7 TERRESTRIAL ECOLOGY

7.1 INTRODUCTION

This section presents the findings of the ecological impact assessment for the preferred development option as a result of an options development and evaluation process with iterative environmental inputs. Site visits and field surveys were undertaken during the period from November 1997 to July 1998 to establish the ecological conditions of the Study Area.

7.2 ENVIRONMENTAL LEGISLATION AND CRITERIA

A number of international and local regulations, legislation and guidelines provide the framework for the protection of species and habitats of ecological importance and those related to the Project are:

- *Forests and Countryside Ordinance* (Cap 96);
- *Wild Animals Protection Ordinance* (Cap 170);
- *Town Planning Ordinance* (Cap 131);
- *Hong Kong Planning Standards and Guidelines Chapter 10* (HKPSG);
- *Technical Memorandum on Environmental Impact Assessment Process* (EIATM); and
- *United Nations Convention on Biodiversity* (1992).

The *Forests and Countryside Ordinance* prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on Government land. Related subsidiary Regulations prohibit the selling or possession of listed rare and protected plant species. The list of protected species in Hong Kong which comes under the Forestry Regulations was last amended on 11 June 1993 under the *Forestry (Amendment) Regulation 1993* made under *Section* 3 of the *Forests and Countryside Ordinance.*

Under the *Wild Animals Protection Ordinance,* designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals are protected under this Ordinance. The Second Schedule of the Ordinance which lists all the animals protected was last revised in June 1992.

The recently amended *Town Planning Ordinance* provides for the designation of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Green Belt or other specified uses that promote conservation or protection of the environment, eg conservation areas. The authority responsible for administering the *Town Planning Ordinance* is the Town Planning Board.

Chapter 10 of the HKPSG covers planning considerations relevant to conservation. This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also addresses the issue of enforcement. The appendices list the legislation and

administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.

Annex 16 of the EIATM sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. *Annex 8* recommends the criteria that can be used for evaluating ecological impact.

The Peoples' Republic of China (PRC) are one of the Contracting Parties to the *United Nations Convention on Biological Diversity* of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. Hong Kong Government has stated that it will be 'committed to meeting the environmental objectives' of the Convention (PELB 1996).

7.3 BASELINE INFORMATION

A literature search on the Study Area was undertaken but no relevant information was identified. According to information from the aerial photographs of the site, the Hong Kong Vegetation Map prepared by the World Wide Fund for Nature, Hong Kong (WWF HK) and the site visits, the southern part of the Study Area is heavily disturbed by intensive human activities, such as residential development and open storage, and ecological resources are virtually absent, except the southern edge of the Government Farm where a fringe of exotic tree species such as *Acacia confusa* and *Casuarina equisetifolia* are found.

Ecological habitats found within the Study Area are mainly located in the central, western and northern portions of the Study Area. These include secondary woodland, agricultural land (both active and abandoned), orchard and stream. A map showing the Study Area and the locations of various habitat types is shown in *Figure 7.3a*. Please note that the categorisation of habitat type is based on ecological perspective and should be referred as landscape elements.

The Study Area was surveyed on foot by an experienced ecology team covering representative areas of each habitat type. Areas of ecological interest identified in earlier field visits were subsequently surveyed in more details. Field surveys were focused in the ecological resources expected to be affected either directly and indirectly by the proposed developments, in particular the secondary woodland on the western part of the Study Area which was identified from preliminary site visits with considerable ecological/conservation potential. On the other hand, the dominant flora or fauna of each habitat/land-use type were also identified. All of the field data are collected in between November 1997 to July 1998 (*Table 7.3a*).

Table 7.3a ***Information of Ecological Surveys for Planning and Development Study of Potential Housing Site in Area 54, Tuen Mun.***

Date	Survey
13/11/97	Habitat survey Stream survey General wildlife survey
20/11/97	Bird survey General wildlife survey
2/12/97	Vegetation survey General wildlife survey
8/1/97	Bird survey General wildlife survey
14/1/98	General wildlife survey
11/3/98	General wildlife survey
11/5/98	Bird survey General wildlife survey
20/5/98	Vegetation survey General wildlife survey Stream survey
13/7/98	General wildlife survey

A brief description of the ecological conditions of the identified habitats is presented below.

7.3.1 Habitat / Vegetation

Secondary Woodland

The predominant ecological component of the Study Area is the large area of secondary woodland that lies along the western and northern boundary. The area of the secondary woodland is estimated to be around 18 ha. The extent of the woodland area is shown in *Figure 7.3b*. This woodland area generally comprises three patches of woodlands with different plant communities, merging into one another without a clear cut boundary.

The trees inside the woodland next to Kwong Shan Village (Woodland 1, *Plate 7.3a*) are mostly evenly distributed with heights ranging from 12 to 18 m, and the canopy is mainly formed by *Castanopsis fissa* and occasionally *Casuarina equisetifolia*, whereas the understorey growth of the woodland is vigorous (~ 70% coverage) with rich ground leaf litter cover, *Psychotria rubra* and *Alocasia macrorrhiza* being the main components in this stratum, and saplings of several native tree species such as *Bridelia tomentosa, Microcos paniculatus* and *Litsea glutinosa, Bridelia tomentosa, Celtis sinensis, Ficus hispida, Mallotus paniculata* are also present. The woodland is observed to be in good condition with limited evidence of human intervention such as trampling, littering, and illegal cutting/felling. With respect to the species and physiognomic characteristics of the woodland, however, this area is believed to have originated from a woodland plantation. This woodland is approximately 2.5 ha in area.

Further to the north of the woodland described above and at the foothills of the Castle Peak, another patch of woodland (Woodland 2, *Plate 7.3b*) composed of mainly naturally grown species was found. This woodland patch is richer in species and the

trees are generally taller in height (15 to 22 metres) forming a clearly defined stratum. *Tutcheria spectabilis* and *Endospermum chinense* are the dominant species in the upper canopy, whereas *Alangium chinensis, Ardisia quiqueflora* and *Machilus* sp. are very common in the sub-canopy at the height of about 6 to 8 m. The under-storey composed mainly of saplings of the canopy species, and several fell logs were also found on the woodland floor with rich leaf litter. This woodland is approximately 2 ha in area.

The woodland patch (Woodland 3, *Plate 7.3c*) extending to the northern boundary of the Study Area is the largest of the three woodlands within the development (approximately 10 ha), comprising a mix of young secondary woodland, plantation woodland and orchard, and forms a tree belt bordering the Castle Peak foothills and the Study Area. The main components of each woodland type are: *Aporusa chinensis* and *Sterculia lanceolata* for the young secondary woodland; *Eucalyptus citriodora* for the plantation; and *Litchi chinensis* and *Dimocarpus longan* for the orchard. A few individuals of the protected tree species *Tutcheria spectabilis* were found near a stream by the Agriculture and Fisheries Department.

Woodland 4 is a *Acacia* plantation (*Plate 7.3d*) which established on the southeast corner of the Study Area. This patch of plantation woodland is quite small and physically linked with a ravine woodland further up the hillslope of Castle Peak to the west outside the Study Area. The size of trees is approximately 8 to 12 m in height and the under-storey is dense with a mix of common native plant species such as *Bridelia tomentosa, Malotus paniculatus* and *Alocasia macrorrihza.*

A list of the plant species found in the secondary woodlands is presented in *Table 7.3a* together with information on the relative abundance of each species. A total of five plant species protected under the *Forestry Regulations* were found, including *Tutcheria spectabilis, Camellia sinensis, Camellia crapnelliana, Rhodoleia championi* and *Michelia macclurei.* All of these five species are found in Woodland 2 dominated by *Tutcheria spectabilis* and *Endospermum chinense.* Except the *Tutcheria spectabilis,* which dominates the upper canopy, the other four species were found in the sub-canopy/under-storey (see *Figure 7.3b*) in limited number only. In addition, *Aquilaria sinensis, Pinus morrisonicola* and *Fokienia hodginsii,* which are protected in the Peoples' Republic of China but are believed to have originated from plantation in Hong Kong, were also found in Woodland 2.

Table 7.3a ***Plant Species Recorded within the Study Area***

Habit	Species[a]	Woodland	Orchard/Village	Agricultural Fields
Tree	*Alangium chinense*	**		
	Antidesma bunius	**		
	Antidesma ghaesembilla	**		
	Aporusa dioica	**		
	Aquilaria sinensis[###]	*		
	Bauhinia blakeana	*		
	Bischofia javanica	*		
	Bridelia tomentosa	***		
	Camellia crapnelliana[##]	*		
	Camellia sinensis[##]	*		
	Canarium album	*		
	Castanopsis fissa	****		
	Casuarina equisetifolia	***	*	
	Celtis sinensis	***		

Habit	Species[a]	Woodland	Orchard/Village	Agricultural Fields
	Cinnamomum burmanni	**		
	Cinnamomum camphora	**		
	Citrus maxima		**	
	Clausena lansium		***	
	Cleistocalyx operculata	*		
	Cratoxylum ligustrinum	***		
	Daphniphyllum calycinum	***		
	Dimocarpus longan		***	*
	Endospermum chinense[#]	**		
	Eriobotrya japonica		**	*
	Ficus hirta	**		
	Ficus hispida	***	*	
	Fokienia hodginsii[###]	*		
	Gossampinus malabarica	*		
	Leucanea leucocephala	**		
	Liquidamber formosana	**		
	Litchi chinensis		****	*
	Lithocarpus glabra	**		
	Litsea glutinosa	**		
	Litsea monopetala	*		
	Lophostemon confertus	****	*	
	Macaranga tanarius	**	**	
	Machilus chinensis	**		
	Machilus velutina	**		
	Mallotus paniculatus	***		
	Mangifera indica		**	
	Melia azedarach	*	*	*
	Michelia macclureii[##]			
	Microcos paniculata	***		
	Musa paradisiaca		****	
	Myrica rubra	**		
	Osmanthus matsumuranus	***		
	Pinus morrisonicola	*		
	Pinus massoniana	***		
	Psidium guajava		**	
	Quercus edithae			
	Rhodoleia championi[##]	*		
	Rhus succedanea	***		
	Sapium discolor	***		
	Sarcosperma laurinum	***		
	Schefflera octophylla	***		
	Schima superba	**		
	Scolopia chinense	**		
	Sterculia lanceolata	***		
	Syzygium levinei	**		
	Syzygium jambos	**		
	Trema orientalis		*	
	Turpinia cochinchinensis	**		
	Tutcheria spectabilis[##]	**		
	Viburnum odoratissimum	***		
Shrub	*Breynia fructicosa*	*		
	Brucea japonica	**		
	Euonymus chinensis	**		

Habit	Species[a]	Woodland	Orchard/Village	Agricultural Fields
	Euphorbia hirta		**	
	Eurya japonica	***		
	Ficus variolosa	*		
	Glochidion eriocarpum	***		
	Helicteres angustifolia	***		
	Ilex asprella	***		
	Ilex pubescens	**		
	Ixora chinensis	**		
	Lantana camara	*	***	*
	Ligustrum sinense	***	**	
	Litsea rotundifolia	***		
	Maesa japonica	**		
	Melastoma sanguineum	*		
	Phyllanthus cochinchinensis	***		
	Phyllanthus reticulatus	**		
	Psychotria rubra	****		
	Randia sinensis	**		
	Rhaphiolepis indica	**		
	Sesbenia cochinchinensis		****	
Herb	*Ageratum conyzoides*		***	**
	Alchornea trewioides		**	
	Alocasia macrorrhiza		***	**
	Alpinia katsumadai	**		
	Amaranthus viridis		**	*
	Apluda mutica	*		***
	Ardisia crenata	**		
	Bidens pilosa		***	**
	Bothriochloa intermedia	***		
	Chloris barbata		***	**
	Cleome gynandra		**	
	Coix lachryma-jobi			**
	Commelina communis			**
	Conyza canadensis		**	
	Cyperus spp.			**
	Dianella ensifolia	**		
	Digitaria cruciata		**	**
	Echinochloa crus-galli		*	**
	Eclipta prostrata			***
	Elephantopus tomentosa	***	**	
	Eleusine indica		*	
	Emilia sonchifolia		**	
	Erigeron floribundus		**	
	Eriocaulon spp.			*
	Frimbristylis spp.			**
	Gynura bicolor		*	*
	Imperata cylindrica		**	
	Juncus spp.			*
	Marsilea quadrifolia			**
	Mimosa pudica		**	
	Miscanthus sinensis		**	
	Nasturtium officinale			****
	Oxalis corniculata		**	***
	Panicum maxima	*	****	

Habit	Species[a]	Woodland	Orchard/Village	Agricultural Fields
	Panicum repens	*	*	***
	Paspalum districhum			**
	Paspalum notatum	**	***	
	Pilea microphylla		**	*
	Plantago major		**	
	Polygonum chinense		**	***
	Polygonum hydropiper			**
	Pteroloma triquetrum	*		
	Ranunculus sceleratus			**
	Rhynchelytrum repens	*	**	
	Rhynoscopa rubra	*	**	**
	Rumex maritimus			**
	Setaria glauca	**		
	Sida acuta		**	
	Solanum nigrum		**	**
	Solanum torvum		*	
	Sonchus oleraceus	*	**	
	Synedrella nodiflora		**	*
	Thunbergia fragrans		**	
	Triumfetta bartramia		**	
	Wedelia chinensis		**	**
Climber	*Buettnera aspera*	**		
	Cansjera rheedii			
	Cuscuta chinense			**
	Dalbergia hancei	***		
	Desmos cochinchinensis	****		
	Ecdysanthera rosea	**		
	Embelia laeta	**		
	Gnetum montanum	**		
	Gymnema sylvestre	*		
	Heterosmilax gaudichaudiana	**		
	Ipomoea babatas			**
	Ipomoea cairica		***	**
	Ipomoea reptans			*
	Ludwigia adscendens			
	Lygodium japonica		*	*
	Morinda umbellata	**		
	Mussendanea pubescens	***		
	Paederia scandens	***	*	**
	Pueraria lobata		***	
	Pueraria phaseoloides		**	*
	Stephania japonica	**		
	Strophanthus divaricatus	***		
	Strychnos angustiflora	***		
	Tetracera asiatica	**		
	Uvaria microcarpa	***		
	Vitis angustifolia	**		
	Zanthoxylum nitidum	**		
	Total Number of Species	**106**	**58**	**42**

Habit	Species[a]	Woodland	Orchard/Village	Agricultural Fields

Notes:

a. Scientific names of plant species follow those used in ***Checklist of Hong Kong Plants*** (1993) Agriculture and Fisheries Department (AFD) Bulletin No.1, Hong Kong Herberium

b. Relative abundance of a species is indicated by the number of '*' signs assigned to that species. The more '*' signs assigned, the higher is the relative abundance.

c. * denotes uncommon species

d. ** denotes species protected under the *Forestry Regulations*

e. *** denotes species protected under the *China Red Data Book*

Agricultural Field/Orchard

Agricultural fields (both active and abandoned) are found in the area between Siu Hang Tsuen, Tsz Tin Tsuen and Kei Lun Wai. The agricultural fields that are actively cultivated can be classified into two categories: one is flooded with water and planted with watercress (*Plate 7.3d*) and water spinach, and the other are mostly planted with ornamental plants. Both categories of agricultural fields are actively managed with strong human intervention, and wildlife groups supported by these actively cultivated fields are observed to be very limited, although the ditches/irrigation channels in between the fields do support a high abundance of mosquito fish and snail, which are very common in similar habitat elsewhere in Hong Kong. During more recent site visits in July 1998, all of the watercress field were observed to be dried up and partly covered by other herbaceous plant, possibly as a result of the end of crop season of the vegetable.

The abandoned agricultural fields (*Plate 7.3d*) is covered by herbaceous plant with height range from 40 cm to 70 cm, and interspersed among the actively operated fields or next to village houses, making up approximately 40% of the total agricultural field area. The dominant species among the abandoned field include the grasses *Apluda mutica* and *Panicum maxima,* the herbs *Polygonum* spp., as well as the climber *Mikania micrantha.* Although records of field observations during dry season (November 1997) indicate that these fields were mostly flooded with water to a depth of about 30 cm and might provide a reliable water source for different wildlife, apparent signs or evidences (foam, grease, and garbage) of human disturbance were also present. The latter would probably reduce the value of this habitat to wildlife. Despite the above, the common Mosquito Fish (*Gambusia affinis*) and Guppy (*Poecilia reticulatus*) were observed to be present in great number in the waters of the scattered fields.

Orchards (*Plate 7.3e*) planted with fruit trees such as banana, litchi and longan are found scattered within the village areas and among agricultural fields. The height of the fruit trees ranges from 3 m to 8 m and varies among species. The ground of the orchards is mostly barren and weedy plants (such as *Ipomoea carica* and *Ageratum conyzoides*) are the most dominant understorey vegetation beneath the fruit tree canopy.

Stream

There are two eastward flowing streams running from western hillside towards the Study Area, one is running across Kwong Shan Tsuen and the other one running towards the west of Po Tong Ha (*Plate 7.3e*). Records of field observations made in the dry season indicate that the water levels in the former stream were quite low with pools of stagnant water and evidence of disturbance by villagers such as the presence of litter and pollutants (grease and foam). The downstream section of the latter stream has been channelised while the upstream section (the section before entering the village area) was dried up or covered heavily with watercress, reflecting the high

nutrient load of the water. No stream wildlife, except mosquito fish, was observed in the stream during the dry-season visits.

During the wet-season visits, the water flows in both the above streams were found to be faster with higher water levels, though the stream running through Kwong Shan Tsuen still suffered from pollution. For the stream running towards the west of Po Tong Ha, the water is more open and inhabited with a high abundance of *Radix plicatulus* and juvenile mosquito fish. Invertebrate fauna of this stream, however, was quite poor and only a few mayfly larvae *(Baetis* sp.) and a freshwater crab *(Potamon* sp.) were observed.

7.3.2 *Animal Wildlife*

Mammal

Except a herd of domestic sheep rambling along the edge of the secondary woodland next to the village area in the northwestern portion of the Study Area, no mammalian wildlife was observed during the site visits. However, mammalian scats, suspected to be originated from Barking Deer and Civet, were found on the edge of the woodland on the western and northern part of the Study Area during the site visits undertaken in November 1997 and July 1998 respectively, indicating the possible usage of the woodland area by these animal species.

Amphibian and Reptile

Reptile species observed during the site visits include the Many-banded Krait *(Bungarus multicinctus multicinctus)* (1 no.), Changeable Lizard (*Calotes versicolor*) (3 nos.) and Small Smooth Skink (*Hemidactylus brookii*) (8 nos.). All of these three species are common in rural Hong Kong and were observed around the village area and the edge of the woodland.

Regarding amphibian wildlife, several Asian Common Toads were observed around the village area in the recent wet-season site visits and a Brown Tree Frog (*Polypedates leucomystax*) was recorded in Woodland 2 by the Agriculture and Fisheries Department during a site visit in May 1998. All of the observed species are common in Hong Kong. An amphibian researcher of the University of Hong Kong suggests that the Study Area is not of particular ecological interest with regard to amphibian fauna (both species richness and abundance), possibly because of the presence of the Mosquito Fish (*Gambusia affinis*) and Guppy (*Poecilia reticulatus*), which are both omnivores that will prey on the tadpoles of amphibians (M. Lau, per comm).

Bird

There were 32 and 17 species of birds recorded in the Study Area in the winter (dry season) and summer (wet season) respectively (see *Table 7.3b*). The species recorded in the area are common and typical to the rural village habitat of Hong Kong and is also representative of the respective seasons. Several bird species, eg Chinese Pond Heron, Buzzard, Black Drongo and Large-billed Crow, may utilise the adjacent secondary woodland and feed in various habitats among the village area. During the summer survey, juvenile Chinese Pond Herons were found roosting on the trees and feeding along the upstream section of the streams but there was no evidence of breeding activities in the area. It is therefore considered that the juveniles herons may be originated from elsewhere along the Tuen Mun-Yuen Long Flood Plain.

Table 7.3b ***Bird Species Recorded in the Study Area***

Common Name	Scientific Name	Status[1]	Habitat[2]	Winter[3]	Summer[3]
Chinese Pond Heron	*Ardeola bacchus*	R	W/S	P	P
Little Egret	*Egretta garzetta*	R	pa	P	P
Black Kite	*Milvus migrans*	R	pa	A	P
Common Buzzard	*Buteo buteo*	W	pa	P	A
White-breasted Crake	*Amaurornis phoenicurus*	R	A	P	P
Oriental Turtle Dove	*Streptopelia orientalis*	W	W	P	A
Spotted Dove	*Streptopelia chinensis*	R	W	P	P
Greater Coucal	*Centropus sinensis*	R	W	A	P
White-throated Kingfisher	*Halcyon smyrensis*	R	A	P	A
Sulphur-crested Cockatoo	*Cacatua sulphurea*	I	pa	A	P
Olive-backed Pipit	*Anthus hodgsoni*	W	W	P	A
Grey Wagtail	*Motacilla cinerea*	W	S/A	P	A
White Wagtail	*Motacilla alba*	W	S/A	P	A
Red-whiskered Bulbul	*Pycnonotus jocosus*	R	W/A	P	P
Chinese Bulbul	*Pycnonotus sinensis*	R	W/A	P	P
Red-flanked Bluetail	*Tarsiger cyanurus*	W	A	P	A
Common Stonechat	*Saxicola torquata*	W	A	P	A
Oriental Magpie Robin	*Copsycus saularis*	R	A	P	P
Common Blackbird	*Turdus merula*	W	W	P	A
Grey-backed Thrush	*Turdus hortulorum*	W	W	P	A
Zitting Cisticola	*Cisticola juncidus*	W	A	P	A
Long-tailed Tailorbird	*Orthotomus sutorius*	R	W/A	P	P
Yellow-bellied Prinia	*Prinia flaviventris*	R	A	P	P
Yellow-browed Warbler	*Phylloscopus inornatus*	W	W	P	A
Dusky Warbler	*Phylloscopus fuscatus*	W	A	P	A
Great Tit	*Parus major*	R	W	P	A
Fork-tailed Sunbird	*Aethopyga christinae*	R	W	P	A
Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	R	W	P	A
Japanese White-eye	*Zosterops japonica*	R	W/A	P	P
Long-tailed Shrike	*Lanius schach*	R	A	P	P
Black Drongo	*Dicrurus macrocercus*	R	pa	A	P
Common Magpie	*Pica pica*	R	W/A	P	A
Large-billed Crow	*Corvus macrohynchus*	R	W	A	P
Black-collared Starling	*Sternus nigricollis*	R	A	P	A
Tree Sparrow	*Passer montanus*	R	A	P	P
White-rumped Munia	*Lonchura striata*	R	A	P	A
Little Bunting	*Emberiza pusilla*	W	A	P	A

Total Number of Birds Species found in dry season: 32
Total Number of Birds Species found in wet season: 17

Notes: (1) Status
I - Introduced
R - Resident
W - Winter Visitor

(2) Habitat
W - Woodland
S - Stream
A - Village, Orchard & Agricultural Field
pa - Seen passby

(3)
P - Present
A - Absent

Invertebrate

Invertebrates observed during the site visits included a few individuals of the

dragonfly *Neurothemis fluvia*[13], which are common in cultivated areas and streams, at the southern edge of the woodland next to Kwong Shan Village, as well as the common *Orthetrum* species reported by the Agriculture and Fisheries Department during a site visit in September 1998. In addition, numerous freshwater snails which are believed to be *Viviparous* sp., a common local species found in ponds[14], were recorded in the abandoned argicultural fields.

7.4 ECOLOGICAL IMPORTANCE

The ecological importance of the habitats identified within the Study Area has been evaluated against the criteria recommended in *Annex 8* of the EIATM.

Secondary Woodland

- *Naturalness:* Woodlands 1 and 2 are more natural than Woodland 3 which is a mix of plantation orchard and young secondary woodland, and Woodland 4 which comprises *Acacia* plantation. Woodland 2 with mainly naturally grown species is the most natural habitat as Woodland 1 is originated from a woodland plantation.

- *Size:* The areas of Woodlands 1, 2, 3 and 4 are approximately 2.5ha, 2ha, 8.5ha and 0.6ha respectively.

- *Diversity:* Relatively higher for Woodland 1 and 2 compared with typical lowland woodland in Hong Kong, and comparatively low for Woodlands 3 and 4.

- *Rarity:* Several rare species were recorded in Woodland 2, which is predominanted by the locally uncommon species *Tutcheria spectabilis* and *Endospermum chinensis*, while several individuals of *Tutcheria spectabilis* were found in Woodland 3. No rare species were found in Woodlands 1 and 4.

- *Re-creatability:* Woodlands 3 and 4 is readily re-created naturally or artificially, but it will take a long time for Woodland 1 & 2 and there is no guarantee that the rare species in Woodland 2 can survive in the re-created woodland.

- *Fragmentation:* The four woodlands are generally not fragmented.

- *Ecological Linkage:* The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way, but may provide movement corridor to wildlife.

- *Potential Value:* The Woodland 2 has high conservation interest because of the presence of rare/protected species.

- *Nursery/Breeding Ground:* No record of significant nursery/breeding ground is found in this EIA.

- *Age:* Woodlands 1 and 2 are relatively mature, judging by the structure of the woodland and the size of the dominant species, while Woodland 3 and 4 are relatively young with simplier structure and smaller tree size.

[13] Wilson, K.D.P. (1995) *Hong Kong Dragonflies.* Urban Council of Hong Kong

[14] Hill, D. S. & Phillipps, K. (1981) *Hong Kong Animals.* Government Printer, Hong kong

- *Abundance/Richness of Wildlife:* Compared with the other habitats identified within the Study Area, the secondary woodland has higher abundance /richness of animal wildlife. Most of the bird species (17 species) were recorded in the woodland area, but all common species (see *Table 7.3b*). The presence of mammal scats indicated the possible utilization of the Barking Deer and Civet which forage in woodland areas[2].

Stream

- *Naturalness:* The streams are semi-natural.
- *Size:* The lengths of the natural stream sections extend for about 400 m, but outside the study area.
- *Diversity:* Low diversity of wildlife observed, in particular for the stream next to Kwong Shan Tsuen.
- *Rarity:* Neither the habitat nor species found are rare.
- *Re-creatability:* The semi-natural stream course could be re-created artificially provided that similar hydrology and physical conditions could be re-provided
- *Fragmentation:* Not applicable.
- *Ecological Linkage:* The streams are not functionally linked to any highly valued habitat in close proximity in a significant way.
- *Potential Value:* The streams have low potential value because of their small size and proximity to pollutant sources.
- *Nursery/Breeding Ground:* No record of significant nursery/breeding ground is found in this EIA.
- *Age:* Not applicable.
- *Abundance/Richness of Wildlife:* The streams support a high abundance of the common mosquito fish but little macro-invertebrate.

Agricultural Field/Orchard

- *Naturalness:* The orchards and agricultural fields are man-made habitats and not natural.
- *Size:* The agricultural field and orchards cover approximately 20 ha.
- *Diversity:* Low diversity of wildlife is observed.
- *Rarity:* No rare species/habitat is found.
- *Re-creatability:* These man-made habitats are readily re-creatable artificially.
- *Fragmentation:* These habitats form a continuous cover and are not fragmented.
- *Ecological Linkage:* They are not functionally linked to any highly valued habitat in close proximity in a significant way.

- *Potential Value:* The value of these habitats is considered low because of the management regime and proximity to disturbance source.

- *Nursery/Breeding Ground:* The orchard and agricultural fields are not important for regeneration and long term survival of the associated wildlife as they are all common and wide-spread in Hong Kong

- *Age:* Not applicable.

- *Abundance/Richness of Wildlife:* High abundance of a few common species, such as mosquito fish. The field surveys did not record a high utilization by the common bird species.

An evaluation of the ecological value of Study Area based on the important species present is provided below, following *Table 3* of *Annex 8* of the EIATM.

- Protection status: Five plant species protected under the *Forestry Regulations* were recorded in Woodland 2, including *Tutcheria spectabilis, Camellia sinensis, Camellia crapnelliana, Rhodoleia championi* and *Michelia macclurei*, while *Tutcheria spectabilis* was found in Woodland 3. In addition, *Aquilaria sinensis, Pinus morrisonicola* and *Fokienia hodginsii*, which are protected in the Peoples' Republic of China were also found in Woodland 2.

- Distribution: *Tutcheria spectabilis* are found mainly in well-established woodlands. Although uncommon in Hong Kong, they are wide spread in China. *Camellia sinensis* can be found in Tai Po Kau and Ma On Shan. They are also frequently found behind villages, mostly originated from plantation. *Camellia crapnelliana* is very rare in Hong Kong with its record confined to a Fung Shui woodland at Mau Ping, Ma On Shan. Wild *Rhodoleia championi* can only be found in woodland at Nam Fung Road on Hong Kong Island, but plantations can be found at a few places in Hong Kong such as the Peak. The record of *Michelia macclurei* in the present study may be a new one as there has been no record in Hong Kong before. This species can be found in Guangdong of South China.

- Rarity: Besides *Tutcheria spectabilis* and *Endospermum chinensis* which are uncommon plants in Hong Kong, other wildlife species observed are common in rural Hong Kong.

In conclusion, the secondary Woodland 2 is considered to be of high ecological importance because of their characteristic plant communities that support both rare or protected species. The mature Woodland 1, believed to be plantation origin, with vigorous under-storey growth and limited human activities, is considered to have a moderate ecological importance. Woodland 3 comprising young secondary woodland and plantation, as well as Woodland 4 with *Acacia* plantation have relatively low ecological importance. The other habitats identified within the Study Area, including the downstream sections of the streams and the agricultural field/orchard, are man-made environment with heavy human intervention and therefore low ecological value. Although the abandoned agricultural fields are mostly flooded and therefore may provide habitat to water-associated wildlife, such as mosquito fish and snail, the generally poor water quality of the fields would probably limit the ecological value of the abandoned fields within the Study Area. In addition, the utilisation by avifauna observed was not high in general.

7.5 *IMPACT ASSESSMENT*

Ecological impact resulting from the proposed developments is mainly associated with landtake that would lead to direct habitat loss. The potential sources of impact and the severity of such impact are indicated below.

7.5.1 *Potential Sources of Impact*

The potential source of impact as a result of the proposed developments are:

- direct habitat loss as a result of site formation for the development;
- habitat loss lead to fragmentation of the woodland on the northern part of the Study Area;
- indirect impact to the surrounding habitats, especially the woodland habitat to the west of the Study Area, as a result of any extensive cutting or felling of trees, trampling of vegetation, illegal dumping of construction wastes or storage material, as well as increase human activities, hence fire hazard;
- direct impact to wildlife that inhabit the Study Area; and
- indirect impact to wildlife, such as avifauna, which utilise the Study Area as movement corridors or foraging habitats.

7.5.2 *Impact Evaluation*

During the development and evaluation of development options for Area 54, there was reiterative environmental input to ensure that the optimal option meets the environmental standards. The preferred development option adopted has in fact incorporated a Conservation Area to conserve the Woodland 2 with rare and protected plant species. An evaluation of the potential impacts associated with the preferred option in accordance with the requirements set out in *Table 1, Annex 8,* EIAO-TM is presented below:

- Habitat quality: The ecological value of the agricultural field/orchard and semi-natural stream channel habitats were identified to be limited and only small areas of these habitats will be affected by the proposed development; no significant ecological impact is therefore anticipated from the loss of these habitats. Woodland 2 with high ecological importance will be conserved as Conservation Area and will not be affected. The proposed distributor road D7 will cause habitat loss to Woodland 3 with low ecological importance as well as a small part of the edge of Woodland 1 with moderate importance. Woodland 4 will not be affected.
- Species: The woodland 1 and 3 areas to be affected is mainly composed of species of plantation origin and no species of ecological/conservation interest will be affected. The rare or protected plant species in Woodland 2 will not be affected. Animal wildlife of conservation interest was not recorded in the Study Area except some mammalian scats. The future urbanisation due to the proposed development may restrict mammal utilisation of the woodland area indirectly.
- Size/Abundance: Based on the current layout of the Preferred Development Option, a total of approximately 3.3 ha of woodland areas will be lost due mainly to the proposed distributor road D7 and LRT reserve, including part of the woodland 3 near the northern boundary of the project limit, approximately 2.7 ha, and some

areas of the eastern edges of woodland 1 approximately 0.6 ha in area. A part of the woodland 3 will be fragmented due to the proposed road D7. The loss of low ecological important agricultural and orchard areas are approximately 7 ha and 1.2 ha respectively.

- Duration: The impact due to the development will be permanent.
- Reversibility: The impact will be permanant and irreversible.
- Magnitude: Most part of the Area 54 is subject to human activities with low ecological importance and therefore the magnitude of the changes due to the proposed development is not considered significant.

Based on the above discussion, the key issue is related to the impact on the secondary woodland areas. The loss of 0.6 ha of Woodland 1 with moderate ecological importance is considered a moderate impact, and the loss of 2.7 ha as well as the fragmentation of Woodland 3 with low ecological importance is considered a low to moderate impact.

7.6 *MITIGATION MEASURES*

Recommendations on alternative development options during the evaluation process were made to avoid and minimise the potential impact to the secondary woodland in general, and Woodland 2 in particular. The present development layout is considered to avoid impact on the more important parts of the woodland areas as far as practicable.

For the loss of 0.6 ha of Woodland 1, areas within the project limit that are available Government land, approximately 0.7 ha in area, have been identified as shown in *Figure 7.3a* for compensation planting. Plant species used for planting should take reference from the species in Woodland 1.

It is also recommended that the road embankment areas for the distributor road D7 be used for tree planting to compensate for the loss of Woodland 3 area. An area of 0.8 ha is estimated available for the tree planting. This include the entire southern embankment of the northern sector of Road D7 (see *Figure 7.3a*). Tree species used should take reference from the native species identified in *Table 7.3a*. Further information on tree planting is given in *Section 8 Landscape and Visual Impact*.

A tree survey should be conducted during the subsequent detailed design stage, in accordance with the technical requirements of the *Works Branch Technical Circular* (WBTC) No. 24/94 & *Planning Environment and Lands Branch Technical Circular* (PELBTC) No. 3/94 on *Tree Preservation*, for the Tree Felling Application, which will also form the basis for the compensation planting recommended above.

Given the proximity of the secondary woodland to the boundary of the proposed developments, it is also recommended that the following good practice be adopted during the construction phase to avoid any unnecessary impact due to uncontrolled construction activities:

- interference to protected tree species *Tutcheria spectabilis* near the stream in Woodland 3 should be avoided. If avoidance is not possible due to engineering constraints, tree individuals should be collected for transplanting to similar habitats nearby tree planting area under the project;

- the locations of storage and works areas etc should be selected to avoid the ecologically sensitive woodland areas as far as possible or otherwise minimise disturbance;

- the woodland area to be encroached upon by the development should be well-defined and minimised as far as possible;

- no construction activities of any nature should be allowed within the woodland 2 area that supports rare or protected plant species;

- fences should be erected along the boundary of construction sites before the commencement of works to prevent tipping, vehicle movements, and encroachment of personnel into adjacent wooded areas;

- regular checks should be made to ensure that the work site boundaries are not exceeded and that no damage is being caused to the surrounding areas; and

- any damage that may occur to individual major trees in the woodland area adjacent to the construction sites should be treated with surgery;

- if there is any loss of the adjacent woodland because of the temporary landtake during the construction phase, the area should be returned to the original status immediately after completion of the Project by on-site tree replanting, using tree species recommended as above;

- building debris should be removed and adequate site preparation should be undertaken prior to compensatory planting;

- wild and uncontrolled open fires should be strictly prohibited within the work site boundary, and appropriate fire control measures should be provided for preventing potential fire damage to the woodland area.

The implementation of the ecological mitigation measures should be checked as part of the environmental audit procedures during the construction period, the procedures of which are presented in the separate Environmental Monitoring and Audit Manual.

For ensuring an appropriate level of protection given to the woodland area during the operational phase, it is recommended that no development should be allowed in Woodland 2 and part of Woodland 1 within the 'Conservation Area' (see *Figure 8.7a*) which should also be fenced off to restrict human activities and the risk of human disturbance to this area.

The designation of the majority of the unaffected secondary woodland area as Green Belt will also afford an appropriate level of protection to the woodland ecological resources.

7.7 *RESIDUAL IMPACT*

With the implementation of the mitigation measures recommended above, the residual impact would be the permanent loss of 1.9 ha of the woodland 3 areas as well as the fragmentation of part of the woodland. Given the small areas of loss with common fruit tree or exotic plantation species with relatively low ecological importance, in the context of the large areas of surrounding intact woodlands, and the use of the habitat by some common animal wildlife, the residual impact is considered low.

7.8 CONCLUSION

The ecological resources within the Study Area comprises secondary woodland, agricultural field (active/abandoned), orchard and degraded area (open storage/wasteland). Field visits conducted within the period from November 1997 to July 1998 identified that the secondary Woodland 2 within the Study Area is an ecologically important habitat that supports uncommon/rare or protected flora including *Tutcheria spectabilis, Camellia sinensis, Camellia crapnelliana, Rhodoleia championi* and *Michelia macclurei*. There are two other large secondary woodland areas with the Woodland 1 in better condition and more mature, therefore ecologically more important than Woodland 3 with fruit and plantation species, as well as Woodland 4 with *Acacia* plantation. However, several individuals of protected tree species *Tutcheria spectabilis* were found in Woodland 3. The other identified habitats in the Study Area are mostly disturbed with low ecological importance. Animal wildlife recorded was limited and no species of conservation interest observed except some mammal scats in the secondary woodland.

Recommendations on alternative development options during the evaluation process were made to avoid and minimise the potential impact to the secondary woodland in general, and Woodland 2 in particular. The ecologically important Woodland 2 area has been conserved as a Conservation Area where no development should be allowed.

Although the Preferred Development Option will encroach upon some of the less important woodland areas and probably lead to fragmentation of the woodland habitat, compensation planting has been maximised within the project limit to mitigate the impact. Given the relatively small scale of the residual low quality woodland loss, approximately 1.9 ha as compared to the entire woodland area of over 15 ha, as well as the even larger woodland area further up the hill slope, low ecological impact is considered from the residual low quality woodland habitat loss and fragmentation. The designation of the majority of the unaffected secondary woodland area as Green Belt will also afford an appropriate level of protection to the woodland ecological resources.

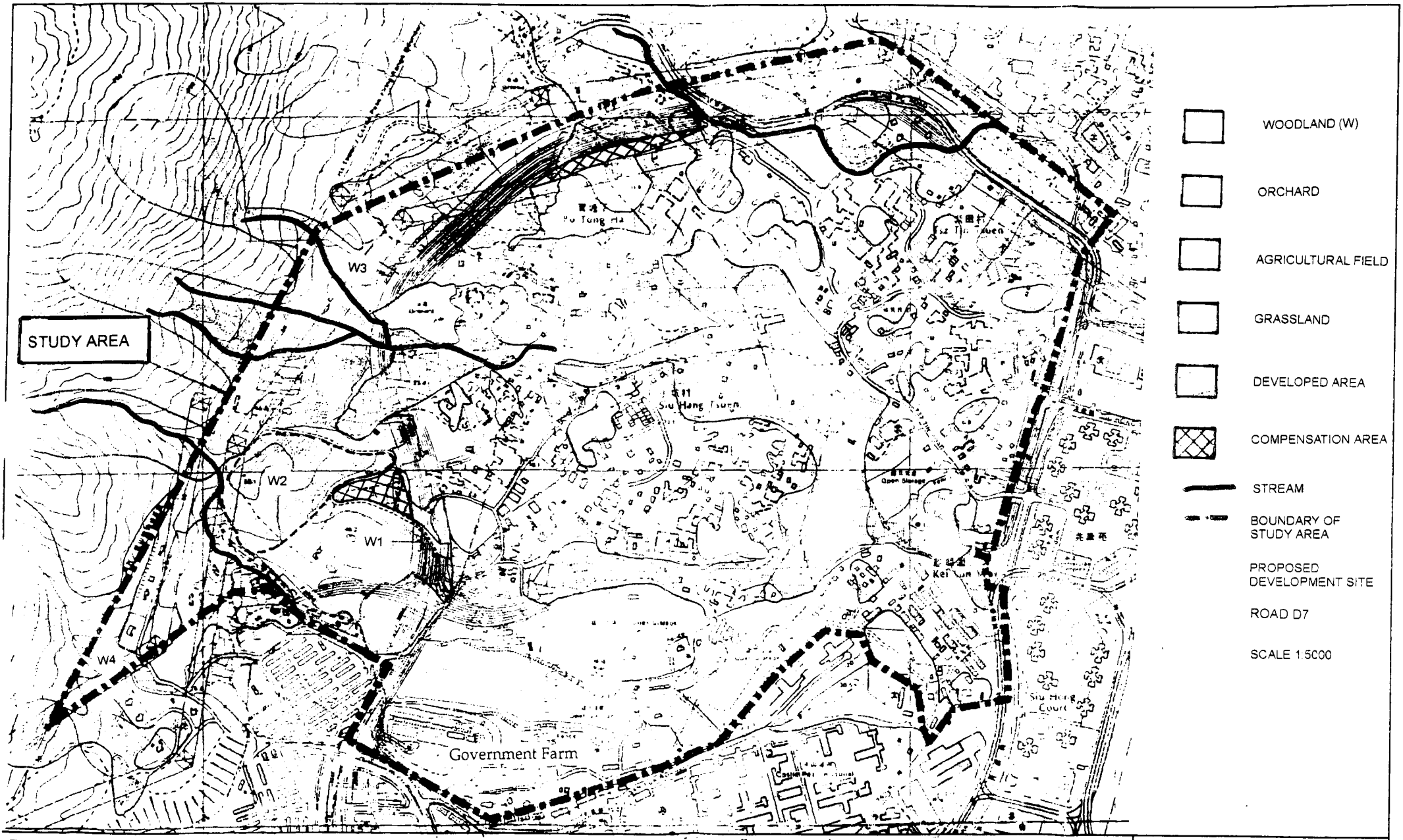

FIGURE 7.3a

HABITAT MAP FOR AREA 54, TUEN MUN

FILE: C1707/C1707a
DATE: 28/05/98

Environmental Resources Management

ERM

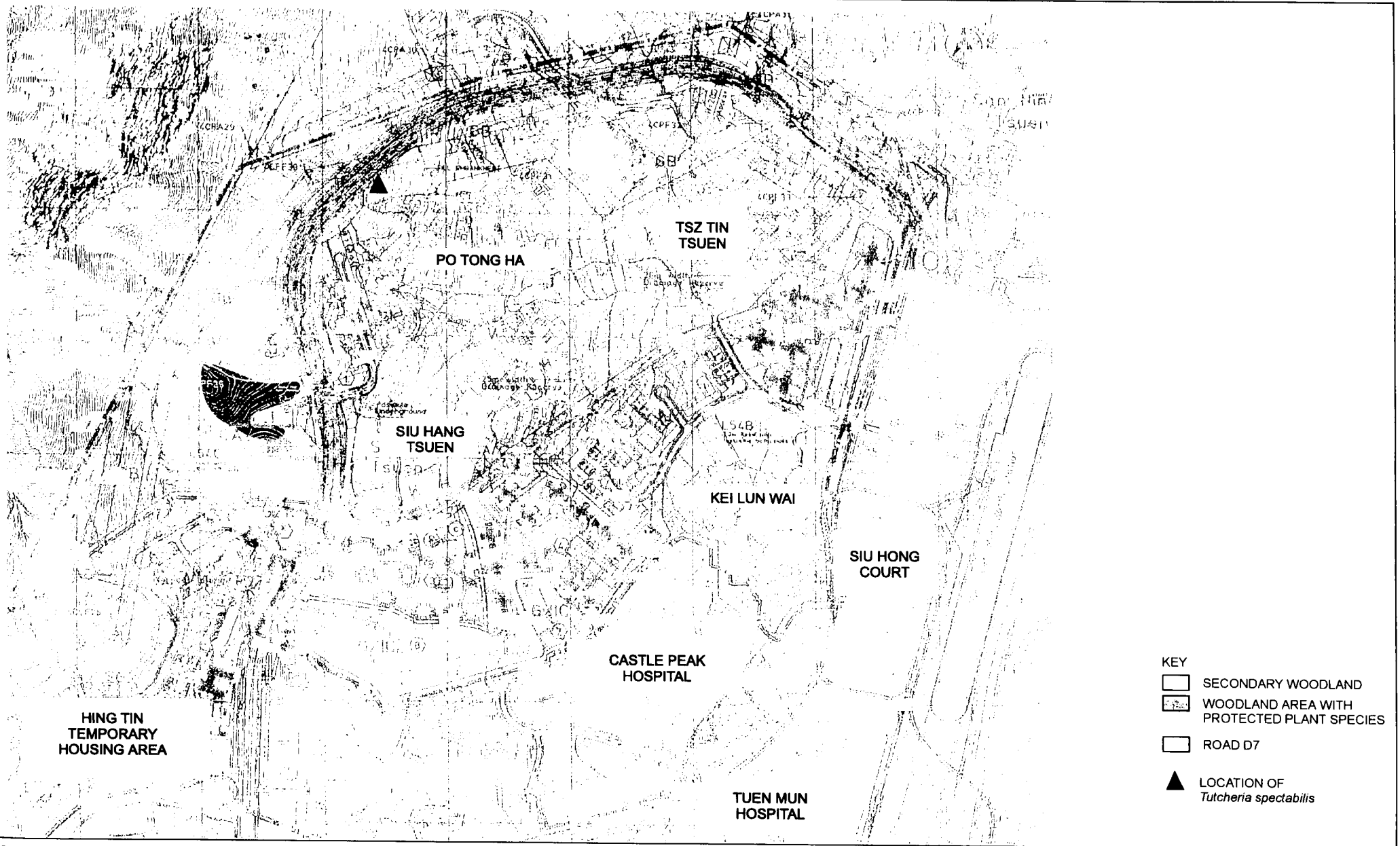

FIGURE 7.3b

EXTENT OF WOODLAND IN TUEN MUN AREA 54

FILE: C1707/C1707k
DATE: 27/05/98

Environmental Resources Management

ERM

Plate 7.3a Woodland 1 next to Kwong Shan Tsuen

Plate 7.3b(i) Woodland 2 at the foothills of Castle Peak

Plate 7.3b(ii) Woodland 2 at the foothills of the Castle Peak

Plate7.3c Woodland 3

Plate 7.3d Woodland 4

Plate 7.3e(i) Active agricultural field planted with water cress

Plate 7.3e(ii) Abandoned agricultural field

Plate 7.3f(i) Stream running across Kwong Shan Tsuen

Plate 7.3f(ii) Upstream section of stream on the west of Po Tong Ha

Plate 7.3g Orchard