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COASTAL EROSION AT PAEKAKARIKI

WELLINGTON'S WEST COAST

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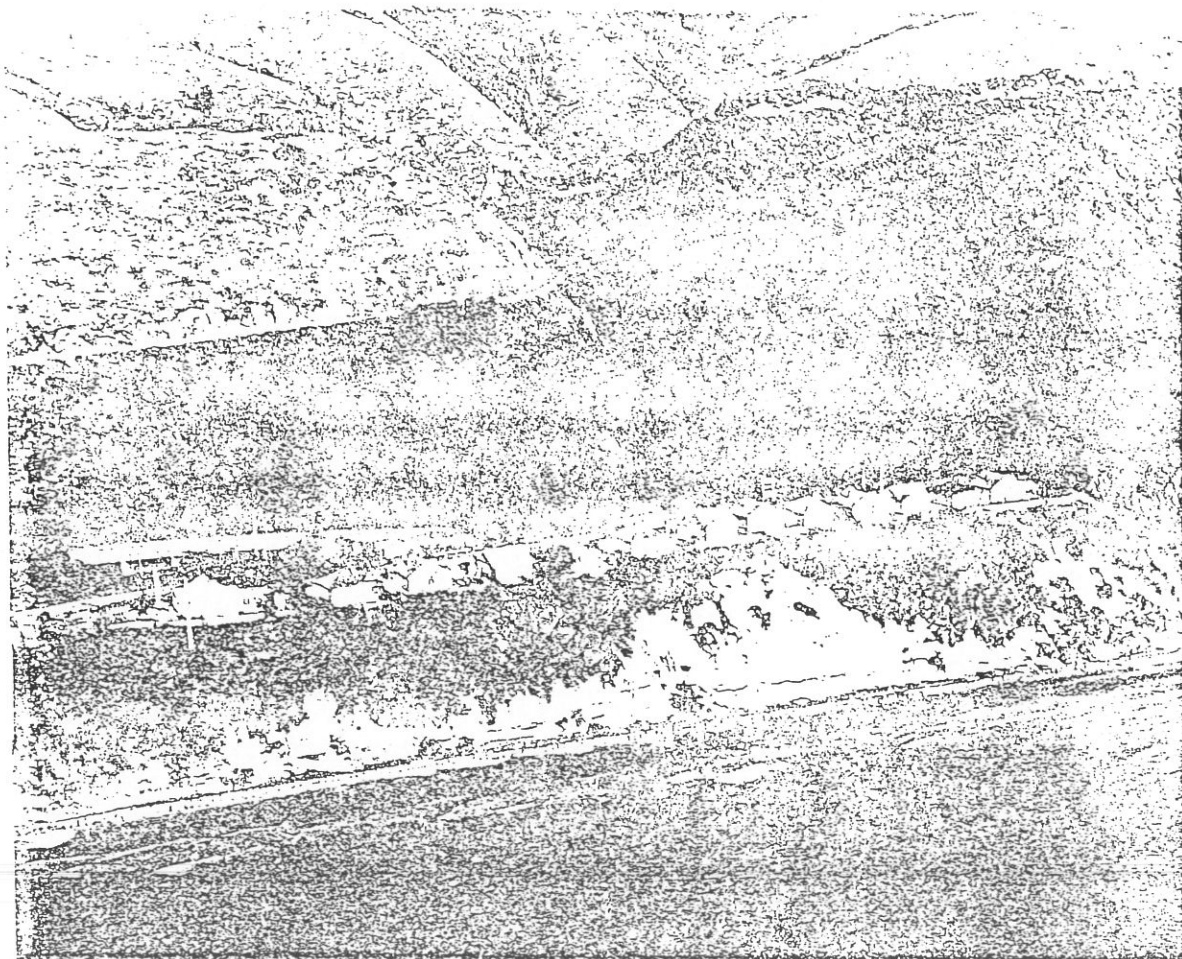
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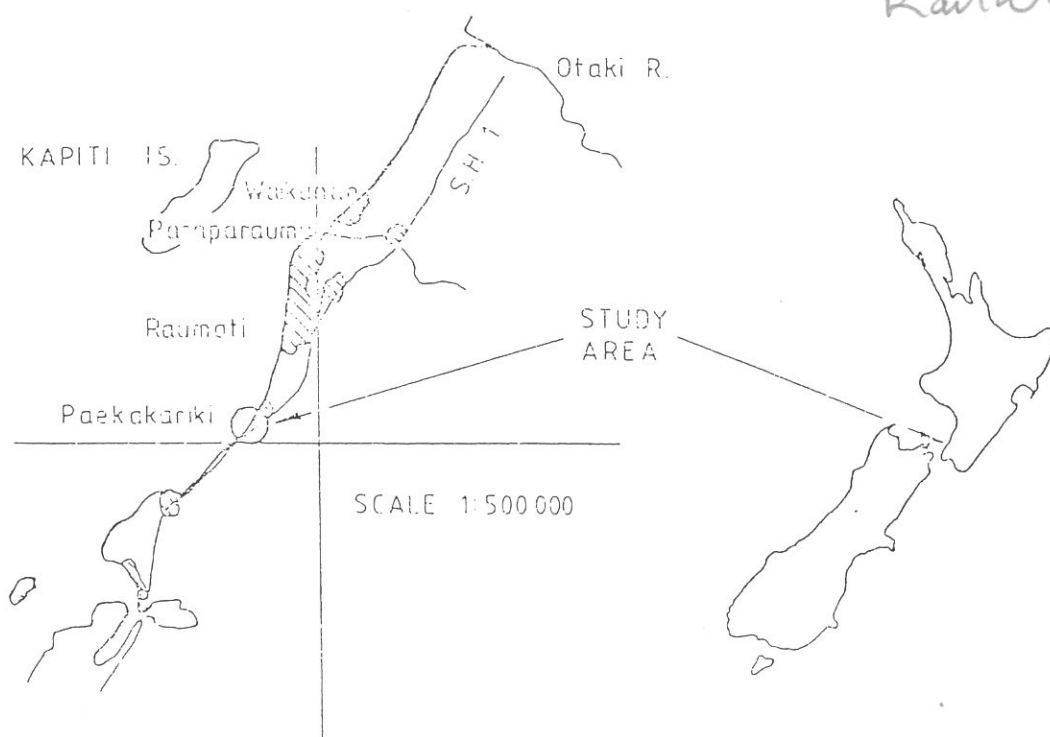
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*Railway houses!*



**FIGURE 1**

LOCATION OF INVESTIGATED COAST AT PAKAKARIKI.  
 OBLIQUE ARIAL PHOTO TAKEN 18 APRIL 1979 SHOWING  
 THE 13 ENDANGERED HOUSES ALONG AMES ST. EROSION  
 HAS ACCELERATED SINCE PHOTO WAS TAKEN. OUTFLANKED  
 BEACH PROTECTION WORKS WERE CONSTRUCTED IN 1959.

# COASTAL EROSION AT PAEKAKARIKI

## WELLINGTON'S WEST COAST

By

JEREMY GIBB AND DERRICK DEPLEDGE

### INTRODUCTION

The Paekakariki coastline discussed in this report (Fig 1) is bounded by State Highway 1 in the south and an unnamed stream in the north. The rapid increase in coastal erosion rates since 1977 (Table 1) is providing a serious threat to public and private property and assets along this exposed section of Wellington's west coast. At present, about 13 houses along the seaward side of Ames Street (Fig 1) are in imminent danger of collapsing on to the beach. Within the next few years and at the present erosion rates about 20 other houses, including the Fisherman's Table Restaurant, will be similarly threatened. Further, State Highway 1 could be threatened 20-30 years from now (1980).

This report attempts to assess the problem and to discuss alternative measures for combatting the erosion. The report was prepared in response to a request by the Wellington Regional Water Board for an assessment of the erosion problem. The request followed an inspection of the Paekakariki coast by the authors and staff from the New Zealand Government Railways, Wellington Regional Water Board, Ministry of Works and Development and Kapiti Borough on 26 June 1979. The report is based on surveys made by the District Surveyor, Wellington Residency (August 1979), staff from the Survey Section, Porirua Residence (April 1974 to October 1976) and field observations by Gibb and Depledge (July, September, October 1979; January 1980).



## GEOLOGICAL HISTORY

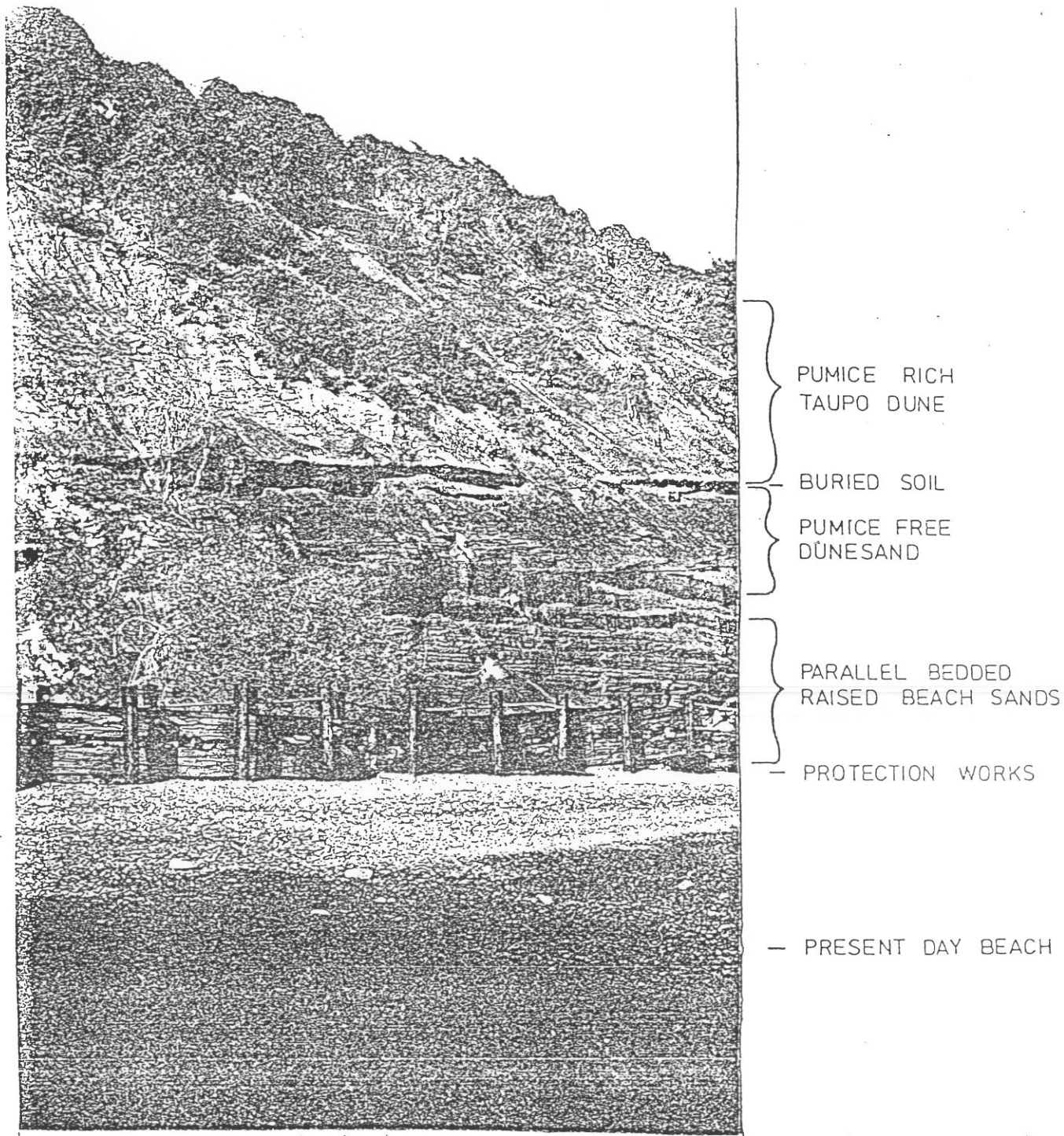
The 1.44 km long Paekakariki coastline discussed in this report borders a very narrow sand plain ranging in width from about 30 m in the south to 150 m in the north. A radiocarbon dated shoreline exposed by coastal erosion 100 m south of the Fisherman's Table Restaurant indicates that the sand plain started to form about 5200 years ago (Fleming 1965). Stratigraphic evidence revealed in the erosion scarp along the foredune at Paekakariki (Fig 2) provides an understanding of events over the last 5200 years.

Fig 2 shows an erosion scarp cut in a 30 m high fore-dune (above M S L). From beach level, there are 2.8-3.0 m of parallel-bedded beach deposits overlain by 3-4 m of cross-bedded pumice-free dune sand capped by a prominent horizon representing a buried soil. The ancient soil horizon is overlain by 14-18 m of cross-bedded pumice rich dune sand deposited soon after the Taupo eruption of A D 150. The present-day soil is formed on the Taupo dune sand.

The stratigraphic evidence (Fig 2) reveals two important points. Firstly, the presently eroding shoreline at Paekakariki was advancing from accretion up to, and for some time after the Taupo eruption. According to Gibb (1978), the trend of accretion reversed to net erosion between A D 150 and 1874. Factors causing this significant reversal are discussed later.

The second point is that the raised beach deposits indicate approximately 3 m tectonic uplift at Paekakariki over the last 5000 years. A net uplift rate of 0.6 mm/yr is therefore inferred. By contrast, between Raumati and Waikanae, 6-18 km north of Paekakariki, there is evidence of tectonic downdrop (Gibb 1979). The pattern of vertical displacements along the coast indicates that the coastline is tilting to the north-west with the zero isobase (no uplift line) passing northward somewhere between Paekakariki and Raumati.

Can this be  
deduced from  
sea level rise  
of 1.2 mm/yr?



## FIGURE 2

PHOTO TAKEN JULY 1979 SHOWING STRATIGRAPHY IN EROSION SCARP ALONG THE FOREDUNE ADJACENT TO ARNES ST., PAKAKARIKI. ABOUT 12m EROSION HAS TAKEN PLACE HERE BETWEEN DECEMBER 1978 AND DECEMBER 1979.

## HISTORIC OBSERVATIONS

Cadastral plans dating from 1894 and ground surveys dating from April 1974 provide an excellent record of erosion trends over the last century. Table 1 summarises rates of erosion for points opposite the Fishermans Table Restaurant (Centennial Inn), Ames Street and at Profile 1B.

TABLE 1 - Rates of retreat from erosion of the toe of the foredune at Paekakariki.

Data up to 1977 from Gibb (1978, Appendix 1).

\* - No rate calculated as period not full year.

\*\* - Advance by landsliding.

Locality NZMS 1 Grid Ref (4th Ed 1977)	Survey Interval (Years)	Accretion (+) or erosion (-) (m)	Rate m/yr	Net rate	Data source
RESTAURANT N160/485570	1894-1940	-12	-0.26	-0.23	Plans
	1940-1977	-6	-0.16		Plans
	1977-1980	-2	-0.66		Survey
PROFILE 1B N160/486572	Apr 74-Aug 74	-21	*	-3.4	Survey
	Aug 74-Sep 75	+11	+10.0		Survey
	Sep 75-Oct 76	-4	-3.64		Survey
	Oct 76-Aug 79	-4	-1.43		Survey
AMES STREET N160/491579	1894-1897	-7	-2.3	-0.84	Plans
	1897-1906	-6	-0.67		Plans
	1906-1926	-18	-0.9		Plans
	1926-1940	+21	+1.5		Plans
	1940-1958	-50	-2.78		Survey
	1958-1977	0	0		Survey
	1977-1980	-12	-4.0		Survey

The erosion trends recorded in Table 1 for Ames Street represent the northern section of coastline "protected" by the rail and log seawall constructed in 1959. Although net erosion took place from 1894 to 1958 a period of accretion is shown between 1926 and 1940. A landslide similar to that recorded at Profile 1B may well explain this anomalous advance. At Ames Street the crest height of the foredune is 26-30 m above M S L. After a period of coastal erosion, the seaward slope of the dune is oversteepened resulting in landsliding and the formation of an apron of loose sand at the toe. Until removed by wave action, the extended toe of the small landslide gives the impression of accretion.

1976 ?  
slowing?  
no effect  
here.

Vertical aerial photographs and field observations indicate that there was no erosion along this section of coast between 1958 and November 1978. In most places the dune toe extended to, or within 2 m of the protection works constructed in 1959. The 7-12 m of erosion that is recorded on Plan D S 159, Sheet 1 relative to the seawall, has all taken place between December 1978 and December 1979 and is actively continuing, especially after severe onshore gales during early January 1980. Plan D S 159 attached to this report, shows the position of the toe of the foredune as at August 1979. The survey was made by the District Surveyor, Wellington Residency, Ministry of Works and Development.

Rates of erosion at Profile 1B (Table 1) are considered here to be representative of trends along the unprotected section of Paekakariki coastline between 1974 and 1980. Although the surveys between April 1974 and August 1979 record a net erosion rate of 3.4 m/yr accretion of 11 m for the period August 1974 to September 1975 is recorded. Interpreting this as accretion would be misleading, as the 11 m advance was caused by a landslide subsequently removed by the sea.

Fig 2 summarises cross-sectional surveys made by survey personnel from the Porirua Residency, Ministry of Works and Development at Profile Site 1B. When the site was last inspected on Tuesday, 31 January 1980, the bench mark established in April 1974 was displaced by sea erosion from the crest of the dune and was lying midway up the erosion scarp.

ANGLE IRON  
ht = 14.90 m

Legend:  
— APR. 1974  
..... AUG. 1974  
--- SEPT. 1975  
- - - OCT. 1976  
— AUG. 1979

1B  
revised ht = 9.89 m

0.00 MSL DATUM

### FIGURE 3

SURVEY CROSS-SECTIONS MADE BY PORIRUA RESIDENCY  
AT BEACH PROFILE 1B BETWEEN APRIL 1974 AND  
AUGUST 1979.

SCALES: HORIZ. 1: 500  
VERT. 1: 100

Opposite the Fisherman's Table Restaurant erosion has been taking place at a slow net rate (0.23 m/yr) since 1894 (Table 1). The rate is considerably lower for several reasons. Firstly, opposite the restaurant there are intertidal reefs that reduce wave energy so that the foredune is only attacked during severe storms. Secondly, the gravel beach is widest at this point compared with the rest of the coastline. The wide beach absorbs most of the wave energy, protecting the foredune from all but the severest storms. Thirdly, the toe of the foredune has been partially protected by concrete slabs being placed on the beach in front of the restaurant.

## COASTAL EROSION PROCESSES

Both long-term and short-term factors operating together are responsible for the coastal erosion at Paekakariki. These factors are resulting in a steady loss of beach sediment from the system. The depleted beach is offering less and less resistance to storm waves so that the incidence of wave attack on the foredune is increasing.

### LONG TERM

Changes in sediment supply rates to the Paekakariki coastline together with a rising sea level are the main long-term factors affecting the coast.

### SEDIMENT SUPPLY

According to Gibb (1978) the Paekakariki coastline is being starved of the natural supply of longshore drift material. The main cause of this is the growing cusped foreland at Paraparaumu which is deflecting the southward drift of sand offshore away from the Paekakariki coastline. Over the last century the continued growth of the foreland at 2.5 m/yr (Gibb 1978) has exacerbated the erosion problem at Paekakariki.

At the time of the Taupo eruption the foreland had not developed to the point of becoming an effective groyne so that the net southerly longshore drift of sand was able to nourish the beach at Paekakariki.

The construction of State Highway 1 along the coast between Pukerua Bay and Paekakariki in the late 1930s (Gibb 1978) has terminated any natural supply of gravel to the beach from the screes south of Paekakariki. According to Mr A W Smith, a past resident at Paekakariki, (pers. comm.1980), a sandy beach existed right along the coast from 1936 to 1940. In the early 1950s the sand disappeared and left the present gravel beach derived from the screes. Today, the gravel is being steadily destroyed by abrasion from wave action resulting in an overall reduction in the volume of beach gravel. The reduction in volume is lowering and narrowing the beach thus reducing its efficiency for providing natural protection of the foredune.

During periods of erosion sand is also supplied directly to the beach system from the foredune. Of the 10 km of eroding coastline between the cusped foreland at Paraparaumu and the south end of Paekakariki, approximately 50% has been protected by impermeable seawalls, the latest being a low timber retaining wall 4.5 km long, that was completed in November 1978 (Weaver 1979). The timber seawall totally blocks input of sand from the foredune to the beach system during erosion periods.

It is of interest to note that prior to the construction of the 4.5 km long seawall no coastal erosion was recorded opposite the Ames Street section of Paekakariki coastline (Table 1). Here, the erosion was observed to commence in December 1978 as a direct result of a depletion of beach sediments. There may be a correlation therefore, between the timing of the construction of the seawall and the onset of erosion opposite Ames Street. A similar acceleration in erosion rates has been observed along the adjacent unprotected coast of Raumati South, south of the timber seawall since it was completed.



## GRAVEL PROPERTIES

As a preliminary investigation, 53 kg of gravel was sampled from the active scree for particle size analysis, resistance to abrasion and general composition. Results are recorded on the attached grading sheet and particle size distribution curve.

The sample was taken randomly along the length of the base of the scree slope and is therefore, only partially representative of the material as a whole. The rock tested was of larger size, more durable and contained a smaller percentage of argillite than the whole volume of scree gravels in the quarry. The mean grain size of the sample is about 95 mm and the diameter of the largest rock is 150 mm and the smallest rock, 1 mm.

The Los Angeles Abrasion Test, developed to test the resistance to abrasion of concrete aggregates, was used as an indication of the likely performance of the quarry greywacke as a beach gravel. The percentage of wear value of 24.9% represents a good quality material. Values of 40% or less are generally accepted in standards as representing the suitability of coarse aggregates for concreting and coarse road materials subject to wear.

We conclude that the scree material in the quarry is likely to be quite adequate for beach replenishment at Paekakariki. It would be unwise to use the weathered greywacke material that is presently being quarried at Paraparaumu for the Raumati seawall. The softer weathered material is highly vulnerable to abrasion.

## BULLDOZING FOREDUNE

Pushing sand on to the beach by levelling the foredune (Crown land) between Ames Street and the Centennial Service Station has been considered as a protection method. If actioned this alternative would almost certainly result in accelerated erosion rather than protection. As mentioned previously we have observed that sand eroded from the foredune does not remain on the beach. By lowering the crest height of the dune the erosion rate would increase as the sea would have less volume of sand to move during storms. State Highway 1 could eventually be threatened as a result.



## SEA LEVEL CHANGES

A rising sea level is a known major cause of coastal erosion, especially along sections of coastline with an inadequate sediment supply. For example, Bruun (1962) has postulated that for every millimetre rise of sea level the shoreline will retreat about 0.3 m from erosion. From an analysis of automatic tide gauge records from the Wellington Harbour Board tide gauge Gibb (1979) found that sea level rose at 2.4 mm/yr from 1903 to 1977. Further, the rate of rise increased dramatically between 1944 and 1975 to 3.9 mm/yr. Although there is an inferred net tectonic uplift rate of 0.6 mm/yr at Paekakariki the rate of sea level rise is outpacing uplift rates.

Now  
was  
this  
mentioned?  
it doesn't

Taking the rate of uplift into account, the apparent rate of sea level rise at Paekakariki from 1903 to 1977 is about 1.8 mm/yr and from 1944 to 1975, 3.3 mm/yr. Assuming "Bruun's Rule" holds true, then since the 1940s one could expect an erosion rate of 1 m/yr as a direct result of rising sea level. Surveys of the coast show that from 1940 to 1980 net erosion rates have ranged from 0.2 m/yr near the Restaurant to 1.8 m/yr opposite Ames Street. Sea level rise therefore, is obviously another significant factor contributing to the erosion at Paekakariki.

Taking the long-term factors discussed above into account, the trend of coastal erosion at Paekakariki will certainly continue. Further, recent depletions in sediment supply together with sea level rise indicate that erosion rates are likely to increase with time.

## SHORT TERM

At Paekakariki the following sequence of events have been observed, resulting in erosion of the foredune.

- 1 The longshore drift of gravels northward during southerly sea conditions results in the beach being lowered in height and narrowed in width in places along the foreshore.

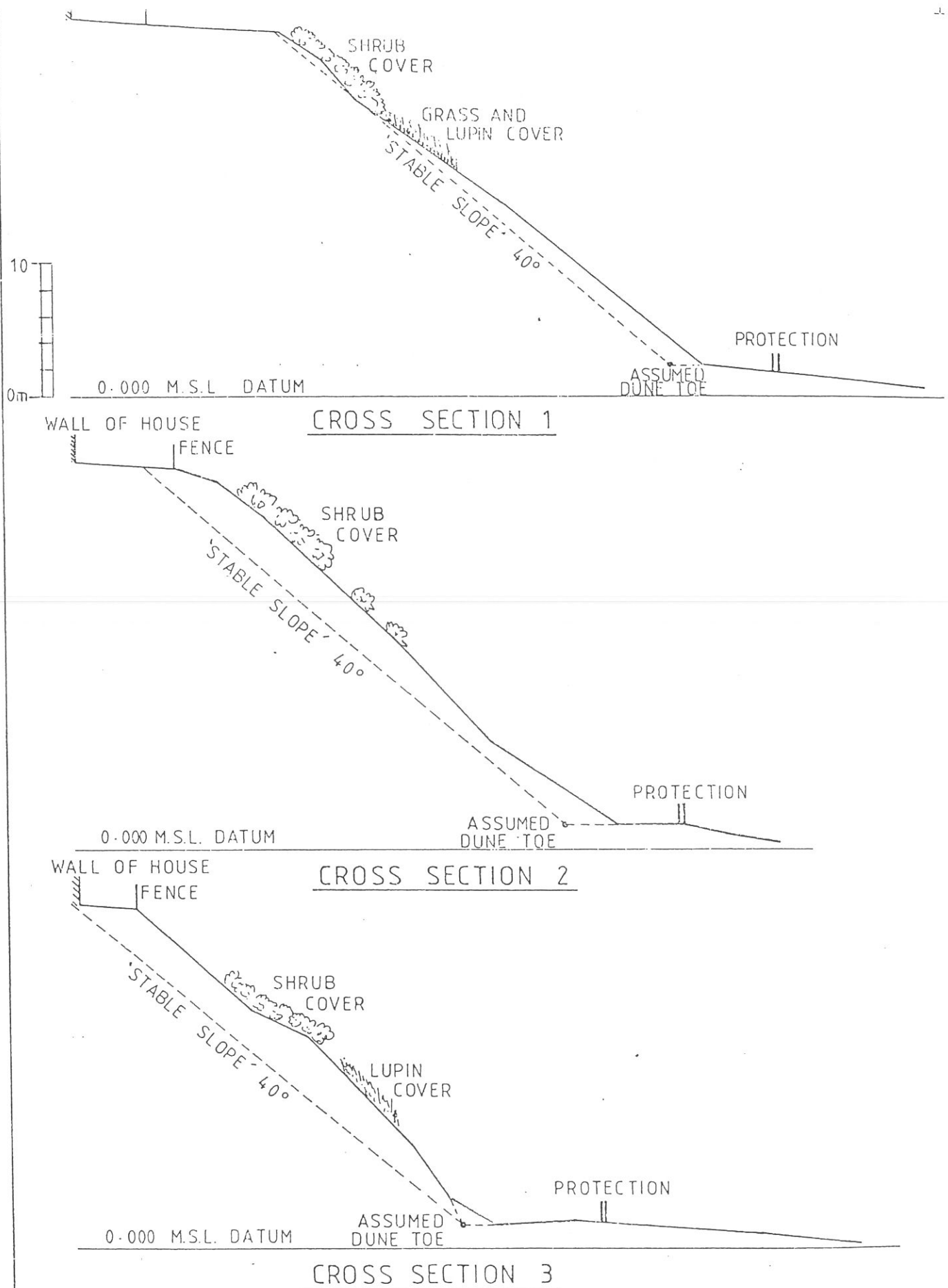
- 2 The lowered narrowed beach is easily overtopped during northwesterly storms exposing the foredune to attack.
- 3 Wave attack results in a near-vertical scarp being cut along the toe of the foredune. The oversteepened seaward slope collapses removing the protective dune vegetation above.
- 4 The devegetated foredune face is now attacked by westerly winds resulting in further collapses until stable slopes of loose sand between  $44^{\circ}$  and  $48^{\circ}$  are formed.

The sand fed to the beach from the eroding foredune does not remain on the beach. The sand is transported seaward during storm activity and is deposited as a longshore bar. Unlike the coastline north of Paraparaumu the sand bar does not return to the beach during calmer weather. Observations during northwesterly gales indicate that the sand migrates southwards in the surf-zone and then offshore in a large rip current about 100 m south of the Fisherman's Table Restaurant. (see Fig 7).

The all important point therefore is that sand placed ( $< 2.0$  mm diam.) on the beach at Paekakariki in small quantities is totally lost from the system. By contrast, the gravel ( $> 2.0$  mm diam.) remains on the beach offering some natural protection to the foredune.

## SLOPE STABILITY IN DUNE SANDS

Aeolian (wind blown) sand deposits are typically rich in quartz, have a limited grain size and are often initially deposited in asymmetric mounds (dunes) with a windward slope of  $6^{\circ}$  -  $15^{\circ}$  and a leeward slope of about  $34^{\circ}$ . A design slope angle of  $1\frac{1}{2} : 1$  is usually adopted for engineering purposes for dry loose sand. This is based on the observed leeward slopes of dunes and corresponds to an angle of internal friction ( $\phi$ ) of  $34^{\circ}$  for such material.



**FIGURE 4**

CROSS-SECTIONS SURVEYED IN AUGUST 1979 OPPOSITE AMES STREET. POSITION SHOWN ON PLAN D.S.159 SHT.1. PROJECTED SLOPE OF 40° REPRESENTS THE STABLE SLOPE THE FOREDUNE IS LIKELY TO ADOPT. POSITION OF DUNE TOE IS INFERRED BY PROJECTING EXISTING EROSION SCARP DOWNWARDS.

NOTE: HORIZ. & VERT. SCALE SAME FOR ALL THREE SECTIONS.

## ALTERNATIVE EROSION CONTROL MEASURES

Our observations show that most, if not all the existing coastal protection works at Paekakariki are inadequate. The gabion protection work (constructed 1972) protecting State Highway 1 is being destroyed along the toe by abrasion from mobile beach gravels (Fig 5). The wire baskets are breaking up under impact of boulders during heavy seas.

Concrete slabs placed on the beach to protect the Fisherman's Table Restaurant are proving partially effective in protecting the foredune. However, during heavy seas the slabs move in response to changes in elevation of the gravel beach.

Adjacent to Ames Street, the rail protection work (constructed 1959) although adequate for the period 1959-1978 has become inadequate since December 1978. In March 1979 logs were placed between the rails (Fig 2) but they have failed to prevent wave action from sucking dune sand through the gaps between the logs.

X North of Ames Street property owners have constructed their own seawalls from cement and car tyres (Fig 6). In most cases the concrete is made from sand off the beach and therefore may have little strength. As a result the walls are undermined and collapsing in several places. Many of the walls are backfilled with sand illegally taken off the adjacent beach. This practice can only exacerbate the erosion as the beach is already losing sediment. 7

Further to the study by Gibb (1978) some likely options for combatting the erosion at Paekakariki are briefly discussed, particularly with reference to further information being available on the option of beach replenishment.

a properly  
designed  
system would  
be much  
performed

However, the form of windblown sand deposits which have stood for several thousand years is often modified by natural weathering and erosion processes and theoretical profiles are rarely encountered. These processes, both mechanical and chemical, alter the strength characteristics of the material and slopes are often steeper and less uniform than those anticipated. In addition, the establishment of a vegetation cover and soil development may stabilise dune sands at a higher angle than would be possible without cover.

## FOREDUNES ON THE PAEKAKARIKI COAST

The three survey cross-sections (surveyed August 1979) shown on Plan D S 159, Sheet 3, indicate that the existing erosion scarps are standing at maximum angles of  $44^{\circ}$ - $48^{\circ}$ . Fans formed from collapse of the oversteepened erosion scarps typically occur at angles of  $33^{\circ}$ - $38^{\circ}$ . The loose sand forming the fans is being removed by wave action exposing the dune toe to further erosion.

Our observations indicate that the average range of existing slopes is from about  $35^{\circ}$  for loose sand to  $45^{\circ}$  for partially consolidated vegetated sand. Average existing slope angles (slope of line from present dune toe to crest) on the three cross-sections are  $38^{\circ}$ ,  $39^{\circ}$  and  $41^{\circ}$ . In order to predict the likely extent of retreat of the foredunes and the subsequent threat to the houses along Ames Street, an overall slope angle of  $40^{\circ}$  is adopted and projected upwards from the present dune toe to intersect the dune crest on all three cross-sections (Fig 4). Fig 4 shows that where houses are close to the seaward edge of the foredune (4 m on cross-section 3) the projected "stable slope" indicates that they are in immediate danger of collapsing on to the beach. Considering that 7-12 m of erosion has taken place over the last twelve months plus the inadequacy of the existing coastal protection, the 13 New Zealand Government Railways owned houses at the south end of Ames Street (Fig 1) could be in imminent danger of collapse.

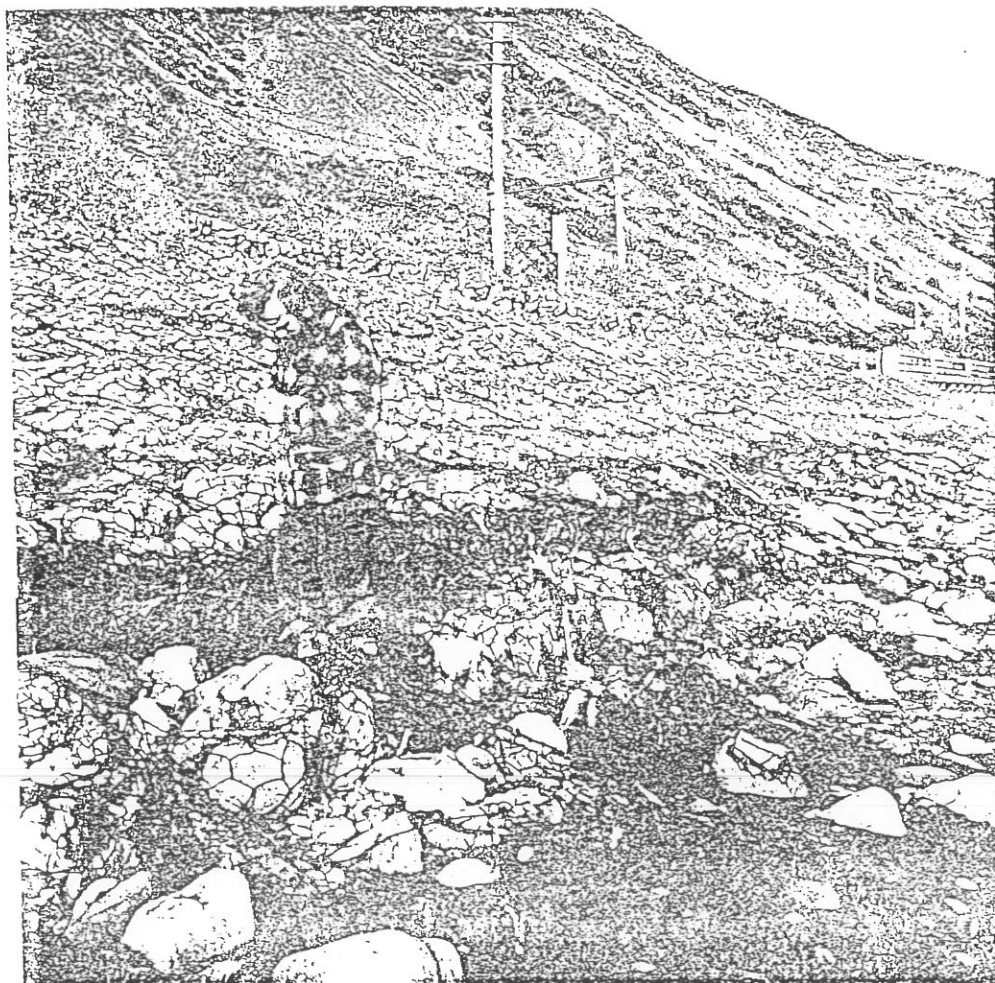


FIGURE 5

PHOTO TAKEN JULY 1979 LOOKING SOUTH SHOWING  
DAMAGE TO GABION BASKETS CONSTRUCTED IN 1972.  
THE SCREE SEEN ABOVE IS RECOMMENDED AS A  
SOURCE OF BEACH GRAVEL.



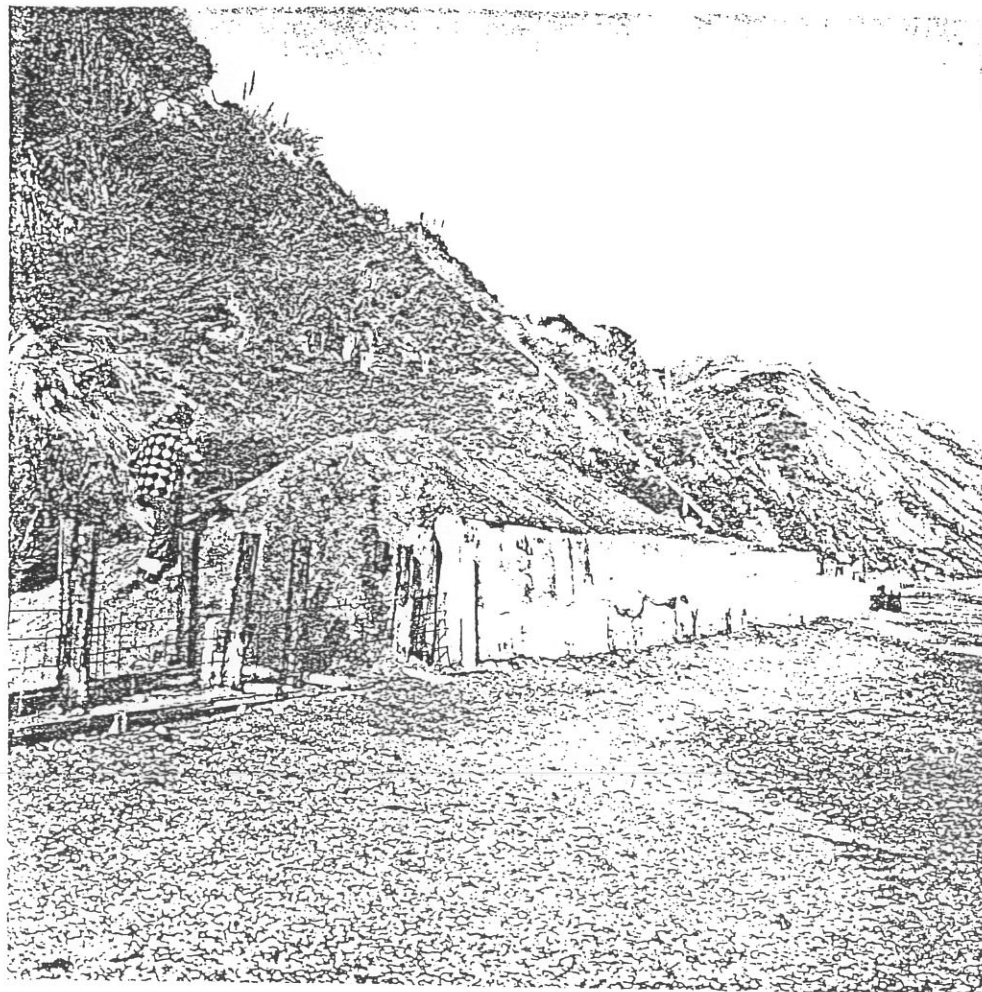


FIGURE 6

PHOTO TAKEN JULY 1979 LOOKING SOUTH SHOWING  
PRIVATELY CONSTRUCTED CONCRETE SEAWALLS. WALL  
IN FOREGROUND IS BACKFILLED WITH SAND ILLEGALLY  
TAKEN OFF ADJACENT BEACH.

## BEACH REPLENISHMENT

Our observations of the beach at Paekakariki show that during storm activity, mean grain sizes greater than 2 mm (gravel) remain on the beach, whereas particles less than 2 mm (sand) are removed. From the viewpoint of beach replenishment it is significant that the sand does not return to the beach. The sand appears to be transported offshore towards Mana Island. ?

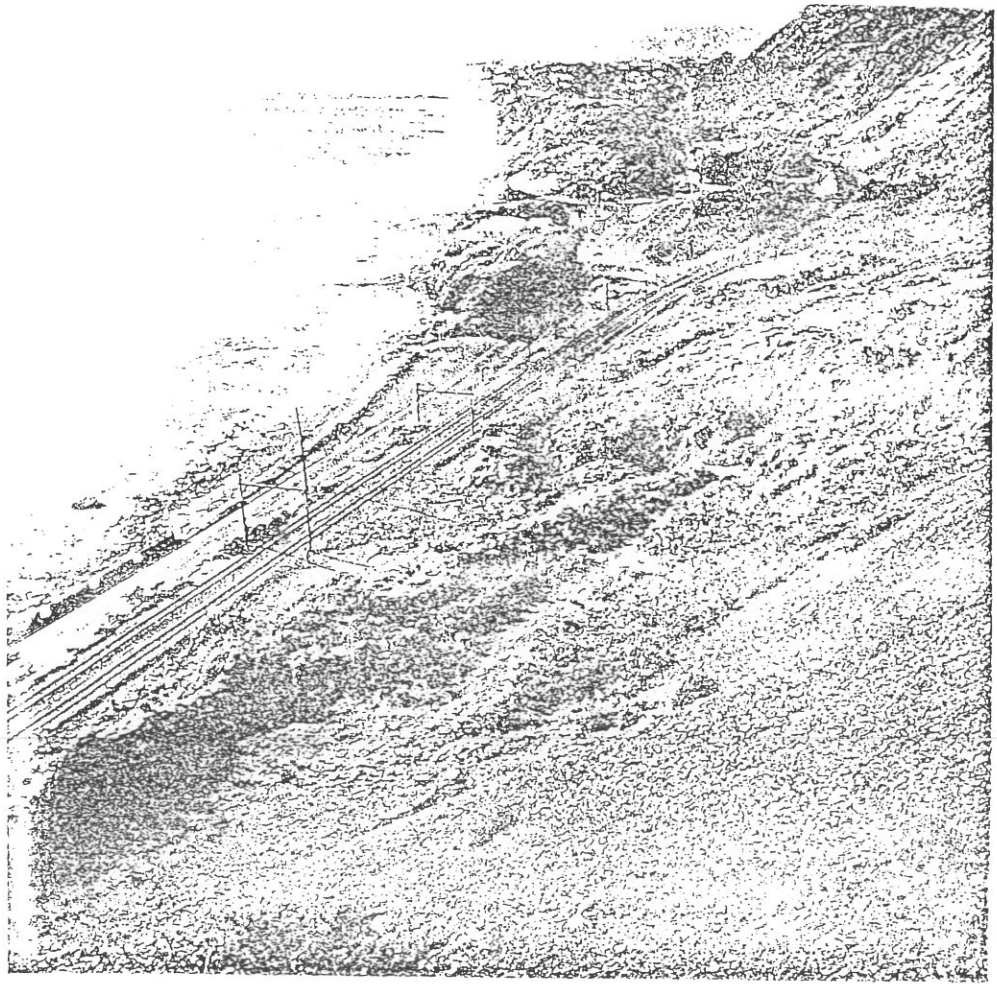
The most suitable material to replenish the beach is gravel. For this reason we investigated an abandoned quarry a few hundred metres south of the problem area (Fig 7). Fig 7 is a view from the quarry looking north. The quarry is accessible by road to the base of the scree and is ideally situated in relation to supplying the beach by the Fisherman's Table Restaurant. u

## GRAVEL VOLUMES

The volume of scree gravel was estimated in January 1980 by the Survey Section, Porirua Residency, Ministry of Works and Development. Cross-sections were surveyed by Abney Level and Tape. Cross-sectional areas were estimated by measuring the slope of the scree at base-level and the slope of the cliff face above the scree. The cliff face slope was then projected to scree base-level and areas calculated. Of the total estimated volume of 34,450 m<sup>3</sup>; about 32,440 m<sup>3</sup> of scree is active and unvegetated. The remainder is vegetated and dormant.

According to Gibb (1978), over a 3 km length of coast from the Fisherman's Table Restaurant northwards, 100,000-150,000 m<sup>3</sup> of gravel added to the beach would be sufficient to advance M H W M up to 20 m seawards. For the 1.44 km of Paekakariki coastline under investigation about half that volume would be required. On this basis there is insufficient material in the scree so that the balance would have to be quarried from the cliff face above the scree. This should pose no threat to the railway below nor to the Paekakariki Hill Road above.





### FIGURE 7

PHOTO TAKEN JULY 1979 FROM THE QUARRY LOOKING  
NORTHWARDS ALONG THE PAKAKARIKI COASTLINE. RAILWAY  
AND SH.1 ARE IN THE FOREGROUND. FISHERMAN'S TABLE  
RESTAURANT MIDDLE TOP OF PHOTO AND RAIL AND  
LOG PROTECTION WORK BEYOND THE RESTAURANT. NOTE  
THE OVERGROWN ROAD ACCESS TO THE BASE OF THE  
SCREE AND ROAD ACCESS ACROSS RAILWAY LINE.  
DEPOSITION POINTS FOR SCREE GRAVEL ONTO BEACH  
ARE VISIBLE NORTH AND SOUTH OF THE RESTAURANT

## ROCK REVETMENT

Rock protection of the eroding bank adjacent to the proprietor's house (Fisherman's Table Restaurant) has been discussed as a short-term protection method. As the concrete slabs have proved partially successful adjacent to the restaurant this method would be an effective remedial measure. In the design of the revetment the toe would need to be buried below the mobile zone of the gravel beach. The height would need to extend to the top of the eroding bank and the wall would have to be constructed in such a way as to avoid storm waves sucking sand through the stones.

## GROYNES

There is inadequate sediment moving alongshore to warrant the construction of a groyne field. The lack of build up of sediment either side of the concrete discharge pipe across the beach at the north end of the investigated area bears testimony to this. Groynes could be a possible alternative once beach replenishment had been carried out.

## DISCUSSION AND RECOMMENDATIONS

Our investigation has revealed that there has been constant erosion of the foredune at Paekakariki since the first accurate survey of the coast was made in 1894. The erosion rate is accelerating and in our opinion a course of action must be taken immediately in relation to property and assets in the investigation area. On the basis of our findings we offer the following recommendations.

1. Evacuation and removal over the next few months of the 13 New Zealand Government Railways owned houses along the seaward side of Ames Street.

- 2 Bank protection of the coastline between the gabions and Centennial Service Station.
- 3 Beach replenishment using gravel quarried from the scree and bare rock face in the area shown in Fig 7. Volumes required are of the order of 50,000-75,000 m<sup>3</sup> to adequately protect the 1.4 km length of coastline at Paekakariki. Gravel should be placed adjacent to the restaurant and service station and between the end of Ames Street and the service station. Beach replenishment should follow the construction of bank protection. Depending on the annual rate of loss of material from the beach by abrasion, the volume will need to be added to each year.
- 4 Following beach replenishment the erosion scarps along the foredune should be revegetated with salt tolerant grasses and shrubs.
- 5 The immediate threat of erosion is not quite so severe for the twenty or so houses between the New Zealand Government Railways owned dwellings and the northern stream in the investigation area. The threat to individual dwellings will vary according to their distance back from the beach. Nevertheless, the continual loss of beach sediment from the system and increasing erosion rate means that they will be threatened in the same way as the dwellings along Ames Street. A programme of beach replenishment would control the erosion rate. However, if nothing is done it is almost certain the houses may have to be moved over the next 5 years or suffer the consequences.
- 6 If no protective action is taken along the 1.4 km stretch of Paekakariki coastline, then State Highway 1 will come under threat from coastal erosion. Based on the increase in erosion rates (Table 1) the highway could be threatened 20-30 years from now (1980).

## ACKNOWLEDGMENTS

Data for this report was gathered by the District Surveyor, Wellington Residency, and staff from the Survey Section, Porirua Residency, Ministry of Works and Development. We gratefully acknowledge their efforts and those of the Wellington District Laboratory staff who analysed the samples.

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