

## **8.0 ECOLOGY**

### **8.1 Introduction**

8.1.1 This section comprises of the ecological assessment of the EIA. The broad objectives of the ecological study are as follows:

- to establish an ecological baseline for the study area, focusing on identifying key areas and key species present;
- to assess the ecological implications of the sewerage project;
- to develop feasible and effective mitigation measures for significant impacts; and
- to determine whether residual, post mitigation impacts are acceptable.

8.1.2 In addition, in accordance with Paragraph 6.5.1.5 of the Study Brief, Ecological Impact “The study shall take into account the importance of ecological components for natural flora/fauna habitats in the development areas. It is essential to observe the importance of protecting, rehabilitating and maintaining the natural environment. The assessment shall focus on issues important to confirm the environmental feasibility of the proposed development. The relevant Guidelines and requirements laid down in Annexes 8 and 16 of the TM shall be followed.”

8.1.3 This ecology assessment provides a baseline for the study area which includes a literature review and results from the field survey work carried out to fill identified data gaps. Potential impacts resulting from the construction and operation of the project have been identified and assessed. Mitigation measures have been proposed and an assessment made on the acceptability of the residual impacts.

### **8.2 Baseline Ecological Literature Review**

#### **Background**

8.2.1 The purpose of the literature review is to identify existing information on the habitats and species which are present within the study area. A comprehensive search was made of the existing data from previous EIAs, research papers published in scientific journals, books and information from special interest groups and naturalists for any relevant information concerning the study area as detailed in the sections below. A complete list of the studies and reports reviewed is provided in Section 8.7.

8.2.2 The Hong Kong University’s Department of Ecology and Bio-diversity was contacted to obtain access to their Terrestrial Biodiversity Survey Database. However, the database is currently in the process of being collated and not available for access until December 1999, after the completion of this study.

#### **Terrestrial Vegetation and Habitats**

8.2.3 The literature reviewed included Thrower (1983, 1984, 1984 and 1988), Urban Council (1971), Hill *et al* (1978), AFD (1993), Zhang *et al* (1997), Chu *et al* (1997) and Hodgkiss (1978) for terrestrial plant species.

### **Coastal and Intertidal Habitats**

- 8.2.4 The literature reviewed for coastal and intertidal data included Morton (1983) on seashore species and ecology. General information on tropical fish ecology was gathered from Lowe-McConnell (1995) and more targeted information on adult fish populations in the waters to the north of Lantau Island was obtained from Richards and Wu (1985), Mouchel (1998) and Mouchel (1998).
- 8.2.5 Hyder (undated) which provided details on fish populations and potential impacts resulting from marine dredging activities in the waters north of Lantau Island was also reviewed.

### **Terrestrial Invertebrates**

- 8.2.6 Information on the distribution and abundance of invertebrates was acquired from Wilson (1998), Walthew (1997) Reels (1998) and Reels and Walthew (1998).

### **Avifauna**

- 8.2.7 The distribution of avifauna was reviewed from the Hong Kong Bird Report (Hong Kong Bird Watching Society 1995). Information on bird sightings was also gathered from various issues of "Porcupine!" and data on bird use of fish ponds was obtained from papers by Melville *et al* (1994) and Chu (1995).

### **Reptiles and Amphibians**

- 8.2.8 Karsen *et al* (1986) contained identification data and notes on species distribution in Hong Kong. Information on herpetofaunal sightings were also gathered from various issues of "Porcupine!".

### **Terrestrial Mammals**

- 8.2.9 Information on sighting of mammals within and around the study area were located in various issues of "Porcupine!", Ades and Reels (1998) describe the value of farmland in general to bats and notes on the land mammals of Hong Kong was provided by Goodyear (1992).

### **Freshwater Fish**

- 8.2.10 Hay and Hodgkiss (1981) guide to Hong Kong freshwater fish gives details on the distribution of the more common species of fish. A more comprehensive checklist of freshwater fish was prepared by Chong and Dudgeon (1992) giving details on the status and distribution of 96 species of freshwater fish in Hong Kong.

## **8.3 Data Gaps**

- 8.3.1 The data obtained from the literature review was mostly related to Hong Kong as a whole with a few records related to the study area and its surroundings. Thus, further study area specific ecological data needed to be collected to enable a full analysis of the ecological impacts. To

accomplish this an initial ecological field survey was carried out.

## **8.4 Initial Ecological Survey**

### **Background**

8.4.1 An initial ecological survey was carried out to provide a wide scale description of the ecology and identify key ecological components. The objectives of the initial ecological survey are as follows:

- identify the habitats occurring within the study area;
- identify any area or species designated as important in Annex 16 of the Technical Memorandum on Environmental Impact Assessment Process, specifically “important habitats where an ecological assessment will be necessary” and “species of conservation importance” (Technical Memorandum, Annex 16, Appendix A, Notes 2 and 3); and
- identify areas or species that require further detailed ecological study in order to fully assess the potential impacts of the project.

### **Habitat Survey**

8.4.2 A habitat survey of the study area was carried out following the method detailed by the Nature Conservancy Council (1990), on the 22-23rd October 1998 and 10th November 1998. The study area was surveyed and all habitats found were mapped.

8.4.3 Field surveys were carried out on the 23rd February 1999 to gather data on the dominant flora and fauna of each habitat along the sewer route. In addition, any species of conservation importance were recorded when identified.

8.4.4 The habitat maps created from the survey are shown in Drawings 8.1 to 8.4 and photographs of each habitat identified along the sewer route are shown in Drawings 8.5 to 8.6. Floral species lists for the study area are given in Appendices C.1 and C.7. Visual or indirect fauna sightings during the course of the surveys were recorded and these are described in the following text.

## **8.5 Scope of Potential Impacts**

8.5.1 With information gathered from the literature and from the initial ecological survey, preliminary identification of potential ecological impacts were made. The impacts identified are summarised in Table 8.1.

**Table 8.1: Summary of Potential Impacts Identified**

Construction	Operation
Loss of habitat and species	Pollution of water bodies in the event of pump or power supply failure and subsequent overflow of raw sewage
Water pollution from suspended solids generated during excavation or other activities	
Disturbance to feeding or breeding birds	

8.5.2 A more detailed description of the key issues identified at the preliminary stage and the habitats and species groups of concern is given below.

8.5.3 The originally proposed sewer alignment directly encroached on the edge of woodland blocks just east of Wong Uk (Area 4) and east of So Kwun Wat Tsuen (Area 6), as shown in Drawings 8.10 and 8.11. While not resulting in habitat fragmentation, laying of the route would result in the removal of some trees within the site boundary and possible damage to the root systems of adjacent trees. In addition, the site boundary just north of Tai Lam Chung Tsuen (Area 1) was very close to the edge of a wooded area leading to the potential for tree roots to be damaged during construction.

8.5.4 Potential direct and indirect impacts on two bird habitats have been identified. The marsh at the southern end of Tai Lam Chung Tsuen (Area 2), shown in Drawing 8.7, may experience changes to its hydrology as a result of pipeline installation. This may have a secondary impact on bird species that frequent the marsh. Direct disturbance of birds that frequent the marsh may also occur during construction. Also, the active brackish water fish culture pond next in the Tai Lam Valley (Area 7), shown in Drawing 8.7 which will have to be partially filled in to accommodate the pumping station. This would result in the loss of potential feeding and breeding habitats for aquatic birds.

8.5.5 Native fish present in a stream located east of So Kwun Wat Tsuen (Area 5), Drawing 8.8, were identified as potentially vulnerable to suspended solids generated during construction, which may adversely stress them. Possible operational impacts may result from emergency discharge of raw sewage into the stream following a pump or power supply failure.

8.5.6 The main estuary and small tributary at Tai Lam Chung (Area 3 & 8), Drawing 8.7, may contain juvenile fish of commercially valuable species. Construction of the pipeline across these areas may generate quantities of suspended solids that could adversely stress any juvenile fish present. Possible operational impacts may result from emergency discharge of raw sewage into these areas following a pump or power supply failure.

## 8.6 Focused Ecological Study

8.6.1 After identifying the potentially significant ecological impacts, further study work was commissioned to enhance the ecological data on these areas to enable a more precise prediction of the significance of the impacts and fill the identified data gaps. The specific aim of the survey work was to provide quantitative data on species occurrence, particularly any

rare species and their associated abundance, in accordance with objectives, bullet points one and two, in Section 8.4.1 above.

8.6.2 Four detailed ecological surveys were carried out:

- a tree survey located at Tai Lam Chung Tsuen, Wong Uk and east of So Kwun Wat Tsuen (Areas 1, 4 and 6), as shown in Drawings 8.7 and 8.8;
- a bird survey at both the marsh at the southern end of Tai Lam Chung Tsuen (Area 2) and the active brackish water fish culture pond next to the Tai Lam Valley Pumping Station (Area 7), shown in Drawing 8.7;
- a survey of stream fish in the So Kwun Wat valley stream, east of So Kwun Wat Tsuen (Area 5), Drawing 8.8; and
- a survey of estuarine juvenile fish in the main estuary and small tributary at Tai Lam Chung (Area 3 and 8), as shown in Drawing 8.7.

8.6.3 Details of the methodology applied and results for each focused survey is given in Appendix D.

## **8.7 Baseline Conditions**

### **Background**

8.7.1 The data collected from the literature and the field studies has been combined to provide an ecological baseline description of the study area. For habitats affected by the project, species list from current field surveys have been included. Where the project is not expected to have any impact, reference has been made to field surveys carried out on similar habitats in the literature.

### **The Study Area**

8.7.2 The study area is split into three sub-areas; Tai Lam Chung Valley, Castle Peak Villas and So Kwun Wat, which are all within the same geographical area. The area is composed of upland blocks of hills of approximately 300-400m in height, which are dissected by long flat wide valley floors. Part of the study area at Tai Lam Chung Valley and Castle Peak Villas includes coastal and marine environments. The study boundary extends 500m from all sides of the site boundary.

### **Upland Habitats**

8.7.3 The uplands in the study area are typical of Hong Kong, where the dryer more exposed areas of hillside tend to be inhabited by a mixture of scrub and short grasses. Where stress from water shortage and periodic hill fires are low, woodland has tended to develop. These areas include north facing slopes, ravines or areas of sub-surface water seepage. Hillsides near village areas tend also to have established woodland as a result of tree planting and protection

by villagers, careful of their *fung shui* duties. It would appear from field observations that fire is the biggest influence on the patchwork of wooded-scrub-grassland areas existing on the hillsides in the study area.

- 8.7.4 Previous vegetation surveys have produced plant species lists for the following areas: WENT Landfill site at Nim Wan (see Appendix C.2), Castle Peak borrow area on the south face of Castle Peak (see Appendix C.3), Tuen Mun uplands for the Foothills Bypass (see Appendix C.4), the power station site at Black Point (see Appendix C.5) and the Sham Tseng Link study (see Appendix C.6). Most of the study area for these surveys consisted of dry uplands which are expected to be characteristic of the Western New Territories uplands. However, the study area appears to possess a higher proportion of upland woodland than found by these studies.
- 8.7.5 Species found in dry upland grasslands are generally common and widespread throughout Hong Kong. These communities tend to be transient, being cleared by periodic hill fires, with the capacity for rapid regeneration in a period of 2-4 years. Upland grassland is a natural habitat that has reached un-natural levels of dominance in Hong Kong, mainly due to human induced hill fires. It covers large areas of the SAR and tends to be of medium to low species diversity. It is very easy to recreate. The ecological value of such a habitat is low.
- 8.7.6 Woodland in the upland areas is semi-mature, of varying ages. Diversity of tree species was found to be medium for the two woodland blocks surveyed at Tai Lam Chung and So Kwun Wat. Composition of the woodland in these areas was found to be typical for Hong Kong. A list of the species found is given in Appendix C.7.
- 8.7.7 Chinese Porcupine and the Small Indian Civet have been recorded for Tai Lam Chung and Tai Lam Reservoir (anon. a. 1998). These species are protected in the SAR under the Wild Animals Protection Ordinance.
- 8.7.8 The results of the survey and analysis of the woodland survey data is shown in Appendix C.7A and in Table 8.2 below. The Hong Kong status of the tree species found are detailed in Appendix C.7B. The locations of the three woodland sites sampled (Locations 1, 4 and 6) are shown in Drawings 8.7 and 8.8. Woodland Areas 1 and 4 displayed similar average diversity values for the tree and understorey layers. Woodland 6 showed the largest diversity in the tree, understorey and field layers. Generally woodland Area 1 possesses a mixture of young and semi-mature trees, with a few mature trees, woodland Area 4 possesses trees that are mainly semi-mature with some mature and young trees. Woodland Area 6 possesses trees that are mainly mature to semi-mature with a few young trees. It would appear from the data that the more mature a woodland is the higher the diversity of the tree, understorey and field layers. The proportion of alien species varied between each wood, with 22% of species alien in Area 1, 30% in Area 4 and 10% in Area 6. The higher the proportion of species are alien the lower the ecological value of the wood. Based on the above location specific parameters, ecological value is ranked as follows for the three areas surveyed: Woodland Area 6, Medium-High, Woodland Area 4, Medium, and Woodland Area 1, Medium.

**Table 8.2 Summary of Woodland Community Parameters and Indexes**

Surveyed March 1999	Woodland Area 1*		Woodland Area 4*		Woodland Area 6*	
	Average of Five Samples	Standard Error in mean	Average of Five Samples	Standard Error in mean	Average of Five Samples	Standard Error in mean
<b>Tree Layer 15 x 15 m Quadrats</b>						
Number of Species	4.6	1.1	4.2	0.7	5.2	0.9
Number of Individuals	23.8	9.0	10.2	1.5	24.4	13.8
Diversity H'	1.4	0.4	1.6	0.3	1.9	0.2
Evenness (Simpson's)	0.6	0.1	0.7	0.0	0.7	0.1
<b>Understorey 10 x 10 m quadrats</b>						
Number of Species	7.0	1.1	12.6	0.7	13.0	2.4
Number of Individuals	26.8	6.4	96.6	11.7	149.8	49.3
Diversity H'	2.2	0.2	2.8	0.2	3.1	0.2
Evenness (Simpson's)	0.6	0.1	0.4	0.1	0.6	0.0
<b>Field 4 x 4 m Quadrats</b>						
Number of Species	-	-	2.8	1.0	3.0	0.5
Number of Individuals	-	-	11.3	4.2	15.0	6.1
Diversity H'	-	-	0.9	0.5	1.3	0.2
Evenness (Simpson's)	-	-	0.8	0.1	0.8	0.1

Note \*: The location of areas 1, 4 & 6 are shown in Drawings 8.7 & 8.8

- 8.7.9 Woodland of the type within the study area, as a habitat, it is not rare in the SAR but recreation of this habitat type would take a long time. In order to replace the current woodland to its existing condition after removal could take anywhere between 20-50 years. Generally the woodland areas within the site are well consolidated with little fragmentation which makes for good continuous habitats for woodland animals. The value of the woodland, as a whole, is considered to be of medium-high ecological value.
- 8.7.10 Several streams descend from the hill tops which feed into the main valley streams at Tai Lam Chung and So Kwun Wat. At the time of survey, during the dry season, their flow was limited. The catchwater along part of Tai Lam Chung and So Kwun Wat valleys intercepts run off from the upper hillside and further reduces the flow of some of the hill streams. The collected water is fed into the Tai Lam Chung Reservoir to the north of the study area. The Pitcher Plant (*Nepenthes mirabilis*), a protected species under the Forestry Regulations, has been recorded within the study area on the south facing slopes of So Kwun Wat valley, west of So Kwun Wat valley and the hills to the north of Siu Lam (Weatherhead undated). It prefers granitic wet soils, with good lighting. The general location for these plants is shown in Drawing 8.9. Where the Pitcher Plant is found, streams would be considered of higher ecological value.

## Lowland Habitats

- 8.7.11 The low lying flat valley bottoms contain a mixture of habitats that have evolved from a mainly agricultural past. These include active agricultural land, abandoned fields in various stages of colonisation by native flora, streams, ponds, marsh, orchards and woodland. Village housing is generally of low density although most habitats surrounding them are greatly modified by human activity. Areas where native flora and fauna are almost entirely excluded include the various access road and the extensive areas of open storage that exist at So Kwun Wat and Tai Lam Chung.
- 8.7.12 These lowland areas are in a state of flux. Presently a large proportion of the land has been abandoned, with current agricultural activity located close to villages. A large proportion of the available flat land has been paved for the purpose of storing commercial cargo containers. It would appear that container storage is on the decline as the number of containers presently on site is much smaller than the number shown on previous aerial photographs. Consequently, these large flat empty areas dominate the lower valley bottoms. The construction of new village housing is a more recent activity, with previous agricultural land being taken up. At the present moment areas of abandoned agricultural land and some small areas of woodland are being cleared for new housing developments. The abandoned agricultural lands at the head of So Kwun Wat valley have been left very much alone, with a greater number of plant and bird species being observed.
- 8.7.13 The large open storage areas offer little opportunity to native flora and fauna. They form large barriers due to their lack of cover and unnatural terrain which inhibit the movement of ground dwelling animals. The various roads that criss-cross the valley bottoms also fragment and reduce connection between various habitats. Other areas that have been cleared for housing projects or are part of village open spaces also exhibit similar characteristics, although villages tend to have a higher number of trees. These areas are considered to be of low ecological value.
- 8.7.14 The area of active agricultural land is greatly reduced and tends to be located around existing villages. Crops observed include *choi sum*, *bat choi*, lettuce and other market garden vegetables and fruits. The natural floral diversity in these areas is low, given the high intensity of agricultural use.
- 8.7.15 Large areas of abandoned or fallow farm land exist throughout the lowlands. Two general community types have been observed. Dry grasslands which are composed of taller coarser grasses on soils which dry out in the dry season and wet grasslands which are composed of shorter finer grass species with associated herbs which remain moist in the dry season. Flora species recorded are shown in Appendix C.1. No rare or uncommon plants were found.
- 8.7.16 Bird species found on agricultural land appear to be generalists, most of which are found in areas of wet agriculture, the urban fringe and on landfill sites or open storage (Leven 1998). Species observed within the study area, during the dry season on abandoned dry agricultural land, include *Lonchura punctulata* (Spotted Munia), *Prinia flaviventris* (Yellow Bellied Prinia) and *Passer montanus* (saturatus) (Tree Sparrow). All species recorded are common in Hong Kong.

8.7.17 The existing agricultural land, grassland and abandoned agricultural land are relatively recent habitats and they still exhibit influences from man and are not precisely natural. The area available in the study area is large. Overall diversity of flora and fauna is expected to be low compared with other natural habitats in Hong Kong. The potential value of these habitats is likely to increase if they are left to follow their natural course of development into scrubland and woodland. Most of the grasslands in the study area are probably less than 7 years old and are, therefore, relatively young. The ecological value of this habitat group is, therefore, judged to be low.

### **Marshland**

8.7.18 The area of marshland located south of Tai Lam Chung Tsuen probably originated from abandoned wet paddy fields. A photograph at the marsh is shown in Drawing 8.5 and its location indicated in Drawing 8.7. Floristically, the plant community present is typical of wet grassland/ marshland. Nine species were recorded, the plant community being a mixture of feral agricultural and native marshland species. A list of these species is given in Appendix C.1. The northern part of the marsh possesses a small pool which has been degraded by physical refuse (old tyres) and some engine oil. The damage is mostly cosmetic, however, and the remainder of the marsh appears to be fairly unaffected by gross disturbance and plant growth appeared healthy.

8.7.19 Results of two separate bird surveys on the marsh, each lasting a 20 minute period, identified 10 species (Appendix C.10). Species associated with the marsh included, *Amaurornis phoenicurus* (White-breasted Waterhen), *Hirundo rustica* (Barn Swallow), *Anthus hodgsoni* (Olive-backed Pipit), *Pycnonotus jocosus* (Crested Bulbul), *Copsychus saularis* (Magpie Robin), *Prinia flaviventris* (Yellow-bellied Prinia), *Motocilla cinerea* (Grey Wagtail), *Centropus sinensis* (Greater Coucal), *Cisticola juncidis* (Fantail Warbler) and *Orthotomus sutorius* (Common Tailorbird), *Gallinago stenura* (Pintail Snipe). Most of the species are widespread and common in Hong Kong, with the exception of *Cisticola juncidis* which is local but not uncommon and *Gallinago stenura* which is local or rare.

8.7.20 Dragonflies have been observed in October 1998 hunting over the marsh, with a total of 6 possible species being recorded. It is not certain whether they breed but it is likely during the wet season.

8.7.21 At the present time in Hong Kong, the availability of marshland is constantly reducing, mainly through developmental pressures on flat land. This particular marsh represents the only sizable area of freshwater wetland recorded inside the study area. It may be considered of local importance as a feeding and breeding area for wetland birds. In some cases these small islands of wetland act as mini stop off points for migrating birds, as in the case of the Pintail Snipe observed and in some cases can provide food and shelter when it is most needed.

8.7.22 The marsh has obviously arisen from disused paddy fields and the species composition of its flora contains wet agriculture species, reducing its naturalness. Physical disturbance to the northern end through disposal of old tyres and some engine oil also reduces the naturalness of this habitat. It is of medium size and not extensive in area. The diversity of flora and fauna together is not high. The majority of species recorded were common to Hong Kong, with the

exception of the Pintail Snipe, a rare winter migrant. Marshland, in any condition, is becoming rarer as a habitat in Hong Kong and, in addition, the potential value of this site is very large, if measures were taken to remove the rubbish, prevent further pollution and create a range of pools for wildlife. The site does provide a migratory stopover point for Snipe and possibly other wetland species. The ecological value of this site is, therefore, judged to be medium.

### **Fish Ponds**

- 8.7.23 The two fish ponds at Tai Lam Valley are for the cultivation of marine fish, most probably *Mugil cephalus* (Grey Mullet), an ubiquitous species. A photograph of the ponds is shown in Drawing 8.5 and their location indicated in Drawing 8.7. The bank vegetation reflects the marine nature with *Hibiscus tiliaceus* (Cuban Bast), *Sesuvium portulacastrum* (Seaside purslane), sedges and *Paspalum distichum* (Knotgrass) close to the water. All plant species recorded are common seashore plants, see Appendix C.1.
- 8.7.24 In a study of the fish ponds in the Deep Bay area, Chu (1995) found that the floristic composition of fish pond sites was relatively simple, with low species diversity which reflects the species characteristic recorded for the Tai Lam Valley ponds.
- 8.7.25 Bird species associated with the ponds observed over two surveys amounted to 4 species (Appendix C.10); namely the Common Kingfisher (*Alcedo atthis*), Magpie Robin (*Copsychus saularis*), Little Egret (*Egretta garzetta*) and White-breasted Waterhen (*Amaurornis phoenicurus*). All species are common and widespread in Hong Kong.
- 8.7.26 The site is a frequent feeding spot for the Common Kingfisher, although this is not its only option for food. The greater area of hunting habitat provided by the main estuary which is adjacent to the ponds reduces the value of this site as a feeding site for piscivorous birds.
- 8.7.27 The naturalness of these ponds is limited, considering the level of human management involved. In addition, since the original floristic survey, part of the bankside flora has been destroyed by the application of weedkillers, further reducing the value of the site to wildlife. The habitat is small, but part of a larger estuarine complex. Species diversity is not high. Fish ponds as a habitat in Hong Kong are on the decrease and this habitat is the only example in the local area, although, it would be relatively simple to recreate this habitat. Potential value of this habitat could be increased by the reduction in intensive management practices, such as the application of weed killer. The habitat is, therefore, judged to be of medium to low ecological value.

### **So Kwun Wat Valley Stream**

- 8.7.28 There is one main stream in the So Kwun Wat Valley. In the upper valley, east of So Kwun Wat Tsuen, the waters are clean, with little anthropogenic input and the stream bed is composed of coarse gravel and sands. At the time of survey during the dry season, the flow was minimal. Where woodland shades the waters, the undergrowth vegetation was limited, while in more open areas, the banks and stream margins were well vegetated with herbs and grasses typical of stream banks. Plant species found along the open banks were *Mikania guaco* (F), *Polygonium hydropiper* (F), *Commelina nudiflora* (F), *Colocasia esculenta* (O), *Ageratom conzoides* (O), the sedge *Cyperus radiatus* (O), *Minosa pudica* (R), an alien

species, *Gynuria bicolor* (R) and the grass *Eleusine indica* (R), see Appendix C.1. All are not rare or particularly uncommon, although the habitat created by the bankside and marginal vegetation will provide shelter and food for the stream fauna.

8.7.29 A fish survey from the upper stream east of So Kwun Wat Tsuen, as detailed in Appendix C.11 and summarised in Table 8.3 below, revealed 4 species of fish, all of which are widespread in Hong Kong and in other parts of China. Diversity, as expressed by the Shannon-Wiener function was low and evenness (Simpsons function) was also low, as shown in Table 8.4. The fish community being dominated by *Poecilia reticulata* and the prevalence of this fish, an alien species to Hong Kong, reduces the naturalness of the fish community as a whole.

**Table 8.3 Stream Fish Species Recorded East of So Kwun Wat Tsuen**

Species	Number Caught	Length (mm)	Weight (g)	Local Distribution	Regional Distribution
<i>Capoeta semifasciolata</i> (Six Banded Barb)	5	35.2	1.5	Widespread	Chang-jiang, Pear River, Min-jiang and Hainan Island
<i>Poecilia reticulata</i> (Guppy)	104	36.9	1.3	Widespread in Hong Kong, non-native species	
<i>Macropodus opercularis</i> (Paradise Fish)	4	51.25	2.25	Widespread in Hong Kong	Distributed widely in the freshwaters of China south of the Chang-jiang
<i>Oreonectes platycephalus</i> (Flat Headed Loach)	9	28	2.5	Widespread in the upper part of streams in Hong Kong	Pearl River Basin

**Table 8.4 Statistics of Captured Stream Fish East of So Kwun Wat Tsuen**

Parameter	Value
Number of Species	4
Number of Individuals	126
Diversity H'	0.84
Evenness	0.36

8.7.30 As well as fish, five different individuals of dragonfly nymph were incidentally collected in the fishing nets, demonstrating that the site is a breeding ground. It is possible that they belong to five different species, although further detailed identification would be required to confirm this. A list of likely candidates are given in Appendix C.12. The population of smaller fish species in the stream will undoubtedly provide a rich food source for these ruthless predators. According to Wilson (1997) over 25 species would be recommended before declaring a site a SSSI. The presence of 5 species would not merit high consideration.

- 8.7.31 A Common Kingfisher on the 23rd February 1999 and a Pied Kingfisher in March 1998 were, also, observed hunting along the stream. The former is common in Hong Kong, the latter is local in distribution.
- 8.7.32 This part of the stream is very natural in character, with little modification to the banks and low input of fertilisers and human wastes. Habitat diversity is good with patches of open and shaded stream which will encourage a range of faunal species. Diversity of fish species was low however, with the community being dominated by the alien species. The presence of the nymphs of five possible species dragonfly increases the value of the habitat on faunal grounds. Overall the various components of flora and fauna add up to a habitat of medium ecological value, worthy of protection from adverse impacts.
- 8.7.33 Progressing down the stream towards the village areas, the clarity of the water is gradually reduced, with algal mats attached to rocks becoming more prevalent. Feeder streams originating from village areas were contaminated with overflow from ill maintained septic tanks. It is, therefore, likely that the algal growth and cloudy water is caused by sewage pollution. The banks of the stream have also been shot-created as a strengthening measure. The naturalness of this part of the stream is therefore low. Diversity of flora and fauna is also expected to be low. It would be relatively easy to recreate the pre-existing habitat by removing the sewage input and restoring the banks to their previous condition. The ecological value of this habitat is, therefore, considered to be low.

### **Tai Lam Chung Valley Stream**

- 8.7.34 Tai Lam Chung valley stream is headed by one of the concrete dams for the Tai Lam Chung Reservoir. Residual flow into the existing stream bed from the reservoir passes through the Tai Lam Chung Correctional Institution. The dry season flow is minimal to non-existent. The stream bed is composed of boulders, gravels and sands, indicating that flow can or has been very large at times. Small pools exist along the stream course, some of which are quite deep, with some containing fish of 10-20cm in length. The banks are colonised by wet grassland. The stream widens out as it joins the main estuary at the entrance to the Correctional Institution. This habitat is ranked of medium ecological value.

### **Coastal and Intertidal**

- 8.7.35 The main coastal habitats consists of sea defence walls, rocky outcrops of headlands and more sheltered sandy bays. The bay at east of Castle Peak Villas and South of Siu Lam, Drawing 8.3, provides a good example of seral change from sea to land. A large bar of sand heads the bay behind which a pool of brackish water has developed. The sand bar is topped by coastal creeping grasses. The pool was observed to contain some small individual fish of unknown species and small individual specimens of mangrove trees. A belt of trees on the landward side of the pool are of the species *Hibiscus tiliaceus*, a coastal species which is found throughout the tropics. Such habitat types are becoming rarer in Hong Kong through coastal development pressures.
- 8.7.36 The main estuary at Tai Lam Chung does not possess a large low water intertidal area in relation to its total high tide area. The majority of the estuary remaining submerged at low water. The

northern end of the estuary contains the highest area of intertidal habitat and is composed of intertidal sand/mud flats which are inhabited by burrowing crabs. The central and southern parts of the estuary are composed of cobble shore with hard seawalls and a few area of sand flats. Grazing snails were observed on the hard substrates.

### Estuarine

- 8.7.37 The stream at Tai Lam Chung enters the long finger of the main estuary at the border of the Correctional Institution. A small tributary exists to the south of the main estuary. It is connected to the sea via a culvert, as shown in Drawing 8.7. The locations of both these areas are shown in Drawings 8.1 and 8.2. Both areas are sheltered from most of the weather and waves, sediments consist of rocky gravels and fine sands suggesting a medium tidal current velocity. The bed is strongly anoxic in places emitting a strong smell when disturbed. This indicates organic enrichment probably from the village sewerage finding its way into the main estuary and small tributary. On a subjective basis therefore, water quality is judged to be fair but probably suffers from inputs of untreated or only partially treated sewage.
- 8.7.38 Birds observed feeding in the main estuary while walking between Area 7 (pond) and Area 2 (marsh) included the Little Egret and Pied Kingfisher, demonstrating that this area is a feeding ground for piscivorous birds.
- 8.7.39 Fish were observed during a site visit in October 1998 of unknown species. Larger individuals (5-10cm in length) taking up feeding positions in the mid sections of the main estuary, with smaller individuals (1-3cm in length) keeping close to the shallows.
- 8.7.40 A survey of the larger juvenile fish (5-10cm in length) was conducted on 13th March 1999, in the main estuary and the small tributary to determine if any commercial species were present. A survey of the smaller sized fish (1-3cm in length) was not carried out because only a few individuals were observed during the site visit in October and the site was therefore not considered to be important for the smaller fish. The results of the survey are given in Appendix C.13 and the locations of the sampling stations are given in Appendix D, Drawing 4. Commercial species of fish recorded include *Mugil cephalus* (Grey Mullet), *Acanthopagrus latus* (Black Bream) and *Monotaxis grandoculis* (Bigeye Barenose), all of which are commercial species. Only two individuals were captured during the survey, *Monotaxis grandoculis* at station 2, and a specimen of *Acanthopagrus latus* near the existing footbridge across the main nullah, west of Tai Lam Chung Tsuen. However, under the footbridge, a large shoal of Grey Mullet were observed, numbering 50-100 fish at 15-20cm in length.
- 8.7.41 From the sampling data and subjective observations, it would appear that the area is a nursery ground for mainly Grey Mullet, a ubiquitous fish, and the infrequent *Acanthopagrus latus* and *Monotaxis grandoculis* which is found widely in Hong Kong. From a fisheries point of view, it is likely that both the main estuary and the small tributary are, therefore, not of great importance.

## 8.8 Summary of Key Resources

- 8.8.1 Key ecological resources have been identified in the study area through literature review and

field surveys. These include designated nature conservation areas, habitats and species which are protected, rare, vulnerable to human disturbance or otherwise of conservation interest. Key sites, habitats and species have been identified based on the criteria set forth in Annex 8, Tables 2 and 3 of the TMEIA, in conjunction with local and international knowledge. Only one recognised site of conservation importance was located within the study boundary, the Tai Lam Country Park. The boundary of the park is shown in Drawings 8.1 to 8.4. The following tables list sites, habitats and species of conservation importance which have been identified in the study area. The distribution of ecological resources identified within the study area that are of value are given in Tables 8.5 and 8.6.

**Table 8.5 Habitats and Sites of Importance Within the Study Area**

Habitat	Importance
Coastal seral complex east of Castle Peak Villas	<ul style="list-style-type: none"> <li>• Uncommon habitat in the HKSAR.</li> <li>• Diverse patchwork of habitats types (beach, small dune colonised by grass, brackish pools and coastal woodland).</li> </ul>
Upper lowland reach of So Kwun Wat valley stream east of So Kwun Wat Tsuen	<ul style="list-style-type: none"> <li>• Habitat very natural in character.</li> <li>• supports 4 fish species, typical of small streams.</li> <li>• breeding site for lotic dragonfly species.</li> <li>• uncommon example of an unpolluted diverse lowland stream habitat.</li> </ul>
Woodland at Tai Lam Chung and So Kwun Wat	<ul style="list-style-type: none"> <li>• area of woodland large.</li> <li>• natural secondary woodland between 20-40 years old.</li> <li>• likely to support a diverse woodland fauna.</li> <li>• recreation possible but would be long term, taking 20-50 years to accomplish.</li> </ul>
Marsh at Tai Lam Chung	<ul style="list-style-type: none"> <li>• medium area &gt; 1 hectare.</li> <li>• locally important for wetland species, as only example of habitat type know for the area.</li> <li>• Stopping off point for migrating water birds.</li> </ul>
Active fish culture ponds, Tai Lam Chung	<ul style="list-style-type: none"> <li>• Provides feeding area for waterbirds.</li> </ul>
Estuary at Tai Lam Chung	<ul style="list-style-type: none"> <li>• Nursery area for two species of commercial fish.</li> </ul>

**Table 8.6 Species of Concern Occurring Within the Study Area**

Species	Importance	Location
<i>Gallinago stenura</i> (Pintail Snipe)	<ul style="list-style-type: none"> <li>• Rare winter migrant.</li> <li>• Requires wetlands with soft soils to feed, such habitat is decreasing in Hong Kong.</li> </ul>	Area 2 (Marsh), Drawing 8.7

8.8.2 These ecological resources are not all equally likely to be affected by the project. The potential impacts are discussed in Section 8.9 below.

## **8.9 Assessment of Impacts**

### **Assessment Methodology**

8.9.1 This section of the report identifies and evaluates the potential ecological impacts of the Tuen Mun Sewerage components. Impact assessment is based on the TMEIA (particularly Annexes 8 and 16) and the Study Brief, which states: "The study shall take into account the importance of ecological components for natural flora/fauna habitats in the development areas. It is essential to observe the importance of protecting, rehabilitating and maintaining the natural environment. The assessment shall focus on issues important to confirm the environmental feasibility of the proposed development."

8.9.2 The significance of ecological impacts is evaluated based primarily on the criteria set forth in Table 1, Annex 8 of the TMEIA; as follows:

- habitat quality;
- species affected;
- size/abundance of habitats/organisms affected;
- duration of impacts;
- reversibility of impacts; and
- magnitude of environmental changes.

8.9.3 Impacts are generally ranked as "minor", "moderate" or "severe", although in a few cases a ranking of "insignificant" (less than "minor") may be given. The ranking of a given impact will vary based on the criteria listed above. Wherever possible, significance of impacts is quantified to allow comparison of impacts. Quantification can be based upon actual measurements, the application of professional judgement and value judgements, as noted in paragraph 5.3.1, Annex 16 of the TMEIA.

8.9.4 Impacts are assessed in the absence of mitigation. Mitigation is proposed in Section 8.10 to reduce significant impacts to acceptable levels. "Significant" is used for the purposes of this report to refer to impacts requiring mitigation and is applied to "minor", "moderate" and "severe" impacts. In the tables summarising project impacts in this section, the column "Mitigation recommended" is checked "yes" for significant impacts.

8.9.5 The ecological impacts of each sewerage area were assessed individually as follows:

- C Tai Lam Chung Valley, covering the Tai Lam Correctional Institution, Tai Lam Chung Tsuen, Luen on San Tsuen and Tai Lam Valley pumping stations and associated sewer alignments,
- C Castle Peak Villas; and

**Table 8.7 Cont'd....**

C So Kwun Wat Valley.

8.9.6 The impact of construction and operation of the sewerage system on each habitat was assessed with further direct and indirect impacts not related specifically to habitat loss being assessed separately.

**Tai Lam Chung Valley Sewer Alignment and Pumping Stations**

**Background**

8.9.7 The route and layout of the Tai Lam Chung Valley sewer alignment is described in Section 2 and shown in Drawing 1.1a.

**Construction Impact**

8.9.8 *Habitat loss:* Construction of the sewer would result in the loss of habitat within the site boundary and the estimated areas lost are given in Table 8.7 below. After construction is complete the excavated material shall be replaced and the surface soils will then be available for recolonisation. In the case of the pumping stations the loss of habitat will be a permanent impact. The assessment of the significance of habitat loss is detailed below and in Table 8.8

**Table 8.7 Habitat Loss Resulting from Sewer Alignment and Pumping Stations in Tai Lam Chung Valley**

Habitat	Total Area of Habitat within Tai Lam Chung Valley (m2)	Area Affected (m2)	Percentage Loss
Bare Ground	541590	10479	1.9%
Grassland	347324	7499	2.1%
Woodland	829273	1643	0.2%
Main estuary and small tributary	86750	215	0.3%
Scrub	548588	1448	0.3%
Pond	5013	363*	7.2%
Orchard	3457	97	2.8%
Ruderal	10416	422	4.0%
Arable Land	17733	125	0.1%
Marsh	6259	5	0.2%

\* Due to Tai Lam Valley pumping station

Notes: (1) All habitats are shown in Drawings 8.1, 8.2 and 8.3

(2) Location of Woodland areas 1 and 4 are located in Drawing 8.7.

8.9.9 *Bare ground:* Although the magnitude of the loss of bare ground is large, the ecological value of this habitat is low. No species of importance were recorded on this habitat and the

- duration of the impact will be short term. The ecological impact as a result of the loss of bare ground is, therefore, ranked as insignificant.
- 8.9.10 *Grassland*: Although the magnitude of the loss of grassland is medium, the ecological value of this habitat is low. No species of importance were recorded on this habitat and the duration of the impact will be short term. The ecological impact as a result of the loss of grassland is, therefore, ranked as insignificant.
- 8.9.11 *Woodland*: The possible damage to the woodland to the north of Tai Lam Chung Tsuen (Woodland Area 1, Drawing 8.7) as a result of the original site boundary being close to the edge of the wood and the roots of the trees was not considered to be of great magnitude, as damage was not expected to be widespread, although some individual trees may have been affected. The woodland is of medium ecological value and no important species were observed. However, it is likely to provide a habitat for some of Hong Kong's protected mammals and the duration of the impact is likely to be long term. Thus, while the impact would be ranked as minor, the site boundary has been revised to avoid any impacts on this area. The original and revised works limit can be seen in Drawing 8.10.
- 8.9.12 The woodland at Wong Uk (Woodland Area 4, Drawing 8.7) is of medium ecological value due to the age and diversity of flora identified and although no important species were observed, it is likely to provide a habitat for some of Hong Kong's protected mammals. Thus, while magnitude of the impact from the original sewer alignment would be small and ranked as moderate, the sewer alignment has been modified to avoid any impacts on this wooded area and is now located along the village access. The original and revised sewer alignment in this area can be seen in Drawings 8.10.
- 8.9.13 *Main estuary and small tributary*: The installation of the pipe bridge across the main estuary will result in a limited permanent loss of bed sediments. The ecological value of this habitat is expected to be low given the low water quality and the anoxic sediments observed in the area. The ecological impact from habitat loss is, therefore, ranked as insignificant.
- 8.9.14 Excavation of the sewer crossing for the small tributary will result in the temporary disturbance to the bed sediments. Ecological value of this habitat is not expected to be high given the poor water quality observed within this water body and the works will be undertaken in the dry season. Recovery from the disturbance is expected to occur over the medium term. Impacts are, therefore, ranked as insignificant.
- 8.9.15 *Scrub*: The ecological value of the scrub is low, no important species were recorded, impacts would be short to medium term but small in magnitude. The impacts related to scrub loss is therefore ranked as insignificant.
- 8.9.16 *Orchard*: The ecological value of the orchard is low with no important species recorded. Impacts would be long term but small in magnitude. The impacts related to orchard loss are, therefore, ranked as insignificant.
- 8.9.17 *Ruderal and Arable Land*: The ecological value of these habitats is low with no important species were recorded and impacts would be short term but small in magnitude.

The impacts related to habitat loss are, therefore, ranked as insignificant.

- 8.9.18 *Marsh:* The ecological value of the marsh habitat is medium with one rare winter migrating bird being recorded. Impacts would be short term but small in magnitude. The impacts related to marshland loss are, therefore, ranked as minor.
- 8.9.19 *Tai Lam Chung Tsuen Pumping Station:* The loss of habitat due to the pumping station is a permanent impact. The proposed pumping station at Tai Lam Chung Tsuen is located on an area of mixed habitats of bare ground and grassland and a few trees. Ecological value of this area is low. No important species are expected and the magnitude of the impact would be small. Therefore, the impact of locating the pumping station on this site is ranked as insignificant.
- 8.9.20 *Tai Lam Valley Pumping Station:* The pumping station at Tai Lam Chung Valley will result in the permanent loss of habitat. The proposed pumping station site will result in the permanent loss of bare ground, orchard and 363m<sup>2</sup> of brackish fish pond. The fish ponds have low species diversity but are considered to be of medium ecological value. The magnitude of this loss, given the availability of other similar habitats, such as the adjacent estuary, is minor. Impact significance is, therefore, ranked as minor.
- 8.9.21 *Luen On San Tsuen Pumping Station:* The proposed pumping station at Luen On San Tsuen will result in the permanent loss of habitat. The proposed pumping station will occupy a small area of bare ground and housing and no important species were recorded. The ecological value of this habitat is low. Therefore, impact significance is ranked as insignificant.

**Table 8.8 Summary of Assessment for Total Habitat Loss in Tai Lam Chung Valley**

Habitat	Ecological Value	Important Species	Duration of Impact	Impact Magnitude	Impact Significance	Mitigation
Arable Land	low	none recorded	short term	small	insignificant	-
Bare Ground	low	none recorded	short term	large	insignificant	-
River / Estuary	medium	none recorded	short term	small	insignificant	(4)
Grassland	low	none recorded	short term	medium	insignificant	-
Marsh	medium	1 rare species	short term	small	minor	✓
Orchard	low	none recorded	long term	small	insignificant	-
Pond*	medium	none recorded	permanent	large	minor	✓
Ruderal	low	none recorded	short term	small	insignificant	-
Scrub	low	none recorded	medium term	small	insignificant	-
Woodland Area 1	medium	none recorded	impact avoided through revision to site boundary			
Woodland Area 4	medium	none recorded	impact avoided through revision to sewer alignment			

\* Due to pumping station at Tai Lam Valley only

Notes: (1) All habitats above are shown in Drawing 8.1, 8.2 & 8.3.

(2) Woodland Areas refer to locations shown in Drawings 8.7, there are no woodlands in areas 2,3 and 5.

(3) Important species refer to “Species of Conservation Importance” as defined in Annex 16, Appendix A, Note 3 of the Technical Memorandum on Environmental Impact Assessment Process.

(4) Impact considered insignificant but from a water quality prespective mitigation recommended. See also Chapter 6.

8.9.22 *Water quality degradation and fisheries:* Dredging the foundations for the pipe bridge across the main estuary will generate suspended solids and possibly reduce the oxygen concentration in the water column. Such a reduction in water quality may harm the juvenile commercial fish identified in the main estuary.

8.9.23 However, water quality impacts will only be short term in nature and of small magnitude. The fish observed are also of a large enough size to enable them to avoid areas of poor water quality and move to cleaner waters. They will quickly return on cessation of the impact.

8.9.24 The above assessment is backed up by observations made on a similar bridging project in the same area. A public footbridge is currently being constructed across the main estuary, adjacent to the proposed pipebridge crossing, under the RPIS Minor Rural Improvement Works Packages 1 and 2, Project TM-068. Grey Mullet were observed swimming in the area before

construction of this bridge commenced. After dredging and foundation laying works were completed, the same species of fish were observed swimming around the newly installed bridge piers.

8.9.25 Impacts on the commercially important juvenile fish recorded in the main estuary is ranked as insignificant.

8.9.26 *Hydrological impacts:* The digging of the trench and the laying of the sewer, may have some adverse drainage impacts on the marsh located south of Tai Lam Chung Tsuen. The open sewer trench may act as a drain collecting water from the marsh. In such an event the water level in the marsh could drop. Once the sewer trench is filled in drainage of the marsh will cease. It is not expected that any great damage will come to the marsh as construction of the sewer in the immediate area of the marsh will be relatively short term and the magnitude of the impact is expected to be small. The significance of this impact is, therefore, ranked as minor.

8.9.27 *Disturbance to birds on the marsh:* Impacts on birds inhabiting the marsh may occur from disturbance during construction of the sewer. A rare winter migrating bird was recorded on the marsh indicating that the habitat is used as a stop-over point for winter birds, although not in great numbers. Magnitude is difficult to assess precisely as there is a paucity of information in the literature regarding bird disturbance. However, it has been shown that some species of bird adapt to new activities in their environment. Generally, the more predictable a disturbance event is the quicker birds adapt. It is likely that construction work will scare away quite a few of the more sensitive and secretive bird species, however, due to the short duration of the construction work in the vicinity of the marsh, the impact is ranked as insignificant.

### **Operation Impact**

8.9.28 *General:* No adverse ecological impacts are expected.

8.9.29 *Water quality:* All chronic discharges of septic tank overflows will cease on commissioning of the Project. Water quality is, therefore, expected to improve greatly in the small drainage streams which pass through the villages and in the main estuary and small tributary. Impact from pollution of local water courses due to the failure of the pump system or power supply, is an unlikely event and, therefore, the risk is very small.

### **Castle Peak Villas**

#### **Construction Impact**

8.9.30 Ecological impacts from construction of the sewer and pumping station at Castle Peak Villas are expected to be minor. Only a small area of scrub will be affected, which is of low ecological value.

#### **Operation**

8.9.31 *General:* No adverse ecological impacts are expected.

8.9.32 *Water quality:* Impact from the discharge of raw sewage into the marine environment due to the failure of the pump system or power supply is an unlikely event due to the provision of mitigation measures in the form of standby pumps, emergency power supply and a telemetry system and, therefore, the risk is very small. In the event of such an occurrence, the quantity of raw sewage entering the sea will be diluted by the much larger volume of sea water. Impacts will be short term and it is predicted that any discharge will be flushed from the bay within 1-2 days. No acute damage to the coastal communities are expected and, therefore, major impacts on surrounding coastal habitats are not expected.

### **So Kwun Wat Sewer Alignment and Pumping Station**

#### **Background**

8.9.33 The route and layout of the So Kwun Wat Valley sewer system is described in Section 2 of this report. This area includes both the villages of So Kwun Wat Tsuen and So Kwun Wat San Tsuen.

#### **Construction**

8.9.34 *Habitat loss:* Construction of the sewer would result in the loss of habitat within the site boundary, the estimated areas lost are given in Table 8.9 below. After construction is complete the excavated material will be replaced and the surface soils will then be available for recolonisation. In the case of the pumping station, the loss of habitat will be a permanent impact. The assessment of the significance of habitat loss is detailed below and in Table 8.10.

**Table 8.9 Habitat Loss Resulting from the Sewer Alignment and Pumping Station in So Kwun Wat Valley**

<b>Habitat</b>	<b>Total Area of Habitat within So Kwun Wat Valley (m<sup>2</sup>)</b>	<b>Area Affected (m<sup>2</sup>)</b>	<b>Percentage Loss</b>
Bare Ground	345898	8729	2.5%
Abandoned Farmland	70036	1133	1.6%
Grassland	206430	1069	0.5%
Woodland	855793	227	0.02%
Ruderal	33968	319	1.0%
Arable Land	55022	371	0.7%
Orchard	20951	300	1.4%
Stream	25143	204	0.8%

8.9.35 *Bare ground:* Although the magnitude of the loss of bare ground is medium, the ecological value of this habitat is low with no species of importance being recorded on this habitat. The duration of the impact will be short term and the ecological impact as a result of the loss of bare ground is, therefore, ranked as insignificant.

- 8.9.36 *Abandoned farm land*: The magnitude of the loss of this habitat is small, the ecological value of this habitat is low, no species of importance were recorded on this habitat and the duration of the impact will be short term. Ecological impact as a result of the loss of habitat is, therefore, ranked as insignificant.
- 8.9.37 *Grassland*: The magnitude of the loss of grassland is small, the ecological value of this habitat is low, no species of importance were recorded on this habitat, and the duration of the impact will be short term. Ecological impact as a result of the loss of habitat is, therefore, ranked as insignificant.
- 8.9.38 *Woodland*: The woodland to the east of So Kwun Wat Tsuen (Woodland Area. 6, shown on Drawing 8.8) is of medium to high ecological value due to the age and diversity of flora identified although no important species were observed. It is also likely to provide a habitat for some of Hong Kong's protected mammals. The original sewer alignment followed the edge of this wood and would have resulted in some trees having to be felled. While, magnitude of this impact will be small and ranked as moderate, the sewer alignment has been modified to avoid any impact on this wood. The original and revised sewer alignments can be seen in Drawing 8.11.
- 8.9.39 *Ruderal and Arable Land*: The ecological value of the these habitats is low, no important species were recorded, impacts would be short term but small in magnitude. The impacts related to habitat loss is, therefore, ranked as insignificant.
- 8.9.40 *Orchard*: The ecological value of the orchard is low, no important species were recorded, impacts would be long term but small in magnitude. The impacts related to habitat loss is, therefore, ranked as insignificant.
- 8.9.41 *Stream*: The ecological value of the stream is medium, no important species were recorded and impacts would be short to medium term and small in magnitude. The impact related to habitat loss is, therefore, ranked as minor.
- 8.9.42 The loss of habitat due to the pumping station is a permanent impact. The proposed pumping station at the east end of So Kwun Wat Tsuen will occupy an area of bare ground used as a lorry park and ecological value of this area is very low. The impact of locating the pumping station is, therefore, ranked as insignificant.

**Table 8.10: Summary of Assessment for Total Habitat Loss in So Kwun Wat Valley**

Habitat	Ecological Value	Important Species	Duration of Impact	Impact Magnitude	Impact Significance	Mitigation
Abandoned Farmland	low	none recorded	short term	small	insignificant	-
Arable Land	low	none recorded	short term	small	insignificant	-
Bare Ground	low	none recorded	short term	medium	insignificant	-

**Table 8.10 Cont'd...**

Habitat	Ecological Value	Important Species	Duration of Impact	Impact Magnitude	Impact Significance	Mitigation
Grassland	low	none recorded	short term	small	insignificant	-
Orchard	low	none recorded	long term	small	insignificant	-
Stream	medium	none recorded	short term	small	minor	✓
Ruderal	low	none recorded	short term	small	insignificant	-
Woodland Area 6	medium - high	none recorded	impact avoided through revised sewer alignment			

8.9.43 *Water quality degradation of stream east of So Kwun Wat Tsuen:* Dredging the channel for the sewer crossing of the stream will generate suspended solids. Such a reduction in water quality may harm the stream fauna. The stream and its riparian habitat is of medium ecological value. However, acute water quality impacts are only expected to last 1 to 2 days. If damage to the faunal community occurs, impacts would be expected to be short to medium term in nature (2 to 6 months) and good recovery of stream fauna is expected as new members of the community will immigrate from further up stream. Suspended solids are not expected to travel far as the bed sediments are composed of sands and gravels. The magnitude of this impact is, therefore, expected to be small and the impact of dredging on stream fauna ranked as minor.

### Operation

8.9.44 *General:* No adverse ecological impacts are expected.

8.9.45 *Water quality:* All chronic discharges of septic tank overflows will cease on commissioning of the Project. Water quality is, therefore, expected to improve greatly in mid to lower reaches of the So Kwun Wat valley main stream. Impact from pollution of local water courses due to the failure of the pump system, is an unlikely event due to the provision of mitigation measures in the form of standby pumps, emergency power supply and a telemetry system and, therefore, the risk is very small. Location of the emergency overflow below So Kwun Wat Tsuen, however, would avoid damage to the more natural upper stream. The overflow has been designed to discharge at the recommended location. Recovery of the streams fauna would be expected to occur relatively quickly as species re-colonise from the more diverse and natural upstream areas.

### 8.10 Mitigation

8.10.1 Mitigation for the impacts identified is given in Tables 8.11 and 8.12 below for the Tai Lam Chung Valley and So Kwun Wat respectively. No mitigation is required for Castle Peak Villas.

**Table 8.11 Recommended Mitigation Measures for Tai Lam Chung Valley**

Impact	Mitigation
Loss of habitat and inadvertent drainage of marsh, Area 2	Minimise predicted 5m <sup>2</sup> habitat loss by careful site practices and minor changes to works area to avoid loss of marshland habitat. It is expected that the necessary changes can be made when the site boundary is being marked out before construction.  Reduce any drainage impact by collecting any water that seeps from the marsh into the open sewer trench during construction and returning it to the marsh.
Water quality impacts in the main estuary and small tributary	Confine excavation works to the dry season in order to limit the impacts from the transportation of suspended materials and undertaken excavation for pipe bridge pier inside a cofferdam.

**Table 8.12: Recommended Mitigation Measures for So Kwun Wat Valley**

Impact	Mitigation
Water quality degradation of stream east of So Kwun Wat Tsuen, Area 5	Laying of the sewer across the stream should be confined to periods of low flow in order to limit the impacts from the transportation of suspended solids.

8.10.2 No residual adverse ecological impacts are predicted, if the above mitigation is applied. However, the resumption of the brackish pond at Tai Lam Valley associated with the pumping station site will present a minor impact for which there is no mitigation. The residual impact is not considered unacceptable, however, due to the small size of the pond, its low species diversity and the availability of other similar habitats such as the adjacent estuary.

## 8.11 Residual Impacts

8.11.1 The project may result in some ecological impacts. However, if the recommended mitigation measures are applied then impacts resulting from the project shall be reduced to an acceptable level. The loss of a fish pond in the Tai Lam Valley will represent a minor residual impact. However, within the overall benefits of the project and the quality and magnitude of habitat loss, the residual impact is considered to be acceptable.

## 8.12 Environmental Monitoring and Audit

8.12.1 The ecological assessment has concluded that there will be no unacceptable impacts if mitigation measures are applied. In light of the minor nature of the impacts predicted and the limited mitigation required to ameliorate these, EM&A during the construction or operational phases is not recommended.

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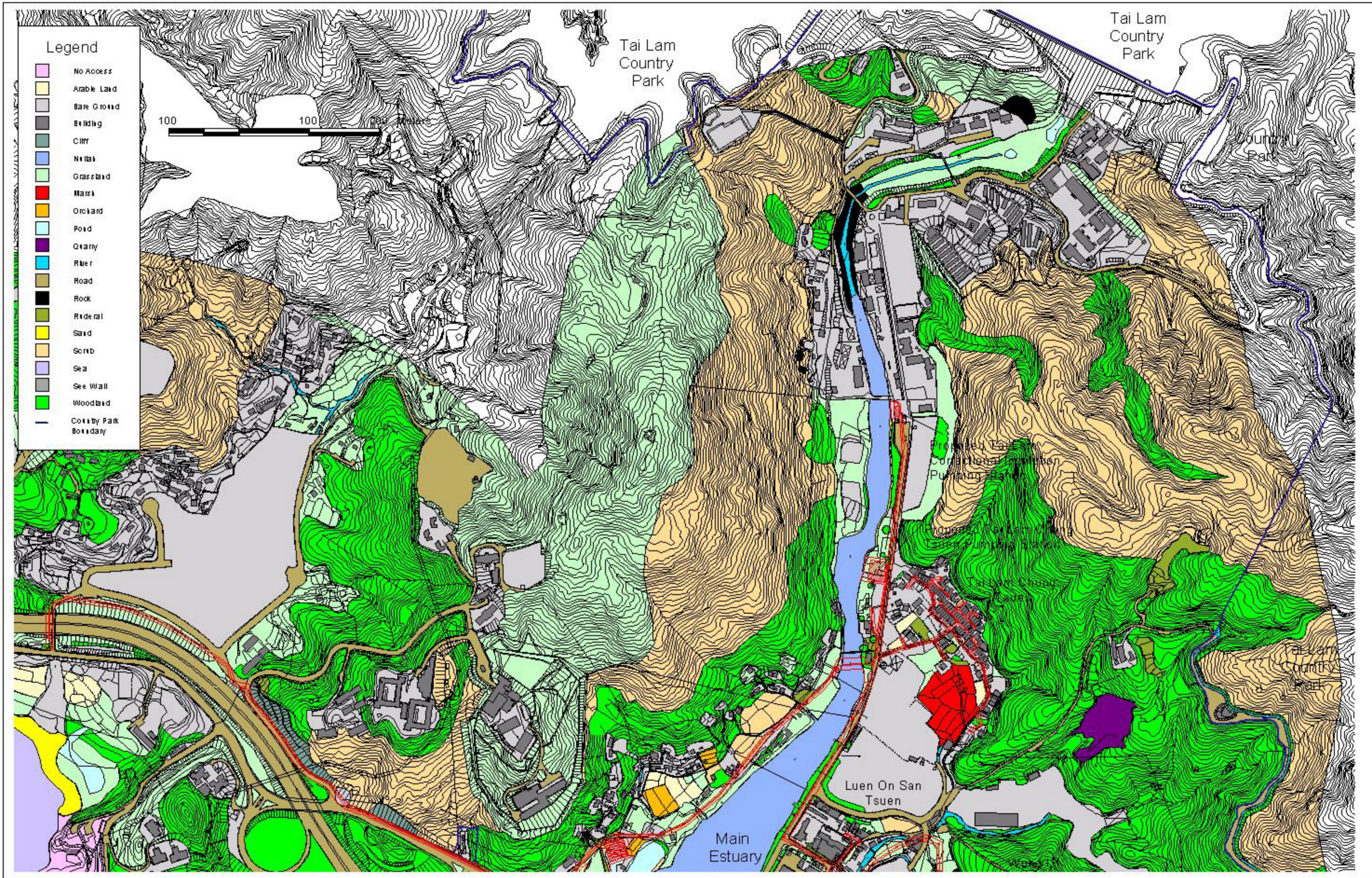
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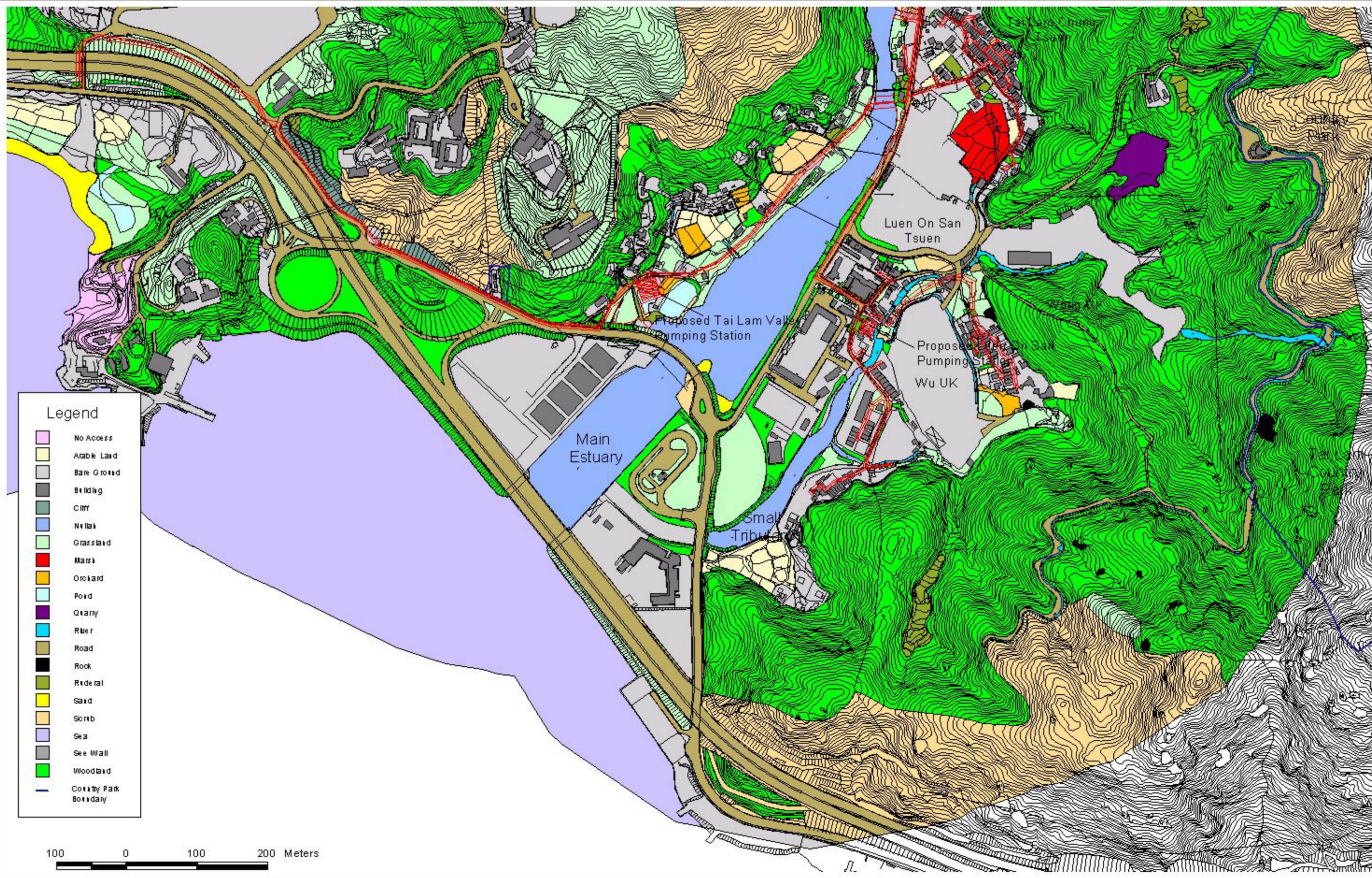
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**Ecological Habitat Map of Tai Lam Chung ( 1 of 3)**

**Mouchel**

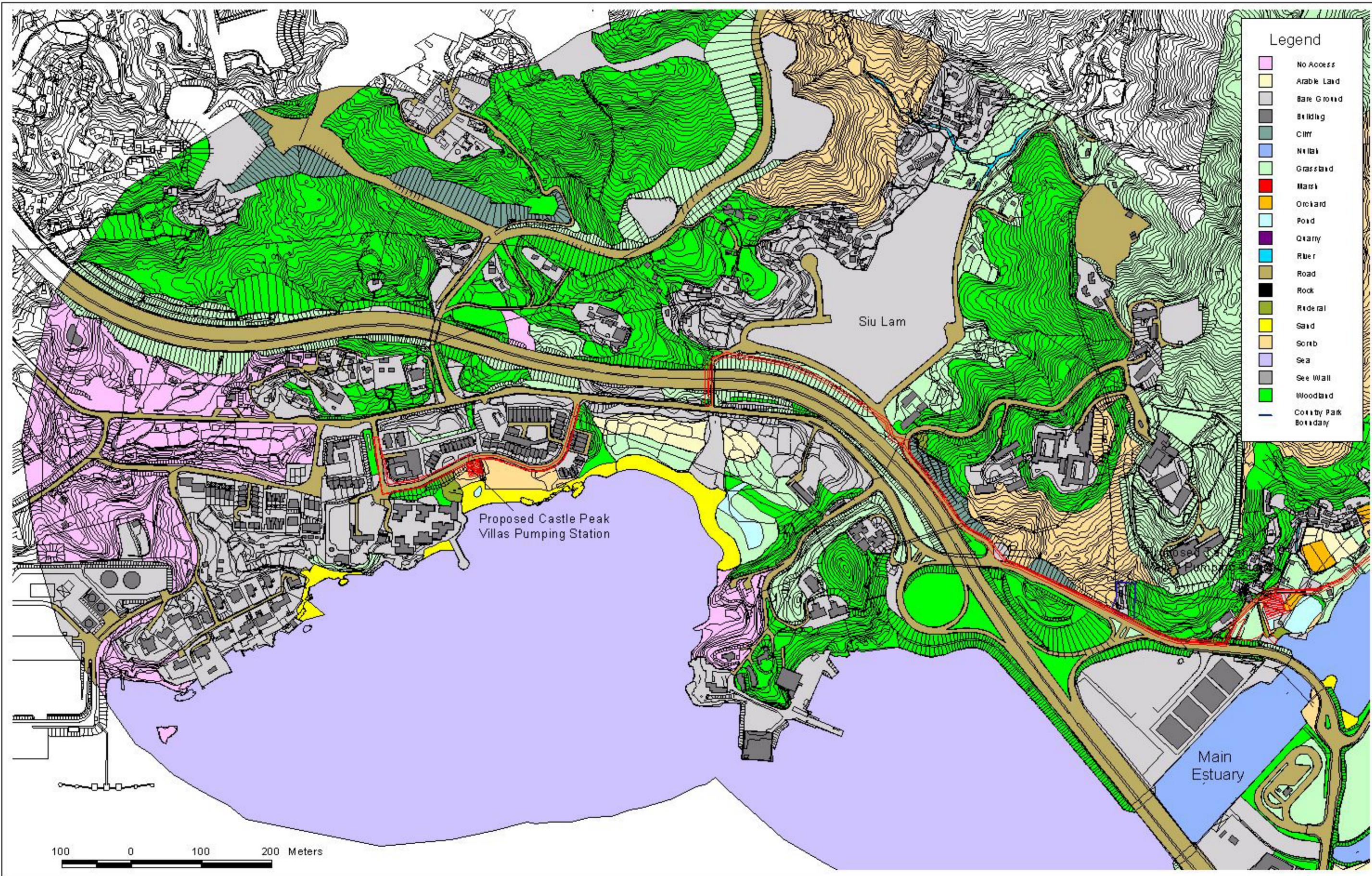
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**Ecological Habitat Map of Tai Lam Chung ( 2 of 3)**

**Mouchel**

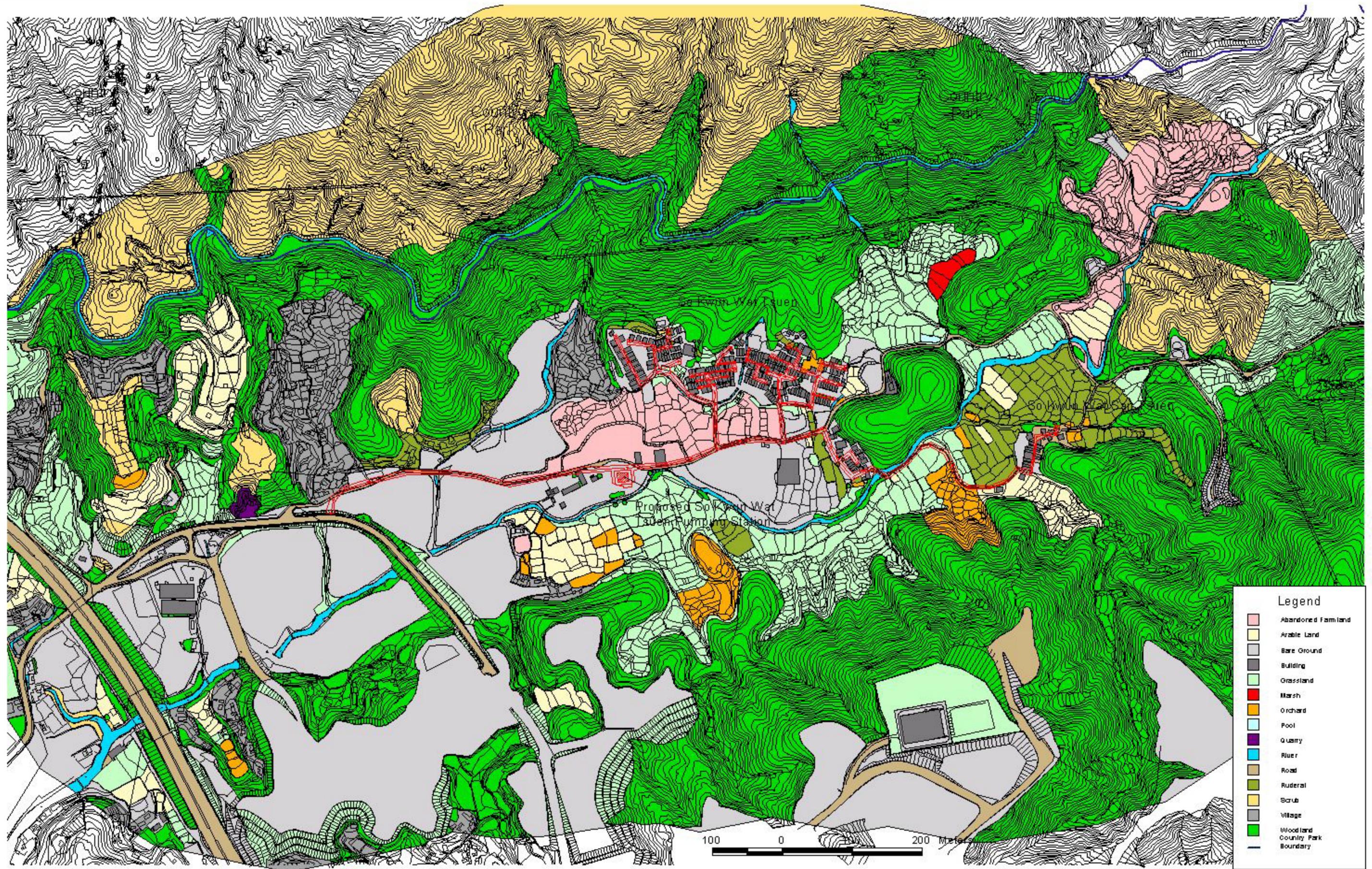
Drawing No. 8.2



**Ecological Habitat Map of Tai Lam Chung ( 3 of 3)**

**Mouchel**

Drawing No. 8.3



## Ecological Habitat Map of So Kwan Wat

Mouchel

Drawing No. 8.4



Woodland habitat containing a diverse floral community and likely to support a diverse faunal community.



Marsh has evolved from disused wet agricultural land and still retains a few agricultural species. Marsh as a habitat is becoming rare in Hong Kong, this example being the only one found within the local area.



The active commercial fish ponds located adjacent to the main estuary is used to cultivate marine fish. Kingfishers and Egrets were observed feeding here.



Water quality of the main estuary is considered to be fair. Juvenile species of commercial fish were observed.

## Examples of Habitat Types found in the Study Area



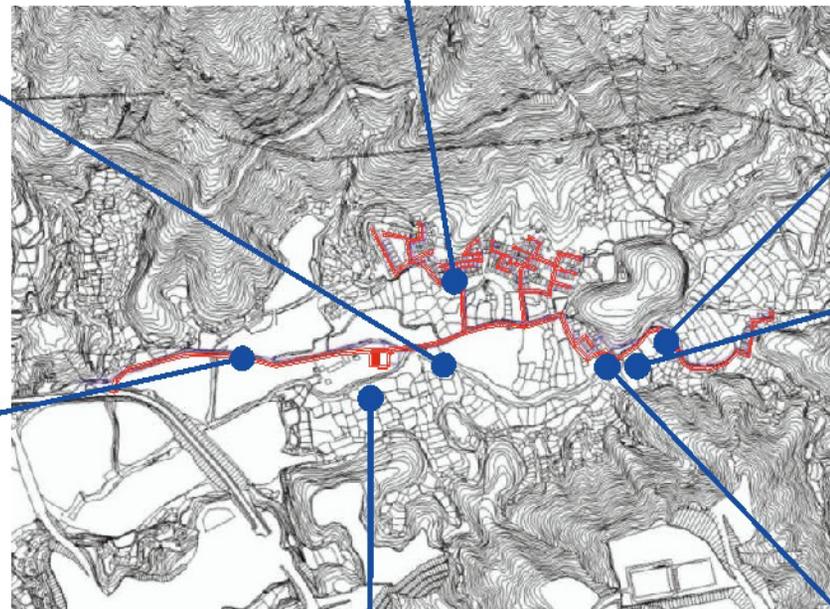
River channel has been strengthened with shotcrete and the existing water quality is poor with algal mat attached on rocks. The naturalness and diversity of the stream is greatly reduced.



Typical village area, with large bare open areas and a few trees



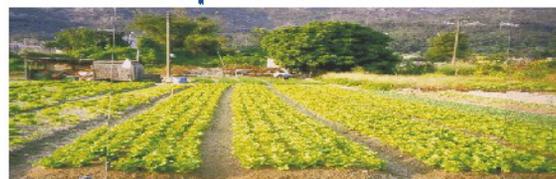
Dry Grassland, with low floral species diversity



Wet Grassland, of medium species diversity.



Open storage area is the major land use along the So Kwun Road the value to wildlife is very limited.

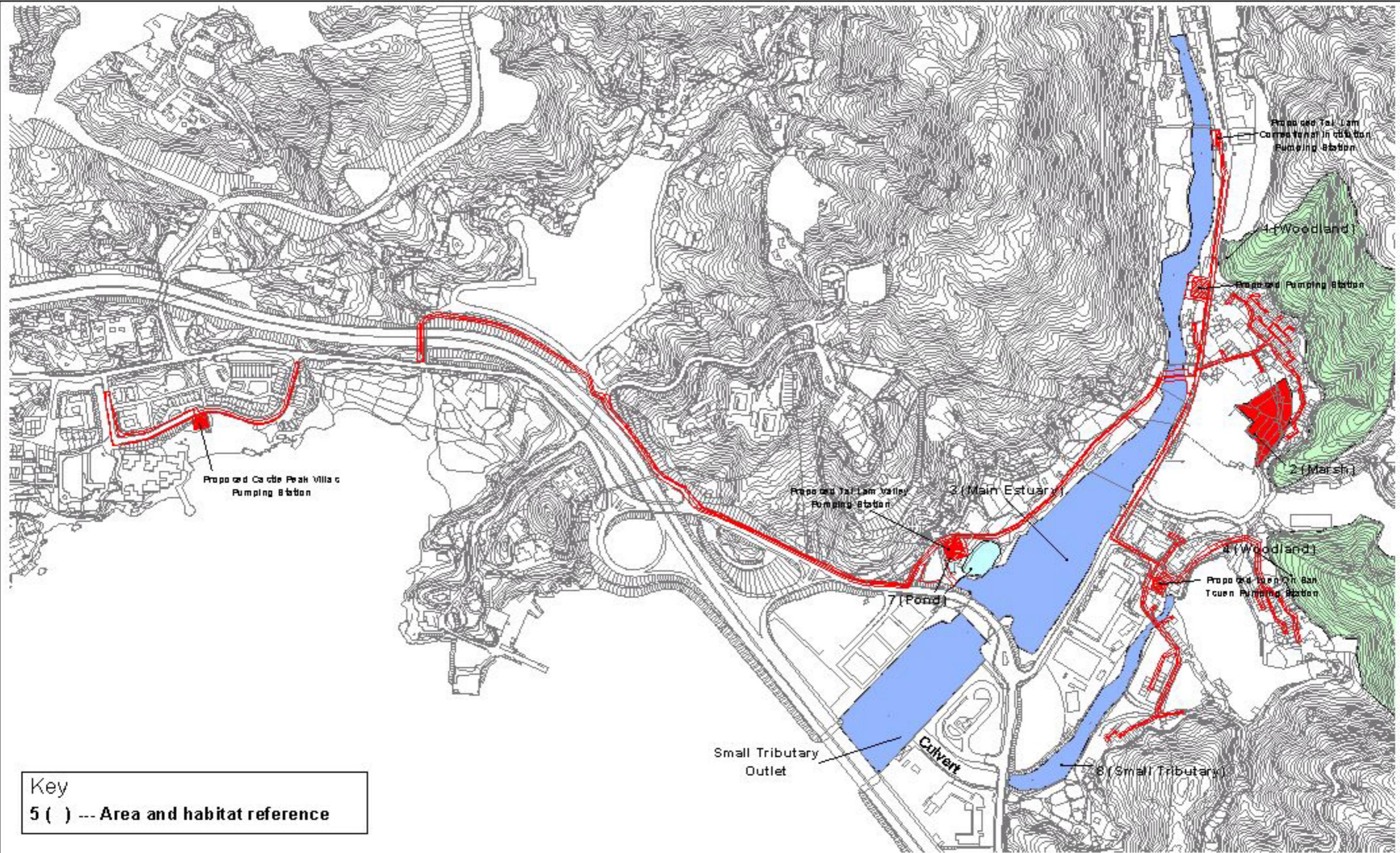


An example of active agricultural land, the area of which has been greatly dedined in New Territories. Naturalness of this habitat is limited, although it may provide a feeding area for a number of bird species associated with agriculture.

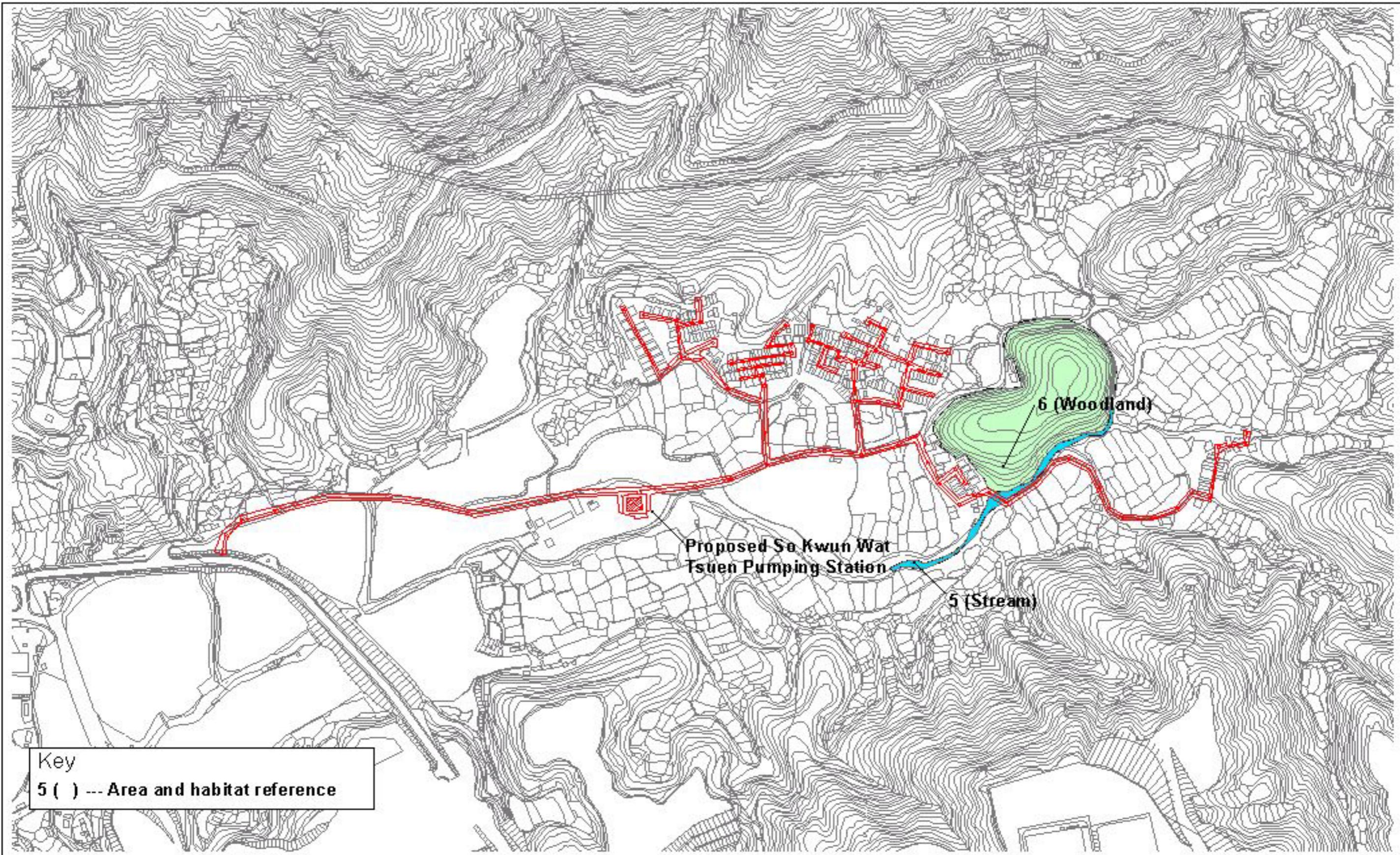


Upper So Kwan Wat stream east of So Kwan Wa Tsuen possess clean waters, with diverse riparian habitats and flora, supporting a range of faunal species.

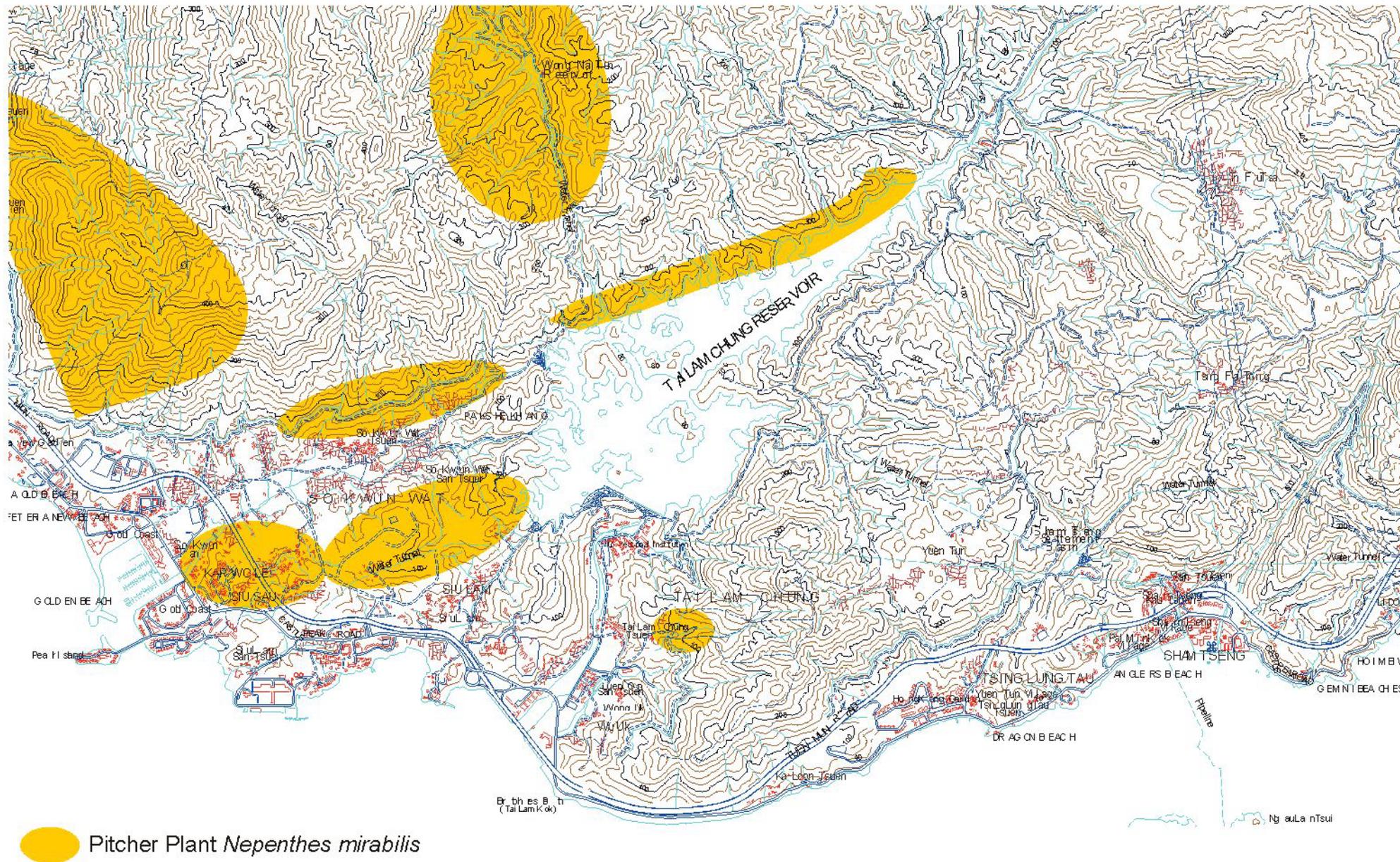
## Examples of Habitat Types found in the Study Area



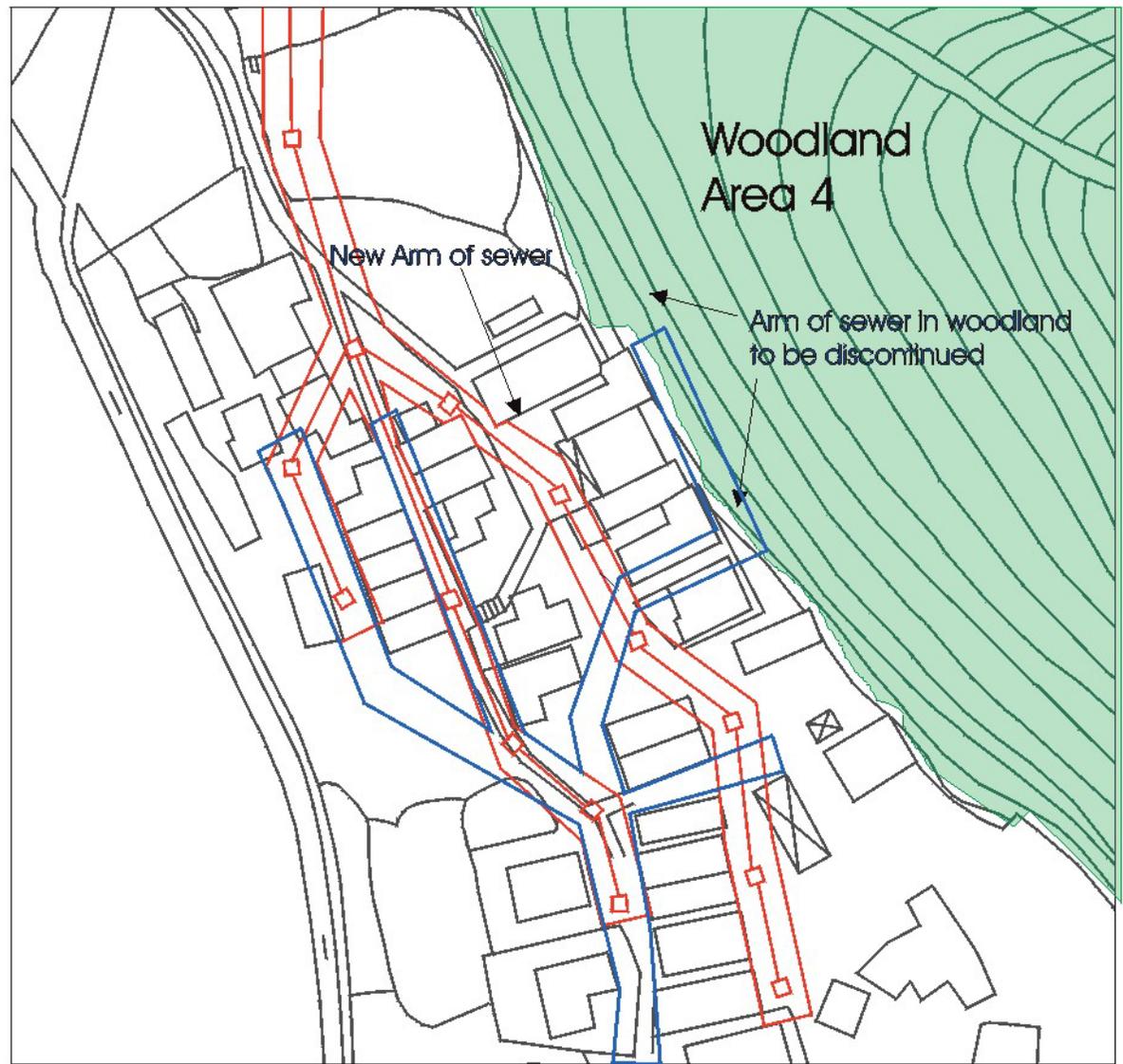
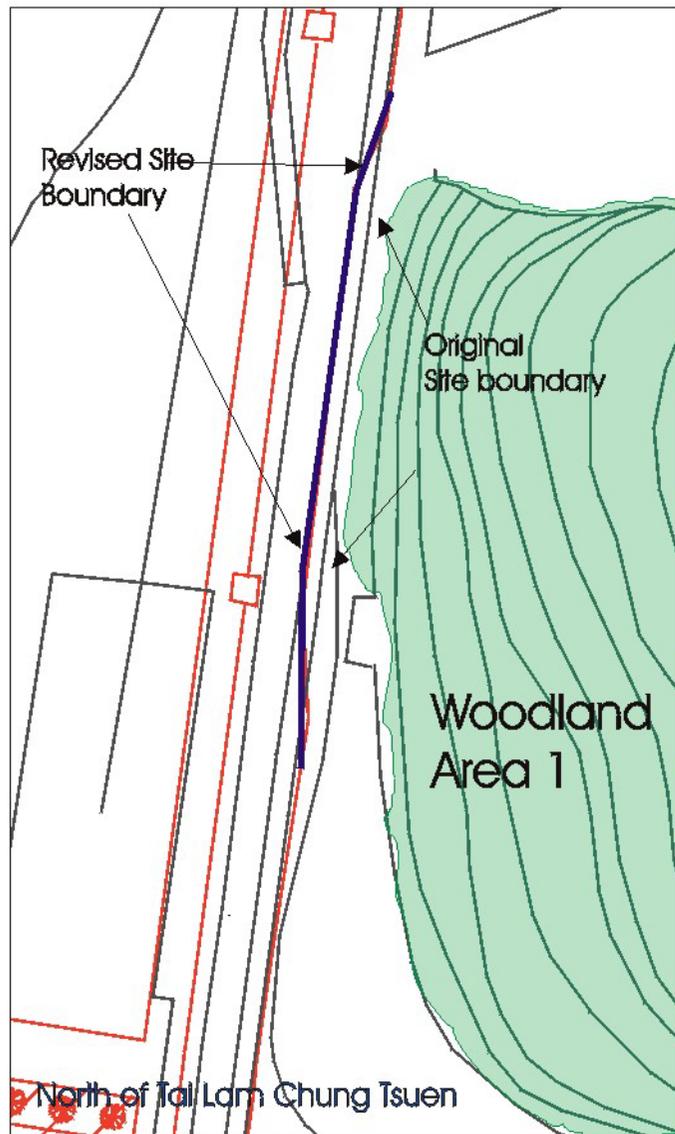
**Location of Potentially Important Ecological Sites**



**Location of Potentially Important Ecological Sites**



Distribution of Pitcher Plant (*Nepenthes mirabilis*) around the Study Area  
 (Source: Weatherhead, undated)



— Revised sewer layout

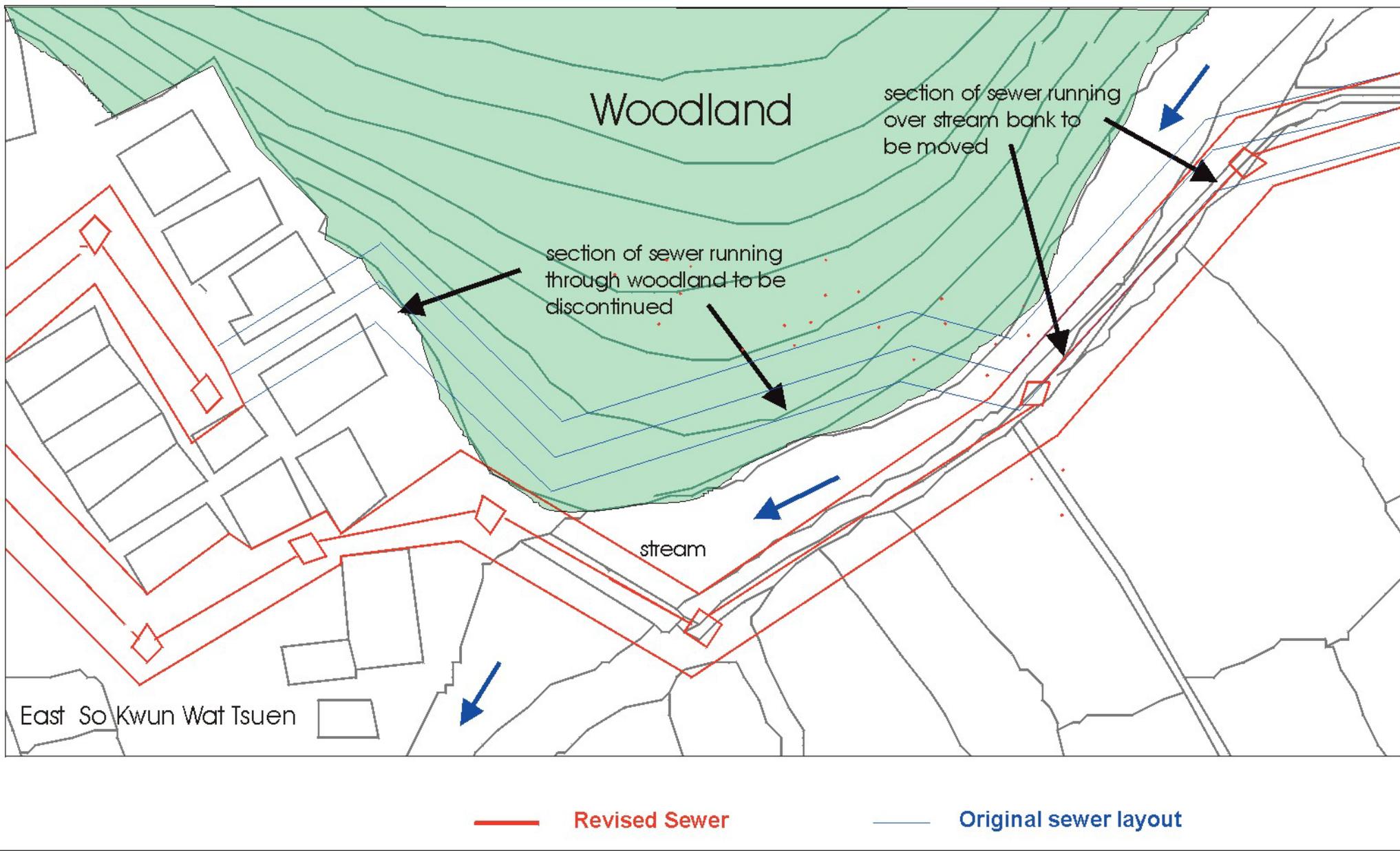
— Original sewer layout

Proposed changes to site boundary and sewer alignment in order to avoid loss of woodland and damage to trees

Mouchel

Drawing No.

8.10



Revision to sewer alignment in order to avoid loss of woodland and stream bank vegetation

Mouchel

Drawing No.

8.11