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A Major Design Study
submitted for
The Diploma in Landscape Architecture
in the
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by
A.R. Petrie

Lincoln College
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The Brief

The Queen Elizabeth Park Board has requested that a research study be undertaken to evaluate the potential of the Park as a recreational resource for the Wellington Region, satisfying both present day demands and the projected future demands.

The objective of this basic research is the production of a policy, which can be recommended to the Board, together with a plan, to guide future development of the Park.
CHAPTER II

Introduction

THE NEED FOR COASTAL RESERVES

In 1968 the Town and Country Planning Branch, Ministry of Works, had the following to say:--

'New Zealand's coastline is approximately 10,000 miles long. Apportioning this statistically there are at present about 270 people to each mile of coast. This is a very low figure compared with the equivalents of 271,000 for Belgium, and 17,000 for Britain, and compares favourably even with Denmark's 1000.'

At first glance it may appear that the citizens of this country have unlimited opportunities for various types of coastline development, virtually without restriction. This has in fact coloured the attitude of many people to a considerable degree - they seem to think there is always another unspoilt bay beyond the present development. However, such is not the case, for much of the coast is relatively inaccessible due to topography, and is also remote from the main centres of population.

It is of considerable significance that the Outdoor Recreation Resources Review Commission (O.R.R.R.C.) estimates that by the year 2000, the demand for recreation in the United States will triple while the population will only double. It is considered likely
that a similar trend will occur in New Zealand, since the people are also an outdoor loving nation and have similar standards of living, in that incomes, education and leisure time are all increasing.

The O.R.R.R.C. found that, although considerable land is already available for outdoor recreation, it does not effectively meet the needs, due to either the location of land, or restrictive management policies. A similar situation exists in New Zealand, for although the nation is well endowed with National Parks, these are easily accessible only to the minority of the population, while the more accessible seashores do not provide a comparative amount of recreation space. The need is not necessarily for a considerably greater total acreage, but for a more meaningful acreage. This will require additional reserves on the coast to offset the imbalance of interior recreation areas, as it was reported in 1964, three quarters of the 26,500,000 holidaymakers in Great Britain were staying on the coast. (Christian 1966).

The O.R.R.R.C. found that while Americans are seeking the outdoors as never before, it is the simple pleasures they seek most; walking, swimming, picnicking and other unorganised activities. When outdoor recreation facilities are available people will use them, and increased mobility has multiplied the need for such facilities. Similar needs are increasing in New Zealand for the same reasons.

Water is a focal point for outdoor recreation, and it is enjoyed in many ways, from
just sitting and watching, to swimming, fishing and boating. Swimming, now one of the most popular outdoor pursuits, is likely to be the most popular of all by the turn of the century. (Clawson and Knetsch 1966).

The value of outdoor activity is essentially a 'renewing' experience - a refreshing change from the work-day-world where one's vitality is restored. The use of leisure time is important to the health of both the individual and the country, 'the opportunity for such outdoor activities is now regarded as one of the necessities of urban life - we know that outdoor recreation prevents the misuse of time and energy, and is a physical, mental, spiritual and moral educator.' (A.R. Riddell 1967).

Modern society rightly or wrongly has a certain amount more time for leisure throughout the year, and if present efforts are successful then a corresponding need for increased recreational facilities will also arise. Under normal circumstances it is most unlikely that the individual's free time will decrease.

This leisure-time factor, plus the population's present affluence, the advent of fast comfortable motor cars, and the construction of higher class roads and more link routes, means that people are now able and willing to travel further and enjoy their recreation. Even today the remotest areas are being invaded by those who wish to 'get away from it all' or 'just to see what's at the end of the road'.
These factors of economics and leisure time have both had a significant influence on the growth in usage of the coast for general recreation. The country's reserves are now available to a larger number of people than ever before, and it is obvious that the use demanded of them will greatly intensify when one looks at both the country's present population, which is still relatively small and the projected figures estimated by the Department of Statistics.

- Population 1971 - 2.86 millions
- Projected population 1990 - 4.45 millions

The 1990 projection represents a 62% increase in only 19 years, and is of significance in that it suggests a corresponding potential demand for recreational requirements.

This increased population is expected to be concentrated almost entirely in urban centres, which due to the fact that they have the fewest facilities per capita and therefore the sharpest competition for land use, generates a higher proportionate demand for recreation outlets than do rural areas. This signifies the urgency of implementing a planned policy immediately for the allocation of further recreational areas within 50 miles of our major cities.

**Present Day Legislation**

Development under existing legislation has often resulted in intense subdivision close to the sea, with, for the most part, a very narrow strip of land separating the sections the Mean High Water Mark. Raumati South illustrates this point where the beach is backed by a row of sections, a legal road and a further row of sections. With few accessways, the
provision for recreation if very meagre when one considers that it must also serve a large population of day visitors.

Today the Counties Amendment Act 1961 (Section 29) states that where land with riparian rights is subdivided, there shall be set aside for public purposes a strip of land not less than one chain wide along the M.H.W.M. of the sea. However, with the consent of the Minister of Lands, the Council may reduce this reserve width to not less than 10 feet, if such width will be sufficient to give the public reasonable access.

While one chain of foreshore reserve provides a measure of public access to the water it often fails to produce the most satisfactory conditions. Most of the existing coastal reserves are unstable which provide neither adequate nor effective space to accommodate the growing numbers who will in the future flock to the beaches to enjoy themselves. In particular they do not provide suitable areas for activities such as picnicking or beach games, nor sufficient scope for providing shade, shelter and sand stabilisation, nor sufficient area for car parking without detracting from the natural splendour of the beach. Equally important but less tangible is the fact that such a narrow strip between the water's edge and private development means a loss in the sense of freedom which is a major goal in recreation.

The result has often been a ribbon-type development along many of the more accessible beach frontages, creating in effect a secluded beach for section owners. Access for the
public is provided usually by 6 foot accessways at intervals. Raumati South is one of the most glorious examples of these 'private' beaches. (G. McQuoid 1969).

FUTURE RECREATION REQUIREMENTS FOR WELLINGTON

The Wellington Regional Scheme Statement states that as an urban development becomes more intensive, there is a tendency for recreational facilities to be reduced in number and size as a result of competition with residential, commercial and industrial interests. At the same time, the larger urban population needs a greater proportion of open space and the way in which the open space is distributed becomes more important.

The larger numbers of people seeking recreation in the open countryside could cause the deterioration or destruction of those very features of fresh air, space and freedom that are being sought. It is most important, therefore, that these places and features be recognised now and preserved.

The last paragraph will be very difficult to uphold when one thinks of the future expansion of such urban areas as the Porirua Basin where today the population of 46,000 is estimated to increase to 73,000 by the year 1980. The preservation of the quality of recreation resources will be overtaxed unless emphatic planning steps are taken now.

There has been a proposed scheme in report form by E.R. Henderson (1971) in which he suggests means of controlling the direction of the expected massive urban sprawl. He would try to establish an interconnected hierarchy of parks, each catering for the different recreational and environmental needs. This hierarchy would include forest parks, catchment
areas, a hill park network, coastal parks, town belts and special valleys.

The suggested areas for coastal parks include Makara and Pencarrow, Henderson states "These areas are found on relatively poor soils and scrub covered hills. Seaward slopes are exposed and the coastline is 'wild' and exciting. In the parks emphasis would be put on preservation of coast, wildlife, watercourses and bush with motorised and related activities kept to a minimum."

If these areas are to be designated as coastal parks there seems to be a scarcity of 'inviting' coastal land earmarked for the future, as these have a greater popularity and more importantly a greater need for protection.
The mouth of the Whareroa Stream
CHAPTER III

History

According to W.C. Carkeek (1966) there was a stronghold of the Ngati Maru tribe situated on a dune close to the mouth of the Whareroa stream on its northern bank (see plate 1). At the foot of the stronghold's eastern and southern approaches the steep face of the hillside gave extra protection by the deep stream which seemed to serve as a moat.

Whareroa was still fortified when E.J. Wakefield called in there on his journey up the coast in 1840. At that time the stronghold or pa had one church and thirty huts. The maori's cultivation consisted of thirteen acres of potatoes, seven of kumara, four of maize, three of wheat and three quarters of an acre of other produce. There were two weather-board barns and several stacks of unthreshed wheat and a considerable quantity of flax which was prepared for the European market.

The total number of males at Whareroa in 1850 numbered 50. There were 32 adult females and 23 children, making a total population of 105.

At the mouth of the Wainui stream on its northern bank was found another pa, this belonging to the Ngati Haumai, a branch of the Ngati Toa tribe. When Wakefield visited it in 1840, he found it a thriving fortified village. However in 1850 Kemp (Survey of the Maori
population in the Wellington District) found the pa in a state of dilapidation and described it as unhealthy. The inhabitants were expected to move within the course of a few months to the new Government village which was considered more sheltered and in every other respect more convenient. At this stage there were eighteen acres of potatoes under cultivation as well as three of wheat, four of maize and three of kumara. Although Wainui pa was said to consist of forty huts and two chapels, it is not clear whether these were part of the new village or of the old pa.

The population consisted of 88 male adults, 76 female adults and 21 children, bringing the total population to 185.

EUROPEAN HISTORY

The first road put through the Paekakariki area to open up the inner part of the Horowhenua lowland is said to have been constructed under the orders of Sir George Grey during his administration as premier in 1877. (Adkin 1948) The survey for the railway had not then been carried out as the consensus of opinion at that time was that the narrow strip of country was of limited extent, the land was of less value than previously supposed, and as the major portion of it was still in the possession of the maoris, the provision of a railway was not warranted. This view persisted until 1880, when the Wellington to Manawatu railway line was constructed. This was probably the greatest single factor in the Europeanization of the district.
Wellington City Council's active recreation area
According to the 1897 Cyclopaedia of New Zealand, the main township in the area was Paekakariki.

"this township, having all the attractive features of a seaside resort is much patronised by pleasure seekers and invalids, the hotel accommodation being good, and mail and train services being satisfactory. (see diagram 3) The soils seem to be rich, but little is being done in the way of tilling of it, the native owners being content to grow enough grain and other crops for their own consumption. The climate is genial, and Paekakariki must become in time a favourite water place for the Capital."

HISTORY OF QUEEN ELIZABETH PARK DOMAIN

The purchase of land along the seafront between Paekakariki and Raumati South as a reserve originated from an approach in April 1941 by the Hutt County Council to the Minister of Internal Affairs. The council was concerned at applications to subdivide, and wanted the coastal strip at least 10 chains deep retained for the general public. The complete purchase of the land required was beyond the finance of the County Council, but it was prepared to contribute 2000 pounds from its own funds towards purchase of this strip. However the Government took a broader and more far-sighted view and approved negotiations being opened for the purchase of a larger area of about 900 acres for a reserve, between the highway and the sea and stretching from Paekakariki township north to the Whareroa Stream.

Although negotiations were opened immediately by the Government, little progress was made because of the prices asked by owners. In the meantime some of the land was occupied
I.T. McKay's original stable
by the U.S. Military Forces and Government was faced with payment of compensation for use and damage done. Here again Government adopted a broad and far-sighted view and decided that it would be better to purchase these lands rather than pay compensation. Over the succeeding years a number of purchases were completed, including the buying of I.T. McKay's farm (McKays Crossing). As a result, approximately 2789 acres were obtained. Some of this was purchased by Department of Lands and Survey by negotiations, and some were acquired by Ministry of Works, because of Army occupation, and transferred across following evacuation by the U.S. Military Forces.

In 1952 Cabinet approved:

(a) in principle the establishment of a Domain Board, representative of the Crown, and contributing local bodies to administer the area west of the road (at that time quoted as 1582 acres) subject to a condition that the Crown would have the right to graze the domain land;

(b) a proposal that contributions for the development of the domain be sought from the Wellington City Council and the local bodies.

It was the understanding of Cabinet that:

(i) the area east of the road (at that time quoted as 1149 acres) be farmed by Department of Lands and Survey pending utilisation, probably for conservation and regeneration.

(ii) any profits from farming it to be apportioned as between the Crown and the Domain Board and this disbursement by Lands and Survey in favour of the Board be regarded as payment
for grazing on the Domain of Crown stock. This was later amended so that farming profits were to be available to the Board at Minister of Lands discretion without further Cabinet authority. (Extracted from the Queen Elizabeth Park's Planning Committee's report).
CHAPTER IV

Natural Sciences

GEOLOGY

With the exception of a few patches of recent sands and gravels occurring as beaches and stream-flats, the rocks found in the study area are a single series of sandy argillites and coarse grained greywackes. They are closely folded in a complex manner, but owing chiefly to the unfossiliferous character of the rocks, the structure has not yet been unravelled. On any cross-section, rapid changes in the direction of the strata is a common feature (C.A. Cotton 1917).

The rocks of the series are of a very variable strength, the weakness of some bands being due, apparently, in great part to their shattered nature. The argillites are invariably transversed by innumerable joints, and so also are the greywackes, as a rule. The greywackes with a few joints are very strong, they weather spheroidally, and when broken present an appearance similar to that of an even-grained igneous rock. The shattered greywackes have in some places been rendered equally strong by the deposition of interlacing quartz veins filling the joint planes. (C.A. Fleming 1970).
Physiographic Features

The material forming the Paekakariki coastal lowlands have originated from two distinct sources.

The features may have been produced by an alternation of retrogradation (or retreat of the shoreline under wave attack) with progradation (or advance of the shoreline due to accumulation of the waste of the land). Such an alternation is necessarily connected with a fluctuation in the ratio of wave-energy to load, for when the supply of waste is small, waves attack a coast vigorously, cut it back, and draw much of the waste produced in this process back into the deeper water off shore where it comes to rest. When there is a large supply of gravel or sand brought in by local streams such as the Whareroa or transported along-shore by the activity of waves and currents from a more distant source, as the abundant waste accumulates at all depths, and some of the material is thrown up on the beach so that the shore-line advances seawards, leaving a prograded strip of new land (G.L. Adkin 1918).

In the study area it is probably the supply of sand, which comes from rivers further to the north, rather than that of gravel brought down by local streams that has caused this phenomenon.
Deposition of Sand

It would seem that during the past there have been three main periods of sand deposition interspersed with intervals of soil formation. It has been found that there are three generations of sand dunes in the south-west coastal lowland which represent three periods in which there was an abundant supply of waste for dune-building. These periods are associated with bursts of volcanic activity in the central North Island and on considerable evidence including the composition of the dune materials and their degree of weathering, the following assumptions can be made. (M.L. Leamy 1955).

3rd generation dunes (youngest) = Taupo rhyolitic shower 1700 years B.C.
2nd generation dunes = Rhyolitic showers between 3320 and 1700 years B.C.
1st generation dunes = Egmont group of andesitic showers older than 9000 years B.C.

Growth of the Coastal Lowland

Where a coast perhaps originally a fault coast, has been cut back to mature stage as found in the Paekakariki area and a change to progradation takes place, a low plain, generally dune-covered is developed. As mentioned earlier, the material is mainly 'imported' but there is a mixture of introduced material with some gravel of local origin near the mouths of the streams. If these streams are closely spaced and bring down much gravel their fans will become confluent, forming a piedmont alluvial plain, but as found in the study area, their supply of gravel is smaller in proportion to the amount of sand being thrown up along the
Legend

- First generation dunes
  3320-9000 years
- Second generation dunes
  3320-1700 years
- Third generation dunes 1700 years and younger

Sand dune development

Diagram 6
shore-line, they will remain separate, and on the spaces between them dune sand may accumulate to a considerable thickness. So that the coastal lowland of general seaward slope with a somewhat irregular surface is developed. (G.L. Adkin 1951).

In the coastal lowland there are four quite distinct physiographic types of surface that can be recognised.

(i) The older sandstone areas of the dissected older lowland, with peneplained tops, mature topography towards the margins, and more or less dissected terraces in the valleys.

(ii) The gravel fans, which may still be confined between low banks of the dune sandstone or may overlap its peneplain surface.

(iii) The newer sand-dunes which still exhibit the forms due to accumulation. These modern dunes are built of grey sand. All except a narrow belt close to the sea are fixed by the vegetation, but beneath the superficial layer of humus, the sand is quite loose. Cotton (1917) notes their general arrangement is at right angles to the coast line. The shore-line of the dune covered fore-land advances as a broad cusp towards Kapiti Island and states that this is an early stage of island tying.

(iv) The last physiographic type of surface is the swampy flats which have accumulated in small lakes due to ponding among the newer dunes, or the result of aggradation in the silt-bearing small streams trenching the older lowlands.

In the coastal lowland of the south-western Wellington, all four of these physiographic elements are important features in the landscape.
Coastal Retrogradation

Although Cotton (1917) states that there are early stages of island tying in progress, the whole stretch of this coastline is now in a retrograding stage, as distinct from the former prograding or building up stage, and although only certain portions of the study area are seriously attacked so far there are clear signs of incipient erosion over the whole length of coastline. (Donnelly 1959).

The fundamental overall result of wave action on this particular length of coast is that of eating into the coastline and of removing material from the beach by the scouring action of the backwash under the force of gravity. Clearly the factors influencing the amount of erosion are the slope of the beach, the nature of the materials on the beach and at the upper limit of wave action and the force of the wave action backed up by high tides and high winds.

The opposite process of prograding or building up of the beach results from the excess material deposited on the shallow off-shore bottom being pushed up the beach by suitable waves or by in-shore currents produced by an off-shore wind. Subsequently wind action moves the dry sand into ridges and dunes. The resulting stable shore profile is one of equilibrium being a balance between the opposite effects of prograding and retrograding. It is a complex system of variable factors involving the supply of material off-shore, beach slope and predominance of wind action combined with depth of water off-shore and direction of prevailing wind.

In spite of the difficult task of analysing the problem in the study area, Donnelly
Coastal erosion
(1959) has determined some significant factors relevant to the problem:-

(i) That the material of the beach and in the sand-hills behind has come from the rocks of the mountains and backcountry per medium of the rivers and sea currents, being deposited in favourable positions off-shore where by water action, the material can be moved in-shore, thus building up the beach.

(ii) From the nature of deposits, the rivers north of Paraparaumu have a predominating influence in producing the material for the littoral drift which has been effective in building up the portion of coastline in question.

(iii) Prior to this period of erosion, the steady accretion had no doubt been due to the excess of littoral drift material being used to build up the beach more rapidly than storms could erode.

(iv) The present period of erosion is due to storm damage and beach lowering exceeding the building up action, thus resulting in overall retrograding of the coastline. This is probably due to:

(a) reduction of the sand material in the littoral drift

(b) the altered conditions of the off-shore sea bottom so that the material in the littoral drift is not being deposited in positions favourable to being cast up over the particular length of coastline.

(v) While it is possible that there may be a reduction in the amount of materials entering the sea, it appears therefore that, as the efforts for preventing soil erosion become more effective, material in the littoral drift will be reduced, and the former prograding coastline can be expected to retrograde at an increasing rate.
CLIMATE

The study area falls within McLintock's (1958) D climatic district and is characterised by west to nor-west winds...relatively frequent gales...rainfall 35 - 50 inches...warm summer...mild winters. Of these, the occurrence of frequent gales is the most significant feature, for the area offers no natural protection against severe weather conditions.

The mean temperatures are moderate 13°C for Paraparaumu, and it is thought that there are only slight differences between coastal and inland situations. Extreme temperatures are rare. The highest maximum temperature recorded at Paraparaumu airport is 31°C, and the lowest -4°C. However, the frequency of low temperatures is greater than that of high temperatures. Ground frost, at its severest from June to August, occur on the average on 45 to 60 days per year. A feature of the temperatures experienced in the area are the comparatively large diurnal (daily) ranges. These tend to be the greatest in summer and the least in winter.

On the whole, temperatures are appreciably warmer than in Wellington and plant species of more northern latitude such as Paspalum dilatatum and Phytolacca octandra grow in sheltered places in the district. (Moar 1961).

Average Mean Temperatures

<table>
<thead>
<tr>
<th></th>
<th>Paraparaumu</th>
<th>Kelburn</th>
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</thead>
<tbody>
<tr>
<td>January</td>
<td>17°C</td>
<td>16°C</td>
</tr>
<tr>
<td>July</td>
<td>8°C</td>
<td>7°C</td>
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SURFACE WIND ANALYSIS

Paraparaumu Airport 1962-69

Diagram 7
In the Study Area, site plays an important part in the temperatures experienced, for differences in relief, soils and the nature of vegetation give rise to small but significant variations. In particular, the diverse relief favours the extensive ponding of air in the low lying areas (see diagram 8). This results in the inland areas being some degrees below those experienced on the dunes; also these areas are the first to experience the effect of frost and the last to warm up during the spring. (J.D. Cowie 1968)

Most of the rainfall is brought by westerly winds, and falls are influenced to a large degree by the position of the high country to the east. Rain is generally evenly distributed through the year, with a general tendency for maximum falls during the late summer – early autumn. There are on average between 100 and 145 raindays per year.

Two features are worthy of note with regards to rainfall in this area. First, annual rainfall totals are lower than most other areas of the middle of New Zealand - in fact it could be one of the driest districts of the North Island. Second, the rainfall is fairly reliable. Annual variability does not exceed 20 per cent, while monthly variabilities are much greater.

As shown below, in August of 1960, 12 days were recorded in receiving 641 m.m. of rain, while in 1969, during the same month, 12 days were recorded in having only 44 m.m.

<table>
<thead>
<tr>
<th>Monthly Rainfalls (Paraparaumu)</th>
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<tr>
<td>------</td>
</tr>
<tr>
<td>1950</td>
</tr>
<tr>
<td>1960</td>
</tr>
<tr>
<td>1969</td>
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</tbody>
</table>
main air stream

turbulent wind cycle

cold air ponding

Foredune
Secondary dune

Diagram 8
Serious droughts are not common, although runs of excessively dry months are more common than runs of excessively wet months, with February having the greatest drought frequency. Less than 10 per cent of all days in the year display 'partial drought' characteristics (Cowie 1968).

Like rainfall, sunshine is also plentiful and approximately 2000 hours of bright sunshine a year are experienced. However, the totals of mean hours per year are well below the totals received at New Plymouth and Nelson. An important factor in the number of sunshine hours received, is the general windiness of the area, which, naturally, keeps the atmosphere in motion, therefore day temperatures down.

The predominance of west and north-west winds (46.8 per cent) are a marked feature of the district showing up positively in the angle of the inland-moving sand-dunes. Although the greatest percentage of wind comes from the west and north-west, the greatest proportion of strong winds are received from the south-west. As shown in diagram 7, there is a distinctive drop in wind recorded at night - a large quantity of these nocturnal winds will be off-shore winds caused by radiated inversion.
HYDROLOGY

The result of extensive overgrazing of land in the upper catchment directly behind the Study Area, when it was a part of the Emerald Glen run-hold has caused accelerated erosion due to the loss of natural ground cover on the hill slopes. Although the soils have moderately good water retention qualities, the rapid run-off of surface water after high intensity rainfalls from the north-west causes 'flash' flooding in the lower reaches of the main streams.

Because of the flat physiographic features of most of the Study Area, there is very little natural fall to permit a fast discharge of storm water, so that large volumes of water must be accommodated by the streams during short periods of peak flow; such conditions are experienced about six times a year. This means that open drains are the only practical solution in draining the area. During normal periods of flow the water moves along the drains by gravitational force out to sea.

The agricultural requirements for water are better served in this area than most parts of the Wellington region. The water needs of the pasture amounts to about 25 - 30 inches per year, ranging from about 1 inch per month in winter to about 3.9 inches in January. From April to October, the requirements are usually fully met by the natural rainfall, but from November to March there are liable to be periods when rainfall is insufficient and the moisture reserves of the soil are drawn upon. (Gabites 1960). In soils that have an underlying layer of sand, the moisture reserve is a minimal amount.
Evapotranspiration

Evapotranspiration is the combined evaporation and transpiration from the land surface and its plants. According to Thornthwaite's formula, the Study Area loses $\frac{13}{100}$ths of an inch of moisture a day during January. While in June the figure drops to $\frac{5}{100}$ths of an inch, this dramatic drop is natural, owing to the fall in maximum day temperatures and the reduction of strong winds.

This factor along with the minimal amount of moisture reserved in the soil, mean pastures are most vulnerable to being 'burnt' during the month of January.
SOILS

Soil Forming Factors

In the Study Area, of the five soil-forming factors; parent material, climate, vegetation, relief and time, parent material and climate are relatively constant in this district, vegetation is largely dependent on the other factors, while relief and time vary and it is the variations in these two factors that cause the major differences between the soils. However, the range of soils found in this area could be defined as a reflection of the microclimate conditions from the extreme dryness and high summer temperatures on the sunny faces of the dunes, to the excessive wetness and lower temperatures in the peaty swamps. (J.D. Cowie 1963).

Soil Types

Three distinct dune building periods can be recognised (Leamy 1955), and these are reflected in the presence of three suites with increasing profile development with increasing age.

Taking the dune soils, the youngest suite is represented by Waitarere sand, a soil forming on the unconsolidated dunes bordering the coast. In this soil the sand is still unweathered and the only profile features that have been developed are a browning of the top inch, by decaying organic matter and a slight aggregation of the sand by plant roots. Waitarere sand is very susceptible to wind erosion once the plant cover is depleted.

Foxton dark grey sand represents the next stage in soil development on the dunes. A
Sarid collecting plants

Ammophila arenaria

Coprosma acerosa

Cassinia leptophylla

Cortaderia toetoe

Muehlenbeckia australis

Pteridium aquilinum var. esculentum

Atriplex moschatum

Phormium cookianum

Leptocarpus simplex

Cordyline australis

Sand binding plant

Festuca littoralis

Spinifex hirsutus

Solanum nigrum

Schoenus spiralis

Lupinus arboreus

Cassinia leptophylla

Cortaderia toetoe

Pteridium aquilinum var. esculentum

Atriplex moschatum

Phormium cookianum

Leptocarpus simplex

Cordyline australis

CROSS SECTION OF EXISTING VEGETATION (A-A1)
rather shallow soil of up to six inches has been built up and the subsoil is stained brown with iron oxide released from the decomposition or weathering of the mineral grains. Drainage is excessive in this soil and although pastures can be established, they are poor and dry off early. The shallow soil is easily broken by stock to expose the underlying loose sand to wind erosion.

The oldest generation is represented by Foxton black sand formed on the more consolidated dunes. The topsoil is very distinct, and may be up to twelve inches deep, while the subsoil is browner in colour than Foxton dark grey sand as a result of greater weathering. Fair pastures are maintained for cattle grazing, but because of the excessive drainage they have a tendency of drying off in summer.

Over this age sequence the main changes in the soils with increasing age have been: 
- an increase in the total organic matter content; 
- an increase in the amount of finer particles such as silt; 
- and the development of a better soil structure. 

These factors are obvious when the Foxton black suite is studied in greater detail. These following factors are to be found: Foxton black sand on the dunes which are excessively draining - the content of organic matter is low. Awahou loamy sand which is found in the higher parts of the sand plains which is again free draining - topsoil slightly higher in organic matter, the subsoil is more yellow in colour and large reddish mottles are present in the subsoil. Finally Omanuka peaty loam is found in the peaty swamps and is formed where drainage is very poor, and because of the anaerobic conditions prevailing for most of the year, partly decomposed organic materials accumulate as peat.
All the soils are potentially fertile, being well supplied with lime, moderately well supplied with phosphate, but they are low in potash. (J.D. Cowie 1969).
VEGETATION

Sand-dune vegetation in general

In any sand-dune area there is an interplay of plants and habitat within the constantly changing topography. This, probably being the most adverse of lowland environments, supports a very limited number of plant species fitted in various ways to maintain themselves in such conditions. However a few species flourish, being plants which can withstand:

(i) a moving substrate which covers and uncovers their roots, has little capacity to store water, and affords no encouragement for seedling establishment.

(ii) strong desiccating winds carrying large amounts of salt and driving abrasive sand.

(iii) rapidly changing temperatures.

During the course of his field work, the researcher studied the vegetation along two profiles (see diagrams 10 and 11) at right angles with the fore-dune, working inland until reaching a stable landscape.

Profile A

This profile was studied north of the Whareroa Stream. The first plant community occurred along the fore-dune. These are the "sand-collectors", plants which can exist in the presence of small amounts of slowly drifting sands, but which lack the upward growing and upward rooting habits of true sand binding plants. The collecting plants act in a purely mechanical manner catching and holding the sand until the following succession of vegetation
establish themselves. (Moore and Adams 1963). In the first profile, the most dominant sand collector was the marram grass *Ammophila arenaria* which will not grow healthily except in sand which is actually in motion. Other collectors found were spinifex *Spinifex hirsutus* and the maori ice plant *Disphyma australe*. On the leeward side of the foredune occurred shrubs such as pimelea *Pimelea arenaria*, sand comprosma *Comprosma acerosa* and cottonwood *Cassinia leptophylla*. These shrubs tolerate a certain amount of drifting sand. Along a pedestrian track that had been established in the trough between the fore-dune and the secondary dune was found coast fescue *Festuca littoralis* and the fast pioneer black nightshade *Solanum nigrum*.

On the exposed side of the secondary dune was the first of the 'sand-binders'. These are the perennial plants which have the power of growing up through the sand as the sand level rises and of putting forth new roots from the rising stems. These plants, and these plants only, can be permanently established on areas subject to occasional sand drifts. Other plants can follow them in an ecological succession only after all the drifting sand has been cut off from the area. The dominating sand binders on the secondary dune along this profile were *Muehlenbeckia australis* and the tree lupin *Lupinus arboreus* which is not only a valuable sand binder, but has excellent nitrogen fixation qualities as well. On the leeward side of the secondary dune bracken fern *Pteridium aquilinum* var *esculentum* had taken over as the dominant vegetation with the occasional groupings of flax *Phormium cookianum*. At the base of the secondary dune, owing to restricted drainage, a swamp had been formed, and found here were the stiff club rush *Scirpus nodosus* and the red rush *Leptocarpus simplex*. From this
point onward, the vegetation comprised entirely of tree lupin with the exception of the random *Cordyline australis*.

**Profile B**

This profile south of the Whareroa Stream in many ways did not conform with those found along the first profile. The main sand collector on the fore-dune was marram grass, on the leeward side of this vulnerable dune was found the prolific growing shrub, *Taupata Coprosma repens*. The trough between the fore-dune and the secondary dune had been developed into a picnic area frequently mown. Although the area was studied during the 'off-period', of the year, it was clear that such an area could stand a moderately high degree of use. The exposed side of the secondary dune was again mantled with the *Muehlenbeckia* spp and the tree lupin. However, the summit of this dune reverted back to sand catching plants - marram grass and *Pingao Desmoschoenus spiralis* which indicated that the dune was still at a 'tender' successional stage. The leeward side of the secondary dune was stable, being covered with tree lupin and flax.

In the older dunes where tracking by dairy cows had caused soil erosion, plants to quickly colonize the exposed sandy loam were black nightshade, variegated thistle *Cirsium lanceolatum* and blackberry *Rubus fruticosus*.

South of this profile *Pittosporum ralphii*, *P. eugenioides* and *P. cornifolium* were found growing profusely, the latter according to T.F. Cheeseman (1924), is a native of Kapiti Island, so that their presence on the mainland is probably due to seed transported by birds.
Developed area between the primary and secondary dunes
Tree Species

When the first European settlers arrived in this district there was an extensive belt of Kohekohe forest *Dysoxylum spectabile* along the coastal strip. A small remnant of this forest still remains on the Study Area. The Kohekohe forest was a semi-coastal forest coming close to the sea, protected along the beach fronts by a narrow band of wind and salt tolerant shrubs and sand-dunes. The remnants studied included Ngaio *Myoporum laetum*, Rimu *Dacrydium cupressinum*, Pohutukawa *Metrosideros excelsa* and Paratrophis *banksii*, there was no actual Kohekohe *Dysoxylum spectabile* as this tree was known to the early settlers as the New Zealand Cedar, this wood being very light and easily split was greatly sought after for fencing posts in loose sand, as in such situations, it was the most durable of all native timbers. (Laing and Blackwell, revised 1964).

In close proximity to the remnants of the Kohekohe forest was a manuka stand *Lepto-spermum scoparium* which would be ultimately superseded by a mixed forest.

Introduced trees include *Pinus radiata* and *Cupressus macrocarpa*. Both of these species, particularly the latter, do exceptionally well in this area. A mature stand of *Eucalyptus globulus* is to be found along the western boundary.

**Introduced plant communities**

In the area behind the consolidated dunes, six major plant communities can be distinguished; the first four represent some stage in regeneration after the effects of fire during the 1900's:-
Remnants of a Kohekohe semi-coastal forest
(i) *Bracken - manuka - gorse community*

(ii) *Manuka community*

(iii) *Bracken community*

(iv) *Gorse community*

(v) *Swamp community*

(vi) *Present pastures.*

A number of plants are common to all or some communities, characteristic species being sweet vernal *Anthoxanthum odoratum*, Yorkshire fog *Holcus lanatus*, cat's ear *Halocharis micrantha*, white clover *Trifolium repens* and suckling clover *T. dubium*. (N.T. Moar, 1952).

(i) *Bracken - manuka - gorse community.* This community is found along the consolidated section of the Study Area (particularly near the motorway alignment). One of its main characteristics is its fairly open aspect. Bracken and manuka develop more rapidly than gorse *Ulex europaeus*, as stock graze gorse seedlings and so hold it in check. As manuka is occasionally cut down, bracken is generally the dominant species which sometimes grows to four feet high.

(ii) *Manuka community.* In most places this community has a patchy appearance because of the cutting down of manuka and the recent development of young seedlings.

(iii) *Bracken community.* With the exception of the completely reclaimed peats, bracken is common, particularly in the northern section of the Study Area, but is dominant over only a small area. The bracken produces a comparatively dense cover, and is characteristic where a hummocky surface has resulted mainly from early burning of peat.
(iv) Gorse community. This community is found in the underdeveloped areas and is the only species present except for a few grasses and weeds in the more open marginal belts.

(v) Swamp community. This community forms a narrow belt running parallel to the main highway. It is probably present as a result of the high mineral content of the peat which is watered by run-off from the adjacent hills. Species found in such an area include raupo Typha muelleri, Phormium cookianum, Carex virgatus, Juncus lampocarpus, Epilobium pallidiflorum. Raupo is the dominant, while Phormium is dense only along the edges.

(vi) Pastures. Pastures cover a considerable portion of the peat land, and is used by the Lands and Survey for town supply dairying. The pasture is in general composed of perennial rye-grass Lolium perenne and white clover. Where the pasture has only been recently established Ranunculus repens is present. Polygonium spp enter the community whenever the peat surface is depressed and moist.

Development of induced communities

As the primitive association has been completely destroyed in the Study Area, no account of the primary succession is possible due to early fires. Nevertheless, the biotic factors, a development from one community to another does occur. Most of the communities present have resulted from uncontrolled use of fire, but the pasture community indicates that with care, the peat can be reclaimed at least for dairying.

The development of plant communities in this area is retarded to a certain extent by the grazing of stock. Thus if a manuka community is replaced by bracken, gorse will develop
Colonizing plants on eroded pasture lands
slowly, even after repeated burning, as stock graze on gorse seedlings.

Drainage also plays a part in the development of the induced plant communities. Bracken enters the community when drainage is initiated, but with continual draining, and grazing by cows, the peat surface can become sufficiently consolidated to permit the establishment of a comparatively good pasture. (N.T. Moar, 1952).
RAUMATI COASTAL PEATS

Peat formation in relation to topography

This area is a complex one. The substratum is a sand-dune topography with irregular depressions. As the level of the peat rise, some of the lower dunes become submerged and contiguous deposits become influent. With draining and burning, this process has been reversed, peat boundaries have receded and hitherto confluent deposits have again become separate. Along the eastern side of the Park, the deposits have been regularly inundated with silt-bearing water from the adjacent steep hillsides. On the lower slopes of these hillsides, trees may be seen with the older roots exposed well above the present ground level. The areas inundated by the run-off from these slopes have begun their development as eutrophic (mineral enriched) basin peats with a swamp vegetation. With the accumulation of peat, the effect of flooding has succeeded, following a transition shrubland stage. (W.F. Harris, 1969)

Under the most favourable conditions this has been swamp forest - an association in which kahikatea Podocarpus dacrydioides is present, with species such as pukatea Laurelia novae-zelandica and maire Eugenia maire which are adapted to swamp conditions (Cockayne, 1928). Over the years the trend was for a gradual transition from swamp forest to a coastal forest. (see vegetation).

The peat formation in relation to groundwater

It is possible to regard peat forming conditions in the area as having diverged into two different types; one in which the area is flooded by aerated surface water which may
be capable of transporting coarse or fine materials; the other in which there is a saturation
of the soil by ground water in which anaerobic conditions tend to develop. In an area such
as this, there is variation, both in the rate and in the volume of water flow, and the
relation of basin to watershed will depend on the depth of flooding and the transporting
power of the water. These variations have found expression in both depth of peat, and
kind of peat.

Sedge peat occurs in the inundated areas, particularly near the Whareroa Stream, but
also south of this stream, and along the eastern margin of the large peat areas bordering the
main highway from McKay's Crossing to Raumati South. It would appear from the borings
carried out by N.T. Moar (1952), that from the thickest peat layer formed in the area is
forest peat, suggesting that the forest peat accumulation may be relatively rapid. Much
of this forest peat is shallow and from the variation in its thickness, it should perhaps
be concluded that the depth of peat and rate of accumulation depends more on the conditions
of accumulation than on the type of peat.

The greatest thickness of sedge peat is found near the Whareroa Stream, and the
thickest forest peat layer is deposited on the western side of Poplar Avenue, Raumati South.
Where a total depth of 9 to 13 feet has been attained in the forest peat, there has been a
transition to a bog stage, characterised the fern Gleichenia. It seems that the depth
of the basin is gradually reduced as peat accumulates, with a corresponding change in the
substratum and in the water regime; also that the depth of a basin is considered in relation
to an open drain and not simply to the height or steepness of neighbouring slopes. Hence there is a diversity in 'shallow' basins which is reflected in the differing peat forming vegetation, and in the peat types that occur in them:-

(i) sedge (raupo and flax)
(ii) rush and moss
(iii) manuka and moss
(iv) swamp forest.

**Developed peat characteristics**

The peat, in developed areas being compact, holds moisture better than the less compacted peat of undeveloped areas. It tends, therefore, to poach, and is susceptible to invasion by rushes. Sweet vernal Anthoxanthum odoratum is ubiquitous but only dominates poorer pasture. Better pasture is dominated by ryegrass, Lolium perenne and white clover Trifolium repens. Knot-grass Polygonum aviculare grows in the wetter areas with rushes; sorrel Rumex acetosa is found in pasture that is liable to dry out. The southern-most area is a narrow strip of fibrous, spongy, swamp peat chiefly under raupo. Most of this land was used as a military camp during World War II, and artificial soils have been created, now under pasture. It is interesting to note that on the side nearest the present main highway, the silt is slightly consolidated and has much tall fescue Festuca arundinacea. (W.F. Harris, 1969).

As a result of draining, particularly in the Wellington City Council area, the peat has shrunk considerably, and the upper layers are mineralised. The top 3 to 8 inches has become
a peaty loam; however when the peat on the surface becomes too dry, microbiological activity is hindered, and mineralisation, with the consequent compaction and improvement of the peat is delayed.

According to D.S.I.R. tests, the Raumati peats have a pH in the vicinity of 5.8. This acidity factor can be corrected under good management.
Coastal Bird Life

Falla (1968) states that the normal vegetation of the western coast, North Island, provides cover of an open kind, which is generally a more favourable environment for large numbers of birds, than a more densely wooded area. Some of the obvious advantageous factors are the good drainage and low humidity, the size and accessibility of numerous insects, the range of edible fruits and protein in the leaves of leguminous plants in such areas.

A noticeable characteristic, is the high proportion of naturalised passerine birds, especially finches. They are not only present in greater density than on most other kinds of favourable country, but they are present in considerable density, at times when the same species are absent or scarce elsewhere. This round the year abundance makes them a significant factor in the biotic mosaic.

It is difficult to say what may have been the ecological significance of some changes that appear to have occurred historically in the composition of the bird fauna. However, indigenous seed and fruit eaters, notably native quail have disappeared, whereas a number of purely insectivorous indigenous birds still occur in the Paekakariki area. Of the naturalised gallinaceous birds, the larger and more conspicuous pheasant seems to fluctuate in abundance more than the smaller Australian brown quail.

Waterfowl associated with fresh water swamps in sand dunes are not likely to differ in species composition because as a group they are less conservatively bound to territory than terrestrial birds and are by habit more mobile and wide ranging. However, during the past few years, there has been a drastic drop in the number of waterfowl, especially the native

The seaward dunes without too much vegetation attract another category of birds, namely waders and gulls, deriving most of their food from the tideline or even from the sea, but requiring adjacent open country for nesting.
After gathering all the preceding data, it becomes obvious that the problems being faced in the Study Area will increase in magnitude and complexity in the near future. The problems are far reaching; most have evolved from past decisions which have become detrimental factors in unbalancing the equilibrium met by nature's forces.

THE FORESHORE

It is an established fact that sand is brought to the Study Area by a southerly drift carrying erosion debris from the Rangitikei and other rivers to the north. The sand is composed principally of grains of quartz and feldspar up to 0.5 m.m. in diameter. (A.E. Esler, 1968). The preponderance of these minerals, the small diameter and the shape of the grain, contribute to the looseness and free mobility of the sand, which makes foreshore stabilization a difficult process on the west coast beaches. Making stabilization even more difficult, is the reduction in the littoral drift due to the control of headwaters of the depositing rivers by the Catchment Boards. (L.S. Donnelly, 1959).

This has meant natural aggradation processes have been changed, giving a decrease in
Seawalls at Raumati South constructed from local driftwood.
sand forming material. This factor has caused the beaches to retrograde at an increasing rate. This process has been established since the 1950's when sea walls were constructed along the foreshore from Paraparaumu to Raumati South, in the belief that this would stop beach erosion. Sea walls, however, provide an obstacle to the movement of the sand by wind from the foreshore to the dunes. Walls will also return all the water thrown onto the wall by the swash, meaning the backwash will be just as powerful, because no water can be lost by percolation into the sand. This means that the sand brought in by the tide moves out again forming bars in shallow water offshore. (A.M. King, 1962).

In 1959, Donnelly reports

"some of the causes tending to facilitate erosion are the constant removal of sand from the beaches for building and other purposes, plus the removal of all the driftwood for sea walls. The former has now practically been stopped by County by-law, but the latter is constantly going on, now that the coastline is populated almost along its entire length." (see plate 7).

However it was observed in May 1972, that the above practices still persist, as a great majority of the sea walls at the Raumati South end have been constructed from the largest pieces of driftwood along the beach, which like the sand, have moved down the coast from the northern rivers. It is obviously not realised that these pieces of wood act as natural groynes which slow down the littoral drift of the sand and act as 'sandcatchers' which supply the foredune with sand and protects it from destructive waves. With this natural barrier
gone, the foredune is prone to erosion. It is quite noticeable that the worst erosion is occurring in close proximity to the township of Raumati South, where logs are in 'dragging distance' for the seawalls - the erosion decreases further south. (W.S. Cooper, 1966).

THE FOREDUNE

The importance of the protection of the foredune cannot be stressed enough. The foredune presents to inland areas, a permanent barrier to the supply of sand from the sea. Its surface is uniformly covered by a growth of sand herbs. This uniform covering of vegetation stops all sand gradually, in such a fashion that by the time the end of the land slope is reached, no sand is drifting inland to injure the sand collectors. This gradual slopeage ensures an even distribution of all fresh sand over the whole dune, so that there are neither hummocks nor gullies to cause wind eddies and wind erosion. (A.E. Esler, 1969).

As future intentions are for the whole of this coastline to be 'opened-up' for public amenity, it should be noted that even now there is man-made erosion present along the foredune, where the natural supply of sand has been cut off by the building of seawalls, so that the foredune has retrogressed into a vulnerable state.

The building of seawalls consequently means a reduction in foredunes. This factor is having repercussions in other natural fields, such as a loss of the nesting habitat for the pied stilt, banded dotterel and the oyster catcher, which are all less common now than in
'Blow-holes' in the secondary dune ridge at Galloway's Gully
From the ecological point of view, the seaward side of a foredune, which is colonised, especially by Spinifex, has a regular shape, with a slope of 14 - 16 degrees, as the plants rhizomes have a tendency to find concavities in the dunes and to gather sand, helping to fill incipient channels. However, most of the foredunes in the Study Area, particularly in the northern section, have marram grass as their dominant species, which builds a dune that is higher and much steeper (24 - 28 degrees). Its clumped habit causes irregular deposition of unprotected sand in its lee and this leads to wind channelling and blowouts. As a binder of subsurface sand it has no equal but this feature is a doubtful virtue when one evaluates its potential to accommodate the usage expected of this area in the future.

"An imperfect foredune which is irregular in outline due to concentration of usage, becomes channelled by wind cuts and is densely covered in parts and bare in others, giving a false sense of security." (A.M. King, 1962).

"Another cause facilitating erosion, is the activity of some beach patrons in destroying vegetation on the foreshore and undermining the sand face at the top of the beach." (Donnelly, 1959).

As already stated, there are indications of sand dune erosion along the coastline of the Study Area. Perhaps the erosion is not as bad as some northern beaches, such as the Muriwai Beach Domain, where, due to a rapid increase in urban population and the upsurge of interest in water oriented recreation, particularly surfing, has led to erosion on such a scale, that two feet of that Domain are lost each week. (P.J. Jew, 1970).
In the Study Area, there are two distinct types of erosion present. At the Raumati South end, the 'wandering dune' type is prevalent. It has originated from the sand which has drifted inland from the damaged foredune and has aggregated into a special type of sandhill. The freely moving sand moves slowly as a mass, not as individual sand grains. These dunes have a great variety of shapes, and move at widely different rates. Their main characteristic lies in their prevailing wind slope which has a gentle grade to it, while the leeward side is extremely steep and moves forward by the constant slipping of the sand at the crest. When a dune of this shape has been formed, it is no longer dependant on fresh supplies of sand from the shore. Its bluff forward face engulfs everything that comes in its path. In the Study Area, the vegetation that such a dune is engulfing includes Phormium cookianum, Coprosma repens and Pittosporum eugenioides (see plate 7). Unless immediate reclamation work is undertaken, these dunes will 'swallow-up' the trough lying behind the foredune, turning it into an unstable sand plain. (C.M. Smith, 1924).

Moving sand is the other type of sand erosion which is evident along the coastline. This has been caused directly by concentration of usage in small areas where people have tracked over and weakened the vegetation leaving the sand unprotected and allowing its removal by the wind. As mentioned earlier, this sand is characterised by inconstant properties, and is usually carried along by the wind at varying heights above the ground. When the sand finally settles in thin layers, it buries herbaceous vegetation or collects in
Drainage impeded by slabs of concrete
temporary round hillocks. At the Paekakariki end of the Study Area, erosion has not only been caused by concentration of usage over small areas but by poor siting of carparks in such an unstable landscape.

THE SECONDARY DUNE

As stated in the physiographic section, the secondary dune consists of two long parallel 'wings' or ridges that unite at their eastern end to form an apex. The caps of these parallel ridges are frequently covered with marram grass, a clear indicator of the sensitivity of this area, because marram grass is the first plant in succession for stabilizing the dune. A more positive indication is the sand erosion across these ridges caused by the tracking of people between each developed 'pocket' and unwise action in the past of bulldozing a track along behind the foredune. (see plate 8). It is worthy of note that the apex of the secondary dunes, especially at the northern end, could not have developed to the same degree in the absence of marram grass because the indigenous flora has no species ecologically equivalent to marram grass as a stabiliser, therefore the acute profile makes it unacceptable to large quantities of usage. At the Paekakariki end of the coast, the secondary dunes have a more rounded appearance because the ridges were 'fixed' by indigenous flora.

It must be positively understood that the topography of 'pockets' and ridges which have developed are not permanent, as they could only be preserved where sand is held near the shore on a rapidly prograding coast. As this is a retrograding coastline, the foredune in its
Erosion of the secondary dune
present form does not have an infinite capacity to hold all the sand that comes ashore so that the sand could well begin to 'wander' inland, smothering vegetation. (J.M. Schofield, 1967).

SOILS AND VEGETATION

It is often quoted that the vegetation growing in an area reflects the conditions of the soil. Such a statement is valid when summing up the state of the soils and vegetation of the Study Area.

The Waitarere soils are the youngest suite found on the unconsolidated dunes bordering the coast. They are very susceptible to wind erosion once the plant cover is depleted and the organic material is exposed to the prevailing wind. An ecological equilibrium can only be returned by establishment of sand collecting plants in vulnerable areas. (J.D. Cowie, 1968)

The next suite inland, Foxton dark grey sand, has a shallow topsoil, which is also easily broken to expose the underlying loose sand to wind erosion. The vegetation is more stable than that found on the first suite, but is still in a fairly sensitive state with the bulk of the plants consisting of sand binders, such as lupin and Muehlenbeckia sp.

The third suite of soils, Foxton black sands, has been formed on the more consolidated dunes, with a topsoil of fourteen inches. The vegetation is mainly comprised of lupin with random areas of pastoral land stocked by dairy cows. On this suite is found the remnants of
a Kohekohe coastal forest. Unfortunately, during the latter years, stock have been allowed to graze through the forest denying the possibilities of regeneration of the species to take place. This forest is in alignment of the proposed motorway, therefore it may have a limited life anyway.

HYDROLOGY

Because of the rapid expansion in developing areas behind the coastal land, drainage of swampy land is in progress. It should be observed that in coastal country, the water table relates to that of the surrounding swamps. Vegetation in coastal country relies on capillary action for its moisture content, so that a rapid drop in the water table will leave plant rooting systems in suberious conditions, causing them to wilt. (I. McHarg, 1969)

Too rapid draining will also cause the surface peat to dry quickly. It crumbles and becomes powdery with the result that lateral movement of water is prevented whilst moisture cannot be drawn by surface evaporation from the wet peat below. The result is that a very dry crumbly peat overlies stagnant peat, which inhibits the development of a good pasture. If the water table should rise after drainage has been initiated, due to local blocking of the drainage system (see plate 10), the induced plant community will revert to a partly primitive community. (A.W. Riddolls, 1958)

Not only does drainage of swampy land have direct environmental implications on man and vegetation, it also affects the wild life in the area. Most of all the water fowl, as the natural habitat for such species as the pukeko Porphyrio melanotus is being destroyed.
Diminishing swamp land, meaning a decrease in waterfowl habitat.
Another reason for the disappearance of waterfowl is the uncontrolled use of herbicides in the open drains to keep them clear of weeds. These extreme measures are not only having a 'permanent' effect on the waterfowl, but is detrimental to the aquatic ecosystems of the streams. (W.D. Billing, 1964).

The earlier mentioned factor of related water tables in coastal sand country should have been taken into consideration when many of the weekend batches were built in the sand troughs at Raumati South, as they become flooded with surface water after a period of high intensity rain.

CONCLUSION

From this chapter have evolved certain factors that make it imperative that certain constraints are placed on future development of the Study Area.

To absorb the required number of people and activities proposed for the area, would mean the existing natural landscape and ecosystem would have to be drastically modified to withstand the 'demand' required of it. Complete stabilisation of the coastal land could result only from afforestation or the introduction of vast quantities of soil, which would allow the use of a wider range of stabilizing plants.

But can man afford to modify this landscape to such extremities? What makes Queen Elizabeth Park is its naturalistic qualities. To modify these would automatically convert it into just-another-park with no identifiable characteristics.

As discussed in Chapter II, up till the present day, most authorities have looked upon
Loss of Recreation Quality

- coastal erosion
  - seawalls
  - catchment-board control
- biological imbalance
  - human impact
  - landscape modifications

Interacting Environmental Factors
the coast as a never ending resource. Unless precautions are taken now, this natural resource could be destroyed for future generation's enjoyment. As Christian (1966) states "To shape a living landscape that maintains a full flow of energy in every habitat, with its rich variety of maritime plants and animals, is no simple task while our knowledge remains comparatively meagre. How can the impressive natural features confronting the oceans be protected, the sense of space and distance be preserved, the right degree of wildness and loneliness be maintained? In short, how can we ensure that those who go to the seaside return refreshed in mind and spirit?"

Positive planning policies must be adopted to help retain the Study Area as a living entity. Allowing for maximum usage of the stable areas and a 'regulated' use of the more vulnerable areas.

The capabilities of the various environments in relation to the impact of man upon them can be summarised as following:

(a) the foreshore, tolerant to heavy usage.

(b) foredune, intolerant; as a consequence no activities should be permitted on this dune.

(c) trough behind foredune, tolerant to light usage but the parallel ridges intolerant to constant usage.

(d) the secondary dune, as vulnerable as the foredune, however limited access across this dune is permissible.
(e) the consolidated dunes, lend themselves to the maximum opportunity for the concentration of usage.
Alignment of the new Motorway
CHAPTER VI

Recreation

THE NEED FOR OUTDOOR RECREATION

"The clock, not the steam-engine is the key-machine of the modern industrial age. For every phase of its development, the clock is both the outstanding fact and the typical symbol of the machine: even today no other machine is so ubiquitous.

Abstract time has become the new medium of existence. One eats, not upon feeling hungry, but when prompted by the clock; one sleeps, not when one is tired, but when the clock sanctions it." Lewis Mumford.

The nature and severity of the emotional stresses and strains of modern life have been emphasized by many writers. Although this viewpoint may sometimes be overstated, it does seem clear that modern life is more ordered in terms of time than was life in earlier periods as the proceeding text describes admirably.

In the past many outdoor recreation specialists have emphasised the psychological and emotional need for outdoor recreation - need for relief from the tensions and emotional strains which modern urban living place upon the individual. To recreation in general, and to outdoor recreation in particular, they ascribe great value, of almost a therapeutic kind.
Some stress that in outdoor recreation the individual can test his physical fitness and ability to cope with nature. Still others emphasise the opportunity which outdoor recreation gives for self-fulfilment and individual choice.

"Deprive man of intimate relationship with the soil or some equivalent, and his bodily powers, as well as spiritual and mental fibre weaken and decay." (J. Forester, 1966).

The psychological and emotional need for outdoor recreation has been over-emphasised up till now. However, the demand for meaningful outdoor recreation is very strong. As people are free to choose how they will spend their time and their money, many will choose outdoor recreation. By their actions, they make it clear that they value recreation highly - more highly than other activities which would have used the same time and money. The 'demand and the need', approaches are not necessarily in conflict. If there does exist a psychological need not measurable in conventional economic terms, then there also exists some form of value in addition to any direct monetary value that may be estimated. (J.L. Knetsch, 1969)

PATTERNS OF RECREATION ACTIVITY

Typically, an outdoor recreation area is used intensively during a brief period of time, moderately at other times, and wholly unused for much greater periods of time, unlike city parks, zoos and museums, which have a constant pattern of usage. Surveys in patterns of usage usually show total attendance by months, which give some idea of seasonal variation in
use, but they generally understate the daily variation of use. At the extremes, such as the Study Area, they may get half their annual use in as few as twenty selected days of the year, and very little use during half to three-fourths of the whole year. Even a calculation of divergencies in attendance based on daily attendance may understate the extreme variation in time of use. Not only may the weeks use occur on Sunday for instance, but much of this may be during the afternoon hours.

The results of a survey undertaken by T.L. Burton (Bracey 1970) of three rural parks in Manchester, showed that these were common features:

(i) The peak period for visits was between 2.30 p.m. and 5 p.m.
(ii) Most visitors lived within 30 miles of the park.
(iii) Most arrived by private car.
(iv) Visitors comprised either family groups or parties of the same age.
(v) 70-75 per cent intended to stay a few hours or the whole afternoon, and 20 per cent, less than one hour.
(vi) In areas where visitors were able to sit near their cars, 20 per cent of the parties chose to do so.
(vii) Family parties which included children, tended to picnic more often than parties of adults.
(viii) Most visitors came from urban and suburban centres.
(ix) 16 per cent remained in their cars most of the time; they were more often the older members of the party.
This survey demonstrates how some visitors prefer activities centred around their cars. Burton concludes that to some people, the car is an extension of the home—a piece which is detachable but can still be used to carry out some of the home's important functions. To what extent should these factors influence the overall planning of a recreation area?

Probably the most comprehensive study of outdoor recreation was prepared for the United States Government in 1962 (O.R.R.R.C.), which should be used as a 'pilot' for patterns of recreation for New Zealand in the future. The results of this study included:

(i) Active use of leisure increases with rise in personal income.

(ii) The satisfaction with the present amount of spare time for recreation, varies with income. In the lowest income level, 63 per cent were content. In the middle income group, 40 per cent were satisfied, while in the highest income group, some 75 per cent were satisfied.

(iii) The survey showed that increases in mobility through the spread of car ownership, was putting existing recreational resources under strain. It is relevant that 52 per cent of car owners wanted more leisure, but only 39 per cent without a car.

(iv) Other factors affecting outdoor recreation were climate, occupation, and urban form. For example, professionals look for more recreational outlets than shopkeepers, and farm workers were least of all interested in recreation.

Some of these factors are already taking effect in New Zealand, such as the professional person being the most conscious of recreation activities. In a survey undertaken in a National Park, it was found that although the professional person makes up only one-tenth of
A view of Kapiti from Beach Road
the New Zealand force, just over half of the trampers using the parks fall into the professional category. (W.R. Cotton, 1972).

TRANSPORTATION AND OUTDOOR RECREATION

It has been found that travel distances are closely related to the kinds of recreation and the timing of available leisure. Also, there is a great variation among users of different areas; some may enjoy a long drive, others may object to it. Seasons and weather also affect travel time and willingness to travel. With these variable factors in mind, the following may never-the-less represent typical one-way distances for certain types of outdoor recreation (M. Clawson and J.L. Knetsch, 1966).

After school and during the day. For mothers with small children, less than one mile.

After work. For adults seeking special opportunities, up to 5 miles.

One-day outings From 35 to 70 miles

Weekend outings From 150 to 200 miles.

As income per capita increases, the average person will be able to afford far more travel than in the past. Car ownership per family will almost surely rise; more families will have more than one car; and a greater proportion of all families will own one car. The anticipated greater leisure will permit more time for driving, in order to reach outdoor recreation areas. As a result of these factors, the average travel per person may well increase from 5000 miles at present to 9000 miles by the year 2000; and an increasing large
Concentrated use has meant the destruction of the natural equilibrium - Paekakariki
proportion of this increased travel will be primarily for recreation in the countryside. The impact of increases of this magnitude upon outdoor recreation areas, will be felt the greatest upon the outlying regional parks. (M. Clawson and J.L. Knetsch, 1966).

Historically, an improvement in transportation has led to an increase in recreation use, while an increase in recreation demand has put a major strain on the transportation systems. There seems to be general situations in which the effect of recreation demand upon transportation facilities is felt.

The first and most obvious - the existence of an outdoor recreation area calls for roads into and out of it. An estimate of the potential use of such an area, by calculation of a Master plan, gives the engineer an idea of the traffic volume with which he will have to cope.

Secondly, the demands for outdoor recreation will create serious highway problems leading out, and back into the major urban centres. While New Zealand is becoming an urban nation (60 per cent of the total population live in cities), most outdoor recreation opportunities lie outside of the cities. Moreover, people have their leisure at similar times. The result is a rush out of the city on Friday afternoon, Saturday and Sunday especially during the summer; and late Sunday there is a rush back in. Weekend traffic peaks often rise above weekday peaks. Routes leading from the cities to the coast often have peak volumes double the designed capacity of the highway. This factor is now more apparent than the continual flow of traffic along State Highway No. 1 from Paraparaumu to Paekakariki on a Sunday afternoon.
PRESERVATION OF RECREATION QUALITY

When the matter of quality in outdoor recreation is considered, there may be a difference between the views of the expert and that of the public. This has been found to be true in the case of foods for example. The public has traditionally valued red apples more highly than other apples, while the expert would rate them as of equal quality. (Bracey, 1969) Nevertheless, some objective standards for quality in outdoor recreation areas can be set up that would have nearly universal acceptance, at least for some activities or kinds of areas. For instance, ocean beaches, streams and other natural swimming areas should have certain characteristics: tides or currents should not be dangerous and sand shores are preferable to mud. Other physical attributes could be cited for other kinds of activities that would involve a high degree of consensus as to quality. However, in each case, areas with high quality features will be preferred over areas of low qualities. (L.G. Gray, 1934).

The planning officers of outdoor recreation resources such as the Study Area, have a responsibility they cannot escape, if they would. People use what they can; if good opportunities are available, they use these, but if only poor ones are available, they use these too. If recreation areas are well maintained, the average person will probably treat them better than if they are ill kept.

"The measures taken to cater for the public are appreciated by the public. (S.S. Winans, 1959)."
USE CAPACITIES FOR A SPECIFIC ENVIRONMENT

No matter how well an outdoor recreation area is planned, particularly in a sensitive coastal landscape, there is some limit beyond which recreation use of a given area cannot be increased without direct loss of recreation quality. Once loss of quality begins, further deterioration often follows swiftly and severely, unless a change in that form of environment and in the acceptable level of expenditure is incurred. It seems almost inescapable that popular areas must have use capacities established and enforced. In many other types of natural resource use, the concept of maximum allowable use has long since been accepted. If too many livestock graze on an area, they consume nearly all the growth of palatable material, the plants are weakened, and in time the productive capacity of the area is lessened. Therefore, there are limits, depending on soil, climate and other factors, beyond which annual output cannot be increased and below which annual harvest must be kept if productivity is to be maintained. (J.P. Dangermond, 1970).

There is no reason to think that recreation use differs from grazing in this respect. There are some limits beyond which use cannot increase without serious deterioration in quality of the recreation experience - and frequently serious physical deterioration of the areas as well.

Unless the trend toward heavier use of some areas can be modified, and in some cases, such as the vulnerable sand dunes of the Study Area, the present degree of intensity of use reduced, then many present favourite recreation areas will suffer severe physical deterioration for all time.
Stability of zones in relation to their recreation demand

Diagram 14
A study by Marion Clawson (1969), shows how under some circumstances, recreation use of areas could be rotated over a period of years. Thus a recreational area could be developed and used rather intensively for some years, and then closed, to be replaced by another in a generally similar location. This would be economically more feasible if improvements were not too costly, and that satisfactory additional areas exist, to which recreational use could be shifted. This type of rotation might be synchronized with another land use such as afforestation. The area could be used for recreation during the growing period, but taken out of recreation use during timber felling and early replanting parts of the cycle.

The costs and benefits of permitting relatively heavy recreation use of an area, and then shifting use elsewhere during the cycle would have to be weighed against the costs and benefits of much lighter but continuous use throughout. Recreation rotation would not be practical for intensively developed areas, nor would recreationists probably be willing to forego use of the most desirable areas during any part of a cycle.

However, the management of recreation areas to conserve, not only the physical resources, but also the quality of the experience, will become more important in the future and will play a bigger part in everyday life.
CHAPTER VII

Future Demands On The Park

To escape from the pressures of urban life and to seek recreation in refreshing surroundings in a rural or coastal setting is not a new phenomenon. However there is one main difference between now and the beginning of the century, or even twenty-five years ago. In those days, the motor car was in its infancy, and the train took people from Wellington to beach resorts such as Paekakariki. (this area in particular being the end of the public service line).

Today all visitors to Queen Elizabeth Park come by car, and most of them expect to take their car with them wherever they want to go in the Park. For some people the car is an extension of the home - a piece which is detachable but can be used to carry out some of the home's important functions. The experts claim that a lot of visitors would object strenuously if anyone tried to separate them from their motor cars. However, separated they must be, and in the very near future.

As over the years there has been a change in the mode of transportation, there have also been changes in the 'users', of the Park. During the earlier days, one found a greater family alliance, with primary groups of mother, father and children enjoying the pleasures of each others company. These days there is a tendency for age-stratification to dominate the
groups using the Park. This cultural change has lead to changes in recreation patterns, where once family groups enjoyed public open space, one finds teenage 'bottle' parties which always cause a deterrent action amongst other age groups, so that certain areas of the Park are almost solely used by one age group. This problem of social differentiation will be a major concern unless strict supervision is kept on new areas that are to be 'opened-up' for public use.

As new areas of the Park become available for recreation, then the use of the already developed areas in the Park's system, of which they are a part, will alter. These changes may come either from the supply side, by the addition of new recreation areas, or the improvement of old ones, or the demand side as the population of the western suburbs increase. Proposed new roads through the Park will make previously inaccessible areas available. So that there will be direct and primary adjustments; the new areas will attract visitors so that the load on established areas is reduced. But this primary adjustment will almost certainly lead to further changes; the new added load on one area leads people to go to another area or the new facility will draw the pressure off some presently overloaded area, thus making it more attractive, due to the regrowing of the natural vegetation in that area, and this in turn will induce people to use it, who previously had rejected it.

In the Dominion newspaper (27th May 1972), M.H. Holcroft stated that "Picnic spots at Paekakariki continue to receive debris, and every year become more jaded, sometimes to the edge of squalor. It is hard to believe that so many people still want to use them. But they do"
One characteristic of the Park is its present extreme seasonality. During the summer months the foreshore and adjacent dunes along the coast are the main target for recreation, while during the winter months this area is comparatively 'empty' of people. The Wellington City Council developed area is used predominantly for active recreation during the winter months, while use over the summer months is light. This leads to both time and space-peakings. Perhaps the only redeeming feature of these peakings of uses, is that they give other areas a recuperation period; but perhaps longer use of suitable areas at a more modest intensity than previously experienced would be just as wise.

As mentioned in a previous chapter, more outdoor recreation has been made possible by increased leisure time, which has lead to both direct and indirect impacts upon the natural environment. The direct effects on Queen Elizabeth Park are mostly adverse, as people crowd onto popular areas. Enough human feet can be as destructive of vegetation, wildlife and natural landforms, as the bulldozer driver in the recent past, when forming car parks along the beach front at Paekakariki.

As a nation we have not learned how to practice management of popular outdoor recreation areas, vulnerable landscapes. Original and present vegetation cannot reproduce under the kind of use situations that have grown up. Unfortunately the day of reckoning has arrived for many of our most popular areas. Life can only be restored back into them, if drastically different methods of management and of use intensities can be devised. As Holcroft concludes:

"Motor cars allow people to set up pressures wherever roads can take them. If
they carry people often enough to one spot, and in sufficient numbers, the countryside feels the weight of a larger population, without actually having one.

At Paekakariki, where a park has turned sour, and a beach is dying, you can see what happens near a city. As the circles widen it may happen elsewhere. I make no predictions. I am merely reporting what I have seen, in 20 years, in a place that was once a safe distance from Wellington, but is now too close to it."

The impact upon the psychic environment may be as great or greater than on the natural environment. A large portion of all present outdoor recreation areas were established because they offered a certain type of solitude or naturalness. In the case of Queen Elizabeth Park, the popularity of some areas has destroyed a lot of the qualities that led originally to the Park's establishment. Up till now the primary purpose of the Park has been for outdoor recreation, while the retention of natural conditions has been important but only secondary. The Park is designated as a Regional Park, and must play a leading role in recreational outlets for Wellington, but as it is a natural heritage of the region, its primary purpose of recreation should therefore go hand in hand with preservation. This is not a fundamental change but only a re-orientation of ideas.

In biological terms, the Park as a natural resource is no better than a lot of the neighbouring coast. What sets it apart is the protection that it should receive as a natural area and to show future generations what the coastline looked like before civilization modified it. As Christian (1964) rightly states "Man made the countryside, God made the coastline."
Similar to the environmental implications dealt with earlier, most of the answers in the outcome of Queen Elizabeth Park do not lie within the boundaries of the Park, but in the decisions made in relation to planning for other Regional Parks in the very near future. The policies set out by the U.S. Government on this matter may possibly be used as a guide-line by local authorities.

(i) The number of parks should be increased until the system includes representative samples of all kinds of scenery and all the kinds of habitats in the region.

(ii) The boundaries of the parks should be redrawn on ecological lines, including sufficient land to allow them to be managed as biological units.

(iii) If the parks are to continue to serve their purpose, the number of visitors to any given park must be held to no more than that park can stand without being markedly changed.

(iv) In nearly every existing park, visitor pressure is already causing changes, not only because of the presence of the people themselves, but because of the engineering necessary to accept their presence. Rather than continue to expand the present kinds of facilities, the Park Service must develop new techniques which have less impact on the park habitat. (Eichhorn, N.D., 1965)

The best conclusion for this chapter and the whole study is provided by the Second Conference of "The Countryside in 1970", where it was stated:
Undeveloped Park-land - what is its best recreation use?
"We feel strongly that in managing any area of the countryside for recreation, the primary objective should be the retention or creation of a varied natural environment. We have a moral obligation to future generations for what we do with the natural world around us. Unless we make conscious efforts to conserve our natural landscape, they will inevitably be destroyed sooner or later by the pressures that man is placing on them. This is not a plea for a minority interest. The essence of all recreation activities in the countryside is the natural environment in which they are pursued."
Design Philosophy

The primary reason why the proceeding information has been compiled is to use it as the basis for decision making when planning the dominant use of different areas of the Park. Certain key factors have arisen from the research that will influence the final overall design.

Probably the most important of these key factors is the generation gap between sand dune formations and therefore have a different range of tolerances for usage. This geomorphological fact must be accepted by the Park's Board and should be considered in future development, such as the proposed Marine Drive from Paekakariki to McKays Road, along the ridgeline of the secondary dune, which is still in a sensitive state of development. To carry out the suggested plans for this road could only result in a great many modifications to the landscape, that should rightly be preserved.

This road would also have a dichotomy effect on future recreation patterns - the foreshore and its environs would become separated from the hinterland east of the proposed road. Instead of one being divorced from the other, they should be coexisting as many factors tie these areas together. In addition, this road from Paekakariki to McKays Road, would generate unnecessary traffic through the Park. The primary function of the Park is to cater for the outdoor recreationist, not the Sunday afternoon driver.

The road pattern should follow what has already been suggested for from the Raumati South end of the Park, where the road is only a means of access into the central areas from
which point visitors can radiate out to their chosen destination. By doing this it alleviates traffic pressure on McKays Road which will become much heavier due to people travelling to and from the golf links, overnight park, and the tramway service.

As mentioned in Chapter V, there are two ways in which the actual recreation areas could be managed - either by heavy use of areas in a rotational pattern, or regular light use, because of the fragility of the natural landforms and the sensitive Ecological state of the ground cover, the latter method of management would be the most desired.

If future planning is undertaken as outlined in this study, it would be found that only a small proportion of park users will walk to the secluded areas, while the majority of visitors will want to stay in close proximity to the family car. The area most suited to accommodate a lot of this public pressure is the trough behind the secondary dune, which is not only capable of withstanding concentrated usage, but is the most desirable area for recreation, being protected from the prevailing nor-westerly wind. There would be formed walking tracks for those people who wished to adventure to the foreshore for a swim.

On land unsuitable for both stock grazing and recreation in its present form, an extensive afforestation scheme could be put into operation to help develop areas of a higher recreation quality for the future. If planted as bold statements on the landscape, they would help to create a rhythmic experience for motorists on the new motorway, of distant and foreshortened views.
The greatest change visualised for the Park is the re-alignment of the tramway. A more meaningful route has been proposed with an authentic township being established as a positive terminal at the end of the line. By doing this, visitors will have added incentive in using this unique means of transportation.
References


DANGERMOND, J.P. 1970. RECREATION AND SATISFACTION OF HUMAN NEEDS. Environment Systems Research Institute, California.


GABITES, J.F. 1960. CLIMATE OF WELLINGTON. Meteorological Note No. 47.


JEV, P. J. 1970. Foredune Stabilisation - Muriwai Beach Domain. SOIL AND WATER JOURNAL 7 (1); 7 (2) p.35.


RIDDOL, A. W. 1958. FARM ENGINEERING. Technical Correspondence School, Wellington.


SMITH, C. M. 1924. Sandy Point Domain Afforestation Scheme. Report for the Invercargill City Council.

FUTURE ENVIRONMENTS OF NORTH AMERICA.


WELLINGTON REGIONAL PLANNING SCHEME 1966.