature of the sediments, it is expected that these plumes will reduce towards natural background levels within about 0.5 to 1.0km. Accordingly, it is unlikely that they will reach Mudjimba Island which is 3.5km away.

The possibility of remobilisation of contaminants contained in sediments by the proposed entrance works has also been identified as an issue (Section 6).

The presence of contaminants in the sediments is unlikely due to the nature of the sediment. Chemical contaminants in marine sediments are generally associated with fine (silt) material. Sediments in the proposed works are recently reworked and deposited marine sands which are unlikely to contain high proportions of silt (see above).

5.6 Fisheries Values

5.6.1 Recreational Fishery

All options under consideration are very similar in terms of their potential impact to the recreational fishery. Therefore the section below relates equally to Options 1 to 4.

The Maroochy River is important recreational fishing location (see Section 2.7). Usage of the area peaks in response to migrations of whiting/flathead (summer), bream (winter) and school holidays. The timing of entrance relocation works is therefore important to avoid conflicts with these periods. Consultation with the recreational anglers body, Sunfish (Section 6.4) has indicated that generally spring and autumn would be the preferred timing for the proposed works.

Areas adjacent to the proposed entrance relocation works are popular recreational fishing areas, particularly for shore-based anglers. As described in Section 7.4, barriers to limit public access to the proposed works area will be erected in the interest of public safety. Therefore, some areas will become unavailable during the works phase. Given the extent of other adjacent areas available, this impact is considered minor.

Access to the northern spit area, once entrance relocation works are complete, will be returned to the present situation. However, relocation of the river entrance will allow access to the majority of the river entrance areas from the Cotton Trees area. This improved access would be of benefit in terms of recreational usage of the area.

The Maroochy River bar is generally unsuitable for ocean access due to its shallow and exposed nature. Very few boats cross this bar, preferring to use the nearby Mooloolah River. Therefore, the proposed entrance works are unlikely to impact upon recreational vessels in either the works or completion phase.

5.6.2 Commercial Fishery

Fisheries regulations prohibit commercial fishing operations downstream of the Cod Hole. Therefore, no direct impacts to commercial fishing operation are likely. Additionally, as the Maroochy River does not support a seagoing fishing fleet, impediment to vessel traffic by entrance relocation works is unlikely.

Some species of migrating fish, particularly sea mullet, enter the river and "lay-up" in areas immediately inside the mouth for a short time to rest before spawning in adjacent coastal waters and/or continuing migration. Commercial fishers which haul net fish on the open beach near the river mouth have expressed concern (Section 6.4) that entrance relocation works have the potential to disrupt normal migration/spawning patterns. Construction activity (eg. noise) may prevent fish from nearing/entering the river entrance or disperse schools both of which could result in reduced catches. The timing of the entrance relocation works is therefore critical to avoid disturbing spawning and/or migrating fish stocks. As the major fisheries are predominantly winter (sea mullet and bream) and summer (whiting and flathead) commercial fishers have advised that the September/October would avoid this possibility.

Concerns have been raised as to the possibility of the creation of plumes of turbid water associated with the entrance relocation works. The material to be removed is reworked marine sands. This is unlikely to contain significant amounts of fine (silt) material. Any plume created as a result of the entrance relocation works is therefore likely to be limited in extent and duration.

Additionally, no significant reserves of marine organisms sensitive to smothering by silt (such as seagrasses or encrusting fauna) are known, (or expected), to be present in the immediate vicinity of the proposed works.

5.6.3 Restocking Research Program

The relocation of the Maroochy River entrance as detailed by Option 2 will result in the direct removal of one of the research programs sampling locations. Option 1 for the entrance relocation will not directly remove this site and, as such, is the preferred alternative by the study coordinator (pers. comm. A. Butcher, QDPI). The study team recognises, however, that this site may be lost due to the southward migration of the river entrance subsequent to relocation works. Additionally, the current regime of sites adjacent to the proposed relocation site may be altered. The effect of this upon sample results is difficult to determine.

5.7 Ecological Values

It needs to be recognised in assessing ecological impacts that:

- although the relocation of the entrance channel will be artificial, river entrance relocation could occur naturally as result of cyclones, and lead to similar ecological consequences.
- fauna communities in dynamic river entrances, such as the Maroochy River, are adapted to a mobile environment and are generally opportunistic and able to adapt to a wide

variety of conditions. Should conditions become sub-optimal, such mobile species generally relocate from the area of disturbance for a short period (eg. floods, cyclonic events) and re-establish when conditions become more suitable. A similar process is anticipated to occur as a result of the Maroochy River relocation.

5.7.1 *Impacts to Aquatic Flora*

All options for the relocation of the Maroochy River entrance addressed in this report will involve the ultimate loss of the mangroves and saltmarsh associated with the small lagoon on the western side of the spit. As noted in Section 2.8, this area is approximately 600 m² and comprises exclusively grey mangroves and saltmarsh vegetation which has established in the past 6 years. Option 1 would not involve their direct removal as part of the relocation works. However the probable natural southward migration of the entrance would ultimately remove these areas. Therefore the discussion of potential impacts below relates equally to both options.

Whilst the area provides habitat for aquatic fauna, it is a relatively minor proportion of the mangrove resource present in the Maroochy River (approximately 633 hectares in total, 84 ha of which are found downstream of the Sunshine Coast Motorway Bridge).

Considering their relatively recent establishment, their upper littoral position (hence availability to aquatic fauna on large tides only), and the minor component they represent of the regional mangrove resource, it is considered that removal of these mangroves will not result in any substantial adverse effects to the conservation status of mangroves in the region, or aquatic fauna. As noted in Section 2.8, the total area of mangroves in the Maroochy River, and to a lesser extent, mangrove distribution, varies significantly as a result of natural fluctuations in the river morphology and tidal range.

Relocation of the entrance channel (both option 1 and 2) is unlikely to result in significant adverse effects to the tidal regime of the lower Maroochy River (Section 5.3). On this basis, it is unlikely that relocating the river entrance will have adverse effects to aquatic flora communities in areas other than the small area of mangroves described above.

It should be noted however, that all marine plants are protected under Section 51 of the *Fisheries Act (1995)*. A permit is required for their disturbance and/or removal. The necessary information for this permit is contained in Appendix G.

5.7.2 *Impacts to Aquatic Fauna*

All options under consideration are very similar in possible impact to aquatic fauna.

The proposed relocation of this channel will result in the disturbance of fauna associated with intertidal areas at the oceanic and river edge of the proposed relocation area. Fauna communities and habitats associated with such areas are typical of those found in the lower Maroochy River and comprise a variety of crab species (eg. soldier crabs), gastropod species and burrowing crustaceans (eg. yabbies). It is probable that the margins of the new channel, once construction works are complete, would be recolonised by similar fauna to that which

presently occurs. Such a process would occur in association with natural movement of the river entrance. In this regard, impacts resulting from the construction works are anticipated to be short term and localised.

The material to be removed from the new entrance channel is anticipated to be placed in the existing river entrance channel (see Section 3.4). This filling operation would result in the smothering of benthic communities in the area to be filled. It is probable that similar communities to those present in the existing channel will rapidly establish in the new channel for similar reasons to those described above.

Analysis of historical aerial photography of the river entrance over the last 40 years indicates that the proposed channel entrance (both options 1 and 2) is unlikely to contain indurated sand (coffee rock). Sections of coffee rock are present in the existing river entrance and present a degree of habitat diversity which will not be available in the relocated entrance. As discussed above the usage of these areas by benthic fauna is limited by the mobile nature of the surrounding sands, periodically covering and exposing the rock, and the extreme current velocities experienced in the area.

The possibility of dredging works significantly impacting on inshore and/or near-shore communities (such as Mudjimba Island) is unlikely because potential turbidity plumes would be limited in extent (< 1.0km) as described in Section 5.5.

5.7.3 Impacts to Shorebirds

Disturbance to shorebirds during the construction phase of entrance relocation will be in the immediate vicinity of the works. This disturbance will be mitigated by the limited extent of these works and the availability of other roosting areas. Timing of the project in the April to November period will ensure that the majority of migratory species will not be present in the Maroochy area.

Once works have been completed the situation (roost/feeding opportunities) will be very similar to the present case.

5.7.4 Impacts to Terrestrial Flora

The proposed construction of a new entrance channel would involve the removal of vegetation which has developed on portions of the northern spit. All such vegetation involves species typical of sand dunes along the Sunshine Coast. Most is recently established (within the last 10 years). The entrance channel relocation would not involve the disturbance of any of the more well-established Casuarinas which occur towards the north of the proposed channel location.

Dune vegetation communities at the river entrance are probably periodically disturbed as a result of cyclonic influences, and are capable of recolonising available habitat rapidly. In this regard, it is probable that sand deposited in the existing river entrance would be rapidly revegetated. However, a Dune Management Plan will be instigated as outlined in Section 7.5.3.

6 CONSULTATION

6.1 Introduction

A range of activities have been undertaken to ensure that public opinions regarding the project were adequately sought and considered. The activities included:

- a public meeting
- public submissions
- direct liaison with fishing organisations and
- direct liaison with government authorities

A summary of the results of this consultation process are given below with the relevant points being taken into consideration in the assessment of options. It should be noted that many public comments and submissions related to the need to carry out works rather than the specific objectives of the study in determining and assessing the impacts of a new northern entrance channel.

6.2 Public Meeting

A public meeting was held at the Maroochy Surf Club on 26 February 1997 following advertisements placed in the local newspaper by the Maroochy Shire Council. The meeting was attended by representatives from the Council, WBM Oceanics Australia, government representatives, stakeholders and the public at large. The main topics raised at the meeting were:

- concern about the haste and restrictive nature of the current investigation
- doubts about the capability of models to predict possible changes and impacts
- observations and questions regarding the historical movements of the entrance
- concerns regarding public safety and infrastructure loss including threat to the CBD
- opinion that Cotton Tree Park approvals are temporary and therefore infrastructure value should not be considered and the area should be considered as a buffer

6.3 Public Submissions

Public submissions regarding the project were called for by advertisement placed in the local newspaper by the Maroochy Shire Council. Some 16 responses were received to the advertisement and a summary of the comments are given in Appendix H. All responses have been forwarded to the Maroochy Shire Council for their consideration.

6.4 Direct Liaison with Fishing Organisations

Meetings were held with the Queensland Commercial Fishermen's Organisation and Sunfish (represent recreational fishing groups within Queensland). Relevant correspondence from these organisations following the meetings are provided in Appendix I.

Representatives of the Queensland Commercial Fishermen's Organisation advise the following.

- It would be preferred if relocation works were not carried out in the period May to August (inclusive) or mid summer as these periods are of vital importance for mullet and bream (winter) and summer whiting (summer) spawning periods.
- Of key concern was the potential for disturbance to mullet entering the Maroochy River and "laying-up".
- Disturbance of mullet entering, resting and leaving the entrance channel would be likely to have significant adverse effects to ocean beach landings of mullet. Mullet are the major species sought by commercial fishermen, and any disturbance to the mullet movement patterns would result in reduced catches and consequently result in economic hardship for the fishermen involved.
- Commercial fishermen have requested that they are consulted prior to the undertaking of any works.
- Turbidity plumes entering the river could be of concern. Fishermen requested that a mechanism is developed to ensure that any turbidity plumes associated with the entrance channel construction were such that they impacted oceanic rather than estuarine areas.
- Commercial fishermen would prefer that any channel relocation works were undertaken in the September/October period.

Discussions with Sunfish representatives indicated the following key concerns.

- Relocation activities are not undertaken at Easter (key holiday period when large numbers of recreational fishermen are present), June-July (bream spawning period), or summer (key holiday period for recreational fishermen and summer whiting spawning period).
- The preferred time for entrance relocation would be Autumn or Spring.

6.5 Liaison with Regulatory Agencies and Advisory Bodies

Communication with approving authorities, particularly Department of Primary Industries, Department of Environment, Department of Transport and the Beach Protection Authority has been maintained during the course of the study. Any aspect of the alternatives discussed which may be controversial have been checked with the appropriate authority before proceeding. The Department of Environment advised that "there are no immediate cultural heritage concerns based on an investigation of the regional cultural heritage site records and the knowledge that all works will occur in areas which have been previously disturbed by natural river and beach processes".

7 DESIGN AND IMPLEMENTATION DETAILS

7.1 Recommended Configuration

Option 1 is the recommended configuration as it will give the greatest potential life of the project if the entrance continues to migrate south as it has done historically. A buffer of some 150m to the carpark on the north shore will accommodate any local short term migration to the north. Some recession of the presently accreted area to the east of the carpark may occur. It is recommended that the existing entrance be closed to maximise the effectiveness of the works.

The new entrance will evolve to a cross-sectional area which is in equilibrium with the tidal prism. This is likely to be similar to that of previous entrance configurations in this area which were around 460m² (below AHD). The existing entrance is somewhat smaller than this but is probably constrained by exposed coffee rock. Although the larger entrance has a greater effect on the upstream conditions compared with the restricted entrance option (Option 3), it is considered that this is likely to be more stable and closer to an equilibrium condition. It is likely that a more constricted entrance would evolve to the larger area in a relatively short time.

Generally, with Option 1, the upstream effects on the tidal regime are less than 10% different from the existing case and are likely to be within the range of natural fluctuations. The lower estuary areas will undergo more significant change but this is not unusual in a highly dynamic coastal zone which naturally has to accommodate the changes caused by floods and cyclones. The flooding, water quality, fisheries and ecological impacts are similar for all options.

7.2 Earthworks Quantity

In order to establish a new entrance it will be necessary to excavate a channel across the spit at the desired location. This channel will need to be similar in size to the expected final channel so that ongoing changes to establish equilibrium are minimised. A preliminary arrangement for earthworks calculation purposes to achieve a cross-sectional area of 460m² below AHD consists of a channel 78 m wide and 4 m deep with 1:3 side batters under water and 1:1 batters in dry sand. The excavation volume associated with this section in the location selected for Option 1 is approximately 480,000 m³. This volume will need to be checked before construction to incorporate dune and spit growth and channel relocation effects.

An alternative and possibly more desirable strategy to reduce dredge volumes and costs would be to construct a smaller channel and allow the tidal processes to scour the entrance, if necessary, until it reaches its own natural equilibrium. A channel 50m wide and 4m deep with side slopes as above would provide a cross-sectional area similar to the existing channel. Preliminary volume calculations for such a channel in the location selected for Option 1 indicate that approximately 320,000m³ would need to be excavated for this case. Such an

approach would minimise initial impacts (as per Option 3) and result in a more gradual change to the ultimate situation.

7.3 Construction Procedure

Because of the large volume of sand to excavate and the short time between tides it will be necessary to use a hydraulic dredge (or dredges) with a capacity of 800 - 1000 m³/hr to excavate most of the channel, cut the final opening and achieve closure of the existing entrance. Some assistance could be gained by using conventional land based excavation equipment in the centre, but the larger component will be dredging from the river side. Also to reduce the effect of the tide and to maximise the time available to excavate the opening it will be desirable to perform the opening and closure works during neap tides.

The general procedure will involve dredging the channel from west to east with the sand being pumped to the existing entrance to achieve partial closure. Final break through should preferably be timed to occur on an ebb tide so that any material scoured is not carried back into the estuary. Following break through, final dredging of the new entrance and closure of existing entrance should take place. It may be necessary to stockpile sand on the southern end of the spit during the early phases of dredging and/or retain an area to be dredged to provide sufficient material for closure and to form a new dune across the existing entrance as discussed below.

7.4 Ancillary Works

To reduce erosion at Cotton Tree it is proposed to cut off the existing entrance channel in this area using the dredge material from the northern entrance opening. To be effective as a natural defence against cyclone breakthrough, the dune will need to be constructed with a crest height of at least 4m, a crest width of at least 50 m and a seaward slope of 1:5 and a landward slope of 1:3. Additional sand will provide a greater buffer against breakthrough and the final profile will be somewhat dependent on the dredging quantities to achieve a cut/fill balance. The dune will also need to be fenced and vegetated to prevent wind erosion as described in Section 2.8.7 and approved by the Beach Protection Authority. Temporary fencing around the work area will also be required for safety reasons.

7.5 Environmental Management

7.5.1 Timing of the Proposed Works

Several factors have been considered in the development for the timing of the proposed entrance relocation works. Environmental considerations resulting in constraints to proposed entrance relocation works are discussed in Section 5.6. These indicate that it would be preferable if relocation works were undertaken in the September/October period.

7.5.2 Boating Hazards

Vegetation in the proposed entrance relocation area should be removed prior to channel excavation. Some potential exists, however, for the future southern movement of the

entrance channel to erode vegetation remaining on the entrance bank, causing the vegetation to fall into the waterway. Small individual plants (such as spinifex) are not considered to be an issue. Larger individual trees however, (such as casuarinas) have the potential to become boating hazards. Therefore it is recommended that a monitoring program be initiated to ensure that large vegetation which falls, or is in immediate threat of falling, into the waterway is removed and disposed of on land.

Direct impact to recreational fishing vessels is unlikely given to limited extent of river based equipment. The dredge will be clearly marked with appropriate navigation lights, etc as required by the Queensland Transport Department. Ancillary equipment, such as pump lines, are likely to be shore-based.

7.5.3 *Dune Restoration and Vegetation*

Vegetation is vital to coastal sand dune stability as it holds the dune sand in place and traps sand blown from the beach to aid dune build-up. Damage or removal of dune vegetation results in wind erosion and lowering of the dune. When this happens sand is blown further inland where it becomes unavailable during beach erosion events. This windblown sand can also cause problems on car parks, roads and in nearby developed areas. The wind eroded beach-dune system is no longer an effective barrier against wave attack and coastline recession could result.

Damage to dune vegetation results from pedestrian usage, vehicle traffic, burning and grazing. Specific information on pedestrian control fences and access tracks is available from the Beach Protection Authority.

Beach access tracks for pedestrians and vehicles in dunal areas usually require some form of surface treatment to prevent: wind erosion; sand displacement and lowering of dune levels; rainfall run-off erosion; and to provide a reasonably comfortable and trafficable surface. All access track surfaces should allow water to soak in so that run-off does not erode adjacent sandy areas. In areas susceptible to wind erosion access tracks over the crest and on the seaward face of the frontal dune should be surfaced with conventional board and chain walkways or roadways. These flexible structures, designed to be lifted when windblown sand accumulates on them, or repositioned when threatened by wave erosion, are described in BPA Leaflets.

When necessary, the re-establishment of frontal sand dunes involves the physical replacement of a mass of sand of appropriate size, shape and location to provide the required protection against storm waves. This must be followed by stabilisation of the sand mass so that it will not be reshaped or relocated by wind action.

Although the methods used in individual locations may vary, the following steps are common to dune re-establishment programs:

1. The construction of the dune to its designed size, shape and location, using the hydraulic dredging of sand from adjacent estuarine sources.

2. The immediate temporary stabilisation of the constructed dune to prevent its deformation by wind action until such time as a vegetative cover can be established.
3. The establishment of a vegetative cover to prevent wind erosion of the dune, encourage further sand deposition and to provide a means by which the dune is capable of natural regeneration after storm damage.
4. The protection of the vegetative cover by physically excluding people, stock and vehicles and preventing fire, all of which cause localised or general destruction of dune plants, and result in wind erosion. Unpreventable damage requires repair, as outlined in (1), (2) and (3) above, if natural regeneration is unable to make good the damage.

An undisturbed frontal dune system is in a complex state of dynamic equilibrium and its stability, shape and position at any time are a result of the interplay of the effects of wind, waves, tides and vegetation. Returning the dune to a natural, undamaged condition provides a degree of flexibility that allows the vegetation line to retreat under wave attack and advance during calmer weather conditions. The achievement of such a situation is the main objective of good dune restoration, and results in a decrease in the extent of erosion of the beach. Failure to trap wind blown sand in the dune results in significant, long term and permanent erosion of the beach/dune system.

For this project an initial profile shape consisting of a 1 in 5 seaward slope, 1 in 3 landward slope, a crest height at least 4 mAHD and a crest width of at least 50 m would be suitable.

On the exposed frontal dune sand spinifex grass (*Spinifex sericeus*) is used to provide ground cover. Following successful establishment of sand spinifex grass, horsetail she-oak (*Casuarina equisetifolia* var. *incana*) tree seedlings can be planted on the crest and landward slope of the frontal dune. This tree is very wind and salt tolerant and provides a wind break behind which less wind and salt tolerant trees and shrubs can be grown. Coastal wattle (*Acacia sophorae*), as an under-storey shrub, could be established on the crest and landward slope of the frontal dune. Other species which could be planted on the landward slope include coastal tea-tree (*Leptospermum laevigatum*), coastal banksia (*Banksia integrifolia*), Cyprus wattle (*Acacia cyanophylla*) and paper-barked tea-tree (*Melaleuca quinquenervia*).

In the less exposed hind dune areas sand spinifex grass can be used as a primary stabiliser and supplemented with plantings of Rhodes grass (*Chloris gayana*) and couch grass (*Cynodon dactylon*). Forage sorghum (*Sorghum vulgare*) can also be planted to provide a quick cover of vegetation and to protect other establishing plants. All planted areas should be mulched to prevent wind erosion. Once initial stability has been achieved tree and shrub species can be planted including those species planted on the frontal dune together with brush box (*Tristania conferta*), bloodwood (*Eucalyptus intermedia*), blue gum (*Eucalyptus tereticornis*), Moreton Bay ash (*Eucalyptus tessellaris*), cupania (*Cupaniopsis anacardioides*), Brisbane black wattle (*Acacia leiocalyx*), sticky hop-bush (*Dodonaea viscosa*) and black she-oak (*Casuarina littoralis*).

7.5.4 Environmental Management Plans

Potential environmental impacts associated with the construction works can be analysed and minimised with the development of Environmental Management Plans (EMP's). It is recommended that these be developed prior to any dredging works and in consultation with the relevant authorities (eg. QDoE, QDPI and QDoT).

EMP's would typically cover the following activities:

- dredging operations;
- dredge material placement;
- interaction with boating and fishing activities; and
- environmental monitoring.

7.6 Environmental Monitoring

Approvals for the works would generally include a monitoring component to confirm impact assessments and to provide guidance for minimising impacts associated with any future works.

Monitoring activities would typically involve:

- measurement of tide level variations throughout the estuary;
- measurement of background turbidity and any turbidity plumes generated during the works;
- aerial photography of shoreline changes;
- observation and measurement of channel changes; and
- measurement of water quality in the estuary.

Preliminary discussions have been undertaken regarding the possibility of the QDPI restocking research program (Section 2.7.3) being extended to encompass a fisheries monitoring component. The project biologist, Mr Adam Butcher, has indicated that this may be feasible, pending further investigation of the details surrounding the relocation works. Liaison between the MSC and QDPI will be required to further investigate this option.

7.7 Further Studies

As the channels and sand banks in the entrance are constantly changing it will be necessary to optimise design and dredging parameters at the time of construction. It is recommended that a detailed earthworks plan be commissioned and it should address the following points:

- current channel depths and locations;
- dredge volume and placement locations; and
- any ancillary channel and fill locations.

It is also recommended that coring and sampling of the sediment in the proposed dredged channel location be carried out to confirm the nature of the sediments and the potential for any stiff (eg. coffee rock) material.

This study has provided certain basic information and assessments of processes and the impacts of a new northern entrance channel. Areas which were beyond the scope of this study and which could be studied in more detail to confirm the predicted impacts include:

- review of historical tide level data to ascertain the extent of natural variations and confirm the model predictions for different entrance configurations;
- more detailed assessment of the impacts changed hydraulic conditions will have on sediment transport processes in the lower estuary and associated erosion/siltation trends; and
- more detailed flooding assessments taking into consideration the potential for scour of the entrance during a flood event.

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8 CONCLUSIONS AND RECOMMENDATIONS

This study has highlighted the highly dynamic nature of the entrance and the range through which the entrance naturally migrates. The impacts on water levels, flows and velocities, water quality, ecological and fisheries values, associated with this natural movement has not been quantified. However, it can reasonably be assumed that relocating the entrance anywhere within this natural range will not cause any effects which may not occur naturally. The impacts on water levels, flows and velocities, water quality, ecological and fisheries values, associated with the four options investigated have been documented in this report.

Based on the results of this study, the most northerly entrance location, Option 1, is recommended as being technically feasible with the longest possible life expectancy and having impacts which are within the range of natural events. Closure of the existing entrance is also recommended to improve the effectiveness of the works.

It is likely that the new entrance will evolve to natural equilibrium cross-sectional area which is larger than the existing entrance. Model results indicate that this configuration will result in a 90% increase in tidal prism in the north channel, a 41% decrease in tidal prism in the south channel and a 9% increase in tidal prism upstream with the velocity changes relating closely to the tidal prism changes.

An area of concern regarding water quality in the lower estuary is at the confluence of Cornmeal Creek, which provides runoff from a significantly urban catchment including the Maroochydore CBD. At present, tidal flow through the south channel is such that the receiving waters of the estuary at Cotton Tree are well flushed.

Since all options being considered maintain a southern channel connection to the sea to the east of Goat Island, then it is unlikely that water quality will deteriorate due to lack of flushing. Numerical modelling has confirmed this.

Some erosion or realignment of the northern foreshore may occur as a result of the works but this is likely to be within the wide area that has naturally accreted as the entrance has migrated southwards.

Flooding of the estuary is unlikely to be adversely affected by the works and may be improved.

With regard to ecological values and fisheries, relocating the entrance anywhere within the natural range will not cause any effects which may not occur naturally, therefore no significant impacts are expected. The timing of the works are important with respect to fish spawning and fishing activities with September/October being the preferred time.

The major earthworks associated with Option 1 will be between approximately 320,000m³ and 480,000m³ of sand relocated from the new entrance to fill the old entrance and build a dune buffer. Conventional hydraulic dredges with a relatively large capacity (800-1000m³/hr) will be required to effect the opening and closure operations.

In conclusion it can be stated that relocating the entrance channel of the Maroochy River to the north (Option 1) is within the range of natural migrations. Therefore it is reasonable to conclude that there would be minimal impacts to the natural environment which are outside the normal range of variations. Water quality at Cornmeal Creek would be maintained by keeping the south channel open. A frontal dune would be constructed and vegetated north from Pincushion as a buffer against encroachment by the ocean.

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9 REFERENCES

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APPENDIX A: STUDY BRIEF

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RELOCATION OF MAROOCHY RIVER ENTRANCE DESIGN STUDY REQUIREMENTS

1. Determine an appropriate location and cross section for a new northern entrance channel across the existing spit growing from the northern bank of the river. (It is expected that the location of the new entrance would be similar to that which existed in 1974).
2. Determine the need for either total or partial closure of the existing entrance channel. Such determination should include the relevant quantities and locations for dredging and deposition of sand.
3. Determine the need for the alteration of any areas within the estuary in order to ensure that the new entrance becomes dominant. Such determination should include the relevant quantities and location for dredging and deposition of sand.
4. Determine the relevant dredging quantities involved in all phases of the project.
5. Describe the dredging procedure which should be adopted in order to effect the project. The description should include timing of dredging works with respect to the tide and the required sand pumping rates.
6. Determine the impact on the tidal and flooding regime of the river and of Cornmeal Creek both during the period of the works and after completion of the works. Such assessment should also include any potential effects on water quality in Cornmeal Creek and the Maroochy River as a result of any changes. Baseline water quality data should be obtained prior to dredging works commencing to enable a comparison with the post dredging status of the estuary.
7. Determine potential impacts on the natural values of the fish Habitat Reserve through relocation of the entrance channel.
8. Liaise with the Department Primary Industries, Fisheries and Forestry to mitigate any detrimental impacts from the dredging works on the Fish Habitat Reserve, particularly with respect to key fish spawning areas and the timing of the dredging works.
9. Where changes to upstream tidal/flooding regimes are determined, evaluate impacts on the natural values of the river and instream islands, including river banks, riparian vegetation and flora and fauna habitat and connectivity.
10. Ensure that appropriate consultation with the local community is undertaken.
11. Should any potential problems be identified, describe means of overcoming such problems.

APPENDIX B: TIDAL HYDRAULIC DATA

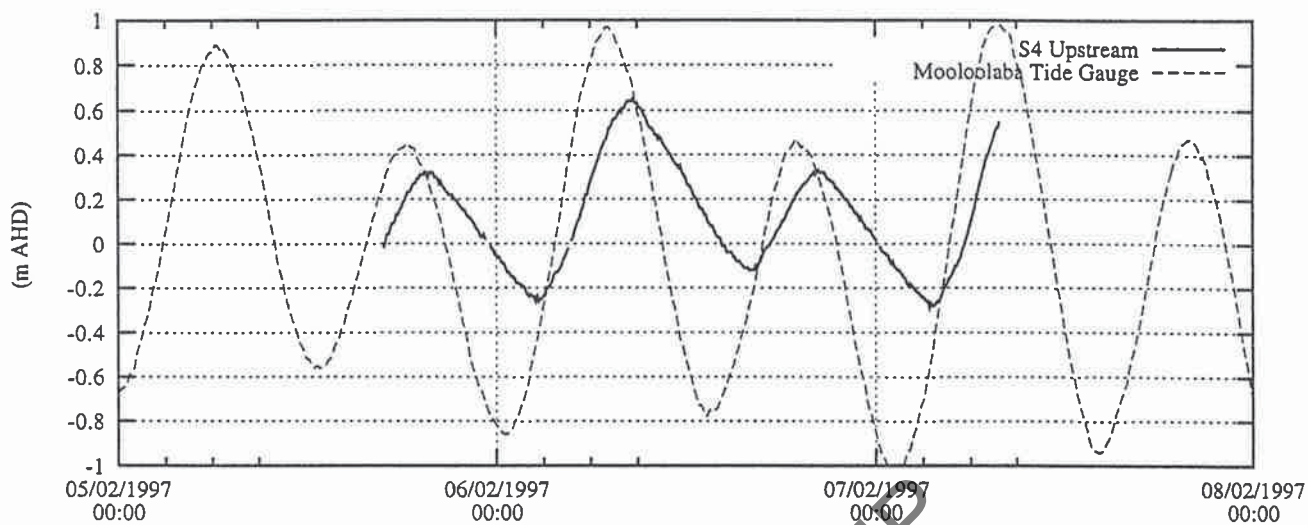
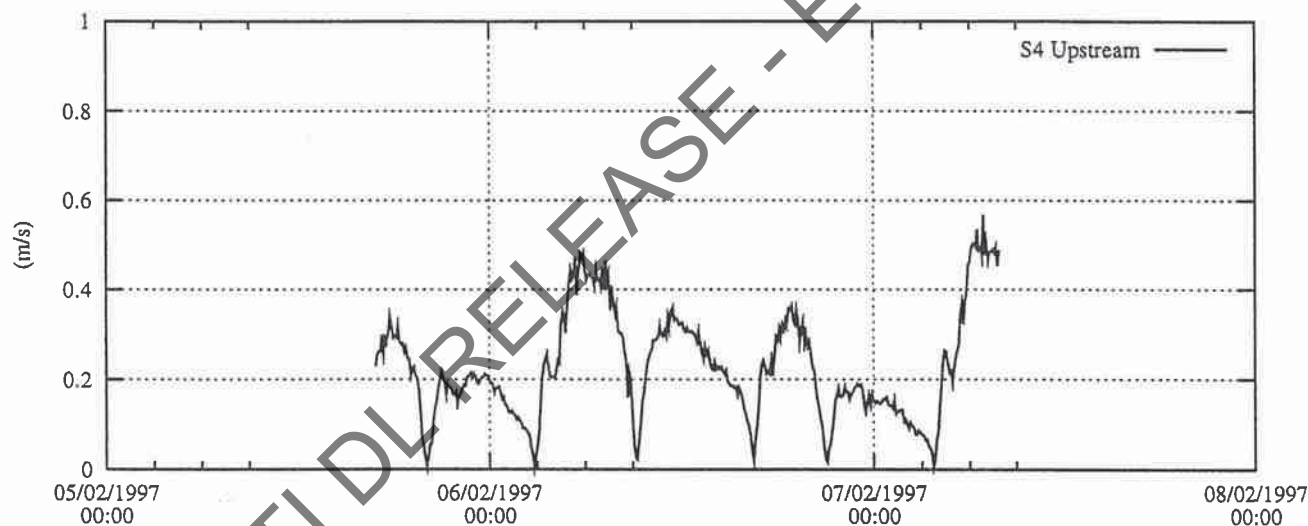
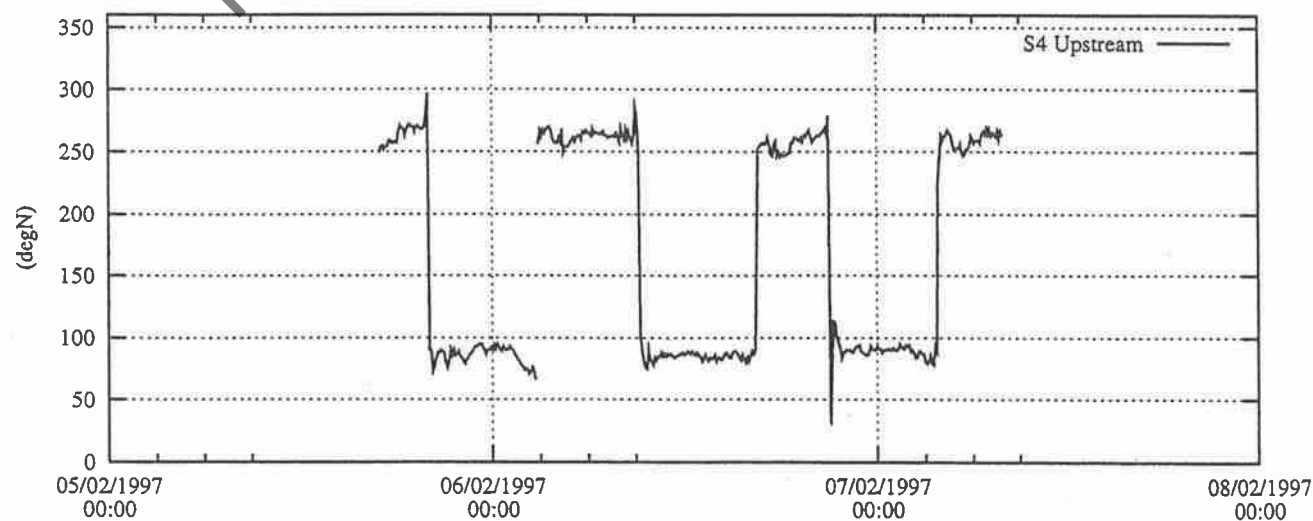
Figure B.1: Upstream S4 Current Meter

Figure B.2: North Channel S4 Current Meter

Figure B.3: South Channel S4 Current Meter

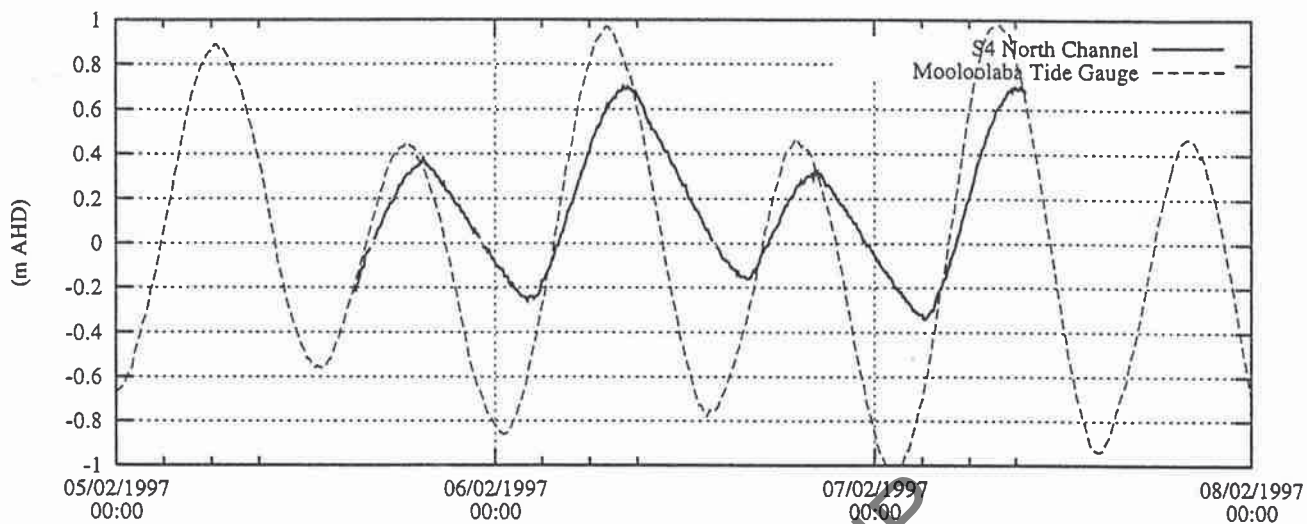
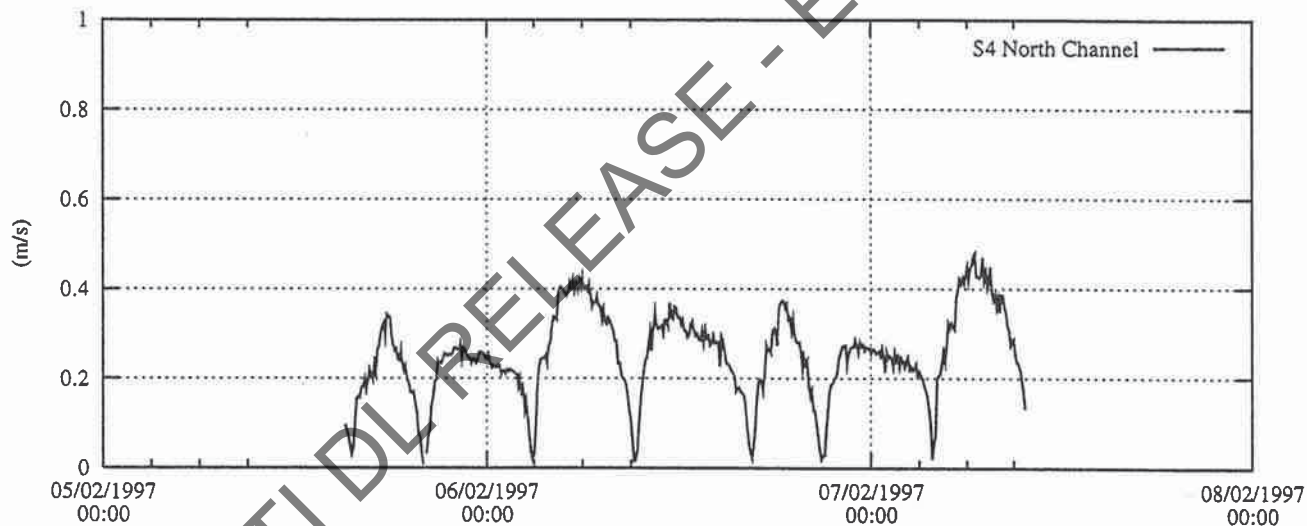
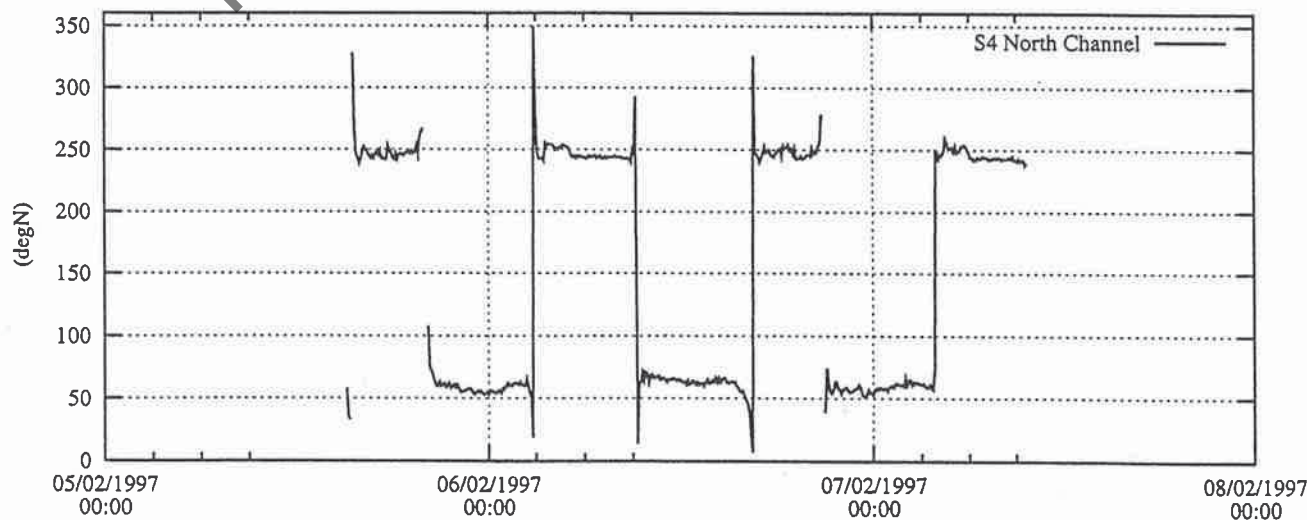
Figure B.4: Water Level Recorders

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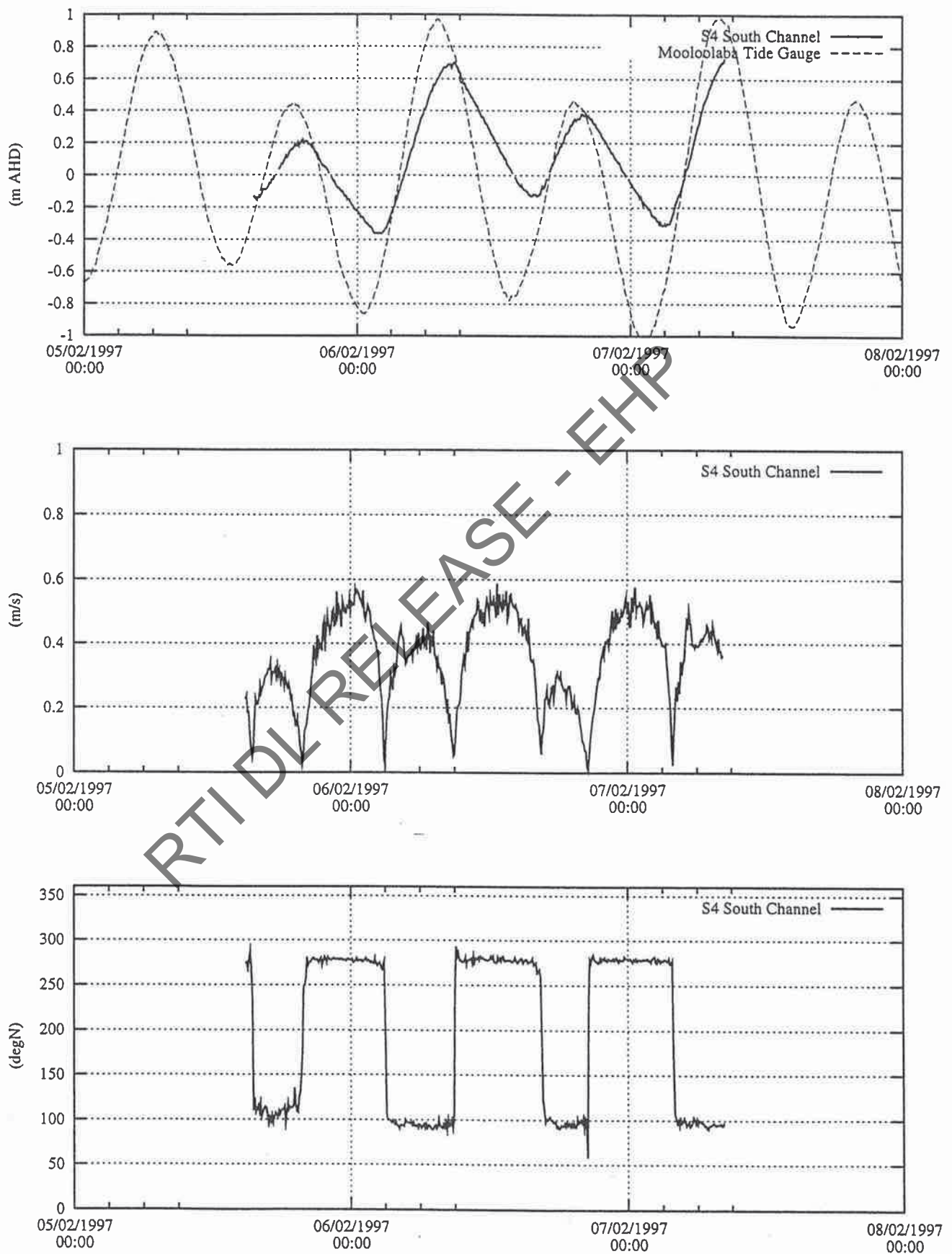
Appendix B: Field Data Collection - Hydraulics
Upstream S4 Current Meter

Figure
B.1



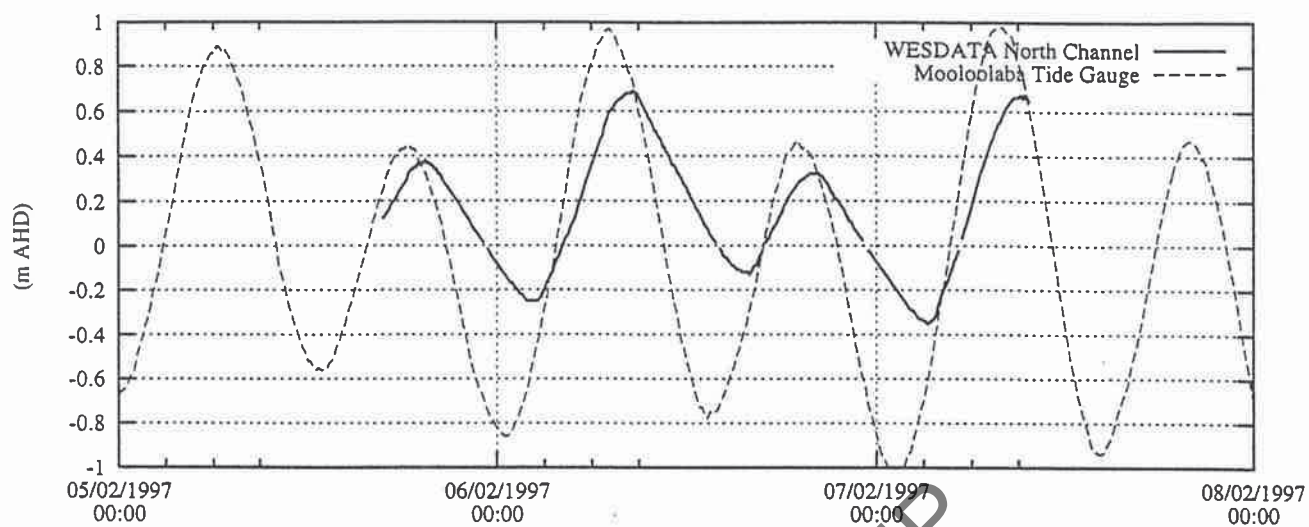
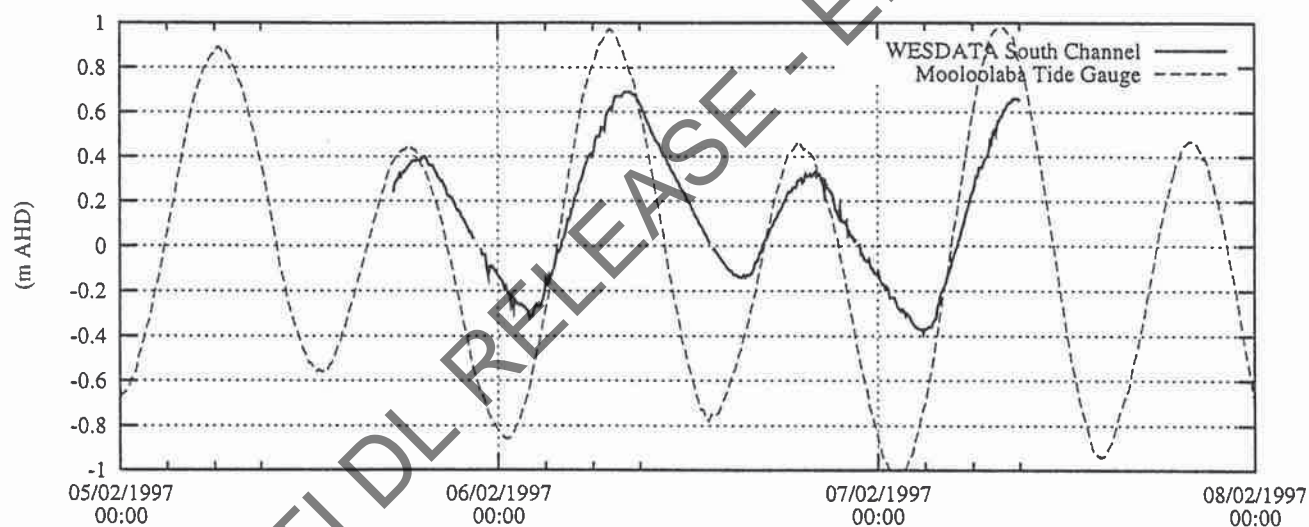
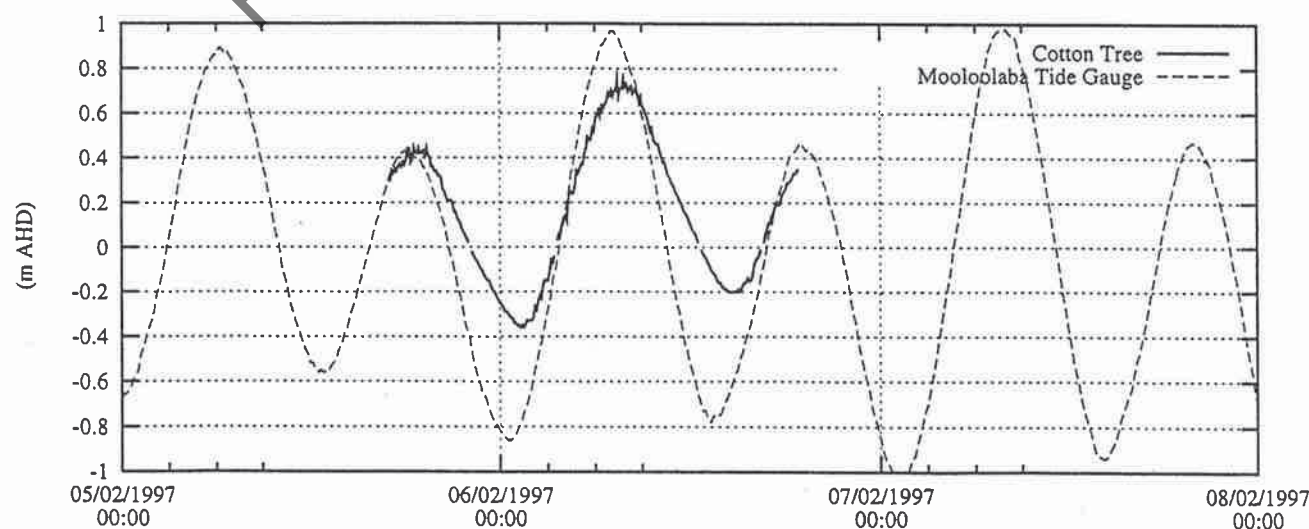
Appendix B: Field Data Collection - Hydraulics
North Channel S4 Current Meter

Figure
B.2



Appendix B: Field Data Collection - Hydraulics
South Channel S4 Current Meter

Figure
B.3



Appendix B: Field Data Collection - Hydraulics
Water Level Recorders

Figure
B.4

APPENDIX C: EXISTING DATA - WATER QUALITY

Figure C.1: DoE Water Quality Data

Figure C.2: DoE Water Quality Data

Figure C.3: DoE Water Quality Data

Figure C.4: DoE Water Quality Data

Figure C.5: DoE Water Quality Data

Table C.1: In-Situ Water Quality Measurements - University of Queensland

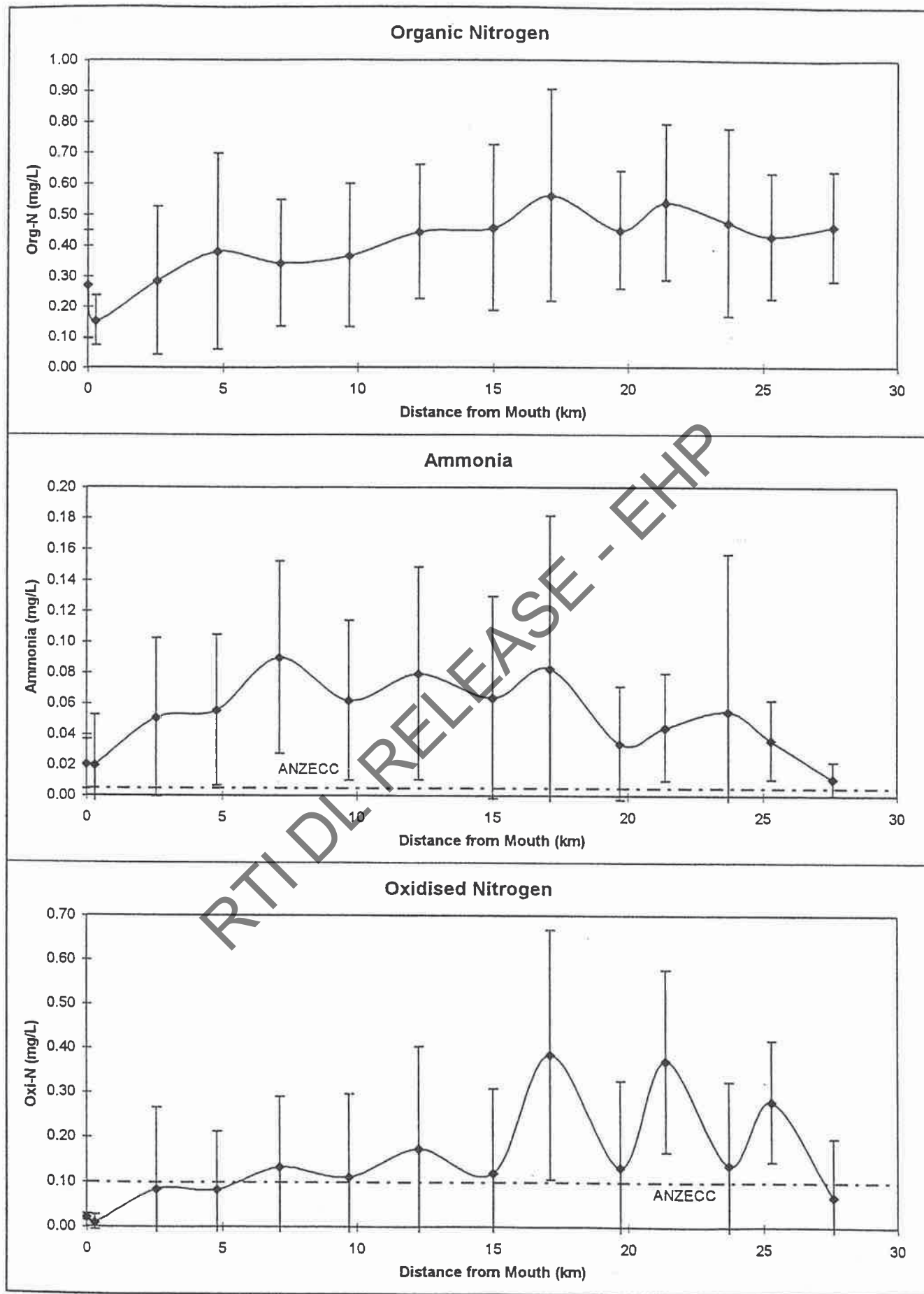
Table C.2: Laboratory Analyses of Water Samples - University of Queensland

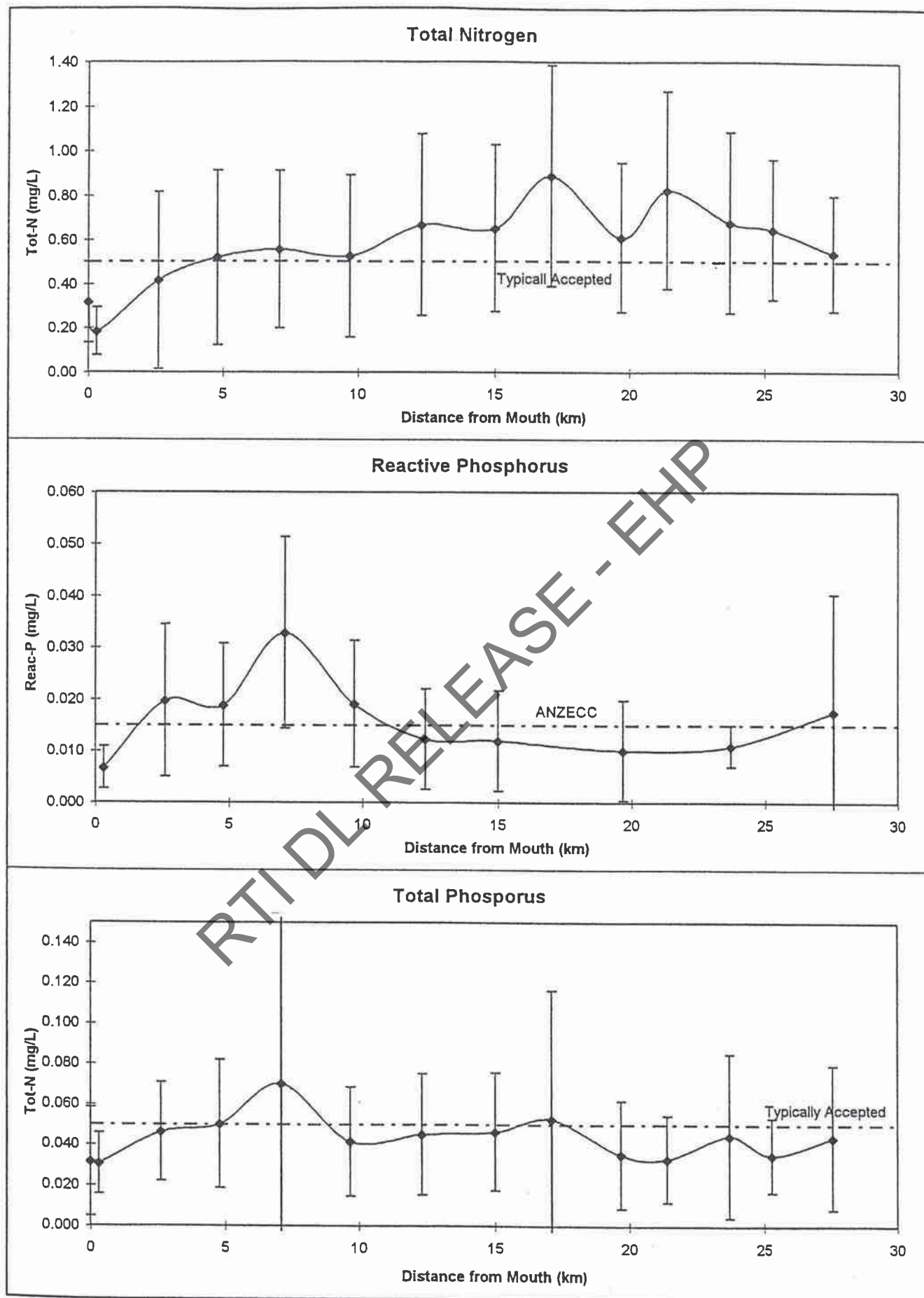
Table C.3: In-Situ Water Quality Measurements - MRCAN Waterwatch

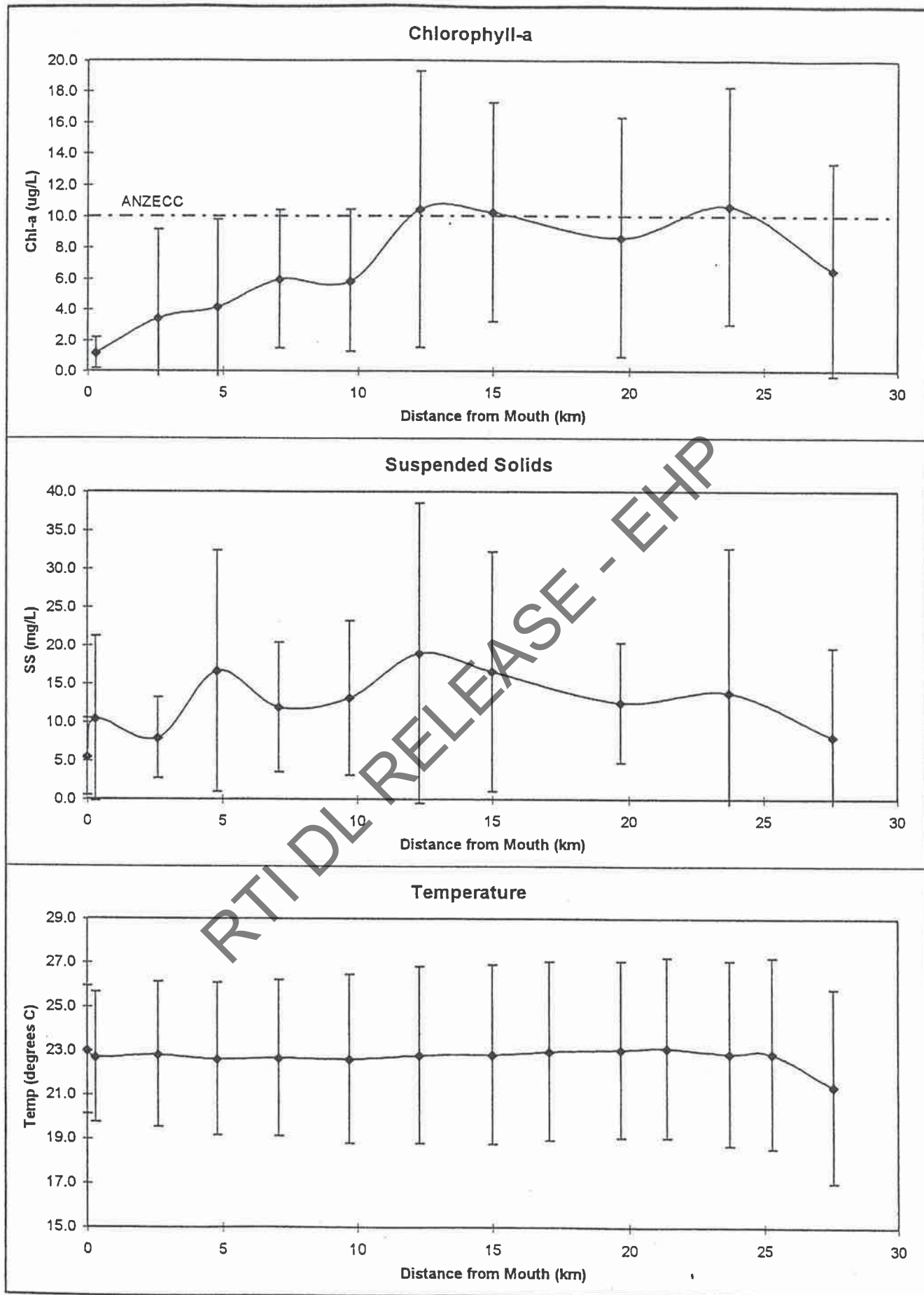
Table C.4: Chemical Water Quality Results - Cormeal Creek

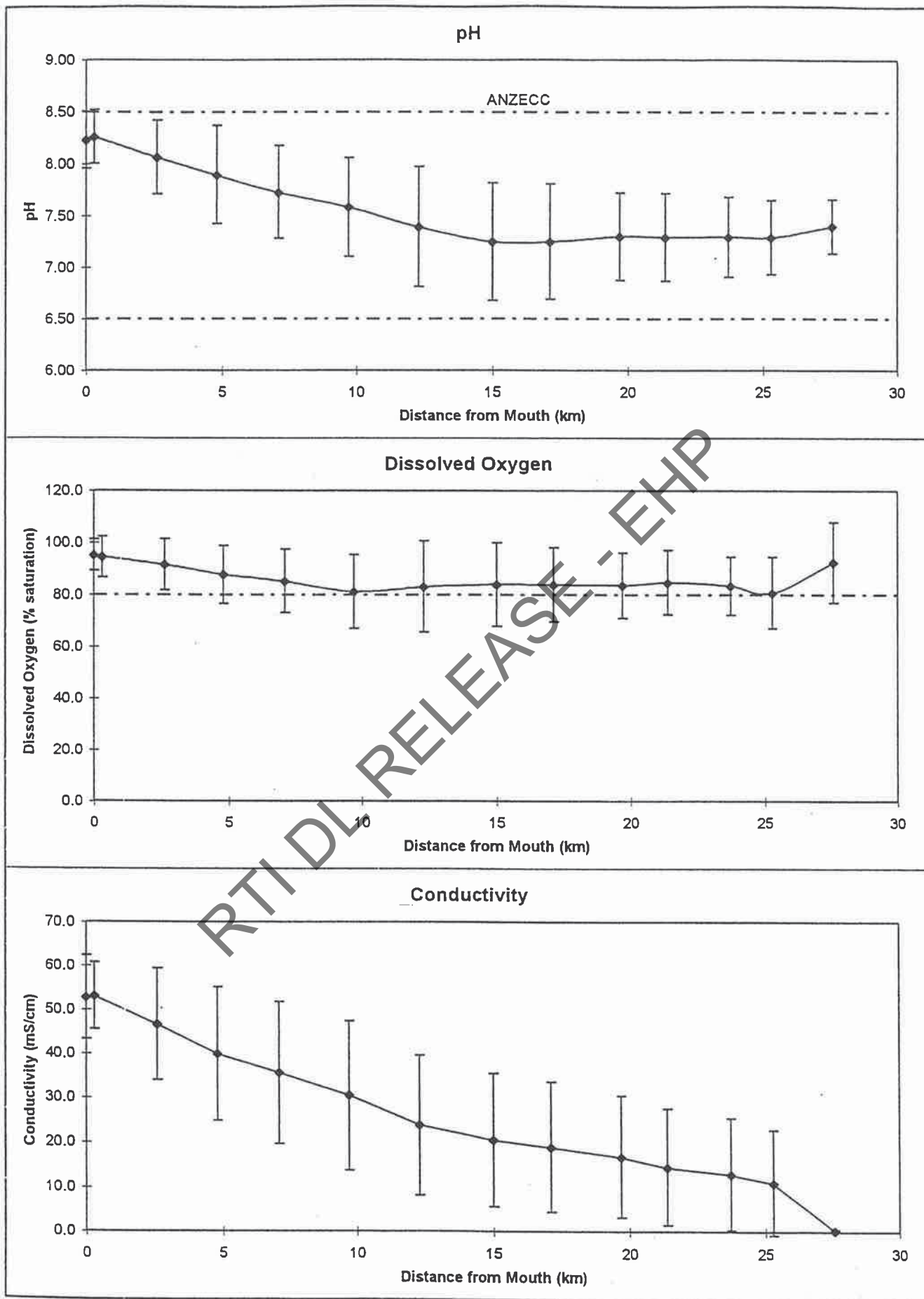
Table C.5: Physical Water Quality Results - Cormeal Creek

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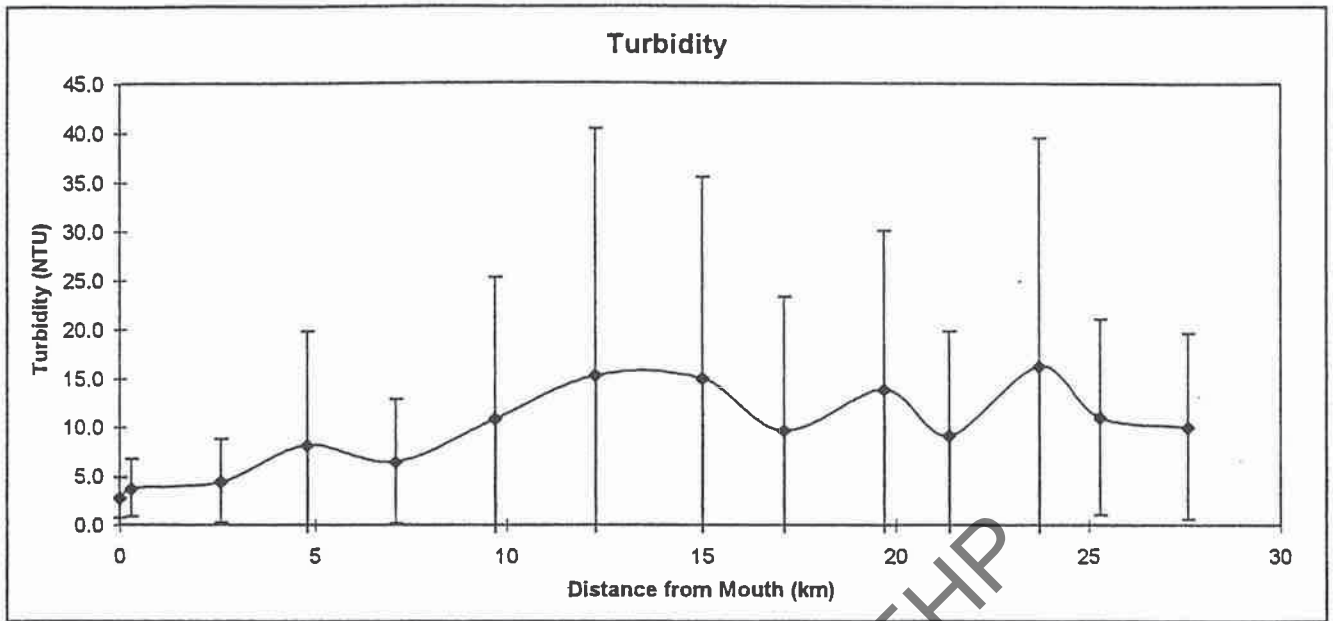






DoE WATER QUALITY DATA

FIGURE
C.4



RTI DL RELEASE - EHP

Table C.1 In-Situ Water Quality Measurements - University of Queensland

AMTD (km)	Date	Temp °C	Salinity g/L	Conductivity mS/cm	D.O. mg/L	D.O. % Sat	pH	Turbidity NTU
0.3	13/4/96	23.6	37.1	56.0	8.09	-	8.62	-
	29/5/96	25.5	36.0	-	6.95	-	8.88	-
	29/10/96	22.8	35.5	-	7.25	-	7.82	-
4.8	13/4/96	22.1	35.1	53.2	6.75	-	8.62	-
	29/5/96	19.4	27.3	-	6.53	-	8.74	-
	29/10/96	24.8	34.7	-	7.14	-	7.64	-
9.7	13/4/96	22.7	28.9	44.4	5.94	-	8.33	-
	29/5/96	20.6	11.4	-	6.83	-	7.97	-
	29/10/96	25.0	31.7	-	5.92	-	7.31	-
12.9	13/4/96	23.5	20.4	32.7	4.67	-	7.96	-
	29/5/96	19.7	7.8	-	7.61	-	7.92	-
	29/10/96	24.8	28.8	-	5.77	-	7.16	-
19.2	13/4/96	23.9	13.7	22.5	5.22	-	7.75	-
	29/5/96	19.4	2.7	-	5.52	-	8.09	-
	29/10/96	25.0	24.1	-	6.32	-	7.17	-
24.5	13/4/96	23.8	7.7	13.5	3.84	-	7.59	-
	29/5/96	18.7	0.1	-	6.09	-	7.78	-
	29/10/96	25.8	19.7	-	6.13	-	7.25	-
35.5	13/4/96	19.0	0.1	0.4	4.97	-	7.63	-
	29/5/96	16.4	0.1	-	6.94	-	7.78	-
	29/10/96	18.5	0.0	-	-	-	-	-

Table C.2 Laboratory Analyses of Water Samples - University of Queensland

AMTD (km)	Date	Suspended Solids mg/L	Total Nitrogen mg/L	Total Kjeldahl Nitrogen mg/L	Organic Nitrogen mg/L	Ammonia mg/L	Oxidised Nitrogen mg/L	Total Phosphorus mg/L	Orthophosphorus mg/L	Chlorophyll a ug/L
0.3	13/4/96	14.62	0.107	0.1	0.092	0.008	0.007	0.019	0.006	1.69
	29/5/96	19.83	-	-	-	0.032	0.012	-	0.005	0.70
	29/10/96	18.65	-	-	-	-	-	-	-	0.45
4.8	13/4/96	15.56	0.334	0.3	0.188	0.112	0.034	0.055	0.039	1.63
	29/5/96	19.43	-	-	-	0.172	0.110	-	0.053	0.96
	29/10/96	44.09	-	-	-	-	-	-	-	6.47
9.7	13/4/96	22.11	0.498	0.4	0.113	0.287	0.098	0.103	0.087	1.33
	29/5/96	23.36	-	-	-	0.137	0.170	-	0.018	4.70
	29/10/96	46.12	-	-	-	-	-	-	-	6.38
12.9	13/4/96	35.95	0.468	0.4	0.304	0.096	0.068	0.035	0.039	2.99
	29/5/96	22.84	-	-	-	0.075	0.153	-	0.045	20.49
	29/10/96	71.51	-	-	-	-	-	-	-	7.67
19.2	13/4/96	37.82	0.518	0.5	0.468	0.032	0.018	0.038	0.004	2.64
	29/5/96	18.20	-	-	-	0.039	0.210	-	0.028	10.69
	29/10/96	35.07	-	-	-	-	-	-	-	5.77
24.5	13/4/96	27.37	0.437	0.4	0.321	0.079	0.037	0.033	0.005	1.87
	29/5/96	6.01	-	-	-	0.040	0.403	-	0.034	3.09
	29/10/96	28.97	-	-	-	-	-	-	-	5.47
35.5	13/4/96	15.09	0.210	0.1	0.076	0.024	0.110	0.019	0.029	0.00
	29/5/96	2.03	-	-	-	0.088	0.260	-	0.027	0.21
	29/10/96	2.71	-	-	-	-	-	-	-	0.50
	ANZECC* Criteria for Estuarine water	< 10% change in the seasonal mean conc				0.005	0.010 - 0.100		0.005 - 0.015	< 10

Table C.3 In-Situ Water Quality Measurements - MRCAN Waterwatch

AMTD (km)	Date	Temp °C	Salinity g/L	Conductivity mS/cm	D.O. mg/L	D.O. % Sat	pH	Turbidity NTU
0.1	21/1/96	-	-	-	-	-	-	-
	19/2/96	27.8	34.8	52.7	-	-	8.32	4
	15/3/96	24.5	33.7	51.2	9.06	-	9.02	3
	4/4/96	22.1	28.8	44.4	6.35	-	8.52	10
	7/5/96	23.1	4.2	1.7	4.20	-	6.83	90
	4/6/96	22.2	26.0	40.5	5.38	-	8.34	-
	11/7/96	19.1	31.6	48.5	6.84	-	8.78	2
	6/8/96	19.9	34.9	53.1	4.20	-	8.82	-
	3/9/96	19.2	35.0	53.0	5.69	-	8.68	-
	9/10/96	22.0	33.3	50.6	4.06	-	8.72	2
	5/11/96	22.5	34.5	52.3	5.34	-	8.30	2
0.8	21/1/96	-	-	-	-	-	-	-
	19/2/96	27.9	34.1	51.7	-	-	8.30	9
	15/3/96	24.4	32.9	50.3	10.75	-	9.01	-
	4/4/96	22.2	26.0	40.5	5.38	-	8.34	10
	7/5/96	-	-	-	-	-	-	-
	4/6/96	21.8	20.6	32.8	4.71	-	8.17	-
	11/7/96	18.8	28.6	44.3	3.90	-	8.62	3
	6/8/96	19.7	35.0	53.2	3.99	-	8.81	-
	3/9/96	19.5	34.8	52.8	5.66	-	8.66	-
	9/10/96	22.0	35.0	50.2	4.06	-	8.68	2
	5/11/96	22.9	34.4	52.1	4.79	-	8.29	3
2.6	21/1/96	-	-	-	-	-	-	-
	19/2/96	7.7	33.5	50.9	-	-	8.28	30
	15/3/96	24.4	30.3	46.7	10.65	-	8.98	10
	4/4/96	21.8	20.6	32.8	4.71	-	8.17	10
	7/5/96	-	-	-	-	-	-	-
	4/6/96	21.8	19.2	30.7	5.72	-	7.99	-
	11/7/96	18.6	21.6	36.8	6.24	-	8.41	5
	6/8/96	19.7	31.5	48.3	4.76	-	8.64	-
	3/9/96	19.6	34.9	52.9	5.31	-	8.66	-

EXISTING DATA - WATER QUALITY

	9/10/96	21.9	32.1	49.0	3.88	-	8.59	4
	5/11/96	23.1	34.1	51.8	5.34	-	8.28	3
3.5	21/1/96	-	-	-	-	-	-	-
	19/2/96	29.0	28.0	43.2	-	-	7.99	15
	15/3/96	-	-	-	-	-	-	-
	4/4/96	21.8	19.2	30.7	5.72	-	7.99	10
	7/5/96	22.9	-	-	4.02	-	6.65	80
	4/6/96	22.5	14.0	23.6	5.10	-	7.69	-
	11/7/96	18.8	21.6	34.4	4.23	-	8.24	7
	6/8/96	20.0	27.8	43.1	4.13	-	8.43	-
	3/9/96	19.3	33.8	51.3	5.26	-	8.59	2
	9/10/96	22.3	30.4	47.7	3.90	-	8.48	4
	5/11/96	23.7	31.5	48.2	5.39	-	8.14	7
4.1	21/1/96	26.2	32.2	49.1	5.31	-	7.19	11
	19/2/96	28.6	22.7	38.8	-	-	7.79	26
	15/3/96	25.0	22.9	36.4	13.66	-	8.98	2
	4/4/96	22.5	14.0	23.6	5.1	-	7.69	10
	7/5/96	20.9	1.0	2.2	5.6	-	7.25	190
	4/6/96	19.4	6.4	11.4	7.64	-	8.01	42
	11/7/96	18.4	26.6	41.5	9.84	-	8.58	130
	6/8/96	18.3	29.7	45.8	8.55	-	8.15	14
	3/9/96	19.3	31.1	47.6	5.28	-	8.39	8
	9/10/96	22.8	30.4	46.6	2.46	-	8.32	14
	5/11/96	23.6	29.8	45.8	4.70	-	7.97	16
7.1	21/1/96	25.9	32.2	49.2	4.43	-	7.18	8
	19/2/96	28.6	22.7	35.8	-	-	7.70	23
	15/3/96	24.5	22.5	35.5	9.85	-	8.77	10
	4/4/96	21.3	12.2	23.4	5.34	-	7.50	10
	7/5/96	22.9	0.2	0.6	3.67	-	6.44	88
	4/6/96	21.5	12.2	20.3	4.94	-	7.18	-
	11/7/96	18.1	14.4	23.8	7.55	-	7.93	7
	6/8/96	19.8	21.4	33.9	4.88	-	8.02	-
	3/9/96	19.3	31.1	46.6	4.90	-	8.29	7
	9/10/96	22.5	29.1	44.8	3.30	-	8.24	4
	5/11/96	23.6	29.8	45.6	3.91	-	7.80	4

EXISTING DATA - WATER QUALITY

9.7	21/1/96	26.5	28.1	47.4	3.98	-	7.18	10
	19/2/96	27.6	20.6	32.7	-	-	7.46	13
	15/3/96	-	-	-	-	-	-	-
	4/4/96	21.5	6.4	20.3	4.94	-	7.18	10
	7/5/96	22.9	0.2	0.6	3.67	-	6.44	88
	4/6/96	21.5	6.4	20.3	4.94	-	7.18	-
	11/7/96	18.1	14.4	23.8	7.55	-	7.93	7
	6/8/96	19.8	21.4	33.9	4.88	-	8.02	-
	3/9/96	19.6	27.1	42.0	4.89	-	8.10	4
	9/10/96	23.1	27.8	42.9	3.24	-	8.13	5
	5/11/96	24.0	28.2	43.5	4.49	-	7.66	17
13.0	21/1/96	26.5	28.1	43.5	8.04	-	7.14	14
	19/2/96	28.9	15.3	25.0	-	-	7.36	31
	15/3/96	21.5	-	-	-	-	-	-
	4/4/96	-	6.4	11.3	5.82	-	6.65	4
	7/5/96	24.9	0.1	0.3	4.70	-	5.67	50
	4/6/96	21.5	6.4	11.3	5.82	-	6.65	4
	11/7/96	18.3	10.1	17.2	7.85	-	7.68	8
	6/8/96	19.7	17.4	28.3	4.85	-	7.69	-
	3/9/96	19.6	22.5	35.7	5.26	-	7.94	14
	9/10/96	23.2	24.8	39.0	2.73	-	7.88	7
	5/11/96	23.6	26.3	41.0	3.15	-	7.34	12

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Table C.4 Chemical Water Quality Results - Cornmeal Creek

Site	NH ₄ (mg/L)	Org-N (mg/L)	NO _x (mg/L)	Tot-N (mg/L)	PO ₄ (mg/L)	Tot-P (mg/L)	TSS (mg/L)
1	< 0.1	< 0.1	0.02	< 0.22	< 0.01	0.02	5.4
2	< 0.1	0.4	0.11	< 0.61	0.05	0.07	6.4
3	0.2	0.2	0.09	0.49	0.04	0.06	4.9
4	0.2	0.1	0.05	0.35	< 0.01	0.05	8.1
5	0.2	0.2	0.05	0.45	0.01	0.04	4.3
6	0.3	< 0.1	0.09	< 0.49	0.05	0.09	5.3
ANZECC Criteria for protection of aquatic ecosystems - Estuarine water	0.005		0.010- 0.100		0.005- 0.015		

Table C.5 Physical Water Quality Results - Cornmeal Creek

Site	Depth (m)	Temp (°C)	Cond. (uS/cm)	Sal. (g/L)	pH	DO (mg/L)	DO (% sat)	Turb. (NTU)
1	0.5	23.85	48.2	32.2	8.28	5.6	79.4	3.8
2	0.5	23.81	49.9	33.5	8.25	7.2	104.0	4.1
3	0.5	23.15	49.2	33.5	8.31	7.5	106.4	8.5
	1.0	23.05	49.3	33.7	8.19	7.0	99.0	6.2
4	0.5	23.97	49.2	32.3	8.60	7.6	108.7	8.2
	1.0	23.86	49.3	33.1	8.22	6.3	90.1	13.2
5	0.5	23.23	49.2	33.5	8.20	7.1	100.4	9.0
6	0.5	23.04	49.3	33.7	8.35	7.3	103.5	6.1
	1.0	22.93	49.3	33.8	8.26	7.2	102.3	7.2
	2.0	22.25	50.2	35.0	8.26	6.5	91.1	8.4

APPENDIX D: FIELD DATA COLLECTION - WATER QUALITY

Table D.1: In-Situ Water Quality Measurements - WBM Oceanics Australia

Table D.2: Chemical Water Quality - WBM Oceanics Australia

Table D.3: Physical Water Quality - Maroochy River Summary

Table D.4: Chemical Water Quality - Maroochy River Summary

RTI DL RELEASE - EHP

Table D.1 In-Situ Water Quality Measurements - WBM Oceanics Australia

AMTD (km)	Date/Tide	Depth (m)	Temp °C	Salinity g/L	Conductivity mS/cm	D.O. mg/L	D.O. % Sat	pH	Turbidity NTU
0.0	3/2/97 Low	0.3	26.40	34.1	51.7	7.16	108.0	8.07	9.4
		1	26.41	34.1	51.7	7.08	106.6	8.07	8.8
		2	26.41	34.1	51.8	7.09	106.6	8.07	9.4
		3	26.43	34.1	51.8	6.99	106.0	8.07	10.8
	3/2/97 High	0.3	25.99	34.8	52.6	6.95	108.0	8.11	4.6
		1	26.01	34.8	52.7	6.94	105.6	8.12	8.6
		2	26.03	34.8	52.7	6.93	105.4	8.12	10.0
		0.1	27.02	33.6	51.1	7.43	114.3	8.05	2.1
	7/2/97 Low	0.9	27.02	33.7	51.3	7.46	114.7	8.07	8.6
		2.3	26.97	33.9	51.5	7.42	114.2	8.09	33.8
		0.3	26.44	34.4	52.2	7.10	106.4	8.10	0.0
		1	26.38	34.4	52.2	6.84	104.3	8.14	0.0
		2	26.37	34.4	52.2	6.78	103.4	8.14	0.0
0.3 North	3/2/97 Low	0.3	27.03	32.5	49.6	7.40	112.2	8.09	19.1
		1	27.05	32.5	49.7	7.46	114.4	8.10	18.1
		2	26.66	33.6	51.0	7.16	107.0	8.08	14.3
		0.3	25.9	34.8	52.9	7.00	105.7	8.11	6.5
	3/2/97 High	1	25.91	34.8	52.8	6.85	103.8	8.12	6.0
		2	25.9	34.8	52.7	6.84	103.9	8.12	6.6
		0.2	27.14	33.2	50.5	7.46	114.6	8.04	0.0
		1	27.11	33.3	50.7	7.33	112.6	8.05	8.5
	7/2/97 Low	1.8	27.09	33.5	50.9	7.29	112.1	8.06	10.0
		0.3	26.5	34.3	52.1	7.1	107.2	8.15	0.0
		1	26.5	34.4	52.1	6.97	106.1	8.15	0.3
		2	26.52	34.4	52.1	6.91	106.0	8.15	0.1
0.3 South	3/2/97 Low	0.3	26.56	33.7	51.2	7.40	113.0	8.07	5.6
		1	25.57	33.2	51.2	7.20	107.8	8.07	6.2
	3/2/97 High	0.3	25.96	34.8	52.96	7.07	107.2	8.12	8.6
		1	25.98	34.7	52.6	6.99	105.9	8.12	8.4
	7/2/97 Low	2	25.97	34.8	52.7	6.92	105.2	8.12	8.7
		0.2	26.97	33.7	51.1	7.51	115.4	8.05	24.7

FIELD DATA COLLECTION - WATER QUALITY

2.0	7/2/97 High	0.5	26.95	33.7	51.2	7.49	115.0	8.05	23.2
	3/2/97 Low	0.3	26.3	34.4	52.1	7.20	105.4	8.1	2.0
		1	26.3	34.4	52.1	6.84	104.2	8.1	0.0
	3/2/97 High	0.3	26.98	32.2	49.2	7.27	109.0	8.08	18.7
		1	26.98	32.2	49.2	6.98	104.6	8.08	16.4
		2	26.89	32.6	49.7	7.07	105.4	8.09	16.2
		0.3	26.11	34.4	52.1	7.20	109.2	52.1	5.7
		1	26.07	34.5	52.2	7.15	107.9	52.2	5.6
		2	25.89	34.7	52.6	6.92	104.9	52.6	6.7
		3	25.9	34.3	52.7	6.93	104.7	52.7	7.3
	7/2/97 Low	0.2	27.13	32.7	49.9	7.37	112.9	8.02	12.3
		1.1	27.14	32.8	50.0	7.33	112.3	8.03	9.9
		1.7	27.14	32.8	50.0	7.31	112.1	8.03	10.2
	7/2/97 High	0.3	26.6	34.4	52.1	6.77	103.9	8.15	0.6
		1	26.6	34.4	52.1	6.78	104.1	8.15	0.7
		2	26.6	34.4	52.1	6.78	104.1	8.15	0.2
		3	26.6	34.4	52.1	6.79	104.1	8.15	0.2
2.6	3/2/97 Low	0.3	27.20	31.4	48.0	7.22	109.6	8.04	5.6
		1	27.10	31.3	48.2	7.15	108.1	8.05	6.2
		2	27.06	31.8	48.8	6.81	102.5	8.05	8.1
	3/2/97 High	0.3	25.96	34.5	52.3	7.22	108.5	8.14	6.6
		1	25.97	34.5	52.3	7.12	107.9	8.15	7.2
		2	26.0	34.5	52.3	7.06	107.2	8.15	7.6
		3	25.97	34.6	52.4	7.05	105.8	8.14	7.8
	7/2/97 Low	0.2	27.22	31.5	48.2	7.52	114.6	7.96	27.1
		0.9	27.15	32.0	48.9	7.15	109.2	7.98	15.4
		1.3	27.13	32.1	49.1	7.09	108.2	7.98	12.2
	7/2/97 High	0.3	26.5	34.4	52.1	6.94	105.7	8.15	1.1
		1	26.54	34.4	52.1	6.88	105.0	8.15	1.1
		2	26.5	34.4	52.1	6.86	105.1	8.15	1.0
3.5	3/2/97 Low	0.3	27.73	30.2	46.4	6.87	105.0	7.97	6.0
		1	27.75	30.3	46.4	6.86	104.3	7.97	7.0
		2	27.48	31.3	47.3	6.50	95.6	7.97	6.7
		3	26.96	31.4	48.8	6.30	96.1	8.01	6.9
		4	25.94	32.7	51.0	5.98	91.1	8.04	8.3

FIELD DATA COLLECTION - WATER QUALITY

	3/2/97 High	0.3	26.59	32.6	49.8	8.19	123.5	8.2	4.7
		1	26.63	32.7	49.8	8.02	124.0	8.21	4.7
		2	26.668	32.9	50.1	8.08	124.4	8.2	4.7
		3	26.75	33.1	50.4	8.12	123.4	8.2	5.2
		4	26.64	33.5	50.8	7.8	118.9	8.2	7.9
	7/2/97 Low	0.1	27.37	30.4	46.7	7.2	109.3	7.91	15.0
		1	27.4	30.4	46.7	7.13	108.2	7.91	12.7
		2	27.38	30.5	46.9	6.97	105.9	7.92	12.4
		2.9	27.3	30.6	47.0	6.93	105.1	7.9	13.1
		2.8	27.23	30.7	47.1	6.73	102.0	7.9	13.7
		4	27.18	30.8	47.2	6.71	101.7	7.9	13.8
	7/2/97 High	0.3	26.6	34.2	51.9	6.9	105.8	8.14	2.6
		1	26.6	24.3	52.0	6.87	105.0	8.14	3.1
		2	26.33	24.4	52.2	6.8	103.5	8.15	3.0
		3	26.3	34.4	52.2	6.77	103.2	8.15	2.5
		4	26.3	34.4	52.2	6.76	103.0	8.15	2.9
4.8	3/2/97 Low	0.3	27.90	29.3	45.2	7.04	105.8	7.92	5.3
		1	27.90	29.4	45.2	6.86	103.8	7.92	7.4
		2	27.90	29.7	45.7	6.75	102.1	7.95	7.7
		3	27.82	30.1	46.4	6.34	94.1	7.95	10.1
	3/2/97 High	0.3	26.72	31.4	48.0	6.94	104.0	8.07	7.9
		1	26.78	31.4	48.1	6.96	104.0	8.09	7.9
		2	26.85	31.8	48.6	6.90	107.1	8.12	8.2
	7/2/97 Low	0.4	27.58	28.9	44.6	7.05	106.4	7.82	11.9
		1	27.5	29.1	44.9	6.92	104.4	7.80	14.0
		2	27.41	29.5	45.4	6.42	97.0	7.81	14.3
		3	27.36	29.5	45.5	6.36	96.0	7.81	13.3
	7/2/97 High	0.3	26.1	34.0	51.6	6.91	105.8	8.12	4.6
		1	26.5	34.1	51.8	9.84	104.2	8.13	4.2
		2	26.42	34.2	51.9	9.79	104.0	8.14	7.2
		3	26.36	34.3	52.0	9.83	104.2	8.14	4.3
7.3	3/2/97 Low	0.3	27.92	27.5	42.7	5.95	89.0	7.68	7.8
		1	27.92	27.5	42.7	5.89	89.5	7.69	8.4
		2	27.92	28.5	43.1	6.05	91.9	7.74	8.5
	3/2/97 High	0.3	27.24	29.8	45.9	7.04	101.5	7.97	8.3

FIELD DATA COLLECTION - WATER QUALITY

7/2/97 Low	1	27.28	29.9	46.0	6.64	66.9	7.98	5.6
	2	27.29	30.1	46.2	6.55	69.9	7.98	5.4
	0.3	27.52	27.1	42.1	6.33	94.4	7.64	19.3
	1.1	27.5	27.2	42.3	6.18	92.3	7.64	15.2
	2	27.45	27.4	42.6	5.88	87.9	7.64	14.1
7/2/97 High	3.2	26.6	32.5	49.5	6.81	103.0	8.03	3.2
	7.1	26.57	32.6	49.8	6.74	101.6	8.05	7.1
	2	26.52	32.1	49.9	6.68	100.9	8.05	6.5

RTI DL RELEASE - EHP

Table D.2 Chemical Water Quality - WBM Oceanics Australia

AMTD (km)	Date/Tide	Suspended Solids mg/L	Total Nitrogen mg/L	Total Kjeldahl Nitrogen mg/L	Organic Nitrogen mg/L	Ammonia mg/L	Oxidised Nitrogen mg/L	Total Phosphorus mg/L	Orthophosphorus mg/L	Chlorophyll a ug/L
0.0	3/2/97 Low	6	0.4	0.4	0.4	0.02	<0.01	0.12	<0.01	15
	3/2/97 High	14	0.4	0.4	0.4	<0.01	<0.01	0.06	<0.01	<5
	7/2/97 Low	8	0.7	0.7	0.7	0.04	0.04	0.09	<0.01	<5
	7/2/97 High	14	0.3	0.3	0.3	<0.01	<0.01	0.17	<0.01	<5
0.3 North	3/2/97 Low	15	0.2	0.2	0.2	<0.01	<0.01	0.11	<0.01	30
	3/2/97 High	11	1.7	1.7	1.7	0.01	<0.01	0.04	<0.01	<5
	7/2/97 Low	16	0.7	0.6	0.6	0.02	0.09	0.13	0.02	5
	7/2/97 High	5	1.1	1.1	1.1	<0.01	<0.01	0.23	<0.01	<5
0.3 South	3/2/97 Low	16	0.5	0.5	0.5	0.03	<0.01	0.11	<0.01	25
	3/2/97 High	8	0.7	0.7	0.7	0.01	<0.01	0.06	<0.01	<5
	7/2/97 Low	4	0.3	0.3	0.3	0.04	0.02	0.17	0.01	5
	7/2/97 High	8	0.3	0.3	0.3	<0.01	<0.01	0.1	<0.01	<5
2.0	3/2/97 Low	13	0.4	0.4	0.3	0.07	0.02	0.17	0.02	30
	3/2/97 High	2	0.4	0.4	0.4	0.02	<0.01	0.07	<0.01	<5
	7/2/97 Low	6	0.3	0.3	0.3	0.05	0.03	0.13	0.03	10
	7/2/97 High	12	0.5	0.5	0.5	<0.01	<0.01	0.1	<0.01	<5
2.6	3/2/97 Low	7	0.5	0.5	0.3	0.19	0.04	0.17	0.04	25
	3/2/97 High	12	0.9	0.9	0.9	<0.01	<0.01	0.08	<0.01	<5
	7/2/97 Low	24	0.5	0.4	0.3	0.13	0.06	0.18	0.06	10
	7/2/97 High	2	0.2	0.2	0.2	<0.01	<0.01	0.04	<0.01	<5
3.5	3/2/97 Low	5	0.6	0.5	0.3	0.16	0.06	0.15	0.04	30
	3/2/97 High	-	0.7	0.7	0.01	7.0	0.02	0.7	0.09	0.02
	7/2/97 Low	20	0.7	0.6	0.4	0.18	0.08	0.18	0.08	10
	7/2/97 High	14	0.2	0.2	0.2	0.02	0.02	0.11	0.02	<5
4.8	3/2/97 Low	5	0.6	0.5	0.4	0.15	0.07	0.19	0.06	15
	3/2/97 High	-	1.3	1.3	0.04	8.0	0.14	1.4	0.13	0.05

FIELD DATA COLLECTION - WATER QUALITY

7.3	7/2/97 Low	8	0.5	0.4	0.3	0.12	0.08	0.23	0.06	10
	7/2/97 High	6	0.6	0.6	0.6	0.01	0.01	0.11	<0.01	<5
	3/2/97 Low	9	0.9	0.8	0.7	0.11	0.09	0.14	0.05	15
	3/2/97 High	-	0.5	0.5	0.07	9.0	0.23	0.8	0.13	0.07
	7/2/97 Low	10	0.8	0.7	0.6	0.11	0.08	0.19	0.05	10
	7/2/97 High	8	0.4	0.4	0.3	0.04	0.04	0.14	0.04	<5
	ANZECC* Criteria for Estuarine water	<10% change in the seasonal mean conc				0.005	0.010 - 0.100		0.005 - 0.015	<10

RTI DL RELEASE - EHP

Table D.3 Physical Water Quality - Maroochy River Summary

AMTD (km)	Temp °C	Salinity g/L	Conductivity mS/cm	D.O. mg/L	D.O. % Sat	pH	Turbidity NTU
0.00	23.08 (2.87)	33.0 (2.7)	52.4 (8.7)	6.11 (1.48)	96.2 (6.8)	8.26 (0.34)	3.32 (3.06)
0.30	22.90 (2.89)	32.9 (4.3)	52.3 (7.3)	6.29 (1.89)	95.6 (8.4)	8.30 (0.28)	4.42 (4.31)
2.60	22.87 (3.59)	30.8 (5.1)	47.0 (11.7)	6.45 (1.56)	93.9 (10.6)	8.11 (0.35)	5.78 (5.91)
4.80	22.71 (3.44)	27.5 (7.5)	40.7 (14.4)	6.94 (2.47)	88.9 (11.4)	7.94 (0.48)	8.78 (11.34)
7.10	22.85 (3.53)	24.7 (7.3)	36.1 (15.3)	5.60 (1.75)	85.5 (12.0)	7.73 (0.46)	7.47 (6.08)
9.70	22.61 (3.66)	21.0 (9.2)	31.2 (16.2)	5.24 (1.24)	81.1 (14.1)	7.60 (0.47)	10.68 (13.44)
12.90	22.81 (3.86)	17.9 (8.5)	24.5 (15.3)	5.60 (1.76)	83.1 (17.5)	7.40 (0.56)	14.56 (22.67)
15.00	22.84 (4.07)	- -	20.6 (14.9)	- -	83.9 (16.0)	7.24 (0.57)	15.00 (20.46)
17.10	22.99 (4.06)	- -	18.9 (14.6)	- -	83.8 (14.2)	7.25 (0.56)	9.70 (13.58)
19.70	23.05 (3.97)	- -	16.9 (13.5)	- -	83.5 (12.6)	7.31 (0.43)	13.86 (16.15)
21.40	23.15 (4.09)	- -	14.5 (13.1)	- -	84.7 (12.3)	7.29 (0.42)	9.20 (10.55)
23.70	22.90 (4.19)	- -	12.9 (12.5)	- -	83.3 (11.2)	7.29 (0.39)	16.19 (23.26)
25.30	22.89 (4.29)	- -	11.0 (11.7)	- -	80.7 (13.8)	7.30 (0.36)	11.00 (9.99)
27.60	21.40 (4.40)	- -	0.3 (0.2)	- -	92.4 (15.5)	7.40 (0.26)	10.05 (9.48)
ANZECC Criteria				> 6 mg/L	> 80-100 % saturation	6.5 - 8.5	

Table D.4 Chemical Water Quality - Maroochy River Summary

AMTD (km)	Suspended Solids mg/L	Total Nitrogen mg/L	Total Kjeldahl Nitrogen mg/L	Organic Nitrogen mg/L	Ammonia mg/L	Oxidised Nitrogen mg/L	Total Phosphorus mg/L	Orth-P mg/L	Chl-a ug/L
0.00	6.8 (5.2)	0.337 (0.176)	0.32 (0.18)	0.30 (0.18)	0.019 (0.015)	0.02 (0.02)	0.05 (0.04)	- -	- -
0.30	11.3 (9.0)	0.247 (0.174)	0.24 (0.17)	0.22 (0.17)	0.021 (0.027)	0.01 (0.01)	0.05 (0.04)	0.01 (0.00)	2.38 (4.60)
2.60	8.2 (5.5)	0.421 (0.364)	0.36 (0.25)	0.31 (0.24)	0.053 (0.054)	0.07 (0.16)	0.06 (0.04)	0.02 (0.02)	4.18 (6.58)
4.80	15.7 (15.1)	0.529 (0.397)	0.44 (0.34)	0.39 (0.33)	0.060 (0.052)	0.08 (0.13)	0.06 (0.04)	0.03 (0.02)	4.68 (5.45)
7.10	11.8 (8.1)	0.565 (0.351)	0.44 (0.23)	0.35 (0.21)	0.093 (0.063)	0.13 (0.15)	0.07 (0.13)	0.03 (0.02)	6.13 (4.48)
9.70	15.2 (11.6)	0.526 (0.357)	0.43 (0.24)	0.36 (0.23)	0.070 (0.063)	0.11 (0.18)	0.04 (0.03)	0.02 (0.02)	5.65 (4.40)
12.90	24.2 (22.4)	0.653 (0.397)	0.52 (0.25)	0.44 (0.22)	0.080 (0.066)	0.17 (0.22)	0.04 (0.03)	0.02 (0.01)	10.42 (8.73)
15.00	16.6 (15.6)	0.654 (0.375)	0.51 (0.28)	0.45 (0.27)	0.064 (0.066)	0.12 (0.19)	0.05 (0.03)	0.01 (0.01)	10.24 (7.05)
17.10	- -	0.887 (0.499)	0.64 (0.33)	0.56 (0.34)	0.083 (0.099)	0.39 (0.28)	0.05 (0.06)	- -	- -
19.70	13.2 (8.5)	0.604 (0.335)	0.48 (0.20)	0.45 (0.19)	0.034 (0.036)	0.13 (0.19)	0.04 (0.03)	0.01 (0.01)	8.54 (7.60)
21.40	- -	0.823 (0.445)	0.58 (0.27)	0.54 (0.25)	0.045 (0.035)	0.37 (0.21)	0.03 (0.02)	- -	- -
23.70	13.8 (18.8)	0.673 (0.407)	0.56 (0.31)	0.47 (0.31)	0.055 (0.102)	0.14 (0.19)	0.04 (0.04)	0.01 (0.00)	10.64 (7.65)
25.30	- -	0.637 (0.308)	0.46 (0.21)	0.42 (0.20)	0.039 (0.026)	0.24 (0.15)	0.04 (0.02)	- -	- -
27.60	8.1 (11.5)	0.539 (0.263)	0.47 (0.18)	0.46 (0.18)	0.011 (0.011)	0.07 (0.13)	0.04 (0.04)	0.02 (0.02)	6.52 (6.87)
	< 10% change in the seasonal mean conc				0.005	0.010 - 0.100		0.005 - 0.015	< 10

APPENDIX E: LIST OF FISH SPECIES ENCOUNTERED BY THE QDPI RESTOCKING RESEARCH PROJECT.

Common Name	Scientific Name
Bream	<i>Acanthopagrus australis</i>
Yellow perchlet	<i>Ambassis marianus</i>
Goby	<i>Arenogobius frenatus</i>
Catfish	<i>Arius</i> sp.
Snub-nosed gar	<i>Arrhamphus sclerolepis</i>
Narrow banded sole	<i>Aseraggodes maculaeuanus</i>
Hardyhead	<i>Atherinomorus ogilbyi</i>
Gudgeon	<i>Butis butis</i>
Dragonet	<i>Callionymus limiceps</i>
Trevally	<i>Carangoides</i> sp
Marbled fortescue	<i>Centropogon marmoratus</i>
Brown Stingray	<i>Dasyatis fluviarum</i>
Long tailed catfish eel	<i>Euristhmus lepturus</i>
Silver biddy	<i>Gerres oyeana</i>
Luderick	<i>Girella tricuspidata</i>
Gobies	<i>Gobidiidae</i> sp.
Southern herring	<i>Herklotsichthys castelnaui</i>
Gar	<i>Hyporhamphus ardellio</i>
Stargazer	<i>Ichthyoscopus lebeck</i>
Common Pony Fish	<i>Leignathus decorus</i>
Tiger mullet	<i>Liza argentea</i>
Flat tailed mullet	<i>Liza subviridis</i>
Moses perch	<i>Lutjanus russelli</i>
Half banded snake-eel	<i>Malvoliophis pinguis</i>
Banded toado	<i>Marilyna pleurostictus</i>
Yellow finned Leather Jacket	<i>Meuschenia trachylepis</i>
Leather jacket	<i>Monocanthus chinensis</i>
Butter - bream	<i>Monodactylus argenteus</i>
Sea mullet	<i>Mugil cephalus</i>
Flicker mullet	<i>Mugil georgii</i>
Pike eel	<i>Muraenesox cinereus</i>
Sand Mullet	<i>Myxus elongatus</i>
Bullrout	<i>Notesthes robusta</i>
Slender seamoth	<i>Pegasus volitans</i>
Trumpeter	<i>Pelates quadrilineatus</i>
Sand Flathead	<i>Platycephalus arenarius</i>
Bar tailed flathead	<i>Platycephalus endrachtensis</i>
Mud flathead	<i>Platycephalus fuscus</i>
Flathead	<i>Platycephalus indicus</i>
Striped catfish	<i>Plotosus anguillaris</i>
Puttynose perch	<i>Polydactylus multiradiatus</i>
Javelin fish small spotted	<i>Pomydasys opercularis</i>
Large Tooth Flounder	<i>Psuedorhombus arsius</i>
Small toothed flounder	<i>Psuedorhombus jenynsii</i>
Tarwhine	<i>Rhabdosargus sarba</i>

Shovel nosed ray	Rhinobatos batillum
Spotted Butterfish	Scatophagus argus
Queen fish	Scomberoides commersonianus
Mud Crab	Scylla serrata
Butterfish	Selenotoca multifasciata
Happy moment	Siganus fuscescens
Golden-lined whiting	Sillago analis
Sand whiting	Sillago ciliata
Winter whiting	Sillago maculata
Rose bellied siphon fish	Siphamia roseigaster
Yellow tail pike	Sphyaena obtusata
Anchovy	Stolephorus carpentariae
Black Sole	Synaptura orientalis
Crescent perch	Terapon jarbua
Toad fish common	Tetractenos hamiltoni
Hamiltons anchovy	Thryssa aestuaria
Weeping toadfish	Torquigener pleurogramma
Toadfish	Torquigener squamicauda
Blacktail tripodfish	Triacanthus biaculeatus
Stout long-tom	Tylosurus gavioloides
Buffons Garfish	Zenarchopterus sp.

(Source : Pers comm. Adam Butcher, QDPI Restocking Research Program)

APPENDIX F: DESCRIPTION OF MIKE11

MIKE11, developed by the Danish Hydraulic Institute, is a software package for the design, analysis and management of river basins, estuaries and channel networks. The package is made up of a number of modules which perform a variety of modelling functions, including hydrodynamic, advection/dispersion, water quality and sediment transport modelling capabilities.

The core of the system is the hydrodynamic module (HD). The model solves the one-dimensional equations of fluid motion using an implicit finite difference solution scheme. The model is dynamic, and as such can be used to simulate time-varying conditions, including tides and flood events. The model can also represent structures such as weirs and culverts in the solution.

Channel geometry is represented in MIKE11 by a series of cross-sections which define a channel. As MIKE11 is a one-dimensional model, results presented are depth averaged and width averaged. Consequently, cross-channel momentum effects or vertical flow variations (such as stratification) cannot be modelled. MIKE11 can be used as a quasi-two-dimensional model by creating a network of channels. In this fashion, the distribution of flow through a network of channels can be simulated.

The only other module used in this study is the advection/dispersion module (AD). The AD module uses the advection-dispersion equation to simulate the movement of a dissolved or suspended material. The advection-dispersion equation is solved numerically using a one-dimensional implicit finite difference scheme. The AD module uses the results of the HD module as input, to describe flow and water level through time and space. A linear decay rate can also be specified.

APPENDIX G: INFORMATION REQUIRED FOR THE DISTURBANCE OR REMOVAL OF MARINE PLANTS, SECTION 51 PERMIT UNDER THE FISHERIES ACT (1995).

NOTE : Section numbering below relates to that shown on the QDPI Section 51 application form.

Section 1 Maroochy Shire Council to complete

Section 2

2.1 Tick "Remove, destroy or damage marine plants" box.

2.2 Maroochy Shire Council to complete

2.3 Location of Mangroves Approximate centre in AMG 509770 7052880. The mangroves occupy a small natural embayment on the western margin of the northern spit of the Maroochy River Entrance. They cover an area of approximately 600m². This stand is exclusively grey mangroves (*Avicennia marina*) from 2 - 5 metres tall with the majority of mangroves being approximately 3 metres tall. Large numbers of seedlings have established (apparently in the past year) and it is likely that this mangrove area will increase in the future in the absence of disturbances.

2.4 Maroochy Shire Council to complete

2.5 Maroochy Shire Council to complete

2.6 Nil

2.7 The removal of the mangroves is required as part of the Maroochy River entrance relocation works.

2.8 The entrance relocation works are required to mitigate the southward migration of the existing river entrance. The Maroochy Shire Council has identified a genuine emergency in that a risk exist that a cyclone may create a new entrance to the south of Pincushion Island, with the implicated threat to property.

Various options for the entrance relocation have been addressed. Both optimal solutions will involve the removal of the afore mentioned area of mangroves, either directly or as a result of subsequent natural entrance migrations.

2.9 Maroochy Shire Council to complete

2.10 If the river entrance is to be located to provide sufficient insurance against erosion of lands south of Pincushion Island, no other options for placement exist. Relocation of the river entrance north of the mangroves in question will not result in direct removal. However,

disturbance is likely by the natural southern migration of the river entrance. The time before this happens is dependant upon coastal/river processes and weather conditions and is expected to be in the order of 1 - 2 years given historical evidence of migration patterns. Therefore both options will ultimately result in mangrove removal. Direct removal is preferred as this will avoid the mangroves falling into the channel (as it migrates south) providing a boating safety hazard.

2.11 All marine plants at the location in question will be removed. No mitigation measures are therefore practicable.

Section 3

3.1 The proportion of mangroves to be remove form a very small component of the available habitat in the lower Maroochy River. (0.007% of mangroves downstream of the Sunshine Coast Motorway Bridge). Additionally, a natural sill has formed at the entrance to the embayment in which they are growing, inhibiting access by estuarine fauna. The removal of this area of mangroves is therefor unlikely to have negligible effect upon the ecology of the Maroochy River

3.2 Maroochy Shire Council to complete

3.3 No

3.4 Maroochy Shire Council to complete

3.5 Maroochy Shire Council to complete

3.6 Maroochy Shire Council to complete

3.7 Maroochy Shire Council to complete

3.8 Maroochy Shire Council to complete

Section 4

Maroochy Shire Council to complete

APPENDIX H: SUMMARY OF PUBLIC SUBMISSIONS

RTI DL RELEASE - EHP

Summary

Name:	Suburb:	Issue Raised:
<p>Section 78B(2) RTI Act</p>		

Name:	Suburb:	Main Issue Raised:
<div>Section 78B(2) RTI Act</div>		<p>groins.</p>

Name:	Suburb:	Main Issue Raised:
Section 78B(2) RTI Act		

PTI DL RELEASE - EHP

APPENDIX I: CORRESPONDENCE FROM FISHING ORGANISATIONS

RTI DL RELEASE - EHP

QCEO

**QUEENSLAND COMMERCIAL
FISHERMEN'S ORGANISATION**

RTI DL RELEASE - EHP

ou ngerely

sch4p4(6) Personal information

STEP



Wildlife Management and Conservation

Wildlife Management

Wildlife

Wildlife

Wildlife Management and Conservation

Wildlife Management and Conservation is a field that focuses on the management and conservation of wildlife and their habitats. It involves a variety of activities, including research, monitoring, and the implementation of conservation plans.

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Wildlife Management and Conservation

sch4p4(6) Personal information

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