

# Tsuen Wan Kwai Chung Drainage Improvement Ecological Baseline Survey (Draft Report)

## 1 METHODOLOGY

The study area for aquatic and terrestrial ecological baseline survey included all areas within 500m from the Preferred Option of the tunnel alignment, the intake points and the outfall (Figure 1).

### 1.1 Literature review

A literature review of the ecological conditions within the study area was conducted. Relevant ecological studies were reviewed. The review included Government and private sector reports.

### 1.2 Reconnaissance survey

A reconnaissance survey was performed on 20 August 2003 at the outset of the study to identify key areas of interest for field surveys and establish counting points for terrestrial fauna in representative areas of selected habitats. No further faunal survey was arranged in urbanized/disturbed areas due to the disturbed nature and low ecological importance as wildlife habitats. The channel downstream to Intake I-1 was underground structures and thus not included for further field surveys.

### 1.3 Field surveys

#### **1.3.1 Habitats and Vegetation**

Field surveys for habitat and vegetation were performed on 20 August, 29 September, 11 and 25 November 2003 to record ecological data within the Study Area and establish the ecological profile for incorporation into this report.

Habitats were mapped based on 2002 government aerial photos and field ground truthing. Representative areas of each habitat type were surveyed on foot.

Plant species of each terrestrial habitat type encountered and their relative abundance were recorded with special attention to rare or protected species. Nomenclature of plant species follows AFCD (2002) and conservation status follows Xing *et al.* (2000), Siu (2000) and Wu and Lee (2000). Coloured photographs of all habitats (terrestrial, freshwater and intertidal) encountered and of ecological features of special importance were provided.

#### **1.3.2 Dragonflies and Butterflies**

Dragonflies and butterflies of village-orchard, woodland, plantation, stream channel and grassland habitats within the Study Area were surveyed using the point count method (Figure 1). Dragonflies and butterflies within 15 m from the centre of sampling points were identified and counted. Dragonflies and butterflies encountered away from sampling points but within the Study Area were also recorded in order to produce a complete species list. Surveys for dragonflies and butterflies were performed on 29 September, 16 October and 19 November 2003. Nomenclature for butterflies follows Walthew (1997) and dragonfly nomenclature follows Wilson (2003).

#### **1.3.3 Herpetofauna**

Surveys of herpetofauna within the Study Area were conducted through active searching. Surveyed areas included stream channels, village orchards, woodlands and plantation habitats. Surveys for herpetofauna were carried out on 3 September (night survey), 6 October and 11 November 2003. Nomenclature used in this report for reptiles follows Karsen *et al.* (1998) while that for amphibians follows Lau and Dudgeon (1999).

### **1.3.4 Birds**

Bird communities of village-orchard, woodland, plantation, stream channel and grassland habitats within the Study Area were surveyed using the point count method (Figure 1). Ten minutes were spent counting birds at each sampling point. All birds seen or heard within 30 m of sampling points were counted. Signs showing breeding (e.g., nests, recently fledged juveniles) within the study area were also recorded. Bird species encountered away from counting points but within the Study Area were also recorded to produce a complete species list. Bird surveys were carried out on 3 September, 6 October and 11 November 2003. Ornithological nomenclature follows Carey *et al.* (2001).

### **1.3.5 Mammals**

Surveys of mammals were conducted by searching as well as recording all sightings, tracks, and signs of mammals found. Mammal surveys were performed on 3 September (night survey), 6 October and 19 November 2003. Nomenclature for mammals follows Reels (1996) and Wilson and Reeder (1992).

### **1.3.6 Stream Fauna**

Stream fauna surveys (including stream fishes and stream invertebrates) were undertaken on 20 August, 20 October and 19 November 2003. Surveys were conducted throughout the three stream courses passing the three proposed intake point locations, including but not being limited to the 4 pre-determined sampling points around each intake (Fig. 1), by direct observation, active searching and sample collection using hand net. Those techniques were used according to the site environment and the behaviour of the target species. For some sensitive fish species, active sampling was difficult, while direct observation (with or without diving mask) was not suitable at some locations with riffles. All stream fauna species sighted and collected were identified in the field, and their abundance was also noted.

### **1.3.7 Intertidal Fauna**

Intertidal fauna surveys were conducted on 25 September and 20 November 2003. Quadrat samplings on 100m transects were originally proposed to be conducted along the coastline within the Study Area. It, however, was found infeasible after the reconnaissance survey because the majority of the coastline within the Study Area had been occupied by construction sites, most of them were parts of the Castle Peak Road widening project. These construction areas were thus inaccessible. While the coastline also contained vertical seawalls near residential buildings and piers, on which sampling was not able to be conducted.

The original sampling method could not be conducted within the study area and had to be modified. Though the majority of the coastline within the Study Area was highly disturbed, efforts were made to identify locations which are still available for sampling. Two sections of coastline, one just outside the eastern edge of the study area boundary and the other one very close to the western edge of the study area boundary, were identified and sampled instead (Fig. 1).

Intertidal fauna were surveyed by quadrat method at three tidal levels, i.e. low, middle and high. At each tidal level, ten quadrats (25 cm x 25 cm) were placed randomly to assess the abundance and distribution of flora and fauna. All animals found in each quadrat were identified and recorded so that density (individuals per m<sup>2</sup>) could be determined.

## 2 RESULTS

### 2.1 Habitats and Vegetation

#### 2.1.1 Literature review

A review of the results of biodiversity surveys of Hong Kong flora (Xing *et al.* 2000, Siu 2000) revealed that 45 plant species of conservation interest were found in the “Tsuen Wan Area” (Appendix 1a), which refers to areas south of LMP-TMS-Tsuen Kam Pass-Tin Fu Tsai, west of Grassy Hill-Needle Hill-Kowloon Reservoirs, east of Tin Fu Tsai-Sham Tseng, as well as Tai Mo Shan and its summit area (Corlett 2000). A large portion of these areas, including the uphill areas inside Shing Mun and Tai Mo Shan Country Parks, are outside our study area. Forty-three out of the 45 species recorded are rare or very rare orchids which mostly inhabit streamside in forests or in grasslands. None of these species was seen within our study area.

#### 2.1.2 Field survey results

Most of the study area below and immediately above the catchwater running along the southern boundary of Shing Mun Country Park was highly urbanised or degraded by agriculture practice and village housing. Terrestrial habitats found within the study area include woodland, plantation, grassland, village-orchard, stream channel, and disturbed/urbanized (Figure 2 & 3). As the intertidal zone within the study area was artificial or highly disturbed, vegetation recorded along the coastline was included in Urbanised/Disturbed habitat type. A total of 240 plant species were recorded, about 30% of which are exotics (Appendix 1b). One locally protected orchid, *Arundina graminifolia* was recorded within the study area. No other plant species of conservation interest was recorded. **Table 1** lists the number of plant species recorded in each terrestrial habitat type.

**Table 1. Habitat types recorded within the study area**

Habitat type	Size (ha/km)	No. of plant species recorded
Woodland	79.1 ha	95
Plantation	181.2 ha	114
Grassland	89.4 ha	46
Village-Orchard	40.5 ha	77
Stream/Channel	7.54 ha(ca. 5km)	73
Urbanised/Disturbed	165.4 ha	45
Intertidal	1 km	\*

\* Plant species recorded along the coastline was included in Urbanised/Disturbed.

#### Woodland

About 14% of the study area was woodland, which scattered on hillsides and along stream ravines and catchwater within the study area. The woodland habitats were young to moderate in age with a rather open canopy of height ranging from 6 to 12 m. The woodlands were composed of a mixture of early successional native plant species and exotic plant species including *Macaranga tanarius*, *Rhus hypoleuca*, *Schefflera heptaphylla*, and *Acacia confusa*. Understorey species consisted of a variety of tree, shrub and herb species, including *Cratogeomys cochinchinensis*, *Miscanthus sinensis*, *Mikania micrantha*, and *Dicranopteris linearis*. The secondary woodland habitats within the study area had moderate species diversity with 95 plant species recorded. No rare/protected species were found in this habitat.

#### Plantation

Plantations formed one third of the study area. They were found along highways and roads as well as natural hillsides and engineering slopes. The cascade and the spiral access ramp of the Outfall 0-1 and most of the Intake I-1 and I-3 were located on this habitat type. Most of the trees ranged between 10-15m in height. Species commonly planted were exotics or naturalized trees, including *Acacia confusa*, *Lophostemon conferta*, *Eucalyptus robusta*, *Acacia auriculiformis* and *Leucaena leucocephala*. Little understorey was developed inside plantations on the engineering slopes, most of which were densely planted as monotypic stands and/or under active management such as weeding and pruning. Plantation on natural hillside had more established understorey comprising densely grown grasses,

herbs, shrubs, and climbers. These included *Microstegium ciliatum*, *Alocasia macrorrhiza*, *Mikania micrantha*, and *Musa paradisiaca*. 114 plant species were recorded. No rare/protected species were found in this habitat type.

#### Grassland

The grassland habitat within the study area has low species diversity and simple structure. A total of 46 plant species were recorded in these habitats. Patchy grasslands were found on hydroseeded areas and hillsides with graves. Grassland on natural terrain was of low vegetation height (mostly less than 1.5m) and dominated by a mixture of native ferns and grasses as well as weedy species. Species commonly seen included *Dicranopteris linearis*, *Microstegium ciliatum*, *Neyraudia reynaudiana*, *Cratogeomys cochinchinensis* and *Rhodomyrtus tomentosa*. The hydroseeded areas had even lower plant diversity and vegetation height.

#### Village-Orchard

This habitat type scattered within the study area. Plant species recorded were mostly village associated trees and orchard trees. Species commonly found included *Dimocarpus longan*, *Musa paradisiaca*, *Litchi chinensis*, *Acacia confusa* and *Macaranga tanarius*. Grasses, herbs and weeds (e.g. *Mikania micrantha*, *Bidens pilosa*, *Eupatorium catarium*, *Ipomoea cairica* and *Microstegium ciliatum*) colonised abandoned orchards and village areas. Seventy-seven species were recorded in this habitat type. The village-orchard mixed habitat within the study area represents man-made habitat and is of little floristic importance. The vehicular access road and personnel access shaft of Intake I-2 lies on this habitat.

#### Stream/Channel

There is approximately a total of 5 km major watercourses within the Study Area. Some watercourses within the Study Area were artificial, such as the catchwater channel running along the southern boundary of Shing Mun Country Park which was a concrete channel.

Most other watercourses within the Study Area were basically natural but at least partially channelled, especially at the lower reaches. The streambeds as well as most of the upper reaches were still in natural conditions, especially above the catchwater

A total of 73 plant species were recorded along stream channels within the study area. Riparian plant species commonly found included *Cleistocalyx operculata*. The tree canopies and/or disturbed streamside were also grown with the climbers including *Mikania micrantha* and *Buettneria aspera*. Other species included *Ilex rotunda*, *Ficus hispida*, *Floscopa scandens*, *Microstegium ciliatum*, *Cyperus* spp. and *Acorus gramineus*.

Due to the nature of the proposed project, three major watercourses, in which intake points for the drainage tunnel are planned to install, were especially concerned.

The first one was an artificial concrete drainage channel containing the Intake I-1 (hereafter referred to as Intake I-1 channel). Most parts of this channel were underground, with an exposed S-shaped section extending from the Shing Mun Tunnel Toll Plaza to Wo Yip Hop Road. The proposed Intake I-1 was located at the downstream end of the open section. There is no riparian vegetation along the full length of the banks of this channel.

The second one is Sam Dip Tam Stream in which the proposed Intake I-2 was located. It originated at the hillsides inside Shing Mun Country Park (the southern slope of Tai Mo Shan), and crossed the catchwater channel on the country park boundary. This stream remained clean and natural until near Lo Wai Road. Though remaining natural, the upper section of Sam Dip Tam Stream was covered by large-sized boulders. Their movement during heavy rainfall has frequently disturbed the streambed and stream banks, and this section of the stream course had little riparian vegetation.

Pollution inputs from residential buildings, restaurants and small-scaled industries were found just upstream to Lo Wai Road and also around the proposed intake located at Sam Dip Tam just downstream to Lo Wai Road, i.e. Intake I-2. The crossing of Sam Dip Tam Stream at Lo Wai Road was

channelled. This stream turned into underground channel near Cheung Pei Shan Road a few hundred metres downstream.

The third one is Tso Kung Tam Stream in which the planned Intake I-3 was contained. This stream had two major tributaries. Lying below Tsuen Lung, close to Route Twisk and just between Tai Mo Shan Country Park and Tai Lam Country Park, the two tributaries joined together near Tso Kung Tam Outdoor Recreation Centre. Pollution inputs from nearby village houses and construction sites were found just upstream to the proposed location for Intake I-3. These watercourses, the two tributaries and the main stream, were natural with abundant riparian vegetation until the main stream reached a nursery garden opposite to Tsuen Wan Centre – a residential estate, where the stream turned into open concrete channel. The open concrete section then became underground a few hundred metres downstream when it hit Discovery Park - another residential estate.

For both Sam Dip Tam Stream and Tso Kung Tam Stream, despite the presence of village housing as well as old and current agricultural practices along the streams, stream sections above and immediately below Intake I-2 and I-3 were still in fairly natural conditions with bouldery stream banks and streambeds. Village-orchard or urbanised/disturbed habitats occupied the stream banks downstream to the proposed intake locations, and finally the lower-reach areas of both streams were turned into underground drainage channels.

### Urbanised/Disturbed

This habitat type consists mainly of urban areas, roads, construction sites and wastelands. The Outfall O-1 was located at an urbanised and disturbed coastline immediately below Castle Peak Road. A total of 45 plant species were recorded within the study area, over 70% of which was planted for landscaping purposes or exotic weed species. Species recorded include roadside trees such as *Melaleuca quinquenervia*, *Delonix regia*, *Acacia confusa* and weeds such as *Mikania micrantha* and *Bidens pilosa*. This habitat was highly disturbed and was of little ecological interest. The only protected orchid species recorded in this study, *Arundina graminifolia*, was found on an engineering slope near the catchwater. It is a terrestrial herb commonly found at grassland and streamside in Hong Kong (Siu 2000).

### Intertidal

Due to its disturbed nature, intertidal habitat within the study area was included as part of the Urbanised/Disturbed habitat type in the habitat map (Fig. 2a & 2b). The extent of the coastline within the Study Area was approximately 1000m in length. Almost the full length of this coastline, except its very western end, was either converted to artificial seawalls, including boulder seawalls and vertical seawalls, or severely disturbed by recently deployed rocks which were used to reinforce the waterfront of the works areas for the road widening project (Fig. 4). The Castle Peak Road Widening project had been being implemented along the section of Castle Peak Road between Ting Kau and Tsuen Wan. Its alignment was very close to, or just adjacent to, the waterfront, and its works areas almost covered the whole coastline within the study area except two residential buildings.

## **2.2 Dragonflies and Butterflies**

### **2.1.1 Literature review**

Five species of dragonflies were reported near our Study Area in Shing Mun (App. 2) (Wilson 1997). Uncommon species included Chinese Mountain Damsel *Calicnemia sinensis* and Yellow-spotted Shadowdamsel *Sinosticta ogatai* (Wilson 2003). Yellow-spotted Shadowdamsel is considered of global concern while Chinese Mountain Damsel of local concern (Fellowes *et al.* 2002). Both Chinese Mountain Damsel and Yellow-spotted Shadowdamsel are inhabitants of forest streams (Wilson 2003).

### **2.2.2 Field survey results**

A total of 17 species of dragonflies were recorded in sampling points in the Study Area (App. 3a). All are abundant or common in Hong Kong (e.g., Chinese Greenwing *Neurobasis chinensis*, Crimson Dropwing *Trithemis aurora*, Indigo Dropwing *T. festiva*) (Wilson 2003). Both abundance and species richness of dragonflies were highest in stream/channel and lowest in grassland in the Study Area (Table 2).

**Table 2. Dragonfly communities at each type of habitat in the Study Area**

	Grassland	Village-Orchard	Stream/channel	Woodland	Plantation
<b>Density (dragonflies ha<sup>-1</sup>)</b>	0.0	11.0	41.0	2.4	14.0
<b>Species richness (No. of species survey point<sup>-1</sup>)</b>	0.0	0.6	2.3	0.2	1.0

No dragonfly was recorded in the disturbed coastal habitat around Outfall O-1.

Only 3 species of dragonflies were recorded in the drainage channel near Intake I-1 (App. 3b). Abundance and species richness of dragonflies were higher in the upstream section than around Intake I-1 (Table 3).

Species richness of dragonflies was similar among downstream and upstream sampling locations of Intake I-2, but abundance at sampling locations upstream to Intake I-2 was lower than those at Intake I-2 and downstream to Intake I-2. Some species recorded at downstream only, including Common Blue Skimmer *Orthetrum glaucum* and Crimson Dropwing, while some other species found only at upstream such as Asian Amberwing *Brachythemis contaminata* and Indigo Dropwing.

At the stream containing Intake I-3, dragonfly abundance declined toward upstream. Species richness was also higher at downstream section of Intake I-3, and species found in downstream of Intake I-3 covered those found in upstream, e.g. Chinese Greenwing and Red-faced Skimmer.

As all dragonfly species recorded in these streams are common and widespread in Hong Kong, not restricted to upstream or downstream sections (Wilson 2003), the differences in dragonfly species composition recorded between upstream and downstream sections at I-2 and I-3 were probably caused by chance only.

**Table 3: Dragonfly communities at intake locations in the Study Area**

Locations*	Intake I-1		Intake I-2			Intake I-3		
	I	U	D	I	U	D	I	U
<b>Density (dragonflies ha<sup>-1</sup>)</b>	14.0	28.0	42.0	42.0	35.5	46.0	42.0	38.0
<b>Species richness (No. of species survey point<sup>-1</sup>)</b>	1.0	2.0	2.5	2.0	2.0	3.3	2.0	2.0

\* U = upstream section; I = Intake point; D = Downstream section.

A total of 19 species of butterfly were recorded in the Study Area (App. 4). All are common or very common in Hong Kong (e.g., Red Helen *Papilio helenus*, Common Mormon *P. polytes*) (Walthew 1997). One additional species, Red Admiral *Vanessa indica*, was recorded in grassland along the Tai Lam catchwater (Figure 2). This species is uncommon in Hong Kong (Walthew 1997). Habitats of Red Admiral include barren hilltops and cultivated lands (Bascombe *et al.* 1999). Abundance of butterfly was highest in plantation, and lowest in grassland (Table 4). Species richness was highest in stream/channel and lowest in grassland.

**Table 4: Butterfly communities at each type of habitat in the Study Area**

	Grassland	Village-Orchard	Stream/channel	Woodland	Plantation
<b>Density (butterflies ha<sup>-1</sup>)</b>	7.1	20.0	23.0	17.0	33.0
<b>Species richness (No. of species survey point<sup>-1</sup>)</b>	0.3	1.0	1.6	0.5	1.3

Species richness of butterfly was low at most of the sampling locations at the streams/channel to be affected by the construction work of the intakes (Table 5) (App. 4b). Both abundance and species richness of butterfly were similar at Intake I-1 and the upstream channel section. For the stream at Intake I-2 (Sam Dip Tam Stream), abundance of butterfly was lowest around Intake I-2. For stream at

Intake I-3 (Tso Kung Tam Stream), both butterfly abundance and species richness were highest around the proposed location of Intake I-3.

**Table 5: Butterfly communities at intake locations in the Study Area**

Locations	Intake I-1		Intake I-2			Intake I-3		
	I	U	D	I	U	D	I	U
<b>Density (butterflies ha<sup>-1</sup>)</b>	14.0	14.0	21.0	14.0	28.0	28.0	42.0	14.0
<b>Species richness (No. of species survey point<sup>-1</sup>)</b>	1.0	1.0	1.5	1.0	2.0	2.0	3.0	1.0

\* U = upstream section; I = Intake point; D = Downstream section.

## 2.3 Herpetofauna

### 2.3.1 Literature review

Seven species of amphibians were recorded in and near the Study Area by Lau and Dudgeon (1999). These were Asian Common Toad *Bufo melanostictus*, Gunther's Frog *Rana guentheri*, Paddy Frog *Rana limnocharis*, Brown Tree Frog *Polypedates megacephalus*, Spotted Narrow-mouthed Frog *Kalophrynus interlineatus*, Butler's Pigmy Frog *Microhyla butleri* and Marbled Pigmy Frog *Microhyla pulchra*. All are common in Hong Kong (Lau and Dudgeon 1999).

Asian Common Toad is ubiquitous in Hong Kong (Lau and Dudgeon 1999). Gunther's Frog and Paddy Frog are common in lowland areas in Hong Kong (*ibid.*). Spotted Narrow-mouthed Frog is found in cultivated lands (Karsen *et al.* 1998). The habit of Butler's Pigmy Frog is poorly known, but this species seems to occur in many types of habitats (*ibid.*). Marbled Pigmy Frog is widely distributed in the New Territories (*ibid.*). Brown Tree Frog is found in many places, from sea level to the summit of Tai Mo Shan (*ibid.*).

Reptile species recorded near the Study Area included Chinese Pond Terrapin *Mauremys mutica*, Five-striped Blue-tailed Skink *Eumeces elegans*, Slender Forest Skink *Scincella modesta*, Brown Forest Skink *Sphenomorphus indicus* and Bicoloured Stream Snake *Opisthotropis lateralis*.

Chinese Pond Terrapin is regarded as introduced, as indirect results of pet and traditional medicine trades (Karsen *et al.* 1998). Specimens of this species were found in a few localities (e.g., Cheung Chau, Tai Tam Reservoir). All terrapins are protected under WAPO in Hong Kong. Slender Forest Skink is only known from a few places in the New Territories, e.g., Tai Mo Shan, Tai Long Wan (Karsen *et al.* 1998). This species usually occurs in mountainous broad-leaf forest. Brown Forest Skink is widely found in many places in the New Territories, and common in Shing Mun Reservoir and Tai Po Kau Nature Reserve (*ibid.*). This species inhabits secondary forest and riparian woodland (*ibid.*), and is considered of local concern (Fellowes *et al.* 2002). Five-striped Blue-tailed Skink occurs in forests and mountainous grassland, and is fairly common in some localities in the New Territories (Karsen *et al.* 1998). Bicoloured Stream Snake is locally common and widely distributed in the New Territories (*ibid.*). This species inhabits slow-flow forest stream (*ibid.*).

### 2.3.2 Field survey results

Hong Kong Newt *Paramesotriton hongkongensis*, Asian Common Toad *Bufo melanostictus*, Gunther's Frog *Rana guentheri* and Hong Kong Cascade Frogs *Amolops hongkongensis* were recorded in the Study Area in September and October 2003.

A single Hong Kong Newt was sighted at Sam Dip Tam Stream upstream to Intake I-2 near the Yuen Yuen Taoist Temple (Figure 2d). This species occurs in clear mountainous streams with rock pools up to 2 m deep, is widely distributed in the New Territories but more localized on Lantau and Hong Kong Islands, (Lau and Dudgeon 1999). Hong Kong Newt is only known from Hong Kong and coastal Guangdong Province (Karsen *et al.* 1998), and is protected under WAPO in Hong Kong and considered of potential global concern (Fellowes *et al.* 2002).

Asian Common Toads and Gunther's Frogs were found in streams around Tso Kung Tam. Gunther's Frogs were also found in small streams flowing into the catchwater alongside Shing Mun Country Park boundary. Gunther's Frog is common in lowland areas, while Asian Common Toad is ubiquitous in Hong Kong (Lau and Dudgeon 1999) (*ibid.*).

Hong Kong Cascade Frogs were recorded in fast flowing streams in the catchwater near Shing Mun Reservoir in September and October 2003 (Figure 2d). This species was first discovered in Tai Mo Shan in 1951 (Pope and Romer 1951 in Lau and Dudgeon 1999). Hong Kong Cascade Frog was once considered endemic to Hong Kong, but was found in Southern Guangdong recently (Lau 1997). This species is found in many localities in the New Territories and Hong Kong Island (Lau and Dudgeon 1999). Hong Kong Cascade Frog lives in swift-flowing hill and mountain streams, particularly those with cascading water (Karsen *et al.* 1998). This species is protected under WAPO in Hong Kong and considered of potential global concern (Fellowes *et al.* 2002).

Common Rat Snake *Ptyas mucosus*, Changeable Lizard *Calotes versicolor*, Long-tailed Skink *Mabuya longicaudata*, Brown Forest Skink, Five-striped Blue-tailed Skink, Reeves' Smooth Skink *Scincella reevesii* and Red-necked Keelback *Rhabdophis subminiatus* were recorded in the Study Area.

Common Rat Snake was recorded near Intake I-2 (Figure 2d). This species is listed in Appendix 2 of CITES (Zhao 1998) and considered of potential regional concern. Common Rat Snake is common in Hong Kong, and is found in many types of habitats, including cultivation, shrubland, ponds and reservoir (Karsen *et al.* 1998).

Changeable Lizard, Long-tailed Skink, Brown Forest Skink, Five-striped Blue-tailed Skink, Reeves' Smooth Skink and Red-necked Keelback were recorded in plantation along the Shing Mun catchwater. Changeable Lizard is commonly found in shrubland and edge of cultivated lands, but rare in forest (Karsen *et al.* 1998). Long-tailed Skink is found in many locations in Hong Kong, but more common in grassland and shrubland (*ibid.*). Brown Forest Skink is widely found in many places in the New Territories, and common in Shing Mun Reservoir and Tai Po Kau Nature Reserve (*ibid.*). Five-striped Blue-tailed Skink is found in forest and edge of forest (*ibid.*). Reeves' Smooth Skink occurs in many types of habitats, including cultivated lands, shrubland and urban parks (*ibid.*). Red-necked Keelback is common in forested or shrubby hillsides (*ibid.*).

## 2.4 Birds

### 2.4.1 Literature review

A total of 53 species of bird, of which 11 species with breeding signs, were recorded in and near the Study Area between 1993 and 1998 by local birdwatchers (Carey *et al.* 1995, 1996, 1998, 1999, 2001) (App. 5). Species of conservation interest included Striated Heron *Butorides striatus*, Black Kite *Milvus lineatus*, Crested Serpent Eagle *Spilornis cheela*, Crested Goshawk *Accipiter trivirgatus*, Greater Coucal *Centropus sinensis*, Lesser Coucal *C. bengalensis*, White-throated Kingfisher *Halcyon smyrnensis* and Black-capped Kingfisher *H. pileata* and Hwamei *Garrulax canorus*. Among them, breeding signs were recorded on Greater Coucal, Lesser Coucal and Hwamei (Carey *et al.* 2001).

Black Kite is considered of potential regional concern (Fellowes *et al.* 2002). Crested Serpent Eagle, Striated Heron, Black-capped Kingfisher and White-throated Kingfisher are considered of local concern (*ibid.*). Crested Serpent Eagle, Black Kite and Crested Goshawk are listed in Appendix 2 of CITES and Class 2 Protected Animals of PRC (Zheng and Wang 1998). Greater Coucal and Lesser Coucal are Class 2 Protected Animals of PRC, while Hwamei is listed in Appendix 2 of CITES (*ibid.*).

Striated Herons are found in coastal mangroves from many locations, but winter records mainly come from wooded streams (Carey *et al.* 2001). Black Kite is found in many types of habitats throughout Hong Kong (*ibid.*). Crested Serpent Eagle and Crested Goshawk are usually recorded in well-wooded areas (*ibid.*). Greater Coucal and Lesser Coucal are common residents. Greater Coucal inhabits a wide range of habitats, while Lesser Coucal mainly in grassy and shrubby hillsides (*ibid.*). Black-capped Kingfisher is common resident, mainly found in coastal areas (*ibid.*). White-throated



Kingfisher is common wetland birds in Hong Kong, and is found in widespread locations (*ibid.*). Hwamei is mainly a shrubland species, and is common and widespread in Hong Kong (*ibid.*).

The Banded-bellied Crake *Porzana paykullii* located near the Shing Mun Tunnel at Wo Yi Hop Road in 1996 was a road-kill, and was the second record of this species in Hong Kong. This species is a vagrant to Hong Kong (Carey *et al.* 2001).

A Slaty-backed Forktail *Enicurus schistaceus* was recorded in the stream near the monasteries at Lo Wai in August 1993 and November-December 1994 (Carey *et al.* 2001). Due to the condition of its feather, the bird was considered an escaped. Slaty-backed Forktail is an occasional visitor, and recorded from a few sites in Hong Kong (e.g., Tai Po Kau) (*ibid.*). This species is commonly found in streams and rivers in South China (Fellowes and Hau 1997, Lewthwaite 1997, MacKinnon and Phillipps 2000).

#### 2.4.2 Field survey results

A total of 21 species of bird were recorded in and near the Study Area during the field surveys (App. 6). Eight additional species were recorded outside sampling points but within the Study Area (App. 7). Bird abundance was highest in woodland, and lowest in grassland (Table 6). Species richness was highest in woodland and stream/channel, and lowest in grassland.

Recently fledged Red-whiskered Bulbul *Pycnonotus jocosus* and Chinese Bulbul *P. sinensis* were observed in woodland and plantation along the catchwaters near Shing Mun Country Park and Tai Lam Country Park in August 2003. White-backed Munia *Lonchura striata* were observed carrying nesting materials in plantation around the catchwater near Shing Mun Country Park. All these species are common and widespread in Hong Kong (Carey *et al.* 2001).

**Table 6: Bird communities at each habitat in the Study Area**

	Grassland	Village-Orchard	Stream/channel	Woodland	Plantation
<b>Density (Birds ha<sup>-1</sup>)</b>	0.6	2.8	5.5	10.2	5.9
<b>Species richness (No. of species survey point<sup>-1</sup>)</b>	0.5	1.3	3.0	3.0	2.8

Species of conservation interest included Striated Heron *Butorides striatus*, Chinese Pond Heron *Ardeola bacchus*, Little Egret *Egretta garzetta*, Black Kite *Milvus lineatus*, Common Buzzard *Buteo buteo*, White-throated Kingfisher *Halcyon smyrnensis*, Emerald Dove and Plumbeous Redstart *Rhyacornis fuliginosus* (Fellowes *et al.* 2002). Locations of sightings of these species were shown on Figure 2.

Striated Heron, White-throated Kingfisher and Plumbeous Redstart are considered of local concern, while Little Egret, Chinese Pond Heron and Black Kite of potential regional concern (Fellowes *et al.* 2002). Black Kite and Common Buzzard are Class 2 Protected Animals of PRC, and are listed in Appendix 2 of CITES (Zheng and Wang 1998). Striated Herons are found in coastal mangroves from many locations, but winter records of this species mainly come from wooded streams (Carey *et al.* 2001). White-throated Kingfisher, Little Egret and Chinese Pond Heron are commonly found in wetland habitats throughout Hong Kong. Black Kite can be found in many types of habitats (*ibid.*). Emerald Dove is uncommon/rare resident in Hong Kong, and is mainly found in well-wooded area (*ibid.*). Plumbeous Redstart is a rare winter visitor in Hong Kong, and occurs in rocky streams (*ibid.*). Common Buzzard occurs in widespread locations throughout Hong Kong and uses a wide variety of open habitats in both rural and urban areas (*ibid.*).

Bird species, which are more stream-dependent and have stream-related distribution pattern, recorded in the whole Study Area included Grey Wagtail *Motacilla cinerea*, Violet Whistling Thrush *Myiophonus caeruleus* and Plumbeous Redstart (Carey *et al.* 2001). Grey Wagtail and Violet Whistling Thrush are common and widespread in Hong Kong (*ibid.*). Plumbeous Redstart is recorded from a few localities in Hong Kong, e.g., Shing Mun Reservoir, Nam Chung (*ibid.*). However, this

species is common in South China (Fellowes and Hau 1997, Lewthwaite 1997, MacKinnon and Phillipps 2000).

Bird species recorded at the channel of Intakes I-1 and the stream of and I-2 were common and widespread in Hong Kong, and of low conservation interest (App. 8). Stream dependent species recorded from stream of Intake I-2 were Violet Whistling Thrush and Grey Wagtail and these two species were recorded in the Intake I-2 and downstream to Intake I-2 respectively.

No bird species was recorded in the proposed intake location I-3. Bird abundance at downstream was higher than I-3 upstream. In Tso Kung Tam Stream, stream-dependent bird species, Grey Wagtail, Plumbeous Redstart and Violet Whistling Thrush, were only found downstream to Intake I-3.

Grey Wagtail, Plumbeous Redstart and Violet Whistling Thrush are not restricted to lower course of streams (MacKinnon and Phillipps 2000 Carey *et al.* 2001). The occurrence of these three species in downstream of I-2 and I-3 was probably only by chance, but not related to environmental factors.

**Table 7: Bird communities at each habitat in the Study Area**

Locations	Intake I-1		Intake I-2			Intake I-3		
	I	U	D	I	U	D	I	U
Density (birds ha <sup>-1</sup> )	5.9	4.7	7.8	11.8	3.6	9.7	0.0	1.2
Species richness (No. of species survey point <sup>-1</sup> )	4.0	2.0	4.0	5.0	2.0	4.8	0.0	1.0

\* U = upstream section; I = Intake point; D = Downstream section.

## 2.5 Mammals

### 2.5.1 Literature review

Ten species of non-flying mammals were recorded in Tai Mo Shan and Shing Mun Country Parks using auto-trigger cameras between November 2001 and March 2002 by The Wildlife Conservation Foundation Hong Kong (Pei *et al.* 2002) (Table 8). All except Wild Boar *Sus scrofa* are protected under WAPO. The relative abundance of these species was also ranked based on the Occurrence Index (number of photographs taken per 1,000 camera working hours).

There was a record of Small Indian Civet in a catchment near the Yuen Yuen Taoist Temple in October 2002 (Anon. 2002). The survey of non-flying mammals in Tai Mo Shan Country Park using auto-trigger cameras did not record any Javan Mongoose *Herpestes javanicus*. However, there were a number of sightings of this species in Tai Mo Shan Country Park (e.g., Anon. 2001, 2002, 2003). The range of Javan Mongoose in Hong Kong has expanded from Mai Po where it was first reported in May 1990 (Goodyer 1992) to many areas of North West New Territories (Reels 1996, Corlett 2001). Based upon the rapid expansion of the range of Javan Mongoose in Hong Kong, the possibility has been raised that the species is introduced to Hong Kong (Corlett 2001). Javan Mongoose is considered of local concern (Fellowes *et al.* 2002). Pallas Squirrel was not recorded in Shing Mun Country Park in the survey using auto-trigger cameras, but this species has been observed in this area (Kwok, pers. obs.). No bat roost was reported within the Study Area (Ades 1999, Lin 2001).

Small Indian Civet and Rhesus Macaque are Class 2 Protected Animals of PRC (Wang 1998). Leopard Cat and Rhesus Macaque are listed in Appendix 2 of CITES (*ibid.*). Chinese Porcupine and Indian Muntjac are considered of potential global concern, Chinese Ferret Badger, Javan Mongoose and Small Indian Civet of local concern, and Masked Palm Civet of regional concern (Fellowes *et al.* 2002).

**Table 8. Non-flying mammals recorded in Tai Mo Shan (TMS) and Shing Mun (SM) Country Parks (Pei *et al.* 2002)**

Common names	Latin names	Occurrence Index	
		TMS	SM
Pallas Squirrel	<i>Callosciurus erythraeus</i>	Abundant	-
Chinese Porcupine	<i>Hystrix brachyura</i>	Medium	Low

Rhesus Macaque	<i>Macaca mulatta</i>	-	Low
Chinese Ferret Badger	<i>Melogale moschata</i>	Low	Low
Javan Mongoose	<i>Herpestes javanicus</i>	-	Abundant
Small Indian Civet	<i>Viverricula indica</i>	Medium	Medium
Masked Palm Civet	<i>Paguma larvata</i>	Low	Low
Leopard Cat	<i>Prionailurus bengalensis</i>	Medium	Medium
Indian Muntjac	<i>Muntiacus muntjak</i>	Very high	Medium
Wild Boar	<i>Sus scrofa</i>	Low	Medium

All except Wild Boar are protected under WAPO in Hong Kong. Small Indian Civet is Class 2 Protected Animals of PRC and listed in Appendix C3 of CITES, while Leopard Cat is listed in Appendix C2 of CITES (Wang 1998). These two species are primarily inhabitants of forest (Sheng *et al.* 1999, Ades *et al.* 2002).

### 2.5.2 Field survey results

Five species of mammals were recorded in forests and plantation within the Study Area. These were the Japanese Pipistrelle *Pipistrellus abramus*, Rhesus Macaque *Macaca mulatta*, Woodland Shrew *Crocidura attenuata*, Pallas Squirrel *Callosciurus erythraeus styani* and Wild Boar.

Japanese Pipistrelle, Pallas Squirrel, Rhesus Macaque and Woodland Shrew were all recorded in habitats along the Shing Mun catchwater. Pallas Squirrel and Woodland Shrew were recorded in plantation, Rhesus Macaque in woodland and Japanese Pipistrelles in plantation and grassland. Pallas Squirrels in Hong Kong are introduced and have established a breeding population (Ades *et al.* 2002). Shing Mun Reservoir is one the main ranges of Rhesus Macaques in Hong Kong (Fellowes 1992). Woodland Shrew is fairly abundant hillsides with shrub and forest (Dudgeon and Corlett 1994). Japanese Pipistrelle, Rhesus Macaque and Pallas Squirrel are protected under WAPO in Hong Kong. Rhesus Macaque is Class 2 Protected Animals of PRC (Wang 1998). Locations of sightings of these species are shown on Figure 2. The digging signs of Wild Boar were sighted in village and orchard near the Shing Mun catchwater. Wild Boar is widespread in Hong Kong (Pei *et al.* 2002). Rhesus Macaque, Woodland Shrew and Pallas Squirrel are inhabitants of woodland. Japanese Pipistrelle can be found in many types of habitats, and may roost in residential (Ades 1999). Wild Boar can be found in shrubland and woodland.

## 2.6 Stream Fauna

### 2.6.1 Literature review

12 species of stream fishes including both native and exotic were recorded in the areas inside and around Tsuen Wan region (Lam 2002). These species included *Parazacco spilurus*, *Zacco platypus*, *Liniparhomaloptera disparis*, *Pseudogastromyzon myersi*, *Schistura fasciolata*, *Silurus cochinchinensis*, *Poecilia reticulata*, *Xiphophorus variatus*, *Oreochromis mossambicus*, *Rhinogobius duospilus*, *Rhinogobius giurinus*, and *Channa maculata*. Among them, except *Pseudogastromyzon myersi*, *Xiphophorus variatus* and *Channa maculata* which are described as occurring in certain local streams, reservoir catchments or estuaries, others are widespread in local water bodies.

### 2.6.2 Field survey results

Aquatic fauna surveys were concentrated on the three stream courses passing the three proposed intake point locations, including but not being limited to the 4 pre-determined sampling points around each intake (Fig. 1). Results of stream fauna surveys are shown in the following 6 tables (Table 9 – 14).

No aquatic fauna was found at all four sampling points in the Intake I-1 Channel. Due to the smooth channel bed and the lack of pools along the channel, it was difficult for aquatic flora and fauna to colonize the drainage channel.

The majority of the upstream section of Sam Dip Tam Stream was fully covered by large-sized boulders, had minimal surface flow and contained a limited number of rock pools until its last 100m length where the surface flow re-appeared and was receiving pollution inputs.

Inside this section of stream, however, aquatic fauna were still fairly diverse and 10 species of fishes and 5 species of invertebrates were recorded (Table 9). Eight out of the ten recorded fish species are considered widespread in local waterbodies (Lam 2002). Sucker-belly loach *Pseudogastromyzon myersi*, though not considered as widespread, still occurs in certain local waterbodies (*ibid.*). Small snakehead *Channa asiatica*, which was found at the end of the upstream section (near Yuen Yuen Hok Yuen), is the only less widespread fish species recorded.

The upstream section of Sam Dip Tam Stream also contained 5 species of aquatic invertebrates, the most diverse location among the present survey. Freshwater crab *Cryptopotamon anacoluthon* was found only at the section upstream to Intake I-2 at Sam Dip Tam in this survey. All the three species of freshwater crabs found in Hong Kong are endemic species. Among them, *Cryptopotamon anacoluthon* is the commonest one, and usually in a higher abundance when compared with the other two species of freshwater crabs. Even though relatively common and widespread in Hong Kong, *Cryptopotamon anacoluthon* is still considered of potential global concern by some local ecologists (Fellowes *et al.* 2001).

The proposed Intake I-2 was located at a large pool just downstream to the current crossing of Sam Dip Tam Stream with Lo Wai Road. Residential sewage inputs were found. 10 species of freshwater fishes were found here. Except *Gambusia affinis*, *Xiphophorus alvarezi* and *Xiphophorus variatus*, the other seven fish species could also be found at the upstream section. No aquatic invertebrates were found here.

No aquatic invertebrates and only 5 species of freshwater fishes were recorded at the downstream section of Sam Dip Tam Stream.

The upstream section at Tso Kung Tam Stream consisted of two major tributaries which joined into a main stream course and form a Y-shaped pattern. It was found that there was no obvious difference between the aquatic communities in the two tributaries and therefore the results were combined in Table 12. Eleven species of fishes were recorded here. The species composition was similar with those in the upstream section of Sam Dip Tam Stream and near Intake-2. All fish species in this section could be found at Sam Dip Tam Stream. Abundant freshwater snails

*Hippeutis cantonensis* which is common near agricultural fields, as well as *Brotia hainanensis* which is usually found in streams in good conditions, were found in this section of stream (Table 12).

Among the 11 species of fish recorded (Table 13), Tso Kung Tam Stream near Intake I-3 contained one fish species not recorded in Sam Dip Tam Stream, i.e. *Nicholsicypris normalis*. This fish is also considered occurring in certain local water bodies (Lam 2002).

AT the section of Tso Kung Tam Stream downstream to Intake I-3, 5 species of fishes and two species of crustaceans were recorded (Table 14). Different from Sam Dip Tam Stream, two kinds of shrimps, i.e. Atyid shrimp *Caridina cantonensis* and Long-armed shrimp *Macrobrachium* sp. were recorded at all three sections of Tso Kung Tam Stream, while at Sam Dip Tam Stream only found at the upstream section. Both shrimps are common and widespread in Hong Kong. The first two pereopods (walking legs) of atyid shrimp are chelate and are characterized by well-developed tufts of setae for the collection of food. In Hong Kong, there are four species of this genus reported, namely, *Caridina cantonensis*, *C. apodosis*, *Caridina trifasciata* and *C. serrata* (Yam 2003). They are detritivores feeding mainly on leaf litter from riparian vegetation. Members of this genus are usually found in mountain streams with clean water. In the present survey, *Caridina cantonensis* were found in the upper course of both Tso Kung Tam and Sam Dip Tam. Density of the shrimp might reach over 200 individual/m<sup>2</sup> at Sam Dip Tam. Long-armed shrimp *Macrobrachium* sp. (Family Palaemonidae) is commonly found in streams throughout Hong Kong. They are predatory and active during night time.

A total of 13 fish species were recorded during stream surveys, including 4 introduced species (*Gambusia affinis affinis*, *Xiphophorus variatus*, *Xiphophorus alvarezi* and *Poecilia reticulata*, all Central America in origin) and 9 native species, all of which belongs to upstream or midstream freshwater fishes with their distributions restricted to clean lentic waters with no or limited human disturbance.

*Poecilia reticulata* was found only at the stream course upstream to Intake I-2 at Sam Dip Tam, while the other three exotic species distributed throughout the two stream courses except that location.

The existing populations of native freshwater fishes found in the two streams were both restricted in the section upstream to the proposed intake locations. Distribution of all fish species were aggregated and restricted in riffles along the streams with gentle flows or with sandy or rocky bottoms. Number of individuals (including all species) found in each riffle or pool were less than 20 in average but might reach over 50 in some large-sized pools (e.g. >1m in both diameter and depth).

There were 5 species of upstream freshwater fishes among the 9 recorded native freshwater fishes. The presence of these upstream species (*Liniparhomaloptera disparis*, *Pseudogastromyzon myersi*, *Schistura fasciolata*, *Silurus cochinchinensis*, *Rhinogobius duospilus*), due to their ecological requirements of completing their life-cycle in a highly natural stream habitat, may in turn reflect or indicate the naturalness of the environment. These species, however, were found diminishing from upstream section toward downstream section along both Sam Dip Tam Stream and Tso Kung Tam Stream, especially below some sewage discharging points.

The distribution of aquatic invertebrates also showed similar pattern. At Sam Dip Tam Stream, aquatic invertebrates were only found at the upstream section, while at Tso Kung Tam Stream, the species richness of aquatic invertebrates also diminished along the stream course. Freshwater snail, *Hippeutis cantonensis*, was found at upstream parts of both streams. Another freshwater snail, *Brotia hainanensis*, was recorded at both upstream and near Intake I-3 sampling points at Tso Kung Tam Stream, but only at upstream sampling point at Sam Dip Tam Stream.

**Table 9.** Aquatic fauna species composition and abundance recorded from stream course upstream to Intake I-2 at Sam Dip Tam.

No	Scientific Name	Status	Abundance
Stream fishes			
1	<i>Zacco platypus</i> (Temminck & Schlegel.)	Obs.	+
2	<i>Parazacco spilurus</i> (Günther, 1868)	Obs.	+
3	<i>Capoeta semifasciolata</i> (Günther, 1868)	Obs.	+
4	<i>Schistura fasciolata</i> (Nichols & Pope, 1927)	Cap.	++
5	<i>Liniparhomaloptera disparis disparis</i> (Lin, 1934)	Cap.	+++
6	<i>Pseudogastromyzon myersi</i> (Herre,)	Cap.	+++
7	<i>Silurus cochinchinensis</i> Valenciennes, 1840	Cap.	+
8	<i>Poecilia reticulata</i> Peters, 1860	Cap.	+++
9	<i>Rhinogobius duospilus</i> (Herre, 1935)	Cap.	+++
10	<i>Channa asiatica</i> (Linnaeus, 1758)	Obs.	++
Invertebrates			
1	<i>Brotia hainanensis</i>		+++
2	<i>Caridina cantonensis</i>		+++
3	<i>Cryptopotamon anacoluthon</i>		+
4	<i>Hippeutis cantonensis</i>		+
5	<i>Macrobrachium</i> sp.		++

+ = less than 5 individuals; ++ = 5-10 individuals; +++ = more than 10 individuals. Cap. = Captured ; Obs. = Observed

**Table 10.** Aquatic fauna species composition and abundance recorded from stream course near Intake I-2 at Sam Dip Tam.

No	Scientific Name	Status	Abundance
Stream fishes			
1	<i>Zacco platypus</i> (Temminck & Schlegel.)	Obs	+++
2	<i>Parazacco spilurus</i> (Günther, 1868)	Obs.	+++
3	<i>Capoeta semifasciolata</i> (Günther, 1868)	Obs.	+++
4	<i>Schistura fasciolata</i> (Nichols & Pope, 1927)	Obs.	+
5	<i>Liniparhomaloptera disparis disparis</i> (Lin, 1934)	Obs.	+++
6	<i>Pseudogastromyzon myersi</i> (Herre,)	Obs.	+++
7	<i>Rhinogobius duospilus</i> (Herre, 1935)	Cap.	+++
8	<i>Gambusia affinis affinis</i> (Baird & Girard, 1853)	Cap.	+++
9	<i>Xiphophorus variatus</i> (Meek, 1904)	Cap.	+++
10	<i>Xiphophorus alvarezii</i> (Rosen, 1960)	Cap.	+++

+ = less than 5 individuals; ++ = 5-10 individuals; +++ = more than 10 individuals. Cap. = Captured ; Obs. = Observed

**Table 11.** Aquatic fauna species composition and abundance recorded from stream course downstream to Intake I-2 at Sam Dip Tam.

No	Scientific Name	Status	Abundance
Stream fishes			
1	<i>Rhinogobius duospilus</i> (Herre, 1935)	Obs.	+
2	<i>Silurus cochinchinensis</i> Valenciennes, 1840	Obs.	+
3	<i>Gambusia affinis affinis</i> (Baird & Girard, 1853)	Obs.	+++
4	<i>Xiphophorus variatus</i> (Meek, 1904)	Obs.	+++
5	<i>Xiphophorus alvarezii</i> (Rosen, 1960)	Obs.	+++

+ = less than 5 individuals; ++ = 5-10 individuals; +++ = more than 10 individuals. Cap. = Captured ; Obs. = Observed

**Table 12.** Aquatic fauna species composition and abundance recorded from stream course upstream to Intake I-3 at Tso Kung Tam.

No	Scientific Name	Status	Abundance
Stream fishes			
1	<i>Zacco platypus</i> (Temminck & Schlegel.)	Obs.	+
2	<i>Parazacco spilurus</i> (Günther, 1868)	Obs.	+
3	<i>Capoeta semifasciolata</i> (Günther, 1868)	Obs.	+
4	<i>Schistura fasciolata</i> (Nichols & Pope, 1927)	Cap.	++

5	<i>Liniparhomaloptera disparis disparis</i> (Lin, 1934)		Cap.	+++
6	<i>Pseudogastromyzon myersi</i> (Herre,)		Cap.	+++
7	<i>Silurus cochinchinensis</i> (Valenciennes, 1840)		Cap.	++
8	<i>Rhinogobius duospilus</i> (Herre, 1935)		Cap.	+++
9	<i>Gambusia affinis affinis</i> (Baird & Girard, 1853)	Obs.		+++
10	<i>Xiphophorus variatus</i> (Meek, 1904)	Obs.		+++
11	<i>Xiphophorus alvarezii</i> (Rosen, 1960)	Obs.		+++
Invertebrates				
1	<i>Brotia hainanensis</i>			+++
2	<i>Caridina cantonensis</i>			++
3	<i>Hippeutis cantonensis</i>			+++
4	<i>Macrobrachium</i> sp.			+

+ = less than 5 individuals; ++ = 5-10 individuals; +++ = more than 10 individuals. Cap. = Captured ; Obs. = Observed

**Table 13.** Aquatic fauna species composition and abundance recorded from stream course near Intake I-3 at Tso Kung Tam.

No	Scientific Name	Status	Abundance
Stream fishes			
1	<i>Zacco platypus</i> (Temminck & Schlegel,)	Cap.	+++
2	<i>Parazacco spilurus</i> (Günther, 1868)	Cap.	+++
3	<i>Capoeta semifasciolata</i> (Günther, 1868)	Obs.	+++
4	<i>Schistura fasciolata</i> (Nichols & Pope, 1927)		++
5	<i>Liniparhomaloptera disparis disparis</i> (Lin, 1934)	Cap.	+++
6	<i>Pseudogastromyzon myersi</i> (Herre, 1932)	Cap.	+++
7	<i>Rhinogobius duospilus</i> (Herre, 1935)	Cap.	+++
8	<i>Gambusia affinis affinis</i> (Baird & Girard, 1853)	Cap.	+++
9	<i>Xiphophorus variatus</i> (Meek, 1904)	Cap.	+++
10	<i>Xiphophorus alvarezii</i> (Rosen, 1960)	Cap.	+++
11	<i>Nicholscypris normalis</i> (Nichols & Pope, 1927)	Obs.	++
Invertebrates			
1	<i>Brotia hainanensis</i>		++
2	<i>Caridina cantonensis</i>		+
3	<i>Macrobrachium</i> sp.		+

+ = less than 5 individuals; ++ = 5-10 individuals; +++ = more than 10 individuals. Cap. =Captured ; Obs. = Observed

**Table 14.** Aquatic fauna species composition and abundance recorded from stream course downstream to Intake I-3 at Tso Kung Tam.

No	Scientific Name	Status	Abundance
Stream fishes			
1	<i>Silurus cochinchinensis</i> Valenciennes, 1840	Obs.	+
2	<i>Rhinogobius duospilus</i> (Herre, 1935)	Obs.	+
3	<i>Gambusia affinis affinis</i> (Baird & Girard, 1853)	Obs.	+++
4	<i>Xiphophorus variatus</i> (Meek, 1904)	Obs.	+++
5	<i>Xiphophorus alvarezii</i> (Rosen, 1960)	Obs.	+++
Invertebrates			
1	<i>Caridina cantonensis</i>		+
2	<i>Macrobrachium</i> sp.		+

+ = less than 5 individuals; ++ = 5-10 individuals; +++ = more than 10 individuals. Cap. =Captured ; Obs. = Observed

## 2.7 Intertidal Fauna

### 2.7.1 Literature review

Coastal habitats lying between Ka Loon Tsuen and Siu Lam, about 6 km to the west of the outfall location, were studied in the EIA for Castle Peak Road Improvement (Maunsell Consultants Asia Ltd. 2001). Only limited number of species (including 6 species from boulder shores, 7 species from

artificial seawalls, and zero from beach) were recorded and all were common and widespread in Hong Kong. All these habitats were ranked as low in terms of ecological value.

The ecological baseline conditions of coastal habitats in Sham Tseng, approximately 3 km to the west of the outfall location, were reviewed in an EIA study (Scott Wilson 2002). Both natural (rocky shores and sandy shores) and artificial (seawalls) intertidal habitats along the Sham Tseng's coastline were considered of low ecological value.

### 2.7.2 Field survey results

The extent of the coastline within the study area was approximately 1000m in length. The full length of this coastline was artificial or disturbed (Figure 4). The Castle Peak Road Widening project is currently being implemented along the section of Castle Peak Road between Ting Kau and Tsuen Wan. Its alignment is very close to, or just adjacent to, the waterfront, and its works areas cover the whole coastline within the study area except two residential buildings.

Almost all the coastlines within the Study Area were converted to artificial seawalls, including both boulder seawalls and vertical seawalls, or severely disturbed by recently deployed rocks that were used to reinforce the waterfront of the works areas for the road-widening project.

The eastern part of the coastlines within the study area was occupied by vertical seawalls including two public piers and a barging area for the construction works for Castle Peak Road widening. Intertidal fauna found at this part of coastline included Rock oyster *Saccostrea cucullata* and Barnacle *Tetraclita squamosa*, which both had coverage percentage less than 5%.

To the west of the vertical seawalls, the coastline fell within construction site boundaries and was thus inaccessible. It, however, could be observed that it was disturbed by recently deployed large-sized boulders for waterfront reinforcement. The outfall location was also inside these inaccessible areas. Overview from the outfall location confirmed that there were recent modifications on the coastline to accommodate a haul road for the construction site.

Immediately west to the outfall location there were two private residential buildings which were not accessible. Further west, the coastline was occupied by construction sites again till the western edge of the study area boundary, where a section of sandy and rocky shores still existed adjacent to the newly built detention walls.

Two locations, one just outside the study area boundary and other one very close to the boundary, were sampled instead to provide ecological information for the vicinity. The Castle Peak Road widening works have been finished in the coastline immediately to the east of the study area eastern edge. The coastline was currently artificial coastline and the waterfront was covered by large-sized boulders that were deployed for wave protection. Some intertidal fauna have colonized the low tidal level of this section. A transect was set in this location (Transect 1). A section of coastline comprising sandy and rocky shores, adjacent to the western edge of the study area boundary, was also studied by quadrat method (Transect 2).

Totally 6 species on intertidal fauna were recorded during quadrat sampling (Table 15). All was common and widespread in Hong Kong. No rare or uncommon faunal species was found during the coastal surveys.

**Table 15** Results of intertidal fauna surveys

Species	Quadrat No.										Mean value
	Transect 1										
High tidal level	1	2	3	4	5	6	7	8	9	10	0
Middle tidal level	1	2	3	4	5	6	7	8	9	10	



	\	\	\	\	\	\	\	\	\	\	0
<b>Low tidal level</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	
<i>Saccostrea cucullata</i>	13	2	\	18	11	\	6	21	3	\	7.4
<i>Thais</i> sp.	2	\	\	4	\	\	\	3	\	\	0.9
<i>Monodonta</i> sp.	3	6	2	5	\	5	\	3	1	\	2.5
<i>Tetraclita squamosa</i>	21	5	16	\	\	17	9	\	6	9	8.3
Total individual number	39	13	18	27	11	23	15	27	10	9	19.2
Species number	4	3	2	3	1	2	2	3	3	1	2.4
Density (No./m <sup>2</sup> )	156	52	72	108	44	92	60	108	40	36	76.8
<b>Transect 2</b>											
<b>High tidal level</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	
<i>Nodilittorina trochoides</i>	\	\	\	\	65	21	\	\	57	39	18.2
<i>Nodilittorina radiata</i>	\	\	\	\	51	31	\	\	75	19	17.6
<b>Middle tidal level</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	
<i>Nodilittorina trochoides</i>	\	\	\	\	37	11	\	\	15	23	8.6
<i>Nodilittorina radiata</i>	\	\	\	\	41	12	\	\	11	31	8.4
<b>Low tidal level</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	
<i>Saccostrea cucullata</i>	\	\	5	\	12	17	\	\	21	\	5.5
<i>Tetraclita squamosa</i>	\	\	4	\	3	6	\	\	\	\	1.3
Total individual number	\	\	9	\	209	98	\	\	179	112	60.7
Species number	0	0	2	0	4	4	0	0	3	2	1.5
Density (No./m <sup>2</sup> )	0	0	36	0	836	392	0	0	716	448	242.8

### 3 EVALUATION OF HABITATS AND SPECIES

The “Important Habitats Where an Ecological Assessment Will Be Necessary” listed in Note 1, Appendix A, Annex 16 to the TM-EIAO existing in or near to the study area are:

- Woodlands larger than 1 ha in size (young, mixed woodland in this study);

Habitats found within the study area were evaluated in terms of ecological importance using the criteria set forth in Annex 8, Table 2 of the TM-EIAO. Details are listed in Tables 16 to 21.

**Table 16 :** Evaluation of ecological importance of woodland

Criteria	Remarks
Naturalness	Secondary, semi-natural
Size	79.1 ha
Diversity	Moderate diversity of plant (95 species), low to moderate structural complexity. Low fauna diversity.
Rarity	None for plant species. Rare bird species Emerald Dove. Mammal species protected by WAPO and regional regulation included Rhesus Macaque. Bird protected by regional and global regulation included Black Kite.
Re-creatability	Habitat characteristics and species composition are difficult to recreate. It will take 10-40 years for the secondary woodlands to be re-created.
Fragmentation	Moderately fragmented. Isolated patches scattered within the study area.
Ecological linkage	Link to stream habitats within the study area
Potential value	Moderate, becoming mature woodland given time and protection from disturbance.
Nursery/breeding ground	Recent fledged Red-whiskered Bulbuls and Chinese Bulbuls. White-backed Munia carrying nesting materials. Can also provide breeding habitats for birds, mammals, butterflies and reptiles.
Age	Young (mostly less than 30 years) based on tree size, woodland structure and species composition.
Abundance/Richness of wildlife	Low for fauna.
Overall Ecological value	Moderate.

**Table 17 :** Evaluation of ecological importance of plantation

Criteria	Remarks
Naturalness	Man-made, planted. Some natural colonization on hillsides.
Size	181.2 ha
Diversity	Moderate diversity of plant (114 species), low structural complexity. Low fauna diversity.
Rarity	Mammal species protected by WAPO included Japanese Pipistrelle and Pallas Squirrel. Bird protected by regional and global regulation included Common Buzzard.
Re-creatability	Easy to recreate
Fragmentation	Moderately fragmented.
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	Limited for roadside plantation. Moderate for plantation on hillsides which may become mature woodland given time and appropriate management (e.g. thinning, fire prevention).
Nursery/breeding ground	Recent fledged Red-whiskered Bulbuls and Chinese Bulbuls. White-backed Munia carrying nesting materials. Can also provide breeding habitats for mammals, butterflies and reptiles.
Age	Young (mostly less than 30 years) based on tree size, structure and species composition.
Abundance/Richness of wildlife	Low for fauna.
Overall Ecological value	Low to moderate.

**Table 18 :** Evaluation of ecological importance of grassland

Criteria	Remarks
Naturalness	Semi-natural, subject to high level of human disturbance (hillside grass-shrubland) / management practice (turf)
Size	89.4 ha
Diversity	Low diversity in flora (46 species), low for fauna.
Rarity	Neither rare nor protected species were recorded during the survey. Uncommon butterfly Red Admiral. Mammal species protected by WAPO included Japanese Pipistrelle
Re-creatability	Could be re-created.
Fragmentation	Continuous patch within study area.
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity.
Potential value	Limited due to presence of graves, frequent fire disturbance or intensive management such as mowing.
Nursery/breeding ground	Limited due to low vegetation cover and frequently disturbed by hill fire.
Age	Young, early stage of succession or in an arrested climax imposed and maintained by hellfire.
Abundance/Richness of wildlife	Low for fauna.
Overall Ecological value	Low.

**Table 19 :** Evaluation of ecological importance of village-orchard

Criteria	Remarks
Naturalness	Man-made habitat.
Size	40.5 ha
Diversity	Moderate for vegetation (totally 76 species for the whole area, mostly fruit trees or exotic species), low for fauna.
Rarity	None for plant species and fauna.
Re-creatability	Readily creatable.
Fragmentation	Scattered within the developed area and were therefore fragmented.
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity.
Potential value	Low.
Nursery/breeding ground	Can provide breeding habitats for birds, amphibians and butterflies.
Age	Young
Abundance/Richness of wildlife	Low for fauna.
Overall Ecological value	Low to moderate.

**Table 20 :** Evaluation of ecological importance of stream/channel

Criteria	Remarks			
	All other streams/channels within the Study Area	Intake I-1 Channel	Sam Dip Tam Stream	Tso Kung Tam Stream
Naturalness	Some are artificial, while the others are semi-natural.	Artificial	Semi-natural	Semi-natural
Size	Approximately 5km for major streams and channels.			
Diversity	Moderate for plants (62 species recorded) and Low for fauna. .			
Rarity	None for plants. Amphibian protected by WAPO included Hong Kong Cascade Frog.	None	Amphibian protected by WAPO included Hong Kong Newt. Reptile protected by global regulation included Common Rat Snake.	Uncommon/rare fauna included Plumbeous Redstart.
Re-creatability	Some are difficult while the others are easy to be re-created	Re-creatable.	Difficult to be re-created	Difficult to be re-created
Fragmentation	Not applicable.			

Criteria	Remarks			
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity.			
Potential value	Low to Moderate	Low ecological potential. The smooth concrete surface of the bed and the banks are difficult for flora or fauna to colonise.	Moderate ecological potential. Though pollution inputs at mid-stream sections were found, the banks of upstream section and also the streambed of upstream and downstream sections remains natural.	Moderate ecological potential. Though pollution inputs at mid-stream sections were found, the banks of upstream section and also the streambed of upstream and downstream sections remains natural.
Nursery/breeding ground	Breeding habitats of dragonflies and amphibians.	Not a nursery/breeding ground	Breeding habitats of freshwater fish, aquatic invertebrates, dragonflies and amphibians.	Breeding habitats of freshwater fish, aquatic invertebrates, dragonflies and amphibians.
Age	Not applicable			
Abundance/Richness of wildlife	Moderate for dragonfly, low for butterfly and birds	Low	Medium to high for freshwater fish, medium for aquatic invertebrates and moderate for dragonfly, low for butterfly and birds	Medium to high for freshwater fish, medium for aquatic invertebrate and, moderate for dragonfly, low for butterfly and birds
Overall Ecological value	Low to Moderate.	Low	Moderate	Moderate

**Table 21 :** Evaluation of ecological importance of urbanised/disturbed

Criteria	Remarks
Naturalness	Man-made habitat.
Size	165.4 ha
Diversity	Low in terms of flora (45 species recorded, mostly exotics) and fauna.
Rarity	One protected but very common orchid species <i>Arundina graminifolia</i> recorded.
Re-creatability	Readily re-creatable.
Fragmentation	Formed a continuous cover within the study area.
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity.
Potential value	Low.
Nursery/breeding ground	Limited due to high human disturbance.
Age	N/A
Abundance/Richness of wildlife	Low
Overall Ecological value	Low

**Table 22:** Evaluation of ecological importance of intertidal habitat within the Study Area

Criteria	Remarks
Naturalness	Man-made or highly disturbed habitat.
Size	Approximately 1000m
Diversity	Low.
Rarity	No protected or rare fauna recorded.
Re-creatability	Readily re-creatable.
Fragmentation	Continuous within the study area.
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity.
Potential value	Low.
Nursery/breeding ground	Limited due to high human disturbance and the pollution level in the seawater.

Criteria	Remarks
Age	N/A
Abundance/Richness of wildlife	Low
Overall Ecological value	Low

In accordance with Table 3, Annex 8 of the EIAO-TM, the ecological value of species was assessed in terms of:

- Protection status;
- Species distribution; and
- Rarity.

Flora and most fauna recorded in the Study Area are typical of disturbed areas, and are of low conservation concern.

The list and evaluation of the floral and faunal species of ecological interest recorded within the study area, according to the TM-EIAO, are given in Tables 23 and 24:

**Table 23 :** Evaluation of floral species with ecological interest within the study area

Species	Growth Form	Location	Protection status	Distribution	Rarity
<i>Arundina graminifolia</i>	orchid	Sprayed slope above catchwater	Protected by Forestry Regulations	Grassland and streamside	Very common (Siu 2000)

**Table 24 :** Evaluation of faunal species with ecological interest within the study area

Common names	Latin names	Location	Protection status	Distribution	Rarity
Japanese Pipistrelle	<i>Pipistrellus abramus</i>	Plantation and grassland along Shing Mun catchwater	Wild Animals Protection Ordinance (Cap 170)	Widespread	Common in Hong Kong
Rhesus Macaque	<i>Rhyacornis fuliginosu</i>	Woodland along Shing Mun catchwater	Wild Animals Protection Ordinance (Cap 170) Class II Protected Animal in PRC	Found in Central New Territories, and part of Sai Kung Peninsula	Common/uncommon in Hong Kong
Pallas Squirrel	<i>Callosciurus erythraeus styani</i>	Plantation along Shing Mun catchwater	Wild Animals Protection Ordinance (Cap 170)	Scattered localities in the New Territories and Hong Kong Island	Uncommon in Hong Kong
Striated Heron	<i>Butorides striatus</i>	Stream near Tso Kun Tam	Wild Animals Protection Ordinance (Cap 170)	Mainly in mangroves	Uncommon in Hong Kong, considered local concern
Chinese Pond Heron	<i>Ardeola bacchus</i>	Stream near Tso Kun Tam, Catchwaters of Tai Lam and Shing Mun	Wild Animals Protection Ordinance (Cap 170)	Distribute widely in lowland wetlands	Common in Hong Kong, considered potential regional concern
Little Egret	<i>Egretta garzetta</i>	Stream near Tso Kun Tam, Catchwaters of Tai Lam and Shing Mun	Wild Animals Protection Ordinance (Cap 170)	Distribute widely in lowland wetlands and coastal areas	Common in Hong Kong, considered potential regional concern
Black Kite	<i>Milvus lineatus</i>	Plantation along Shing Mun catchwater	Wild Animals Protection Ordinance (Cap 170) Class II Protected Animal in PRC CITES Appendix II	Distribute widely in Hong Kong, can be in many types of habitats.	Common in Hong Kong, considered potential regional concern
Common Buzzard	<i>Buteo buteo</i>	Woodland along Tai Lam catchwater	Wild Animals Protection Ordinance (Cap 170) Class II Protected Animal in PRC CITES Appendix II	Distribute widely in Hong Kong, can be in many types of habitats.	Common/uncommon in Hong Kong
Emerald Dove	<i>Chalcophaps indica</i>	Woodland along Shing Mun catchwater	Wild Animals Protection Ordinance (Cap 170)	Distribute widely in Hong Kong	Uncommon /rare in Hong Kong

White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Upstream of Intake I-2	Wild Animals Protection Ordinance (Cap 170)	Distribute widely in lowland wetlands and coastal areas	Common in Hong Kong, considered local concern
Plumbeous Redstart	<i>Rhyacornis fuliginosu</i>	Downstream of Intake I-3	Wild Animals Protection Ordinance (Cap 170)	Found along streams	Rare in Hong Kong, considered local concern
Common Rat Snake	<i>Ptyas mucosus</i>	Near proposed location of Intake I-2	Appendix 2 of CITES	Widely distribute in Hong Kong, occur in many types of habitats	Common in Hong Kong, considered potential regional concern
Hong Kong Newt	<i>Paramesotriton hongkongensis</i>	Upstream of proposed location of Intake I-2	Wild Animals Protection Ordinance (Cap 170)	Widely distribute in the New Territories, more localised on Hong Kong and Lantau Islands. Only known from Hong Kong and coastal Guangdong Province.	Uncommon /rare in Hong Kong, considered potential global concern
Hong Kong Cascade Frog	<i>Amolops hongkongensis</i>	Streams along catchwater of Shing Mun	Wild Animals Protection Ordinance (Cap 170)	Widespread in swift-flowing hill and mountain streams, particularly those with cascading water	Fairly common in Hong Kong, considered potential global concern
Red Admiral	<i>Vanessa indica</i>	Grassland along Tai Lam catchwater	Not protected	Found in barren hilltops and cultivated lands	Uncommon in Hong Kong
Freshwater crab	<i>Cryptopotamon anacoluthon</i>	Stream section upstream to Intake I-2 at Sam Dip Tam	Not protected	In streams of good conditions in Hong Kong	Common and widespread in Hong Kong

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