

8. ECOLOGY

8.1 Introduction

This section presents the findings of the ecological impact assessment (EcoIA) undertaken to fulfil the requirements for the proposed road widening of Tolo Highway between Island House Interchange at south Tai Po and Fanling, as detailed in EIA Study Brief ESB-004/1998. This includes:

- Assess and evaluate the baseline ecological conditions (habitats and species) of the Study Area, i.e., from either side of the highway and the two Project limit ends to a study boundary of 500 m beyond;
- Utilise the collated baseline conditions to predict the potential ecological impacts of the proposed road widening works, and subsequent day-to-day operations of the widened highway;
- Mitigate any identified impacts; and
- Identify any residual ecological impacts.

8.2 Baseline Habitat Description

For the purpose of this study the 'Study Area' is referred to as 500 m from either side of the highway and the Project limit ends.

8.2.1 Literature Review

An extensive literature review has been undertaken to collate relevant information regarding ecological resources within the Study Area. References consulted include:

- EIA for Additional Treatment and Water Transfer Facilities for the Metropolitan Area and North-eastern New Territories Investigation Study;
- Scientific publications;
- Journal articles; and
- Liaison with WWF scientists.

A full bibliography is provided in the list of references.

8.2.2 Consultation

Consultation has been undertaken with several conservation organisations to identify ecological information applicable to the study including:

- Kadoorie Farm and Botanical Garden Corporation;
- The Hong Kong Bird Watching Society; and
- Agriculture, Fisheries and Conservation Department.

8.2.3 *Field Survey*

8.2.3.1 *Vegetation/Habitat Survey*

Baseline Habitat Survey

The initial habitat survey of the Study Area commenced during the latter half of May 1999. It entailed mapping the boundaries of the different ecological habitats present within the Study Area, i.e., 500m from either side of the north and south bound highway carriageways, onto scaled maps. The information was then transposed on to digitised habitat maps of the Study Area. Please refer to Figures 8.1.1 – 8.1.6. Vegetation was identified within each habitat to the lowest taxonomic level as far as possible to enable assessment of conservation value.

Following completion of the four month field survey, the project limit at the Island House was extended by 300 m to resolve an interfacing issue with the adjacent proposed road widening scheme. The ecological impacts of proposed road widening along the section of Tolo Highway which has been added into the present scheme, was addressed in full in an earlier EPD-endorsed EIA. The EIA was commissioned by Highways Department as part of the *Feasibility Assignment for Widening of Tolo Highway and Traffic Surveillance and Information System, April 1997*. The EIA concluded that there would be no significant impacts arising from the construction and operations of the widened road. As the current scheme is identical in nature to the earlier approved project, no further baseline surveys or assessments have been undertaken for the extension to the project limits.

Vegetation Survey

A non-systematic vegetation survey was conducted by walking along the foot paths throughout the study area to the project boundary limits. Representative species lists were prepared for each habitat type to account for variations in habitat type / vegetation community structure. This approach also enabled a non-quantitative estimate of relative abundance to be made (i.e. categorising of species as common, local, rare and so on). Species identified were compared with Territory-wide and regional abundance estimates to determine which species if any, are of conservation importance based on relative rarity. For any species of flora that were identified as rare, endangered or protected under local regulations or international conventions; the location and species name were documented.

Detailed Habitat Assessment

Following completion of the initial habitat mapping, the proposed works were evaluated and those posing potential additional impacts were identified and subjected to more focused ecological assessments. A 10 x 10 m plot at the Shek Kwu Lung Fung Shui woodland was surveyed to quantify the species composition, vegetation density and relative dominance of the habitat. This confirmed area was surveyed given that the proposed impacted area will be confined to the north-western edge of the wood and the steep gradient of the topography.

8.2.3.2 *Bird Survey*

Initial Habitat Survey

During the initial habitat survey undertaken in the latter half of May, the locations of all bird species observed were documented.

Monthly Monitoring Survey

Subsequently avifauna were surveyed monthly throughout the Study Area on 31 May, 22 June, 24 July, August 1, 1999. Each species of bird observed or heard was documented using the method known as Registration Mapping (Bibby *et al*; 1992).

Point Counts

During the initial habitat survey, habitats within the vicinity of the following areas were observed to support a higher density of birds.

- A = Tai Po
- B = Ha Wun Yiu
- C = Pun Chun Yuen
- D = Kau Liu Ha
- E = Tai Wo
- F = Adjacent to KCRC close to Tong Hang

Point counts (Bibby *et al*; 1992) were subsequently undertaken at each of the above sites between 1000 - 1600 hrs on the 31 May, 22 June, 24 July, August 1, 1999. One point count was undertaken per hectare, each lasting 15-minutes. To calculate densities, birds were recorded on point counts both at the point of the observer and at a fixed band width/distance away from the observer (*e.g.* 30m). Densities were calculated using the method defined in Bibby *et al*; 1992.

8.2.3.3 *Mammals*

A survey was undertaken within the Study Area to identify the presence of mammals. This was performed by walking the entire site following a random route. Surveys for mammals were undertaken between 1000 - 1600 hrs and an additional nocturnal surveys that included bat surveys were undertaken between 1800 – 2400 hrs on 31 May, 22 June and 24 July. Sightings of mammals, in addition to evidence of tracks, animal droppings, footprints and burrows were all documented.

8.2.3.4 *Reptiles*

Refugia to capture reptiles were deployed throughout the Study Area using a randomised sampling strategy. These were deployed between 1000 - 1600 hrs and checked between 1800 - 2400 hrs on 31 May, 22 June and 24 July.

8.2.3.5 *Amphibians*

Amphibians were searched for in ponds/wet areas (*e.g.* fish ponds, streams) using bottle traps and torch light at dusk. Surveys were conducted on 31 May, 22 June and 24 July.

8.2.3.6 *Butterflies, Dragonflies and Damselflies*

Butterflies, dragonflies and damselflies were surveyed throughout the study area, using the random route survey method whereby the surveyor walked over the study area following a random route and documenting all species identified to the lowest taxonomic level as far as possible. The surveys were undertaken on 13 May, 22 June and 24 July 1999.

8.2.3.7 Freshwater Habitats

Freshwater habitats (*e.g.* natural stream courses) present within the Study Area were mapped during the initial habitat assessment undertaken during the latter half of May. Those water courses adjacent to Tolo Highway that were designated as ecologically sensitive receivers were sampled once on June 22, 1999. The sampling locations are illustrated in Figures 8.6.

Aquatic Flora

Aquatic plants present within freshwater habitats were identified to species level and the abundance quantified on June 22, 1999.

Aquatic Fauna

- *Kick Sampling*

The macrobenthos was sampled at each of the freshwater sensitive receivers using kick sampling. A D-frame mesh net (mesh size, 0.5 mm) was placed on the stream bed with the mouth facing upstream. Upstream the stream bed was kicked to dislodge benthos. This process was replicated three times. Netted fauna were identified to species level and densities calculated.

- *Netting*

An aquatic net was deployed into the watercourse to collect larger organisms *e.g.* fish. Collected organisms were identified to lowest taxonomic level as far as possible.

8.3 Baseline Survey Findings

8.3.1 Introduction

The Study Area lies within a 500 m corridor on either side of the carriageway of the sections of the Tolo Highway / Fanling Highway to be widened, which extends from Island House Interchange in Tai Po to Fanling. Habitats identified during the field surveys are all typical of Hong Kong and summarised in this section. A total of fourteen different ecological habitat types were identified within the study, these are defined in Figures 8.1.1 – 8.1.6.

8.3.2 Coverage of Different Habitat Types within the Study Area

The composition of the area and overall percentage for each of the habitats within the Study Area are summarised in Table 8.1. Each habitat present within the study site is discussed briefly.

Table 8.1 Habitat Types within 500m of the Study Area

Habitat Type	Area (hectares)	% of total Study Area
Terrestrial Habitat		
Active Agricultural Land	24.5	11.10
Inactive Agricultural Land	50	22.60
Orchards	4	1.80
Grassland	5.5	8.60
Natural Woodland	19	8.60
Plantation Woodland	26	11.80
<i>Fung Shui</i> Woodland	7.5	3.40
Freshwater Habitat		
Natural Rivers and Streams	8300 m	-
Artificial drainage channel	7300 m	-

Habitat Type	Area (hectares)	% of total Study Area
Ponds	0.07	0.03
Inter-tidal Habitat		
Mangroves	0.05	0.02
<i>Marine</i>		
Sea	8.25	3.70
Urbanised / Developed Areas		
Urbanised/ Developed & Village Areas	58.5	26.50
Cemetery	4	1.80
Total	207.37 ha	100%

The Study Area totals approximately 207.37 ha of land. Excluding the developed and urbanised areas, the dominant habitats within the Study Area are inactive agricultural land (50 ha, 22.6%), plantation woodland (26 ha, 11.8%) and active agricultural land (24.5 ha, 11.1%). A summary of the key habitats of the Study Area are presented in the following sub sections and correspond to regions within the Study Area defined on Figures 8.1.1 – 8.1.6.

- **Area 1** – Area 1 is located in the northern portion of the Study Area comprises the urbanised area of Fanling, Wo Hop Shek and the village environs of Tong Hang and Kiu Tau. Dominant ecological habitats identified include plantation and natural woodlands.
- **Area 2** – Includes the environs of Kiu Tau, Kau Lung Han San Wai, Yuen Leng, Tai Wo, Nam Wa Po and Tai Hang. Ecological habitats present within Area 2 include plantation, natural and *Fung Shui* woodlands as well as active and inactive Agricultural Land. In addition, a pond is located adjacent to Nam Wa Po village, whilst several natural and artificial watercourses flow through the area.
- **Area 3** – Comprises the residential settlement of Hong Lok Yuen, together with several small villages: Mui Shue Hang, Wai Tau Tsuen, Wo Tong Pui, Kau Liu Ha and Hang Ha Po. Dominant ecological habitats include active and inactive Agricultural Land. In the eastern portion of Area 3, plantation and natural woodlands exist in the vicinity of Mui Shue Hang. A natural river flows from the western region down to Lam Kam Road Interchange where it has been engineered into an artificial drainage channel.
- **Area 4** – Consists of the urban areas of Tai Po Tau Shui Wai, Kam Shek New Village, Shek Kwu Lung. A tract of plantation woodland is present at Mui Shue Hang, whilst natural woodland is present at Kam Shan and Pun Chun Yuen. A small area of *Fung Shui* woodland is present at Shek Kwu Lung. Natural stream courses are present in the southern region of Area 4, whilst an artificial drainage channel flows adjacent to Tai Po Tau Shui Wai.
- **Area 5** – Is located in the southern region of the Study Area and includes the urbanised areas of Ma Wo Pan Chung San Tsuen, Tai Po Market, Wan Tau Tong Estate, Lai Chi Shan and Sheung Wun Yiu. Terrestrial ecological habitats within the Study Area include natural woodland around Kam Shan, Pun Chun Yuen and To Yuen Tung and plantation woodland around Shan Tong New Village and along the perimeter of Tolo Highway. A small *Fung Shui* woodland is present at Ha Wun Yiu. A tract of grassland is present at Sheung Wun Yiu, as well as on the southern side of Tolo Highway at Lai Chi Shan and a small orchard is present to the north east of Shan Tong new village. Small areas of inactive and active agricultural land are located to the south of Tolo Highway.
- **Area 6** – To the west of the highway the land is urbanised, whilst to the south the ecological habitats are dominated by plantation woodlands along the perimeter of the highway and Sheung Wong Yi Au, and natural woodlands at Ha Wong Yi Au and Tai Po Kau. A small *Fung Shui* woodland is present at Ha Wong Yi Au. The marine environment of Tolo Harbour is present adjacent to the highway in this area, whilst a

small area of inter-tidal mudflat is present along the southern boundary of Yuen Chau Tsai, where a small stand of mangroves is located.

8.3.3 Description of Terrestrial Habitats

8.3.3.1 Active Agricultural Land

There is a total of 24.5 ha (11.1%) of active agricultural land present within the Study Area, with Areas 2 and 3 being the key areas (see Photo 8-1 in Appendix 8.2). Active agricultural land within the Study Area is typically irrigated, and a variety of crops are grown which change on a seasonal and annual basis. A summary of the species grown is presented in Table 8.2. While fruit trees are the dominant crop, three species of vegetables are also grown in the northern region of the Study Area. Area 2 from Kiu Tau to Tai Hang supports the greatest area of active agricultural land within the boundaries of the Study Area.

In addition, a further 4 ha or 1.8% of the Study Area comprises land dominated by orchards (see Photo 8-2). Species grown are identified in Table 8.2.

Table 8.2 Species Identified in the Active Agricultural Land

Common Name	Species Name	Areas within Study Area *					
		1	2	3	4	5	6
Fruit Trees							
Banana	<i>Musa paradisiaca</i>	+	+	+		+	
Grape Fruit	<i>Citrus paradisi</i>		+				
Guava	<i>Psidium guajava</i>		+	+	+		
Longan	<i>Dimocarpus longan</i>	+	+	+	+	+	+
Lychee	<i>Litchi chinensis</i>	+	+	+	+	+	+
Mango	<i>Mangifera indica</i>	+	+		+	+	+
Papaya	<i>Carica papaya</i>		+	+		+	
Peach	<i>Amygdalus persica</i>		+	+			+
Pummelo	<i>Citrus maxima</i>		+				+
Rose-apple	<i>Syzygium jambos</i>		+	+	+	+	
Sugar apple	<i>Annona squamosa</i>	+	+				
Wampi	<i>Clausena lansium</i>	+	+				
Vegetables							
Bitter Cucumber	<i>Momordica charantia</i>		+				
Indian Lotus	<i>Nelumbo nucifera</i>		+				
Wax Gourd	<i>Benincasa hispida</i>		+				
Total no. of species identified in each area		6	15	7	5	6	5

Note: * Numbered areas correspond with those defined on Figures 8.1.1 – 8.1.6.

8.3.3.2 Inactive Agricultural Land

Inactive agricultural land comprises 50 ha of land (22.6%) of the Study Area, and is the dominant ecological habitat within Area 2 (Figure 8.1.2; see Photo 8-3) and Area 3 (Figure 8.1.3). This habitat is predominantly covered with short and tall grasses, shrubs, and abandoned fruit trees including the species defined in Table 8.2.

8.3.3.3 Grassland

Grassland comprises 5.5 ha (8.6%) of the ecological habitat within the Study Area and is present in Area 1 (around Wo Hop Shek San Tsuen and Tong Hang; see Photo 8-4) and Area 5 (Sheung Wun Yiu and Lai Chi Shan) of the Study Area.

Within Area 1, located on the hillside behind Wo Hop Shek San Tsuen, the habitat is comprised of a grassland-shrub mosaic which is likely to have been created following past hill fires. Dominant species include *Dicranopteris linearis*, *Miscanthus sinensis* and *Rhus hypolenca*. The grassland habitat present on Bird's Hill between Kau Lung Hang and Tong Hang is of similar species composition, with *D. linearis* and the grasses *M. sinensis* and *Arundinella setosa* dominant.

Within Area 5, located between Sheung Wun Yiu and Lai Chi Shan, the grassland habitat was dominated by three species: *Microstegium cilianon*, *Miscanthus sp.* and *Panicum sp.*

No rare or protected species were identified in any of the grassland habitats present within the study area.

8.3.3.4 Natural Woodlands

A total of 19 ha (8.6%) of natural woodland is present within the Study Area. The largest woodland is located in the area of Pun Chun Yuen in Area 4 (Figure 8.1.4; see Photo 8-5), whilst other large stands of woodland are present in Areas 1, 5 and 6 (Figures 8.1.1, 8.1.5 – 8.1.6).

Table 8.3 illustrates dominant species of trees and shrubs identified within the Study Area during the baseline field surveys. All these species are found commonly throughout the Study Area.

The woodland at Island House adjacent to WWFs' offices contains a variety of species of palms, e.g., Bamboo Palm (*Chrysalidocarpus lutescens*) and trees including: Chinese Banyan (*Ficus microcarpa*), Camphor (*Cinnamomum camphora*), Chinese hackberry (*Celtis sinensis*), Chinese Privet (*Ligustrum sinense*) and Tallow Tree (*Sapium sebiferum*) (WWF, unpublished).

Table 8.3 Summary of Dominant Tree / Shrub Species in the Study Area

Species	Form	Abundance					
		Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
<i>Acacia confusa</i>	Tree	+	+	+	+	+	+
<i>Acronychia pedunculata</i>	Tree			+			
<i>Alangium chinense</i>	Tree/ Shrub					+	
<i>Albizia lebbek</i>	Tree	+	+	+	+	+	+
<i>Aleurites moluccana</i>	Tree	+	+	+	+	+	+
<i>Aporosa dioica</i>	Tree/ Shrub					+	
<i>Araucaria heterophylla</i>	Tree		+				
<i>Bridelia tomentosa</i>	Tree	+	++	+		++	
<i>Celtis sinensis</i>	Tree	+	+	+	+	+	+
<i>Choerospondias axillaris</i>	Tree					+	
<i>Cinnamomum camphora</i>	Tree	+	++	++	+	+	++
<i>Delonix regia</i>	Tree	+	+++	++	+	+	+
<i>Dimocarpa longan</i>	Tree	++	+++	++	+	+	+
<i>Ficus elastic</i>	Tree	+	+	+		+	
<i>Ficus hirta</i>	Tree/ Shrub	+	+	+	+	+	+
<i>Ficus microcarpa</i>	Tree	+	+	++	+	+	+
<i>Gossampinus malabarica</i>	Tree	+	++	+	+	+	+
<i>Litchi chinensis</i>	Tree	+	++	+	+	++	+
<i>Litsea glutinosa</i>	Tree	+				+	
<i>Liquidambar formosana</i>	Tree			+		+	+
<i>Livistona chinensis</i>	Tree	+	+	+	+	+	+
<i>Macaranga tanarius</i>	Tree	+	+	+	+	+	+

Species	Form	Abundance					
		Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
<i>Mangifera indica</i>	Tree	+	++	+			
<i>Melia azedarach</i>	Tree	+					++
<i>Michelia alba</i>	Tree		+	+		+	
<i>Microcos paniculata</i>	Tree	+	+			+	
<i>Plumeria rubra</i>	Tree				+		
<i>Rhus chinensis</i>	Tree				+	+	
<i>Sapium discolor</i>	Tree			+			
<i>Schefflera octophylla</i>	Tree	+		+		+	+
<i>Sterculia lanceolata</i>	Tree			+	+		+
<i>Sterculia nobilis</i>	Tree		+				
<i>Syzygium jambos</i>	Tree	+	+	+		+	+

Notes: + = A small number of species are present within the Study Area
 ++ = An average abundance of the species is found within the Study Area
 +++ = This species was frequently found within the Study Area

8.3.3.5 Plantation Woodlands

Plantation woodlands make up 26 ha or 11.8% of the Study Area. Although they occur throughout the Study Area, their presence is most notable along the highway boundary and for landscaping purposes around developed areas (see Photos 8-6 & 8-7). Plantation woodlands typically comprise lower species diversity and are of a more simple habitat structure compared to natural woodlands (Dudgeon & Corlett, 1994). This description applies to the plantation woodlands within the study area which had a relatively simple structure due to similarities in species age with the consequence that there is little overall vegetation stratification below the tree canopy (i.e. predominantly grasses) and low species density. Hence, plantation woodland present with the study area is of lower heterogeneity compared to natural woodland. Table 8.4 summarises the dominant species present within the Study Area.

Table 8.4 Species of Trees and Shrubs in Plantation Woodland

Vegetation Group	Common Name	Species Name
Native Tree Species	Big-leaved Fig	<i>Ficus virens</i>
	Camphor Tree	<i>Cinnamomum camphora</i>
	Chinese Banyan	<i>Ficus microcarpa</i>
	Elephant's Ear	<i>Macaranga tanarius</i>
	Hong Kong Orchid Tree	<i>Bauhinia blakeana</i>
	Lebbek Tree	<i>Albizia lebbek</i>
	White Popinac	<i>Leucaena leucocephala</i>
Exotic Tree Species	Acacia	<i>Acacia confusa</i>
	African Tulip Tree	<i>Spathodea campsnulata</i>
	Bauhinia	<i>Bauhinia spp.</i>
	Brisbane Box	<i>Tristania conferta</i>
	Cadaga	<i>Eucalyptus torelliana</i>
	Candlenut Tree	<i>Aleurites moluccana</i>
	Chinese Hibiscus	<i>Hibiscus rosa-sinensis</i>
	Coral Tree	<i>Erythrina indicaa</i>
	Earleaf Acacia	<i>Acacia auriculiformis</i>
	Horsetail Tree	<i>Casuarina equisetifolia</i>
	Flame of the Forest	<i>Delonix regia</i>
	Indian Almond	<i>Terminalia catappa</i>
	Lemon-scented Gum	<i>Eucalyptus citriodora</i>
	Melia	<i>Melia azedarach</i>
	Paper-bark Tree	<i>Melaleuca leucadendron</i>
Long-leaved iron wood	<i>Casuarina stricta</i>	

Vegetation Group	Common Name	Species Name
	Queen Crape-myrtle	<i>Lagerstroemia speciosa</i>
	Slash Pine	<i>Pinus elliottii</i>
	Spider Tree	<i>Crateva religiosa</i>
	Swamp Mahogany	<i>Eucalyptus robusta</i>
	Tree Cotton	<i>Gossampinus malabaruca</i>
Native Shrub Species	Azalea	<i>Rhododendron spp.</i>
	Gordonia	<i>Gordonia axillaris</i>
Exotic Shrub Species	Bamboo Palm	<i>Chrysalidocarpus lutescens</i>
	Buddha Bamboo	<i>Bambusa ventricosa</i>
	Calliandra	<i>Calliandra haematocephala</i>
	Chinese Fan-palm	<i>Livistona chinensis</i>
	Crape-myrtle	<i>Lagerstroemia indica</i>
	Dwarf Date Palm	<i>Phoenix roebelenii</i>
	Dwarf Ixora	<i>Ixora coccinea</i>
	Golden Bamboo	<i>Bambusa vulgaris</i>
	Golden Dewdrops	<i>Duranta repens</i>
	Oleander	<i>Nerium indicum</i>
	Yellow Oleander	<i>Thevetia peruviana</i>
Exotic Herb Species	Spider Lily	<i>Hymenocallis americana</i>

8.3.3.6 *Fung Shui* Woodlands

Fung Shui woodlands, in general, are present adjacent to traditional villages and typically comprise original trees that have been preserved and hence are generally older than specimens growing in natural and plantation woodlands (see Photo 8-8). Historically, villagers have also planted additional medicinal and edible species within the woodland for both medicinal purposes and species that produce edible fruits that can be harvested for food, e.g., *Litchi*, *Dimocarpa longan* and *Citrus spp.* (Dudgeon & Corlett, 1994; WWF, unpublished). Table 8.3 summarises the dominant species of trees and shrubs found in Study Areas 1 - 6.

Fung Shui woodland are located adjacent to the following villages within the Study Area: Wong Kong Shan, Tong Hang and Wo Hop Shek San Tsuen in Area 1 (Figure 8.1.1); Nam Wa Po and Yuen Leng in Area 2 (Figure 8.1.2); Ha Wun Yiu in Area 5 (Figure 8.1.5); and at Ha Wong Yi Au within Area 6 (Figure 8.1.6).

Since approximately 0.04 ha of *Fung Shui* woodland is anticipated to be lost at Shek Kwu Lung (Area 4, Figure 8.5.4) to accommodate construction of a permanent new elevated slip road onto Tolo Highway, a quantitative 10x10 m survey of this woodland was undertaken.

For the 100 m² of *Fung Shui* woodland surveyed at Shek Kwu Lung, dominant species were identified which include *Aquilaria sinensis* (28.53%), *Sapium sebiferum* (28.43%), *Cratoxylum cochinchinense* (14.78%), *Zanthoxylum avicennae* (10.24%), *Aporosa dioica* (6.73%), *Litsea glutinosa* (4.59%), *dead trees* (4.46%), and *Choerospondias axillaris* (2.23%). All recorded floral species are common and widespread in Hong Kong, although *Aquilaria sinensis* is a protected species in mainland China. The lower canopy comprised *Ilex asprella*, *Psychortia rubra* and *Litsea rotundifolia*.

8.3.4 Description of Freshwater Habitats

8.3.4.1 Natural Rivers and Streams

Natural streams/small rivers are present in each of the six areas, with a cumulative length of approximately 8300 m throughout the Study Area (Figures 8.5.1 - 8.5.5; Photo 8-9). Together the water courses support a range of freshwater organisms as detailed in Section 8.3.6.3. Several of these natural water courses presently pass below the existing Tolo Highway/ Fanling Highway.

Together the watercourses support a range of freshwater organisms as detailed in Section 8.3.6.3. These habitats also provide a feeding ground for a variety of water birds observed within the Study Area, e.g. White Breasted Watermelon (*Amaurornis Phoenicurus*).

The substrate of the watercourses present in Areas 1, 2 and 3 comprise a combination of natural soft mud and pebbles. Riparian vegetation includes orchard tree species. Since the watercourses flow through active agricultural land, the water is likely to be organically enriched.

Within Areas 4, 5 and 6 the watercourses possess a stony substrate. Within the upper reaches the banks remain natural and support riparian vegetation including *Ficus spp.* and *Bambusa spp.* The banks of the lower watercourses have been artificially modified for stabilisation and drainage purposes. The largest stream course in the centre of Area 5 is a typical modified lowland water course with most of its bed engineered (see Photo 8-10). The water quality at these areas also appears to be organically enriched by agricultural runoff.

8.3.4.2 Artificial Drainage Channels

A total of 7300 m of artificial drainage channels are present within the Study Area (see Photo 8-10). These habitats have been dramatically modified including being dredged, embanked and lined with concrete to effectively manage high flood regimes. Such channels support far fewer organisms than natural water courses.

8.3.4.3 Ponds

An artificial pond, which may be a *Fung Shui* pond, is located adjacent to Nam Wa Po village and supports a variety of organisms including large Goldfish (see Photo 8-11). Several species of amphibians were heard and several Red-eared Sliders (*Trachemys scripta elegans*) were observed. Barn Swallows were also observed catching insects over the pond.

8.3.5 Description of Inter-tidal Habitats

8.3.5.1 Mudflat

A very small area of inter-tidal mudflat is present along the southern coastal area of Yuen Chau Tsai, which is intermittently exposed during low tide (Refer to Figure 8.1.6; see Photo 8-12).

8.3.5.2 Mangal

A small stand (0.05 ha, 0.02%) of mangroves is present in the inter-tidal zone adjacent to Island House (WWF, undated a & c). Ground truthing of this site confirmed that this site predominately supported *Kandelia candel*.

8.3.5.3 Marine Waters (see Photo 8-12)

The marine environment of Tolo Harbour encompasses 8.25 ha of the Study Area (3.70%). The western portion of the marine environment has been reclaimed to facilitate further land reclamation. Along a majority of the land/sea interface artificial sea walls with random 'rip rap' blocks have been constructed.

8.3.6 Wildlife Survey Results

8.3.6.1 Birds

Table 8.5 presents a summary of the birds identified during the baseline ecological surveys within the Study Area. The avifaunal surveys were undertaken on 31 May, 22 June, 24 June and 1 August 1999, respectively.

A total of 34 species of birds were identified within the Study Area (refer to Table 8.5). The common and Latin names for each of these species, along with their distribution within each of the 6 regions of the Study Area and the habitat type that they were observed in are summarised in Table 8.5. In addition, for each species their residency and conservation status in Hong Kong is defined, as is their listed conservation status in the PRC.

Ten species were observed in Areas 1 & 4, whilst in Area 3, 24 species were observed. Area 3 comprises active and Inactive Agricultural Land, natural and plantation woodlands; natural water courses and an artificial drainage channel, which offer a variety of feeding grounds for avifaunal species. This likely accounts for the higher density of birds in this area.

A total of 28 Hong Kong resident species of birds were observed over the duration of the surveys. In addition one introduced species was also observed (Feral Pigeon, *C. livia*). As defined in the fifth column of Table 8.5, several species of birds that are classified as seasonal visitors were also identified over the duration of the ecological surveys. These include:

Summer Visitors

- Barn Swallow (*H. rustica*)

Winter Visitor

- Common Sandpiper (*A. hypoleucos*)
- Fantail Warbler (*C. juncidis*)
- Grey Wagtail (*M. cinerea*)
- Yellow Wagtail (*M. flava*)

Passage Migrants

- Barn Swallow (*H. rustica*)
- Common Sandpiper (*A. hypoleucos*)
- House Swift (*A. nipalensis*)
- Yellow Wagtail (*M. flava*)

The species identified within each of the eight different ecological habitats are defined in Table 8.5. Only two species of birds were observed in the marine and inter-tidal mudflat habitat. These include the Common Sandpiper (*A. hypoleucos*) and Night Heron (*N. nycticorax*) which are both typical of this type of habitat. The habitat where the greatest number of birds were observed in the Study Area was the Natural Woodland (16 different species) which supports a diverse range of floral species which, in turn, support a diversity of fauna which provide foraging opportunities for birds.

A total of 31 species were observed that are considered to be common throughout Hong Kong. No rare species were observed.

Point Counts

Figures 8.3.1 – 8.3.4 illustrate the six locations throughout the Study Area where point counts were undertaken on a monthly basis, from May to August. Table 8.6 illustrates the location and habitat composition for each of the locations of the point counts, whilst Table 8.7 summarises the results of the point count data. The locations of each of these six locations are summarised in the proceeding text.

Table 8.6 Location and Habitat Composition of Point Counts

Site	Location	Habitat Composition
A	Tai Po	<ul style="list-style-type: none"> • Tai Po Egretty
B	Ha Wun Yiu	<ul style="list-style-type: none"> • Plantation woodland • Natural woodland • <i>Fung Shui</i> woodland • Watercourse
C	Pun Chun Yuen	<ul style="list-style-type: none"> • Natural woodland • Stream
D	Kau Liu Ha	<ul style="list-style-type: none"> • Active and Inactive Agricultural Land
E	Tai Wo	<ul style="list-style-type: none"> • Active and Inactive Agricultural Land • Natural woodland
F	Adjacent to KCRC close to Tong Hang	<ul style="list-style-type: none"> • Stream • Artificial drainage channel • Grassland • Natural woodland • Plantation woodland

- **Location A** - Table 8.7 illustrates that ‘Location A’(Tai Po Egretty) supports the highest density of birds in the study area., This can be attributed to the Egretty being a nesting ground for Little Egrets (*E. garzetta*) and other *Ardeidae* species. In addition, the data illustrate that during May and June numbers were low (62 and 52 respectively), whilst in July and August densities increased (150 and 387 respectively). This higher number is most probably attributed to a greater number of *E. garzetta* present at the Egretty during the breeding season.
- **Location B** – Comprised of woodland, which accounts for the presence of typical species that, inhabit such habitats e.g. Common Tailorbird (*O. sutorius*). In addition, several species of water birds were also identified along the water courses, e.g. White Breasted Waterhen (*A. phoenicurus*), White Breasted Kingfisher (*H. smyrenensis*) and Chinese Pond Heron (*A. bacchus*).
- **Location C** – This sample site is located at Pun Chun Yuen, which is comprised of a natural woodland and a watercourse. Species observed at this site include the Chinese Bulbul (*P. sinensis*), Crested Bulbul (*P. jocosus*) and White-eye (*Z. japonica*) which are typical species found in this habitat in Hong Kong. Compared to the other 5 sites, densities were low at Location C.

Table 8.5 Birds Identified within the Study Area during the Initial Ecological Surveys

Common Name	Species Name	Observed in Area *						Habitat Type Observed In							Residency Status in Hong Kong #					Conservation Status in HK #			Status in PRC #			
		1 (Refer to Figure 8.1.1)	2 (Refer to Figure 8.1.2)	3 (Refer to Figure 8.1.3)	4 (Refer to Figure 8.1.4)	5 (Refer to Figure 8.1.5)	6 (Refer to Figure 8.1.6)	Active Agricultural Land	Inactive Agricultural Land	Grassland	Natural Woodland	Plantation Woodland	Fung Shui Woodland	Water Course	Marine & Mudflat	Resident	Summer Visitor	Winter Visitor	Passage Migrant	Introduced	Widespread & Common	Local but not Uncommon	Very Local or Rare in Hong Kong	Common	Protected Class II	Protected Class I
Barn Swallow	<i>Hirundo rustica</i>		*	*			*	*								*		*		*			*			
Black-faced Laughing Thrush	<i>Garrulax Perspicillatus</i>						*			*					*					*			*			
Black-necked Starling	<i>Sturnus nigricollis</i>	*	*	*			*	*	*		*				*					*			*			
Cattle Egret	<i>Bubulcus ibis</i>		*				*	*							*					*			*			
Chinese Bulbul	<i>Pycnonotus sinensis</i>	*	*	*	*	*	*	*	*	*	*	*			*					*			*			
Chinese Pond Heron	<i>Ardeola bacchus</i>		*	*		*	*	*	*	*					*					*			*			
Common Kingfisher	<i>Alcedo atthis</i>			*									*		*					*			*			
Common Sandpiper	<i>Actitis hypoleucos</i>					*	*						*	*			*	*		*			*			
Common Tailorbird	<i>Orthotomus sutorius</i>	*	*	*	*				*	*	*	*			*					*			*			
Crested Bulbul	<i>Pycnonotus jocosus</i>	*	*	*	*	*	*	*	*	*	*	*			*					*			*			
Crested Myna	<i>Acridotheres cristatellus</i>	*	*	*	*	*	*	*	*	*	*	*			*					*			*			
Fantail Warble	<i>Cisticola juncidis</i>		*						*						*		*			*		*				
Feral Pigeon	<i>Columba livia</i>		*	*			*						*					*		*		*				
Greater Coucal	<i>Centropus sinensis</i>			*			*	*							*					*			*		*	
Grey Wagtail	<i>Motacilla cinerea</i>					*							*				*			*			*			
House Swift	<i>Apus nipalensis</i>					*							*		*			*		*			*			
Koel	<i>Eudynamis scolopacea</i>			*					*						*					*			*			
Little Egret	<i>Egretta garzetta</i>	*				*	*		*		*	*			*					*			*			
Magpie	<i>Pica pica</i>		*					*	*	*	*				*					*			*			
Magpie robin	<i>Copsychus saularis</i>		*	*	*	*			*	*	*	*			*					*			*			
Night Heron	<i>Nycticorax nycticorax</i>			*								*	*		*					*			*			
Plain Prinia	<i>Prinia inornata</i>		*	*			*	*	*						*					*	*		*			
Red-vented bulbul	<i>Pycnonotus aurigaster</i>	*	*	*	*	*	*	*	*	*	*	*			*					*			*			
Rufous-backed Shrike	<i>Lanius schach</i>			*			*								*					*			*			
Spotted Dove	<i>Streptopelia chinensis</i>	*	*	*	*	*	*	*	*	*	*	*			*					*			*			
Spotted Munia	<i>Lonchura punctulata</i>			*	*							*			*					*	*		*			

Common Name	Species Name	Observed in Area *						Habitat Type Observed In						Residency Status in Hong Kong #				Conservation Status in HK #			Status in PRC #					
		1 (Refer to Figure 8.1.1)	2 (Refer to Figure 8.1.2)	3 (Refer to Figure 8.1.3)	4 (Refer to Figure 8.1.4)	5 (Refer to Figure 8.1.5)	6 (Refer to Figure 8.1.6)	Active Agricultural Land	Inactive Agricultural Land	Grassland	Natural Woodland	Plantation Woodland	Fung Shui Woodland	Water Course	Marine & Mudflat	Resident	Summer Visitor	Winter Visitor	Passage Migrant	Introduced	Widespread & Common	Local but not Uncommon	Very Local or Rare in Hong Kong	Common	Protected Class II	Protected Class I
Tree Sparrow	<i>Passer montanus</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*					*			*			
White Wagtail	<i>Motacilla alba</i>		*			*	*	*					*		*					*			*			
White-backed Munia	<i>Lonchura striata</i>			*					*		*				*					*			*			
White-breasted Kingfisher	<i>Halcyon smyrnensis</i>		*	*		*							*		*					*			*			
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>		*	*		*							*		*					*			*			
White-eye	<i>Zosterops japonica</i>	*		*		*			*	*					*					*			*			
Yellow-bellied Prinia	<i>Prinia flaviventris</i>			*					*						*					*			*			
Yellow Wagtail	<i>Motacilla flava</i>					*	*						*				*	*			*		*			
Number of birds in category		10	19	24	9	15	12	14	14	9	16	11	10	12	2	28	1	4	4	1	30	4	0	33	1	0

Notes:

Vincy et al (1994)

Area*

Area 1 = Fanling, Wo Hop Shek San Tseun

Area 2 = Kau Lung Hang, Yuen Leng, Nam Wah Po

Area 3 = Tai Hang, Wai Tau, Hong Lok Yuen, Tai Wo

Area 4 = Shek Kwu Lung, Mui Shue Hang

Area 5 = Pun Chun Yuen

Area 6 = Ha Wun Yiu

Table 8.7 Results of Point Count Data for Birds

Common Name	Species Name	Location A				Location B				Location C				Location D				Location E				Location F			
		May	June	July	Aug	May	June	July	Aug	May	June	July	Aug	May	June	July	Aug	May	June	July	Aug	May	June	July	Aug
Black-faced Laughing Thrush	<i>Garrulax sannio</i>							2								2				4			2		
Black-necked Starling	<i>Sturnus nigricollis</i>													1		4	1	3	1	10		1	5		
Chinese Bulbul	<i>Pycnonotus sinensis</i>	1	1	2	4			3	1	1		2				1	2			2	2	2	2	5	
Chinese Pond Heron	<i>Ardeola bacchus</i>			1	1	1	2																1	1	
Common Kingfisher	<i>Alcedo atthis</i>					1																		1	
Common Sandpiper	<i>Actitis hypoleucos</i>					1																			
Common Tailorbird	<i>Orthotomus sutorius</i>		2		1												2		2		1			1	
Crested Bulbul	<i>Pycnonotus jocosus</i>	1	2					1	3	1		2	4				1		2		4	3	1		
Crested Myna	<i>Acridotheres cristatellus</i>			1											2	1	4	2				3			
Fantail Warble	<i>Cisticola juncidis</i>													1											
Feral Pigeon	<i>Columba livia</i>			8	1																				
Greater Coucal	<i>Centropus sinensis</i>																								
Grey Wagtail	<i>Motacilla cinerea</i>					1																			
House Swift	<i>Apus nipalensis</i>							3																	
Koel	<i>Eudynamis scolopacea</i>										4														
Little Egret	<i>Egretta garzetta</i>	60	45	130	370										1	4				1		1			
Magpie	<i>Pica pica</i>				2						6	1	1			1	1							1	
Magpie robin	<i>Copsychus saularis</i>				3	1		1												1				2	
Night Heron	<i>Nycticorax nycticorax</i>					1																			
Plain Prinia	<i>Prinia inornata</i>							3			1														
Red-vented Bulbul	<i>Pycnonotus aurigaster</i>				1																				
Rufous-backed Shrike	<i>Lanius schach</i>													1											
Spotted Dove	<i>Streptopelia chinensis</i>			2	1			1	1							2	2				1				
Spotted Munia	<i>Lonchura punctulata</i>									1															
Tree Sparrow	<i>Passer montanus</i>			6	3			1	3						2	4	3	1	4	5	6	1	1	1	2
White Wagtail	<i>Motacilla alba</i>					1		2	1								4								
White-breasted Kingfisher	<i>Halcyon smyrnensis</i>					1											1								
White-breasted Waterhen	<i>Amauromis phoenicurus</i>					2	1		1							1					1		1		
White-eye	<i>Zosterops japonica</i>		2					2	5				3				3								
Yellow Bellied Prinia	<i>Prinia flaviventris</i>																								
Yellow Wagtail	<i>Motacilla flava</i>					1																			
Total Densities		62	52	150	387	11	3	17	17	3	1	14	8	3	5	10	33	5	11	7	25	8	12	12	13

- **Location D** – Is located at Kau Liu Ha and is dominated by active and Inactive Agricultural Land. Species observed at this location include Black-faced Laughing Thrush (*G. perspicillatus*) and Crested Myna (*A. cristatella*) which are commonly found foraging in such habitats in Hong Kong. Densities were highest during August (33), which is attributed to increased foraging activities by adult birds to collect food for young. Also, when this survey location was visited in August, the active agricultural land was being tilled resulting in disturbance to soil and hence creation of additional feeding opportunities for birds.
- **Location E** – Is situated at Tai Wo and comprises active and Inactive Agricultural Land, as well as natural woodland. Species observed were similar to those observed at Location D. Densities were higher during August compared to the previous three months.
- **Location F** – Comprises natural and modified water courses, grassland and natural and plantation woodlands. Species identified include Tree Sparrow (*P. montanus*), Chinese Bulbul (*P. sinensis*) and Crested Bulbul (*P. jocsus*) which are all typical of this habitat in Hong Kong. Densities were relatively consistent during the survey programme.

8.3.6.2 Amphibians & Reptiles

Table 8.8 provides a summary of the amphibians and reptiles that were identified either by observation or call during the baseline ecological surveys. Of six amphibian species encountered, the most common was the Asian Common Toad (*Bufo melanostictus*). None of the other five species are rare or protected in Hong Kong.

A total of four species of reptiles were identified, all of which are common. The most common reptile was the exotic Red-eared Slider (*Trachemys scripta elegans*) with six individuals identified in the pond at Nam Wah Po and a further specimen in the stream at Kau Lung Hang.

A Four Clawed Gecko (*Gehyra mutilata*) was identified in Area 3 of the Study Area. This species is relatively uncommon in Hong Kong. Its distribution is believed to be restricted to Pak Tam Chung in the New Territories, Choi Hung in Kowloon and several localities on Hong Kong Island and Lantau Island. This species typically resides in the crevices of buildings and is attracted to well illuminated areas during the nocturnal hours to catch night-flying insects (Karsen *et al*, 1998).

Table 8.8 Species of Amphibians and Reptiles Within the Study Area

Common Name	Species Name	Recorded Habitat	Conservation Status in HK	Area species was recorded in						Range		
				1	2	3	4	5	6	Low	High	Mean
Asian Common Toad	<i>Bufo melanostictus</i>	S, AC, IA, AA	Common	+	1	1	1	9		1	9	3
Asiatic Painted Frog	<i>Kaloula pulchra</i>	IA, S, AA	Common	+	1	1				1		1
Marbled Pigmy Frog	<i>Microhyla pulchra</i>	IA, AA	Common		1					1		1
Brown Tree Frog	<i>Polypedates leucomystax</i>	IA	Common					1		1		1
Gunther's Frog	<i>Rana guentheri</i>	IA, AA	Common		1	1		4		1	4	2
Paddy Frog	<i>Rana limnocharis</i>	IA, AA,	Common	+	1	1				1		1
Bowring's Gecko	<i>Hemidactylus borwingii</i>	P	Very Common						1	1	1	1
Four Clawed Gecko	<i>Gehyra mutilata</i>	V	Uncommon			1				1	1	1
Greater Green Snake	<i>Cyclophiops major</i>	IA	Common		1					1	1	1
Red-eared Slider	<i>Trachemys scripta elegans</i>	S, Pd	Common	1	6					1	6	3

Notes:

Numerical numbers represent actual observation of species

P, plantation; V, village; AA, active agricultural land; IA, inactive agricultural land; S, stream; Pd, pond; AC, artificial channel;

+ Species heard

8.3.6.3 Freshwater Benthos

Five water courses within the boundaries of the Study Area were sampled to identify the typical freshwater habitat of the Study Area. Sampling was undertaken at the following water courses, the locations of which are illustrated in Figure 8.6.

- S1** Pun Chun Yuen stream
- S2** Shek Kwu Lung stream
- S3** Lam Tsuen river
- S4** Tai Wo stream
- S5** Kau Lung Hang stream

Appendix 8.1 illustrates the benthic and invertebrate species identified at each of the sites. Table 8.9 summarises the quantitative data for abundance and diversity of aquatic species collected by the kick sampling procedure.

A total of 24 different species were identified from the five water courses, and no rare or protected species were identified. The stream flowing adjacent to Tai Wo (S4) supported the highest diversity with the dominant species being a species of mollusc (*Melanoides tuberculata*). The stream at Kau Lung Hang (S5) supported the greatest abundance of organisms, with *Chironomidae* being the dominant species (total 36 individuals). This species indicates that this water course is polluted with organic material (Shea, 1993).

The presence of *Chironomidae* in the water courses of Pun Chun Yuen stream (S1) and Tai Wo stream (S4) may indicate that the agricultural practices operating within the catchment of this stream are contributing the organic pollutants into the water course.

However, a low abundance of *Eirocheir japonicus*, a species of freshwater crab, was also identified in the stream at Pun Chun Yuen stream (S1). This species typically only inhabits natural streams of good water quality (Shea, 1993), and therefore indicates that the water quality is relatively good.

Suspended sediments (level not quantified) were high in the stream at Shek Kwu Lung (S2), which is attributed to the construction works currently ongoing at Lin Au water works. The poor water quality of this stream was reflected by no organisms being collected from the kick sampling process and only a low number of individuals of *Hippeutis cantonensis* collected using the aquatic net (refer to Appendix 8.1).

Table 8.9 Summary of Aquatic Species Abundance and Diversity Data collected by Kick Sampling at Sites S1 – S5

	S1 Pun Chun Yuen stream	S2 Shek Kwu Lung stream	S3 Lam Tsuen river	S4 Tai Wo stream	S5 Kau Lung Hang stream
Abundance	14	0	6	57	71
No. of Species	5	0	2	10	9

8.3.6.4 Freshwater Fish

Species of fish caught at each of the five water courses are detailed in Appendix 8.1. Species identified within the Study Area include *Poecilia reticulata* and *Gambusia affinis* in Pun Chun Yuen stream (S1) and the Lam Tsuen river (S2), *P. reticulata* from Tai Wo stream (S4) and whilst *Sarotherodon mossambicus* and *P. reticulata* in the Kau Lung Hang Stream (S5).

Parazacco spilurus is distributed widely in freshwater courses throughout Hong Kong and is listed as vulnerable in the China Red Data Book.

8.3.6.5 Mammals

Over the monthly ecological surveys only two species of mammals were identified within the Study Area:

- Belly-banded Squirrel (*Callosciurus erythraeus styani*) - Two specimens were identified in the natural woodland habitat of To Yuen Tung (Area 5) during the August bird survey. *Callosciurus erythraeus styani* is a protected under the Wild Animals Protection Ordinance, although they are common in many areas of Hong Kong including Tai Po Kau which is located adjacent to the Study Area (Goodyer, 1992).
- Japanese Pipistrelle (*Pipistrellus abramus*) – A specimen of *P. abramus* was identified flying over an orchard at Lam Tsuen. This species is common in Hong Kong and generally roosts on buildings (Ades, 1990). This species is protected under the Wild Animals Protection Ordinances but there are no significant impacts on the species and their habitat as the habitats are located far from the Project area.

8.3.6.6 Butterflies

Table 8.10 summarises the species of butterflies identified within the Study Area. A total of fifteen different species were identified, with the Common Grass Yellow butterfly (*Eurema hecabe*) and the Common White butterfly (*Artogeia canidia*) being the dominant species.

Table 8.10 Species of Butterflies Identified within the Study Area

Family	Common Name	Species Name	Habitat	* Status	Area Recorded					
					1	2	3	4	5	6
Papilionidae	Common Mormon	<i>Papilio polytes</i>	N, F	vc				✓		✓
	Dark Mormon	<i>Papilio protenor</i>	F, N	c	✓			✓		✓
	Great Mormon	<i>Papilio memnon</i>	N	c				✓		
Pieridae	Common Grass Yellow	<i>Eurema hecabe</i>	N, P, IA,	vc	✓	✓	✓	✓	✓	✓
	Common White	<i>Artogeia canidia</i>	N, P, IA, AA	c	✓	✓	✓	✓		✓
	Great Orange Tip	<i>Hebomoia glaucippe</i>	N	c					✓	
	Lemon Migrant	<i>Catopsilia pomona</i>	N, P	c	✓		✓		✓	✓
Nymphalidae	Common Faun	<i>Faunis eumeus</i>	N	c				✓		
	Coomon Sergeant	<i>Athyma perius</i>	N	c					✓	
	Great Eggfly	<i>Hypolimnas bolina</i>	N, F	c				✓		
Lycaenidae	Blue Tiger	<i>Tirumala limniace</i>	N	c					✓	
	Common Crow	<i>Euploea core</i>	N	vc					✓	
	Pea Blue	<i>Lampides boeticus</i>	N, P	c					✓	
	Pale Grass Blue	<i>Zizeeria maha</i>	N	c				✓		
	Plum Judy	<i>Abrisara echerius</i>	N, P	vc				✓		
No. of species identified in each defined Study Area					4	2	3	9	6	5

Notes:

* Status: c = common; vc = very common. (Source: Walthew,1997)

N, natural woodland; F, *Fung Shui* wood; P, plantation; IA, inactive agricultural land; AA, active agricultural land.

The summary of the species distribution in Table 8.10 indicates that the habitat within Area 4 is an important area for butterflies within the Study Area. The following butterflies Dark Mormon (*Papilio protenor*), Common Mormon (*P. polytes*), Great Eggfly (*Hypolimnas bolina*), Great Orange Tip (*Hebomoia glaucippe*) were found predominantly in the natural woodlands, which are extensive in the Pun Chun Yuen area.

The plantation habitats along the roadside is relatively low in terms of ecological value for species diversity as only 5 common species of butterfly were recorded.

8.3.6.7 Odonata

Odonata refers to dragonflies and damselflies. Table 8.11 presents the distribution of species of this group within the Study Area.

The water courses and ditches around active and inactive agricultural land within Areas 2 and 3 were identified as the most important habitats for dragonflies. Five abundant / common species identified along with one species, *Orthetrum triangulare*, classed as uncommon by Wilson (1997). Two species of damselfly, namely *Copera ciliata* and *Prodasineura autumnalis* were recorded at the stream of Pun Chun Yuen (Area 4).

Table 8.11 Species of Damselfly and Dragonfly in the Study Area

Sub-order	Species Name	* Status in Hong Kong	Area Recorded					
			1	2	3	4	5	6
Damselfly	<i>Copera ciliata</i>	Common				✓		
	<i>Prodasineura autumnalis</i>	Abundant				✓		
Dragonfly	<i>Orthetrum glaucum</i>	Abundant	✓	✓	✓	✓	✓	✓
	<i>Orthetrum pruinosum</i>	Abundant	✓	✓	✓	✓		✓
	<i>Orthetrum triangulare</i>	Uncommon		✓				
	<i>Pseudothemis zonata</i>	Common		✓	✓			
	<i>Rhyothemis variegata</i>	Common	✓					
	<i>Palpopleura sexmaculata</i>	Common			✓			✓

* Source: Wilson (1997)

8.4 Evaluation of Habitats and Ecological Impacts

8.4.1 Introduction

Based on the baseline ecological information presented in the previous section, Section 8.4 provides an evaluation of the ecological value of each of the habitats present within the Study Area. Habitat impacts have been evaluated according to the requirements of *Annex 8 of the Technical memorandum on the EIAO*.

Whilst the main ecological concern is specifically with respect to direct habitat loss, the final part of this Section refers to the potential impacts of noise, dust and a deterioration in water quality which may arise as a consequence of the works.

This section on ecological evaluation includes all habitats within the Study Area regardless of whether or not they are permanently or temporarily affected by the works. Whilst the key area of concern during the evaluation is the direct loss of habitat, the evaluation also considers operational impacts and transitional impacts (during site demobilisation / handover).

The following Table 8.12 summarises the area and percentage of habitats scheduled to be lost or impacted by the proposed widening of Tolo Highway. In total, it is estimated that 12.64 ha of habitat will be lost, 9.75 ha of which will be plantation woodland. The boundaries of the impacted areas have been superimposed over the habitat map to illustrate their extent and location (Figures 8.5.1 – 8.5.6).

Table 8.12 Habitats areas to be Lost / Impacted by Construction

Habitat	Direct Loss or Impacted Habitat Within the Study Area	
	Ha	% of Total Habitat
Terrestrial Habitat		
Plantation Woodland	9.75	4.42
Natural Woodland	0.74	0.34
Grassland	0.41	0.91
Inactive Agricultural Land	0.195	0.09
Active Agricultural Land	0.075	0.03
<i>Fung Shui</i> Woodland	0.04	0.02
Freshwater Habitat		
Artificial drainage channel	520 m	-
Natural Rivers and Streams	60 m	-
Urbanised / Developed Areas		
Urbanised / Developed & Village Areas	1.43	0.65
TOTAL	12.64 ha	6.46%

8.4.2 Plantation Woodlands

Plantation woodlands occur predominantly along the boundaries of the Tolo/Fanling Highway (refer to Figures 8.5.1 – 8.5.6). A total of 9.75 ha of plantation woodland are scheduled to be lost due to the highway widening including provisions for works areas.

Table 8.13 summarises the ecological evaluation of the plantation woodlands within the Study Area. Eleven species of birds were identified in plantation woodland, whilst five species of butterfly were identified, no mammals were found to inhabit the plantation woodland. Compared to natural woodland, species diversity was lower and lacked the presence of any rare or protected flora species. Hence this habitat is considered to be of lower ecological value compared to natural and *Fung Shui* woodlands. Ecologically, the predicted loss of approximately 9.75 ha of plantation woodland is considered to be insignificant. Following completion of the proposed works, the newly created roadside areas could be replanted with a more diverse range of native plant species (subject to local availability) to enhance both the landscape value of the area and ecological diversity. Refer to Section 9 regarding the proposed replanting areas and Appendix 9.1 regarding the recommended species used for planting.

Table 8.13 Ecological Evaluation of Plantation Woodland

Criteria	Plantation Woodland
Abundance/Richness of Wildlife	Low
Age	Young-moderate
Diversity	Low
Ecological Linkage	Plantations along side of highway are linked physically to natural woodland.
Fragmentation	Plantation in the northern region of the study site is fragmented
Naturalness	Planted by humans
Nursery/breeding grounds	None
Potential Value	Could be increased by planting more native species
Rarity	None
Re-creatability	Achievable in the short term
Size	26 ha
Conclusion	Low ecological value

8.4.3 Natural Woodlands

Some fringe areas of natural woodlands will be lost or indirectly impacted by the proposed highway widening, e.g. adjacent to Tai Po Road (Area 3, Figure 8.5.3), Kam Shan (Area 4, Figure 8.5.4); and To Yuen Tung (Area 5, Figure 8.5.5). It is anticipated that approximately 0.74 ha of natural woodland habitat will be lost to accommodate the proposed works. However, most natural woodland will be unaffected by the works, and thus the overall ecosystem function will not be adversely affected.

Table 8.14 summarises the evaluation of the ecological value of natural woodland habitat. The field surveys indicated that natural woodland is an important habitat for birds (16 different species were observed, compared to between 2 and 14 species for the other habitats. In addition, Belly Banded Squirrels *Callosciurus erythraeus styani* were identified foraging in the natural woodland adjacent to To Yuen Tung, in addition to 15 species of butterflies. With the exception of the Squirrel, which is a protected species, no rare, endangered or ecologically important species are known to exist within the habitat.

In addition the proposed area scheduled to be lost is relatively small (0.74 ha) compared to the overall size of the habitat (19 ha). Following completion of the works, a variety of trees and shrubs will be replanted along the highway to replace those lost. Appendix 9.1 details species that may be appropriate for replanting following completion of the works. Hence, in the longer term impacts will be relatively insignificant.

Table 8.14 Ecological Evaluation of Natural Woodland

Criteria	Natural Woodland
Abundance/Richness of Wildlife	Moderate
Age	Moderate
Diversity	Moderate
Ecological Linkage	Natural woodland located notably in the south westerly region of the site (e.g., Pun Chun Yuen area) is relatively well linked to other ecological habitats thereby providing an ecological corridor for wildlife
Fragmentation	Very fragmented in the northern region of the Study Area
Naturalness	Natural habitat that has been modified by humans
Nursery/breeding grounds	Likely to providing nesting areas for a variety of species of birds, possibly mammals
Potential Value	Ecological value would be high if the disturbance factors were removed
Rarity	No rare or protected flora or faunal species identified.
Re-creatability	Achievable in the longer term
Size	19 ha
Conclusion	Moderate ecological value

8.4.4 Fung Shui Woodlands

Approximately 0.04 ha of *Fung Shui* woodland is anticipated to be lost at Shek Kwu Lung (Area 4, Figure 8.5.4) to accommodate construction of a permanent new elevated slip road on Tolo Highway. A quantitative survey of a 10x10 m plot of this woodland revealed that the three dominant species included *Aquilaria sinensis* (28.53%), *Sapium sebiferum* (28.43%), *Cratoxylum cochinchinense* (14.78%) and *Zanthoxylum avicennae* (10.24%). A total of 10 species of birds were observed in the Fung Shi woodland, and two species of butterflies. *Fung Shui* woodlands are relatively old and biologically diverse, they are therefore considered to be of moderate to high ecological value. Table 8.15 summarises the ecological evaluation of the woodland at Shek Kwu Lung. Overall the impact on this woodland is low due to small affected area and its fragmented nature.

Other Fung Shui woodland in the Study Area is located at Wo Hop Shek (Area 1) and by Ha Wun Yiu (Area 5). There is no loss of woodland at either of these locations due to the works.

Table 8.15 Ecological Evaluation of *Fung Shui* Woodland

Criteria	<i>Fung Shui</i> Woodland
Abundance/Richness of Wildlife	Moderate
Age	Old
Diversity	Structurally complex and diverse species
Ecological Linkage	Linked to other forms of woodland habitat
Fragmentation	Habitat at Ha Wun Yiu has been slightly fragmented to accommodate urban encroachment
Naturalness	Natural habitat that historically has been modified by villagers
Nursery/breeding grounds	Dense vegetation provides good habitat for a variety of species of birds and other wildlife
Potential Value	Moderate due to proximity of highway and urban areas
Rarity	No rare species of flora or fauna were identified
Re-creatability	Achievable in the longer term
Size	7.5 ha
Conclusion	<i>Moderate ecological value</i>

8.4.5 Grassland

Approximately 0.41 ha of grassland which is located adjacent to the KCRC railway is scheduled to be lost during the highway widening scheme (Area 1, Figure 8.5.1). This is a common ecological habitat type throughout Hong Kong and comprises low flora and faunal species diversity. Only nine species of birds were identified within this habitat. Table 8.16 summarises the evaluation of the ecological impacts. Since the habitat is considered to be of relatively low ecological value, and any disturbance is reversible by replanting schemes, the impacts are considered to be insignificant.

Table 8.16 Ecological Evaluation of Grassland

Criteria	Grassland
Abundance/Richness of Wildlife	Low
Age	Not known
Diversity	Low
Ecological Linkage	Provides linkage to other adjacent habitats
Fragmentation	Areas within Study Area relatively intact
Naturalness	Natural
Nursery/breeding grounds	None
Potential Value	Low
Rarity	No rare or protected species are known to reside in this habitat
Re-creatability	Achievable in the short term
Size	5.5 ha
Conclusion	<i>Low ecological value</i>

8.4.6 Active Agricultural Land

Active agricultural land covers 24.5 ha of the Study Area, notably adjacent to Tai Hang, Tai Wo and Kau Lung Hang Lo Wai villages. Active agricultural land is common throughout the New Territories, and whilst these habitats are artificial and subjected to a high level of ongoing human disturbance they are important habitats to a variety of wildlife including many species of birds, amphibians, and Odonata as emphasised in the previous subsections. Over the course of the field surveys 14 species of birds were identified, one species of butterfly and five species of amphibians.

Table 8.17 summarises the ecological evaluation of active agricultural land within the Study Area. It should be noted that the composition and size of active agricultural land within the Study Area may change both seasonally and on an annual basis as crops are harvested and areas set aside as fallow. A total of 0.075 ha of agricultural land is anticipated to be impacted. However, since this area is relatively small, and no rare, endangered or protected species are known to reside within this area the loss of this habitat is considered to be relatively insignificant.

Table 8.17 Ecological Evaluation of Active Agricultural Land

Criteria	Active Agricultural Land
Abundance/Richness of Wildlife	Moderate
Age	Not known
Diversity	Relatively low
Ecological Linkage	Provides linkage to adjacent habitats
Fragmentation	Sites are relatively fragmented as interspersed with Inactive Agricultural Land; fragmentation patterns may also change on a seasonal or annual basis
Naturalness	Artificial
Nursery/breeding grounds	Moderate as supports several species of birds, amphibians, reptiles and Odonata
Potential Value	Moderate
Rarity	None
Re-creatability	Achievable in the short term
Size	24.5 ha
Conclusion	Moderate ecological value

8.4.7 Inactive Agricultural Land

Inactive Agricultural Land covers 50 ha of the Study Area, notably adjacent to Tai Hang, Tai Wo and Kau Lung Hang Lo Wai villages. As with active agricultural land, Inactive Agricultural Land is also common throughout the New Territories. Whilst these habitats are artificial they are considered as important habitats for a variety of wildlife including many species of birds, amphibians, reptiles and Odonata. Fourteen species of birds, five species of amphibians and one species of butterflies were identified in the Inactive Agricultural Land. Table 8.18 summarises the ecological evaluation of Inactive Agricultural Land within the Study Area. It should be noted that the composition and size of Inactive Agricultural Land within the Study Area may change seasonally and on an annual basis as land is brought back into active production.

A total of 0.195 ha of agricultural land is anticipated to be impacted. However, because this area is relatively small, and no rare, endangered or protected species are known to inhabit this area, the loss of this habitat is considered to be insignificant.

Table 8.18 Ecological Evaluation of Inactive Agricultural Land

Criteria	Inactive Agricultural Land
Abundance/Richness of Wildlife	Moderate
Age	Not known
Diversity	Relatively low
Ecological Linkage	Provides linkage to adjacent habitats
Fragmentation	Sites are relatively fragmented as interspersed with active agricultural land; fragmentation patterns may also change on a seasonal or annual basis
Naturalness	Artificial
Nursery/breeding grounds	Moderate; supports several species of birds, amphibians, reptiles and Odonata
Potential Value	Moderate
Rarity	None
Re-creatability	Achievable in the short term
Size	24.5 ha
Conclusion	Moderate ecological value

8.4.8 Artificial Drainage Channel

Artificial drainage channels currently intersect under Tolo/Fanling highway at several locations, including Kui Tau (Area 2, Figure 8.5.2), Wai Tau Tsuen (Area 3, Figure 8.5.3) and To Yuen Tung (Area 5, Figure 8.5.5). Approximately 520 m of artificial drainage channel could be potentially impacted within the Study Area. Table 8.19 summarises the ecological evaluation for artificial drainage channels within the Study Area. Due to the total artificial composition of these habitats no adverse impacts are anticipated.

Table 8.19 Ecological Evaluation of Artificial Drainage Channels

Criteria	Artificial Drainage Channels
Abundance/Richness of Wildlife	Poor
Age	Recent
Diversity	Low
Ecological Linkage	Poor
Fragmentation	Not fragmented
Naturalness	Artificial
Nursery/breeding grounds	None known
Potential Value	Poor
Rarity	Neither species nor habitat are rare
Re-creatability	Achievable in the short term
Size	7.3 km
Conclusion	Low ecological value

8.4.9 Natural Water Courses

Table 8.20 summarises the ecological evaluation of water courses within the Study Area. Overall, the water courses in proximity to the existing Highway support a variety of wetland species. Whilst the ecological value of such habitats is considered to be moderate it could potentially be improved if current water quality levels are enhanced. A cumulative total of approximately 60 m of natural stream habitat may potentially be affected by construction activities. This total length comprises three separate sections of stream habitat, each with an impact zone (length) of 20 metres. All three streams are depicted by Figure 8.1.2, one either side of Tai Wo, and one near to Kiu Tau. The impact on each of these streams would be insignificant. All other water courses passing in proximity to the works are not anticipated to be affected as the Highway is elevated.

Any adverse impact upon the three stream sections would occur during the construction stage of the project and would be short-term, temporary and localised. It is expected that any stream areas affected would be quickly re-colonised by stream flora and fauna.

Good site management and careful mitigation measures e.g. screening off water courses (see Section 8.5.6) shall be implemented to ensure impacts are avoided/minimised.

Table 8.20 Ecological Evaluation of Natural Watercourses

Criteria	Natural Watercourses (Streams/ Rivers)
Abundance/Richness of Wildlife	Relatively high
Age	Not known
Diversity	Moderate
Ecological Linkage	Linkage to adjacent habitats and areas
Fragmentation	Habitats are partially fragmented
Naturalness	Relatively natural with exception to the channels which have been partially cemented
Nursery/breeding grounds	Good where water quality is acceptable
Potential Value	Good
Rarity	None
Re-creatability	Difficult possibly achievable in the long term
Size	8.3km
Conclusion	<i>Moderate ecological value</i>

8.4.10 Orchards

Figures 8.5.1 – 8.5.5 illustrate the location of orchards within the Study Area, whilst Table 8.21 summarises the ecological evaluation of the orchards. This small area of habitat is of relatively low ecological importance compared to other habitats.

Table 8.21 Ecological Evaluation of Orchards

Criteria	Orchards
Abundance/Richness of Wildlife	Low
Age	Not known
Diversity	Low
Ecological Linkage	Linkage to adjacent habitats
Fragmentation	Fragmented
Naturalness	Artificial
Nursery/breeding grounds	Low
Potential Value	Low
Rarity	None
Re-creatability	Achievable in the short term
Size	4 ha
Conclusion	<i>Low ecological value</i>

8.4.11 Inter-tidal

Inter-tidal habitat area comprises of 0.05 ha of mangroves dominated by *Kandelia candel*. During low tide within the small bay between the highway and Island House mud flat is exposed. However, since a large proportion of the natural inter-tidal habitat has already been lost to accommodate reclamation, which is now replaced by concrete rip rap correspondingly the inter-tidal area of this habitat is considered to be of low ecological value. Table 8.22 summarises the evaluation of inter-tidal habitat.

Table 8.22 Ecological Evaluation of Inter-tidal Habitat

Criteria	Inter-tidal habitat
Abundance/Richness of Wildlife	Medium
Age	Not known
Diversity	Medium
Ecological Linkage	Linked to marine habitat
Fragmentation	Fragmented as some habitat has been lost to reclamation
Naturalness	Natural, partially artificial
Nursery/breeding grounds	Medium
Potential Value	Low
Rarity	None
Re-creatability	Not applicable
Size	0.05 ha
Conclusion	Low ecological value

8.4.12 Marine Waters

The marine waters of the study area encompasses 8.25 ha. A substantial amount of reclamation has already occurred and is underway around the coastline of Inner Tolo Harbour. This reclamation along with pollution contributes to a disturbed marine environment, and for these reasons the ecological value of the marine environment within the Study area is low. Table 8.23 summarises the evaluation.

Table 8.23 Ecological Evaluation of Marine Habitat

Criteria	Marine habitat
Abundance/Richness of Wildlife	Medium
Age	Not known
Diversity	Low
Ecological Linkage	Linked to inter-tidal habitat
Fragmentation	Fragmented as some lost to reclamation
Naturalness	Disturbed
Nursery/breeding grounds	Low
Potential Value	Low
Rarity	None
Re-creatability	Not applicable
Size	8.25 ha
Conclusion	Low ecological value

8.4.12.1 Noise Disturbance

Indirect ecological impacts from the proposed widening of the Tolo / Fanling Highway may include elevated levels of noise and associated disturbance. Such human induced disturbance has the potential to disturb faunal species including birds (Hockin *et al*, 1992) which may lead to changes in behaviour patterns, including disturbance to breeding activities and foraging for food.

Tai Po Egretty is an important nesting area for Little Egrets (*E. garzetta*) and Chinese Pond Herons (*A. bacchus*) and is a designated SSSI. This Egretty was established after the Tai Po KCRC station was opened, and the number of breeding pairs at the Egretty does not appear to be affected by normal operational use of the railway or the station (Young & Cha, 1995). During the field surveys Little Egrets were observed foraging in the adjacent water courses of the study site and along Tolo Harbour. Similar observations made by local ornithologists monitoring the behaviour of Egrets along the East Rail line south of Tai Po Market indicate that egrets adapt to the presence of trains passing by (Pers. comm., Tucker/Leven). No

adverse impacts are therefore anticipated to the Tai Po Egret by the current road widening project.

8.4.12.2 *Dust*

Dust may be generated by construction activities, particularly the movement of heavy machinery / equipment, during various activities of site clearance / site formation. Such dust may potentially be released as a fugitive emission into the air, or it may loosely settle on the surface of the disturbed ground suitable for transport by surface run-off water.

Fugitive dust emissions are anticipated to be very localised and not significant. However, there are a variety of control measures which may be taken for the control of fugitive dust.

For water quality the potential dispersion of dust / sediment released into any water course is anticipated to be greater than for air quality issues. Run-off may increase the level of turbidity and suspended solids in nearby waters with potential impacts upon aquatic fauna species. However, any such release of sediment into the aquatic ecosystem is unlikely to be significant.

There are various control measures which may be taken to avoid significant adverse impacts. Recommendations are presented in the following section on Impact Mitigation. It is considered that provided these measures are taken there will be no residual impact.

8.4.12.3 *Site run-off and Sewage Effluent*

Considerations for liquid waste and water quality management include the potential for generation of diffuse source surface run-off and sewage effluent. Associated with any run-off / leachate entering the aquatic environment there may be various potential contaminants including sediment, organic, oil, grease and solvents.

Recommendations for control measures are presented in the following section on Impact Mitigation. Provided the recommended control measures are taken there will be no residual impact.

8.5 Impact Mitigation

Table 8.25 (see page 8-31) summarises the ecological impacts within the Study Area along with measures required to mitigate / control them. Specific measures to be implemented within the Study Area to control identified impacts are presented below. Precise details as to the implementation of mitigation measures / good practices is presented in the 'Implementation Schedule' (Section 13).

Full consideration shall be given to impact avoidance and mitigation measures during the detailed design stage of the scheme.

8.5.1 *Delineation of Works Area*

Boundaries of proposed works areas shall be clearly identified and separated from external areas by a physical barrier to prevent encroachment of adjacent habitats. Individual trees which fall within the works areas but which work plans show do not require removal are to be retained and fenced off to maximise protection.

8.5.2 *Check of Hoarding Positioning*

In order to ensure suitable positioning of hoardings to separate the works areas from external areas, a check of hoarding positioning and durability shall be made prior to the start of any works as a checking exercise. This shall follow the plans of the works contractors. Any individual trees as referred to above which need not be included within the works area but which may be adversely affected by the works shall be identified.

A member of the Resident Site Staff shall be available throughout the works to respond to queries of the construction Contractor(s) and shall implement regular site checks to ensure containment of the works within the designated works areas.

8.5.3 *Ecological Compensation Planting*

Although field survey investigations did not identify any individual vegetation species of particular conservation value, the loss of key areas of vegetation as determined by the site investigations is to be compensated by a planting / replanting programme. This ecological compensation will include all areas of terrestrial habitat loss, excluding urbanised / developed areas (approx. 11 hectares) which are affected by site clearance / formation works as identified in Section 8.4. Of this 11 hectares (ha), some 9.75ha is plantation woodland.

The landscape assessment in Section 9 proposes a total of approximately 21 hectares for mitigatory planting. This area includes replanting at those locations which the EIA has identified as being directly affected by the construction works (i.e. ecological compensation for vegetation / habitat loss), and also takes account of planting needs primarily for landscaping purposes (i.e. immediately along the side of the road and along the central reservation). The ecological compensation areas include planting as direct habitat loss as well as the reinstatement of those areas temporarily occupied during the construction works.

Six key areas for ecological compensation planting have been identified, with a cumulative planting area of 5.0 ha. These six areas will generally provide linkage with existing woodland habitats. The locations of the six areas along the highway are indicated by Table 8.24 below, and on Drawings 551/L/5101 to 5109.

Table 8.24 Key Areas for Ecological Compensation Planting

Approximate Chainage	Highway Side	Approximate Planting Area (ha)
700 – 850	South	0.5
1240 – 1850	North	1.6
2050 - 2200	South	0.5
2200 – 2370	South	0.6
2800 – 2920	East	0.6
3600 – 3700	East (at approach road access)	1.2

Recommendations for species composition are provided in Appendix 9.1, although the final species planting schedule shall be subject to review at the Detailed Design stage.

The division of vegetation planting and maintenance responsibilities within Government shall follow the guidelines stipulated in Works Branch Technical Circular (WBTC) 24/94.

Other considerations to avoid / minimise impacts on existing vegetation include defining in advance of the works the precise works area required. This may then be physically demarcated with hoarding to avoid encroachment onto adjacent land. Any areas of mature vegetation which are within the demarcated area but which need not be affected by the works should also be isolated. This is particularly so with regards to tree preservation.

8.5.4 Construction Dust

There are various examples of good practice which can be implemented to avoid / minimise incidences of dust emission related with construction activities. These include:

1. vehicle washing facilities including a high pressure water jet shall be provided at every discernible or designated vehicle exit point;
2. during construction all temporary site access roads shall be sprayed with water to suppress dust as necessary, and all dusty materials should be sprayed with water immediately prior to any handling; and
3. all debris should be covered entirely by impervious sheeting or stored in a sheltered debris collection area.

A full list of appropriate dust control measures can be referred to under Schedule Parts I-IV of the Air Pollution Control (Construction Dust) Regulation on 'Dust Control Requirements'.

8.5.5 Site run-off and Sewage Effluent

The potential for surface run-off can be minimised through the application of good construction practices, such as avoiding complete site clearance to maximise vegetation cover and root penetration which encourage water retention.

In general, construction phase mitigation measures should be in accordance with ProPECC PN1/94 on 'Construction Site Drainage'. These include the use of sediment traps, wheel washing facilities for vehicles leaving the site, adequate maintenance of drainage systems to prevent flooding and overflow, sewage collection and treatment, and comprehensive waste management (collection, handling, transportation, disposal) procedures.

More specific mitigation shall be as follows:

1. all waste / spoil storage areas and material stockpiles shall be bunded with run-off directed towards oil and sediment traps. Similarly, any maintenance of construction plant shall be undertaken within a bunded area;
2. areas of exposed soil and material stockpiles should be covered during the rainy season, or at any time of year when rainstorms are likely;
3. all vegetation within the Site other than the trees for transplanting and felling shall be retained during site formation to maximise ground cover in order to minimise the potential for surface run-off. This particularly includes the areas close to the stream to the south; and
4. the contents of the oil and sediment traps and all sewage wastes arising during construction shall be collected and disposed of off-site in accordance with the requirements of the Waste Disposal Ordinance.

8.6 Residual Impacts

In the long term no residual impacts will arise from the proposed works. The area of replanting as ecological compensation is approximately 5.0 ha compared to 0.04 ha lost.

8.7 Conclusion

The Ecological Assessment has identified adverse ecological impacts which it is known will occur, such as habitat loss / vegetation clearance, and which may potentially generate an adverse impact, i.e. fugitive dust emissions / surface run-off to nearby watercourses.

The extent of habitat loss is summarised in Table 8.12. Most of the habitat affected by the works is plantation woodland which is of low ecological value. Other key areas of habitat loss are natural woodland and fung shui woodland which are of moderate ecological value,

and also grassland which is of low ecological value. None of the habitats affected support any vegetation species of conservation value.

Mitigation measures for habitat loss have been proposed which are considered acceptable and sufficient to compensate any losses. Apart from habitat loss there is the potential for localised impacts upon air quality and water quality from site clearance / site formation which will loosen sediment. This may give rise to fugitive dust emissions and may result in transfer of the soil into nearby water courses as surface run-off. However, there are various 'good practice' guidelines which should be implemented to avoid or control such potential impacts. Provided the recommended measures are taken then no significant adverse ecological impacts are anticipated. For this purpose, it is recommended that these practices form part of the construction contract specifications.

Table 8.25 Summary of Impacts, Mitigation Measures and Residual Impacts within the Study Area

	Area of habitat in Study Area (m ²)	Area of Habitat to be affected i.e., lost or disturbed	% of habitat to be affected i.e., lost or disturbed	Ecological evaluation e.g. high, moderate or low ecological value, with key species associated with the habitat and in turn their conservation value	Impact assessment in absence of mitigation	Mitigation Measures	Potential for mitigation and its extent/ deliverability e.g., on-site, off-site	Significance of Residual Impact High = ●●● Moderate = ●● Low = ● Blank = No residual impact
Active Agricultural	24.5	0.075	0.03	Moderate	●	Minimise the clearance of land required to accommodate the highway widening Fencing boundaries of works areas	Not applicable	Not applicable
Inactive Agricultural	50	0.195	0.09	Moderate	●	Minimise the clearance of land required to accommodate the highway widening Fencing boundaries of works areas	Not applicable	Not applicable
Orchards	4	None	Not applicable	Low	●	Not applicable	Not applicable	Not applicable
Grassland	5.5	0.41	0.91	Low	●	Minimise the clearance of land required to accommodate the highway widening Fencing boundaries of works areas	Not applicable	Not applicable
Natural Woodland	19	0.74	0.34	Moderate	●●	Identification and preservation of mature trees Fencing boundaries of works areas Replanting with native species along the highway corridor.	On site	Not applicable
Plantation Woodland	26	9.75	4.42	Low	●	Fencing boundaries of works areas Replanting with native species	On site	Not applicable
<i>Fung Shui</i> Woodland	7.5	0.04	0.02	Moderate	●●	Minimal clearance of <i>Fung Shui</i> woodland Fencing boundaries of works areas Replanting with native species along the highway corridor.	On site	●
Natural Rivers and Streams	8300m	60m	-	Moderate	●●	Implement good site practices e.g. waste management control, waste water interceptors	On site	Not applicable
Artificial drainage channel	7300m	520m	-	Low	●	Minimal clearance of <i>Fung Shui</i> woodland	On site	Not applicable
Ponds	0.07	None	Not applicable	Moderate	Not applicable	Not applicable	Not applicable	Not applicable
Mangroves	0.05	None	Not applicable	Low	Not applicable	Not applicable	Not applicable	Not applicable
Sea	8.25	None	Not applicable	Moderate	Not applicable	Not applicable	Not applicable	Not applicable

● Low ecological impact ●● Moderate ecological impact

8.8 References

- Bibby, Burgess & Hill, D.A. (1992) *Bird Census Techniques*. Cambridge University Press.
- China Wildlife Conservation Association. 1992. *Atlas of Birds of China*. Henan Science and Technology Publ.
- Goodyer, N.J. (1992) Land Mammals of Hong Kong. *Memoirs of Hong Kong Natural History Society*. No. 19:71-78.
- Hockin, D., Ounsted, M., Gorman, M., Hill, D., Keller, V. & Barker, M.A. (1992) Examination of the Effects of Disturbance on Birds with Reference to its Importance in Ecological Assessments. *Journal of Environmental Management*. **36**:253-286.
- Shea, S.S. (1993) *Determinants of Macro Invertebrate Community Structure on Stone Surfaces in Hong Kong Streams*. Ph.D. Thesis. Department of Zoology, University of Hong Kong.
- Vincy, C, Phillips, K. & Lam, C.Y. (1994) *Birds of Hong Kong and South China*. Hong Kong: Hong Kong Government. 244 pp.
- Young, L & Cha, M.W. (1995) The History and Status of Egrettries in Hong Kong. Hong Kong Bird Report. 1994:196-215.
- Walthew, G. (1997) The Status and Flight Periods of Hong Kong Butterflies. *Porcupine!* No. 16 : 43-37. (Newsletter of the Dept. of Ecol. & Biodiv., University of Hong Kong.).
- Wilson, K.D.P. (1995) An annotated checklist of the Hong Kong dragonflies with recommendations for their conservation. *Memoirs of Hong Kong Natural History Society*. No. 21:1-68.
- WWF (No date a), *Island House Nature Trail*. The Island House Conservation Studies Centre. World Wide Fund for Nature Hong Kong.
- WWF (No date b), *Hong Kong Habitats III Hong Kong Woodlands*. The Island House Conservation Studies Centre. World Wide Fund for Nature Hong Kong.
- WWF (No date c), *Hong Kong Habitats II Hong Kong Mangroves*. The Island House Conservation Studies Centre. World Wide Fund for Nature Hong Kong.