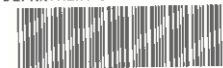


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COASTAL EROSION MANAGEMENT OPTIONS

FOR

PIGEON BAY RECREATION RESERVE

BANKS PENINSULA

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ABSTRACT

Pigeon Bay Recreation Reserve is a small beach ridge system at the head of Pigeon Bay, Banks Peninsula. The reserve is 1.14 hectares near the head of the bay. It protrudes into the bay with a boulder beach, a spit and a sheltered sandy bay as its main coastal features.

The reserve is administered by the Pigeon Bay Recreation Reserve Board and is used for camping, fishing, tennis and barbecues. Since management of the area became the responsibility of the local residents in 1930, concern has been expressed for erosion occurring on the seaward face.

The reserve was found to have existed as a boulder bank in its natural state and to have been modified for ship building purposes in the 1850's. The level of the reserve was subsequently raised considerably by material deposited on it by a slip from the hillside above and behind it.

Comparison of surveys carried out in 1929 and 1981 indicates that the seaward face of the reserve is retreating at 0.1 m yr^{-1} , that the spit is advancing at about 0.6 m yr^{-1} and that the sand beach is advancing at about 0.6 m yr^{-1} . Average annual rates such as these disguise the fact that the changes tend to take place episodically, usually as a result of storm conditions. The reserve as a whole is increasing in area.

Movement of beach material, and hence changes in the shape and area of the reserve, is caused by littoral drift. The amount of

material moved is not large and the movement is in a single direction, towards the bay head.

The board has three principal options to choose from. It may do nothing and accept the consequences of continued accretion and erosion. Alternatively the board may choose to build one of a number of structures to protect areas of the reserve subject to erosion. The third choice the board has is to feed the area of loss with appropriate beach material. These options are examined in detail and the likely consequences discussed.

The option selected by the board will reflect the long term management strategy that it adopts for Pigeon Bay Recreation Reserve.

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CHAPTER IINTRODUCTION

This project presents the results of an investigation into coastal erosion at Pigeon Bay Recreation Reserve, on the east side of Pigeon Bay, Banks Peninsula. The reserve is presently administered under the Reserves Act 1977, by a board of members appointed by the Minister of Lands. In implementing the provisions of the Reserves Act, the board has recently prepared a draft management plan. Section 3.6 of this plan expresses the board's concern regarding the erosion of the coastline of the reserve, and accords remedial action a high priority.

The management plan for the reserve states that the policy of the board is, "to investigate and implement if possible means of halting erosion by the sea on the western side of the reserve, and at the head of the lagoon to the south". It is proposed to implement this policy by seeking qualified comment, and investigating possible engineering solutions and their respective costs for the western coastline. For the head of the lagoon the board intends to seek advice on the processes occurring in this area and on a course of action that it has devised. The board intends to seek this advice through the University of Canterbury.

1.1 THE AREA

Figure 1.1 shows Pigeon Bay Recreation Reserve located on the eastern side of Pigeon Bay, the largest bay of Banks Peninsula

after Akaroa and Lyttelton Harbours. It is approximately 80 kilometres by road from Christchurch. The bay runs inland south by west and narrows from 1600 metres wide at the mouth to about 800 metres wide at the head and is seven kilometres long (Figure 1.2). The reserve lies almost at the head of Pigeon Bay, occupies 1,138 hectares and forms a protuberance into the sea with a spit from its southern end oriented toward the head of the bay. This spit forms a shallow and sheltered area of water as is shown in Figure 1.3. The shape and formation of the reserve is unusual and interesting. While such features are not common, it is not a unique or special phenomenon. Similar land-forms do exist, usually on a larger scale and in higher wave energy environments. It is therefore possible to analyse the processes occurring in Pigeon Bay by reference to principles and methods that are internationally accepted.

1.2 THE PROBLEM

Over the 50 years that the reserve has been managed for recreation purposes it has been known locally that the foreshore is eroding. Opinions have varied as to the distance that the seaward face has retreated, from "a couple of chains" to "two or three rows of trees", but of the existence of eroding forces there has been no doubt. There is clear evidence of parts of the seaward berm collapsing into the sea and of some of the macrocarpa trees close to this having died of salt burn. The northern section of the reserve is used for camping, and some campers have built retaining walls

to safeguard their sites. While affording some protection, this activity has tended to increase the problem by accelerating erosion adjacent to the structures.

1.3 THE PURPOSE OF THIS STUDY

The purpose of this report is to achieve an understanding of the recent coastal changes that have taken place at Pigeon Bay Recreation Reserve in order that management options can be prepared and their respective consequences can be predicted. It will remain for the Board to assess these options with respect to the long term goals it hopes to achieve and to adopt such policies as may best accomplish the selected option.

To make a rational statement about the possible consequences of erosion control methods, it is first necessary to understand the active natural coastal processes causing the problem, and secondly to be able to predict the likely outcome of any remedial action taken, including any undesired side-effects. It is also necessary that some knowledge be available about the land itself, such as its geomorphology. It is therefore essential that before examining options for coastal management, sufficient information about the land-form be gathered and interpreted. It is important to understand the origins of the present shape and structure of the reserve. This begins with an explanation of how the formation came into existence and its structure before and after human intervention. In addition some effort must be made to explain the dynamics bringing about change in the land, and the types

of changes which have taken place. From the combination of these facts, it should be possible to predict what future changes may be expected. It should also be possible to accurately foresee the results that may follow adoption of any one of the available management options. To endeavour to make responsible management decisions without a full understanding of the patterns of change, the processes and their interactions would be at least precipitate.

It is not the intention of this report to recommend to the Reserve Board which course of action it should choose. The management responsibility remains with that body. It is hoped that having decided the long term future of the site, the board will then be sufficiently informed about the wider implications of the alternative operational techniques to make a sound judgement about future management that will achieve its desired end.

1.4 THE STRUCTURE OF THE REPORT

As a prelude to the understanding and interpretation of the physical data gathered, Chapter II of this report will briefly detail the administrative and cultural history of Pigeon Bay Recreation Reserve. Information for this section was gained mostly from files of the Christchurch Office of the Department of Lands and Survey, supplemented by local and general knowledge.

Chapter III contains a summary and conclusions from the

physical information gathered in the course of the study. This includes historical data from public survey records, new survey work carried out by the author, aerial photographs and auger sampling of the sub-strate.

Chapter IV explains the natural forces that are acting upon the land mass and how these have brought the reserve to its present state. Some reference is also made to other similar features referred to in international literature.

The options available to the board are examined in Chapter V. These cover the full range of alternatives available to coastal managers at all levels and the likely consequences for the reserve and its environs, both direct and indirect.

The concluding chapter summarises the findings of Chapters III and V and makes some general comments about coastal land management.

CHAPTER VICONCLUSION

The Pigeon Bay Recreation Reserve Board has recognised that erosion is active on the land it has the responsibility for administering. The board has been aware that the natural forces have been acting on the feature for some considerable time, but had no details on the amount of land lost or the rate at which the coastline was receding. In discussion with local residents and users of the reserve, it became apparent that opinions on the amount of erosion that had taken place in living memory varied considerably. Some believed that the reserve had once extended about forty metres further into the sea than it does presently, while others felt that about three rows of trees, probably about 10 metres, had been lost from the reserve. This highlights a problem with all erosion or accretion sites. Local opinion tends to diverge considerably on the magnitude of the problem, with a bias toward enlarging it. It is not satisfactory to base management decisions on such subjective data.

In recognising the problem, the board has indicated in its draft management plan that it desires to make an appropriate response to it. It states that before doing so it wishes to seek informed advice on the processes occurring locally and the likelihood for controlling the problem. It has proposed that on the receipt of this advice, it will further investigate engineering possibilities and costs with a view to implementation. It is the aim of this report to supply the board with

adequate information on which to make a sound judgment on the response it will make to its problem.

The feature that is now known as the Pigeon Bay Recreation Reserve has undergone considerable modification by both Man and Nature. At some early date, when it consisted of a single boulder bank, the supply of boulders was cut off when a road was constructed along the shore of the bay. A stream carrying weathered hillside rock was diverted and the supply of its bed load material ceased. This material had been carried down to the sea shore by the stream, and then moved by the longshore current of the sea to form a wedge shaped boulder bank as indicated in the earliest maps of the area. During the 1850's the feature was modified, probably for ship building purposes, and became longer, narrower and of constant width with a sheltered bay landward of it, probably with a sandy beach where it joined the mainland. Early in the 20th century a slip of some magnitude occurred on the hillside above and behind the reserve and a large quantity of fill, a mixture of soil, vegetation and weathered small rock, was deposited in the sheltered bay between the spit and the shore. Soil samples indicate that this area had been a swamp before this event. At some time subsequent to the slip the area must have been levelled, and in 1914 the Pigeon Bay Road Board planted the area with blue gums and macrocarpas. To some extent this may have stabilized the land. From 1930 onwards, when the reserve was placed under the day to day management of a group of local residents,

there exists written evidence that the side of the reserve facing into Pigeon Bay has been the subject of erosion by the sea, and this has been of concern to both residents and users.

This study has shown that while the reserve is definitely subject to erosion from the sea, the system is neither as active nor as simple as was generally thought. In fact, in the period of 52 years since 1929 the total area of land increased as a result of the natural processes rather than decreased, although material is being removed from the seaward face of the land. The heavier boulder type sediments are deposited around the distal end of the spit while the sand and silt that has accumulated over the original boulder bank is deposited in the sheltered bay landward of the spit. In all, there has been a net growth of over 10% in the area of the reserve over that time. The average retreat of the seaward face is about 10 centimetres per year, and the advance of the spit and the beach at the south end is greater than 60 centimetres per year. It should be understood that while these values represent averages over 52 years, erosion takes place in episodes during storms. In any one year or during a single storm greater quantities than these may be moved. The most serious aspect of this erosion, is that the original boulder bank is being gradually removed, particularly at the northern end where the 1851 evidence indicates that the bank was at its narrowest. Without further examination it is not possible to estimate how much

of this now remains. It can be stated however, that when the original bank is breached, the rate of erosion of the rest of the reserve will increase dramatically. After more than a hundred years it is not likely that much remains of the boulder ridge.

This study also shows that concern for minor erosion of the beach in the sheltered bay is unfounded. Over the last 52 years this has advanced about 35 metres so that with no alteration to the natural processes this will tend to continue. Should the sediment supply be arrested by the construction of control structures the advance would be stopped. It is not likely that erosion could be induced in this area by such actions.

The reserve board is now faced with a number of responses to its problem. These responses are quite different in their nature, and vary considerably in their total effect. It is important that in its deliberations over the selection of one of the options the board gives full recognition to the impacts supplementary to the prime objective. The board must first decide on the values it considers most important for its reserve and choose the erosion management technique that will not only control the problem, but which will also safeguard or enhance the other attractions of the area.

The board may choose to do nothing and allow nature to take its course. In doing so, it will be recognised that in the

long term, the reserve will undergo considerable change, and that it will be unlikely to be suitable for camping and picnicking or as a base for yachtsmen, though it may retain some value as a fishing area. In this case the board would foresee the termination of its own activities, or it may wish to pursue some other site at which to conduct its activities. It is unlikely that such a site could be located in Pigeon Bay if all the present functions were to continue. It is more likely that if only land oriented facilities were to be considered, such as camping, picnics and barbecues, and tennis courts then a site may be found that would be suitable, if a local land owner were to be amenable to a sale. It is not proposed in this report to pursue the likelihood of finance being made available by either central or local government for the purchase of a new area for a reserve, other than to recognise that such a matter would require much negotiation.

The board may choose to make a more typical coastal management response and build some sort of protecting or retaining structure. Such responses are the most common reaction to coastal erosion problems, both within New Zealand and overseas. While structures do often prove adequate for the needs of erosion sites, it is not uncommon for further problems to occur as a result of the structure either at the original site or at an adjacent one. In some cases, such as at Omaha Beach in New Zealand, the coastal structure may prove to be totally inadequate. The structures discussed in this report are those that could adequately and effectively control erosion at Pigeon Bay, and from the narrow point of view of the loss

of land at the foreshore would be satisfactory. They do however have certain drawbacks. All structures built in such a dynamic area would require professional engineering advice on their design, construction and maintenance. Sufficient expertise in this area is not easily found. The cost of any structure, particularly the construction and maintenance, is likely to be considerable.

As the resources of the reserve board itself are relatively modest, financial assistance would have to be sought, either with the local authority, or central government through the Department of Lands and Survey or the Ministry of Works and Development and the Soil Conservation and Rivers Control Council. This latter body has already assisted with protection work and may consider doing so again. The availability of such finance is not known. However, while finance may be available for the building of structures, the Soil Conservation and Rivers Control Council does not assist in the maintenance of them. This aspect would be the sole responsibility of the board. The greatest concern in selecting a structural feature to solve the problem of coastal erosion, is the environmental side effects. In almost all cases, structures tend to remove any sense of a natural environment by their visual impact, but may also create other problems for marine life habitats and yachtsmen, and cause erosion in other areas. It is also necessary if there is involvement below mean high water mark, that approvals and licences are sought from the Ministry of Transport or such body as it has delegated authority to under the Harbour Act 1950.

If it is the overriding desire of the board to retain the reserve as near to its present character as possible and it also wishes to exert some control over the erosion of the seaward berm, then beach renourishment will best achieve this. It could be carried out relatively simply and the financial cost of such an exercise is not likely to be beyond the resources of the board, though it is probable that support would be required from central government. Renourishment would involve the dumping and placement of Banks Peninsula boulders of a similar size to those already making up the beach, at the northern end of the present reserve. This area is important for two reasons. Boulders dumped here would be free to be moved by the longshore drift, along the entire length of the sea front thereby benefiting the whole reserve. More importantly however, the period of time over which the erosion regime has been active and the width of the original boulder ridge at the northern end, would indicate that its present width is not great. It may therefore be a matter of some immediacy that restorative action be taken, or at the very least some protection of the remaining feature. Should this underlying structure be breached at any time, the effects on the reserve would be considerable and it would be unlikely that the present state could be retrieved. The relative inexperience in New Zealand of beach renourishment programmes should not deter the board from this course of action if for other reasons it is the most preferred.

In the light of the present accumulated information, the board must now make a decision on how it will treat its

erosion problem. It must be guided in this exercise by the form that it wishes the reserve to take in the long term, and by the amount of impact that is acceptable on the other aspects of Pigeon Bay. It is expected that this decision will also be constrained by the availability of finance and by the influence of other regulatory bodies.

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