NPA's Submission to
Land + ENVIRONMENT COURT

4.0 ENVIRONMENTAL ISSUES

A number of reports have been prepared and these include vegetation, fauna and archaeological studies as referenced in Section 7.0. Generally the site has been described as containing important vegetation and animal communities which are located mostly on slopes and within gullies. Archaeologica 'eposits have also been identified throughout the area. This section discusses environmental issues which are relevant to an assessment of the merits of both the four hectare and the two hectare proposal.

4.1 KOALA COMMUNITIES

4.1.1 Current Information

The presence of the koala colony was first noted in 1986 and since that time some 85 sightings have been recorded (CSIRO, 1988). A detailed study carried out by the CSIRO (op cit) correlated koala sightings and evidence of their presence with different habitat types.

Koalas were found to be closely associated with *Eucalyptus Punctata* which is likely to be the animals' prime food source.

The distribution of *E. Punctata* is an indicator of prime koala habitat; it is dominant on slopes along the O'Hares Creek gorge near the northern and eastern sections of the site. Marginal koala habitats were identified by the CSIRO as those areas where *E. punctata* occurs as a minor component of other tree communities. Figures 4 and 5 give the extent of prime and marginal habitat as well as showing the locations of koala sightings. The CSIRO have commented that marginal habitats are probably important routes and temporary food sources for koalas moving from one area of prime habitat to another. Koalas were clearly associated with *E. punctata*, however, their presence has also been associated with other eucalyptus species (Symbiosis 1988, p. 13).

The CSIRO study was undertaken over a short period of time and was essentially an attempt to correlate available evidence of koalas with vegetation type. There is currently little ecological information relating to numbers, fecundity and mortality rates or koala movements. The viability of the community has not been assessed and there is little information on levels of impacts that can be safely tolerated by individuals or the community.

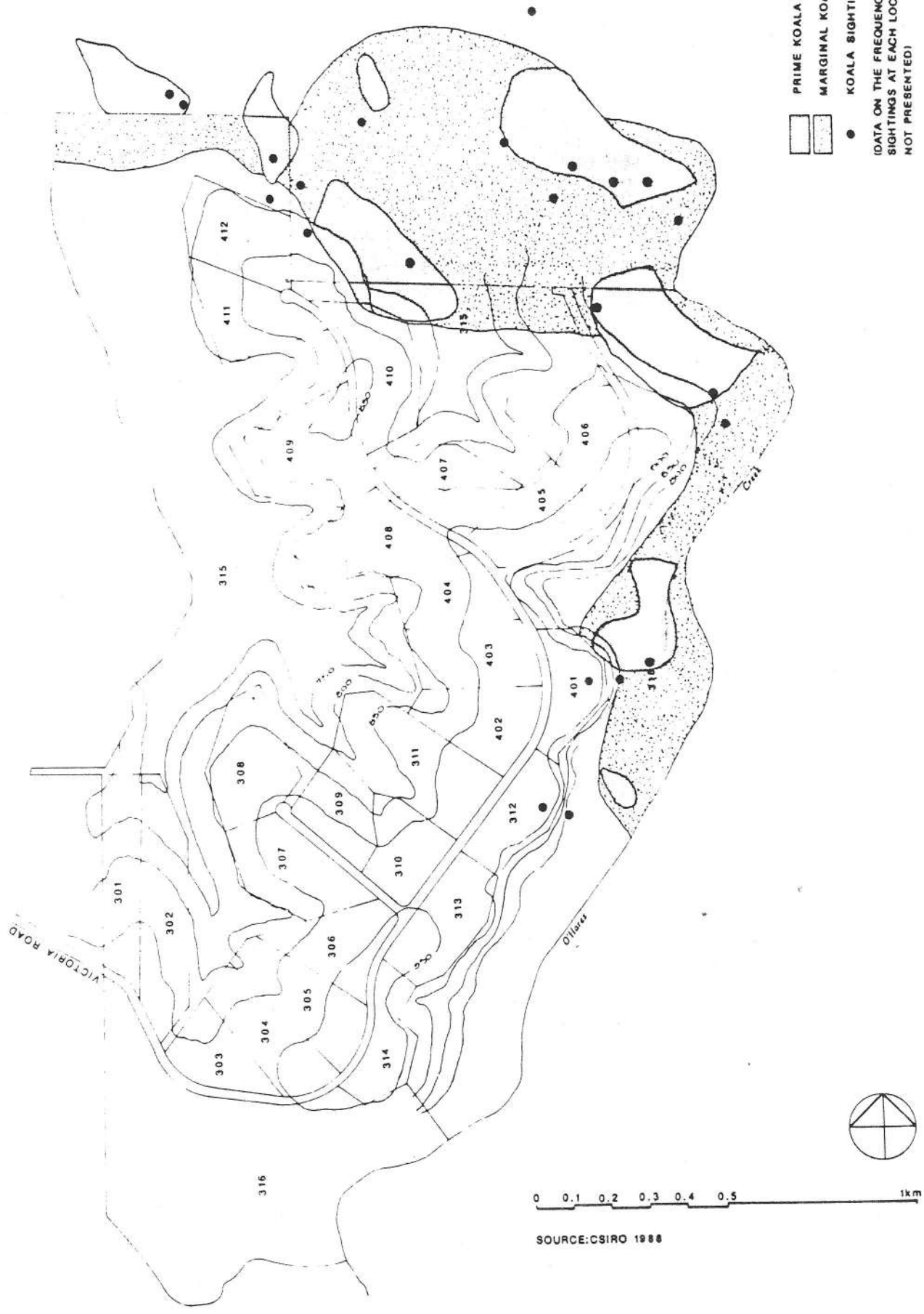

Figure 4
PRIME & MARGINAL KOALA HABITAT
JA[illegible]FOUR HECTARE PROPOSAL

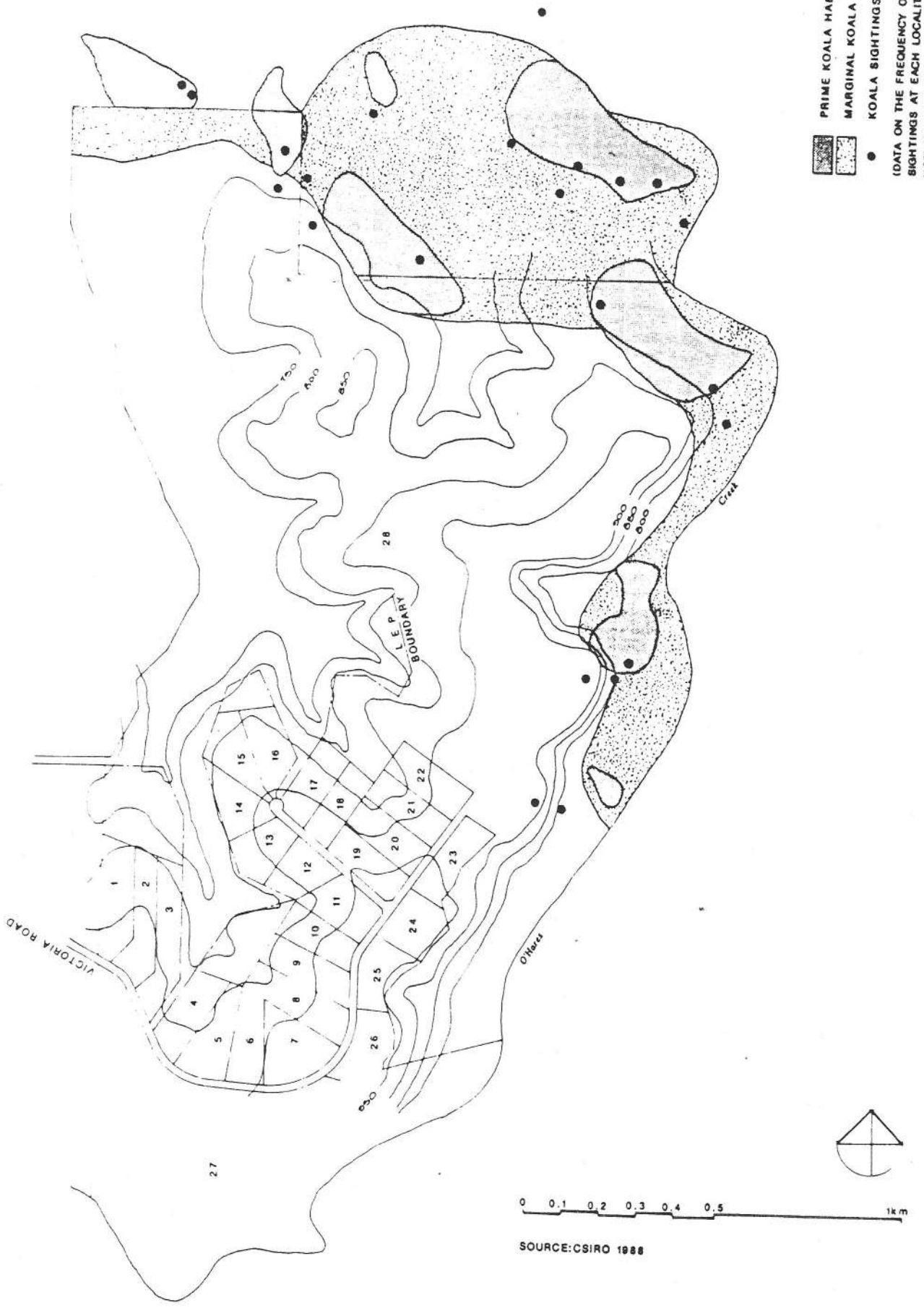

Figure 5
PRIME & MARGINAL KOALA HABITAT
TWO HECTARE PROPOSAL

4.1.2 Background and General Impacts

As previously mentioned there is little information regarding the lifecycle, habits or general characteristics of the Wedderburn koala colony. The following discussion gives general information on koalas drawn from a report by the CSIRO (CSIRO, 1989) as well as assessing the likely impacts resulting from the proposal.

i. General Description

Koalas are the largest of the strictly arboreal (tree dwelling) marsupials. Their mature body weight ranges from around 5 kilograms in Queensland to 15 kilograms in Victoria. Being large means that they are relatively slow moving in trees and are unable to build nests or shelter in tree hollows. Their fur is a very effective insulator so they can maintain body temperature when exposed to strong and cold winds. The fur on the belly is thinner than on the back, and changes in posture are used to increase or decrease heat loss. Large size also means that adult koalas have few predators when in trees, although they are susceptible on the ground when moving between trees.

The claws of koalas are well adapted for gripping tree trunks and branches and the method of climbing is by gripping around trunks. This contrast with the possums, which climb by "walking" up the trunk. Thus, koalas leave a characteristic series of horizontal scratches on tree trunks whereas possums leave vertical scratches.

Koalas are marsupials, which means they have a different mode of reproduction to other mammals in that the young are born at a very immature stage (like a human foetus) and nourished in the pouch by milk until independence is possible. Marsupials are native to Australasia and South America, although the South American marsupials are very different to the Australasian ones. Hence, the kangaroos, koalas and possums which characterise the Australian marsupials are unique in the world (op cit, p. 1).

ii. Life Cycle

Koalas usually mate once each year, in spring/early summer. This ensures that the young reach independence in the following spring/early summer when young eucalypt foliage is usually available. This is important as young animals have very exacting nutritional requirements and

cannot cope with the mature leaves eaten by the adults. Gestation (pregnancy) lasts about 35 days, after which the young is born and develops in the pouch for a further 22 weeks before it has its first layers of fur and begins to poke its head out of the pouch. During this time the young feeds not only on milk but also on gut contents of the mother exuded from her anus. It is thought that this "pap" primes the baby koala's gut with bacteria that it will need for digesting leaves as an adult.

After another 4-5 weeks the young emerges from the pouch fully for the first time and by 36 weeks it spends much of its time out of the pouch riding on the mother's back and begins to sample eucalypt leaves. During this time the young is particularly vulnerable if separated from its mother because it has not developed the physiology or habits to survive independently and is still small enough to be prey for predators.

By 12 months of age the young has developed the dentition necessary for eating eucalypt foliage and is more or less independent. Young females usually stay in the same habitat as their mothers and have their first young at about 18 months. Young males usually leave the area at about two years of age and may roam for two to three years before settling.

Because the breeding cycle takes a full 12 months, delay in breeding due to bad weather, illness or perhaps disturbance can mean that a female koala will miss a breeding season every few years. Similarly, if a mother loses her young she cannot breed again in that season. Although few female koalas lose their young normally, excessive disturbance due to human activity, particularly by uncontrolled dogs, could increase loss of young and have a considerable impact on the growth of a koala colony close to an urban centre (op cit, p. 2).

Koalas appear from zoo records to be capable of living to 18 or more years, but probably do not live this long in the wild. In the past the major causes of death probably were Aborigines, dingoes, fires and droughts. Large owls also are suspected to take young koalas. Today motor vehicles and dogs account from many deaths around urban centres (op cit, p. 2).

iii. Habitat requirements

Koalas are closely associated with *Eucalyptus* forests, which provide their main source of food (eucalypt leaves). Koalas and eucalypt forests were once widely distributed in eastern Australia, South Australia and Western Australian. Since European settlement, this range has contracted markedly with the clearing of forests. Koalas are now extinct in Western Australia and have had

to be reintroduced to South Australia. They were once thought to be extinct in NSW but now are known to exist in small populations in remnant patches of favourable habitat and in inaccessible areas of undisturbed forest. It is generally accepted that loss of habitat is the greatest threat to koalas today (op cit, p. 2).

Koalas do not live throughout all eucalypt forests. In fact probably less than 10% of existing forests are suitable for them because only these contain acceptable food (op cit, p. 2). The CSIRO has shown that most favourable areas are forest on high fertility soil, the same soil sought by farmers and graziers for crops and stock and by foresters because the trees grow taller there. Much of this remaining land is privately owned. The CSIRO (op cit, p. 9) argue that identification of these areas of prime koala habitat (ie. using computer mapping procedures and field surveys) and development of plans for their management are of high priority if koalas are to be conserved. It would appear that the Wedderburn site is one such area.

iv. Ranging habits

Koalas do not move much and are largely solitary animals. Although some rare examples of long movements (a few kilometres) have been reported, koalas usually stay within a home range of 1-2 hectares. Home ranges usually are 1-1.5 hectares (males bigger than females) and are largely separate although male home ranges often overlap with those of several females and in isolated patches of good habitat where dispersal of young is restricted koalas can live at very high densities (>3 per hectare). The size of the home range and the viable population density depends on the density of acceptable food trees. Koalas have been known to die out completely when their food trees have been defoliated even though many other tree species may have been present. Koalas usually do not defend territories, but males are hierarchical and defend their access to females.

Koalas spend about 19 hours per day resting or sleeping. The rest of the time is spent moving, eating, grooming and in social interactions. Most activity is at night and feeding is concentrated just before and after dusk and just before dawn.

In the context of the Wedderburn situation, most koala movements would be along the gorge and within forested corridors (op cit, p. 2). It is not expected that the open ground on the plateau would be used to significant extent.

v. Feeding habits and nutrition

As indicated above, koalas are closely associated with *Eucalyptus* trees. The diet of koalas is almost exclusively eucalypt foliage, although they do eat small amounts of a number of other native trees and bushes and even some introduced Radiata pine (op cit, p. 3). Koalas are regarded as extremely fastidious eaters, choosing a very small number of eucalypt species to feed from. This knowledge has come mostly from observations of koalas in captivity. In the wild koalas are a little less fussy but nevertheless generally appear to only accept a tiny proportion of the eucalypt species that exist in Australia. There are perhaps 10-15 species at the most that koalas will accept as a staple diet but an undetermined number (perhaps up to 50, but that is a wild guess) that they will eat in small amounts.

It is not just the species of tree that is important but the environment in which the tree grows (especially soil type) and the other species with which it grows (op cit, p. 3). This is why the CSIRO report (CSIRO, 1988) identified tree communities that are important to koalas at Wedderburn rather than species alone. It appears that the nutrient availability to the tree from the soil affects the nutritional quality of the leaves. In particular the balance between nutrients (protein, fat and sugars), toxic compounds (non-tannin phenolics and essential oils), and compounds interfering with digestion (tannins and lignin) is probably more favourable when soil fertility is high.

Koalas are in a unique situation nutritionally. On the one hand, they are too small in theory to cope with eucalypt foliage as a diet because it contains a high proportion of almost indigestible material (fibre), not much protein, and a lot of the potentially toxic compounds mentioned above. This means eucalypt foliage provides very little energy and because of scaling effects in physiological processes a mammal should need to be very large to cope with such a diet. On the other hand, koalas cannot be any larger because the trees would not hold them. As it is they have difficulty accessing the youngest leaves (which are the most nutritious) on the tips of small branches.

To get around these handicaps, koalas have a very low rate of metabolism (50% of most other mammals) and a highly specialised digestive tract than enables them to maintain a high food intake so they can meet their nutritional requirements from the small amount of nutrient in the leaves (op cit, p. 3). This has two further consequences. Firstly, koalas have a delicate nutrient economy and must conserve energy wherever possible (this might explain why they appear so inactive). Secondly, they require a regular and abundant supply of food. If their food supply is

cut down or damaged or if the koalas are denied access to it for even a few days they lose considerable condition and can die very quickly. Similarly, although it may appear to humans that alternative food is available, often it is not and koalas may starve to death in the middle of a forest of eucalypt leaves that they find unacceptable.

Around the Campbelltown area, two species, in particular *Eucalyptus tereticornis* (the red gum) and *Eucalyptus punctata* (the grey gum) probably were the main food trees for koalas before clearing. At Wedderburn 1-3 tree communities dominated by the grey gum now appear to be the main reason(s) that koalas are present. Wedderburn is an interesting site because many of the species present could be regarded as low nutrient species elsewhere and not usually associated with koalas (except for the grey gum). However, CSIRO analyses (CSIRO, 1989, p. 3) indicate unusually high levels of at least some nutrients in the leaves of all species. This might have arisen from local geological conditions or from past management practices on the plateau. Whatever the reason, the CSIRO have suggested (op cit, p. 3) that the suitability of this habitat for koalas could be decreased if water and/or nutrient flows to the gorge area are altered (up or down). CSIRO research elsewhere (op cit, p. 3) suggests that overly high supplies of nutrients can cause eucalyptus to synthesize more toxic compounds.

vi. Disease

The problem of disease for koalas has been overstated recently, but there are still strong reasons to protect disease-free colonies. The disease(s) that have received most publicity are caused by a bacterium called *Chlamydia psittaci*. This causes inflammation of the eyes leading to blindness in extreme cases and can move into the urinary tract to cause "dirty tail" (leaking of urine onto the rump fur) and bladder and kidney pathology. It can also get into the female reproductive system causing inflammation around the ovaries. It does not affect the functioning of the ovaries but can stop the passage of eggs to the uterus and hence can cause infertility.

These are all extreme scenarios. Possibly the majority of koala colonies around Australia have some level of infection but they are still mostly fertile growing populations. Even females that become infertile can recover. The disease is worst when the population is stressed (eg. nutritionally or socially by overpopulation), so management of habitat and numbers of koalas should take care of the disease problem. *Chlamydia* is one of the most ubiquitous bacteria in the animal kingdom. A relative of it is responsible for eye infections and venereal disease in human populations and probably most other mammals as well. *Chlamydia* probably was responsible for epidemics among koalas around the turn of the century, from which they recovered.

Having played down the threat from the disease, it should be added that where disease-free colonies are found they are of great importance because they can be used as stock to re-establish koala in areas where they have become extinct. If the Wedderburn colony is disease-free, this would give it added significance.

vii. Effects of forest clearing

In stable koala colonies, young males between two and four years of age disperse and may roam for several years until establishing themselves in new habitat. When a colony becomes too dense for its food supply the young females also disperse. When old animals die young ones move back from surrounding areas to take their place. It is important in managing koalas to maintain routes for these movements. Otherwise, populations become too large and eat out their food supply, fertility falls and the animals eventually die, or the population becomes unstable because of lack of recruits.

The importance of not fragmenting the existing koala habitat at Wedderburn or severing access to the adjacent reserves to the north and east was previously pointed out (CSIRO, 1988).

viii. Effects of urbanisation

Effects of urbanisation on koalas have not been studied extensively, but the experiences of fauna authorities and interest groups at Phillip Island (Vic), Avalon and Port Macquarie (NSW) give some insights. At all three sites numbers of koalas have declined as urban centres have grown and the incidence of disease may also have increased, although there are inadequate data to verify this. There are no good studies of the effects of human presence on koalas. Some people argue that koalas are stressed by the attention they get from people but others claim to have seen no such effects. It is almost certain that some harassment of koalas will come from a small proportion of any human community, and management of koalas near towns should allow for this. What is clear is that cars and domestic dogs have increased mortality of koalas around urban centres. At Phillip Island, for example, 60% of deaths have been found to be caused by cars and 6% by dogs (CSIRO, 1989, p. 5).

4.1.3 Regional Significance of the Wedderburn Koala Colony

i. Distribution of Koalas

The significance of the Wedderburn colony cannot be properly assessed without knowing whether it is part of a much larger colony, how large that colony is and what its distribution is. There is evidence (op cit, p. 5) that the larger colony spreads for some distance up O'Hares Creek and along the Georges River to the north of Wedderburn. More detailed study is needed to determine the security of this colony and to assess the risks to it from fragmentation and urbanisation. If, as it appears, the Wedderburn colony is the southernmost extreme of the large colony then disturbance of it might not fragment the large colony but such disturbance would almost certainly put pressure on the large community as animals moved from Wedderburn to find new habitat. The extent of this pressure would depend on the size and distribution of the larger colony and the extent of underutilised habitat for the displaced animals to move into. If, on the other hand, koala colonies exist to the south of Wedderburn and communicate with the northern colonies, the strip of habitat along O'Hare's Creek would be very important and disturbance to it could fragment the koala populations in the area.

Relevant to the Wedderburn proposal is a report prepared by Warringah Shire Council on koala populations along the Barrenjoey Peninsula (Smith et al, 1989). This report gives some indication of the effects of urbanization on koala numbers. In 1970 there was an estimated 123 koalas on the Peninsula. Today there are just eight remaining koalas distributed from Newport Heights to Careel Head. The principal factors that have caused this decrease are considered to be habitat loss due to extensive tree death from urban runoff, dogs, motor vehicles and disease.

ii. Conservation of the Community

Given the limited terms of reference for the CSIRO study (CSIRO, 1988) and the fact that detailed information is not available on feeding preferences and annual and daily movements of koalas in the area, the actions necessary to conserve the colony can only be given in general terms.

Generally koalas would need to be protected from undue disturbance and be assured of continuous access to the areas of prime habitat in the reserve to the north of the site. As well, areas of prime koala habitat would need to be protected from undue disturbance or influences which would affect the ecology and physiology of the trees. Undue disturbance to the koalas

could result from harassment by feral or domestic animals, especially dogs, or excessive or insensitive use of the areas by humans. Bushfires, the incidence of which could be influenced by human activity, are an extreme form of potential disturbance and threat. Steps would need to be taken to minimise or eliminate all of these potential causes of disturbance.

The CSIRO report (CSIRO, 1988) recommended that no active management of the areas of prime koala habitat was needed at present, although it did note that future research might indicate the need for some form of manipulative management for the benefit of koalas and other wildlife. Judging from the extent of undergrowth, the main areas of prime koala habitat on the slopes of the O'Hares Creek gorge have not been burnt for some time and, therefore, the threat of bushfire in the gorge might be high. Bushfires in the gorge would most likely be hot and fast moving, and could, therefore, have severe effects on the local koala population. Given these circumstances, fire management would need to balance fire risks to property without destroying prime koala habitat, nor the koalas themselves.

To provide access for koalas between patches of prime habitat, intermediate areas of marginal habitat would need to remain undisturbed. Provision of these access routes, especially to the Crown land to the north, is important because koala populations have been observed to overutilise their food supplies when confined to an island of good habitat and to decline as a result (op cit, 1988, p. 8).

The ecology and physiology of the trees in the prime habitat could be affected by various human activities and of particular concern would be those with the potential to alter the flow of water and nutrients down the slopes on which *E. punctata* is found. Excessive clearing of land or application of fertilizers or sewage effluent could detrimentally affect the flow of water and increase nutrient levels.

4.1.4 Specific Impacts of Proposals

i. Four hectare Proposal (Figure 4)

In this proposal all areas of prime koala habitat are within the area designated for public reserve or in Crown land to the north of the site. However, some lots and roads adjoin marginal or prime koala habitat including lots 312-314, 401, 405, 406 and 410-412. Retention of an adequate buffer zone on these lots would be difficult and, in the long term, would probably not be achievable because of the need for fire controls as well as general human activities (CSIRO,

1988, p. 8). Development of all lots could potentially affect the gorge's ecology by changing water and nutrient flows and causing soil erosion, increased access by feral or domestic animals, fire, or destruction of vegetation. Impacts resulting from easier access, physical disturbance, fire and feral animals would most likely become evident over a relatively short period of time. However, destruction of koala habitat due to changed water and nutrient flows and increased soil erosion might take a number of years before it occurred. As previously discussed there is a delicate equilibrium between protein, fats, sugars and toxic compounds contained within the gum leaves consumed by koalas. The potential for adverse impacts resulting from stormwater and nutrient runoff is more fully discussed in Sections 4.5, 4.6 and 5.1.

It is also questioned whether enforcement of certain relevant provisions of LEP 32 and DCP 6 which aim to protect the natural bushland (Appendix 4 and 5) and the agreement between the Minister for the Environment and the developer (Appendix 2) are enforceable in a practical sense to the extent necessary to ensure the survival of the koala colony. Development of the plateau area would greatly facilitate access to koala habitats and achievement of the necessary restriction of humans, particularly children, and feral animals would be improbable, if not impossible.

In Section 4.4 a discussion of fire control requirements is given. For this site the fire controls defined in DCP 6 were deemed to be inadequate in this high fire risk area. Additional controls, as recommended by the DEP, would also be necessary, including ring road fire trials and extensive cleared fire breaks.

These controls would be incompatible with preserving certain characteristics of the existing environment, particularly maintaining vegetation cover and controlling excessive water runoff and soil erosion. As well a ring road would provide direct access to gorge areas and development would increase the prevalence of fires in the area. The CSIRO report (CSIRO, 1988) considered that the latter factor would be one of the greatest threats to koalas.

ii. Two Hectare Proposal (Figure 5)

Lots 23-26 adjoin marginal koala habitat and impacts on the koala community would be similar to those described for lots 312-314 in the four hectare proposal. Other impacts such as human and feral animal disturbance resulting from greater accessibility, as well as fire, water and nutrient impacts similarly apply to this proposal.

Due to smaller lot sizes and higher housing densities there would be a greater intensity of

development. The increased disturbance to soil and drainage and resulting impacts associated with stormwater and pollutant runoff would be considerably greater than for the four hectare proposal. This is more fully discussed in Sections 4.5, 4.6 and 5.1.

Although direct physical impact on the koala community and its habitat would probably be lessened by the two hectare proposal, pollutant runoff would be accentuated due to greater development intensity. So, in effect, the two hectare proposal would simply delay the eventual degradation or even destruction of prime koala habitat along creeks.

4.2 VEGETATION

4.2.1 Description of Vegetation Cover

The site vegetation is diverse and consists of shrubs, mallees and gum trees on the plateau area and open woodland of various eucalypt associations on the western and eastern slopes. Four communities were identified by Payne (Payne, 1989) and their distribution is shown in Figures 6 and 7 (Payne, 1989). Communities 1, 2 and 4 are well conserved in national parks and reserves, however, communities 1 and 2 have particular significance because of their pristine condition (op cit, p. 16) and their continuity with bushland in adjoining Crown land and the Holsworthy Army Base (op cit, p. 16). There is a wide diversity and abundance of plants and a complete species list is attached under Appendix 6 (Payne, 1988).

Community 3 is characterised by trees up to 20 metres high with a mid-dense to open canopy cover sometimes intermixed with pockets of mallees. The understorey is mid-dense with a cover of smaller trees and shrubs. There are three subcommunities which are found on the mid to north areas of the plateau, perimeter edges and over the eastern slopes. Community 3 is regarded as having a high conservation value due to the presence of a number of rare or restricted species including important upland "hanging swamps" (op cit, p. 16).

Of particular importance is the western slopes area between proposed lots 309 and 409 (four hectare proposal) which is represented by pockets of "hanging swamps" containing flora adapted to specialized conditions. Associated with this vegetation type is a particular invertebrate insect fauna and a pollen gathering and insect seeking avifauna. These pockets are located at the head of small creeks and serve as filter for sediment and nutrients. There are also a number of classified rare or threatened species and these, together with their relative significance (based on

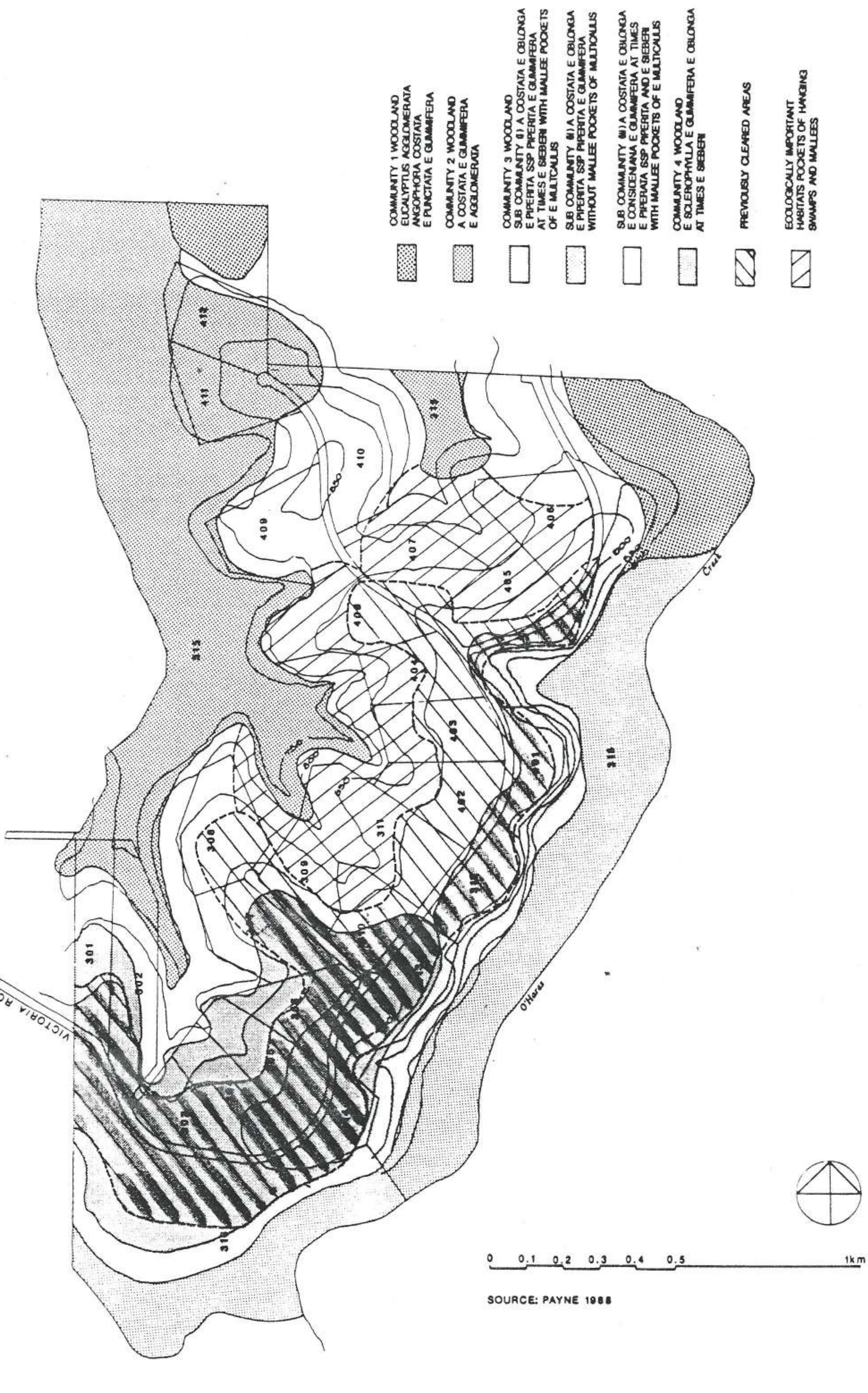

Figure 6
VEGETATION
FOUR HECTARE PROPOSAL

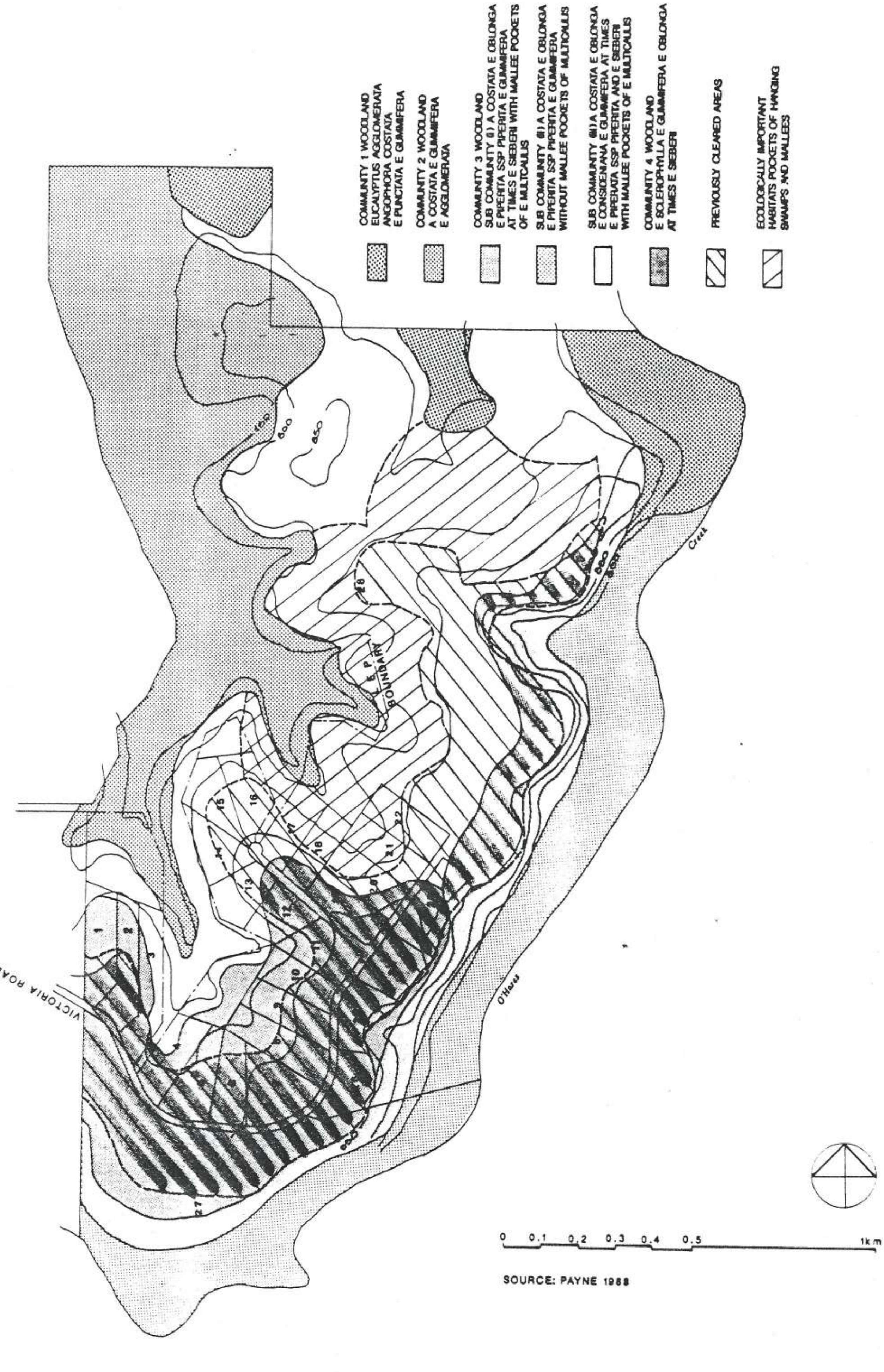

Figure 7
VEGETATION
TWO HECTARE PROPOSAL

the Briggs and Leigh (1989) system of classification) and locations are given in Table 4.1.

TABLE 4.1
RARE OR THREATENED PLANT SPECIES

Species	Location
Melaleuca deanei	Several trees observed on Lots 301 and 302 (near road) (3RC)
Grevèllea diffusa *	All plateau areas and along creek line below Winton Close. Restricted distribution range of less than 100 km
Pultenaea aristata	Isolated areas on western side of plateau (3V)
Tetratheca negleta	Moist areas on western side of plateau (3RC)
Grevellea longifolia	South east on ridge and below the cliff line (2RC, Payne, 1990)
Eucalyptus multicaulis *	Throughout Community 3 on rocky outcrops. Only known from a few sites in NSW. Limited distribution and under risk. (Coded by Pryor)
Blechnum ambiguum *	Fern likely to be found under caves and moist ledges
Austromgrtus tencisfolia *	Likely to be found along rock Creek beds
Leucopogon complexicaulis	Rocky Creek beds (3RC)
Acacia bynoeana	Shaley outcrops - may have been present on lots 301 and 302 (3V)
Melichrus ureolatus *	Plateau area. Uncommon in Sydney district
Eucalyptus squamosa	Previously recorded on plateau, probably Community 4 (3V)

Source: Payne, 1988, p. 17-20.

Note: **Risk code for rare or threatened species** (Briggs and Leigh, 1989)

2. Geographic range less than 100 km
3. Geographic range greater than 100 km
V. Vulnerable
R. Rare (not presently threatened)
C. Population reserved

* Plants not classified are species of special conservation significance to the area (Payne, 1988).

Figure 1
SITE LOCATION

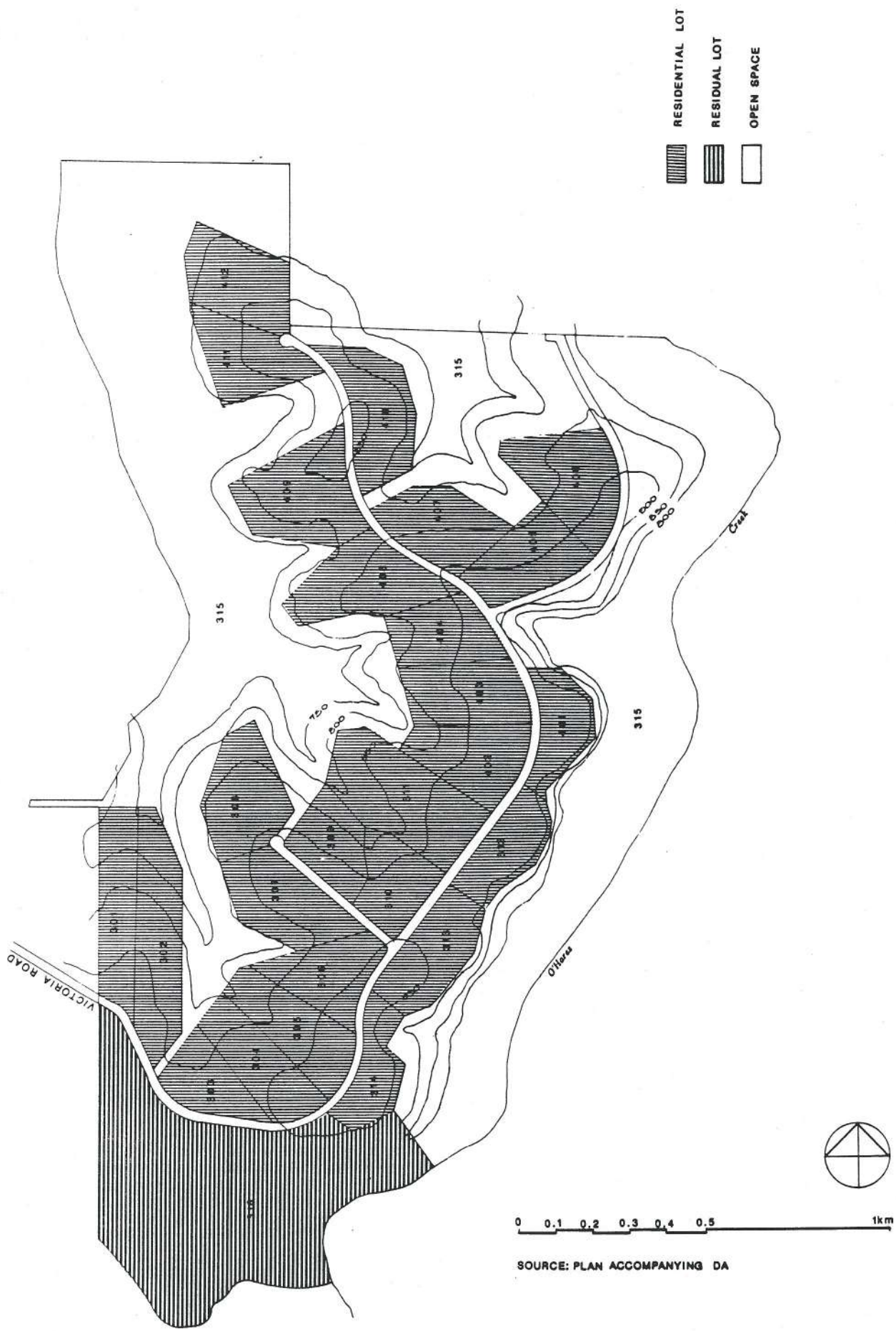

Figure 2
FOUR HECTARE PROPOSAL

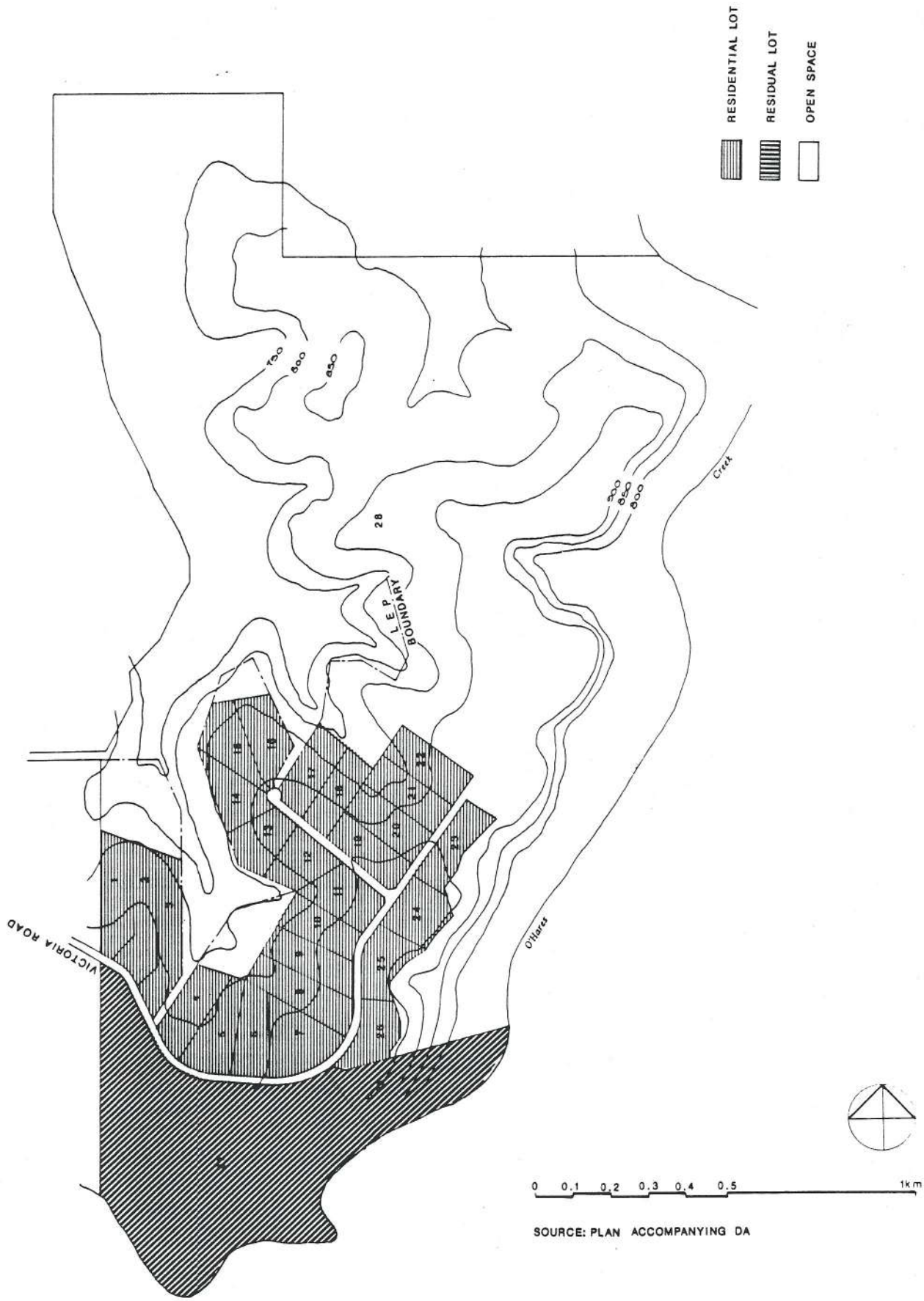

Figure 3
TWO HECTARE PROPOSAL