

7 TERRESTRIAL ECOLOGY

7.1 INTRODUCTION

7.1.1 This Section of the report presents the results of the assessment of potential impacts from the construction and operation of the Theme Park and associated development on terrestrial and freshwater (aquatic) ecological resources in the Assessment Area. Mitigation measures required to maintain identified impacts to within acceptable levels are recommended, as appropriate. Supplementary terrestrial ecological information is provided in *Annex F*.

7.2 LEGISLATION, STANDARDS, GUIDELINES AND CRITERIA

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

- Country Parks Ordinance (Cap 208);
- Forests and Countryside Ordinance (Cap 96);
- Wild Animals Protection Ordinance (Cap 170);
- Town Planning Ordinance (Cap 131);
- Hong Kong Planning Standards and Guidelines Chapter 10 (HKPSG);
- Technical Memorandum for the Environmental Impact Assessment Ordinance (EIAO TM); and
- United Nations Convention on Biodiversity (1992).

COUNTRY PARKS ORDINANCE

7.2.2 The *Country Parks Ordinance* (Cap. 208) provides for the designation and management of country parks and special areas. Country parks are designated for the purpose of nature conservation, countryside recreation and outdoor education. Special Areas are created mainly for the purpose of nature conservation.

FORESTS AND COUNTRYSIDE ORDINANCE

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

WILD ANIMALS PROTECTION ORDINANCE

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

TOWN PLANNING ORDINANCE

7.2.5 The amended *Town Planning Ordinance* provides for the designation on Outline Zoning Plans of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Conservation Area, Country Park, Green Belt or other specified uses that promote conservation or protection of the environment. The authority responsible for administering the *Town Planning Ordinance* is the Town Planning Board.

HONG KONG PLANNING STANDARDS AND GUIDELINES

7.2.6 *Chapter 10* of the *HKPSG* covers planning considerations relevant to conservation. This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also addresses the issue of enforcement. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.

EIAO TM

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

UNITED NATIONS CONVENTION ON BIOLOGICAL DIVERSITY

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

7.3 EXISTING ENVIRONMENT AND SENSITIVE RECEIVERS

7.3.1 This section summarises the terrestrial ecological resources within the Assessment Area and identifies key potentially sensitive receivers. The Assessment Area as for the terrestrial ecological assessment as defined in the Study Brief includes all areas within 500 m from the boundary of the scope of the EIA study or the area likely to be impacted by the proposed developments.

7.3.2 A literature review has been undertaken to identify previous and ongoing assessments and reports covering the terrestrial ecological conditions within the Assessment Area, which includes the lands, the foreshore areas and other places designed for the Project. Reports that were reviewed include:

- Northshore Lantau Development Feasibility Study (NLDFS) EIA, CED (2000);
- Route 10 - North Lantau to Yuen Long Highway Investigation and Preliminary Design Southern Section EIA, HyD (1999);
- Lantau Port Development, Stage 1 Container Terminals 10 and 11, Preliminary Design Study, CED (1995); and
- The Conservation Strategy for Lantau, Green Lantau Association *et. al.* (1998).

7.3.3 Consultations with local ecologists have also been undertaken where appropriate. Habitat and ecological communities within the Assessment Area has been mapped with reference to the Vegetation Map prepared by World Wide Fund for Nature Hong Kong (1994).

- 7.3.4 Broad scoping field surveys were then undertaken to fill the information gaps and supplement and field check the data collected through the baseline/literature review process. Areas of ecological interest that may be directly or indirectly affected by the proposed development were then surveyed in more detail.
- 7.3.5 All the field data for the NLDFS Study Area including the Theme Park area were collected between January 1999 and December 1999, covering the wet and dry seasons (See *Annex F-1 Survey Schedule*). The ecological surveys covered habitat/vegetation, stream fauna, avifauna, mammals, herpetofauna and invertebrates. Further supplementary field surveys were specifically conducted for the Theme Park Assessment Area, covering all the listed categories, in November and December 1999, including a night survey of wildlife in December 1999. The survey methodologies are presented below.

SUMMARY OF SURVEYS

- 7.3.6 A summary of field surveys and methodologies adopted is provided in the following sections:

Habitat/Vegetation

- 7.3.7 Each representative habitat type was surveyed on foot. All plant species encountered were identified and recorded to species level, whenever possible; the relative abundance of the plant species were also recorded. The dominant flora or fauna of each habitat/land-use type were also identified, with subsequent further habitat and vegetation verifications undertaken.

Stream Fauna

- 7.3.8 The physical conditions of the streams were recorded. Stream fauna were investigated through direct observation and active searching.

Avifauna

- 7.3.9 All bird species identified and numbers encountered in all major habitat types within the Assessment Area were recorded in the field. Surveys were undertaken during the wet and the dry season.

Wildlife (Mammals and Herpetofauna)

- 7.3.10 Signs or other evidences of mammal presence were noted in the field by active searching in potential mammal habitats.
- 7.3.11 Sampling techniques involving direct observation and active searching for reptiles in potential shelter sites/hiding places and amphibians in potential habitats were employed.

Invertebrates (Butterflies Dragonflies and Damselfly)

- 7.3.12 Butterfly, dragonfly and damselfly fauna were investigated by direct observation/ searching in all major habitat types within the Assessment Area. Surveys were undertaken during the most active period for the invertebrates, the wet season.

Night-time Survey

- 7.3.13 A night-time survey was undertaken mainly focusing on nocturnal avifauna. The presence of any large mammals was also noted.

BASELINE CONDITIONS - HABITAT/VEGETATION

- 7.3.14 The north-eastern part of Lantau within the Assessment Area comprises predominantly a grassland/shrubland mosaic habitat. The other terrestrial habitat types within the Assessment Area include tall shrubland, secondary woodland, abandoned farmland, wetland, plantation, village/orchard, wasteland, freshwater stream as well as backshore vegetation. A habitat map showing locations of recorded flora and fauna of ecological interest are shown in *Figure 7.3a*; photographs of the principal types of habitats in the Assessment Area are provided in *Figures 7.3b-1 to 4*.
- 7.3.15 A description of the general ecological conditions for each of the identified habitats are given below. Details of plant species recorded are presented in *Annex F-2*.

Secondary Woodland

- 7.3.16 Secondary woodlands present within this area of Lantau are continuous with an average height of more than 6 m. The secondary woodland at Ngong Shuen Au and the headland between Pa Tau Kwu Pak Wan and Pa Tau Kwu Nam Wan are confined to the low-altitude area next to villages and ravines, *Figure 7.3b-1* shows a typical secondary woodland. The plant species diversity is considered moderate with a total of 55 species recorded. Due to their proximity to villages and orchards, introduced tree species such as *Dimocarpus longan* and *Leucaena leucocephala*, as well as crop plants were also found.
- 7.3.17 Plant species recorded are typical of secondary woodlands in Hong Kong and dominant tree species recorded include common species *Cratogeomys cochinchinense*, *Aporosa dioica*, *Litsea glutinosa*, *Mallotus paniculatus*, *Microcos paniculata* and *Schefflera octophylla*. Height of trees range from 6-12 m. The dominant species and the structure of the woodlands suggested that the secondary woodlands have been regenerated recently by succession in the last 30-50 years.

Tall Shrubland

- 7.3.18 Tall shrubland is a transitional stage in ecological succession between shrubland and woodland. The tall shrubland recorded comprised woody vegetation with average heights ranging from 2 - 4 m (see *Figure 7.3b-1*). They occur in scattered patches and a total of 53 plant species were recorded in the Assessment Area. This habitat has low species and structural diversity. In the Assessment Area, such habitats were mostly found along streams and in valleys which have been less affected by hill-fires. These tall shrubland habitats are dominated by the shrub *Cratogeomys cochinchinense*, *Litsea rotundifolia*, *Litsea glutinosa*, *Microcos paniculata* and *Rhus succedanea*; no rare or protected species were recorded during the field surveys.

Grassland/ Shrubland Mosaic

7.3.19 The grassland/ shrubland mosaic is the dominant habitat type within the Assessment Area, locating on hillslopes and ridges (*Figure 7.3b-1*). The species composition of this habitat is mainly herbaceous or woody plant species with an average height of less than 1.5 m. A total of 68 plant species, but no rare or protected species, were recorded during the surveys. Major/dominant plant species include the common shrub *Baeckea frutescens*, *Arundinella setosa*, *Cymbopogon goeringii*, *Eulalia quadrinervis*, *Ischaemum barbartum* and the fern *Dicranopteris pedata* were recorded. The dominant species present indicated that such habitat had been frequently disturbed by hill fires. The species and structural diversity are considered low to moderate.

Abandoned Farmland

7.3.20 This habitat is represented by a small patch behind the beach of Pa Tau Kwu (see *Figure 7.3b-1*). The dominant species include *Neyraudia arundinacea* (*N. reyaudiana*), *Mikania micrantha*, *Apluda mutica* and *Cyclosorus interruptus*. Only 14 species were recorded and neither rare nor protected species were found. This habitat is poor in floristic diversity and also simple in structure. Since the habitat was formed by human activity, it is low in naturalness and high in re-creatability.

Wetland

7.3.21 Brackish wetlands are dominated by grasses with an average height of less than 1.5 m and a relative high salinity. A brackish wetland patch (approximately 1 ha) was found next to CLP Penny's Bay Gas Turbine Plant and is dominated by the *Zoysia* sp. This habitat type is low in habitat heterogeneity and floristic diversity.

7.3.22 A narrow strip of freshwater wetland area (approximately 1 ha) is located adjacent to the north east boundary of the Cheoy Lee shipyard on the eastern side of Penny's Bay. At least part of the wetland is permanently flooded (see *Figure 7.3b-2*). Vegetation present is dominated by herbs less than 1.5 m tall. The dominant species include *Fuirena ciliata*, *Fimbristylis complanata*, *Fimbristylis acuminata* and *Eragrostis* sp. This habitat was probably formed as a result of natural drainage from the hillsides/ land behind the shipyard being obstructed by the shipyard reclamation. Naturalness is, therefore, only moderate and recreatability is high. This habitat is poor in floristic diversity and also simple in structure.

7.3.23 Among the 14 plant species recorded, one rare species, *Fimbristylis acuminata* (covered approximately 500 m²), one protected species, pitcher plant *Nepenthes mirabilis* (covered approximately 80 m² in total, see *Figure 7.3b-2*) and *Fimbristylis complanata* (covered approximately 500 m²), were found.

7.3.24 *Fimbristylis acuminata*, a cyperaceae wetland herbs, is locally rare in Hong Kong but has been seen in a few wetland sites in Hong Kong, including Shui Hau (Lantau), Hoi Ha and Lai Chi Chong (Sai Kung). The pitcher plant *Nepenthes mirabilis* is a carnivorous creeping subshrub which is protected in Hong Kong under the Forest and Countryside Ordinance. The species is widespread in South East Asia and is distributed from Southern China (Guangdong and Hainan), Indochina to Northern Australia. It is also widely cultivated as an ornamental plant and can adapt to wide range of habitats. It is common in Hong Kong and can be found along streams in Western New

Territories (Castle Peak, Tai Lam, Siu Lam, So Kwu Wat), Western Lantau (Man Cheung Po) and Northern Lantau (Hau Hok Wan), and North East Lantau (Pak Mong). *Nepenthes mirabilis* usually form a large dense colony

Plantation

7.3.25 This habitat type is dominated by woody species planted for landscape purposes. Plantations comprise mainly *Acacia confusa* and *Leucaena leucocephala* and were found around the CLP Penny's Bay Gas Turbine Plant and adjacent excavated hillside (see *Figure 7.3b-2*). Only four tree species were found with heights of trees ranging from 5 - 15 m. All the trees species are introduced species of relatively low ecological importance.

Orchard/Village

7.3.26 Orchards were found among villages at Ngong Shuen Au (see *Figure 7.3b-1*). Dominant components included common fruit trees such as *Dimocarpus longan* and *Clausena lansium*, as well as ornamental/landscape trees such as *Acacia confusa* and *Albizia lebbek*. Tree species associated with human activity such as *Celtis tetrandra* (*C. sinensis*) and *Macaranga tanarius* were commonly observed, while typical secondary woodland tree species such as *Bridelia tomentosa* and *Litsea glutinosa* 6 - 12 m in height, were also found. Neither rare nor protected plants were recorded among the 40 recorded species.

Wasteland

7.3.27 Wastelands refer to open flatland areas formed from reclamation next to the Cheoy Lee shipyard and the CLP Penny's Bay Gas Turbine Plant (*Figure 7.3b-2*). Dominant species such as *Neyraudia reyaudiana* and exotic weeds including *Mikania micrantha* and *Lantana camara* were recorded. This habitat is very open and low in floristic diversity (23 species in total), habitat heterogeneity and naturalness.

Backshore Vegetation

7.3.28 A total of 70 plant species were recorded in backshore vegetation habitats. Vegetation found at the backshore of sandy beaches included dominant plant species of *Clerodendrum inerme*, *Scaevola sericea*, *Vitex rotundifolia*, *Macaranga tanarius*, *Cerbera manghas* and *Hibiscus tiliaceus*. Floristic diversity was low to moderate, with one rare species, *Schoenus falcatus* (*Figure 7.3b-3*).

7.3.29 The backshore vegetation of rocky shores is continuous with shrublands or secondary woodlands further landward (see *Figure 7.3b-3*). Dominant plants found included *Cladium marisus*, *Heteropogon contortus*, *Scaevola*, *Scolopia chinensis* and *Neyraudia arundinacea* (*N. reyaudiana*). Floristic diversity is moderate but habitat heterogeneity is very low as a result of sparse vegetation. Three rare species, *Berchemia lineata*, *Schoenus falcatus* and *Scleria rugosa* and one restricted species *Eriocaulon merrilli*, all the species are not protected, were found in back shore vegetation at Penny' Bay, the covered areas of these species are approximately 10 m², 90 m², 5 m² and 20 m² respectively.

7.3.30 Of the above species, *Schoenus falcatus* (see *Figure 7.3b-3*) is considered the most important because it was for the first time recorded in Hong Kong under the present study, found only in the area with water flow and near rocky shore at Penny's Bay. The species had neither been reported in the Biodiversity Survey (1998, in preparation) nor by J. Shaw (1999). This species has been reported in Kuizhou, Guangxi, Taiwan, Vietnam and Ryukyu Island; the species had not been reported in Guangdong up to Tang and Wang (1961). *Berchemia lineata*, a creeping shrub found on rocky shore, is also locally rare but not protected in Hong Kong and had only been seen on Sai Wan (Sai Kung) and a few outlying islands. Scattered individuals were found on the rocky shore on the west side of Penny's Bay (see *Figure 7.3a*). *Scleria rugosa*, a cyperaceae annual herb, is rare but not protected in Hong Kong and had only been seen along stream in Tai Tam (Hong Kong) and Lai Chi Chong (Sai Kung). A small populations of this species was found in backshore vegetation of rocky shore with freshwater seepage on the west shore of Penny's Bay.

Freshwater Streams

- 7.3.31 The four main freshwater streams within the Assessment Area are Mong Tung Hang Stream behind the Cheoy Lee shipyard, a stream behind the CLP Penny's Bay Gas Turbine Plant and two streams at Pa Tau Kwu Pak Wan and Pa Tau Kwu Nam Wan (see *Figure 7.3a* for locations).
- 7.3.32 The upper Mong Tung Hang Stream with rocky substrate was observed to be natural and free from visible pollution, with shrubby riparian vegetation. The lower section is channelised and is routed under the shipyard (see *Figure 7.3b-3*).
- 7.3.33 The stream behind the CLP Penny's Bay Gas Turbine Plant is a natural watercourse and was observed to be free from visible pollution, with shrubland habitats along the upper section, and brackish wetland at the estuary in Penny's Bay.
- 7.3.34 The conditions of the two streams at Pa Tau Kwu are similar given their similarity in geographic and physical environment. Both streams are small with bedrock as substratum; habitats along these streams comprise riparian vegetation including shrubland/grassland species. The stream at Pa Tau Kwu Pak Wan flows into the sea. The stream at Pa Tau Kwu Nam Wan is smaller than the stream at Pak Wan, and it drains into an abandoned agricultural field.
- 7.3.35 In general all upper stream courses upland of the Tsing Chau Tsai headland have limited water flow. These small bedrock streams are expected to support only limited aquatic life.

BASELINE CONDITIONS - WILDLIFE AND FAUNA

- 7.3.36 A review of the survey findings indicates that the wildlife recorded within the Assessment Area show little seasonal variation with the exception of the avifauna (birds). More bird species was recorded within the Assessment Area during the winter season (about 28% of the recorded bird species are winter visitors to Hong Kong). Neither rare nor protected wildlife species were found during the night survey. The key findings of the wildlife surveys are presented below; details of wildlife species recorded are provided in *Annex F-3*.

Mammals

7.3.37 Faeces of civets were observed only once in January 1999 on a major path on Fa Peng Teng where the dominant vegetation is grassland/shrubland mosaic (see *Figure 7.3a*). No more records of civet nor their faeces were found during the survey period. No signs of other mammal, such as barking deer (*Muntiacus reevesi*) were recorded, which is likely to be due to the lack of suitable habitats as the areas are too open and there is not sufficient cover for large mammals.

Herpetofauna

7.3.38 For herpetofauna, only 3 common species, the Paddy Frog *Rana limnocharis*, Brown Tree Frog *Polypedates megacephalus* and Ornate Pigmy Frog *Microhyla ornata* were recorded in freshwater wetland areas behind the Cheoy Lee shipyard during the field surveys.

7.3.39 Although several populations of Romer's Tree Frog (*Philautus romeri*) have been recorded in Lantau Island, no signs of Romer's Tree Frogs (including tadpoles and audible frog calls) were found during the surveys conducted in February, May, October, November and December 1999.

Invertebrates

7.3.40 Nine species of dragonfly and damselfly were recorded in the Assessment Area and they are all common in Hong Kong. The habitats within the Assessment Area are not favourable for dragonflies and damselflies, most of recorded species were encountered close to areas with fresh water.

7.3.41 The field surveys recorded thirty-four species of butterfly, but none of which is rare nor of ecological significance. Most of the butterflies were encountered at the edge of woodlands and often settle on nearby shrubby vegetation.

Stream Fauna

7.3.42 No rare, endangered, nor endemic stream invertebrates were found at any of the stream sampling sites; identified species were all common and typical of freshwater streams in Hong Kong.

7.3.43 Five fish species were found in the streams, including the locally rare Rice Fish (*Oryzias latipes*) in Mong Tung Hang Stream (*Figure 7.3b-3*). Mosquito Fish (*Gambusia affinis*) were identified in seepage pools and artificial ditches in the shipyard, as well as Grey Mullet (*Mugil cephalus*), Mudskipper (*Periophthalmus cantonensis*) and *Therapon jarbua* in the stream behind the CLP Penny's Bay Gas Turbine Plant. Except the Rice Fish which is locally rare (location shown in *Figure 7.3a*), the others are common species. No fish species were found in upper stream.

7.3.44 According to Chong and Dudgeon (1992), the distribution of the Rice Fish *Oryzias latipes* in Hong Kong has reduced dramatically, and is now restricted to a few isolated sites in Hong Kong, including: Chi Ma Wan on Lantau, Sam A Tsuen in NorthEast New territories, eastern Sai Kung and Tung Chung area. It can be considered as endangered in Hong Kong due to the fragmented distribution of generally small populations. It is unusual to find this species in a the fast flowing stream such as Mong Tung Hang stream, as the species usually inhabits standing waterbodies or slow-flowing streams (Pan, 1991; Kawanabe and Mizuno, 1996). The population at Mong Tung Hang stream is restricted to the lowest natural reach of the stream course before the channelized concrete watercourse section close to the Cheoy Lee shipyard.

Avifauna

7.3.45 Almost all the 32 species of avifauna recorded in the Assessment Area and its immediate environs are common in Hong Kong such as the Black-eared Kite (*Milvus milgrans*), Common Sandpiper (*Actitis hypoleucos*), Spotted Dove (*Streptopelia chinensis*), Chinese Bulbul (*Pycnonotus sinensis*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Japanese White-eye (*Zosterops japonica*), Long-tailed Shrike (*Lanius schach*) and Yellow-bellied Prinia (*Prinia flaviventris*). The rare migrant Sparrowhawk (*Accipiter* sp.) was observed flying pass.

7.3.46 The most significant finding of the avian survey is the recording of the locally rare White-bellied Sea Eagle (*Haliaeetus leucogaster*) in Pa Tau Kwu. From our survey records in this study, White-bellied Sea Eagles *Haliaeetus leucogaster* were observed foraging from Yi Chuen to Pa Tau Kwu in earlier surveys and were initially considered to comprise one of the known local breeding White-bellied Sea Eagles from Green Island or Tang Lung Chau. However, a breeding pair of White-bellied Sea Eagle and their nest was recently (November and December 1999) identified in the woodland at Pa Tau Kwu during avian survey in the Study Area (see *Figure 7.4a-1* for the location and *Figure 7.4b-4* for the photographic record of the bird). A White-bellied Sea Eagle juvenile, estimated to be 1 - 2 years old and capable of flight, was also recorded in the Pa Tau Kwu woodland during the avian survey in November 1999 but left and has not been seen again after November 1999. The nest was located on a tree *Tetradium glabrifolium*, approximately 3 - 4 m above the ground and facing towards Pa Tau Kwu Nam Wan. The nest was estimated to be 1.1 m in width and 0.3 m in depth comprising large fresh wooden sticks and twigs (see *Figure 7.4b-4*). The relatively small nest size indicates recent construction or occupation; additionally it has been reported recently that a nesting pair of White-bellied Sea Eagles previously located on Tang Lung Chau south of Ma Wan have vacated their nest.

7.3.47 The White-bellied Sea Eagle is a scarce breeding species in Hong Kong, with between 10 and 20 breeding pairs previously recorded during 1993-99), including the one in Tang Lung Chau (based on up to 20 different breeding sites identified), which is distributed in different parts of the Hong Kong waters including Tolo Harbour, Mirs Bay, Port Shelter, south and west of Hong Kong Island, and both north and south of Lantau.(Hong Kong Bird Watching Society, in prep.). Their nests are usually built on steep and rocky islands with major preference of big trees in a commanding position on a wooded knoll or headland (Wells, 1999). The size of nest is usually about 1.5 m across and comparatively thin when new. The nest would be used repeatedly with nest refurbishment in each breeding season by the same pair (Viney *et. al.*, 1994).

- 7.3.48 The White-bellied Sea Eagle has a wide distribution, ranging from India and Sri Lanka to South China, the Philippines, Wallacea, New Guinea as well as Bismarks to Australia and Tasmania (Howard & Moore, 1998; del Hoyo *et. al.*, 1994), with its presence restricted to Guangdong and Fujian Provinces in China and occasional records of non-breeding birds elsewhere (Cheng, 1987). White-bellied Sea Eagles are known to be predominantly piscivorous, taking mainly fish carrions (Blackers *et. al.*, 1985). White-bellied Sea Eagles in Hong Kong are also predominantly piscivorous and feed on live fish, but the extent to which they scavenges is not known.
- 7.3.49 Based on literature in Australia, the White-bellied Sea Eagle may be susceptible to human disturbance and may abandon their nest or young (or be deterred from breeding) when disturbed (Marchant & Higgins, 1993). However the locally breeding White-bellied Sea Eagles recorded on Green Island, however, are tolerant to the existing disturbance such as from helicopter, boats travelling pass, and the urban development at Kennedy Town approximately 600 m away. The presence of the breeding pair of the White-bellied Sea Eagles at the Pa Tau Kwu woodland indicates that the surrounding disturbance from motor boats, ships, helicopter and aircraft may have a minor impact on the birds. Therefore the White-bellied Sea Eagles in Hong Kong may have certain degree of tolerance to disturbance.

ECOLOGICAL VALUE/ IMPORTANCE

- 7.3.50 An evaluation of the ecological value/ importance of the recorded habitats in the Assessment Area has been prepared in accordance with the EIAO TM Annex 8 criteria; evaluation results are provided in Table 7.3a-e.

Table 7.3a - Ecological Value of Secondary Woodland in the Assessment Area

Criteria	Ngong Shuen Au	Pa Tau Kwu headland
Naturalness	The secondary woodlands have been modified and subjected to human disturbance.	Natural habitat with limited human disturbance.
Size	The average size is approximately 2 ha.	Approximately 2 ha in size.
Diversity	The species diversity is moderate.	The species diversity is moderate
Rarity	No rare nor protected species were found in the habitat.	Two adults of rare White-bellied Sea Eagles <i>Haliaeetus leucogaster</i> were recorded in the woodland. A juvenile was recorded only in November 1999 (details refer to Section 7.3.3).
Re-creatability	It will take some time (10-40 yrs) for the secondary woodlands to be re-created.	It will take some time (10-40 yrs) for the secondary woodlands to be re-created.
Fragmentation	The woodlands are not fragmented.	The woodland is not fragmented.
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	The potential value is considered moderate.	The potential value is considered moderate.
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	A nest of White-bellied Sea Eagles <i>Haliaeetus leucogaster</i> was found inside the woodland.
Age	The habitats are relatively mature.	The habitats are relatively mature.
Abundance/ Richness of Wildlife	Moderate	Moderate

Criteria	Ngong Shuen Au	Pa Tau Kwu headland
Ecological value	Moderate	High

Table 7.3b - Ecological Value of Grassland/Shrubland Mosaic and Tall Shrubland in the Assessment Area

Criteria	Grassland/Shrubland Mosaic	Tall Shrubland
Naturalness	Natural habitat but subject to frequent hill-fires.	Natural habitat but subject to hill-fires.
Size	The grassland/shrubland mosaic is the predominant habitat types within the Assessment Area.	Small patches of tall shrubland; mostly found along streams and in valleys.
Diversity	The species diversity is low.	The species diversity is low
Rarity	No rare nor protected species were found in these habitat types. This habitat type is the most common and dominant landscape in Hong Kong.	No rare nor protected species were found in these habitat types. This habitat type is the most common and dominant landscape in Hong Kong.
Re-creatability	The vegetation type is secondary and readily re-created naturally or artificially and would recover easily from disturbance.	The vegetation type is secondary and readily re-created naturally or artificially and would recover easily from disturbance.
Fragmentation	The grassland/shrubland mosaic is not fragmented.	The tall shrubland habitats are fragmented.
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	The potential value is considered low.	The dense vegetation cover of the tall shrubland suggest that it has the potential to be transformed into woodland, the potential value is therefore considered moderate.
Nursery ground	No record of significant nursery or breeding ground were found in the survey.	No record of significant nursery or breeding ground were found in the survey.
Age	The habitats are frequently disturbed and therefore are secondary in nature.	The habitats are disturbed and therefore are secondary in nature.
Abundance/ Richness of Wildlife	Low	Low
Ecological value	Low	Low

Table 7.3c - Ecological Value of Wetland in the Assessment Area

Criteria	Brackish Wetland	Freshwater Wetland
Naturalness	Naturalness is only moderate.	Naturalness is only moderate and partially man-made habitat.
Size	Small in size.	Small in size.
Diversity	The species diversity is low.	The species diversity is low
Rarity	No rare nor protected species were found in this habitat type.	Two rare plant species, <i>Fimbristylis acuminata</i> and <i>Fimbristylis complanata</i> , and one protected species, pitcher plant <i>Nepenthes mirabilis</i> , were found.
Re-creatability	Re-creatability is moderate to high.	Re-creatability is moderate to high.
Fragmentation	These habitat types are not fragmented.	The wetlands are not fragmented, but small in size.
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	Low value for man-made habitats.	The potential value is considered moderate.

Criteria	Brackish Wetland	Freshwater Wetland
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground was found in the survey.
Age	Not applicable.	The habitats probably formed recently by seepage from hillsides behind after reclamation.
Abundance/ Richness of Wildlife	Low	Moderate
Ecological value	Low	Moderate

Table 7.3d - Ecological Value of Wasteland/ Abandoned Farmland/ Plantation/ Orchard/Village and Backshore Vegetation in the Assessment Area

Criteria	Wasteland/Abandoned Farmland/ Plantation/ Orchard/Village	Backshore Vegetation
Naturalness	All are man-created habitats.	Natural habitat with limited human disturbance.
Size	All small in size.	Moderate in size
Diversity	The species diversity is low.	The species diversity is moderate.
Rarity	No rare nor protected species were found in these habitat types.	Three rare plant species, <i>Berchemia lineata</i> , <i>Schoenus falcatus</i> and <i>Scleria rugosa</i> and one restricted plant <i>Eriocaulon merrilli</i> were found in back shore vegetation at Penny's Bay.
Re-creatability	All the habitat types can be re-created easily.	It has a moderate re-creatability.
Fragmentation	These habitat types are not fragmented.	The habitats are not fragmented but always have a linear shape.
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	Low value for man-made habitats.	The potential value is low.
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground was found in the survey.
Age	Not applicable.	Relative mature and stable.
Abundance/ Richness of Wildlife	Low	Low
Ecological value	Low	Moderate

Table 7.3e Ecological Value of Stream Habitats in the Assessment Area

Criteria	Pa Tau Kwu North Wan/ Pa Tau Kwu South Wan/ behind the CLP Penny's Bay Gas Turbine Plant	Mong Tung Hang
Naturalness	The streams are largely natural and free of pollution.	The streams are largely natural and free of pollution.
Size	The length of the natural streams at Pa Tau Kwu Pak Wan, Pa Tau Kwu Nam Wan and behind the CLP Penny's Bay Gas Turbine Plant are approximately 1100 m, 600 m, 1600 m respectively.	The length of the natural streams is approximately 1600 m.
Diversity	The species diversity is moderate to low.	The species diversity is moderate to low.

Criteria	Pa Tau Kwu North Wan/ Pa Tau Kwu South Wan/ behind the CLP Penny's Bay Gas Turbine Plant	Mong Tung Hang
Rarity	No rare nor protected species were found in these habitat types.	Locally rare Rice Fish (<i>Oryzias latipes</i>) was found at the lower section of Mong Tung Hang Stream.
Re-creatability	The stream habitats could be re-created.	The stream habitats could be re-created.
Fragmentation	Not applicable.	Not applicable.
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	The potential value is moderate to low.	The potential value is moderate to low.
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground was found in the survey.
Age	Not applicable	Not applicable
Abundance/ Richness of Wildlife	Low	Low
Ecological value	Moderate	High

- 7.3.51 Based on the ecological conditions presented in the above sections, it is considered that the grassland/shrubland mosaic and tall shrubland habitats within the Assessment Area have generally low value because of their low species diversity and most of the species identified are common, widespread and typical to such habitats in Hong Kong.
- 7.3.52 The ecological value of the abandoned farmland, orchard/village and plantation habitats is limited given the frequent human disturbance and low species diversity in these habitat types.
- 7.3.53 The predominant freshwater streams remain natural and apparently unpolluted and are generally considered to be of moderate ecological value. The lower stream courses are relatively more important since most of the stream associated wildlife recorded were found there; the upper stream courses which are small with bedrock as substratum and support fewer aquatic species.
- 7.3.54 The brackish wetlands are considered to have generally low value because of their low species diversity and most of the species identified were common, while the freshwater wetland are considered to have generally moderate value.
- 7.3.55 All the secondary woodlands and backshore vegetation have generally moderate ecological value, except the woodland in Pa Tau Kwu which is a nesting ground for the locally rare White-bellied Sea Eagle. This area of woodland is considered to have a high ecological value.
- 7.3.56 Flora of ecological interest identified within the Assessment Area (refer to Figure 7.3a for location) comprise seven locally restricted/rare plant species of conservation interest including *Berchemia lineata*, *Fimbristylis acuminata*, *Fimbristylis complanata*, *Eriocaulon merrilli*, *Schoenus falcatus*, *Scleria rugosa* and pitcher plant *Nepenthes mirabilis*.

- 7.3.57 Fauna of ecological interest found within the Assessment Area include the rare Rice Fish (*Oryzias latipes*) found in the lowest section of the Mong Tung Hang Stream, as well as the White-bellied Sea Eagles *Haliaeetus leucogaster* and their nest site identified at Pa Tau Kwu woodland.
- 7.3.58 An evaluation of identified species of ecological interest recorded in the Assessment Area has been prepared in accordance with the EIAO TM *Annex 8* criteria (see *Table 7.4f-g*).

Table 7.3f - Evaluation of Floral Species with Ecological Interest within Assessment Area

Species	Growth Form	Location	Protection Status	Distribution	Rarity
<i>Eriocaulon merrilli</i> *	Herb	Penny's Bay	Not protected	Tung Chung, Sai Kung and Lai Chi Wo	Restricted
<i>Fimbristylis acuminata</i> #	Herb	Penny's Bay	Not protected	Shui Hau, Hoi Ha and Lai Chi Chong	Rare
<i>Fimbristylis complanata</i> #	Herb	Penny's Bay	Not protected	Lai Chi Wo, Ngoon Ping at Ma On Shan and Tai Ho.	Rare
<i>Nepenthes mirabilis</i> (Pitcher plant)#	Herb	Penny's Bay	Protected	North Lantau and New Territories, etc.	Restricted
<i>Berchemia lineata</i>	Shrub	Penny's Bay	Not protected	Tai Long Wan (Sai Kung), Ping Chau (Mirs Bay) and Lung Kwu Chau	Rare
<i>Schoenus falcatus</i> *	Herb	Penny's Bay	Not protected	Sze Pak Wan	New and rare
<i>Scleria rugosa</i>	Herb	Penny's Bay	Not protected	Lai Chi Chong and Violet Hill	Rare

Note: * Species which may be directly impacted due to the development (refer to *Section 7.5*)

Species which may be disturbed due to the development (refer to *Section 7.5*)

Mitigation measures for important plant species are recommended in *Section 7.7*

Table 7.3g - Evaluation of Faunal Species with Ecological Interest within Assessment Area

Species	Growth Form	Location	Protection Status	Distribution	Rarity
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	Pa Tau Kwu woodland	Proposed national first-grade wildlife for protection	Ten to 20 breeding pairs in HK SAR have been recorded and distributed in different parts of Hong Kong (Hong Kong Bird Watching Society, in prep.)	Locally rare
<i>Oryzias latipes</i>	Rice Fish	Mong Tung Hang stream	Not protected	Chi Ma Wan, Sam A Tsuen Tung Chung and Eastern Sai Kung	Locally rare

7.4 ASSESSMENT METHODOLOGY

7.4.1 A desktop literature review and supporting field surveys (summarised above in *Section 7.2*) were conducted in order to establish the ecological profile of the area within and surrounding the Assessment Area.

7.4.2 The potential impacts on terrestrial ecological resources due to the development of the Project have been assessed in accordance with the approach outlined under EIAO TM Annex 16; identified impacts have been evaluated based on the criteria in EIAO TM Annex 8.

7.5 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

CONSTRUCTION PHASE

7.5.1 The potential terrestrial ecological impacts arising from Project construction activities may include:

- Direct impacts as a result of habitat loss, loss of species, habitat fragmentation and indirect impact to fauna/ wildlife associated with these habitats (eg. loss of feeding grounds etc.) as a result of landtake for construction of the Project; and
- Indirect impact to the surrounding habitats and associated fauna/ wildlife due to increased human activities, disturbance by construction plant, equipment and activities as well as the potential for accidental events such as bush/ hill fires.

OPERATION PHASE

7.5.2 The potential terrestrial ecological impacts arising from Project operational activities may include:

- Indirect impacts to the surrounding habitats and associated fauna/ wildlife as a result of Project operational factors including:
 1. Noise from fireworks, Theme Park operations (day and night-time), transportation systems and equipment;
 2. Light and glare from fireworks and laser show at night-time; and
 3. General disturbance associated with the presence of people in the assessment area.

7.6 PREDICTION AND ASSESSMENT OF ENVIRONMENTAL IMPACTS

7.6.1 This section presents an assessment of the potential impact on the terrestrial ecological resources within the Assessment Area, based on the proposed development of Project facilities described in *Section 2*.

7.6.2 The significance of identified impacts to terrestrial ecological resources has been evaluated according to criteria specified in *Table 1 of Annex 8 of the EIAO TM*.

CONSTRUCTION PHASE

7.6.3 The following assessment focuses on potential terrestrial ecological impact on natural habitats in relation to the proposed developments associated with the Project as outlined below. A summary of terrestrial habitat losses is provided in *Table 7.6a*. A plan showing terrestrial habitats and resources potentially impacted by Project related development proposals is provided in *Figure 7.6a*

Direct Impact

Penny's Bay Reclamation and Associated Works

- 7.6.4 It has been estimated that natural terrestrial habitats within the Penny's Bay area likely to be directly affected by the reclamation include approximately 0.3 ha of secondary woodland at Ngong Shuen Au and 1.9 ha of grassland/shrubland mosaic, 0.7 ha of brackish wetland, 0.4 ha of plantation and 11 ha of village/orchard and wasteland (see *Figure 7.6a* and *Table 7.6a*).
- 7.6.5 In the present design, the construction of the Western Drainage Channel will retain the natural coastline of the western side of Penny's Bay, and therefore the backshore vegetation with rare/restricted species will not be affected. However, some of the backshore vegetation below the general reclamation level +4 to +6.5 mPD at the southern Tsing Chau Tsai headland (approximately 1 ha) and below reclamation level +6.5 to +10 mPD near Wan Tuk at Penny's Bay (zoned as Amenity Area, approximately 1 ha) would be directly impacted by the reclamation works, including the rare/restricted plant *Schoenus falcatus* and *Eriocaulon merrilli* (see *Figure 7.6b-1 & 2*).

Chok Ko Wan Link Road from Yam O to Penny's Bay Interchange

- 7.6.6 The western section (approximately 1.5 km) of CKWLR from Yam O to Penny's Bay would directly affect about 1.4 ha of secondary woodland, 2 ha of tall shrubland and 2.5 ha of grassland/shrubland mosaic at Ngong Shuen Au (see *Figure 7.6a & c*). Detailed assessment of the impact of the CKWLR on terrestrial ecology is reported in the NLDFS EIA.

Road P2 and Penny's Bay Rail Link

- 7.6.7 The Road P2 connecting Yam O and Theme Park would directly affect about 0.1 ha of secondary woodland at Ngong Shuen Au, 0.1 ha of plantation and 0.4 ha of grassland/shrubland mosaic at Chok Ko Wan Tsui (see *Figure 7.6b-1 & c*). As the railway will be constructed on reclaimed land and the portal areas at both ends of the Rail Link are wasteland and grassland/shrubland mosaic, no terrestrial impact will be expected due to the PBRL construction.

Table 7.6a - Summary of Terrestrial Habitat Loss (ha).

Habitat Loss	Theme Park and Associated Developments* (ha)	CKWLR (ha)	Total (ha)
Secondary Woodland	0.4	1.4	1.8
Tall Shrubland	0	2	2
Grassland/Shrubland Mosaic	2.3	2.5	4.8
Brackish Wetland	0.7	0	0.7
Freshwater Stream	0	0	0
Man-made habitat: Plantation/Wasteland/ Village/Orchard	11.5	0	11.5

*Exclude CKWLR

- 7.6.8 The potential impact on wildlife associated with the habitats that will be directly loss (mainly shrubland and grassland habitats) is considered low given that the species present are of low ecological significance and that the wildlife may be displaced to similar habitats available in the surrounding area.

Indirect Impacts

- 7.6.9 Indirect impacts to terrestrial ecology may arise from increased human activities associated with construction work, such as material storage and construction site runoff, if uncontrolled. This may disturb the habitats and the associated flora and fauna, particularly the rare/restricted plants species *Fimbristylis acuminata*, *Fimbristylis complanata* and pitcher plant *Nepenthes mirabilis* behind the Cheoy Lee shipyard of Penny's Bay, the rare Rice Fish *Oryzias latipes* in Mong Tung Hang stream, and *Berchemia lineata* and *Scleria rugosa* along the west coast of Penny's Bay (Figure 7.6a). There may be fragmentation of the predominantly grassland/shrubland mosaic with concomitant effects on wildlife movement.
- 7.6.10 Another potential indirect construction impact from the Penny's Bay reclamation is disturbance to the locally rare White-bellied Sea Eagle *Haliaeetus leucogaster*. As discussed in Section 7.3.3, the White-bellied Sea Eagles in Hong Kong have been found to have certain degree of tolerance to disturbance. Noise and general disturbance effects associated with the construction of the Penny's Bay reclamation works, would have low to moderate impact as quiet construction plant will be used (refer Section 4.6) for the Penny's Bay Stage II reclamation, and the construction activities of Theme Park Phase I and II will be over 1 km and 500 m from Pa Tau Kwu, respectively. However it cannot be ruled out that construction activities may lead to possible nest site abandonment or breeding failure as a worst case result.
- 7.6.11 The principal indirect threat to these birds of prey would be related to the increased human access to the Project Area during construction activities (not presently represented in Pa Tau Kwu area) such as possible hill fires, nest predation or human theft of eggs or young birds.

OPERATIONAL PHASE

- 7.6.12 The operational ecological impacts have been assessed for the following key issues:

- Increased human access; and
- Theme Park operations including fireworks and laser show.

General Increased Human Access

- 7.6.13 Similar to the construction phase, after completion of the Theme Park and associated development indirect impacts to terrestrial ecology may arise from increased human activities resulting in an increased risk of fires which would threaten the habitat and wildlife, and possible collecting and trampling effects on the rare/restricted/protected species such as the Rice Fish (*Oryzias latipes*) in Mong Tung Hang Stream and pitcher plants (*Nepenthes mirabilis*) behind the shipyard, if uncontrolled. It should, however, be noted that the Theme Park fireworks will not increase the risk of fires as the fireworks displays are designed to return to ground within a designated safety area within the Theme Park (see Section 10).

Theme Park Operations (including fireworks and laser show)

- 7.6.14 In general, there are no adverse impacts to general wildlife within the Assessment Area since no significant nocturnal wildlife activities was recorded in the night survey.
- 7.6.15 Project operational activities have the potential to disturb the White-bellied Sea Eagles. Disturbing influences directly and indirectly associated with the Project may include noise/ light from fireworks

displays, laser effects in the Theme Park, light/ glare from the new facilities, transportation noise (road, rail and sea traffic) and operational plant noise (pumps etc.). However given the physical separation from the Pa Tau Kwu site, only the planned nightly laser show and short duration fireworks displays are considered to represent the most significant potential disturbing influence on the birds.

- 7.6.16 As the lasers beam will be terminated on, non-reflective, fixed objects within the Theme Park and no significant nocturnal wildlife activities recorded in the night survey, the impacts are expected to be low.
- 7.6.17 The current nest site is located about 2 km from the Theme Park Phase I low/mid level fireworks launching position and about 0.8 km from the Theme Park Phase II low/mid level fireworks launching position. The noise impact from Theme Park Phase I fireworks is not expected to be high due to the long distance separation. However, the Theme Park Phase II fireworks may result in a disturbance to the White-bellied Sea Eagles, leading to possible site abandonment or breeding failure as a worst case result.
- 7.6.18 Similar to the construction phase, increased access by humans not presently represented in Pa Tau Kwu area may also pose an indirect threat to White-bellied Sea Eagle such as possible hill fire, nest predation or human theft of eggs or young birds, if uncontrolled.

OVERALL IMPACT EVALUATION

- 7.6.19 summary evaluation of Project related impacts on terrestrial ecological resources in the Assessment Area is provided in *Table 7.6b-e*.

Table 7.6b - Overall Impact Evaluation of Secondary Woodland

Evaluation Criteria	Pa Tau Kwu	Ngong Shuen Au
Habitat quality	The habitat quality of secondary woodland is high.	The habitat quality of secondary woodland is moderate.
Species	The key species that would be indirectly impacted is the locally rare White-bellied Sea Eagle <i>Haliaeetus leucogaster</i> at the Pa Tau Kwu secondary woodland. Potential disturbance would result from increased human access such as fire risk or theft of eggs or young birds, and the Phase II fireworks displays which may lead to possible site abandonment or breeding failure as a worst case.	There may be potential direct or indirect impact to the wildlife inhabiting the areas.
Size/Abundance	No direct habitat loss to Pa Tau Kwu secondary woodland.	Loss of area of the secondary woodlands at Ngong Shuen Au will be approximately 1.8 ha.
Duration	The duration of indirect impact will persist during construction and operation phases.	The duration of impact will persist during construction and operation phase.
Reversibility	The indirect impact to the secondary woodland is reversible.	The impact of direct loss of secondary woodlands is irreversible.
Magnitude	The scale of indirect impact on White-bellied Sea Eagle is low to moderate (construction) and moderate to high (operation).	The scale of habitat loss is small.
Overall impact conclusion	Moderate to High	Moderate

Table 7.6c - Overall Impact Evaluation of Backshore Vegetation

Evaluation Criteria	Discussion
Habitat quality	The habitat quality of backshore vegetation is moderate.
Species	There may be potential direct impact to the rare/restricted plant species found in backshore vegetation at Penny's Bay, including <i>Schoenus falcatus</i> and <i>Eriocaulon merrilli</i> .
Size/Abundance	Loss of area of the backshore vegetation will be approximately 4 ha due to the reclamation works at Penny's Bay. In the present design, the construction of Western Drainage Channel will avoid the destruction of and maintain the natural coastline in the west side of Penny's Bay, the backshore vegetation and the rare/restricted would not be affected.
Duration	The duration of impact will persist during construction and operation phase.
Reversibility	The impact of direct loss of backshore vegetation is irreversible.
Magnitude	The scale of habitat loss is small in the context of the surrounding similar habitats.
Overall impact conclusion	Moderate

Table 7.6d - Overall Impact Evaluation of Brackish Wetland

Evaluation Criteria	Discussion
Habitat quality	The habitat quality of brackish wetland is low.
Species	There may be potential direct or indirect impact to the wildlife inhabiting the areas.
Size/Abundance	Loss of area of the brackish wetland will be approximately 0.7 ha.
Duration	The duration of impact will persist during construction and operation phase.
Reversibility	The impact of direct loss of brackish wetland is irreversible.
Magnitude	The scale of habitat loss is small.
Overall impact conclusion	Low

Table 7.6e - Overall Impact Evaluation of Tall Shrubland, Grassland/Shrubland Mosaic, Plantation, Wasteland and Other Habitats

Evaluation Criteria	Discussion
Habitat quality	All the habitats has low quality.
Species	There may be potential direct or indirect impact to the wildlife inhabiting the areas.
Size/Abundance	Approximately 2 ha of tall shrubland, 4.8 ha of grassland/shrubland mosaic, 0.5 ha of plantation and 11 ha of wasteland will be lost.
Duration	The duration of impact will persist during construction and operation phase.
Reversibility	The impact of direct loss is irreversible. The habitat is readily re-created and will recover easily.
Magnitude	The scale of habitat loss is small in the context of the surrounding similar habitats.
Overall impact conclusion	Low

7.6.20 Overall, potential impacts on terrestrial ecological resources due to the Project is not expected to be high since most of the habitats impacted (such as the predominant grassland/shrubland) are generally of low ecological importance.

7.6.21 The loss of secondary woodlands at Ngong Shuen Au and backshore vegetation along the Penny's Bay associated with this Project are considered to represent a moderate impact.

- 7.6.22 The rare/restricted plant *Schoenus falcatus* and *Eriocaulon merrilli* will be lost at Penny's Bay and Chok Ko Wan Tsui.
- 7.6.23 The potential indirect ecological impact to the locally rare White-bellied Sea Eagles *Haliaeetus leucogaster* are expected to be moderate to high primarily due to noise and human disturbance.
- 7.6.24 The potential cumulative impacts due to Northshore Lantau Development and Chok Ko Wan Link Road are detailed in NLDFS EIA.

7.7 GENERAL MITIGATION OF ADVERSE ENVIRONMENTAL IMPACTS

- 7.7.1 As discussed in the previous section, major impact would be related to loss of secondary woodlands at Ngong Shuen Au, backshore vegetation and indirect impact to the locally rare White-bellied Sea Eagles. Other habitats, such as grassland/shrubland mosaic, would not be mitigated due to their low ecological value and commonness in Hong Kong.
- 7.7.2 The following mitigation measures in relation to compensating habitat loss and minimising impact on species of ecological interest, as well as good construction practice to minimise disturbance to the surrounding environment, are recommended below. In accordance with the EIAO TM, the hierarchy for ecological mitigation (first avoidance of impact, then minimisation of impact, then compensation of impact), has been adopted where appropriate.

HABITAT/VEGETATION LOSS

- Provide secondary woodland planting to compensate for the approximate loss of 1.8 ha of the woodland at Ngong Shuen Au which cannot be avoided by the Penny's Bay reclamation, Road P2 and CKWLR alignment. As considerable areas, not less than 6 ha, of woodland planting are proposed on the adjacent hill side to the east of Ngong Shuen Au (see *Section 12*), sufficient compensatory woodland will be provided. Species used for planting should take reference from the species identified in the Tree Survey and be native to Hong Kong or South China region.
- Design the Western Drainage Channel of the Phase I Penny's Bay Reclamation to retain the natural coastline and avoid impact on the backshore vegetation so as the associated locally restricted, rare or protected plant species present within the Assessment Area, including the plant *Berchemia lineata* and *Scleria rugosa* (see *Figure 7.3a* for location).
- Adjust development/construction area to avoid/minimize direct impact on the rare/restricted plant *Schoenus falcatus* and *Eriocaulon merrilli* at Penny's Bay and Chok Ko Wan Tsui. If avoidance of these habitats and plant species is not possible, transplanting of affected individuals should be undertaken to similar environment as the original habitat, rocky shore with freshwater seepage or near a small stream, before the works start. A detailed vegetation survey of these affected areas should be undertaken at the Detailed Design stage to identify the individuals of the concerned species, as a basis for details of design refinement and transplanting requirements. Since the growth form of the plant species required for transplantation is herb, the whole plants with their inhabited soil can be relocated to suitable habitat directly. All the individuals of the species should be relocated. Seeds of the target species are recommended to collect so as to preserve the genetic resource and allow more source plant to transplant in case of the failure of transplantation. The seeds should be collected and preserved or germinated appropriately by qualified botanist and institution respectively. Sze Pak Wan is the only, nearest and suitable site for the transplantation, however, it is small and may have not enough suitable habitats for transplantation. When the available sites in Sze Pak Wan being fully occupied, South-east Chi Ma Wan Peninsular (Lantau) are other recommended sites for transplantation.

WHITE-BELLIED SEA EAGLE

- Prohibit construction workers access to the nesting site of White-bellied Sea Eagles at Pa Tau Kwu secondary woodland through warning and regular audit by Site Engineer, and fence off the public land access from the development areas during construction and Theme Park areas during operation.
- Use quietened construction plant and equipment for Penny's Bay Stage II Reclamation (refer *Section 4.6*).
- Locate Theme Park fireworks launching site as far away from the nesting site as possible. However, it was considered not practicable for the Phase II launching site to locate elsewhere due to the constraints on the Theme Park design pertaining to guest safety. The launch site for the Theme Park Phase I is located approximately 2 km from Pa Tau Kwu. A cantilevered noise barrier was considered as a potential mitigation measure to screen the fireworks noise from the White-bellied Sea Eagles nest but was considered not practicable as it will introduce temporary noisy construction disturbance in close proximity to the nesting site, and such structure will be large and intrusive, and may block the flight path and additionally may undermine the commanding position of the nesting site.
- Avoid directing any laser beams towards the Pa Tau Kwu area.

CONSTRUCTION PRACTICE

- Erect fences where practical along the boundary of construction sites before the commencement of works to prevent tipping, vehicle movements, and encroachment of personnel into adjacent areas, particularly where the rare/protected species, such as are Rice Fish *Oryzias latipes* in Mong Tung Hang stream, White-bellied Sea Eagles *Haliaeetus leucogaster* at Pa Tau Kwu woodland, Pitcher Plant *Nepenthes mirabilis*, *Fimbristylis acuminata* and *Fimbristylis complanata* behind Cheoy Lee shipyard, and *Berchemia lineata* and *Scleria rugosa* along the west coast of Penny's Bay, are located;
- Reinstate temporary work sites/disturbed areas to its original condition immediately after completion of the construction;
- Select haul routes, storage and works areas etc. to avoid or minimize disturbance to ecologically significant areas (refer to *Figure 7.3a*);
- Check the work site boundaries regularly to ensure that they are not exceeded and that no damage has been caused to surrounding natural habitats;
- Prohibit and prevent open fires within the work site boundary during construction and provide temporary fire fighting equipment in all work areas;
- Ensure no access for site workers or delivery of machinery from Pa Tau Kwu Pak Wan and Pa Tau Kwu Nam Wan.

7.8 RESIDUAL ENVIRONMENTAL IMPACTS

7.8.1 With the implementation of the mitigation measures recommended above, there may still be residual terrestrial ecological impacts associated with the Theme Park and associated developments.

7.8.2 Although construction disturbance effects (e.g. noise) could potentially be controlled such that disturbance to the White-bellied Sea Eagles would be minimised, and the Theme Park fireworks displays would be located remote from the nesting site to reduce potential disturbance, abandonment of the nest site at Pa Tau Kwu woodland as result of construction and operational disturbances could not be ruled out. However the White-bellied Sea Eagles should be able to find suitable alternative nesting sites, such as the remote Tang Lung Chau or Kau Yi Chau (with previous record of White-bellied Sea Eagles breeding but the nest site has been abandoned),

Southeast Lantau, or Sunshine Island with woodland areas, should they abandon the nesting site at the Pa Tau Kwu.

- 7.8.3 The 6 ha of woodland compensation planting will adequately mitigate the loss of 1.8 ha of secondary woodland. Transplanting of impacted individuals of the rare/restricted plant *Schoenus falcatus* and *Eriocaulon merrilli* should be undertaken to mitigate any direct loss. The freshwater wetland and Mong Tung Hang Stream will be avoided and therefore no residual impact is expected. For the other habitat types impacted, given their low ecological importance affected, the residual impact is considered minimal.

7.9 ENVIRONMENTAL MONITORING AND AUDIT (EM&A)

- 7.9.1 Monitoring and auditing of ecological resources has been recommended for the detailed design, construction and operation stages. The specific monitoring requirements are detailed in Annex N of this EIA Report which comprises the stand-alone Project EM&A Manual.

7.10 CONCLUSIONS

- 7.10.1 The major habitat types within the Assessment Area comprises secondary woodland, tall shrubland, grassland/shrubland mosaic, brackish/freshwater wetland, village/orchard, wasteland, plantation, freshwater streams, as well as backshore vegetation. The field surveys which have been undertaken indicate that the grassland/shrubland mosaic, which are typical of similar habitats elsewhere in Hong Kong, are the main habitat type. The identified secondary woodland, backshore vegetation, freshwater wetland and freshwater stream habitats are considered to have moderate to high ecological value, and all the others habitats a low value. The plant species with ecological interest may be affected by the Project is *Schoenus falcatus* and *Eriocaulon merrilli*. Two locally rare faunal species have been recorded in the Assessment Area: the Rice Fish (*Oryzias latipes*) in the lower Mong Tung Hang Stream and the White-bellied Sea Eagle (*Haliaeetus leucogaster*).
- 7.10.2 The proposed developments associated with the Project will generally lead to a loss of low ecological value terrestrial habitats with low ecological impact. Mitigation measures are recommended to avoid or reduce the potential impacts on habitats of moderate to high ecological value such as woodland compensation planting.
- 7.10.3 Noise and general disturbance effects associated with the construction of the Penny's Bay reclamation works, would have low to moderate impact as quiet construction plant will be used for the Stage II reclamation, and the construction activities of Theme Park Phase I and II will be over 1 km and 500 m from Pa Tau Kwu, respectively. However, the assessment does indicate the potential worst case scenario of abandonment of the nest, although possible suitable habitats and nesting sites are available in the area. Additionally, the assessment identifies that the principal threat to these birds of prey comprises the threats from egg and young birds from human access to the nest area. Consequently, the mitigation measures to protect the White-bellied Sea Eagle from the principal threat include prohibiting human access to their nesting site during the construction phase via secure fencing and monitoring. Adopting the precautionary principle, EM&A before and during construction is recommended to monitor these birds. With the implementation of the recommended mitigation measures, no significant residual impact are expected to this bird of prey,

although abandonment of the nest can not be ruled out, as possible suitable habitat and nesting sites are available in the vicinity of the Assessment Area.

- 7.10.4 During operation of the Theme Park and associated developments, an identified impact comprises the possibility of the White-bellied Sea Eagles abandoning the existing nesting site due to noise from the remote (more than 2 km and 800 m from Phase I and II, respectively), nightly laser show and short duration fireworks displays. Human interference impact identified may be mitigated by the further prohibition of human access during Project operation by secure fencing. It is, thus, considered necessary to extend the EM&A programme during Theme Park operation to monitor the reaction of White-bellied Sea Eagle to the fireworks. In the worst case of abandonment of the pair from their nest during operation, possible suitable habitat and nesting sites are available in the vicinity of the Assessment Area and thus no residual impact is predicted.
- 7.10.5 A summary of impact prediction, mitigation measures and residual impacts associated with the proposed Theme Park was shown in *Table 7.10a*.

Table 7.10a - Summary of Ecological Impacts for Theme Park

Issue	Construction Impact	Operational Impact
Penny's Bay Reclamation and Associated Works		
Potential Impacts	Loss of approximately 0.3 ha of secondary woodland at Ngong Shuen Au and 1.9 ha of grassland/shrubland mosaic, 0.7 ha of brackish wetland and 0.4 ha of plantation; Loss of rare plant, <i>Schoenus falcatus</i> and <i>Eriocaulon merrilli</i> ; Indirect impact, particularly noise disturbance, to the locally rare White-bellied Sea Eagle <i>Haliaeetus leucogaster</i> at Pa Tau Kwu secondary woodland; Indirect impact to rare/restricted plants species <i>Fimbristylis acuminata</i> , <i>Fimbristylis complanata</i> and pitcher plant <i>Nepenthes mirabilis</i> behind the Cheoy Lee shipyard of Penny's Bay, the rare Rice Fish <i>Oryzias latipes</i> in Mong Tung Hang stream, and <i>Berchemia lineata</i> and <i>Scleria rugosa</i> along the west coast of Penny's Bay, due to increased human activities.	Indirect impact, particularly noise disturbance due to night-time Theme Park operations (including fireworks and laser show), to the locally rare White-bellied Sea Eagle <i>Haliaeetus leucogaster</i> ; and Indirect impact to rare/restricted plants species <i>Fimbristylis acuminata</i> , <i>Fimbristylis complanata</i> and pitcher plant <i>Nepenthes mirabilis</i> behind the Cheoy Lee shipyard of Penny's Bay, and the rare Rice Fish <i>Oryzias latipes</i> in Mong Tung Hang stream;

Issue	Construction Impact	Operational Impact
Mitigation	<p>Compensatory woodland planting on the adjacent hill side to the east of Ngong Shuen Au; Prohibit construction workers access to the nesting site of White-bellied Sea Eagles at Pa Tau Kwu secondary woodland through warning and regular audit by Site Engineer, and fence off the public land access from the development areas; Use quietened construction plant and equipment during Penny's Bay Phase II reclamation (refer Section 4.6);</p> <p>Adjust development/ construction area to avoid/minimize direct impact on the locally restricted, rare or protected plant species. If avoidance of these plant species is not possible, transplanting of affected individuals should be undertaken;</p> <p>Erect fences where practical along the boundary of construction sites before the commencement of works</p> <p>Reinstate temporary work sites/disturbed areas immediately after completion of the construction;</p> <p>Select haul routes, storage and works areas etc. to avoid or minimize disturbance to ecologically significant areas;</p>	<p>Locate Theme Park fireworks launching site as far away from the nesting site as possible. However, it was considered not practicable for the Phase II launching site to locate elsewhere due to the constraints on the Theme Park design pertaining to guest safety. The launch site for the Theme Park Phase I is located approximately 2 km from Pa Tau Kwu;</p> <p>Avoid directing any laser beams towards the Pa Tau Kwu area;</p>
	<p>Check the work site boundaries regularly to ensure that they are not exceeded and that no damage has been caused to surrounding natural habitats;</p> <p>Prohibit and prevent open fires within the work site boundary during construction and provide temporary fire fighting equipment in all work areas;</p> <p>Ensure no access for site workers or delivery of machinery from Pa Tau Kwu Pak Wan and Pa Tau Kwu Nam Wan.</p>	
Residual Impacts	<p>With the implementation of the recommended mitigation measures, no significant residual impact are expected, however, abandonment of the nest by the White-bellied Sea Eagle can not be ruled out.</p>	<p>In the worst case of abandonment of the White-bellied Sea Eagle from their nest during operation, possible suitable habitat and nesting sites are available in the vicinity of the Assessment Area and thus no residual impact is predicted.</p>
Environmental Acceptability	<p>No significant adverse residual impacts.</p>	<p>No significant adverse residual impacts;</p>
Chok Ko Wan Link Road from Yam O to Penny's Bay Interchange		
Potential Impacts	<p>Loss of approximately 1.4 ha of secondary woodland, 2 ha of tall shrubland and 2.5 ha of grassland/shrubland mosaic at Ngong Shuen Au.</p>	

Issue	Construction Impact	Operational Impact
Mitigation	<p>Compensatory woodland planting on the adjacent hill side to the east of Ngong Shuen Au;</p> <p>Erect fences where practical along the boundary of construction sites before the commencement of works</p> <p>Reinstate temporary work sites/disturbed areas immediately after completion of the construction;</p> <p>Select haul routes, storage and works areas etc. to avoid or minimize disturbance to ecologically significant areas;</p> <p>Check the work site boundaries regularly to ensure that they are not exceeded and that no damage has been caused to surrounding natural habitats;</p> <p>Prohibit and prevent open fires within the work site boundary during construction and provide temporary fire fighting equipment in all work areas.</p>	
Residual Impacts	No residual impacts identified.	
Environmental Acceptability	No adverse impacts.	
Road P2		
Potential Impacts	Loss of approximately 0.1 ha of secondary woodland at Ngong Shuen Au, 0.1 ha of plantation and 0.4 ha of grassland/shrubland mosaic at Chok Ko Wan Tsui.	
Mitigation	<p>Compensatory woodland planting on the adjacent hill side to the east of Ngong Shuen Au;</p> <p>Erect fences where practical along the boundary of construction sites before the commencement of works</p> <p>Reinstate temporary work sites/disturbed areas immediately after completion of the construction;</p> <p>Select haul routes, storage and works areas etc. to avoid or minimize disturbance to ecologically significant areas;</p> <p>Check the work site boundaries regularly to ensure that they are not exceeded and that no damage has been caused to surrounding natural habitats;</p> <p>Prohibit and prevent open fires within the work site boundary during construction and provide temporary fire fighting equipment in all work areas.</p>	
Residual Impacts	No residual impacts identified.	
Environmental Acceptability	No adverse impacts.	