APPENDIX II

SURVEY METHODS AND RESULTS

1. Vegetation Mapping

Using aerial photographs and ground surveys the vegetation was mapped and described as outlined by Bagnall (1975), although soil features were not recorded. Particular note was made of the condition of and damage to the vegetation.

2. Quantitative Sampling

Circular, horizontal plots of 2 m radius were used for quantitative work. The centre of each plot was marked by a point-sampling pole which was used to record the uppermost canopy cover over 2 m above ground. A 2 m rule was used to determine the plot boundary. Fifty such plots were used, evenly spaced along 7 parallel sampling lines. Each line was run on a magnetic bearing of 220° from one side of the stand to the other. No plots were laid within 8 m of the vegetation margin.

From each plot were recorded:

A. each vascular plant species growing (rooted) within the plot or epiphytic on a plant growing within the plot

B. the presence of any tree seedlings ($\leq$ 10 cm ht)

C. the height of each young tree between 10 and 200 cm ht

D. the circumference or diameter of each tree (>2 m ht), both at breast height (1.4 m) and at 50 cm above ground level

E. the nature, extent and approximate age of any damage to each tree

F. the diameter or circumference at 50 cm ht of each felled tree; also the height of felling, the approximate age of the cut and whether the felled tree was alive or dead at the time of recording.

A plant was included within the plot if 50% or more of its base area was within the plot. On sloping ground the ground level was taken at the lateral midpoint of the tree.

3. Ageing of Trees

Specimens of gorse and tawa recently killed by development activity were taken for ageing by ring counting. The trees were from vegetation type 3a (gorse samples) at the head of Balliol Drive and 6t (tawa samples).

4. Treatment of Sample Data

Basal areas of trees were calculated assuming circular cross sections. The ratio of summed basal areas at 50 cm ht to those at breast height was calculated separately for each species using the data from unfelled trees. The factor so obtained was then used to correct the basal areas at 50 cm ht on felled tree stumps to a comparative extrapolated value at breast height. Density data was treated both as plant density (i.e. separate stems at ground level) and stem density (i.e. separate stems at breast height).

All density and basal area data were extrapolated to a ha^{-1} basis as vertically projected on to a plane surface.

The frequency percent occurrences of species were calculated from the species presence/absence data.

5. Results

The survey results are incorporated within the preceding report. The following sections and tables comprise more detailed supportive information, where this was obtained.

I. Ageing of plants

The ages of gorse plants collected from vegetation type 3a were as follows: 21, 23, 23, 28 and 29 years.

The ages of the youngest tawa trees collected, corrected for time since death, were as follows: (dbh in parentheses) 39 (14.5 cm), 39 (12.5 cm) and 58 years (15.5 cm). These tawa were as small as any measured within the forest, and suggest that regeneration of tawa effectively ceased in the late 1930's.

II. Vegetation type descriptions

1a, pasture on steep slopes

Grazed pasture on slopes of approximately 10-40°.

1. 0.5-1.5 m; up to 50% cover on margins; scattered tauhinu, gorse and occasionally olearia solandri.

2. grazed pasture; perennial rye grass and browntop (90% cover); with cocksfoot, sheep sorrel, sweet vernal, Poa pratensis, barley grass, fiddle dock, dove's foot, dandelion and Yorkshire fog (together c. 10% cover).

1b, pasture on moderate slopes

Grazed pasture on slopes of < c. 10°.

1. grazed pasture of browntop and perennial rye grass (100% cover).

1c, recently burned shrublands

Areas of vegetation type 2b with some marginal areas of type 3a burned in the summer of 1974-75.

1. 2-3 m; dead, charred stems of gorse with marginal areas of mahoe.

2. 0.5 m; 60-100% cover; resprouting gorse, gorse seedlings, herbaceous species and local areas of bracken.

2a, tauhinu/pasture

1. 1-1.5 m; 5-80% cover; tauhinu with scattered gorse.

2. grazed pasture (refer type 1a).

2b, gorse shrubland

1. 1-2.5 m; 80-100% cover; gorse.

2. up to 0.5 m; litter; with, scattered in older stands, seedling and young sapling mahoe and karamu.

3a, gorse shrubland with mahoe

1. 2-3 m; gorse (60-80% cover) and mahoe (20-30% cover)

2. up to 2 m; up to 60% cover; bracken, local but more abundant on steep faces where upper canopy is not or poorly developed.

3. 5% cover; scattered, seedling and sapling, mahoe, karamu and kaikomako.

3b, mixed shrubland - pasture

1. up to 4 m; 20% cover; scattered mahoe overgrown by bush lawyer and bush pohuehue.

2. 0.5-2 m; bracken (30% cover) and Coprosma rhamnoides (30% cover) overgrown by coastal pohuehue.

3. pasture in canopy gaps (refer type 1a).

4a, mahoe forestland in gullies

1. 4-6 m; up to 30% cover; emergent mamaku in lower gullies.

2. 3-4 m; main canopy of mahoe (70% cover); with kaikomako, karamu, fuchsia and rangiora (together about 30% cover); abundant bush lawyer and bush pohuehue is overgrowing the canopy.

3. subcanopy; undergrazed, but ferns and some seedlings, particularly of mahoe, kaikomako and putaputaweta

4b, mahoe forestland on faces

1. 2-4 m; canopy of mahoe (80% cover) with gorse (10% cover, dominant on margins), karamu (10% cover) and scattered scotch broom.

2. subcanopy of ferns and seedlings, especially of mahoe, kaikomako and pigeon wood.

4x, old mahoe forestland

1. 2.5-4 m; mahoe (95% cover), karamu (5% cover), with scattered gorse, mamaku and kaikomako; over 100% total cover.

2. undergrowth of ferns and kawakawa with seedlings and young saplings, particularly of mahoe, kaikomako, pigeon wood, titoki and hinau.

5, immature forest

1. up to 10 m; < 5% cover; occasional emergent northern rata and rewarewa.

2. 4-6 m; mahoe (80% cover) and kaikomako (10% cover) with scattered lancewood, tawa, titoki and pigeon wood.

3. 1-2.5 m; kawakawa (10% cover) and mapou (5% cover), with scattered Coprosma areolata and Coprosma rhamnoides.

4. ground cover, undergrazed until recently; scattered ferns, young kawakawa, and scattered seedling mahoe, kohekohe, pigeon wood and titoki; no tawa seedlings. Severe trampling from children. Much rubbish and spoil marginally from building and subdivision work.

6k, kohekohe dominated mature forest

1. 10-12 (-14) m; 0-30%; tawa, with scattered hinau and rewarewa.

2. 6-8 (-10 m); 50-100%; kohekohe with scattered pigeon wood, rewarewa, titoki and mahoe; also on ridges and forest margins are mapou and Coprosma areolata.

3. 1-3 m; up to 80% cover; kawakawa, with hangehange, raurekau, and sapling kohekohe, mahoe and titoki.

4. ground cover; up to 70%; ferns, especially Asplenium bulbiferum, Blechnum filiforme and Phymatodes scandens. On dryer sites Lastreopsis hispida, Phymatodes diversifolium and Uncinia uncinata are common; seedling kohekohe, mahoe, kaikomako and Coprosma areolata.

Climbers are abundant in strata 1 and 2, particularly supplejack and ratas (largely red climbing rata). Also in these strata are abundant epiphytic ferns and occasional astelias, but no epiphytic orchids.

6t, tawa dominated mature forest

1. 10-12 (-18) m; 40-95%; tawa, with scattered rewarewa, hinau and kahikatea; pukatea in gullies.

2. 6-8 (-10) m; 5-60%; kohekohe, with scattered titoki and mahoe.

On the upper ridges strata 1 and 2 are not distinguishable and are at c. 6 m ht.

3. &
4. Refer type 6k.

Climbers and epiphytes as for type 6k.

P, planted macrocarpa

1. 8-10 m; 100% cover; macrocarpa.

2. sparse ground cover of small herbs and grasses.

TABLE 1 – List of vascular plant species recorded from mature forest of Redwood Bush. Species growing only on the forest margins are not included. Common names are shown in parentheses; *, exotic species; g, present only in canopy gaps; d, recorded only from the area proposed for urban development; t, recorded by Atkinson (1972) but not seen in the present study; the figure is the frequency percent in 50 circular plots of 2 m radius. Except where authorities are cited, nomenclature follows Allan (1961), Moore and Edgar (1970), New Zealand Weed and Pest Control Society (1969) and Edgar (1971), the latter taking priority.

1. TREES AND SHRUBS

Alectryon excelsus (titoki) 30%
Aristotelia serrata (wineberry) d 0%
Beilschmiedia tawa (tawa) 30%
Brachyglottis repanda (rangiora) 24%
Carpodetus serratus (putaputaweta) 2%
Coprosma areolata 56%
Coprosma australis (raurekau) 28%
Coprosma rhamnoides 36%
Coprosma robusta (karamu) g 12%
Coprosma propinqua x C. robusta g 2%
Corynocarpus laevigatus (karaka) 4%
Dacrycarpus dacrydioides (kahikatea) 2%
Dysoxylum spectabile (kohekohe) 94%
Elaeocarpus dentatus (hinau) 14%

Eugenia maire (swamp maire) t
Fuchsia excorticata (fuchsia) 3%

most trees have died in recent years

Geniostoma ligustrifolium (hangehange) 88%
Griselinia lucida (puka) 0%
Hedycarya arborea (pigeonwood) 22%
Knightia excelsa (rewarewa) 8%
Laurelia novae-zelandiae (pukatea) 2%
Leycesteria formosa (Himalayan honeysuckle)* g
Lophomyrtus bullata (ramarama) 2%
Macropiper excelsum (kawakawa) 92%
Melicytus ramiflorus (mahoe) 66%
Myrsine australis (mapou) 84%
Olearia rani (heketara) 12%
Paratrophis microphylla (turepo) 0%
Pennantia corymbosa (kaikomako) 46%
Podocarpus ferrugineus (miro) 4%
Podocarpus totara (totara) t
Pseudopanax arboreus (fivefinger) 8%
Pseudopanax crassifolius (lancewood) 2%
Sambucus nigra (elder) * d 2%
Schefflera digitata (pate) 0%
Solanum aviculare (poroporo) g 2%
Solanum laciniatum (poroporo) t
Ulex europaeus (gorse) * g 0%

2. LIANES

Clematis paniculata (clematis) 4%
Freycinetia banksii (kiekie) t,
Hedera helix (ivy) * 0%
Metrosideros diffusa (climbing rata) 34%
Metrosideros fulgens (red climbing rata) 40%
Metrosideros perforata (climbing rata) 22%
Muehlenbeckia australis (bush pohuehue) 20%
Muehlenbeckia complexa (coastal pohuehue) 2%
Parsonsia heterophylla (parsonsia) 88%
Ripogonum scandens (supplejack) 60%
Rubus cissoides (bush lawyer) 2%
Tetrapathaea tetrandra (native passion flower) 26%

3. FERNS

Asplenium bulbiferum 70%
Asplenium bulbiferum x A. hookerianum 10%
Asplenium falcatum 16%
Asplenium flaccidum 26%
Asplenium hookerianum 14%
Asplenium lucidum 52%
Botrychium australe var. millefolium d 2%
Blechnum chambersii Tindale 16%
Blechnum filiforme 94%
Blechnum membranaceum 4%
Cyathea dealbata (ponga) 34%
Cyathea medullaris (mamaku) 0%

most plants are dead

Dicksonia squarrosa (wheki) t
Histiopteris incisa g d 0%
Hymenophyllum demissum 22%
Hymenophyllum sanguinolentum t

Hypolepis tenuifolia 2%
Lastreopsis decomposita d 2%
Lastreopsis glabella 26%
Lastreopsis hispida 32%
Lastreopsis velutina d 2%
Pellaea rotundifolia 12%
Phymatodes diversifolium 30%
Phymatodes scandens 72%
Polystichum richardii 4%
Pteridium aquilinum var. esculentum (bracken) g 4%
Pteris macilenta (8%)
Pteris tremula d 0%
Pyrrosia serpens 28%
Rumohra adiantiformis 2%
Thelypteris pennigera d 4%
Todea hymenophylloides 10%

4. GRASSES AND SEDGES

Anthoxanthum odoratum (sweet vernal) * g d 0%
Carex dissita d 0%
Carex forsteri g d 0%
Dactylis glomerata (cocksfoot) * g 8%
Holcus lanatus (Yorkshire fog) * g d 0%
Juncus pallidus d 0%
Juncus sarophorus d 0%
Lolium perenne (perennial rye grass) * g d 2%
Microlaena stipoides (meadow rice grass) 16%
Poa annua * g d 2%
Schoenus maschalinus d 2%
Scirpus prolifer d 0%
Uncinia banksii (hook grass) 6%
Uncinia uncinata (hook grass) 62%

5. IRISES, LILIES, ORCHIDS

Astelia solandri 2%
Collospermum hastatum 0%
Iris sp. * d 2%
Microtis unifolia d 0%
Pterostylis banksii 24%
Pterostylis graminea d 2%
Thelymitra longifolia d 0%

6. OTHER HERBS AND SUB-SHRUBS

Cardamine debilis 4%
Carduus tenuiflorus (winged thistle) * g d 2%
Cerastium glomeratum (annual mouse-ear chick weed) * g d 2%
Cirsium vulgare (scotch thistle) * g 8%
Digitalis purpurea (fox glove) * g 4%
Erigeron sp. (fleabane) * g 12%
Galium aparine (cleavers) * g 24%
Geranium robertianum (herb robert) * g 2%
Hydrocotyle americana 2%
Hydrocotyle novae-zelandiae 0% strongly hispid form with leaves 8-25 mm diam.

Hypericum androsaemum (tutsan) * g 4%
Hypochaeris radicata (catsear) * g 8%
Mycelis muralis (wall lettuce) * d 2%
Myosotis sylvatica (wood forget-me-not) * d 0%
Oxalis corniculata (oxalis) * g 2%
Plantago lanceolata (plantain) * g d 2%
Prunella vulgaris (self heal) * g 4%
Ranunculus hirtus 2%
Ranunculus repens (creeping buttercup) * g 0%
Senecio jacobaea (ragwort) * g 6%
Senecio sylvaticus (wood groundsel) * g 0%
Solanum nigrum (black nightshade) * g 12%
Sonchus oleraceus (sow thistle) * g 6%
Stellaria media (chickweed) * g d 4%
Stellaria parviflora (native chickweed) 4%
Taraxacum officinale (dandelion) * g d 4%
Trifolium repens (white clover) * g d 2%
Urtica incisa (stinging nettle) d 2%
Vicia hirsuta (hairy vetch) * g d 2%
Vicia sativa (including V. angustifolia) (vetch) * g d 2%

TABLE 2 – Distribution of vascular plant species in mature forest (including both kohekohe dominated and tawa dominated mature forest). The areas proposed for urban development and as a reserve are those shown on the subdivisional plans, not those in the district scheme.

- total no. indigenous species:	92 + 2 hybrids and 6 species last recorded in 1972 (Atkinson 1972)
- no. indigenous species confined to proposed urban area:	17 (19% of total indigenous)
- total no. exotic species:	34
- no. exotic species confined to proposed urban area:	16 (47% of exotic species)
- $\bar{x}$ no. species/plot in proposed reserve area:	19
- $\bar{x}$ no. species/plot in proposed urban area:	20
- $\bar{x}$ no. exotic species/plot in proposed reserve area:	0.4
- $\bar{x}$ no. exotic species/plot in proposed urban area:	3.2
- $\bar{x}$ no. exotic species/plot in lower marginal plots*:	4.3
- $\bar{x}$ no. exotic species/plot in upper marginal plots*:	–

* the marginal plots are those at the ends of each sample line; the lower marginals are adjacent to existing urban development; the upper marginals are beside seral vegetation.

TABLE 3 – Canopy composition of mature forest including both tawa dominated and kohekohe dominated. Only the uppermost foliage over 2 m above the ground surface is recorded on 50 sample points. Errors are to one standard error calculated using the formula given by Atkinson (1962).

Species	% cover and error
Dysoxylum spectabile (kohekohe)	48±7
Beilshmiedia tawa (tawa)	30±6
Melicytus ramiflorus (mahoe)	6±3
canopy gap	6±3
Myrsine australis (mapou)	4±3
Elaeocarpus dentatus (hinau)	2±2
Geniostoma ligustrifolium (hangehange)	2±2
Olearia rani (heketara)	2±2
	100