

FIGURE A2.1. SEDIMENT SAMPLING SITES ON THE HOLOCENE BARRIER. NOTE THAT LONG RIDGE SAMPLES ARE NUMBERED 1-9 TO DISTINGUISH THEM FROM TRANSECT SAMPLES.

2. *INCLUSIVE GRAPHIC STANDARD DEVIATION (SORTING)*

$$\sigma_I = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6.6}$$

$\sigma_I (\phi)$	Verbal Classification
Under 0.35	Very well sorted
0.35 - 0.50	Well sorted
0.50-0.71	Moderately well sorted
0.71 - 1.00	Moderately sorted
1.00-2.00	Poorly sorted
2.00-4.00	Very poorly sorted
over 4.00	Extremely poorly sorted

3. *INCLUSIVE GRAPHIC SKEWNESS*

$$Sk_I = \frac{\phi_{16} + \phi_{84} - 2\phi_{50}}{2(\phi_{84} - \phi_{16})}$$

SkI (ϕ)	Verbal Classification
-1.00 - -0.30	Strongly coarse-skewed
-0.30 - -0.10	Coarse-skewed
-0.10 - +0.10	Near symmetrical
+0.10 - +0.30	Fine-skewed
+0.30 - +1.00	Strongly fine-skewed

4. *GRAPHIC KURTOSIS*

$$K_G = \frac{\phi_{95} - \phi_5}{2.44(\phi_{75} - \phi_{25})}$$

KG (ϕ)	Verbal Classification
Under 0.67	Very platykurtic
0.67-0.90	Platykurtic
0.90 - 1.10	Mesokurtic
1.10-1,50	Leptokurtic
1.50 - 3.00	Very leptokurtic
Over 3.00	Extremely leptokurtic

Full details of size parameters for Matakana Barrier samples are included in Betts (1996).

Mineralogy

The 2 ϕ -4 ϕ sieve fraction was retained for mineralogical analysis, following the procedure of Healy (1978). Heavy minerals were separated from the samples by flotation in an aqueous solution of sodium polytungstate, of specific gravity 2.90 (Callahan 1987). The heavy and light fractions were mounted on slides in clove oil and examined under a petrographic microscope. A minimum of 300 grains was counted for each sample.

Full details of the sand mineralogy of Matakana Barrier samples are included in Betts (1996).

References

- Betts, H.D. 1996. Late Quaternary evolution of Matakana Island, Bay of Plenty, New Zealand. Unpublished M.Sc. Thesis, Dept. of Geography, Massey University, Palmerston North.
- Callahan, J. 1987. A nontoxic heavy liquid and inexpensive filters for separation of mineral grains. *Journal of Sedimentary Petrology* 57, 765-766.
- Folk, R.L. and Ward, W.C. 1957. Brazos River bar, a study in the significance of grain size parameters. *Journal of Sedimentary Petrology* 27, 3-27.
- Healy, T.R. 1978. Some textural and mineralogical investigations of the Rangitaiki Plains foreshore and river sands. Bay of Plenty coastal erosion survey report 78/4. Bay of Plenty Catchment Commission, 74 p.

Appendix 3

STRATIGRAPHY AND SOILS OF TRANSECT G-H

Sections with soils and stratigraphy described in Table A3.1 are recorded from five swales on the outer part of the barrier along the transect line G-H (Fig. A3.1). The swales are numbered 1 to 5 in a harbourward direction. The youngest swale (1, Fig. A3.1) is *c.* 115 m harbourward of the Taupo foredune; the oldest swale (5, Fig. A3.1) is on the immediate seaward side of Long Ridge.

Airfall Kaharoa Tephra is present in all swales. In each swale the tephra buries a well-developed soil. In swales 1, 2, 3 and 5 the buried soil has the appearance of a podzol with a pale, apparently leached horizon separating a darkish topsoil from the subsoil. Podzolisation, however, is much less apparent from the soil profile descriptions (Table A3.1) and soil chemistry (Table A3.2).

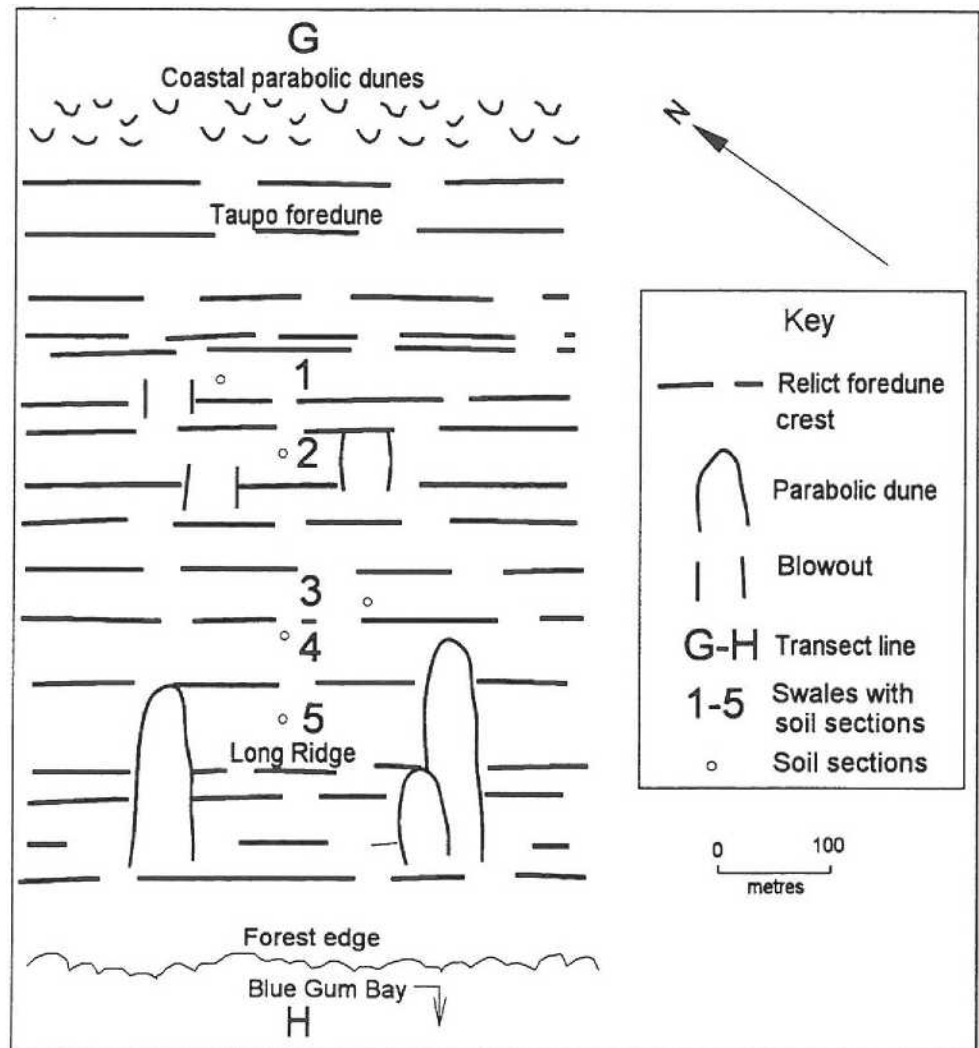


FIGURE A3.1. TRANSECT G-H SHOWING LOCATION OF SECTIONS DESCRIBED IN TABLE 1. FOR LOCATION OF TRANSECT SEE FIGURE 8 (MAIN TEXT).

Inspection pits seaward of the five swales show that immediately harbour ward of the Taupo foredune the Kaharoa Tephra fell on a very poorly-developed topsoil overlying whitish-grey sand, and seaward of the Taupo foredune it appears to have fallen on sand with little or no observable soil development.

In all five swales the tephra is buried by stratified sandy deposits up to 72 cm thick. Whether the overlying sand accumulated from natural processes following the Kaharoa eruption or from cultural processes is not clear. In Swale 4 the sandy deposit immediately above the tephra contains lenses of clean and dirty sand, together with shell and charcoal fragments, suggesting cultural processes at least played a part in its accumulation.

The sand layer immediately overlying the Kaharoa Tephra in swales 2 to 5 has lumps of the tephra and pieces of charcoal mixed through it and, in Swale 4, it also contains occasional shell fragments. The sand layer in swales 2, 3 and 5 is reasonably well mixed and there is no sign of the internal lenses present in swale 4. The layer is 27 cm thick in Swale 5 and 22 cm thick in Swale 4, but its thickness in swales 2 and 3 appears to have been reduced by subsequent forestry operations.

The lumps of Kaharoa Tephra in the sand layer in swales 2, 3, and 5 indicate disturbance of the underlying tephra after the sand layer had been deposited. This disturbance was also probably responsible for introducing charcoal into the layer from above. The disturbance is not attributed to forestry operations which produce a layer often containing pieces of pine wood and pine cones. The extent over which the disturbance occurs in each of the swales has not been investigated, although in Swale 5 where several pits were dug the disturbance occurs over an area of at least 10 m by 10 m.

Gardening in prehistoric times is thought to be the cause of the disturbance. The presence of the well-mixed sand layer in at least three of the swales, and its extent in Swale 5, supports gardening as a probable cause insofar as its occurrence suggests a reasonable areal extent for the mixed layer. The mixed layer is matched by a disturbed soil of similar thickness and content which extends over a distance of 80 m in the section along Hunter's Creek. It is similar to gardened soils on sand dunes at Papamoa 15 km southeast of Matakana Barrier (see main text) and has a thickness which is consistent with gardened soils elsewhere in New Zealand (McFadgen 1980).

The chemistry of the garden soil does not differ significantly from the chemistry of the soil beneath the Kaharoa Tephra (Table A3.2) suggesting that soil chemistry is unlikely to provide a useful means of identifying garden soils on the barrier.

References

- McFadgen, B.G. 1980. Maori Plaggen Soils in New Zealand, Their Origin and Properties. *Journal of the Royal Society of New Zealand* 10, 3-18.

TABLE A3.1. DESCRIPTIONS OF SWALE STRATIGRAPHY AND BURIED SOILS.
SWALE 5

DEPTH (cm)	DESCRIPTION
0-25 (Sand from dug holes)	Brown (10YR4/4) sand. Very friable. Single grain with some weakly developed medium granular structure. Few roots. Sharp irregular boundary.
25-55 (Soil disturbed by forestry)	Brownish-black (10YR2/2) sand with many fine and few medium faint mottles. Very friable. Single grain with weakly developed fine and medium nut structure. Few roots, with charcoal fragments. Sharp irregular boundary.
55-72 (Garden soil) uAp	Black (10YR1.7/1) sandy loam with many fine and medium distinct and prominent mottles of greyish yellow brown (10YR6/2) in lower part of the horizon. Very friable to friable. Moderately developed fine nut and medium to coarse granular structure. Few roots, few fine charcoal fragments. Sharp irregular boundary.
72-76 (Kaharoa Tephra)	Kaharoa Tephra, dull-yellow (2.5Y6/3). Layer of variable thickness from 2 to 10cm comprising a basal coarse component 3-4cm thick overlain by fine component. Few to many distinct black fine and medium mottles. Upper part disturbed by gardening. Few roots. Sharp irregular boundary.
76-81 (Buried topsoil) uA1	Brownish-black (10YR2/2) sandy loam with few fine and coarse distinct mottles of Kaharoa Tephra. Very friable. Fine to medium granular structure with some fine nut. Few roots, many fine and medium angular pumice lapilli (Taupo), and few fine charcoal fragments. Distinct boundary.
81-95 uA2(?)	Dull yellowish-brown (10YR4/3) sandy loam with many fine and medium faint greyish yellow brown (10YR4/2) mottles. Very friable. Weak to moderately developed very fine to medium nut structure. Few roots. Distinct boundary.
95-119 uB	Yellowish-brown (10YR5/6-5/8) sandy loam with many medium to coarse distinct brownish-black (10YR3/2) and dull yellow-orange (10YR6/3) mottles. Very friable. Moderately developed very fine to medium nut structure. Few roots. Distinct boundary.
119+ C	Brown (10YR4/4) sand with many large, irregular, faint dull yellowish-brown (10YR5/4) mottles. Loose to very friable. Single grain. Few roots.

SWALE 4

DEPTH (cm)	DESCRIPTION
0-14 (Soil disturbed by forestry)	Black to dark-grey sand with pine needles and wood overlying light brown sand with some charcoal fragments. Distinct irregular boundary.
14-25	Medium-brown to dark-brown sand with charcoal and shell fragments increasing in quantity towards bottom of layer. Rare lapilli. Distinct irregular boundary.
25-33	Light-brown sand with shell fragments and charcoal fragments. Occasional lapilli. Distinct irregular boundary.
33-37	Dark-greyish-brown sand with abundant whole and fragmented shells and charcoals. Distinct wavy boundary.
37-43	Shell midden with abundant burnt and unburnt, whole and fragmented shells. Distinct wavy boundary.
43-66	Black sandy peat with patches of white Kaharoa Tephra, lenses of grey sand, occasional lapilli and fragments of charcoal and shell. Distinct irregular boundary.
66-74 (Kaharoa Tephra)	Layer of fine Kaharoa Tephra, 5cm thick, overlying 3cm of coarse tephra.