VEGETATION AND FLORA OF MAUAO HISTORIC RESERVE VOLUME 1

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1. INTRODUCTION

This project was commissioned by the Tauranga District Council to provide information to underpin the future management of Mauao Historic Reserve. The objectives of the survey were:

1. To carry out a botanical survey of Mauao Historic Reserve.
2. To provide detailed information on landform, vegetation pattern, and species distributions.
3. To provide an historical perspective on vegetation development and use this as a basis to provide recommendations for future management.
4. To provide management recommendations.

Mauao (Mt Maunganui) is located at the entrance to Tauranga Harbour and is a prominent landmark of the Tauranga District (see Figure 1). It is in the Tauranga Ecological District, in the Northern Volcanic Plateau Ecological Region (McEwen, 1987).

The climate of Mauao can be generally characterised as warm temperate, its close proximity to the sea resulting in relatively infrequent frosts (Tauranga District Council 1996). The predominant winds are from the west or southwest, the windiest season being spring and the calmest winter. Mean annual rainfall recorded at Tauranga Airport is 1300 mm, with late autumn and winter being the wettest part of the year and summer the driest. The mean annual temperature at Mauao is 14.1°C, with a maximum recorded temperature of 33.2°C (January) and a minimum recorded temperature of -5.3°C (May).

Detailed descriptions and maps of landforms and vegetation are provided in this report. The report is presented in two volumes. Volume One contains sections on survey methods, vegetation history, vegetation and habitat descriptions, flora and vegetation management. The appendices include a list of indigenous species, natural and planted, a list of common names used in the text, and definitions of technical terms. Volume Two contains distribution maps for most of the indigenous species known to be present on Mauao.

2. SURVEY METHODS

The field survey methods used in the project are set out below.

2.1 Landform

General

Mauao is a low mountain (252 m) composed of Pleistocene minden rhyolites (Healy *et al.* 1964). The easy gradient of the lower slopes becomes progressively steeper further upslope, the undulating summit being generally surrounded by rocky precipitous cliffs.

Mauao is bounded by sea on three sides; to the north and west it is exposed to the open sea, with Tauranga Harbour to the south. On its eastern side It is connected by a low sand isthmus to the flats and low hills east of Tauranga. The foreshore on Mauao is generally rocky, with small shell beaches in the north east and sand beaches in the south west.

Methods

An initial assessment of the underlying geology of Mauao was completed prior to commencement of field work. Information from Healy, Schofield and Thompson (1964) indicated that landforms could not be derived from differences in the underlying geology. A field survey was then undertaken and topological differences were used as the basis for the differentiation of landforms. Landforms were mapped onto an enlarged colour photocopy of an aerial photograph (1:3595; 1999) and notes were collated on the features that characterise each landform unit.

The definitions below were used for field mapping and the landform pattern is mapped in Figure 1.

Landform Descriptions

Brief descriptions are provided below for the 10 landform types mapped in Figure 1.

1. Rocky shore

   A rocky shore is present around most of the coastal margin of Mauao. The substrate varies from boulders to basal rock headlands

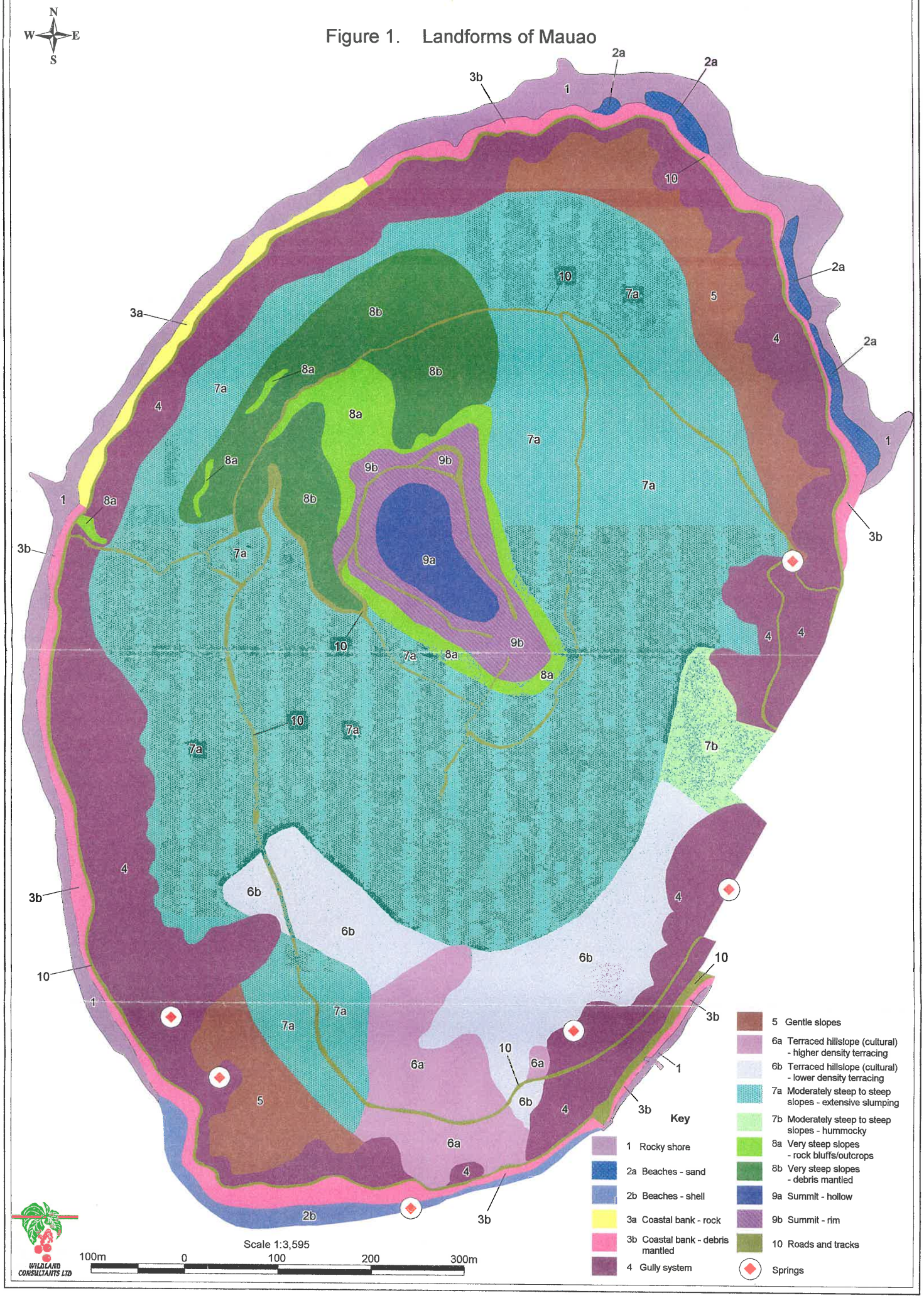
2. Beaches
   (a) sand beach
   (b) shell beach

   Sand beaches are present on the southern, harbour facing shores, with shell beaches on the northern, open seaward shores. The beaches are relatively small in extent compared to the extent of rocky shore.

3. Coastal bank
   (a) rock
   (b) debris mantled

   A coastal bank is present below the track along the seaward margin, with a debris mantled variant more common than rock bank. A rock bank present at the northern end of Mauao, exposed to the open sea.

Figure 1. Landforms of Mauao



4. Gully system

A gully system is present along the toeslope of Mauao, above the coastal track. It is generally steep (*c.*20° on average) comprising of a series of small gullies and dividing 'ridges'.

5. Gentle slopes

Gently sloping areas (generally 5-10°) immediately above the gully system at the northern and southern ends of Mauao.

6. Terraced hillslope (cultural)
   (a) higher density terracing
   (b) lower density terracing

Relatively large areas of hillslope terraced by polynesians for cultivation and settlement. The terracing present in some areas is more prominent and denser than others.

7. Moderately steep to steep slopes
   (a) with extensive slumping
   (b) hummocky surface

Moderately steep to steep slopes (approximately 10-35°) are the predominant landform of Mauao. Boulders are common on the surface, particularly on the eastern slopes. An area in the east shows evidence of extensive slumping.

8. Very steep slopes
   (a) rock bluffs/outcrops
   (b) debris mantled

Immediately below the summit there is a rim of rock bluffs and outcrops with a slope generally greater than 35°. On the northern face, debris mantled steep slopes extend down to adjoin the gully system. The most extensive area of rock bluffs and outcrops is present in this area.

9. Summit
   (a) hollow
   (b) rim

The summit has been divided into an outer rim, which is relatively flat and undulating, with a hollow in the center, which is generally of lower elevation than the rim and more sheltered.

10. Roads and tracks

2.2 Vegetation

Existing information was collated and assessed; e.g. Gardiner 1995, Beadel 1994, Bishop & Beadel 1997.

An enlarged colour photocopy of a 1999 aerial photograph was used initially to identify vegetation boundaries. Field inspections were then undertaken to describe the vegetation types and refine the boundaries between them. The composition of the canopy and understorey were described by inspections of the canopy using binoculars and inspection of understorey vegetation on foot.

Broad vegetation and habitat classes and more detailed vegetation types and habitats were defined following the classification of Atkinson (1985). A detailed vegetation and habitat map is presented in Figure 2. The following vegetation classes and types were delineated and described (refer to Appendix 2, definitions of terms used in the vegetation classification).

Vegetation Class	Vegetation/Habitat Type	
Forest	1.	Pohutukawa forest[1]
Treeland	2.	Pohutukawa treeland
	3.	Pohutukawa-rewarewa/akepiro-mingimingi-hangehange-manuka-karamu-mamaku treeland.
	4.	Macrocarpa/karaka-pohutukawa treeland
	5.	Sycamore-karaka-radiata pine treeland
	6.	Radiata pine-eucalyptus-(sycamore)/pohutukawa-poplar treeland
	7.	Poplar-paulownia-silky oak-bead tree treeland
	8.	Poplar treeland
	9.	Poplar shelterbelt
Treefernland	10.	Mamaku treefernland[2]
	11.	(Pohutukawa)-(rewarewa)/mamaku-mahoe treefernland
Scrub	12.	Pohutukawa/mingimingi-akapino-hangehange scrub
	13.	(Pohutukawa)-(kanuka)-(rewarewa)-(totara)/mahoe-whauwhaupaku-manuka-karamu-howthorn-mingimingi scrub
	14.	Totara-mahoe-hawthorn scrub
	15a.	Mahoe-mingimingi-hangehange-karamu scrub
	15b.	Mapou-mingimingi-mahoe-karamu scrub
	16.	Manuka-kanuka-mingimingi-(pohutukawa) scrub
	17.	Kawakawa-whau-mamaku scrub
	18.	Gorse-manuka-Spanish heath-pampas scrub
	19.	Pohutukawa/gorse-pampas scrub
	20.	Gorse-Spanish heath-pampas-rarahu-smilax scrub

1 Includes types 1a, b, c.
2 Includes types 10a, b.

Vegetation Class	Vegetation/Habitat Type
Shrubland	21. Kawakawa-pohuehue/pohuehue-blackberry shrubland
	22. Manuka-(pohutukawa)-(akeake)-(mingimingi) shrubland
	23. Pohutukawa/mahoe-mingimingi-hawthorn-kawakawa-gorse shrubland
	24. Gorse-pampas tussock-shrubland
	25. Gorse-woolly nightshade/kikuyu grass shrubland
Planted Areas	26. Totara treeland
	27. Ngaio-akeake-pohutukawa/kikuyu grass-gorse treeland
	28. Ngaio scrub[1]
	29. Whau-karamu-ngaio-(tarata)-(manuka)-(pohutukawa)-(taupata)/kikuyu grass-cocksfoot shrubland
	30. Pampas/paspalum-gorse-kikuyu grass tussock-grassland
Vineland	31. Pohuehue-rarahu-*Isolepis nodosa* fern-vineland
	32. Pohuehue-rarahu kawakawa-mingimingi-mahoe-blackberry fern-vineland
	33. Japanese honeysuckle-gorse-rarahu vineland
Fernland	34. Pohutukawa/rarahu fernland
Tussockland and Rockland	35. Pohutukawa-taupata/*Isolepis nodosa* tree-tussockland
	36. Pampas-gorse shrub-tussockland and rockland
Grassland	37. Kikuyu grass-ratstail grassland[2]
	38. Ratstail grassland
	39. Gorse-paspalum-pampas shrub-grassland
	40. (Manuka)/cocksfoot-paspalum-bidibid grassland
Miscellaneous	41. Summit road, 4WD track and walking tracks
	42. Water reservoir
	43. Rocky foreshore
	44. Sand beach
	45. Shell beach
	46. Sealed road
	47. Jetty

1 Includes types 28a, b.

2 Includes types 37a, b.

2.3 Species Distributions

Mapping the distribution of all indigenous species was undertaken as a second phase of the project. The landform and vegetation maps (Figures 1 and 2) were used to provide a framework for mapping species distributions. Two methods were used. Canopy species were mapped in the field using aerial photographs and binoculars. Many transects were traversed across Mauao to record species present in understoreys.

The distribution of each indigenous species was mapped on A3 black and white aerial photographs (scale 1:3,595; supplied by Tauranga District Council, flown 1997). Relative abundance was recorded using the following cover classes: 1 = <1% (of the vegetation cover); 2 = 1-5%; 3 = 6-25%; 4 = 26-50%; 5 = 51-75%; and 6 = 76-100%.

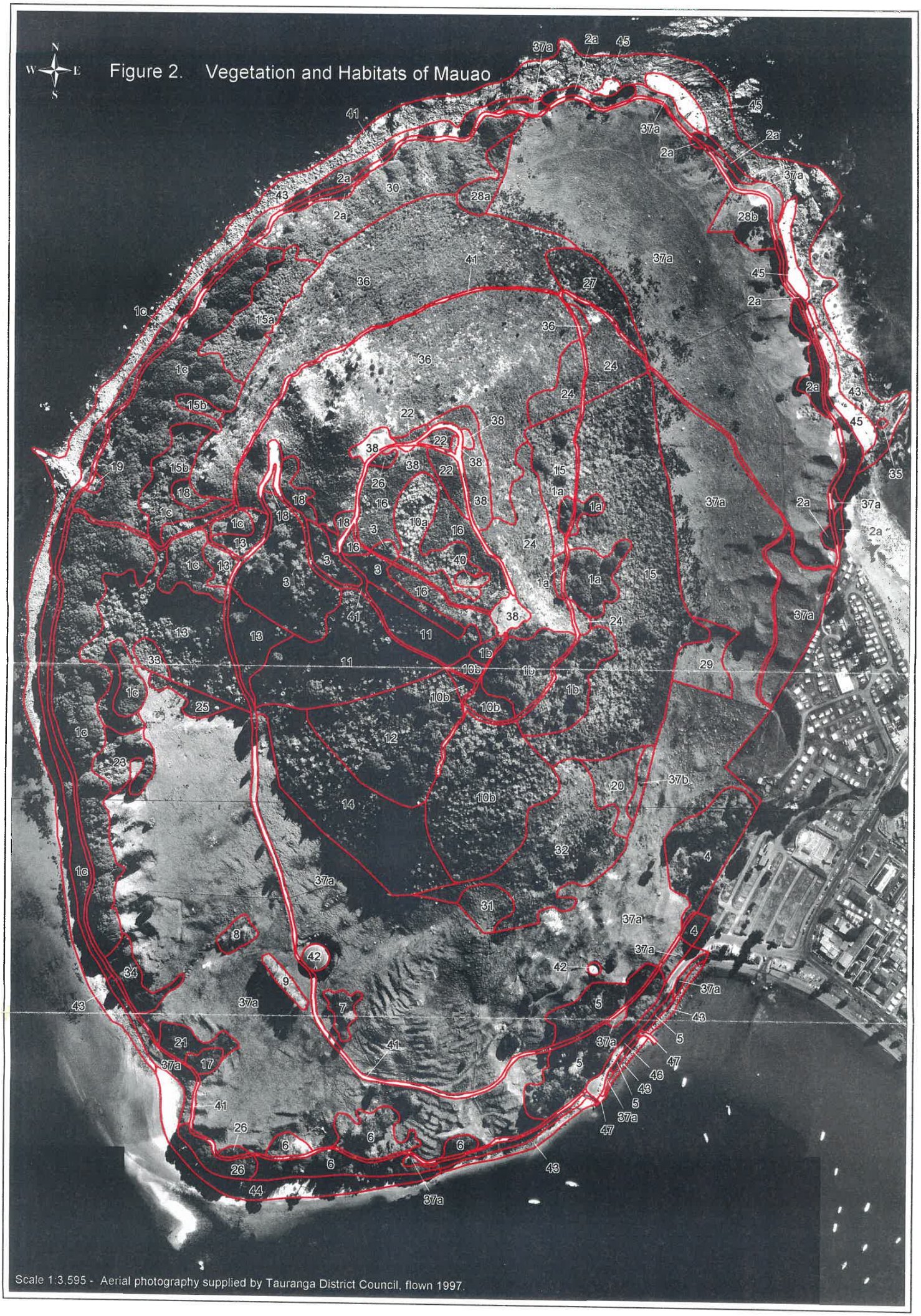

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Figure 2. Vegetation and Habitats of Mauao
Scale 1:3,595 - Aerial photography supplied by Tauranga District Council, flown 1997.

The exact distributions of many herbaceous species could not be determined due to their scattered occurrences and/or inconspicuous character. In this case the average cover of the species was assessed within each vegetation type.

Some species would have been missed for the following reasons:

- They have a highly local distribution.
- Some grasses did not have seed heads at the time of the survey and could not be positively identified.
- Some terrestrial orchids are only present above ground and conspicuous in certain times of the year and could not be located when the survey was carried out.
- The bluffs were not surveyed comprehensively as they are too steep and dangerous without specialist safety equipment and support.

3. VEGETATION HISTORY

Pre-Human

Prior to human occupation Mauao would have been covered almost entirely with coastal forest of pohutukawa (*Metrosideros excelsa*) , puriri (*Vitex lucens*), karaka (*Corynocarpus laevigatus*), ngaio (*Myoporum laetum*), houpara (*Pittosporum crassifolium*) and kanuka (*Kunzea ericoides* var. *ericoides*), and shrubs or small trees of karo (*Pittosporum crassifolium*), houpara, mapou (*Myrsine australis*), whau (*Entelea arborescens*) and nikau (*Rhopalostylis sapida*). There are likely to have been local occurrences of rimu (*Dacrydium cupressinum*), northern rata (*Metrosideros robusta*), tawa (*Beilschmiedia tawa*), hinau (*Elaeocarpus dentatus*), rewarewa (*Knightia excelsa*), mangeao (*Litsea calicaris*) and kamahi (*Weinmannia racemosa*). Specialist species would have been present on bluffs, beaches, coastal rocks and seepages, such as *Euphorbia glauca*.

Human-Induced Change

People lived on Mauao for many centuries.

> "The most elaborate fortified sites in the region were at Maunganui, Mangitawa and on the hills at Papamoa. Maunganui, an isolated mount protected by the sea on all sides except the narrow sandy isthmus to the east, was an ideal site for a large fortified village. The main village was on the south side and the remnants of extensive terracing and numerous middens testify to its long occupation."
>
> (Stokes 1980)

Fire

Fire will have been an important factor in the ecology of Mauao since human occupation. The original vegetation will have been cleared at an early stage, and fire would have been used repeatedly to keep Mauao relatively open. Pre-European vegetation was mapped as

"fern and manuka scrub" by Stokes (1980). A large fire was reported in November 1842 (Cunningham and Musgrave 1989) and an 1858 illustration shows the southern and western slopes devoid of heavy vegetation. Refer to Plate 1 below.

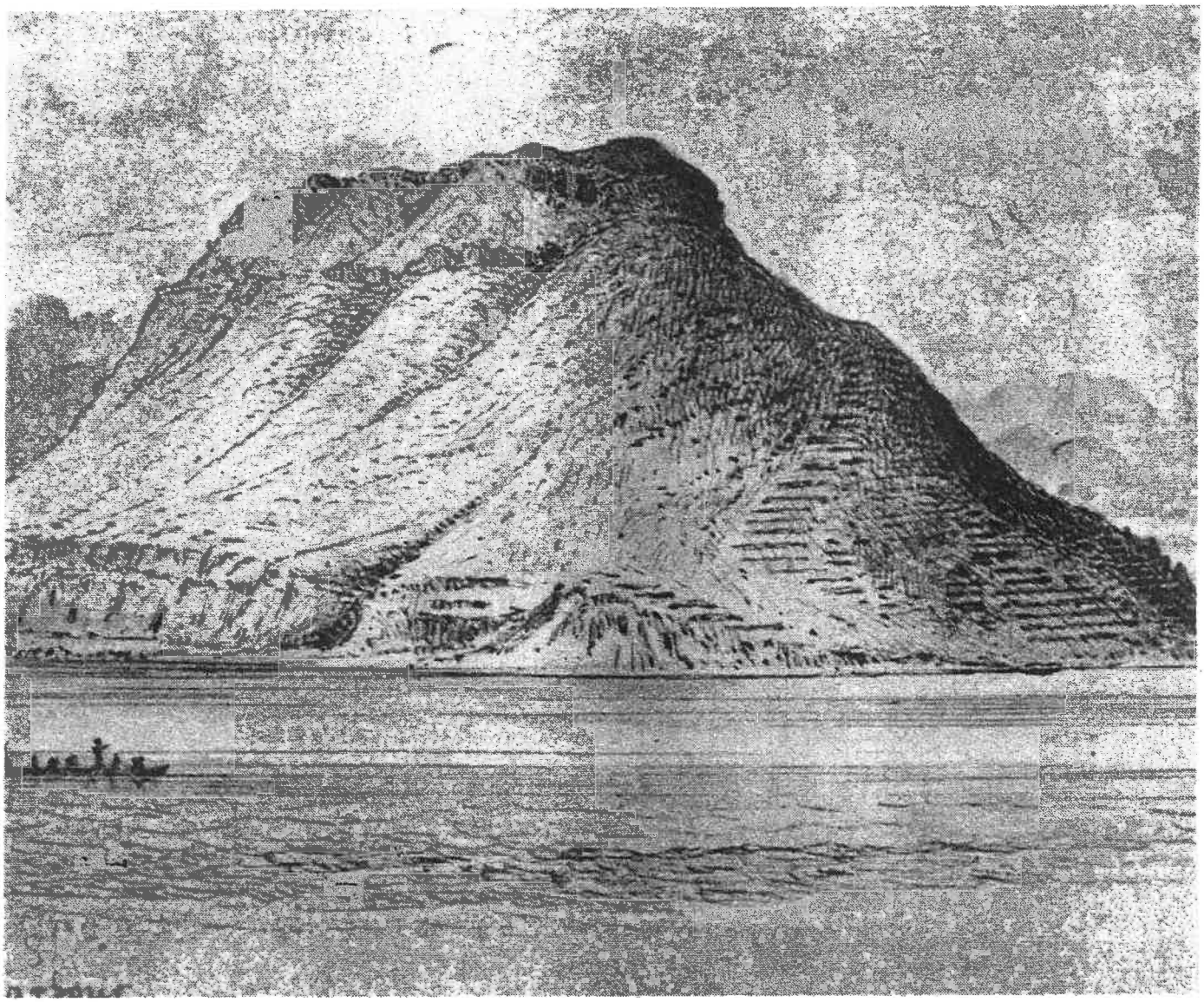

Plate 1: Southern slopes of Mauao in 1858.
(An etching reproduced from BOP Times 26 May 1987.)

From analysis of aerial photographs from 1943 to 1999 it is evident that fire has affected the vegetation of parts of Mauao at reasonably regular intervals over the last 60 or so years. Evidence of most recent fire related vegetation change is confined to the northern flanks of Mauao, with a different extent affected within the same general area by each fire episode. Most of the indigenous-dominant vegetation on the southern and western slopes has not been affected by fire since 1943, probably reflecting the slightly damper environment on these slopes and the lower flammability of the more advanced vegetation successions.

In the 1943 aerial photograph earlier successional vegetation is evident over a reasonably large area. Refer to Figure 3 - a vegetation map derived from the 1943 aerial photography. There is no evidence of fire between 1943 and 1959 as shown by a large increase in the numbers of pines (*Pinus* sp.) in the vicinity of the summit and in the area affected by fire prior to 1943.

From interpretation of aerial photographs taken in 1977 it appears that between 1959 and 1977 only a restricted area on the upper northern slopes was affected by fire. However, Cunningham and Musgrave (1989) noted that "fires in the mid-1960s were particularly severe" and that the road to the summit was constructed in the late 1960s to provide vehicle access for fire fighting.

The 1996 aerial photograph shows evidence of an earlier major fire and this is supported by an article in the Bay of Plenty Times Supplement (26 May 1987) which documents a planting expedition in response to a "disastrous fire early this year". The area affected by this fire was still clearly evident on the 1996 aerial photograph, with a large area of gorse (*Ulex europaeus*)-dominant vegetation.

There was a major fire in Decmeber 1997 which burnt nearly all of the gorse-dominant vegetation, and also some vegetation that was not burnt in 1987 (refer to Figures 4 and 5).

From comparison of the 1943 and 1999 vegetation maps (Figures 3 and 4) it is apparent that there have been significant changes to the vegetation over the last 56 years. Major changes are summarised below:

- Much of the scrub on the western and southern slopes in 1943 has developed into treefernland, treeland and forest.
- The area of pasture has diminished.
- Exotic treeland is no longer present on upper slopes.
- Pohutukawa treeland and forest along the western slopes in 1943 has developed into a larger area of indigenous forest.
- The extent of pohutukawa treeland on the coastal margin has increased.

Recent fires on Mauao appear to have occurred at 10-15 year intervals (pre-1943, mid-1960s, 1987, 1997), and have all occurred in the same area; on the northern slopes.

Grazing

It is not clear when grazing of domestic stock was first undertaken on Mauao but it was most likely early this century or even the later part of the 1800s. An undated manuscript held in the Tauranga Library ("Taina" - Visions of Boyhood) relates to early childhood and notes that "manuka clad its upper slopes, with many magnificent pohutukawa and karaka in groves, or clinging above the rocky shores". It also records an observation of a "boundary rider whose job was to keep the cattle that grazed the Mount from straying".

Figure 3. Broad Vegetation Pattern (Vegetation Classes) on Mauao in 1943

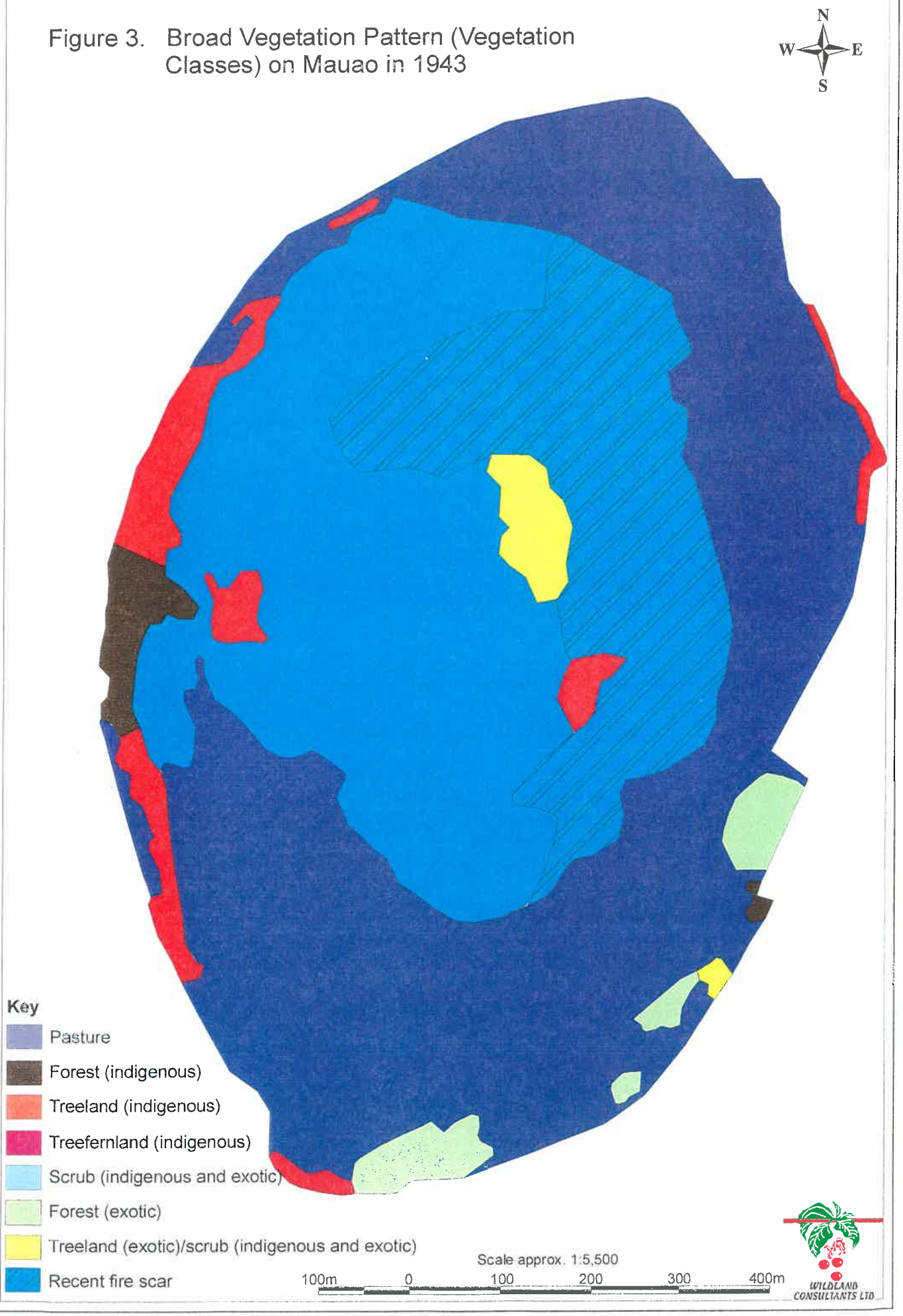

Figure 4. Broad Vegetation Pattern (Vegetation Classes) on Mauao in 1999

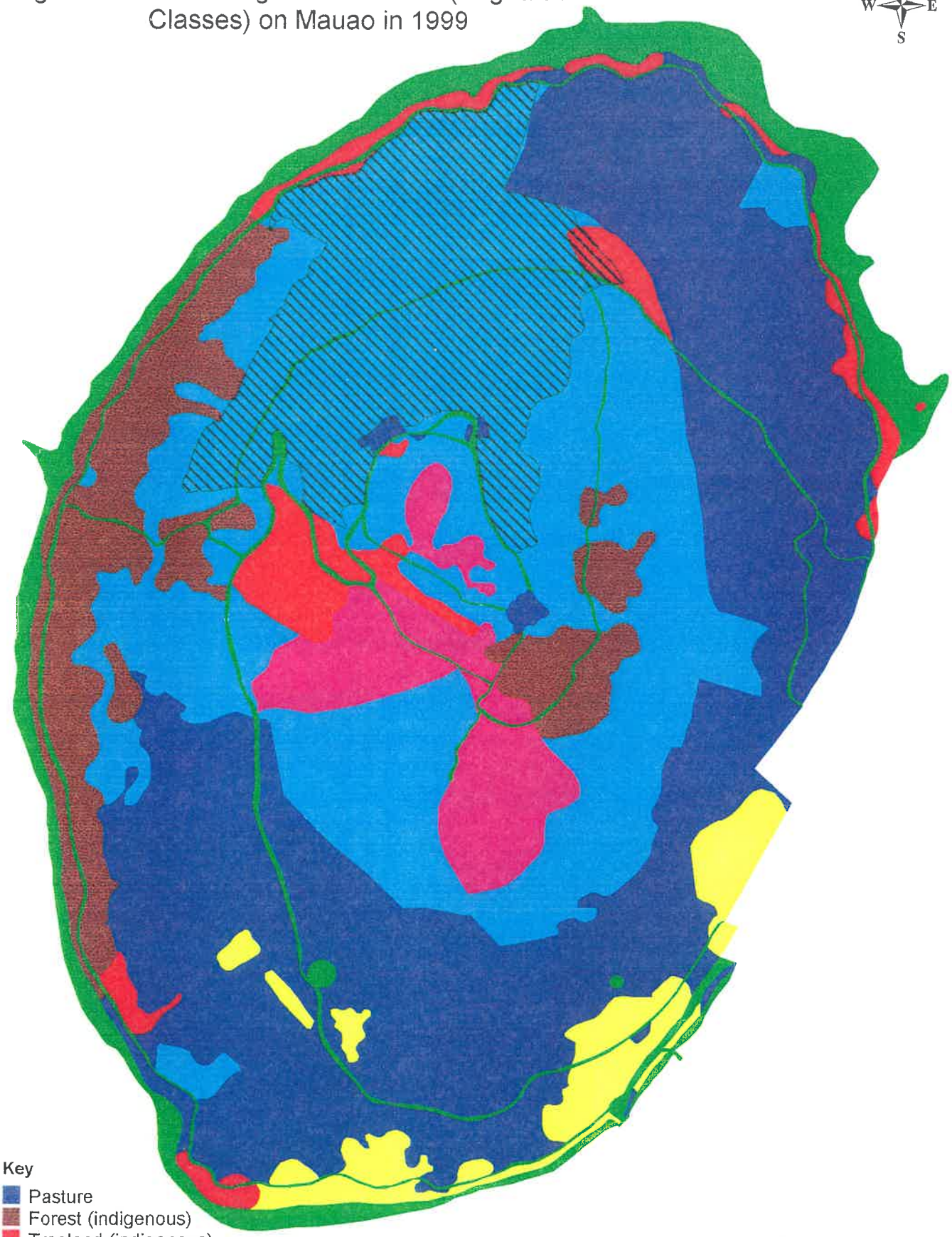


Figure 5. Extent of 1997 Fire
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Scale 1:5,500 - Aerial photography supplied by Tauranga District Council, flown 1997

A 1930 photograph in Cunningham and Musgrave (1989) appears to show low vegetation only over the eastern slopes, and pasture was present on the lower slopes in the early 1930s (W.T. Davies pers. comm.). At this time the 'scrub line' was apparently similar to the present day, and rabbits were abundant in the grassland (W.T. Davies pers. comm.).

Tracks and Planting

The summit track was built in 1898 (Bellamy 1982) and there is a long history of planting extending back to the 1880s (Cunningham and Musgrave 1989) and the early 1900s (Bellamy 1982). Apparently many of the 1880 plantings were destroyed by fire (Cunningham and Musgrave 1989). These later authors also note that there were regular Arbor Day excursions from Tauranga in the late 1880s to plant trees, including one J.C. Adams who also took scouts to the summit and had them use catapaults to scatter karaka berries in all directions!

General

Oblique photographs of the eastern slopes of Mauao in 1929, 1940s and 1960 are shown in Plates 2, 3 and 4 (supplied by Tauranga District Libraries). In 1929 the vegetation was all low vegetation; by the 1940s pines were well established and were very prominent by 1960.

Plate 2: Eastern view of Mauao in 1929. (Supplied by Tauranga District Libraries.)

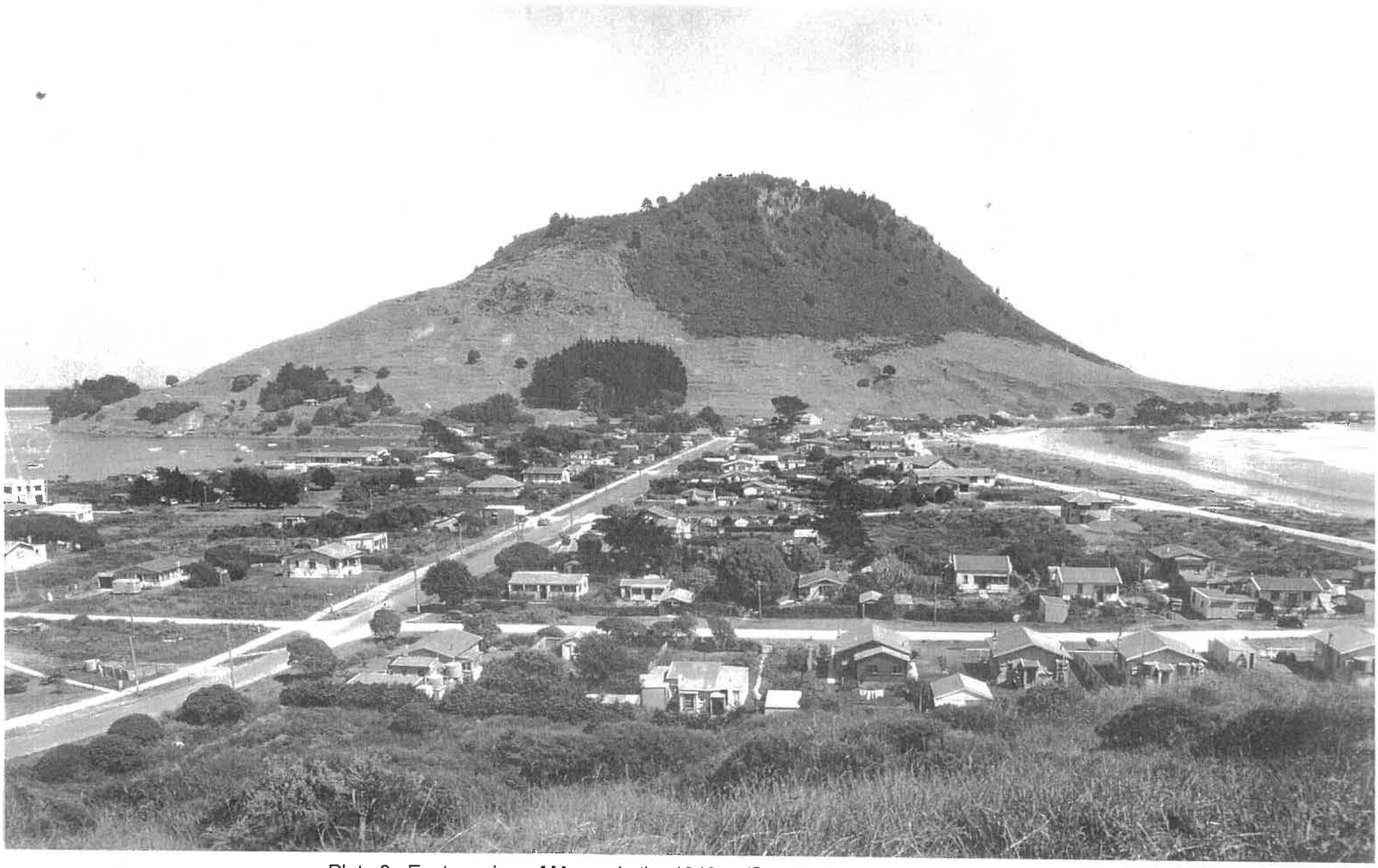


Plate 3: Eastern view of Mauao in the 1940s. (Supplied by Tauranga District Libraries.)

Plate 4: South-eastern view of Mauao in 1960. (Supplied by Tauranga District Libraries.)

4. VEGETATION AND HABITAT DESCRIPTIONS

General

A detailed vegetation map has been prepared. Refer to Figure 2. The broad pattern is of a strip of pasture on the lower slopes adjacent to the coast with secondary indigenous vegetation (or a mixture of indigenous and exotic species) extending from the pasture margin to the summit. On the western side indigenous vegetation extends from the sea to the summit, with well developed pohutukawa forest present in this area. There are small patches of pohutukawa treeland scattered along the northern and southern shorelines, and some patches of exotic treeland and forest on the southern and eastern margins. A large area of secondary vegetation on the northern and north-western slopes was burnt in a fire in Decmeber 1997 and is being replanted, with intensive weed control also underway.

Detailed descriptions are provided below of each of the vegetation/habitat types mapped in Figure 2.

FOREST

1 Pohutukawa forest

Pohutukawa (*c.*20 m in height on average), generally the sole canopy component of this forest type, is dominant on the upper slopes of the eastern face of Mauao and extending around to the southern face and onto the lower slopes of the western face. The understorey, however, is considerably more diverse and three sub-types are described below.

1a The small fragments of pohutukawa forest on the eastern slope have a dense middle tier (2-5 m) of hangehange (*Geniostoma rupestre* var. *ligustrifolium*) in association with ponga (*Cyathea dealbata*) and mahoe (*Melicytus ramiflorus* subsp. *ramiflorus*), in contrast to an open shrub tier (0.3 m-2 m) of scattered akepiro (*Olearia furfuracea*), kakaha (*Astelia banksii*) and karamu (*Coprosma lucida*). Pukupuku (*Doodia media*) and *Adiantum cunninghamii* dominate the ground cover (<0.3 m) with mahoe and hangehange seedlings common along with seedlings of climbing asparagus (*Asparagus scandens*).

1b Mamaku (*Cyathea medullaris*), hangehange and mahoe dominate the middle tier of the larger area of pohutukawa forest south of the eastern slope. The shrub tier is dominated by hangehange in association with taurepo (*Rhabdothamnus solandri*), kakaha and karamu; ground cover comprises pukupuku and *Adiantum cunninghamii*. Overall the understorey is both dense and diverse, other species present including akepiro, mingimingi (*Leucopogon fasciculatus*), kiokio (*Blechnum*

novaezelandiae) *Uncinia uncinata*, huruhuruwhenua (*Asplenium oblongifolium*) and turutu (*Dianella nigra*).

1c Pohutukawa dominant forest on the lower slopes on the western side has a middle tier and shrub tier generally characterised by karamu, hangehange and kawakawa, however both the composition and density of species in these tiers varies throughout this area. There are small local areas where taurepo is dominant. Other indigenous species present in the middle tier and shrub tier include kawakawa, akepiro, mapou, ponga, mamaku, mingimingi and whauwhaupaku (*Pseudopanax arboreus* var. *arboreus*). The ground cover comprises pukupuku and *Adiantum cunninghamii*, with other indigenous species including puniu (*Polystichum vestitum*), *Oplismenus imbecillis, Microlaena stipoides, Carex testacea* and seedlings of hangehange, kawakawa and mahoe. Two kahikatea (*Dacrycarpus dacrydioides*) saplings were noted.

The understorey varies on the western toeslope above the coastal track. Toward the north it is generally open and exposed to salt spray and wind. Local areas of kawakawa up to 0.5 m tall are present in the shrub tier. *Microlaena avenoides, Carex testacea*, ratstail (*Sporobolus africanus*) and kikuyu grass (*Pennisetum clandestinum*) dominate the groundcover with a localised area of *Baumea juncea* in association with *Isolepis nodosa*, kakaha and scattered pampas (*Cortaderia jubata*). There is also a localised area where mapou forms a dense low scrub in association with manuka (*Leptospermum scoparium*) and rarahu (*Pteridium esculentum*) and occasional *Baumea juncea*, grading into fernland dominated by rarahu in association with *Baumea juncea* and scattered *Isolepis nodosa*.

To the south the middle tier and shrub tier are densely populated by kawakawa, with pukupuku, *Carex testacea, Oplismenus imbecillis* and *Adiantum cunninghamii* characterising the ground cover.

The understorey is generally open on the bank immediately adjacent to the foreshore below the coastal track. Understorey composition varies in association with substrate type. Boulder banks are present in the northwest and are sparsely vegetated with scattered small patches of *Isolepis nodosa, Baumea juncea* or oioi (*Leptocarpus similis*). Debris-mantled banks are present south of the boulder banks and are the more common substrate type. Understorey composition is variable within this substrate type, although the ground cover is generally dominated by varying mixtures of exotic grasses including paspalum (*Paspalum dilatatum*), kikuyu grass and ratstail. The shrub tier is more variable, an area of open taupata (*Coprosma repens*) in association with houpara grading into dense kawakawa in association with whau.

Plate 5: Pohutukawa forest on the lower western slopes of Mauao, 1999.

Plate 6: Pohutukawa forest understorey with *Adiantum cunninghamii*, *Doodia media* and kawakawa, Mauao 1999.

TREELAND

2 Pohutukawa treeland

Pohutukawa dominant treelands (*c.*18-20 m in height) are present on coastal banks below the coastal walking track at the northern and southern ends of Mauao. They are described below as two sub-types

2a Pohutukawa treeland present on coastal bank below the walkway on the northern side of Mauao is exposed to the sea and wind. A few radiata pine are present in the canopy. There is no middle tier or shrub tier, and the ground cover is generally devoid of vegetation save occasional small areas of *Isolepis nodosa, Baumea juncea, Cyperus ustulatus* and kikuyu grass. Upslope from the track, the ground cover is generally dominated by kikuyu grass with occasional taupata and pampas in the shrub tier

2b Pohutukawa treeland present at the southern end of Mauao has a dense shrub tier dominated by kawakawa. The ground cover is generally bare with occasional pukupuku and exotic grasses, particularly kikuyu grass

3 Pohutukawa-rewarewa/akepiro-mingimingi-hangehange-manuka-karamu-mamaku treeland.

Emergent pohutukawa and rewarewa (*Knightia excelsa*) (*c.*18 m in height) are scattered throughout with some local concentrations over dense scrub (*c.*3-4 m canopy). The scrub comprises varying mixes of akepiro, mingimingi, hangehange, manuka, karamu and mamaku. Small pockets dominated by pampas and gorse or mamaku are present, and occasional emergent kanuka were also noted. Kakaha is the most abundant shrub tier component; other species present include ponga, hangehange and koromiko (*Hebe stricta* var. *macroura*). There are several large rock outcrops within this vegetation type on which kakaha and akepiro are particularly abundant. Pukupuku is the most common ground cover species, although leaf litter is the main ground cover component.

4 Macrocarpa/karaka-pohutukawa treeland

Macrocarpa is emergent over a canopy of karaka in association with pohutukawa. The canopy is generally 16-18 m high, with a variable density becoming more open toward the upper slopes. The understorey is open and species poor. Planted phoenix palms (*Phoenix canariensis*) are present in the middle tier, with kawakawa numerous on the lower margin in the shrub tier. Where the canopy is dense the ground cover is bare. Further upslope where the canopy is open there are patches of rarahu fernland, pampas and scattered shrubs including taupata. The ground cover is dominated by exotic grasses, particularly kikuyu grass, with small clumps of pukupuku.

5 Sycamore-karaka-radiata pine treeland

Sycamore and karaka form a relatively open canopy *c.*20 m in height in association with radiata pine on the southern side of Mauao near the old pilots wharf. Several exotic tree species are present as minor components of the canopy, including Lombardy poplar (*Populus* sp.) tree of heaven (*Ailanthus altissima*), macrocarpa (*Cupressus macrocarpa*) and brush wattle (*Albizia lophantha*). The middle tier and shrub tier are relatively sparse, although there are some dense localised areas of kawakawa, and cotoneaster (*Cotoneaster glaucophyllus*) and barberry (*Berberis glaucocarpa*) are present in low numbers. The ground cover is either dominated by exotic species such as kikuyu grass, cocksfoot (*Dactylis glomerata*), cleavers (*Galium aparine*) and climbing asparagus, or, in local areas where the canopy is dense, predominantly absent.

6 Radiata pine-eucalyptus-(sycamore)/pohutukawa-poplar treeland

Radiata pine and eucalyptus in association with sycamore (the tallest up to 25 m in height) are emergent over pohutukawa and poplar. Other subcanopy species include macrocarpa and karaka. Some dense kawakawa shrub stands are associated with denser areas of pohutukawa. Mingimingi and pohuehue (*Muehlenbeckia complexa*) are also present in the shrub tier. In both open areas and under trees, grassland characterised by kikuyu grass, cocksfoot, ratstail and bidibid (*Acaena* sp.) predominates. There are several felled and wind thrown trees.

7 Poplar-paulownia-silky oak-bead tree treeland

A small area of planted exotic trees dominated by poplar, paulownia, silky oak and bead tree (14-20 m tall). There is no understorey and the ground cover is dominated by kikuyu grass.

8 Poplar treeland

A planted poplar treeland *c.*18 m in height. The shrub tier is dominated by kawakawa in association with mamaku, karamu and pampas. Bare ground is present under the kawakawa, with pasture growing where the shrub tier thins. Other species present include pukupuku and turawera (*Pteris tremula*).

9 Poplar shelterbelt

A planted poplar (*Populus* sp.) shelterbelt 20 m ore more in height is located on the slope below the water reservoir.

TREEFERNLAND

10 Mamaku treefernland

Mamaku treefernland (*c.*8 m in height) is present on the summit and upper southern slopes of Mauao. Two sub-types are described below:

10a Mamaku treefernland on the summit has a dense shrub tier of hangehange and mingimingi in association with karamu and ponga. The ground cover generally comprises leaf litter with *Adiantum cunninghamii* and kiokio.

10b Mamaku treefernland on the southern slopes has a shrub tier characterised by hangehange in association with kawakawa and ponga, other species present including rangiora (*Brachyglottis repanda* s.s.), mingimingi, mahoe, akepiro and koromiko. The ground cover generally comprises pukupuku and *Adiantum cunninghamii* with other common elements including kowaowao (*Phymatosorus pustulatus*), puniu, huruhuruwhenua and *Uncinia uncinata*. Hangehange seedlings and saplings are abundant. Numerous large pine tree stumps were observed.

11 (Pohutukawa)-(rewarewa)/mamaku-mahoe treefernland

Emergent pohutukawa and rewarewa are thinly scattered over dense mamaku in association with mahoe. The canopy is generally between *c.*8-10 m tall. Taurepo dominates the shrub tier in association with hangehange and kiokio. Ground cover comprises leaf litter, with pukupuku, *Adiantum cunninghamii*, and local kawakawa, mingimingi and *Uncinia uncinata*.

SCRUB

12 Pohutukawa/mingimingi-akepiro-hangehange scrub

Scattered large pohutukawa (*c.*20 m in height) are emergent over a dense canopy of mingimingi, akepiro and hangehange *c.*3-4 m tall. Other canopy components include mamaku, whauwhaupaku and mahoe. Kakaha is common in the understorey. There is good regeneration with seedlings and saplings of rewarewa, pohutukawa, mapou and whauwhaupaku noted. Ground cover generally comprises pukupuku and *Adiantum cunninghamii*. Other ground cover species include *Uncinia uncinata*, kowaowao and turutu.

13 (Pohutukawa)-(kanuka)-(rewarewa)-(totara)/mahoe-whauwhaupaku-manuka-karamu-hawthorn-mingimingi scrub.

Occasional pohutukawa, kanuka, totara (*Podocarpus totara*) and rewarewa are emergent over a variable canopy generally comprised of mahoe, manuka, whauwhaupaku, karamu, hawthorn and mingimingi *c.*6 m tall. Hawthorn tends to

be most abundant in scrub adjacent to the pasture area, and houhere is locally abundant in the same area. Mamaku and karaka are minor components of the canopy, karaka particularly so in the canopy adjacent to the margin. Some of the totara may have been planted but it is now establishing naturally. On the lower slopes kanuka is replaced by mapou and the canopy becomes similar to vegetation type 15b. On the lower slope there are numerous local infestations of Japanese honeysuckle (*Lonicera japonica*) smothering canopy species.

Kawakawa dominates both the middle and shrub tiers, with hangehange, ponga, akepiro and koromiko also present. Bare ground and pukupuku dominate the ground cover in association with Japanese honeysuckle. Rarahu is dominant along the forest margin.

14 Totara-mahoe-hawthorn scrub

Totara in association with mahoe and hawthorn form a dense scrub of variable height, averaging *c.*5 m tall. Other canopy components include mamaku, mapou and whauwhaupaku. The shrub tier is variable but typically comprises kawakawa, hangehange, mingimingi and ponga. The ground cover is dominated by pukupuku in association with *Adiantum cunninghamii*; hangehange and kawakawa seedlings and saplings were commonly observed. Rarahu is dominant along the forest margin bordering the pasture.

15a Mahoe-mingimingi-hangehange-karamu scrub

Secondary scrub dominated by a mix of mahoe, mingimingi, hangehange and karamu is a prominent feature of Mauao, particularly on the highly visible eastern slopes. Canopy height is variable, but is generally between 3-4 m. There are a few scattered, large pohutukawa emergent over the canopy. Other species present in the canopy include karaka, totara, mamaku and koromiko. Mamaku is locally abundant, particularly adjacent to pohutukawa, and in depressions. Wattles occur locally. The composition of the shrub tier generally reflects the canopy, but also includes ponga, kawakawa and larger ferns such as turawera and huruhuruwhenua. Rarahu, pampas, Spanish heath (*Erica lusitanica*) and gorse are locally abundant where the canopy thins. Pukupuku and *Adiantum cunninghamii* are co-dominant in the ground cover, however pukupuku becomes more dominant in more open areas. Other common components of the ground cover include *Oplismenus imbecillis*, kowaowao and seedlings of mahoe. Weeds are a common feature of this vegetation type, particularly Japanese honeysuckle on the margins and climbing asparagus throughout.

Plate 7: Mixed scrub (vegetation type 15a), pasture, exotic treeland (in foreground), pohutukawa forest adjacent to bluffs; Mauao 1999.

Scrub on the lower north-western slope is of lower stature, *c.*2-3 m tall on average. It is generally less diverse and of younger successional age than the eastern scrub. Dead rarahu is abundant in the understorey, which is less developed, and the shrub tier lacks the diversity of ferns. Ground cover is similar and seedlings and saplings of mapou, mahoe and hangehange were noted.

15b Mapou-mingimingi-mahoe-karamu scrub

This vegetation borders part of the pohutukawa forest on the lower western slopes. It is generally similar to type 15 above, however mapou is the most abundant canopy component in association with mingimingi, mahoe and karamu. The canopy is generally *c.*4 m in height, with occasional emergent rewarewa and kanuka. There is a small dense stand of mamaku and another of kanuka. The shrub tier contains mingimingi, hangehange, kakaha and abundant dead rarahu, and mapou saplings were also commonly noted. Canopy gaps are characterised

by a dense layer of rarahu. Ground cover mainly comprises leaf litter with some pukupuku and *Adiantum cunninghamii*.

16 Manuka-kanuka-mingimingi-(pohutukawa) scrub

Scrub (up to *c.*2 m in height) dominated by manuka in association with kanuka, mingimingi, and occasional young pohutukawa, forms the predominant vegetation cover of the summit. It is generally around 3 m in height and has recently been cleared of gorse, Spanish heath and pampas. This clearance has resulted in the creation of numerous canopy gaps, particularly near the summit road. Numerous seedlings and saplings of hangehange, akepiro, rewarewa and pohutukawa were observed. The ground cover is sparse and generally comprises leaf litter with scattered *Morelotia affinis*, *Paesia scaberula*, *Baumea juncea* and occasional *Gonocarpus incanus*.

17 Kawakawa-whau-mamaku scrub

A small patch of scrub *c.*5 m tall dominated by kawakawa, with one individual of both whau and mamaku present. The understorey has been grazed out by stock and is generally bare.

18 Gorse-manuka-Spanish heath-pampas scrub

Highly modified scrub dominated by gorse in association with manuka, Spanish heath, manuka and pampas. Occasional karamu, sapling pohutukawa, and akepiro are also present in the canopy. The ground cover is dominated by exotic species including inkweed (*Phytolacca octandra*) and Japanese honeysuckle.

19 Pohutukawa/gorse-pampas scrub

Gorse in association with pampas forms a dense scrub with occasional emergent pohutukawa dominate an old landslide scar on a toeslope on the western side of Mauao. The vegetation is generally dominated by exotic species including inkweed, paspalum and black nightshade. The area has been recently sprayed.

20 Gorse-Spanish heath-pampas-rarahu-smilax scrub

A highly modified dense scrub *c.*1-2 m tall, dominated by gorse in association with Spanish heath, pampas, rarahu and smilax (*Asparagus asparagoides*). Other minor canopy components include Japanese honeysuckle and pohuehue. The ground is bare except within canopy gaps, where cover is dominated by a mix of kikuyu grass, paspalum, bidibid and pukupuku.

SHRUBLAND

21 Kawakawa-pohuehue/pohuehue-blackberry shrubland

A small area of kawkawa and pohuehue (*c.*2 m tall) surrounded by blackberry and pohuehue. The ground is bare in areas where the canopy is dense, and covered by exotic grasses including kikuyu grass and paspalum in open areas.

22 Manuka-(pohutukawa)-(akeake)-(mingimingi) shrubland

A recently partially cleared area previously dominated by gorse. The resultant vegetation comprises scattered manuka with a few pohutukawa, akeake and mingimingi. The ground cover is predominantly leaf litter with occasional exotic grasses, particularly ratstail. Some seedling pohutukawa and rewarewa and *Pomaderris phylicifolia* were noted in the ground cover.

23 Pohutukawa/mahoe-mingimingi-hawthorn-kawakawa-gorse shrubland

An area of open vegetation of variable composition (ranging from *c.*2-20 m tall), generally comprising mahoe, mingimingi, hawthorn, kawakawa and gorse. There are several large pohutukawa present and several dense patches of rarahu. Kikuyu grass dominates the ground cover in open areas with pukupuku common on steeper banks below pohutukawa.

Plate 8: Manuka-(pohutukawa)-(akeake)-(mingimingi) shrubland (vegetation type 22), Mauao Summit 1999.

24 Gorse-pampas tussock-shrubland

A highly modified vegetation type dominated by gorse in association with pampas (*c.*2 m tall) is present on the steep rocky faces of the upper eastern slopes. Other exotic species present include inkweed, Japanese honeysuckle, woolly nightshade, blackberry and climbing asparagus. Occasional akeake, pohutukawa, *Pomaderris phylicifolia* and turutu are present, particularly on rock outcrops which are extensive within this vegetation type. Manuka is locally abundant in the north of this area where it boarders vegetation type 15.

25 Gorse-woolly nightshade/kikuyu grass shrubland

Shrubland (1-2 m tall) characterised by gorse in association with woolly nightshade has developed over pasture. Kikuyu grass dominates canopy gaps. The density of the shrub canopy generally precludes the establishment of a ground cover. Other species noted include woolly mullein (*Verbascum thapsus*), inkweed, cocksfoot and Scotch thistle (*Cirsium vulgare*).

PLANTED AREAS

26 Totara treeland

A small grove of planted totara (12 m tall) on the northern side of the summit. The shrub tier is sparse, characterised by mingimingi with a few individuals of hangehange, mahoe and mamaku. Pukupuku is the most abundant ground cover species.

27 Ngaio-akeake-pohutukawa/kikuyu grass-gorse treeland

Planted ngaio (2-4 m tall) with scattered akeake and pohutukawa. The canopy is open and the understorey dominated by exotic species, particularly gorse and blackberry in the shrub tier and kikuyu grass, paspalum and fleabane in the ground cover.

28 Ngaio scrub

28a An area of planted ngaio 1.5-2.5 m tall. The understorey is sparse and of low diversity. Kikuyu grass dominates the ground cover. Other common species include paspalum, gorse, purple top and woolly mullein.

28b As per 28a but with a component of pohutukawa in the canopy

29 Whau-karamu-ngaio-(tarata)-(manuka)-(pohutukawa)-(taupata)/ kikuyu grass-cocksfoot shrubland

A planted area comprising whau, karamu and ngaio in association with tarata, manuka, pohutukawa and taupata. In some areas the canopy is quite dense, however it is mostly open shrubland *c.* 1-2 m tall. Kikuyu grass dominates the ground cover with lesser quantities of cocksfoot.

30 Pampas/paspalum-gorse-kikuyu grass tussock-grassland

Pampas forms an open canopy over paspalum, kikuyu grass and gorse seedlings on the lower slope of the northern area accidentally burnt in Decmeber 1997. The vegetation is essentially of the same nature as vegetation type 36, below. However the area has been recently planted, most commonly with ngaio, harakeke and pohutukawa, after spraying and slashing of gorse and pampas.

VINELAND

31 Pohuehue-rarahu-*Isolepis nodosa* fern-vineland

Pohuehue and rarahu form a dense, low (0.5-1 m tall) cover in association with *Isolepis nodosa*. Tall fescue (*Festuca arundinacea*), cleavers and bidibid are common in gaps.

32 Pohuehue-rarahu kawakawa-mingimingi-mahoe-blackberry fern-vineland

Dense vegetation (*c.* 1 m tall) characterised by pohuehue and rarahu in association with kawakawa, mingimingi, mahoe and blackberry. Other minor components of the canopy include karamu, hangehange and akatataramoa (*Rubus schmidelioides*). Mahoe, kawakawa and mingimingi are locally dominant, forming a canopy up to 2.5 m tall, with pukupuku dominant in the ground cover. Generally however, the ground cover is either bare or dominated by exotics including inkweed, tall fescue, woolly mullein and paspalum in open areas.

33 Japanese honeysuckle-gorse-rarahu vineland

A highly modified area dominated by Japanese honeysuckle which is smothering the underlying shrubs. Gorse and rarahu occur locally. There are no species in the understorey due to the density of the canopy.

FERNLAND

34 Pohutukawa/rarahu fernland

Occasional pohutukawa are emergent over a dense cover of rarahu. Pampas and kawakawa are also present. The ground is generally bare.

TUSSOCKLAND AND ROCKLAND

35 Pohutukawa-taupata/*Isolepis nodosa* tree-tussockland

A rock outcrop characterised by pohutukawa, taupata and *Isolepis nodosa*. The ground cover is sparse with much bare rock. Ratstail is the most abundant ground cover species, with *Samolus repens, Sarcocornia quinqueflora, Disphyma australe* and *Dichondra repens* also commonly seen. One individual of karo (*Pittosporum crassifolium*) was present.

36 Pampas-gorse shrub-tussockland and rockland

Rock outcrops and bluffs are a prominent feature on upper slopes. Pampas in association with gorse dominates a large area on the northern slopes of Mauao that was burnt in Decmeber 1997 by an accidental fire. Indigenous species are uncommon within this vegetation type, but most abundant on the extensive rocky outcrops and bluffs. Indigenous species noted include pohutukawa, karamu, akeake (*Dodonaea viscosa*), kakaha, koromiko, turutu, and *Pomaderris phylicifolia*. The ground cover is dominated by exotic species, the grasses paspalum and ratstail being most common. The indigenous grass *Rytidosperma gracile* was also commonly seen around rock outcrops. The predominantly exotic areas of this vegetation type were recently sprayed and slashed in preparation for planting.

Plate 9: Kakaha (*Astelia banksii*) on rock bluffs on the north-western side of Mauao, 1999.

GRASSLAND

37a Kikuyu grass-ratstail grassland

Pasture dominated by kikuyu grass in association with ratstail is a dominant feature of the flatter eastern, southern and south-western lower slopes of Mauao. Pohuehue and pukupuku are present in localised areas, generally associated with boulders or steep banks. A few indigenous trees are present, including several planted totara along the margin of the summit access road. Sprayed areas of gorse are common adjacent to areas of secondary scrub and forest, particularly on the eastern slopes. Sheep graze the pasture.

37b A small area on the east has been fenced off from grazing. Rarahu and blackberry (*Rubus fruticosus* agg.) have increased in abundance.

Plate 10: Pasture and gully system on lower slopes adjacent to the motorcamp. The pasture adjoins vegetation type 15. Mauao, 1999.

38 Ratstail grassland

There are numerous small areas of ratstail dominated grassland on cleared areas of the summit. Other species present include catsear, kikuyu grass and seedlings of gorse, Spanish heath and pampas.

39 Gorse-paspalum-pampas shrub-grassland

A burnt area on the north of the summit dominated by a dense carpet of gorse seedlings and paspalum with numerous re-sprouting pampas. Manuka and Spanish heath seedlings are also common. Dead standing gorse and manuka indicate that the area was previously covered in shrubland, probably of a similar nature to vegetation type 22 above.

40 (Manuka)/cocksfoot-paspalum-bidibid grassland

An open grassy clearing dominated by cocksfoot and paspalum in association with bidibid. Scattered manuka are present throughout, and *Paesia scaberula*, rarahu and kiokio are locally dominant next to the mamaku treefernland.

MISCELLANEOUS

41 Summit road, 4WD track and walking tracks

The tracks are generally bare, except for the walking tracks and 4WD track through the pasture on the eastern slopes. These tracks are dominated by vegetation type 37a, kikuyu grass-ratstail grassland. The summit road also has exotic grasses on the margins and down the centre of the road in places.

42 Water reservoir

43 Rocky foreshore

The rocky foreshore generally lacks terrestrial vegetation. There are, however, some small patches of *Samolus repens, Sarcocornia quinqueflora, Disphyma australe* and *Dichondra repens* at the high tide mark and on some rock outcrops.

44 Sand beach

45 Shell beach

46 Sealed road

47 Jetties

5. FLORA

The flora is relatively diverse, reflecting the range of habitats present, including cliffs, tall forest, bluffs and rock outcrops, open track margins, beaches, secondary vegetation in various stages of regeneration, rocky foreshore and seepages. One hundred and one naturally occurring indigenous species were identified and a summary of the growth forms (e.g. grasses, ferns), numbers, and when they were recorded is presented in Table 1. Fourteen new species were recorded during the current survey. Twenty-eight indigenous species are known to have been planted.

No nationally threatened species (as per Cameron *et al.* 1995) are currently known to occur in the reserve although there is an historic record of *Olearia pachyphylla* (P. de Lange pers. comm.), which is classed as Endangered. Several species of limited distribution within the Tauranga Ecological District are present on Mauao and these are discussed further below.

One hundred and twenty-nine adventive species are known to occur on Mauao. A detailed account was compiled previously on the distribution and threats posed by these species (Bishop and Beadel 1997) and they are not discussed further in this report.

TABLE 1: Naturally occurring indigenous species on Mauao

	Previously recorded and located during current survey	First recorded during 1999 survey	Previously recorded but not located during current survey	Total species
Gymnosperms		1		1
Monocot. trees and shrubs	1			1
Dicot. trees and shrubs	30	2	3	35
Dicot. lianes	6			6
Lycopods and psilopsids	2	1	1	4
Ferns	19	5		24
Orchids	6	1		7
Grasses	6			6
Sedges	10	2		12
Rushes			1	1
Monocot. herbs	2		1	3
Composite herbs	5	1		6
Dicot. herbs (other than composites)	14	1		15
Total Species	101	14	6	121

Species with limited distributions

Psilotum nudum has not been recorded elsewhere within the Tauranga Ecological District. This population is one of the few known coastal occurrences in the Bay of Plenty Region, although it is present in many geothermal areas and on Putauaki (Mt Edgecumbe).

Plate 11: *Psilotum nudum* on rock bluffs on the north-western side of Mauao, 1999.

One individual of *Lepidosperma laterale* was found on Mauao, which is near the southern limit of distribution for the species. This is one of only two known populations within Tauranga Ecological District, the other being at Bowentown Heads (Beadel 1992) and it is also known from near Te Puna.

Only a single individual of mangemange (*Lygodium articulatum*) has been found on Mauao to date and this is the only record of this species in Tauranga Ecological District.

No detailed flora of the Tauranga Ecological District has been compiled to date. The following species are currently only known from Mauao but may be present elsewhere in

the Ecological District: *Hymenophyllum demissum, H. dilatatum, Lycopodium deuterodensum, Hoheria populnea* var. *lanceolata, Olearia rani, Rhabdothamnus solandri, Adiantum hispidulum, Carex breviculmis, Lagenifera pumila, Senecio hispidulum, Oxalis exilis, Wahlenbergia violacea, Pittosporum eugenioides, Corybas oblongus, Corybas rivularis* agg., *Pterostylis alobula, Pterostylis banksii, Tmesipteris tannensis* and *Trichomanes reniforme*.

6. VEGETATION MANAGEMENT

Restoration

In the current management plan it is stated that iwi would like to have indigenous species planted to facilitate the return of indigenous avifauna. The relevant section states that iwi aspirations are "To restore the Mana of Mauao by replanting trees and plants naturally occurring in coastal forest, rejuvenate the diversity of birdlife, and generally beautify Mauao."

There is considerable scope for ongoing active ecological restoration of Mauao. It has many similarities to some Bay of Plenty islands (c.f. Moutohora or Whale Island) and in the medium to long term it could offer substantial opportunities for nature conservation, in conjunction with ongoing high levels of public usage.

To achieve this a sound understanding is needed of the ecological characteristics, opportunities and threats. A shared vision of a possible future state is also needed.

Fire

There is a long history of fire on Mauao and future fires are virtually inevitable, regardless of the type of vegetation present. This is due to the exposed and seasonally dry nature of the site, which leads to extreme levels of fire risk and vegetation flammability. Given this high level of risk, the Council should:

- maintain a year round total fire ban (including cigarettes);
- maintain a high level of fire suppression readiness, including regular revision of the fire plan for Mauao;
- promote public awareness of the need for tight restrictions on fire.

Fire flammable vegetation is always going to be a feature of Mauao. Nevertheless, the more advanced the successions become the less vulnerable they are likely to be. The greatest risk is to areas of early successional scrub on the northern slopes. Planting on Mauao should avoid the use of flammable species such as manuka. This is very suitable for revegetation but other species are less likely to carry fire; e.g. karamu and ngaio.

Vegetation Succession

Large dead gorse was observed in the understorey of many of the secondary indigenous vegetation (types 3, 12, 13, 14, 15a and 15b), indicating that over time a native canopy has developed through the gorse. It is also evident that a range of indigenous species have established within stands of gorse.

If fire can be prevented, natural regeneration and succession will proceed relatively rapidly on sites without domestic stock. The relatively rapid rate of this succession is indicated by the significant degree of change between 1943 and 1999, as illustrated in Figures 4 and 5 and discussed in the section on Vegetation History.

A key element for the successful revegetation of Mauao is to allow and encourage this naturally rapid rate of vegetation development.

Tracks

Prior to any future track construction or re-alignment, all potentially affected sites should be inspected to determine if any populations of threatened or local species are present.

Management Units

Mauao has been subdivided into 6 broad management units and suggestions are provided below to underpin broad management guidelines. Refer to Figure 6. Potential planting sites have been identified, to increase the area of indigenous vegetation. This would provide a larger area of habitat for indigenous plants and animals, and to support iwi aspirations for Mauao.

Suites of species for potential planting within the management units are listed below. Different suites are suggested for each of the landform units within each management unit (refer to Figure 1). Planting sites will need to be selected to suit the requirements of each species (e.g. nikau should only be planted in sheltered and shaded gullies to the south).

- Management Unit 1

  It is suggested that part(s) or all of this area be considered for the re-establishment of indigenous forest. Fencing and the exclusion of stock would be required, and consideration would need to be given to the need for open areas for recreation.

  Species potentially suitable for planting are listed below:

  Gully System

  pohutukawa (*Metrosideros excelsa*)
  houpara (*Pseudopanax lessonii*)

taupata (*Coprosma repens*)
karo (*Pittosporum crassifolium*)
karamu (*Coprosma robusta*)
koromiko (*Hebe stricta* var. *stricta*)
ngaio (*Myoporum laetum*)

Gentle Slopes

pohutukawa (*Metrosideros excelsa*)
houpara (*Pseudopanax lessonii*)
ngaio (*Myoporum laetum*)
taupata (*Coprosma repens*)
karo (*Pittosporum crassifolium*)
karamu (*Coprosma robusta*)
koromiko (*Hebe stricta* var. *stricta*)
ti kouka (*Cordyline australis*)
puriri (*Vitex lucens*) - only when initial cover has been established

Coastal Bank

pohutukawa (*Metrosideros excelsa*)
houpara (*Pseudopanax lessonii*)
taupata (*Coprosma repens*)
Melicytus novae-zelandiae

Moderately Steep to Steep Slopes

pohutukawa (*Metrosideros excelsa*)
houpara (*Pseudopanax lessonii*)
taupata (*Coprosma repens*)
karo (*Pittosporum crassifolium*)
karamu (*Coprosma robusta*)
koromiko (*Hebe stricta* var. *stricta*)
ngaio (*Myoporum laetum*)

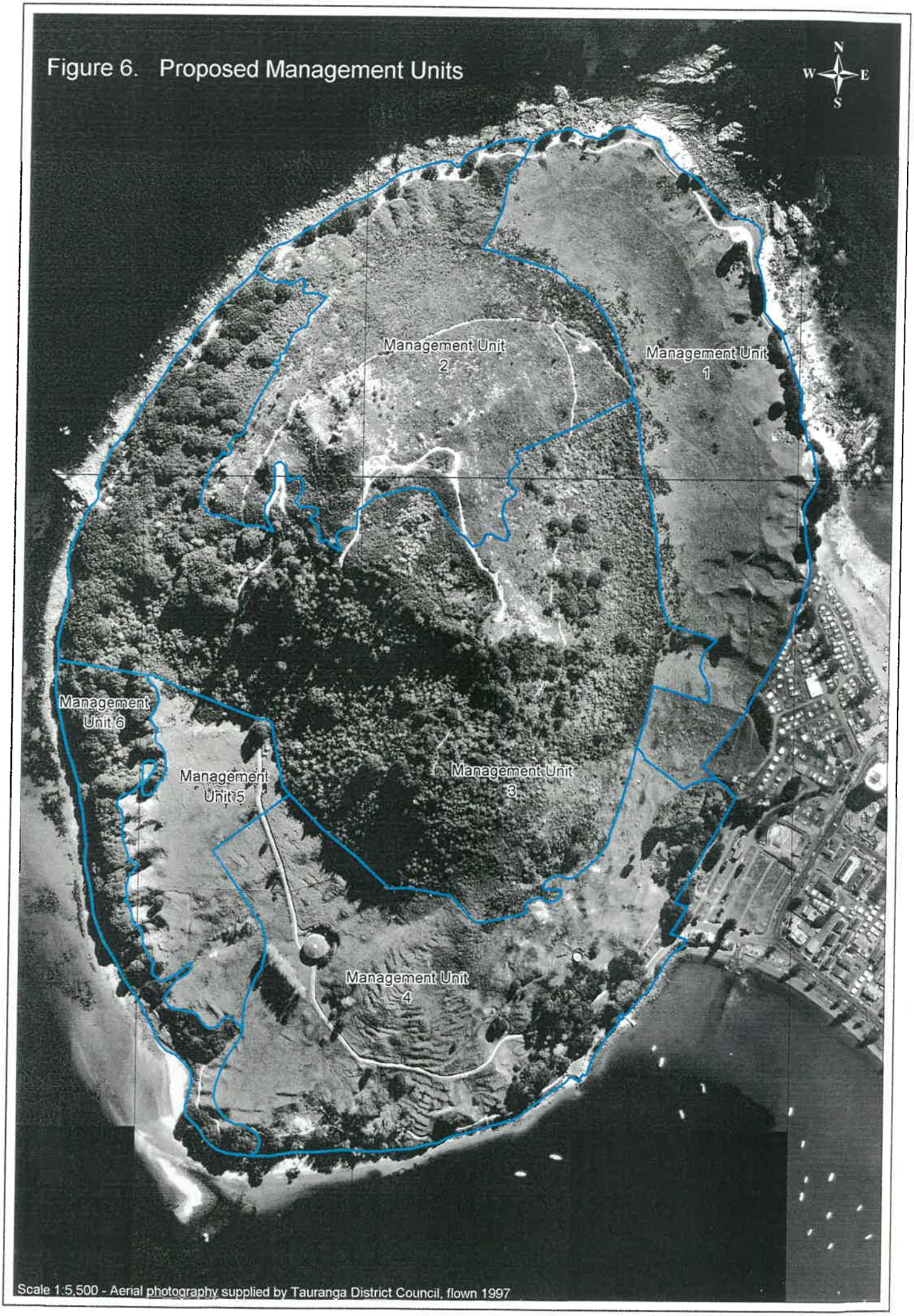
- Management Unit 2

  This area is currently being cleared and planted. Recent clearance provides opportunities for new weed infestations to become established. Ongoing monitoring of this area is recommended.

- Management Unit 3

  This contains most of the well developed indigenous vegetation on Mauao and little active management is required. This also applies to the gorse-dominant scrub below the rock bluffs on the upper eastern slopes. Observations on Mauao indicate that gorse acts as a 'nurse' cover, allowing the development of secondary indigenous vegetation. Limited clearance of exotic species has been undertaken in the vicinity of the summit and further active management is not recommended except for the control of invasive weeds. Ongoing weed monitoring should be undertaken, with control as necessary.

Figure 6. Proposed Management Units



- Management Unit 4

  Extensive Polynesian terracing is evident within this area, which is of considerable archaeological value. Maintenance of pasture in this area is the most appropriate vegetation cover. The middens that have been fenced off provide an opportunity for the establishment of photo points to monitor vegetation change over time with the exclusion of stock.

- Management Unit 5

  It is suggested that this area be considered for the re-establishment of indigenous forest. It would require fencing and the exclusion of stock.

  Species potentially suitable for planting are listed below:

  Moderately Steep to Steep Slopes

  pohutukawa (*Metrosideros excelsa*)
  puriri (*Vitex lucens*)

  Gully System

  pohutukawa (*Metrosideros excelsa*)
  ngaio (*Myoporum laetum*)
  karaka (*Corynocarpus laevigatus*)
  puriri (*Vitex lucens*)
  whau (*Entelea arborescens*)
  nikau (*Rhopalostylis sapida*)
  houpara (*Pseudopanax lessonii*)
  totara (*Podocarpus totara*)
  karamu (*Coprosma robusta*)
  koromiko (*Hebe stricta* var. *stricta*)
  taupata (*Coprosma repens*)
  kawakawa (*Macropiper excelsum* var. *excelsum*)
  hinau (*Elaeocarpus dentatus*; incl *E. d.* var. *obvoatus*)
  rewarewa (*Knightia excelsa*)
  kahikatea (*Dacrycarpus dacrydioides*)

  Gentle Slopes

  totara (*Podocarpus totara*)
  kowhai (*Sophora tetraptera*)
  pohutukawa (*Metrosideros excelsa*)
  karamu (*Coprosma robusta*)
  koromiko (*Hebe stricta* var. *stricta*)
  rimu (*Dacrydium cupressinum*)

- Management Unit 6

  This area should be fenced and stock excluded. It is predominantly pohutukawa forest and treeland and the understorey is being degraded by sheep grazing. The shrub tier and ground layer have been severely depleted, and little regeneration was observed. The exclusion of stock would facilitate the development of a more diverse and abundant understorey and would also promote regeneration.

  Species potentially suitable for planting are listed below:

  Coastal Bank

  pohutukawa (*Metrosideros excelsa*)
  houpara (*Pseudopanax lessonii*)
  taupata (*Coprosma repens*)
  Melicytus novae-zelandiae

  Gully System

  pohutukawa (*Metrosideros excelsa*)
  whau (*Entelea arborescens*)
  karaka (*Corynocarpus laevigatus*)

Management of Threatened and Local Species

The flora of Mauao reflects the diverse character of the habitats present. The distribution and relative abundance of various species will change as vegetation succession proceeds. It is also likely that more species will continue to establish naturally.

If track construction or other development is considered in, or near, habitats where *Psilotum nudum, Lepidosperma laterale* and *Lygodium articulatum* occur, these species should first be located and protected.

One of the *Psilotum nudum* populations was located in an area used for recreational climbing. However not all cliffs were intensively surveyed and further populations are likely to be present. The population on the climbing site should be monitored. If *Psilotum nudum* becomes threatened by increased climbing activity it may become necessary to survey other parts of Mauao to ensure the species is secure.

Several nationally threatened or local species that occur naturally in coastal areas in the Bay of Plenty Region may have been present previously on Mauao and consideration could be given to the establishment of locally sourced populations. Potentially suitable species and the appropriate habitats for establishment are listed below. Small scale planting trials should be considered, as the causal factors of decline may still be operating and hence re-establishment may not be successful. Any plantings should be monitored.

Beaches

Euphorbia glauca (Waiu-o-Kahakura; classed as rare in Cameron *et al.* 1995)
Lepidium oleraceum (Nau, Cook's scurvey grass; classed as endangered in Cameron *et al.* 1995)

Shrubland and secondary forest

Pimelea tomentosa (classed as rare in Cameron *et al.* 1995)
Olearia pachyphylla (classed as endangered in Cameron *et al.* 1995)
Carmichaelia williamsii (classed as vulnerable in Cameron *et al.* 1995)

Forest, scrub and shrubland

Nestegis apetala (coastal maire)
Pisonia brunoniana (parapara)

Vegetation Monitoring

A series of photopoints should be established to monitor vegetation change on Mauao. These should include views of all side slopes and views of the main vegetation/habitat types. Photographs should be taken at regular intervals, say every 1-3 years.

It is also recommended that long term monitoring be established to identify new weed infestations and to monitor the rate of spread, or otherwise, of current infestations.

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LIST OF INDIGENOUS AND PLANTED INDIGENOUS SPECIES

1 = Species not previously recorded
2 = Species previously recorded in Bishop and Beadel (1997)
3 = Historic record (P. de Lange pers. comm.)

1.1 NATURALLY OCCURRING INDIGENOUS SPECIES

Gymnosperms

Phyllocladus trichomanoides (1)	tanekaha

Monocot. trees and shrubs

Cordyline australis	ti kouka

Dicot. trees and shrubs

Brachyglottis repanda	rangiora
Carmichaelia australis	makaka, maukoro
Coprosma lucida	karamu
Coprosma macrocarpa (2)	
Coprosma repens	taupata
Coprosma robusta	karamu
Coriaria arborea var. *arborea*	tutu
Corynocarpus laevigatus	karaka
Dodonaea viscosa	akeake
Entelea arborescens	whau
Gaultheria antipoda (1)	tawiniwini
Geniostoma rupestre var. *ligustrifolium*	hangehange
Hebe stricta	koromiko
Hoheria populnea var. *lanceolata*	houhere, lacebark
Knightia excelsa	rewarewa
Kunzea ericoides var. *ericoides*	kanuka
Leptospermum scoparium	manuka
Leucopogon fasciculatus	mingimingi
Macropiper excelsum var. *excelsum*	kawakawa
Melicytus ramiflorus subsp. *ramiflorus*	mahoe
Metrosideros excelsa	pohutukawa
Myoporum laetum	ngaio
Myrsine australis	mapou
Olearia furfuracea	akepiro
Olearia pachyphylla (3)	

Olearia rani	heketara
Pittosporum crassifolium (1)	karo
Pittosporum eugenioides	tarata
Pittosporum tenuifolium subsp. *tenuifolium* (2)	kohuhu
Pomaderris phylicifolia	
Pseudopanax arboreus var. *arboreus*	whauwhaupaku, five finger
Pseudopanax lessonii	houpara
Rhabdothamnus solandri	taurepo
Vitex lucens	puriri
Weinmannia racemosa	kamahi

Dicot. lianes

Calystegia sepium	
Calystegia soldanella	
Clematis paniculata	puawananga
Muehlenbeckia complexa	pohuehue
Parsonsia capsularis	akakiore
Rubus schmidelioides	akatataramoa

Lycopods and psilopsids

Lycopodium deuterodensum (2)	puakarimu
Lycopodium varium (1)	iwituna
Psilotum nudum	
Tmesipteris tannensis	

Ferns

Adiantum cunninghamii	huruhuru tapairu
Adiantum hispidulum	
Asplenium flaccidum	makawe
Asplenium oblongifolium	huruhuruwhenua
Asplenium polyodon	pekato
Blechnum novae-zealandiae	kiokio
Blechnum filiforme	panako
Cyathea dealbata	ponga
Cyathea medullaris	mamaku
Dicksonia squarrosa	wheki
Doodia media	pukupuku
Histiopteris incisa	matata
Hymenophyllum demissum (1)	irirangi
Hymenophyllum dilatatum (1)	
Hymenophyllum sanguinolentum (1)	piripiri
Lygodium articulatum (1)	mangemange
Paesia scaberula	matata

Phymatosorus pustulatus	kowaowao
Polystichum richardii	puniu
Pteridium esculentum	rarahu
Pteris macilenta	
Pteris tremula	turawera
Pyrrosia eleagnifolia	
Trichomanes reniforme (1)	raurenga

Orchids

Corybas oblongus	
Corybas sp. (*C. rivularis* agg.)	
Earina autumnalis (1)	
Microtis unifolia	maikaika
Pterostylis alobula	
Pterostylis banksii	tutukiwi
Thelymitra longifolia	maikuku

Grasses

Deyeuxia avenoides	
Microlaena stipoides	
Oplismenus imbecillis	
Poa anceps subsp. *anceps*	
Rytidosperma gracile	
Zoysia pauciflora	

Sedges

Baumea juncea	
Carex breviculmis	
Carex testacea	
Cyperus ustulatus (1)	
Isolepis cernua	
Isolepis nodosa	wiwi
Lepidosperma laterale (1)	
Leptocarpus similis	oioi
Morelotia affinis	
Schoenus tendo	
Tetraria capillaris	
Uncinia uncinata	kamu, matau a Maui

Rushes

Juncus gregiflorus (2)	wi

Monocot. herbs (other than orchids, grasses, sedges and rushes)

Astelia banksii	kakaha
Dianella nigra	turutu
Lemna minor (2)	

Composite herbs

Gnaphalium audax	
Gnaphalium gymnocephalum	
Lagenifera pumila (1)	
Pseudognaphalium luteoalbum	pukatea
Senecio hispidulum	
Senecio lautus	

Dicot. herbs (other than composites)

Centella uniflora	
Dichondra repens	
Disphyma australe (1)	horokaka
Drosera peltata subsp. *auriculata*	
Gonocarpus incanus	piripiri
Haloragis erecta subsp. *erecta*	toatoa
Oxalis exilis	
Oxalis rubens	
Pelargonium inodorum	kopata
Peperomia urvilleana	
Ranunculus reflexus	maruru
Samolus repens	
Sarcocornia quinqueflora	ureure
Selliera radicans	
Wahlenbergia violacea	

1.2 PLANTED INDIGENOUS SPECIES

Gymnosperms

Agathis australis	kauri
Dacrycarpus dacrydioides	kahikatea
Dacrydium cupressinum	rimu
Podocarpus totara	totara

Monocot. trees and shrubs

Cordyline australis	ti kouka

Phormium tenax	harakeke
Rhopalostylis sapida	nikau

Dicot. trees and shrubs

Coprosma grandifolia	kanono
Coprosma repens	taupata
Coprosma robusta	karamu
Corynocarpus laevigatus	karaka
Dodonaea viscosa	akeake
Entelea arborescens	whau
Griselinia littoralis	broadleaf
Hebe stricta	koromiko
Hebe sp. (*H. parviflora* agg.)	
Hoheria populnea var. *lanceolata*	houhere, lacebark
Leptospermum scoparium	manuka
Melicytus novae-zelandiae	
Metrosideros excelsa	pohutukawa
Myoporum laetum	ngaio
Myrsine australis	mapou
Olearia paniculata	akirako
Pittosporum crassifolium	karo
Pittosporum eugenioides	tarata
Pseudopanax lessonii	houpara
Vitex lucens	puriri

Dicot. lianes

Muehlenbeckia complexa	pohuehue

ADVENTIVES

Gymnosperms

Pinus pinaster	maritime pine
Pinus radiata	radiata pine
Cupressus macrocarpa	macrocarpa

Dicot. trees and shrubs

Acacia dealbata	silver wattle
Acacia longifolia	Sydney golden wattle
Acacia sophorae	Sydney golden wattle
Acer pseudoplatanus	sycamore

Ailanthus altissima	tree of heaven
Albizia lophantha	brush wattle
Berberis glaucocarpa	barberry
Buddleia davidii (Wilcox and Ecroyd 1984)	buddleia
Chamaecytisus palmensis	tree lucerne
Chrysanthemoides monolifera	boneseed
Cotoneaster glaucophyllus f. *serotina*	cotoneaster
Cotoneaster simonsii (Wilcox and Ecroyd 1984)	khasia berry
Crataegus monogyna	hawthorn
Erica lusitanica	Spanish heath
Euonymus japonicus	Japanese spindle tree
Hakea sericea (Wilcox and Ecroyd 1984)	prickly hakea
Impatiens sodenii	shrub balsam
Jasminum mesnyi	primrose jasmine
Ligustrum lucidum	tree privet
Ligustrum sinense	Chinese privet
Lupinus arboreus	lupin
Lycium ferrocissimum	African boxthorn
Paulownia tomentosa	paulownia
Populus alba cv. Nivea	silver poplar
Quercus ilex	oak
Rhamnus alaternus	Italian buckthorn
Rosa rubiginosa	sweet brier
Rubus sp. (*R. fruticosus* agg.)	blackberry
Solanum mauritianum	woolly nightshade
Teucrium fruticans	teucrium
Ulex europaeus	gorse

Dicot. lianes

Dipogon lignosus	mile a minute
Hedera helix	ivy
Lonicera japonica	Japanese honeysuckle
Passiflora edulis (Wilcox and Ecroyd 1984)	passionfruit
Senecio mikanioides	German ivy
Senecio petasitis	velvet groundsel
(*Vitis* sp.?)	

Monocot. trees and shrubs

Phoenix canariensis	Phoenix palm
Tracycarpus fortunei	fan palm

Grasses

Agrostis capillaris	browntop

Anthoxanthum odoratum	sweet vernal
Aristida ramosa	Australian wire grass
Briza minor	shivery grass
Bromus diandrus	ripgut brome
Cortaderia jubata	pampas
Cortaderia selloana	pampas
Cyonodon dactylis	Indian doab
Dactylis glomerata	cooksfoot
Holcus lanatus	Yorkshire fog
Lolium perenne	rye grass
Miscanthus nepalensis	Himalaya fairy grass
Paspalum conjugutum (Gardiner 1995)	
Pennisetum clandestinum	Kikuyu grass
Poa annua	annual poa
Poa pratensis	Kentucky bluegrass
Sporobolus africanus	ratstail

Sedges

Carex divulsa
Cyperus congestus
Cyperus eragrostis

Monocot. herbs (other than orchids, grasses, sedges and rushes)

Arum italicum	Italian arum
Asparagus asparagoides	smilas
Asparagus scandens	climbing asparagus
Colocasia esculenta	taro
Hedycharium gardnerianum	wild ginger
Ixia maculata	ixia
Narcissus pseudonarcissus	daffodil
Tradescantia fluminensis	tradescantia

Composite herbs

Cirsium vulgare	Scotch thistle
Conyza albida	fleabane
Crepis capillaris	hawksear
Erigeron karvinskinus	Mexican daisy
Gnaphalium coarctatum	cudweed
Hypochoeris radicata	catsear
Leontodon taraxacoides	hawkbit
Leucanthemum vulgare	oxeye daisy
Mycelis muralis	wall lettuce
Senecio bipinnatisectus	Australian fireweed

Senecio jacobaea	ragwort
Senecio sylvaticus	wood groundsel
Sonchus asper	prickly puha
Sonchus oleraceus	puha
Taraxacum officinale	dandelion

Dicot. herbs (other than composites)

Acaena agnipila (Wilcox and Ecroyd 1984)	Australian sheep's bur
Acaena novae-zelandiae	piripiri, bidibid
Acanthus mollis	acanthus
Anagallis arvensis	scarlet pimpernel
Aphanes arvenis	parsley piert
Dianthus ameria	Deptford pink
Dipsacus fullonum	wild teasel
Epilobium ciliatum	willow herb
Foeniculum vulgare	fennel
Fumaria muralis	scrambling fumitory
Galium aparine	bedstraw
Geranium sp.	geranium
Hypericum perforatum	St John's wort
Lactuca serriola	prickly lettuce
Linum bienne	
Lotus pedunculatus	lotus
Marrubium vulgare	horehound
Medicago nigra	bur medick
Ornithopus perpusillus	wild seradella
Physalis peruviana	cape gooseberry
Phytolacca octandra	inkweed
Plantago lanceolata	plantain
Plantago major	broad-leaved plantain
Polycarpon tetraphyllum	allseed
Prunella vulgaris	selfheal
Ranunculus repens	creeping buttercup
Ranunculus scleratus	celery-leaved buttercup
Rumex acetosella	sheep's sorrel
Rumex obtusifolius	dock
Rumex saggitattus	climbing dock
Sagina procumbens	pearlwort
Sigesbeckia orientalis (Wilcox and Ecroyd 1984)	
Silene gallica	catchfly
Solanum chenopodioides	velvety nightshade
Solanum linnaeanum	Apple of Sodom
Solanum marginatum	white-edged nightshade
Solanum tuberosum	potato
Soliva valdiviana	Onehunga weed

Stellaria media	chickweed
Trifolium repens	white clover
Tropaeolum majus	garden nasturtium
Verbascum thapsus	woolly mullein
Verbena bonariensis	purpletop

GLOSSARY

2.1 List of common plant names used in text

akatataramoa	*Rubus schmidelioides*
akeake	*Dodonea viscosa*
akepiro	*Olearia furfuracea*
barberry	*Berberis glaucocarpa*
bead tree	*Melia azedarack*
bidibid	*Acaena novae-zealandiae*
black nightshade	*Solanum nigrum*
blackberry	*Rubus fruticosus* agg.
brush wattle	*Albizia lophantha*
catsear	*Hypochoeris radicata*
cleavers	*Galium aparine*
climbing asparagus	*Asparagus scandens*
cocksfoot	*Dactylis glomerata*
cotoneaster	*Cotoneaster glaucophyllus* f. *serotina*
eucalyptus	*Eucalyptus* sp.
fleabane	*Conyza albida*
gorse	*Ulex europeaus*
harakeke	*Phormium tenax*
hangehange	*Geniostoma rupestre* var. *ligustrifolium*
hawthorn	*Crataegus monogyna*
houhere	*Hoheria populnea*
houpara	*Pseudopanax lessonii*
huruhuruwhenua	*Asplenium oblongifolium*
inkweed	*Phytolacca octandra*
Japanese honeysuckle	*Lonicera japonica*
kahikatea	*Dacrycarpus dacrydioides*
kakaha	*Astelia banksii*
kanuka	*Kunzea ericoides* var. *ericoides*
karaka	*Corynocarpus laevigatus*
karamu	*Coprosma robusta*
karo	*Pittosporum crassifolium*
kawakawa	*Macropiper excelsum* var. *excelsum*
kikuyu grass	*Pennisetum clandestinum*
kiokio	*Blechnum novae-zelandiae*
koromiko	*Hebe stricta*
kowaowao	*Phymatosorus pustulatus*
Lombardy poplar	*Populus canadensis*
macrocarpa	*Cupressus macrocarpa*

mahoe	*Melicytus ramiflorus* subsp. *ramiflorus*
mamaku	*Cyathea medullaris*
manuka	*Leptospermum scoparium*
mapou	*Myrsine australis*
mingimingi	*Leucopogon fasciculatus*
ngaio	*Myoporum laetum*
oioi	*Leptocarpus similis*
pampas	*Cortaderia selloana*
paspalum	*Paspalum distichum*
paulownia	*Paulownia tomentosa*
phoenix palm	*Phoenix canariensis*
pohuehue	*Muehlenbeckia complexa*
pohutukawa	*Metrosideros excelsa*
ponga	*Cyathea dealbata*
poplar	*Populus* sp.
pukupuku	*Doodia media*
puniu	*Polystichum richardii*
purpletop	*Verbena bonariensis*
radiata pine	*Pinus radiata*
rangiora	*Brachyglottis repanda*
rarahu	bracken; *Pteridium esculentum*
ratstail	*Sporobolus africanus*
rewarewa	*Knightia excelsa*
Scotch thistle	*Cirsium vulgare*
silky oak	*Grevillea robusta*
similax	*Asparagus asparagoides*
Spanish heath	*Erica lusitanica*
Sycaomore	*Acer pseudoplatanus*
tall fescue	*Festuca arundinacea*
tarata	*Pittosporum eugenioides*,
taupata	*Coprosma repens*
taurepo	*Rhabdothamnus solandri*
totara	*Podocarpus totara*
tree of heaven	*Ailanthus altissima*
turawera	*Pteris tremula*
turutu	*Dianella nigra*
whau	*Entelea arborescens*
whauwhaupaku	*Pseudopanax arboreus*
woolly mullein	*Verbascum thapsus*
woolly nightshade	*Solanum mauritianum*

2.2 Definitions

3.2.1 Technical terms

Boulderfield

Land in which the area of unconsolidated bare boulders (>200 mm diam.) exceeds the area covered by any one class of plant growth-form. Boulderfields are named from the leading plant species when plant cover ≥ 1%.

Cushionfield

Vegetation in which the cover of cushion plants in the canopy is 20-100% and in which the cushion-plant cover exceeds that of any other growth form or bare ground. Cushion plants include herbaceous, semi-woody and woody plants with short densely packed branches and closely spaced leaves that together form dense hemispherical cushions. The growth form occurs in all species of *Donatia, Gaimardia, Hectorella, Oreobolus,* and *Phyllachne* as well as in some species of *Aciphylla, Celmisia, Centrolepis, Chionohebe, Colobanthus, Dracophyllum, Drapetes, Haastia, Leucogenes, Luzula, Myosotis, Poa, Raoulia,* and *Scleranthus.*

Grassland

Vegetation in which the cover of grass in the canopy is 20-100% and in which the grass cover exceeds that of any other growth form or bare ground. Tussock-grasses are excluded from the grass growth-form.

Fernland

Vegetation in which the cover of ferns in the canopy is 20-100% and in which the fern cover exceeds that of any other growth form or bare ground. Tree ferns >10 cm dbh are excluded as trees (cf. FOREST).

Forest

Woody vegetation in which the cover of trees and shrubs in the canopy is >80% and in which tree cover exceeds that of shrubs. Trees are woody plants >10 cm dbh. Tree ferns >10 cm dbh are treated as trees.

Herbfield

Vegetation in which the cover of herbs in the canopy is 20-100% and in which the herb cover exceeds that of any other growth form or bare ground. Herbs include all herbaceous and low-growing semi-woody plants that are not separated as ferns, tussocks, grasses, sedges, rushes, reeds, cushion plants, mosses or lichens.

Lichenfield

Vegetation in which the cover of lichens in the canopy is 20-100% and in which the lichen cover exceeds that of any other growth form or bare ground.

Loamfield/Peatfield

Land in which the area of loam and/or peat exceeds the area covered by any one class of plant growth-form. The appropriate name if given depending on whether loam or peat forms the greater area of ground surface. Loamfields and peatfields are named from the leading plant species when plant cover ≥ 1%.

Mossfield

Vegetation in which the cover of mosses in the canopy is 20-100% and in which the moss cover exceeds that of any other growth form or bare ground.

Pasture

Pasture species include sweet vernal, ryegrass, browntop, dandelion, foxglove, with scattered *Drosera peltata* subsp. *auriculata*, *Microtis unifolia*, Yorkshire fog, selfheal, white clover and *Poa trivialis*.

Reedland

Vegetation in which the cover of reeds in the canopy is 20-100% and in which the reed cover exceeds that of any other growth form or open water. Reeds are herbaceous plants growing in standing or slowly-running water that have tall, slender, erect, unbranched leaves or culms that are either hollow or have a very spongy pith. Examples include *Typha, Bolboschoenus, Schoenoplectus validus, Eleocharis sphacelata,* and *Baumea articulata*.

Rockland

Land in which the area of residual bare rock exceeds the area covered by any one class of plant growth-form. Cliff vegetation often includes rocklands. They are named from the leading plant species when plant cover ≥ 1%, e.g. [koromiko] rockland.

Rushland

Vegetation in which the cover of rushes in the canopy is 20-100% and in which the rush cover exceeds that of any other growth form or bare ground. Included in the rush growth form are some species of Juncus and all species of *Sporadanthus, Leptocarpus,* and *Empodisma.* Tussock-rushes are excluded.

Sandfield

Land in which the area of bare sand (0.02 - 2 mm diam.) exceeds the area covered by any one class of plant growth-form. Dune vegetation often includes sandfields which are named from the leading plant species when plant cover ≥ 1%.

Scrub

Woody vegetation in which the cover of shrubs and trees in the canopy is >80% and in which shrub cover exceeds that of trees (cf forest). Shrubs are woody plants <10cm dbh.

Sedgeland

Vegetation in which the cover of sedges in the canopy is 20-100% and in which the sedge cover exceeds that of any other growth form or bare ground. Included in the sedge growth form are many species of *Carex, Uncinia, Isolepis,* and *Bolboschoenus.* Tussock-sedges and reed-forming sedges (cf. reedland) are excluded.

Shrubland

Vegetation in which the cover of shrubs in the canopy is 20-80% and in which the shrub cover exceeds that of any other growth form or bare ground. It is sometimes useful to separate tussock-shrublands as a sub-class for areas where tussocks are >20% but less than shrubs. (Note: the term scrubland is not used in this classification.)

Stonefield/Gravelfield

Land in which the area of unconsolidated bare stones (20-200 mm diam.) exceeds the area covered by any one class of plant growth-form. The appropriate name is given depending on whether stones or gravel form the greater area of ground surface. Stonefields and gravelfields are named from the leading plant species when plant cover ≥ 1%.

Treeland

Vegetation in which the cover of trees in the canopy is 20-80%, with tree cover exceeding that of any other growth form, and in which the trees form a discontinuous upper canopy above either a lower canopy of predominantly non-woody vegetation or bare ground, e.g. mahoe/rarahu treeland. (Note: Vegetation consisting of trees above shrubs is classified as either forest or scrub depending on the proportion of trees and shrubs in the canopy.)

Tussockland (including flaxland)

Vegetation in which the cover of tussocks in the canopy is 20-100% and in which the tussock cover exceeds that of any other growth form or bare ground. Tussocks include all grasses, sedges, rushes, and other herbaceous plants with linear leaves (or linear non-woody stems) that are densely clumped and > 10 cm height. Examples of the growth form occur in all species of *Cortaderia, Gahnia* and *Phormium*, and in some species of *Chinochloa, Poa, Festuca, Rytidosperma, Cyperus, Carex, Uncinia, Juncus, Astelia, Aciphylla* and *Celmisia*. It is sometimes useful to separate flaxland as a subclass for areas where species of *Phormium* are dominant.

Vegetation Type

A term which includes the dominant canopy species and structural class of an area of vegetation, e.g. rimu/tawa-kamahi forest, *Isolepis nodosa/ Muehlenbeckia complexa* sedge-vineland.

In addition, cover values and tiers are included, i.e.

<u>tawa</u>	over 50% cover of the double underlined species
<u>tawa</u>	between 25-49% cover of the underlined species
tawa	between 5-24% cover of non-underlined species
(tawa)	less than 5% cover of the bracketed species
(rimu)/tawa	indicates less than 5% cover of rimu emergent over a canopy of tawa
tawa-hinau	indicates tawa and hinau occur in the same tier
ⓘ	mosiac

Vineland

Vegetation in which the cover of unsupported (or artificially supported) woody vines in the canopy is 20-100% and in which the cover of these vines exceeds that of any other growth form or bare ground. Vegetation containing woody vines that are supported by trees or shrubs is classified as forest, scrub or shrubland. Examples of woody vines occur in the genera *Actinidia, Clematis, Lonicera, Metrosideros, Muehlenbeckia, Ripogonum, Vitis* and others.

2.3 Symbols and abbreviations

approx.	approximately
DOC	Department of Conservation
ha	hectare
m	metre